Staff Summary for April 17-18, 2024

22. Southern California Steelhead

Today's Item **Information ☐** **Action ☒**

Consider the petition, Department's status review report, and comments received to determine whether listing southern California steelhead as endangered under the California Endangered Species Act (CESA) is warranted.

Summary of Previous/Future Actions

• Received petition	June 14, 2021
• Transmitted petition to Department	June 23, 2021
• Published notice of receipt of petition	July 16, 2021
• Receipt of petition at public meeting; approved Department's 30-day extension request	August 18, 2021
• Receipt of Department's 90-day evaluation report at public meeting	December 15, 2021
• Closed public hearing and administrative record, and continued deliberations to April 2022 meeting	February 16-17, 2022
• Determined petitioned action may be warranted, initiating Department's one-year status review	April 20-21, 2022
• Approved Department's six-month extension request	October 12-13, 2022
• Public notice of having received the Department's one-year status review	February 14-15, 2024
• **Today, potentially determine if listing is warranted**	**April 17-18, 2024**

Background

On June 14, 2021 the Commission received a petition to list southern California steelhead (SCS; *Oncorhynchus mykiss*) as endangered under CESA (Exhibit 1). At its April 2022 meeting, the Commission determined that listing may be warranted, and subsequently provided notice regarding SCS's protected, candidate species status. The notice prompted the Department's status review of the species, as required by California Fish and Game Code Section 2074.6.

The Commission received the Department's status review report on January 18, 2024 (exhibits 2 and 3), and highlighted receipt of the report on its February 14-15, 2024 meeting agenda for public awareness. The status review report represents the Department's final written review of the status of SCS. Based on the information provided, possessed, and received, the Department has concluded that the petitioned action to list SCS as endangered under CESA is warranted, and further recommends implementing the management recommendations and recovery measures described in the status review report.

At today's meeting, the Commission may consider the petition, the Department's written evaluation and status review report, written and oral comments received, and the remainder of the administrative record, to determine if listing SCS as endangered under CESA is warranted. Findings will be adopted at a future meeting.

Significant Public Comments

1. The Endangered Habitats League urges the Commission to classify SCS as endangered under CESA, stating that research shows the fish is critically endangered due to urbanization, agriculture, and water development damaging its habitat. Additionally, the league states that the petition and the Department's report provide strong scientific backing for the listing. (Exhibit 5)
2. A member of the public supports listing SCS under CESA, stating that research shows that the species populations are in danger of extinction. (Exhibit 6)
3. The Cachuma Conservation Release Board requests that the Commission hold the hearing for the listing in southern California (rather than San Jose), as southern California is closer to the natural range of the fish and the agencies that would be most impacted by the listing. (Exhibit 7)
4. The Cachuma Operation and Maintenance Board (COMB) notes concerns about how its data was used in the Department's status review report, stating that data from different surveys was mixed and may lead to inaccurate comparisons of steelhead abundance, and that there are limits to using migrant trapping data. COMB recommends using snorkel survey data to provide a more representative picture of steelhead abundance in the Santa Ynez River basin. COMB questions the report's recommendation and believes COMB's data presents a different conclusion. (Exhibit 8)
5. The Pasadena Casting Club supports listing SCS as endangered, stating that club members have observed its decline due to habitat loss, and that the fish is a barometer of watershed and environmental health. The club states that protecting the fish will benefit water quality, watersheds, recreation, and Californians. (Exhibit 9)
6. A law firm representing the United Water Conservation District (UWCD) argues that the potential CESA listing of SCS as endangered is not supported by sufficient evidence. The firm states that the Department's status review report fails to address key evidence necessary for the Commission's final listing decision, including evidence on resident populations, the interplay between anadromous and resident populations and its effect on species persistence, and the effect of barriers on the long-term persistence of the fish. Additionally, the firm claims that the status review did not follow judicial guidance that examination of this evidence would likely be necessary for any final listing decision. The firm holds that the Commission should either find the listing not warranted or remand the status review to the Department for reconsideration. Attachments sent with the letter include a transcript from previous SCS litigation, a technical memorandum on an SCS lifecycle model, an SCS recovery plan, a South-Central/Southern California Coast Steelhead recovery planning domain five-year review, and a report on the occurrences of steelhead trout in southern California between 1994 and 2018. (Exhibit 10)

7. UWCD submits comments regarding the Department's status review, as well as previously submitted comments, for the Commission's review. UWCD states that the status review does not provide an analysis of the status of the species based on the best available science and that the recommendation from the Department to list SCS under CESA is premature. UWCD states that the Commission should find that listing is not warranted at this time and should delay the listing decision until after additional data collection. UWCD also states that the information it has provided demonstrates the need for a more transparent analysis of the data. (Exhibit 11)
8. Rancho Mission Viejo maintains that it follows the Southern Subregion Habitat Conservation Plan (SSHCP) to protect endangered species and their habitats on the southern Orange County ranch, and that it has already addressed a steelhead passage barrier in San Juan Creek by building a bridge and removing an old crossing, as outlined in the steelhead recovery plan. If steelhead return to the area, the ranch hopes ongoing conservation efforts under the SSHCP will be recognized and the need for incidental take permits under CESA can be avoided. (Exhibit 12)
9. A coalition of 26 non-governmental organizations supports listing SCS, stating that the populations are nearing extinction due to habitat loss from urbanization, agriculture, and water development. The coalition further states that a healthy steelhead population benefits California's future by signaling a resilient ecosystem. Also included are signatures from over 2000 individuals who support listing the fish. (Exhibit 13)
10. The Santa Clarita Valley Water Agency (SCV) disputes the steelhead distribution map in the Department's status review report. SCV points out that the map shows steelhead presence in the upper Santa Clara River east of Piru Dry Gap, although SCV believes there is no evidence to support this distribution, and requests that the Department correct the map to show no steelhead in that section of the river. If the Department disagrees, SCV asks that supporting data be provided, and an explanation of how steelhead distribution was determined for the area. Additionally, SVC provides a white paper titled *Review of Current and Historical SCS in the Upper Santa Clara River Watershed*. (Exhibit 14)
11. The Association of California Water Agencies (ACWA) expresses concern that the Department's status review does not consider all available science, particularly the role of resident rainbow trout populations in the overall steelhead population health. ACWA claims that listing SCS under CESA would not provide additional protections beyond those from the federal Endangered Species Act listing, but would create redundancies and potentially hinder water management projects. ACWA requests that the Commission consider resident rainbow trout contributions to steelhead populations in its final decision and exclude coastal watersheds with concrete-lined flood channels from the listing, as they block steelhead passage. Additionally, ACWA provides two technical memoranda, one from Four Peaks Environmental Science & Data Solutions and one from Cramer Fish Sciences. (Exhibit 15)
12. CalTrout forwarded a public support letter with over 4700 signatures collected by EnviroVoters. (Exhibit 16)
13. The Los Angeles County Sanitation District expresses concern for the potential impacts from an SCS listing on wastewater treatment operations, which it states could

result in the need for expensive upgrades to treatment facilities. The district also states that the Department's distribution map is inaccurate and requests that the Commission correct the map to remove SCS designation from the upper Santa Clara River. The district also requests to work with the Department to develop regulations that will protect the fish but allow essential services to continue. (Exhibit 17)

14. The California Building Industry Association opposes listing SCS, stating that there is not enough solid science to justify the listing and that the Department's report relies on uncertain data sources, leading to inaccurate range maps showing steelhead in places where they likely are not present. The association suggests using data from the U.S. Fish and Wildlife Service for better accuracy. Additionally, the association is concerned for the listing's impact on water agencies and homebuilding. (Exhibit 18)

Recommendation

Commission staff: Determine that listing southern California steelhead as endangered is warranted, as recommended by the Department.

Department: List southern California steelhead as endangered under CESA.

Exhibits

1. Petition, received June 14, 2021
2. Department transmittal memo, received January 18, 2024
3. Department status review report, dated February 2024
4. Department presentation
5. Letter from Dan Silver, Executive Director, Endangered Habitats League, received March 18, 2024
6. Letter from Stephen Kanne, received March 20, 2024
7. Letter from Lauren Hanson, Board President, Cachuma Conservation Release Board, received March 21, 2024
8. Letter from Polly Holcombe, Board President, COMB, received March 26, 2024
9. Letter from Edward Wallace, Conservation Chair, Pasadena Casting Club, received March 29, 2024
10. Letter from David Boyer and Christopher Francis, attorneys for United Water Conservation District, Atkinson, Andelson, Loya, Ruud & Romo, received April 3, 2024 (Note: This link goes to an external document due to file size)
11. Letter from Mauricio Guardado, General Manager, UWCD, received April 3, 2024
12. Letter from Laura Coley Eisenberg, Senior Vice President, Regulatory Compliance & Open Space Management, Rancho Mission Viejo, received April 3, 2024
13. Co-written letter from 26 non-governmental organizations, received April 3, 2024
14. Letter from Stephen Cole, Assistant General Manager, SCV, received April 4, 2024
15. Letter from Stephen Pang, State Relations Advocate, ACWA, received April 4, 2024
16. Email from Russell Marlow, Senior Project Manager, CalTrout, received April 4, 2024
17. Letter from Raymond Tremblay, Department Head, Facilities Planning, Los Angeles Sanitation Districts, received April 4, 2024

18. Letter from Nick Cammarota, Senior Vice President & General Counsel, California Building Industry Association, received April 4, 2024
19. Department memo, *Evaluation of Additional References Received for the Status Review of southern California steelhead* (Oncorhynchus mykiss), received April 11, 2024

Motion

Moved by ___________ and seconded by __________ that the Commission, pursuant to Section 2075.5 of the California Fish and Game Code, finds the information contained in the petition to list southern California steelhead (*Oncorhynchus mykiss*), and the other information in the record before the Commission, **warrants** listing southern California steelhead as an endangered species under the California Endangered Species Act, consistent with the Commission staff and Department recommendations. Findings will be adopted at a future meeting.

OR

Moved by ___________ and seconded by __________ that the Commission, pursuant to Section 2075.5 of the California Fish and Game Code, finds the information contained in the petition to list southern California steelhead (*Oncorhynchus mykiss*), and the other information in the record before the Commission, **does not warrant** listing southern California steelhead as an endangered species under the California Endangered Species Act.

California Fish and Game Commission
P.O. Box 944209
Sacramento, Ca 94244-2090

June 7, 2021

Notice of Petition: Southern California Steelhead (*Oncorhynchus mykiss*)

Commissioners,

California Trout ("CalTrout") is pleased to submit the following petition to list the Southern California steelhead (*Oncorhynchus mykiss*) as an Endangered Species under the California Endangered Species Act (CESA, FGC § 2050 et seq). This petition demonstrates warranted listing under CESA based on the factors specified in the statute.

CalTrout has been a statewide leader on trout, salmon, and steelhead conservation since its founding 50 years ago. It is CalTrout's belief that abundant wild fish indicate healthy waters and that healthy waters benefit all Californians. With more than sixty large-scale, "boots on-the-ground" conservation projects underway, in tandem with public policy efforts in Sacramento, CalTrout's six regional offices work tirelessly to advance our cause through a three-pillared approach to conservation.

Southern California steelhead ("Southern steelhead") is an iconic species on the South Coast of California. Southern steelhead are culturally important and serve as an indicator species to gauge the broader health of the entire watershed. The species is currently experiencing an alarming rate of habitat loss, compounded by climate crisis impacts. According to the California Department of Fish and Wildlife's Steelhead Restoration and Management Plan for California (1996), "southern steelhead are the most jeopardized of all of California's steelhead populations." This petition utilizes the best available science to fully establish that Southern California steelhead face the threat of certain extinction.

Twenty-five years ago, CalTrout was recognized in the forward of the state's Steelhead Restoration and Management Plan as being a leader in this cause. Today we again see a clear need for action by the Fish and Game Commission, and we request that the Fish and Game Commission list Southern California Steelhead as endangered.

We appreciate your consideration and look forward to working with the Commission on this critical listing. Please do not hesitate to reach out if you have any questions or would like to further discuss the petition.

Sincerely,

Curtis Knight
Executive Director
California Trout

CALIFORNIA TROUT
FISH · WATER · PEOPLE

California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

June 7th, 2021

The California Department of Fish and Wildlife (CDFW) published their Steelhead Restoration and Management Plan for California twenty-five years ago (McEwan and Jackson, 1996). This plan laid out the blueprint for restoring this important and valued state resource by restoring degraded habitat and re-establishing access to historic habitat that is currently blocked. This plan reaffirmed the state's mandate framed in The Salmon, Steelhead Trout, and Anadromous Fisheries Act of 1988 (SB 2261) to significantly increase natural production of salmon and steelhead by the year 2000. As stated in the Plan, severe anadromous fish population declines, the potential for species listings under the Endangered Species Act (ESA), fulfillment of legislative mandates, and the state's Public Trust obligations called for immediate implementation of CDFW's Steelhead Management Plan.

Since its publication in 1996, agencies and concerned organizations have made consistent efforts to reverse the course of population decline for Southern California Steelhead (*Oncorhynchus mykiss*). It is now 2021, and Southern steelhead have seen little demonstrable improvement in population numbers and long-term persistence (National Marine Fisheries Services (NMFS) 5-Year Update, 2016) since the species' federal ESA listing in 1997. We respectfully submit this petition to list Southern California Steelhead as an endangered species under the California Endangered Species Act (CESA F&GC § 2050 et seq.).

Southern steelhead is an iconic species on the South Coast of California. Southern steelhead are culturally important and serve as an indicator species to gauge the broader health of the entire watershed. The species is experiencing an alarming rate of habitat loss, compounded by climate crisis impacts. Yet it is still not listed as endangered by the State of California.

The State of the Salmonids: Status of California's Emblematic Fishes (2017) used an exhaustive literature review and a standardized protocol (Moyle et al. 2015) to determine that Southern steelhead are of "Critical Concern," with the population in danger of extinction with the next 25–50 years due to anthropogenic and environmental conditions. Going further, it states, "Since their listing as an Endangered Species in 1997, Southern steelhead abundance remains precariously low." This statement only reinforces how dire the situation has become. CDFW, in their own management plan, stated that "Southern steelhead are the most jeopardized of all of California's steelhead populations."

Preventing the extinction of Southern steelhead will have long-term implications for all steelhead populations on the West Coast (Boughton et al. 2007b, 2006, NMFS 2016). Over millennia, steelhead have evolved an ability to use a variety of shifting habitats. Southern steelhead took advantage of this plasticity and honed it in the naturally dynamic environment of Southern California and Northern Mexico (NMFS 2016). The mechanisms underlying anadromy for Southern steelhead, which is an important component of their life history variation, are not completely understood. However, research and *in situ* studies point to both environmental and genetic components having significant influence on their life-history pathway.

Extirpation of Southern steelhead would initiate a process of irreversible, cumulative extinctions of other native *O. mykiss* populations through three main pathways. First, irreversible loss of heritable genetic loci responsible for anadromy will prevent their transmission to future progeny. Second, *O. mykiss* in Southern California tolerate higher water temperatures and more variable dissolved oxygen levels, and can therefore contribute these adaptive traits to steelhead in northern regions as they experience warming of coastal waters. Third, fish passage barriers that completely block access to freshwater spawning grounds prevents genetic mixing on a regional scale, and thus the few remaining Southern steelhead or the freshwater resident native rainbow trout that maintain anadromous genetic characteristics, are substantially reproductively isolated (Hoelzer et al. 2008). This isolation by habitat fragmentation represents an important uncoupling in the evolutionary legacy of the species and a direct threat to its continued existence.

Paraphrasing Fish and Game Code 2062, an endangered species under CESA is a native species or subspecies which is in serious danger of becoming extinct throughout all, or at least a significant portion of its range due to one or more causes—including loss of habitat, change in habitat, overexploitation, predation, competition, or disease. Southern steelhead are in danger of becoming extinct throughout their entire range primarily through modification, degradation, and simplification of required habitat for full life-history, and loss of access to historical habitat to maintain genetic diversity. Southern steelhead's continued existence is threatened by predation and competition from non-native aquatic species in their currently accessible habitat and in historical habitat once access is restored. The requirements to list Southern California steelhead as endangered under CESA F&GC § 2050 et seq. are met and exceed over its entire range and distribution.

This petition utilizes the best available science to fully establish that Southern steelhead face the immediate threat of certain extinction due to the loss, fragmentation, and simplification of their habitat and provides clear evidence that the State of California must exercise its mandate to protect native salmonids and steelhead by listing Southern steelhead as endangered.

California Trout, Inc was recognized in the foreword of the state's Steelhead management plan as being a leader in this cause. Today we again see a clear need for leadership and action by the Fish and Game Commission. We request that the Fish and Game Commission list Southern California Steelhead as endangered.

Scientific Information Required for Listing Petition:

Population trend (A)

The Southern steelhead population has decreased substantially from the estimated historic population size (Boughton et al. 2005, Boughton and Goslin 2006, Boughton et al. 2006). The Southern California Coast Steelhead distinct population segment (DPS) has been estimated to have annual runs of between 32,000 and 46,000 returning adults. Today, the annual run is estimated to be less than 500 total returning adults in any given year (Busby et al. 1996, Williams et al. 2011, Good et al. 2005, Helmbrecht and Boughton 2005, Boughton and Fish 2003). The four watersheds historically exhibiting the largest annual anadromous runs—Santa Ynez River, Ventura River, Santa Clara River, and Malibu Creek—have experienced declines in run size of greater than 90 percent (Boughton et al. 2005, Good et al. 2005, Helmbrecht and Boughton 2005, Busby et al. 1996). Simply put, Southern steelhead remain in danger of extinction (Williams et al. 2011, Moyle 2017).

A comprehensive status review of steelhead was conducted by Busby et al. (1996), who characterized Evolutionarily Significant Units (ESUs) using the conceptual framework of Waples (1991), and then assessed extinction risk of each ESU. The Southern California Coast Steelhead DPS, based on the ESU definition, was subsequently listed as endangered by NMFS under the U.S. Endangered Species Act in 1997. The original listing characterized the southern range limit as the eastern end of the Santa Monica Mountains. In 2002, the ESA listing area was extended further south to the Tijuana River system at the U.S. border with Mexico. The listing was further modified in 2006 to include only the anadromous component of the ESU, which is composed of both anadromous and freshwater-resident forms of O. mykiss which can co-exist within watersheds. Good et al. (2005) updated the status of Pacific coast steelhead populations and another update was conducted in 2010 (Williams et al. 2011). None of these updates or reviews led to changes in the status of the species' listing. It has remained endangered under ESA.

Following the significant rise in Southern California's human population after World War II and the associated land and water development within coastal drainages, the Southern steelhead's population rapidly declined. This led eventually to the extirpation of populations in many watersheds, leaving only remnant or sporadic populations (Boughton et al. 2005, Good et al. 2005, Helmbrecht and Boughton 2005, Busby et al. 1996). A central tenet of the NMFS Recovery Plan (2012) is that a viable DPS will consist of a sufficient number of viable discrete populations that may be spatially dispersed but nevertheless adequately connected to achieve the long-term persistence and evolutionary potential of the species. The goal of status-review updates is to assess whether viability metrics for the DPS are moving toward or away from the viability criteria. The consensus of publications is that the status of the Southern California Coast steelhead DPS has not changed appreciably since the federal listing in 1997 (NMFS 1996, Busby et al. 1996, NMFS 2016). The most recent publication which compiled adult steelhead abundance through existing monitoring programs of various types and anecdotal observations within this DPS documented only 177 adult steelhead observations in the past 25 years (Dagit et al. 2020).

Range (B) and Detailed Distribution Map (L)

NMFS identifies the Southern California steelhead DPS as being comprised of the coastal watersheds extending from the Santa Maria River system south to the U.S. border with Mexico (Titus et al. 2010, NMFS 2012). Historically, *O. mykiss* occurred at least as far south as Rio del Presidio in Mexico (Behnke 1992, Burgner et al. 1992).

The range of watersheds within the DPS are generally classified in two basic types depending on their geomorphology; short coastal streams that are part of the coastal ranges, and larger river systems that extend inland through the coastal ranges. The smaller coastal systems are typified by the character of the Santa Monica and Santa Ana Mountain watersheds. The larger watershed class includes the Santa Maria, Santa Ynez, Ventura, Santa Clara, San Gabriel, Santa Ana, Santa Margarita, San Luis Rey, and San Diego

Rivers. These systems were further classified by predominate environmental and climate processes into five biogeographic population groups (BPGs). The entire range covers approximately 12,700 mi^2 with 25,700 mi. of streams (NMFS 2012). The established range of Southern steelhead contains several large human population centers with almost 22 million people. This figure, and level of landscape development and resource use implicit in it, is central to the current degraded condition of Southern steelhead

The range of the Southern steelhead is generally accepted as stated above, but not all stream miles within this range are equally habitable. NMFS used an Intrinsic Potential model to characterize and prioritize habitat suitability for species recovery. These models used an established set of factors to predict the potential for unimpaired over-summering habitat to be present at any given location in the DPS (Boughton 2006, NMFS 2012).

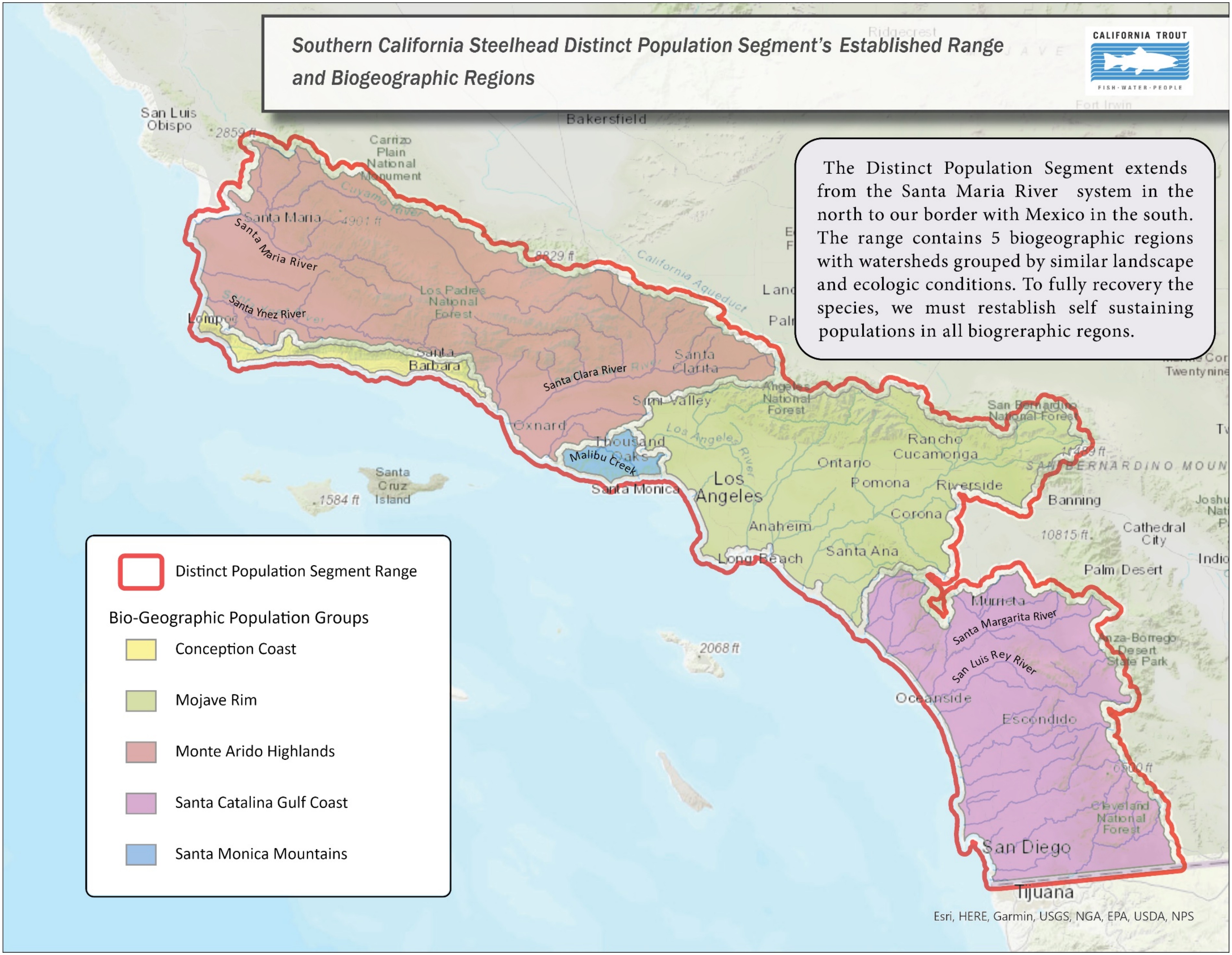
In general, Intrinsic Potential modeling is based on the idea that natural processes will tend to generate suitable habitat in reaches where discharge, gradient and topography meet certain criteria (Burnett et al. 2003). The parameters to model potential over-summering habitat for Southern steelhead included mean annual air temperature, mean discharge of streams during August and September, mean August air temperature and limiting access gradient in addition to stream gradient, discharge, and topography (Boughton et al 2006).

This work developed the ranked prioritization of watersheds within the DPS based on their environmental capacity to support a Southern steelhead population. This led to the designation of Category 1, identified to have the highest priority for recovery, followed by Category 2 then Category 3 populations within each of the five BPGs. This works assists in prioritizing restoration activities for target watersheds. However, the NMFS Recovery Plan describes the scientific basis for population-level and DPS-level recovery criteria whereby multiple populations within each BPG must have self-sustaining populations (NMFS 2012, NMFS 2016)

The delineation of the physical boundaries of Southern steelhead's range has been supported by genetic analysis and the observed variances among different *O. mykiss* populations. Early allozyme analysis of mitochondrial DNA performed before the ESA listing demonstrated a high degree of interpopulation differentiation within California (Nielsen 1994). Comparison of DNA samples among watersheds within the DPS to populations north of the DPS showed large differences in genetic markers. Samples collected from river system between the Santa Ynez River and Malibu Creek indicate the presence of mitochondrial DNA that is rare in steelhead populations north of the Southern steelhead DPS. (Busby et al. 1996). More recent genetic analyses of *O. mykiss* populations at the southern end of their range, using high-resolution genotyping of microsatellite loci and single nucleotide polymorphism (SNP) loci, indicate that the southern boundary of Southern steelhead range extends to northern Baja California, south of the U.S. border with Mexico (Abadia-Cardoso et al, 2015; Abadia-Cardoso et al, 2016).

Southern California Steelhead Distinct Population Segment's Established Range and Biogeographic Regions

The Distinct Population Segment extends from the Santa Maria River system in the north to our border with Mexico in the south. The range contains 5 biogeographic regions with watersheds grouped by similar landscape and ecologic conditions. To fully recovery the species, we must restablish self sustaining populations in all biogreraphic regons.



Distribution (C)

The spatial structure of Southern steelhead is influenced by fish passage barriers. The majority of watersheds historically occupied by Southern steelhead experienced extirpation due to anthropogenic barriers (Boughton et al 2005). The current distribution of Southern steelhead is defined as all anadromous waters below total natural barriers or man-made structural barriers (NMFS 1997). Anadromous adult Southern steelhead have been extirpated from approximately 60% of their historical range due to habitat fragmentation (NMFS 2012).

Southern steelhead have a complex life history that is central to their historical and current distribution. As covered in more detail in the Life History and Required Habitat sections, Southern steelhead predominantly express two forms: full anadromy and resident-freshwater. The anadromous and the resident-freshwater form co-exist throughout the DPS (Boughton et al 2006, Pearse et al. 2014).

The interplay of their life-history, their required habitat types, and distribution --both historical and current -- is complex (Boughton 2006). The freshwater resident form, or rainbow trout, are an integral part of the steelhead population, because anadromous adults can be the offspring of freshwater resident parents (Courter et al. 2013, Kendall et al. 2015, Abadia-Cardoso et al. 2016). It is likely that a combination of environmental and genetic factors determines anadromous or resident phenotype, which may be regulated by epigenetic factors (Baerwald et al, 2016). Genetic sampling above and below impassable dams within the established DPS for Southern steelhead indicates that they tend to be each other's closest relative (Clemento et al 2009.)

A number of barrier removal and habitat restoration projects have been implemented over two decades to address threats throughout the DPS (NMFS 2016). However, a number of large, complex fish passage barriers remain in place or not fully functional, even though significant investment over the years has supported advanced engineering design. The state ESA listing is anticipated to help move these projects forward into construction to realize their potential in species recovery. Environmental impacts from high intensity wildfires, floods, and extended drought have further reduced the number of small, isolated, remnant freshwater resident populations found in the upper tributaries (NMFS 2012). The Thomas Fire (2017) impacted many drainages throughout Santa Barbara and Ventura Counties; the Whittier Fire (2017) impacted the Santa Ynez watershed in Santa Barbara County, the Woolsey Fire (2018) impacted all creeks in the Santa Monica Mountains except Topanga Creek. The Holy Fire (2018) burned through Coldwater Canyon Creek in Riverside County which contains one of two known native rainbow trout populations descended from steelhead at the most southern extent of their range in California. Subsequent fire related floods and debris flows following these catastrophic events can cause local extirpation if emergency translocations are not performed in time.

Abundance (D)

Steelhead abundance numbers are naturally subject to high variability. Due to the character of the river systems in the DPS, monitoring of run sizes is difficult to quantify. Estimates of the historical (pre-1960s) abundance are available for several rivers in the DPS. The Santa Ynez River before 1950 is estimated to have had an annual run of 20,000-30,000 adult Southern steelhead. The Ventura River, pre-1960, had estimated annual runs of 4,000-6,000 returning adults. The Santa Clara River, pre-1960, was 7,000-9,000 returning adults and Malibu Creek, pre-1960, 1,000 adult returns. (NMFS 2012).

A review of the data from life-cycle monitoring stations at Vern Freeman Diversion Fish Ladder, Robles Diversion Fish Passage Facility, from migrant trapping by Cachuma Operation and Maintenance Board and the CDFW's Coastal Monitoring Program (CMP) support the finding that little to no change has been observed in total abundance or spatial structure of Southern steelhead since the initial federal listing (Williams et al 2011, NMFS 2012, NMFS 2016). The most productive systems support single digit runs of returning adults on any given year (Busby 1996, Williams et al. 2011, Dagit et al. 2020). Contemporary literature reviews of monitoring data support the conclusion that the total population estimate is dangerously low. This is further illustrated by the recent compilation of all monitoring program data and independent observations within the federal ESA listing area between 1998-2018. This work documented only 177 positive identifications of returning adult Southern steelhead in the past 25 years (Dagit et al. 2020).

Fish that express the resident freshwater life-history strategy play a central role to the continued existence of Southern steelhead. If the current course of modification and loss of available habitat for anadromous Southern steelhead is not corrected, there will be a greater need for resident freshwater rainbow trout to produce the vast majority of smolts that express anadromy and enter the Pacific Ocean. Smolt production is the product of both resident freshwater and anadromous life-history strategies (NMFS 2012). Due to shrinking suitable habitat below natural or man-made barriers to migration; rainbow trout will be a key component to ensure we maintain and re-establish the expression of anadromy and that any smolts produced by freshwater residents have access to required habitat over the entire course of their journey to the ocean and upon their return.

Recent studies have shown the resident freshwater populations still possess the alleles associated with anadromy (Pearse et al. 2009; Abadia-Cardosa et al. 2016). These results indicate that adoption of the freshwater resident life-history pattern does not necessarily result in the loss of the genetic potential for anadromy. The genetic potential of resident *O. mykiss* to express anadromy remains (Nielsen 1999; Courter et al. 2013; Phillis et al. 2016; Apgar et al. 2017) and, given the opportunity through restoration activity, could support re-establishing viable anadromous populations.

It is important to note that these freshwater resident populations are at risk from watershed-scale adverse anthropogenic impacts, quickening climate stress and other population level threats to their continued success. Catastrophic wildland fire, long term drought and continued human alteration of headwater habitat all put additional pressure on resident freshwater rainbow trout populations (NMFS 2012). Excessive loss of local freshwater resident populations can lead to lower genetic variability and fitness (Pearse et al. 2014; Abadia-Cardoso et al. 2016; Leitwein et al. 2017). Indeed, genetic analysis of rainbow trout at the southernmost extent of their range in the United States indicate that these populations have low allelic diversity (Clemento et al. 2009; Pearse et al. 2009; Jacobson et al. 2014; Abadia-Cardosa et al. 2016; Apgar et al. 2017), potentially leading to decreased retention of the genetic markers that support anadromy and overall fitness

The movement of adult steelhead between watersheds is an important factor as well. Anadromous adults are known to stray from their natal systems and could be important for re-establishing viable populations in formerly occupied watersheds (Bell et al. 2011). This could serve as a pathway to re-introduce genetic material across separate sub-populations (Garza et al. 2014). The inter-play of resident freshwater and anadromous life-histories is a critical component of Southern steelhead's current and future abundance and must be considered for recovery of the species.

Life history (E)

Steelhead are a highly migratory and adaptive species utilizing multiple habitat types over their complete life-history. The life cycle of Southern steelhead generally includes a freshwater period in coastal river systems followed by a migration to a marine environment to reach sexual maturity. Southern steelhead can express a great amount of variation in the timing and duration of each life-history stage in comparison to other species within the genus (Hayes et al. 2011, Quinn 2005, Hendry et al. 2004) This flexibility and malleability of life-history trajectories unique to Southern steelhead (Sloat and Reeves 2014, Kendall et al. 2015) is the evolutionary manifestation of the variability in environmental conditions that is characteristic of Southern California. This is particularly evident in the high number of sand-berm built estuaries in the DPS that must breach due to sufficient streamflow following winter rains to allow steelhead migratory access to a particular watershed.

Southern steelhead will spend one to four years maturing in the Pacific Ocean (Jacobs et al. 2011, Borg 2010, Haro et al. 2009, Leder et al. 2006, Quinn 2005, Davies 1991, Groot and Margolis 1995, Northcote 1958). Anadromous adults grow substantially larger than freshwater residents, leading to higher fecundity of returning anadromous females (NOAA 2012). After reaching maturity, Southern steelhead typically return to their natal river system to spawn, although strays do occur and may be an important vector to maintain genetic variability and connection across basins (Garza et al. 2014) Spawners typically return between January and May, but year-to-year variation in environmental conditions across diverse geographic settings have allowed Southern steelhead variability in spawning period. Variability in access to any river system is compounded by the sporadic nature of hydrologic connectivity common to river systems in Southern California.

Following sand-berm breaching, whereby a lagoon becomes an estuary that connects a freshwater stream to the ocean, steelhead will move into coastal river systems. Upon entering the river system, Southern steelhead can migrate several to hundreds of miles to reach suitable spawning habitat. Upon finding suitable gravel, females excavate a redd and deposit their eggs. Males then fertilize the eggs, after which the eggs are covered with gravel by the female. The embryos' incubation time may vary from three weeks to two months depending on environmental conditions. Newly hatched *O. mykiss* or alevins will then remain in the gravel for an additional two to six weeks. Unlike salmon, adult steelhead do not typically die following their spawning trip, and have been observed to return to the ocean and then come back to freshwater to spawn again. The frequency and nature of repeat spawning by Southern steelhead as a species, is poorly understood, but this iteroparous life-history strategy can occur (Moyle et al 2008, Moyle 2002).

Juvenile Southern steelhead or parr will rear and forage in a variety of freshwater habitat types depending on their maturation rate before beginning their migration to the ocean. Southern steelhead parr will spend between one to three years in freshwater before migrating to the ocean (Shapovalov and Taft 1954, Moore 1980, Quinn 2005). The timing of out-migration is influenced by a variety of environmental cues including streamflow, temperature, and breaching of the sand berm at the river's mouth. Out-migration to the ocean usually occurs in the late winter and spring . Smolts will spend a short time in the estuary. Here the mixing of fresh and saltwater habitats allows for the morphological changes that smolts need to undergo to prepare themselves for the ocean environment. In some watersheds, smolts may rear in a lagoon or estuary for several weeks or months prior to entering the ocean.

In contrast to Central California lagoons where juveniles grow substantially faster and larger than their riverine reared counterparts (Smith 1990, Bond et al. 2008, Hayes et al. 2008, Atkinson 2010), Southern steelhead are less frequently observed in estuaries. This may be attributed to low population numbers, adaptation for rapid outmigration, and/or poor lagoon habitat. Studies from more northern estuaries support the idea that larger juveniles have a higher survival advantage after outmigration into coastal marine waters and, as a result, have a greater opportunity to return to their natal streams as adults for spawning (Bond et al. 2008, Hayes et al. 2008, and Atkinson 2010). Therefore, if conditions permit, increased juvenile steelhead estuarine rearing prior to emigration could be a critical contributor to enhance the viability of steelhead populations.

The cycle described above is referred to as their fluvial-anadromous life-history strategy. Southern steelhead can also express two additional life-history trajectories: a freshwater-resident pathway and a lagoon-anadromous pathway. The freshwater-resident pathway describes *O. mykiss* that complete their entire life cycle in freshwater. Fish that follow this life-history trajectory are commonly known as rainbow trout. Rainbow trout will incubate, hatch, rear, mature, reproduce, and die in freshwater. A lagoon-anadromous pathway describes a hybrid option. Southern steelhead smolts out-migrate, but can remain in the lagoon or estuary for a year before returning upstream to freshwater habitat to spawn.

These descriptions only cover the predominant life-history pathways for *O. mykiss*. It does not, however, capture the full complexity of the life-history permutations that can be exhibited by *O. mykiss*. Plasticity of life-history should be considered the central characteristic for Southern steelhead in understanding their life cycle (Kendall et al. 2015). An interplay between environmental conditions and adaptive behavior likely causes shifts between resident and migratory life-history behavior expressed by a Southern steelhead (Kendall et al. 2015, Pearse et al. 2014, Pearse 2016, Satterthwaite 2012; Beakes 2010). The seasonality of the hydrologic cycle impacts the predominant life-history trajectory expressed in particular watersheds. Southern steelhead's long-term viability is dependent on this life-history plasticity, and on their ability to migrate to new habitat.

Kind of habitat necessary for survival (F)

Habitat characteristics at any one location may change significantly from year to year in the Southern California Mediterranean climate. A Mediterranean climate is distinguished by warm, wet winters under prevailing westerly winds and calm, hot, dry summers, as is characteristic of the Mediterranean region and parts of California, Chile, South Africa, and southwestern Australia. As water warms and preferred habitat alters seasonally, hydrological connectivity between habitat types becomes important, and influences the ability of *O. mykiss* to move throughout the river system to seek refuge areas if needed. Their multiple life-history trajectories rely on a network of habitat types to build in the critical redundancy. This allows any individual to complete their life cycle by exploiting the best available habitat for that stage of development at any given time. A simple example is that juvenile Southern steelhead can find the necessary thermal refugia to over-summer in a tributary that flows year-round or in the river's estuary. The interplay of habitat type, habitat condition, and the connectivity between habitats over time is paramount in their development and survival.

Southern steelhead require cool, clean water, and complex, connected habitat. Each habitat type must provide sufficient nutrients and foraging opportunities to allow for the growth and development required for their current life-history stage (NMFS 2012). Ocean-going adult steelhead require sufficient water quality, depth, cover, and marine vegetation. Estuary and lagoon habitats must provide uncontaminated water and substrates with connected wetlands for juveniles. Effective mobility for juvenile and adult Southern steelhead requires mainstem river migration corridors that are free of obstruction. They must also minimize excessive risk of predation and provide enough water quantity to allow for cover, shelter, and holding areas.

The geological character of their geographic range is young, highly erodible sedimentary rock. Excessive sedimentation and turbidity are critical water quality components in all habitat types and impacts how Southern steelhead utilize each habitat type. Freshwater spawning sites must provide sufficient water quantity as well as good water quality. Southern steelhead gravel sizes must fall within a range that supports spawning and incubation. Freshwater rearing habitat must provide sufficient water quantity and quality with lateral connectivity to the floodplain. These characteristics are essential for rearing and foraging as it provides refugia and habitat complexity.

Within each of these habitat types, Southern steelhead realize changes in their availability depending on the habitat conditions or quality. The preferred biotic conditions of any habitat type are subject to the immense variability common in Southern California. Documented habitat tolerances and ranges are important, but Southern steelhead's ability to move into microenvironments in response to changing conditions is a critical component of their required habitat types and conditions (Moyle et al. 2017). Their required habitat conditions align with habitat types suited to their life-history development stage.

The primary habitat conditions that influence Southern steelhead development are temperature, dissolved oxygen, water depth, and velocity. Of these, water temperature is the best studied and can change significantly diurnally and seasonally. Southern steelhead tolerate warmer water temperatures than more northern salmonids, as they have adapted to a wider range of environmental conditions characteristic of a highly variable climate. The upper temperature threshold of 25°C has been observed to coincide with cessation of feeding and retreat to thermal refugia in Southern steelhead (Boughton et al. 2015, Sloat and Osterback 2013, Spina 2007).

Juvenile Southern steelhead regularly persist in conditions outside of the ideal range. Juvenile steelhead prefer water temperature in the range of 10–17 ° C, but have been observed in the Ventura River with water temperature that peaked at 28°C (Carpanzano 1996). The relatively warm water of the Ventura River has been observed to result in more rapid growth of juvenile steelhead than has been observed in more northerly populations (Moore 1980, McEwan and Jackson 1996).

While temperature is a principle biotic condition impacting overall survival of Southern steelhead, dissolved oxygen, water depth, and water velocity during their freshwater development stages are important factors as well. Dissolved oxygen levels, as influenced by water temperature, above 5mg/L is considered adequate for survival. In contrast, 3 mg/L is considered to be the lethal lower limit for unimpaired growth (EPA 1986) , but is dependent on duration, magnitude, frequency, and accessibility of refugia (McLaughlin et al. 2009, Matsubu et al. 2017, Huber and Carlson 2020).

For returning adult Southern steelhead, 7 inches is considered the minimal water depth needed for successful migration. Water velocities over 10 ft/sec are considered sub-optimal for migration upstream (Bovee 1978, Thompson 1972, Barnhartt 1986). Water velocities that hinder the swimming of adult returners have a greater impact on effective migration than depth (Barnhartt 1986). Southern steelhead fry prefers water depths that are from 2–14 inches with juveniles occupying similar depths with observed preference for 10–20 inches (Bovee 1978).

Factors affecting the ability to survive and reproduce (G)

Destruction, modification, and fragmentation of native habitat are recognized as the primary causes for the decline of the Southern steelhead (NMFS 2012). This has occurred due to the development of water infrastructure, agriculture, urbanization, and climate change-induced events including catastrophic wildland fire and drought. Water storage, withdrawal, diversions, flood control, and hydropower have greatly reduced, disconnected, simplified, or eliminated Southern steelhead habitat. These actions have modified natural flow and sediment regimes, which in turn have resulted in degraded water quality, changes in aquatic species communities, depletion of necessary flows for life-history development, and disrupted habitat maintenance processes (NMFS 2012). The Conservation Action Planning (CAP) Workbooks (Hunt, 2008) prepared for NMFS informed the federal recovery plan and hold true today. The CAP Workbooks resulted from reviewing existing information on steelhead habitat conditions and assessing the magnitude and extent of threats to steelhead and their habitats. These workbooks were used to develop recovery planning actions across the DPS.

Large dams in the Ventura River, Santa Clara River, Santa Ynez River, Malibu Creek, and other impassable barriers created by water diversions, flood control channels and certain bridges have had the most profound effect on blocking Southern steelhead migration between the ocean and upstream freshwater spawning, rearing, and foraging areas. These barriers disconnect the longitudinal and lateral ecosystem processes of the headwaters from lower sections and restrict floodplain access. This not only blocks migration to upstream spawning, rearing and foraging habitat but also restricts and impedes the effective out-migration of smolts (Stoecker and Kelley 2005). In some cases, migration through and access to critical habitat is blocked as is the case for 100-ft tall Rindge Dam in the lower three miles of Malibu Creek in the Santa Monica Mountains BPG (U.S. Army Corps of Engineers, 2020). Land development, whether for agriculture or urban development, leads to reduction in habitat complexity, alteration of flow and sediment transport, and degrades water quality (Moyle et al. 2017). Both agriculture and urbanization increase water demand. Even though almost 80% of water in Southern California is imported, over-reliance on surface diversion and groundwater pumping has resulted in depletion of instream flows and groundwater aquifers.

The rate of change in climate conditions brought on by climate crisis is a significant challenge to the continued existence of Southern steelhead. Climate change models for Southern California that evaluate conservative atmospheric forcing projections predict warmer atmospheric temperatures, sea level rise, ocean acidification, increased surface water temperatures, and changes in frequency, severity, duration, and intensity of drought and precipitation (Wade et al. 2013). Climate crises will exacerbate the problems associated with anthropogenic degradation of riverine, estuarine, and marine habitats already present (Williams et al. 2015). Floods and persistent drought conditions have periodically reduced already limited spawning, rearing, foraging habitats, and migration corridors.

Impacts to Southern steelhead from climate crisis impacts include direct effects from temperature such as mortality from heat stress, changes in growth and development rates, expanded parasite range and disease susceptibility. Changes in the flow regime also affect survival and behavior. Southern steelhead mortality and growth rates are also expected to suffer from the indirect effects that result from changes in the freshwater habitat structure and the invertebrate and vertebrate community, which govern food supply and predation risk (Crozier et al. 2008, Petersen and Kitchell 2001). Expected behavioral responses include shifts in seasonal timing of important life-history events, such as adult migration, spawning, fry emergence, and juvenile migration (Hayes et al. 2011, Boughton et al. 2009).

Direct threats to survival and reproduction include the presence of non-native vegetation and aquatic species that outcompete Southern steelhead for limited resources. Poor water quality and inconsistent water flow are hallmarks of unsuitable habitat for Southern steelhead, which can be exacerbated by competition or predation from non-native species.

As the impacts of climate change become more pervasive, catastrophic events such as fire and extended drought will lead to sudden extirpation of already fragmented populations. These reproductively isolated populations become more inbred through time, and as their genetic diversity decreases, their resilience to environmental threats may also decrease. All of these interactingand negative feedback loops have earned Southern steelhead a rating of “critically vulnerable” to the impacts of climate change, with a forecast of being likely to go extinct by 2100 without strong conservation measures (Moyle et al 2013).

Degree and immediacy of threat (H)

Southern steelhead are facing the highest degree of concern and an immediacy of threat to the continued persistence of this species over the next 50 years. Anadromous *O. mykiss* in southern California face significant threats from water and land management practices that have degraded or curtailed freshwater and estuarine habitats. This has severely reduced the capability of the species to sustain viable populations within most watersheds (Moyle et al. 2011, 2008). Given the current status of the species and the degraded condition of many freshwater and estuarine ecosystems, the continued existence of the species may be further threatened by shifts in climatic and oceanographic conditions (NMFS 2012).

Recent assessments of Southern steelhead forecast that they are in danger of extinction within the next 25–50 years due to the degradation of habitat associated with human development and the widespread impacts of climate crisis (Moyle et al 2017). This assessment is the result of a standardized protocol scoring for seven metrics: area occupied (anadromous and resident freshwater), estimated adult abundance, dependence on human intervention for persistence, environmental tolerance under natural conditions, genetic risks, vulnerability to climate change and anthropogenic threats. Scoring of the metrics was based on literature reviews, expert knowledge, and interviews with species experts (Moyle et al 2017).

Impact of existing management efforts (I)

Federal

The principal management strategy for Southern steelhead lies at the federal level for regulatory and recovery planning within the DPS boundaries. The listing of the Southern steelhead in 1997 under the Endangered Species Act (62 FR 43937) covered steelhead in anadromous water below natural and man-made fish passage barriers within the Southern California Coastal Steelhead DPS, which followed the geographic boundaries of the Southern steelhead ESU. The original listing was bounded by the Santa Maria River at the northern end, to Malibu Creek in the Santa Monica Mountains at the southern end. After documentation of steelhead in San Mateo Creek in San Diego County by CDFW biologists in 1999-2001, and genetic analysis by NOAA showing native steelhead ancestry, the ESA listing was extended south to the U.S.-Mexico border in 2002 (67 FR 21586). As such, the federal ESA listing established requirements for steelhead consultation under NMFS jurisdiction for this amended area, and the Southern California Steelhead Recovery Plan was produced by NMFS pursuant to that listing.

Four U.S. National Forests within the DPS (Angeles, Cleveland, Los Padres, San Bernardino) all have land management practices in place that require protection and conservation decisions to account for listed species. The federal government's oversight of the Clean Water Act (CWA) Section 404/401 Program requires that any project undergo consultation with NMFS when in the listing area for Southern steelhead. Additionally, the federal governments oversight and certification of the Flood Insurance Program through the Federal Emergency Management Agency (FEMA) strongly influences development of floodplains.

Even with these tools at the federal government's disposal, their impact on the long-term survivability of Southern steelhead has been challenging. No discernable change in total population size has been detected since the species was listed by the federal government in 1997. NMFS oversight and management of the species to date has been a key component directing the work of recovering the species. This has been supplemented by project funding from multiple federal agencies to implement NMFS Recovery Plan across the DPS. As stated above, many steelhead migration barriers have been remediated since the federal ESA listing. However, a number of large fish passage barriers remain in place or not fully functional. Significant investment over the years has supported advanced engineering design for remediation of these barriers, but implementation has been problematic.

The lack of legal basis to enforce recalcitrant landowners, entities, and agencies that are responsible for providing protections under ESA has presented problems. The rapid translation of scientific advances in understanding watershed and population dynamics, the ambiguity in the criteria established by NMFS during their oversight of passage barrier remediation has hindered implemented needed restoration actions. Without the species listed under CA Endangered Species Act, NMFS is, in most cases, the only government agency with direct oversight over the condition of the species and its required habitat. This has resulted in protracted legal battles and little option for enforcement.

The impact from the loss of habitat, exploitation of natural resources and the threat from aquatic invasive species has remained unchanged in successive status reviews by NMFS (Williams et al 2011, NMFS 2016). Major milestones of the federal recovery plan remain unachieved. Obsolete dams in the Ventura River and Malibu Creek system still stand. The Vern Freeman Diversion, long recognized as an ineffective partial passage barrier on the main stem of the Santa Clara River, a Core 1 population, has not been remediated over two decades and two lawsuits. Flow releases from Bradbury Dam to support Southern steelhead development in the Santa Ynez, a Bureau of Reclamation project, were secured after a lengthy regulatory process, but Bradbury Dam provides no opportunity for passage to two-thirds of Southern steelhead native headwater habitat in this system. Additional legal protection is imperative to move forward these projects essential to the species' survival.

Another impact of the federal listing is the ability to conduct scientific analysis on the species itself. It is not for lack of interest or want that the most fundamental research to establish the genetic uniqueness of the species pre-dates the federal listing. Federal guidelines and policies on the handling of the species for research purposes are a deterrent to continued research even though there has been significant innovation and advancement in DNA and gene sequencing technology.

State of California

The State of California has several published plans that provide for the management and conservation of Southern steelhead. The Steelhead Restoration and Management Plan for California (1996) written by California Department of Fish and Wildlife is foremost among these. This management plan identified the "impending extinction" of Southern steelhead within twenty-five years. Southern steelhead were given the highest priority for department management conservation action. The State of California's application of the Public Trust Doctrine is a second tool that provides the state a broad-based legal precedent to address threats to Southern steelhead survival. Fish and Game Code Sections 1600–1603 and 5935–5937 are additional mechanisms for State oversight in the management of Southern steelhead. The California State Water Resources Control Board (SWRCB) administers the water rights permitting system. They control utilization of waters for beneficial uses throughout the state (Grantham and Moyle 2014).

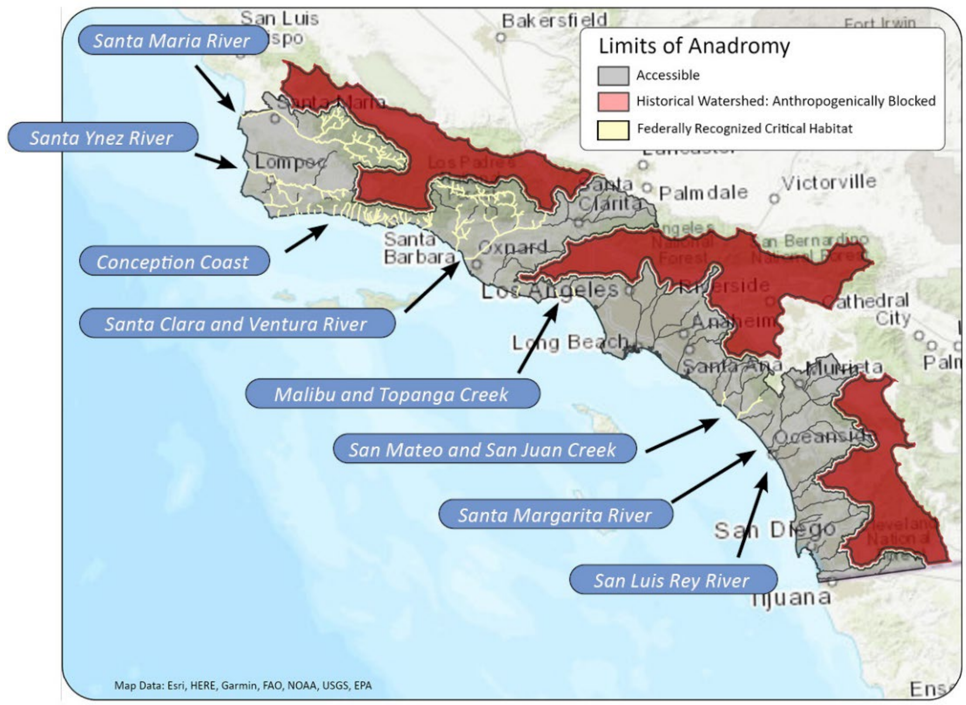
However, the system does not provide an adequate regulatory mechanism to implement the requirements of CDFG Code Sections 5935–5937 for the owner of any dam to protect fish populations below impoundments. Additionally, SWRCB generally lacks the effective oversight and regulatory authority over groundwater development comparable to surface water developments for out-of-stream beneficial uses.

Section 1600 Lake or Streambed Alteration Agreements program is the principal mechanism through which the CDFW provides protection of riparian and aquatic habitats. However, increased protection through this mechanism is needed to protect riparian and aquatic habitats important to migrating, spawning, and rearing steelhead.

Finally, monitoring of stocks (particularly annual run-sizes) is essential to assess the current and future status of individual populations and the DPS, as well as to develop basic ecological information on the Southern steelhead populations of the Recovery Planning Area. However, the Coastal Monitoring Plan remains unfinished for the Southern California region, and long-term funding for its implementation has not been identified and secured.

Suggestions for future management (J)

CalTrout recommends that the Fish and Game Commission list the species as endangered under CESA accepting the current limits of anadromy as established by the ESA listing for this species (NMFS 2002, 2012). The federal ESA listing covers *O. mykiss* downstream of total manmade or natural barriers in anadromous waters, and these fish are under jurisdiction of NMFS. O. mykiss upstream of total barriers are not covered under the federal ESA listing, and are under jurisdiction of the U.S. Fish & Wildlife Service.



We need to recognize Southern steelhead as endangered at the state level to augment the protection provided by the federal listing.

This recommendation is put forth because no demonstrable increase in Southern steelhead abundance has occurred since the initial ESA listing and the threat of extinction is immediate (NMFS 2011, NMFS 2016, Moyle et al. 2017).

CalTrout wants to ensure that all state agencies have the clear mandate to prioritize for Southern steelhead protection and conservation in strategic planning, funding appropriations, and resource management plans. The listing of Southern Steelhead as endangered will provide full acknowledgement to Californians of the fundamental importance this species has to the state and the ecosystem.

Listing of the species as endangered will allow the state and its citizens to realize the value of funds invested to date in Southern steelhead recovery. Many of these Southern steelhead conservation projects are large scale efforts with multiple stakeholders, and have required significant funds for planning, design, and implementation. As more projects are planned and move into construction, the state listing will be important for successful implementation and effectiveness monitoring of these projects.

Specifically, when the commission lists the Southern steelhead as endangered, CDFW will have direct authority to oversee projects proposed within the current limits of anadromy. This will provide CDFW the ability to establish species-specific mitigation measures that must be met for take coverage to be authorized.

CalTrout supports following the federal ESA listing coverage for below barrier steelhead, while keeping the above-barrier resident rainbow trout outside the ESA listing coverage. Above-barrier native rainbow trout are precious genetic resources for Southern steelhead recovery, but also are part of a robust sport fishery in the mountains of Southern California. Excluding these rainbow trout from CESA coverage also allows for emergency translocation after wildland fire without regulatory delays, and allows for conservation brood stock development and research to be performed to increase the genetic and geographic diversity of native rainbow trout of steelhead ancestry.

Our recommendation of adopting the federal ESA listing structure is intended to conserve key ecologic and evolutionary processes to preserve species diversity, while incorporating ESU-defining features of reproductive isolation and adaptation (Waples 1991). The anadromous component of the ESU covers a precariously small steelhead population expressing the anadromy trait in a discontinuous spatial context trending towards extinction. It therefore meets the four Viable Salmonid Population criteria (abundance, trends, spatial structure, diversity) used to guide ESA risk assessments (McElhany et al 2000), as well meeting the discrete and significant criteria for listing under CESA. The resident component of the ESU covers a large number of native rainbow trout that are geographically dispersed, but are genetically demonstrable remnant populations of Southern steelhead (Abadia-Cardoso et al 2016). These trout have been reproductively isolated behind barriers for decades, and have undergone localized adaptation.

Following the existing paradigm of quantitative genetics, most phenotypes are controlled by many genes of small effect (Waples, 2018). The interplay of neutral and adaptive loci enabling rainbow trout to survive in diverse above-barrier habitats, as well as the extent to which anadromy-associated genes are subject to selective pressure in resident trout, is not clearly understood. This is particularly evident in the case of chromosomal inversions (e.g., *Omy5* locus)(Pearse et al 2014) and transcriptional regulators (e.g., Greb1L)(Hess et al 2016, Prince et al 2017, Mohammed et al 2013). These have been shown to be important in triggering anadromy and/or run timing, in which a small number of genes produce a large impact on phenotypes. In this regulatory hierarchy, one or more master regulator proteins and/or epigenetic conditions can regulate hundreds of genes of varying penetrance, and thereby produce ecological/evolutionary diversity.

Native rainbow trout that have undergone adaptive evolution are still at risk from environmental threats such as drought, fire, flood in addition to anthropogenic threats. The proposed CESA management framework allows for emergency translocation of these above-barrier fish before sudden extirpation. It also allows for research to increase understanding of physiological tolerances unique to Southern steelhead and applicable to salmonids statewide. This ESA listing framework also provides for continued recreational fishing in the mountains of Southern California where native rainbow trout persist above major barriers. This in itself is a significant consideration for the state and its people. This is further impetus for the state, considering the diverse threats to steelhead and resident rainbow trout, to remove barriers and provide access to historical habitat in high priority watersheds, as identified through Intrinsic Potential modeling and designated in the NMFS Recovery Plan, to promote genetic interbreeding to the extent possible as soon as possible.

Additionally, CalTrout recommends that:

a) special restrictions of catch-and-release, barbless lures only regulations apply to native trout in areas demonstrated to have steelhead lineage (Abadia-Cardoso et al 2016),
b) signs be posted and fishing survey boxes be installed at key access points in the DPS for fishers that clearly state the role of these native rainbow trout in Southern steelhead recovery and what information is being collected,
c) only triploid (non-reproducing) rainbow trout be stocked in streams within the DPS, and
d) that stocked reservoirs and still-water bodies have adequate barriers to escape of hatchery trout into high priority Southern steelhead recovery rivers throughout the DPS.

CalTrout recommends the adopting of the current ESA listing area not only to preserve the organizing principles that currently directs recovery actions, but also to establish a state-level endangered species redundancy. For a species that is endemic and iconic to the coast of Southern California, redundancy in the species' protection at the state level will lay the groundwork for redundancy in Southern steelhead populations within the DPS.

Availability and sources of information (K)

The National Marine Fisheries Service as a part of the National Oceanic and Atmospheric Administration generated the majority of the information presented here through the NMFS Southern California steelhead Recovery Plan and 5-year status reviews, other technical documents, scientific publications, and biological opinions. CDFW and other state agencies have published Southern steelhead planning, recovery, and assessment documents which have also served to draft this petition. CDFW's Steelhead Restoration and Management Plan for California and NMFS's Southern California Steelhead Recovery Plan are cited throughout. Extensive research on *O. mykiss* physiological tolerances and behavior, particularly on resident rainbow trout, is provided by reference herein, as well as the most recent assessment of adult steelhead population abundance (Dagit et al. 2020).

The scoring of the potential for extinction of Southern steelhead is a product of the comprehensive overview of salmonid species in California conducted most recently by Moyle and co-authors in 2017.

CESA Listing Factors

CESA regulates that a species should be listed as endangered or threatened if the Fish and Game Commission determines that its continued existence is in serious danger by one or any combination of the following factors:

Present or Threatened Modification or destruction of habitat

Southern steelhead have declined in large part because of the degradation, simplification, fragmentation, and total loss of habitat (Hunt & Associates 2008). The destruction of habitat is the result of human land use, agriculture, and flood control management decisions. Water withdrawal, storage, conveyance, and diversions have greatly reduced or eliminated historically accessible Southern steelhead habitat.

Modification of natural flow regimes by water infrastructure development has resulted in increased water temperatures and depleted the flow necessary for migration, spawning, rearing, and forging. This has also resulted in the disruption of habitat forming and ecosystem maintenance processes. While previous loss of habitat was strictly the result of more tangible, direct anthropogenic activity, climate crisis is amplifying these impacts at an accelerating pace.

This assessment of the Present or Threatened Modification or Destruction of habitat is the result of a comprehensive analysis outlined in the Conservation Action Planning Workbooks. This process used available information in a consistent, transparent, and reproducible fashion to assess aquatic habitat quality and anthropogenic threats to that habitat (The Nature Conservancy 2010, Kier Associates and NMFS 2008, Hunt & Associates 2008). This process was applied to all 45 watersheds that comprise the Southern steelhead DPS. The assessment published in 2012 concluded that the general DPS-wide condition of all major watershed was “Fair” to “Poor” with only 4 of the 45 watersheds were assessed to score a ”Good” rating (NMFS 2012).

The DPS-wide threat of habitat modification and destruction remains a concern (NMFS 2011, NMFS 2016). While a number of smaller restoration actions have created landscape level habitat improvements, the practices over the past century including large dam construction, mainstem channel straightening and floodplain disconnection, remain in place and their legacy of alteration continues to ripple through time to this day.

Overexploitation

Southern steelhead populations historically supported an important recreational fishery throughout their range. Reporting on recreational angling for Southern steelhead on the Santa Ynez indicated a vibrant fishery with substantial angling opportunities prior to development of the Bradbury Dam/Lake Cachuma Facilities. Similar accounts are true for the Ventura, Santa Clara, and other river systems such as San Juan Creek and San Mateo Creek in the DPS (NMFS 2012). Recreational angling for Southern steelhead increased the mortality of returning and freshwater-resident adults, but is not considered the principal cause for the decline of the species (NMFS 2012).

Predation

Introductions of non-native aquatic invasive species (AIS) resulted in increased predator populations in numerous river systems in the DPS. Once established, these introduced species increase the level of predation experienced by native salmonids (NMFS 1996, Busby et al. 1996). AIS in the Southern steelhead DPS are pervasive and deleterious. These species are known to prey on rearing juvenile Southern steelhead (Cucherousset and Olden 2011).

NMFS concluded that the information available on these impacts to steelhead did not suggest that the DPS was in danger of extinction, or likely to become so in the foreseeable future because of predation. (NMFS 2012). It is recognized that small, isolated populations of Southern steelhead can be more vulnerable to extinction through the combination of multiple secondary threats, and the role predation plays may be heightened under the current degraded condition of their native habitat.

Competition

In addition to the increase of predation on Southern steelhead by AIS, Southern steelhead are also in direct competition for critical aquatic habitat and resources with AIS (Marks et al. 2010, Scott and Gill 2008, Fritts and Pearson 2006, Bonar et al. 2005, Dill and Cordone 1997) including fishes and amphibians such as largemouth bass, redeye bass, bullhead, sunfish species, and bullfrogs. All these species thrive in warmer slow-moving water. They can also withstand lower water quality conditions than Southern steelhead. The combination of a Mediterranean climate and decades of habitat loss led to habitat conditions suitable for uncontrolled AIS population growth. This uncontrolled population growth of AIS is evident in Sespe Creek, a tributary of the Santa Clara River. Designated as critical habitat by NMFS and a State identified Wild and Scenic River, it is teeming with AIS in the slow-moving pool habitat. However, in the smaller tributaries in this system with cool water temperatures and greater slope, there are healthy juvenile Southern steelhead population numbers (Stillwater 2019).

The presence of invasive species in San Mateo Creek in northern San Diego County is another example where invasive species threaten the recovery of Southern steelhead. In recent years, the San Diego Regional Water Quality Control Board has sought to combat this problem using a novel approach by preparing a 303d listing for invasive aquatic species in San Mateo Creek as a non-point source pollutant. This proposal has received preliminary approval by the Regional Water Board for incorporation into the San Diego Regional Basin Plan. A formal 303d listing would open up significant funding to remove invasive aquatic species from San Mateo Creek. The last purported Southern steelhead observed in 2017 in lower San Mateo Creek was likely lost due to predation by invasive species.

Disease

The combination of disease, AIS infestation and predation are likely to play a major role in the population size of Southern steelhead. Many diseases are known to influence the development and survival of steelhead (Noga 2000, Wood 1979, Rucker et al 1953), although limited data or information exists to explicitly link infection levels and rate of mortality (NMFS 2012). With the increased environmental stress on resident rainbow trout populations that are experiencing impacts due to climate crisis, they will likely encounter new parasites that have expanded range which may lead to sudden extirpations of the few remaining coastal steelhead populations.

Other Natural Occurrences or human related activities

Southern steelhead are on the front line for climate crisis impacts. The DPS covers the southern edge of the species' total range on the West Coast. The DPS is projected to experience the greatest overall increase of air and water temperatures. Persistent drought has increased surface air temperatures and altered natural precipitation patterns (Williams et al. 2015, NMFS 2016). This has accelerated the loss of habitat needed for all life-history stages for an already stressed population. Climate change will have a significant impact on their continued existence (Wade et al 2013). Climate crisis impacts on salmonid species are increasing over time. Building resiliency into the remaining populations of Southern steelhead is essential to their survival (Williams et al. 2016) and to the survival of salmonids further north along the coast. Even given their inherent plasticity, the impacts of climate crisis will outpace their ability to utilize this flexibility. The most recent NMFS 5-year status review completed in 2016 concluded that the ongoing drought and ocean conditions in the years preceding its publication likely reduced the survival of Southern steelhead across the DPS.

Conclusion

Southern steelhead are an iconic California species that deserve the highest level of state protection. State and federal entities have had decades to address the precipitous and continuing decline in Southern steelhead populations through all manner of guidance, policy, and mandate. Yet this species remains on the brink of extinction throughout its range. The principal condition for protection under CESA is met.

Southern steelhead have an irreplaceable impact on Southern California watersheds and communities. The total loss of this species will have irreversible consequences.

For this reason and all of those presented in this petition, CalTrout requests that the California Fish and Game Commission use the powers that it has vested to list this species as endangered under the California Endangered Species Act. We must ensure that future Californians have the ability to enjoy this amazing species.

Sincerely,

Curtis Knight
Executive Director
California Trout

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State of California
Department of Fish and Wildlife

Original on file,
received January 18, 2024

M e m o r a n d u m

Date: January 8, 2024

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director

Subject: Status Review Report for Southern California Steelhead (*Oncorhynchus mykiss*)

The California Department of Fish and Wildlife (Department) has prepared the attached status review report for southern California steelhead (*Oncorhynchus mykiss*) for the California Fish and Game Commission (Commission) pursuant to the California Endangered Species Act, Fish and Game Code section 2050 et seq. The Commission published the Notice of Candidacy Findings on May 11, 2022, directing the Department to prepare a status review report. On October 12, 2022, the Commission approved a Department request for a 6-month extension to further analyze the petition and complete its status review report in accordance with Fish and Game Code section 2074.6.

The Department completed the attached status review report as required by Fish and Game Code section 2074.6. The status review report contains the Department's review of the best scientific information available to the Department on the status of southern California steelhead and serves as the basis for the Department's recommendation to the Commission that the petitioned action to list southern California steelhead as endangered is warranted. The Department finds that southern California steelhead is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease.

If you have any questions or need additional information, please contact Jay Rowan, Branch Chief, Fisheries Branch at (916) 212-3164 or by email at Jay.Rowan@wildlife.ca.gov.

Attachment

ec: California Department of Fish and Wildlife

Chad Dibble, Deputy Director
Wildlife and Fisheries Division

Jay Rowan, Branch Chief
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Sarah Mussulman
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Robin Shin
Senior Environmental Scientist (Specialist)
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State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION CALIFORNIA ENDANGERED SPECIES ACT STATUS REVIEW OF SOUTHERN CALIFORNIA STEELHEAD (ONCORHYNCHUS MYKISS)

January 2024

Southern California Steelhead Rainbow Trout, CDFW photo

Prepared by
California Department of Fish and Wildlife

Suggested citation:

California Department of Fish and Wildlife (CDFW). 2023. Report to the California Fish and Game Commission. California Endangered Species Act Status Review for Southern California Steelhead (*Oncorhynchus mykiss*). California Department of Fish and Wildlife, 1416 Ninth Street, Sacramento CA 95814, Sacramento CA 95814. 186 pp., with appendices.

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BEUTI – Biologically Effective Upwelling Transport Index
BPG – Biogeographic Population Group
CATEX – Categorical Exclusion
CCE – California Current Ecosystem
CESA – California Endangered Species Act
CEQA – California Environmental Quality Act
CFS – cubic feet per second
CMP – California Coastal Monitoring Program
CMWD – Casitas Municipal Water District
COMB – Cachuma Operations and Maintenance
Commission – California Fish and Game Commission
Creeks Division – City of Santa Barbara Creeks Restoration and Water Quality Improvement Division
CRR – cohort replacement rate

CUTI – Cumulative Upwelling Transport Index
CWA – Federal Clean Water Act
Department – California Department of Fish and Wildlife
DIDSON - dual-frequency identification sonar
DO – dissolved oxygen
DPS – Distinct Population Segment
DWR – California Department of Water Resources
EA – Environmental Assessment
EIR – Environmental Impact Report
EIS – Environmental Impact Statement
EPA – United States Environmental Protection Agency
ESA – Federal Endangered Species Act
ESU – Evolutionary significant unit
FERC – Federal Energy Regulatory Commission
FONSI – Finding of No Significant Impact
FRGP – Fisheries Restoration Grant Program
GSA – Groundwater sustainability agency
GSP – Groundwater sustainability plan
HCP – Habitat Conservation Plan
LWD – large woody debris
NCCP – Natural Community Conservation Plan
NEPA – National Environmental Policy Act
NGO – Non-Governmental Organization
NMFS – National Marine Fisheries Service
RCDSMM – Resource Conservation District of the Santa Monica Mountains
SCCWRP – Southern California Coastal Water Research Project
SCWRP – Southern California Wetlands Recovery Project
SGMA – Sustainable Groundwater management Act
SNP – single nucleotide polymorphism
SST – sea surface temperature
SWRCB – California State Water Resources Control Board
TMDL – Total Maximum Daily Load
USACE – United States Army Corp of Engineers
USBR – United States Bureau of Reclamation
USFWS – United States Fish and Wildlife Service
UWCD – United Water Conservation District
WSRA – Federal Wild and Scenic Rivers Act
YOY – young-of-the-year

EXECUTIVE SUMMARY

This status review of southern California steelhead (*Oncorhynchus mykiss*) (Status Review) has been prepared by the California Department of Fish and Wildlife (Department) for the California Fish and Game Commission (Commission) pursuant to the requirements of the California Endangered Species Act (CESA; Fish & G. Code, § 2050 et seq.). This Status Review is based on the best scientific information currently available to the Department regarding each of the components listed under Section 2072.3 of the Fish and Game Code and Section 670.1 of Title 14 of the California Code of Regulations. In addition, this Status Review includes a preliminary identification of habitat that may be essential to the continued existence of the species, the Department's recommendations for management activities, and other recommendations for the recovery of the species (Fish & G. Code, § 2074.6). This Status Review has been independently reviewed by scientific peers pursuant to Fish and Game Code Section 2074.6.

In this Status Review, southern California steelhead are defined as "all *O. mykiss* below manmade and natural complete barriers to anadromy, including anadromous and resident life histories, from and including the Santa Maria River (San Luis Obispo and Santa Barbara counties) to the U.S.-Mexico Border." This range encompasses five biogeographic population groups of *O. mykiss* (from north to south): Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast. To capture the life history variability that is included in the scope of the CESA listing unit evaluated in this Status Review, "southern California steelhead rainbow trout" (Southern SH/RT) is used to describe the proposed CESA listing unit.

The Department recommends that the Commission find the petitioned action to list Southern SH/RT as an endangered species under CESA to be warranted. The Department further recommends implementation of the management recommendations and recovery measures described in this Status Review.

The scientific data available to the Department indicates a long-term declining trend of Southern SH/RT and low range-wide abundances. The decline of Southern SH/RT can be attributed to a wide variety of human activities, including, but not limited to, urbanization, agriculture, and water development. These activities have degraded range-wide aquatic habitat conditions and limited the amount of suitable and accessible spawning and rearing habitats. Dams and other impediments obstruct access to a significant portion of historical Southern SH/RT habitats in many rivers within the proposed listing area, some of which have multiple major dams on a single mainstem.

Climate change projections for Southern SH/RT range predict an intensification of typical climate patterns, such as more intense cyclic storms, droughts, and extreme heat. These projections suggest that Southern SH/RT will likely experience more frequent periods of adverse conditions and continued selection pressure against the anadromous life-history form. Impacts of the most recent prolonged period of drought from 2012 – 2017 resulted in significant reductions in all life-history forms and stages of Southern SH/RT, and few populations have rebounded as current abundance estimates remain low relative to pre-drought conditions. The ability of Southern SH/RT to persist will likely depend on the successful recruitment of migrants from resident populations in refugia habitats. However, virtually all refugia populations are currently above impassable barriers. Furthermore, many southern California watersheds do not contain upstream drought refugia. In these instances, recolonization of Southern SH/RT from source populations in other watersheds is likely the only mechanism for these populations to rebound (Boughton et al. 2022a).

1. INTRODUCTION

1.1 Petition History

On June 14, 2021, the California Fish and Game Commission (Commission) received a petition (Petition) from California Trout to list southern California steelhead (*Oncorhynchus mykiss*) as endangered pursuant to the California Endangered Species Act (CESA; Fish & G. Code, § 2050 et seq.).

On June 23, 2021, pursuant to Fish and Game Code Section 2073, the Commission referred the Petition to the California Department of Fish and Wildlife (Department) for evaluation.

On July 16, 2021, pursuant to Fish and Game Code Section 2073.3, the Commission published notice of receipt of the Petition in the California Regulatory Notice Register (Cal. Reg. Notice Register 2021, No. 29-Z, p. 921-922).

On August 18, 2021, pursuant to Fish and Game Code Section 2073.5, the Commission approved the Department's request for a 30-day extension to complete its petition evaluation report.

On October 29, 2021, the Department provided the Commission with a report, "Evaluation of the Petition from California Trout to List Southern California Steelhead (*Oncorhynchus mykiss*) as Endangered under the California Endangered Species Act" (Evaluation). Based upon the information contained in the Petition, the Department concluded, pursuant to Fish and Game Code Section 2073.5, that sufficient information exists to indicate that the petitioned action may be warranted and recommended to the Commission that the Petition be accepted and considered.

On April 21, 2022, at its public meeting pursuant to Fish and Game Code Sections 2074 and 2074.2, the Commission considered the Petition, the Department's Evaluation and recommendation, comments received, and oral testimony. The Commission found that sufficient information exists to indicate the petitioned action may be warranted and accepted the Petition for consideration.

On May 13, 2022, pursuant to Fish and Game Code Section 2074.2, the Commission published its Notice of Findings for southern California steelhead in the California Regulatory Notice Register, designating southern California steelhead as a candidate species (Cal. Reg. Notice Register 2022, No. 19-z, p. 541).

On October 12, 2022, pursuant to Fish and Game Code Section 2074.6, the Commission approved the Department's request for a six-month extension to complete its status review report.

1.2 Status Review Overview

Pursuant to Fish and Game Code Section 2074.6 and the California Code of Regulations, Title 14, Section 670.1, the Department has prepared this status review to indicate whether the petitioned action to list southern California steelhead as endangered under CESA is warranted (Status Review). An endangered species under CESA is "a native species or subspecies . . . which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species under CESA is "a native species or subspecies . . . that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (*id.* at § 2067). A species' range for CESA purposes is the species' California range (Cal. Forestry Assn. v. Cal. Fish and Game Com. (2007) 156 Cal.App.4th 1535, 1551).

Using the best scientific information available to the Department, this Status Review includes information on each of the following components pursuant to Fish and Game Code Section 2072.3 and Title 14 of the California Code of Regulations Section 670.1: population trend(s), range, distribution, abundance, life history, factors affecting the species' ability to survive and reproduce, the degree and immediacy of threats, the impact of existing management efforts, the availability and sources of information, habitat that may be essential to the continued existence of the species, and the Department's recommendations for future management activities and other recovery measures to conserve, protect, and enhance the species.

Southern California steelhead, as defined in the Petition, means all *O. mykiss*, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from and including the Santa Maria River (San Luis Obispo and Santa Barbara counties) to the U.S.-Mexico Border (CDFW 2021a Petition Evaluation). The Department accepts the taxonomy as published by Behnke (1992) that identifies southern California *O. mykiss* as being included in the range of Coastal Rainbow Trout (*O. mykiss irideus*), which have a broad distribution extending from Alaska to Baja California (Moyle 2002). The Department has long referred to these fish as "steelhead rainbow trout" (Shapovalov and Taft 1954), which captures the life history variability that is included in the scope of this status review for both anadromous and resident forms of the species. Thus, the Department will refer to the Petitioner's proposed listing unit as southern California steelhead rainbow trout (*O. mykiss*;

Southern SH/RT) throughout the remainder of this Status Review. This naming convention is slightly different than what was used by the Petitioner in the Petition, but the Department asserts the importance of recognizing the full scope of life history diversity included in the listing unit.

This Status Review report is not intended to be an exhaustive review of all published scientific literature relevant to the Southern SH/RT. Rather, it is intended to summarize the best scientific information available relevant to the status of the species, provide that information to the Commission, and serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. Specifically, this Status Review analyzes whether there is sufficient scientific information to indicate that the continued existence of Southern SH/RT throughout all or a significant portion of its range is in serious danger or is threatened by one or a combination of the following factors: present or threatened modification or destruction of its habitat; overexploitation; predation; competition; disease; or other natural occurrences or human-related activities (Cal. Code Regs., tit. 14, § 670.1, subd. (i)(1)(A)).

1.3 Federal Endangered Species Act Listing History

The federal Endangered Species Act (ESA) defines "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature" (16 U.S.C. § 1532). In 1991, the National Marine Fisheries Service (NMFS) adopted its policy on how it would apply the definition of "species" to Pacific salmon stocks for listing under the ESA (ESU Policy). Under the ESU Policy, a salmon stock is considered a distinct population segment (DPS) if it constitutes an evolutionary significant unit (ESU) of the biological species (NMFS 1991). In February 1996, the United States Fish and Wildlife Service (USFWS) and NMFS published a joint DPS policy for the purposes of ESA listings (DPS Policy) (NMFS 1996a). Section 3.1 of this Status Review describes the ESU Policy and DPS Policy in greater detail.

In 1997, NMFS listed the Southern California Steelhead ESU as endangered under the federal ESA. The Southern California Steelhead ESU only included naturally spawned populations of anadromous *O. mykiss* (and their progeny) residing below long-term, natural and manmade impassable barriers in streams from the Santa Maria River, San Luis Obispo County (inclusive) to Malibu Creek, Los Angeles County (inclusive) (NMFS 1997). In 2002, NMFS extended the geographic range of the Southern California Steelhead ESU listed under the federal ESA south to the U.S.-Mexico border (NMFS 2002).

In 2001, the U.S. District Court in Eugene, Oregon, ruled that NMFS improperly excluded certain hatchery stocks from the listing of Oregon Coast Coho Salmon after NMFS had concluded that those hatchery stocks were part of the ESU being considered for listing but not essential for recovery (*Alsea Valley Alliance v. Evans* (D. Or. 2001) 161 F. Supp. 2d 1154, 1162). Based in part on the *Alsea* decision, in 2002 NMFS announced that that it would conduct an updated status review of 27 West Coast salmonid ESUs, including the Southern California Steelhead ESU (NMFS 2006). In 2004, NMFS proposed to continue applying its ESU Policy to the delineation of DPSs of *O. mykiss* and to include resident *O. mykiss* that co-occur with the anadromous form of *O. mykiss* in 10 *O. mykiss* ESUs, including the Southern California Steelhead ESU (NMFS 2006).

In 2005 USFWS wrote to NMFS stating USFWS's "concerns about the factual and legal bases for [NMFS's] proposed listing determinations for 10 *O. mykiss* ESUs, specifying issues of substantial disagreement regarding the relationship between anadromous and resident *O. mykiss*" (NMFS 2006). After discussions with USFWS regarding the relationship between anadromous and non-anadromous *O. mykiss*, in 2006 NMFS decided to depart from their past practice of applying the ESU policy to *O. mykiss* stocks and instead apply the joint DPS Policy (NMFS 2006). Concurrent with that decision, NMFS relisted the Southern California Steelhead ESU as the Southern California Steelhead DPS under the federal ESA (NMFS 2006). As part of its 2006 relisting of southern California steelhead, NMFS concluded that the anadromous life form of *O. mykiss* is markedly separate from the non-anadromous life form of *O. mykiss* within the geographic boundary of the Southern California Steelhead DPS—as well as the geographic boundaries of the other nine *O. mykiss* ESUs that NMFS was relisting as DPSs at that time—due to "physical, physiological, ecological, and behavioral factors" (NMFS 2006). The Southern California Steelhead DPS only includes the anadromous life-history component of *O. mykiss* and is defined as including all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassible barriers in streams from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico border (Table 1) (NMFS 2006).

2. BIOLOGY AND ECOLOGY

2.1 Species Description

The species *O. mykiss* is one of the most widely distributed of Pacific salmonids, occupying nearly all coastal streams from Alaska to southern California and from Russia's Kamachatka Peninsula to South Korea in the western Pacific. Steelhead is the common name for the anadromous form of *O. mykiss*, while Rainbow Trout is the common name applied to the freshwater resident form (Behnke 1993; Moyle 2002). *O. mykiss* possess 10–12 dorsal fin rays, 8–12 anal fin rays, 9–10 pelvic fin rays, 11 – 17 pectoral fin rays, and a slightly forked caudal fin (Moyle 2002). They have 9–13 branchiostegal rays and 16–22 gill rakers on each arch (Moyle 2002). Teeth are present on both upper and lower jaws, the tip and shaft of the vomer, as well as on the tip of the tongue (Fry 1973; Moyle 2002). Between 110–180 small, pored scales make up the first row above the lateral line (Fry 1973; Moyle 2002).

Table 1. Common nomenclature for Oncorhynchus mykiss (adapted from Boughton et al. 2022b).

Term	**Description**
Oncorhynchus mykiss	A species of Pacific salmonid composed of both anadromous and freshwater-resident forms, which all spawn in freshwater rivers and streams.
Steelhead	Individuals: *O. mykiss* that are anadromous (individuals that migrate to and spend one or more seasons in the ocean); here used to mean adult steelhead.
Rainbow Trout	Individuals: *O. mykiss* that are freshwater resident (individuals that complete their life cycle in freshwater), here used to mean adult Rainbow Trout.
Steelhead Rainbow Trout	Population(s): contains both steelhead individuals and Rainbow Trout individuals.
Juvenile *O. mykiss*	Immature fish whose fate as steelhead or Rainbow Trout cannot yet be established.
Anadromous waters	Stream reaches that are accessible to migrating steelhead (those not blocked by complete natural or artificial barriers). It is important to note that *Oncorhynchus mykiss* individuals, occurring in anadromous waters, may or may not express the anadromous life history type (e.g., smoltification).

The steelhead life history form is thought to be named for the sometimes silvery-metallic appearance of its back and head. The steelhead body profile is fusiform, with typically “bullet-shaped” heads and distinct narrowing at the base of a powerful tail, suited for often-demanding and lengthy upstream spawning migrations. In the marine environment, steelhead body coloration includes a blueish-green dorsum (back) and silver or white coloration over the rest of the body (Fry 1973; Moyle 2002). Black spots typically cover the dorsal, adipose, and caudal fins, as well as the head and back (Fry 1973). When adult steelhead return to spawn in freshwater, their silver sheen fades and a pink or red lateral band develops along the sides and on the opercula, while the silvery-blue coloration on the back transitions to an olive green or brown (Barnhart 1986). These characteristics are very similar to those exhibited by resident Rainbow Trout (Fry 1973); thus, it can be difficult to differentiate the anadromous and resident forms based only on outward appearance. Adult steelhead, however, are generally larger than adult Rainbow Trout in a given stream system since they spend time feeding and growing in the ocean (NWF 2020; USFWS 2020).

Juvenile *O. mykiss* have body coloration similar to that of resident adults, while also exhibiting 5–13 oval parr marks along the lateral line on both sides of the body (Moyle 2002). These parr marks are dark bluish-purple in coloration and are widely spaced, with the marks themselves being narrower than the spaces between them (Moyle 2002). A total of 5–10 dark spots also line the back, typically extending from the head to the dorsal fin. There are usually few to no marks on the caudal fin, and the tips of the dorsal and anal fins are white to orange (Moyle 2002).

After a year or more of development, some *O. mykiss* undergo the transitional process of smolting, which is a series of morphological, physiological, and behavioral changes that prepare the fish for entry into brackish estuaries and then ocean environments (Fessler and Wagner 1969; McCormick 2012). Smolting is the primary physiological characteristic that distinguishes the anadromous life history variant from the resident one within the species. Smolts lose their parr marks and develop silver coloration during the downstream migration process. After entering the ocean, young steelhead will reside in the saltwater environment for 1–4 years while feeding and growing quickly (Moyle 2002). Juvenile *O. mykiss* that do not smolt and remain in freshwater generally lose their parr marks as they grow and develop into adult Rainbow Trout.

The sexual maturation process for anadromous steelhead involves the development of secondary sex characteristics such as bright coloration and sexual dimorphism, including the development of a hooked snout, or kype, in males. These secondary sex characteristics are typically reabsorbed once spawning is complete, although jaw shape may never fully revert to the pre-spawn condition (Shapovalov and Taft 1954).

Different populations of *O. mykiss* can exhibit variations in growth rate, size, and body shape depending on their life histories and habitats utilized. For example, Bajjaliya et al. (2014) studied morphometric variation between four California steelhead DPSs and found that coastal steelhead (populations with adults migrating less than 160 km from the ocean to their sample site) were significantly larger in size and had a more robust body type than steelhead found in California’s Central Valley drainages and the Klamath-Trinity basin (populations with adults migrating more than 160 km from the ocean to their sample site). These morphological differences provided the basis for recognizing “coastal type” and “inland type” steelhead in California (Bajjaliya et al. 2014). However, the morphometric variation in populations of steelhead occurring in more southerly DPSs, such as the Southern California Steelhead DPS, may include features of both the large, coastal type as well as smaller, inland-type *O. mykiss* that occur in interior drainages (Bajjaliya et al. 2014).

2.2 Taxonomy and Systematics

Steelhead and Rainbow Trout are members of the bony fish class Osteichthyes, in the order Salmoniformes and family Salmonidae. In 1792, J. J. Walbaum classified Rainbow Trout from populations on the Kamchatka Peninsula in Russia as *Salmo mykiss* (Moyle 2002). During the next century, using J. Richardson's description of Columbia River steelhead as *S. gairdneri* and Gibbons's description of juvenile steelhead from San Leandro Creek as *S. iridea*, both the biology and fishing communities began referring to resident Rainbow Trout and steelhead as *S. irideus* and *S. gairdneri*, respectively. It was ultimately discovered that Rainbow Trout and steelhead are the same species, and North American scientists applied the original species name, *mykiss*, to North American populations (Moyle 2002).

In the 1970s, analyses of polymorphic proteins, or allozymes, were utilized to determine the degree of species relatedness and evolutionary divergence among salmonids (Quinn 2018). These studies indicated that Coho and Chinook salmon (*O. kisutch* and *O. tschawytscha*, respectively) were most closely related to Pink, Chum, and Sockeye salmon, and that Rainbow and Cutthroat trout were most closely related to each other (Quinn 2018). This phylogeny was assumed until researchers analyzed relatedness by looking at differences in mitochondrial DNA, which showed that Coho and Chinook salmon were related more closely to steelhead than they were to the other three genera of salmon (Quinn 2018). Based on this study, Smith and Stearley (1989) reorganized the taxonomy to reflect both the use of the name *mykiss* for North American Rainbow Trout and the inclusion of Rainbow and Cutthroat trouts in the Pacific salmon genus *Oncorhynchus*, but with their own distinct lineages.

Pacific salmonid lineages continue to be studied using a variety of genetic and statistical methods (Quinn 2018). There has been debate over the relationship between Rainbow and Cutthroat trouts with regards to genetics versus morphology and behavior. Stearley and Smith (1993) and Esteve and McLennan (2007) found that the idea of monophyly (a group descending from a most recent common ancestor) of these two trout species is not supported by either morphological or behavioral traits, even though mitochondrial DNA suggests otherwise. Esteve and McLennan (2007) attribute this contradiction to hybridization events that have led to a high rate of genetic introgression between the two species (Chevassus 1979). This introgression can dilute the distinctiveness of these close relatives and convolute phylogenetic reconstruction (Esteve and McLennan 2007). Although some uncertainty remains surrounding these evolutionary relationships, it is now accepted that within the genus *Oncorhynchus*, Coho and Chinook salmon have the closest relationship to each other, with Pink (*O. gorbuscha*), Chum (*O.*

keta), and Sockeye (*O. nerka*) salmon in their own group, and Rainbow (*O. mykiss*) and Cutthroat (*O. clarkii*) trout in another group (Kitano et al. 1997; Crête-Lafrenière et al. 2012; Quinn 2018; Figure 1).

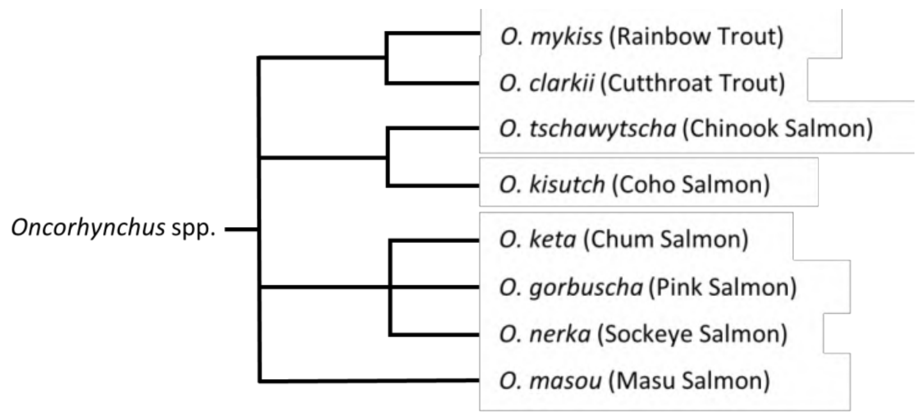


Figure 1. Consensus relationships of Oncorhynchus species from morphological, allozyme, ribosomal RNA, mitochondrial DNA, and short interspersed repetitive elements data across multiple studies. Adapted from Figure 1 in Kitano et al. (1997)

2.3 Range and Distribution

Range is the general geographical area in which an organism occurs. For purposes of CESA and this Status Review, the range is the species' California range (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal.App.4th 1535, 1551). Distribution describes the actual sites where individuals and populations of the species occur within the species' range.

Oncorhynchus mykiss is native to both coastlines of the Pacific Ocean and spawns in freshwater streams, from the Kuskokwim River in Alaska, south to Baja California along the eastern Pacific, and from Russia's Kamchatka Peninsula in the western Pacific (Moyle 2002). The species is widely distributed throughout the northern Pacific Ocean during its ocean phase. Coastal steelhead within the state historically occupied all perennial coastal streams, from the Oregon/California border to the U.S.-Mexico border (Moyle 2002). Steelhead are also native to the Central Valley, including both the Sacramento and San Joaquin River basins, and have been found as far upstream as the Pit and McCloud rivers (Moyle 2002). It is likely that most suitable streams in the Sacramento and San Joaquin River basins with ocean access have historically supported runs of steelhead (Moyle 2002).

Southern SH/RT currently occupy fluvial habitat from the Santa Maria River at the border of San Luis Obispo and Santa Barbara counties south to the U.S.-Mexico border. This range encompasses five biogeographic population groups (BPGs), collectively described by NMFS as the Southern California steelhead DPS (Boughton et al. 2007; NMFS 2012a). BPGs are steelhead subpopulations within a DPS that occupy contiguous areas that share broadly similar physical geography and hydrology, generally within a single watershed unit. The combinations of these physical characteristics represent the suite of differing natural selective regimes across the watersheds occupied by Southern SH/RT. These varying selective pressures have led to life history and genetic adaptations that enable subpopulations to persist in distinctive and dynamic habitats that have shaped each BPG. The purpose of delineating BPGs for steelhead populations is to ensure the preservation of the range of genetic and natural diversity within each DPS for recovery and conservation purposes (NMFS 2012a). The BPGs that form the Southern SH/RT DPS are (from north to south): Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast.

While some near-coastal populations of Southern SH/RT are small, there are likely dispersal dynamics that contribute to their stability and persistence (Boughton et al. 2007). The movement of spawning adults between BPGs may be an important mechanism for maintaining the viability of steelhead populations (NMFS 2012a). Dams and other impediments obstruct access to a significant portion of historical Southern SH/RT habitats in many rivers within the proposed listing area, some of which have multiple major dams on a single mainstem. There is evidence that loss of access to upstream habitat has resulted in a northward range contraction of anadromous Southern SH/RT (Boughton et al. 2005), whose study also found a strong correlation between steelhead population extirpations and anadromous barriers, as well as urban and agricultural development.

2.4 Life History

An individual fish's genotype, condition, and a variety of environmental factors influence the expression of anadromy versus stream residency (Sloat et al. 2014; Busby et al. 1996; Pascual et al. 2001; Courter et al. 2013). Juvenile *O. mykiss* prior to the smolting life stage are difficult to distinguish without genetic, morphological, or physiological evaluations (Negus 2003; Beeman et al. 1995; Haner et al. 1995; Pearse et al. 2014). Adult steelhead returning to streams from the ocean are often easier to identify due to their larger size relative to most resident Rainbow Trout adults in the same stream system and their overall steel-gray color (Dagit et al. 2020). While anadromy and residency are the two primary life histories, *O. mykiss* life history expression is notably plastic and can be quite variable (Moyle 2002). For example, individuals may exhibit the lagoon-anadromous life history, spending their first or second summer rearing in seasonal lagoons in the estuaries of streams before outmigrating to the ocean (Boughton et al. 2007).

Unlike other Pacific salmonids, which are semelparous and perish almost immediately after spawning, *O. mykiss* can be iteroparous (Moyle 2002), with the potential to spawn up to four times but typically not more than twice (Shapovalov and Taft 1954). Steelhead that spawn and return to the sea are called “kelts.” These fish can either spawn consecutively, returning the next season after their first spawn, or they may return a year later after spending an extra year at sea (Light et al. 1989). Reportedly, females survive spawning events more frequently than males (Shapovalov and Taft 1954; Ward and Slaney 1988; Busby et al. 1996; Marston et al. 2012), although males can repeat spawn in significant numbers, especially in smaller, near-coastal stream systems (Marston et al. 2012).

Steelhead exhibit two seasonal migratory patterns, or run types: 1) winter, also called “ocean-maturing” or “mature-migrating;” and 2) summer, also called “stream-maturing” or “premature-migrating.” The names of these two runs are reflective of the seasonal timing when adult steelhead reenter estuaries and rivers to reproduce (Busby et al. 1996; Moyle 2002). Only the winter-run form of steelhead occurs in southern California streams, consistent with what is believed to be the historical condition (Moyle 2002). Southern SH/RT typically begin migrating upstream from December through May, with returning adults often reliant upon winter rainstorms to breach sandbars at the mouths of stream estuaries and lagoons, providing seasonal upstream spawning passage (California Trout 2019). Steelhead age-at-maturity is dependent on a number of factors, including time spent in either or both freshwater and marine environments; however, adult returning spawners are usually 3 or 4 years old, having spent 1-3 years in freshwater and 1-2 years at sea (Shapovalov and Taft 1954). Southern SH/RT steelhead spawning runs are dominated by age 3+ fish, with 2 years spent in fresh water and 1 year in the ocean, although many smolt after only 1 year in fresh water (Busby et al. 1996). Shapovalov and Taft (1954) found that the average age of male spawners (about 3.5 years) was lower than that of female spawners (close to 4 years) in Waddell Creek, CA. Non-anadromous Rainbow Trout can mature anywhere between 1 and 5 years but are commonly age 2+ or 3+ years, with a fork length of ≥13 cm (Moyle 2002). Rainbow Trout typically spawn during the spring months, from February through June (Moyle 2002).

Spawning usually occurs in shallow habitats with fast-flowing water and suitable-sized gravel substrates, often found in riffles, faster runs, or near the tail crests of pool habitats. When female *O. mykiss* are ready to spawn, they will select a suitable spawning site and excavate a nest, or redd, in which they deposit their eggs to incubate (Moyle 2002). Adequate stream flow, gravel size, and low substrate embeddedness are crucial for egg survival, as these conditions allow oxygenated water to permeate through sediments to the egg (Coble 1961). During redd construction, the female may be courted by multiple males. Following completion of the redd, the most dominant males fight for position alongside the female, depositing milt while the female deposits her eggs (Quinn 2018). Immediately following fertilization, females cover their eggs with gravel (Barnhart 1986). Females dig multiple smaller pits within the broader redd where they deposit a portion of eggs into each pocket until all the eggs are expelled

(Shapovalov and Taft 1954; Quinn 2018). Adult steelhead are often accompanied by resident male Rainbow Trout during spawning, as they attempt to participate by quickly swimming, or darting, in and out of steelhead redds (Shapovalov and Taft 1954). These fish are sometimes referred to as "egg-eaters," although it is generally accepted that the main purpose of their presence is to contribute to spawning rather than consume newly laid eggs (Shapovalov and Taft 1954). If adult steelhead cannot emigrate back to the ocean after spawning, they require large, deep pools that provide refuge during the hot summer months (Boughton et al. 2015).

Fecundity, among other biological and environmental factors, contributes substantially to reproductive success. Egg production is positively correlated with fish length, although there is wide variation in female steelhead fecundity at a given size (Shapovalov and Taft 1954; Quinn 2018). Larger females tend to produce larger and greater numbers of eggs; however, energy demands for gonad development create a physiological tradeoff between the number and size of eggs produced (Quinn 2018). Thus, females generally produce either many smaller eggs or fewer larger eggs. Quinn (2018), referencing multiple sources of data, showed that female steelhead of average size produce slightly over 5,000 eggs. Moyle (2002) provides a range of eggs per female from 200 to 12,000 and states that steelhead generally produce about 2,000 eggs per kilogram of body weight. Rainbow Trout less than 30 cm in total length usually have under 1,000 eggs per kilogram of body weight (Moyle 2002).

Multiple factors contribute to egg development and incubation time; however, eggs generally incubate in stream gravels for up to several months. Temperature has the greatest effect on the incubation period; colder water slows development, and warmer water increases the rate of development (Quinn 2018). Incubation can take from 19 days at an average temperature of 60°F (15.6°C) to 80 days at an average temperature of 40°F (4.4°C) (Shapovalov and Taft 1954). Dissolved oxygen (DO) levels in surrounding waters also influence life stage development rates in Southern SH/RT and other salmonids. Higher DO levels lead to more rapid egg development, while eggs exposed to low levels of DO during incubation produce much smaller alevins (yolk-sac fry) than those exposed to high DO (Quinn 2018). Fry emerge from the gravel 2-3 weeks after hatching, once the yolk sac is fully or almost entirely absorbed, at which time they form schools along stream banks (Shapovalov and Taft 1954). During their first year of life, *O. mykiss* juveniles develop small territories and defend them against other individuals in their age class (Shapovalov and Taft 1954; Barnhart 1986). Juvenile *O. mykiss* generally feed on many different species of aquatic and terrestrial insects, sometimes cannibalizing newly emerged fry (Barnhart 1986). Further north, feeding generally peaks during the summer months and is depressed during the winter months; however, *O. mykiss* in California typically have higher growth rates in the winter and spring than summer and fall (Hayes et al. 2008; Sogard et al. 2009; Krug et al. 2012). As they grow, juveniles will move into deeper, faster water and are often found in riffle or swift-run habitats (Shapovalov and Taft 1954; Barnhart 1986). Larger juvenile *O. mykiss* can outcompete and displace their smaller counterparts from ideal habitats, such as deep pools or run complexes, leaving smaller individuals to often inhabit suboptimal habitats, such as riffles (Barnhart 1986).

Parr will ultimately begin transitioning into smolts and migrate downstream to estuaries and lagoons, where they complete the process of smolting. Smolt outmigration to the ocean typically occurs from March–May in southern California but can vary depending on factors such as connectivity between the ocean and estuary or lagoon and streamflow (Booth 2020). Compared to other Pacific salmonids, steelhead have the greatest variability in the timing and duration of freshwater inhabitance, ocean entry, time spent at sea, and return to freshwater (Barnhart 1986). Resident Rainbow Trout early life stages mirror those of anadromous steelhead, up until their life history strategies diverge (Moyle 2002). Rather than migrating out to the ocean like steelhead, resident *O. mykiss* will reside in freshwater for the remainder of their lives.

Little is known regarding steelhead stock-specific utilization of and distribution in the ocean environment. While much is known about the status and abundance of commercially important ocean stocks of Pacific salmon, steelhead-specific research on this topic is lacking and hampered by the inability to differentiate individual stocks using standard sampling methods (Barnhart 1986; Light et al. 1989; Moyle 2002). Unlike Pacific salmon species, steelhead are rarely captured in the ocean; therefore, information specific to Southern SH/RT ocean distribution is not available. Limited tag recoveries by North American fisheries research and management agencies showed no differences in the ocean distribution of steelhead by stock (Light et al. 1989). Attempts to distinguish steelhead population units from one another in terms of ocean distribution are confounded by findings that all steelhead apparently congregate in shared ocean feeding grounds, regardless of their origin or run type (Light et al. 1988).

Pacific steelhead smolts quickly migrate offshore after entry into the ocean (Daly et al. 2014) and, once in the open water, generally move in a northwestern trajectory from spring to summer and follow a southeastern pattern from fall to winter (Okazaki 1983; Light et al. 1989). In the winter, steelhead are found in the eastern North Pacific (Myers et al. 2016) and tend to be closer to shore than during other times of the year (Light et al. 1989). California steelhead do not appear to migrate any farther west than the Gulf of Alaska (Light et al. 1989), and, overall, steelhead migration patterns appear to be strongly tied to “thermal avoidance.” Migratory-based thermal avoidance involves fish movement patterns that remain within a narrow range of tolerable sea surface temperatures, suggesting that steelhead ocean migration may be largely influenced by physiological responses to temperature (Hayes et al. 2016). Ocean steelhead are typically found within seven meters of the sea surface, within the epipelagic zone, although they have been found at more than three times that depth (Light et al. 1989).

Studies addressing steelhead ocean behavior, distribution, and movement are limited; however, as with other salmonids, steelhead tend to exhibit strong homing behavior to their natal streams, with some exceptions. Evidence of straying has been documented in central California steelhead populations (Donohoe et al. 2021), while genetic population structure analyses suggest that historical (natural) exchange of genetic information occurred between coastal populations of steelhead (Garza et al. 2014).

2.5 Genetics and Genomics

2.5.1 Role of Genetics and Genomics in Evaluating Steelhead Population Structure

To date, most genetic studies focused on quantifying the population structure of salmonid species have used neutral genetic markers (e.g., microsatellite DNA). Neutral markers are not directly linked with a particular life history trait, and it is assumed that they are not under direct selection. This class of genetic marker continues to be used to investigate and define salmonid listing units and population structure (e.g., Busby et al. 1996) in both California and across the Pacific Northwest. These types of markers have also been successfully used for decades to delineate populations and ESUs based primarily on reproductively isolated lineages. These markers remain valuable, in that they are the standard for determining the genetic structure and relatedness of species and, thus, their evolutionary histories.

More recently, the advent and rapid development of “adaptive” genetic markers have provided fishery managers and geneticists with a new suite of tools. Adaptive genetic markers provide putative associations with specific life history characteristics, and the “genetic type”, or “variant” infers information about a phenotype of interest. Specific genes, or genomic regions, within individuals or subgroups may vary from the overall pattern exhibited by a species. Of particular relevance to Southern SH/RT is the role that adaptive genetic variation plays in migratory behavior. This relationship is still being evaluated, and uncertainties remain regarding the level of influence genetics may have on migration phenotype. See Section 2.6.5 for more information.

2.5.2 Patterns of O. mykiss Genetic Population Structure

Geography and local environmental factors influence the genetic structure of *O. mykiss* populations, a pattern referred to as "isolation by distance". Evidence of isolation by distance is shown in *O. mykiss* populations throughout their range. Studies based on neutral mitochondrial DNA analysis have demonstrated a pattern of isolation by distance in populations spanning the western coast of the United States, including among coastal California steelhead populations (Hatch 1990; Reisenbichler et al. 1992; McCusker et al. 2000). Nielsen (1999) found a pattern of isolation by distance when looking at the microsatellite loci of southern California and northern California steelhead populations. Bjorkstedt et al. (2005) suggested that genetic variation in salmonid populations generally increases with greater distances between watersheds. Pearse et al. (2007) analyzed geographic structure within the Klamath-Trinity River basin and consistently found a positive relationship between geographic distance and genetic relatedness—specifically, that genetic divergence between populations increased as a function of geographic distance.

Garza et al. (2004) evaluated population structure across coastal California populations using microsatellite loci to understand the relationship between genetic distance and the geography of coastal steelhead populations. This study's results included a bootstrap consensus tree showing clustering of geographic locations corresponding to five DPS assignments in coastal California steelhead (Figure 2). The long terminal branches in this consensus tree demonstrate that, while migration is important to the populations in this study, the conflicting evolutionary processes of random genetic drift and local adaptation were likely responsible for the genetic differentiation between the populations. The general isolation-by-distance pattern of genetic diversity is also visually apparent.

Aguilar and Garza (2006) found a significant relationship between geographic distance and genetic distance in coastal *O. mykiss* using both major histocompatibility complex genes, which can be helpful in identifying salmonid population structure, and microsatellite loci. This significant relationship represented isolation through distance. Garza et al. (2014) reaffirmed that genetic variation is associated with isolation by distance using microsatellite loci from samples of coastal California steelhead. Across all coastal California steelhead populations sampled, there was evidence that population structure is dependent on geographic distance. Their phylogeographic trees also suggested that population structure was almost entirely consistent with geographic proximity.

Populations within a watershed, even those disconnected by barriers, have been shown through microsatellite DNA analyses to be more genetically similar than those in adjacent watersheds (Clement et al. 2009; Garza et al. 2014). However, anthropogenic impacts including stocking, barrier construction, and habitat destruction have resulted in weaker relationships between geographic proximity and relatedness in modern *O. mykiss* populations (Pearse et al. 2011).

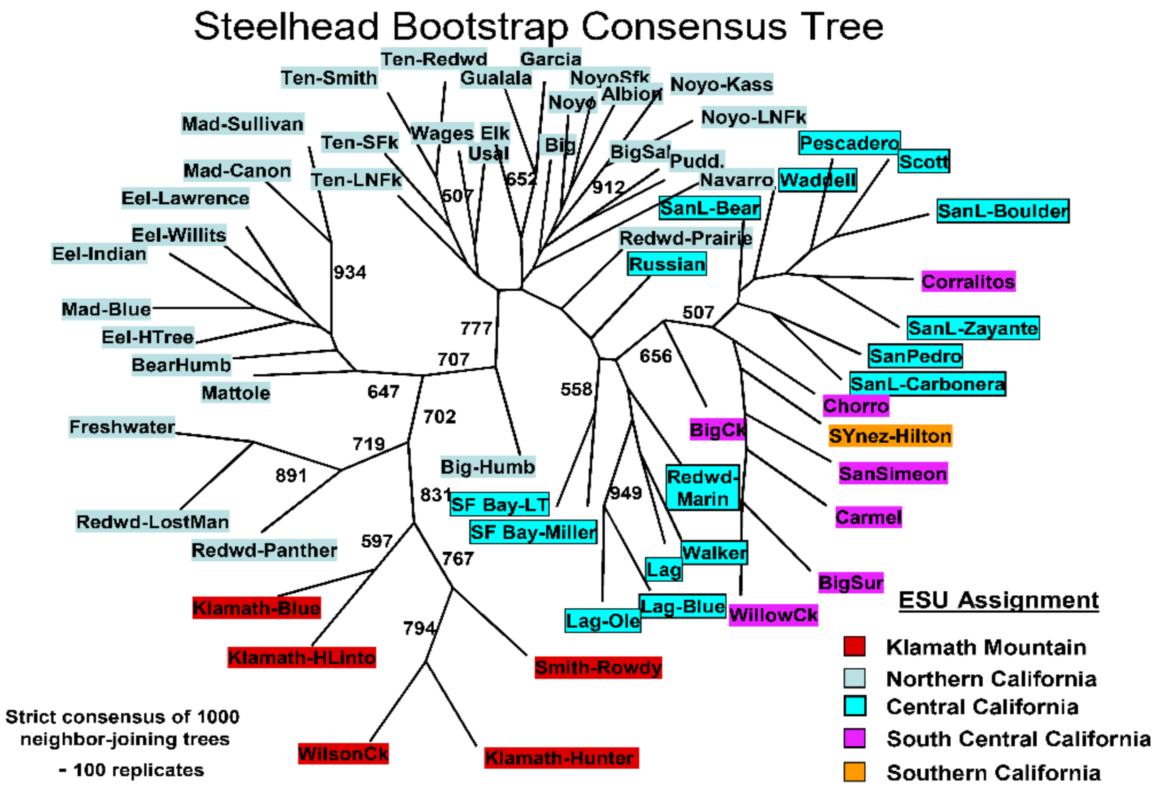


Figure 2. Majority-rule consensus tree, with genetic data bootstrapped 1,000 times, showing chord distances and neighbor-joining trees for 62 coastal California steelhead populations. (from Garza et al. 2004).

2.5.3 Genetics of the Southern California SH/RT

Busby et al. (1996) posited that the extreme environmental conditions found in southern California could result in both substantial local adaptations of and gene flow impediments between *O. mykiss* populations in the region. Nielsen (1999) hypothesized that the substantial interpopulation genetic diversity found in southern California's mostly small and somewhat isolated *O. mykiss* populations could be the result of a transitional ecotone, where two adjacent Pleistocene source populations have met and blended. Allozymes, mitochondrial DNA, and microsatellites have uncovered significant and unique genetic diversity in southern California steelhead, with traits not found in more northern populations. Busby et al. (1996) noted that a mitochondrial DNA type exists in steelhead populations between the Santa Ynez River and Malibu Creek that is rare in populations to the north, and samples from Santa Barbara County were found to be the most genetically unique of any wild coastal steelhead populations analyzed. In general, *O. mykiss* at the extreme southern end of their range have low genetic diversity (Clemento et al. 2009; Pearse et al. 2009; Jacobson et al. 2014; Abadía-Cardoso et al. 2016; Apgar et al. 2017). Loss of genetic diversity is often a consequence of declines in population size (Allendorf et al. 1997), which have been observed in Southern SH/RT populations.

2.5.4 South-Central and Southern California Genetic Relationships

Clemento et al. (2009) conducted a genetic analysis of steelhead populations in California south of Monterey Bay using microsatellite data to elucidate patterns of genetic differentiation and gene flow. In terms of coastwide population structure, the authors found that southern California steelhead populations were grouped with all other steelhead populations south of San Francisco Bay and were well-distanced from populations north of San Francisco Bay. Population genetic structure does not correspond with geographic management boundaries because genetically based population clusters are not separated by current federal-ESA-listed DPS boundaries. Overlap in clustering was detected between populations from nearby watersheds, and genetic differentiation between populations in the South-Central California Coast steelhead DPS and the southern California steelhead DPS could not be detected. Additionally, the construction of phylogeographic trees did not result in the separation of populations from the two DPSs into distinct genetic lineages based on their current ancestry (Figure 3). In populations south of San Francisco Bay, no apparent isolation by distance pattern corresponding with DPS boundaries was detected. This may be a result of metapopulation dynamics occurring between these *O. mykiss* populations. Although a lack of genetic differentiation was observed across these southern DPSs, allozymes, mitochondrial DNA, and microsatellites have uncovered significant and unique genetic diversity in southern California steelhead (see Section 3.2.2 for more information). Further, the Department recognizes other factors that define Southern SH/RT, such as unique regional biogeography, ecology, physiology, and behavior of the population groups (Boughton et al. 2007).

2.5.5 Role of Genetics in Life History Expression

Many *O. mykiss* populations are considered “partially migratory,” meaning they contain both migratory (e.g., anadromous) and non-migratory (e.g., resident) individuals (Chapman et al. 2011). It is widely accepted that migratory behavior and migration-associated traits are heritable in partially migratory populations (Pearse et al. 2014; Hecht et al. 2015; Phillis et al. 2016). In recent years, studies have revealed that important migration-related characteristics in *O. mykiss*, such as maturation, growth, development, and smolting, are linked to specific genomic regions that are under natural selection (Nichols et al. 2008; Martínez et al. 2011; Hecht et al. 2012; Miller et al. 2012; Pearse et al. 2014). Phenotypic expression of anadromy vs. residency has since been found to be strongly associated with a large genomic region on *O. mykiss* chromosome 5 (*Omy5*) (Martínez et al. 2011; Hecht et al. 2012; Pearse et al. 2014; Leitwein et al. 2017; Kelson et al. 2019). This *Omy5* migration-associated region exhibits unique alleles, associated with either anadromy or residency as their phenotypic expression, and these *Omy5* genetic variants are thought to be the result of a chromosomal inversion (Pearse et al. 2014; Leitwein et al. 2017).

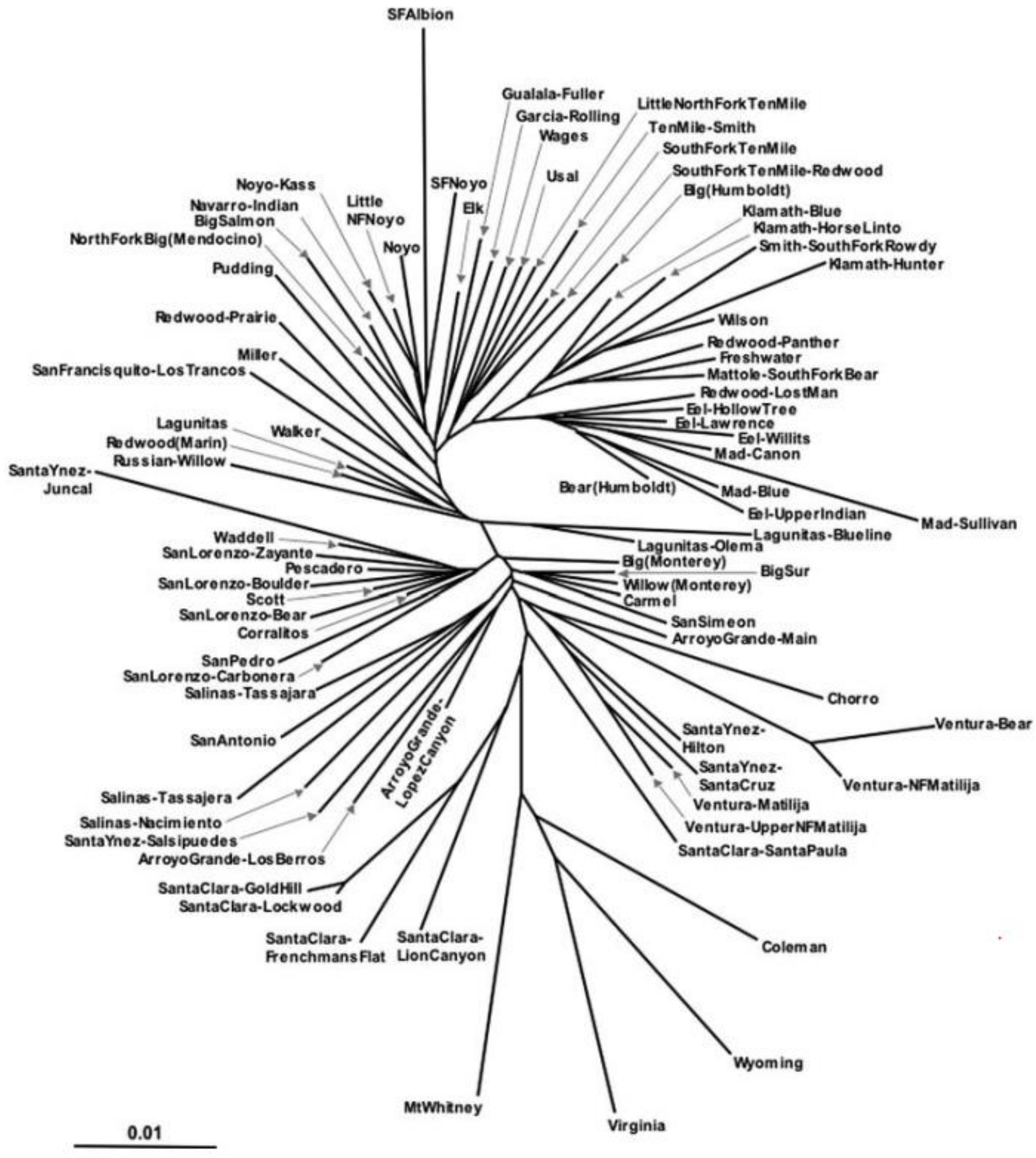


Figure 3. Unrooted neighbor-joining chord distance tree of 84 coastal O. mykiss populations in California (from Clemento et al. 2009).

Chromosome *Omy5* is associated with multiple life history characteristics related to migration vs. residency in *O. mykiss*, explaining morphological and developmental variation between the two life history forms (Nichols et al. 2008; Martínez et al. 2011; Hecht et al. 2012). Nichols et al.

(2008) used quantitative trait loci analysis to locate specific loci associated with smolting and found several genomic regions that were linked with morphological and physiological smolting indicators. The study was the first of its kind in terms of finding connections between specific genomic loci and the migration characteristics of a species of fish. In addition, Martínez et al. (2011) found multiple microsatellite markers on *Omy5* that were correlated with differential selection between anadromous and resident *O. mykiss*, while Hecht et al. (2012) identified associations between *Omy5*, body morphology, and skin reflectance, which are linked to the smolting process and the anadromous phenotype. Pearse et al. (2014) found that specific *Omy5* loci diverged between above-barrier and below-barrier *O. mykiss* populations that had differing frequencies of the anadromous phenotype.

Populations with higher potential to support anadromous or migratory individuals typically have a higher population-wide frequency of the anadromous variant of Omy5 than populations that have a higher frequency of the resident rainbow trout, such as those above manmade and natural barriers (Pearse et al. 2014; Leitwein et al. 2017). This suggests that utilizing comparative anadromous *Omy5* variant frequency data between steelhead populations may indicate which populations have a higher likelihood of producing anadromous offspring, as well as having utility in identifying above-barrier populations with the genetic potential to support or bolster downstream anadromous populations. Results from Kelson et al. (2020) suggest that the *Omy5* genomic region also regulates physiological traits, such as juvenile growth, which will subsequently influence residency vs. anadromy (Figure 4).

Sex determination has also been genetically linked to the migratory phenotype of *O. mykiss* (Rundio et al. 2012). Migratory ecotype composition within a population is typically female-dominated, a phenomenon that has been observed in multiple salmonid species (Jonsson et al. 1998; Páez et al. 2011; Ohms et al. 2014; Kelson et al. 2019) and may be due to a strong correlation between fecundity and body size (Hendry et al. 2004; Quinn 2018). Female steelhead that migrate to the ocean can grow larger in the highly productive marine environment than their counterparts in the less productive freshwater environment and, as a result, produce greater numbers of embryos. Their genetic traits, which control the anadromous ecotype, are therefore predominant in most populations.

Alternate life history ecotypes within a given watershed are typically more closely related to each other than to their life history stage equivalents in other watersheds (Nielsen and Fountain 1999; Docker and Heath 2003; Narum et al. 2004; Olsen et al. 2006; McPhee et al. 2007; Leitwein et al. 2017). These close genetic relationships indicate some degree of gene flow between sympatric life history forms of *O. mykiss* (Olsen et al. 2006; McPhee et al. 2007; Heath et al. 2008), although the level of gene flow is dependent on environmental, physiological, and genetic factors, such as watershed size and degree of reproductive isolation between life history forms (Heath et al. 2008). Regardless, the close genetic relationships between sympatric populations of steelhead and Rainbow Trout suggest that the populations interbreed and that close relatives, including full siblings, may express alternative ecotypes (or other life-history variation, e.g., adfluvial or lagoon migration). Therefore, managing individual fish with different life histories separately is biologically unjustified, and the two life history variants should be considered a single population when found coexisting in streams (McPhee et al. 2007). Additionally, freshwater resident populations can retain alleles associated with anadromy (Nielsen and Fountain 1999; Phillis et al. 2016; Apgar et al. 2017) and can contribute to the viability of anadromous *O. mykiss* populations.

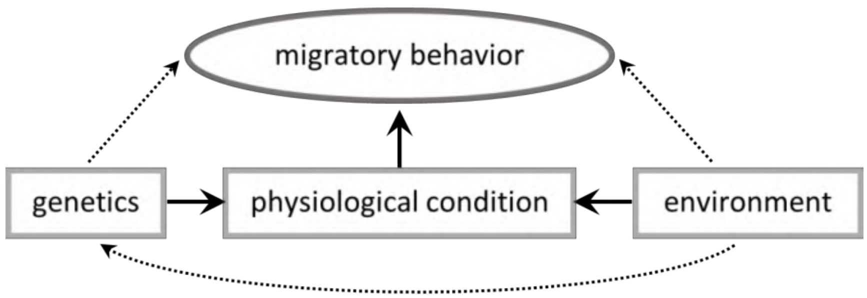


Figure 4. Schematic of indirect genetic control of migratory behavior. Genetic variation and the environment influence physiology, which then impacts migratory behavior (adapted from Kelson et al. 2020).

2.5.6 Above-Barrier vs. Below-Barrier Genetic Relationships

Studies have shown that populations of *O. mykiss,* above and below barriers within the same drainage, are closely related to one another (Heath et al. 2008; Clemento et al. 2009; Pearse et al. 2009; Leitwein et al. 2017; Fraik et al. 2021). Clemento et al. (2009) used microsatellite data to evaluate steelhead population structure above and below barriers in southern California streams and determined that populations separated by barriers are typically more closely related to each other than to populations in adjacent watersheds, consistent with many previous barrier studies. This relationship had strong bootstrap support, especially for natural-origin steelhead populations. For example, populations from the Santa Clara River formed a monophyletic lineage on the unrooted neighbor-joining tree constructed from samples taken in five main southern California watersheds (Figure 5).

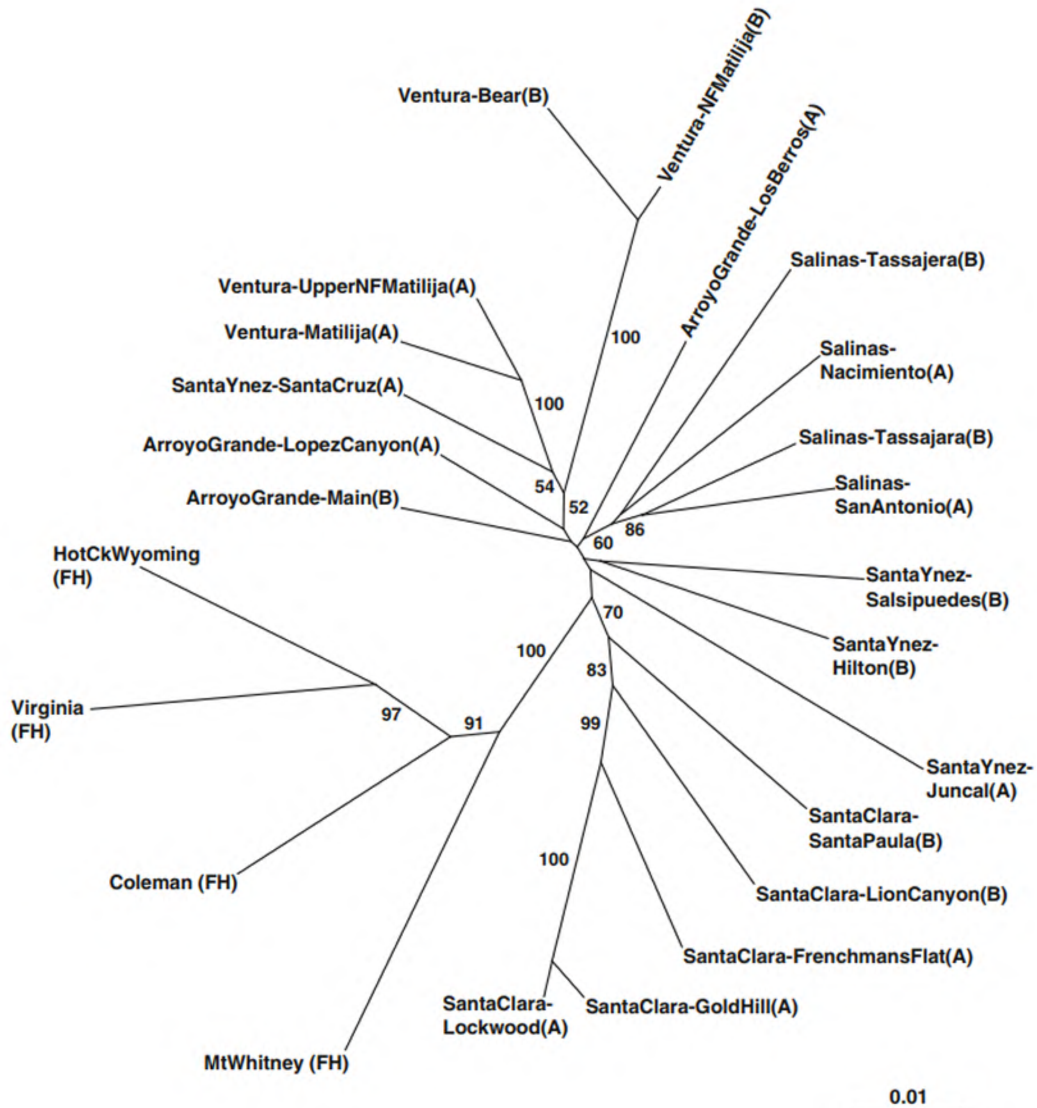


Figure 5. Unrooted neighbor-joining dendogram showing chord distances between 24 sampled naturally spawning populations both above and below barriers, denoted with A and B, respectively. Strains of Rainbow Trout from Fillmore Hatchery used for regional stocking are indicated with FH. Numbers associated with branches indicate percentage >50% of the 10,000 bootstrap replications in which the branch appeared (from Clemento et al. 2009).

Fraik et al. (2021) recently studied patterns of genetic diversity both before and after dam removal on the Elwha River (in Washington state) and determined that populations separated by natural barriers had greater genetic differentiation than those separated by long-standing dams. Following the removal of major artificial dams on the Elwha, they also detected admixture of above- and below-dam lineages and recolonization of upstream areas by steelhead.

While many fish populations separated by barriers within the same watershed have been shown to be closely related (Heath et al. 2008; Clemento et al. 2009; Pearse et al. 2009; Leitwein et al. 2017), major barriers to anadromy, both natural and artificial, have been found to prevent gene flow between populations upstream and downstream of the obstruction (Pearse et al. 2009; Abadía-Cardoso et al. 2019; Fraik et al. 2021). Multiple studies have demonstrated that there is often a discrepancy between life history expression (Nielsen 1999; Pearse et al. 2009) and associated adaptive genetic variation (Leitwein et al. 2017; Phillis et al. 2016; Apgar et al. 2017; Abadía-Cardoso et al. 2019) across major fish passage barriers. In a number of California watersheds, *O. mykiss* populations above major barriers, especially permanent artificial barriers, have shown decreased anadromous allelic frequency when compared with the population below (Leitwein et al. 2017; Phillis et al. 2016; Abadía-Cardoso et al. 2019). Likewise, in San Francisco Bay Area study streams, most above-dam *O. mykiss* populations, have significantly lower frequencies of the anadromous *Omy5* genotype than populations downstream of barriers (Leitwein et al. 2017). Abadía-Cardoso et al. (2019) also found decreased frequencies of anadromous alleles above barrier dams in the American River drainage.

Reduced migratory allelic frequency in fish populations above longstanding natural barriers is the expected condition since the population is fragmented and gene flow is unidirectional. Fish can almost always move, either passively or volitionally, over barriers in the downstream direction, potentially contributing genes to the downstream population. Those that inhabit waters upstream of permanent barriers either assume a resident life history or must migrate downstream, taking migratory alleles with them and further reducing their frequency in the upstream population (Leitwein et al. 2017). It is also important to note that some above-barrier fish populations exhibit less genetic diversity (lower heterozygosity) than their below-barrier counterparts within the same drainage (Martínez et al. 2011). In some cases, however, fish carrying anadromous alleles may not be able to move downstream over barriers, especially large artificial dams and other complete barriers, which may help maintain anadromous *Omy5* variants in some above-dam populations (Leitwein et al. 2017; Pearse et al. 2014). It also appears that some large, above-barrier reservoirs can act as “surrogate oceans” and may assist in the retention of anadromous genotypes and the expression of the adfluvial life history type (Leitwein et al. 2017). However, a reservoir environment imposes different selective pressures than migration to the northern Pacific Ocean, and therefore we would expect the anadromous genotype to be changed over time and eventually lose its ability to express a successful anadromous phenotype.

Apgar et al. (2017) recently investigated the effects of climate, geomorphology, and fish passage barriers on the frequency of migration-associated alleles in *O. mykiss* populations across four California steelhead federal-ESA-listed DPSs (Southern California, South-Central

California Coast, Central California Coast, and Northern California). Long-term natural barriers and artificial dams that provide no fish passage had the most pronounced negative impact on migration-associated allele frequency. Southern California DPS populations had the lowest frequency of *Omy5* haplotypes associated with anadromy of all California DPSs sampled. The Southern California DPS also exists in a number of heavily developed watersheds, with the greatest average number of partial and complete artificial barriers of the DPSs sampled. Removal of these barriers was predicted to substantially increase the frequency of anadromous alleles in southern California watersheds (Apgar et al. 2017).

2.5.7 Genetic Impacts of Historical Stocking

Clemento et al. (2009) conducted a genetic analysis using microsatellite loci to elucidate the genetic population structure of *O. mykiss* in southern California, with an emphasis on above- and below-barrier genetic relationships. Their analysis included an evaluation of genetic influences of long-standing Fillmore Hatchery stocking on naturally spawned populations in the region. In regional population structure analysis, Fillmore Hatchery Rainbow Trout strains clustered separately from all wild populations, both above and below barriers. This dispersal pattern indicates that there was no evidence of hatchery introgression with wild *O. mykiss* within the Southern SH/RT range (Clemento et al. 2009).

Abadía-Cardoso et al. (2016) used microsatellite and SNP loci to elucidate *O. mykiss* ancestry at the extreme southern extent of its range. Most samples collected for this study were from populations above anadromous barriers, which mostly precludes any analysis of Southern SH/RT genetic lineage pertinent to the proposed CESA listing unit, which includes only below barrier *O. mykiss*. The evaluated southern California *O. mykiss* populations had lower genetic diversity than other California steelhead populations and, genetically, most resembled hatchery Rainbow Trout. The most northern of the evaluated populations of the Southern SH/RT exist in the Santa Maria, Santa Ynez, and Santa Clara rivers, all of which exhibit genetics associated with the native coastal steelhead lineage, matching the results of Clemento et al. (2009) and Nielsen et al. (1997). Many of the more southern populations have been almost entirely replaced by hatchery produced Rainbow Trout, and only select populations in the San Luis Rey River, Coldwater Canyon Creek, the Santa Ana River watershed, and the San Gabriel River were found to have significant native coastal steelhead ancestry. Based upon these findings, the authors recommended that conservation planning focus on these populations for the preservation of native coastal lineages. These populations also had shared ancestry with the native coastal *O. m. nelsoni* from Baja California. Secondarily, they identified Bear Creek and Devil's Canyon Creek as high value populations with remnant, detectable levels of native ancestry. Also, in contrast to northern coastal steelhead populations, southern California *O. mykiss* showed low allelic frequency correlated with anadromy at *Omy5* loci, again consistent with extensive introgressive hybridization with hatchery Rainbow Trout and limited opportunities to express the anadromous life history. Low genetic variation, observed in populations with predominantly native ancestry, may not allow them to endure changes in environmental conditions, particularly rapid and dramatic changes like those being driven by escalating climate change impacts to the region. Abadía-Cardosa et al (2016) further recommended a managed translocation strategy between the few remaining southern populations with native ancestry to help slow the erosion of native genetic diversity. They found a high variability in the frequency of alleles associated with anadromy, suggesting that many populations of Southern RT/SH may maintain the capability to express the anadromous phenotype.

Nuetzel et al (2019) examined population genetic structure of *O. mykiss* populations in the Santa Monica Mountains BPG using a set of SNP markers. Specifically, they conducted genetic analyses of *O. mykiss* from Topanga, Malibu and Arroyo Sequit creeks and compared SNP data to the existing data from the Abadía -Cardosa et al (2016) study, including Omy5 genetic marker data. Their results indicate that Malibu Creek trout are almost entirely of native ancestry. The analysis of Topanga Creek trout was more complex, suggesting that Topanga Creek is a predominantly unique native population with some introgressive hybridization with hatchery Rainbow Trout. The authors did not have a sufficient sample size from Arroyo Sequit Creek to draw meaningful inferences about the ancestry of that population. Both Malibu and Topanga creeks were also found to have relatively high frequencies of the anadromous Omy5 alleles. Together, both of these populations can be a valuable genetic resource for recovery of southern California native coastal *O. mykiss*.

3. ASSESSMENT OF PROPOSED CESA LISTING UNIT

The Commission has authority to list species or subspecies as endangered or threatened under CESA (Fish and G. Code, §§ 2062, 2067). The Legislature left to the Department and the Commission, which are responsible for providing the best scientific information and for making listing decisions, respectively, the interpretation of what constitutes a “species or subspecies” under CESA (*Cal. Forestry Assn. v. Cal. Fish and G. Com.* (2007) 156 Cal.App.4th 1535, 1548-49). The Department has recognized that similar populations of a species can be grouped for efficient protection of bio- and genetic diversity (*id.* at 1546-47). Further, genetic structure and biodiversity in California populations are important because they foster enhanced long-term stability (*id*. at p. 1547). Diversity spreads risk and supports redundancy in the case of catastrophes, provides a range of raw materials that allow adaptation and persistence in the face of long-term environmental change, and leads to greater abundance (*ibid*.).

Courts should give a “great deal of deference” to Commission listing determinations supported by Department scientific expertise (*Central Coast Forest Assn. v. Fish & Game Com.* (2018) 18

Cal.App.5th 1191, 1198-99). Courts have held that the term “species or subspecies” includes ESUs (*id*. at 1236, citing *Cal. Forestry Assn.*, 156 Cal.App.4th at pp. 1542 and 1549). The Commission’s authority to list necessarily includes discretion to determine what constitutes a species or subspecies (*id.* at p. 1237). The Commission’s determination of which populations to list under CESA goes beyond genetics to questions of policy (*ibid.*). The Department and Commission’s determinations of what constitutes a species or subspecies under CESA are not subject to the federal ESA, regulations based on the federal ESA, or federal ESA policies adopted by NMFS or USFWS, but those sources may be informative and useful to the Department and Commission in determining what constitutes a species or subspecies under CESA.

The ESU designation has been used for previous Pacific salmon listings under CESA, including the Sacramento River Winter-run Chinook Salmon ESU (Endangered, 1989), the Central Valley Spring-run Chinook Salmon ESU (Threatened, 1999), Southern Oregon-Northern California Coast Coho Salmon ESU (Threatened, 2005), and the Central California Coast Coho Salmon ESU (Endangered, 2005). In 2022, the Commission listed northern California summer steelhead as endangered under CESA. In support of that listing, the Commission determined that the petitioned listing unit qualified as a subspecies under CESA “based on the discreteness (when compared to other ecotypes) and significance of that listing unit within the state of California” (Cal. Fish and G. Com. 2022).

3.1 DPS and ESU Criteria

The federal ESA defines “species” to include “any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature” (16 U.S.C. § 1532). In 1991, NMFS adopted its policy on how it would apply the definition of “species” to Pacific salmon stocks for listing under the ESA. Under the NMFS ESU Policy, a salmon stock is considered a DPS if it constitutes an ESU of the biological species. To be considered an ESU, the salmon stock must meet two criteria (NMFS 1991):

1. “It must be substantially reproductively isolated from other conspecific population units; and
2. It must represent an important component in the evolutionary legacy of the species.”

Generally, reproductive isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different population units (NMFS 1991). The evolutionary legacy of a species refers to whether the population contributes substantially to the ecological and genetic diversity of the species as a whole (NMFS 1991).

In February 1996, USFWS and NMFS published a joint DPS policy for the purposes of ESA listings. Three elements are evaluated in a decision regarding the determination of a possible DPS as endangered or threatened under the ESA. These criteria are (NMFS 1996a):

1. "Discreteness of the population segment in relation to the remainder of the species to which it belongs;
2. The significance of the population segment to the species to which it belongs; and
3. The population segment's conservation status in relation to the [federal ESA's] standards for listing (i.e., is the population segment, when treated as if it were a species, endangered or threatened [under the federal ESA's standards])."

A population segment is discrete if it meets either of two conditions specified in the DPS Policy (NMFS 1996a):

1. "It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of Section 4(a)(1)(D) of the [ESA]."

If a population segment is determined to be discrete based on physical, physiological, ecological, or behavioral factors, its significance and status are then evaluated based on several characteristics specified in the joint DPS Policy. These include, but are not limited to (NMFS 1996a):

1. "Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon.
2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon.
3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range.
4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics."

Under the DPS Policy, if a population segment is found to be both discrete and significant, its status is then evaluated for listing based on listing factors established by the federal ESA.

3.2 Southern SH/RT Evaluation under the Joint DPS Policy

The proposed listing unit (Southern SH/RT) in the Petition is "all *O. mykiss* below manmade and natural complete barriers to anadromy, including anadromous and resident life histories, from and including the Santa Maria River (San Luis Obispo and Santa Barbara counties) to the U.S.-Mexico Border." Southern SH/RT is a subtaxon of the species *O. mykiss*. The anadromous life history of Southern SH/RT is not markedly separate from the non-anadromous life history of Southern SH/RT below manmade and natural barriers to anadromy. To determine whether Southern SH/RT is a subspecies for the purposes of CESA listing, the Department used the joint DPS Policy to determine whether Southern SH/RT is a DPS. The Department evaluated the proposed listing unit by applying the first (discreteness) and second (significance) criteria of the joint DPS Policy but not the third criterion (the population segment's conservation status in relation to the federal ESA's standards). The Department did not apply the third criterion because after using the discreteness and significance criteria to determine whether Southern SH/RT is a DPS and hence a subspecies for purposes of CESA, the Department will assess the listing unit's status in relation to CESA's standards rather than the federal ESA's standards.

In 2006 NMFS concluded that application of the joint DPS Policy to West Coast *O. mykiss*, including the Southern California Steelhead DPS, was logical, reasonable, and appropriate (NMFS 2006). Further, NMFS concluded that use of the ESU Policy, which was originally intended for Pacific salmon, should not continue to be applied to *O. mykiss*, a type of salmonid with characteristics not typically exhibited by Pacific salmon (NMFS 2006). The Department finds that the application of the discreteness and significance DPS criteria from the DPS Policy is appropriate, logical, and reasonable for identifying whether Southern SH/RT is a subspecies for purposes of CESA because the taxon exhibits characteristics that are not typically exhibited by other Pacific salmonids, for which the ESU policy was developed.

3.2.1 Discreteness

Markedly Separate: Yes. The Department considers Southern SH/RT to be markedly separate from other populations of the taxon along the West Coast of North America based on unique regional biogeography, ecology, physiology, and behavior of Southern SH/RT. Point Conception in southern California is a well-studied biogeographic boundary that separates different physical oceanographic processes and the abundance and distribution of many marine species (Horn and Allen 1978; Horn et al. 2006; Miller 2023). The coastal areas north of Point Conception have cooler water temperatures, stronger upwelling, high nutrient concentrations, and the coastline is generally rocky. Within the southern California Bight, water temperatures are warmer, upwelling is weaker, and the coastline is typically sandy. While intraspecific genetic breaks do not always coincide with biogeographic boundaries near Point Conception (Burton

1998), the Department maintains that the DPS standards for discreteness do not require absolute separation of a DPS from other members of this species, because this can rarely be demonstrated in nature for any population of organisms (NMFS 1996a).

The life history of Southern SH/RT relies more heavily on seasonal precipitation than populations of the same taxon occurring farther north (Busby et al. 1996). Because average precipitation is substantially lower and more variable and erratic in southern California than regions to the north, Southern SH/RT are more frequently exposed to adverse environmental conditions in marginal habitats (i.e., warmer water temperatures, droughts, floods, wildfire) (Busby et al. 1996). Morphologically, anadromous forms of Southern SH/RT are typically longer in length and more streamlined in shape than more northern populations to enable passage through southern California's erratic and low streamflow watersheds (Moyle et al. 2017).

The Department also considers Southern SH/RT to be markedly separate from above-barrier populations of *O. mykiss* in watersheds that are within the geographic scope of the proposed listing unit, because these above-barrier populations do not contribute substantially to the below-barrier populations of Southern SH/RT. Despite several studies showing that above and below barrier *O. mykiss* populations within the same drainage are closely related, major artificial and natural barriers to anadromy prevent migration and gene flow between these populations (Heath et al. 2008; Clemento et al. 2009; Pearse et al. 2009; Abadia-Cardoso et al. 2019; Fraik et al. 2021). Disconnection between populations is further illustrated by the fact that a number of above-barrier *O. mykiss* populations exhibit reduced migratory allelic frequency compared to below-barrier Southern SH/RT. This is particularly true for *O. mykiss* populations in southern California, where long-standing natural and artificial barriers that impede fish passage have led to a lower frequency of migratory alleles associated with anadromy than in populations further north (Apgar et al. 2017).

International Border: No.

3.2.2 Significance

Unique Ecological Setting: Yes. The range of Southern SH/RT represents one of the southernmost regions of the taxon's entire West Coast Range of North America. Within this range, the watersheds that occur south of the Santa Monica Mountains have a semi-arid climate that is characterized by low precipitation, high evaporation rates, and hot and dry summers (CDFW 2021d). This climate type represents a unique ecological setting for Southern SH/RT relative to most *O. mykiss* populations along the West Coast of North America that occur in Mediterranean climates characterized by summer fog.

The ecological setting for Southern SH/RT is characterized by significant urbanization which is unique among many other federally listed steelhead DPSs that occur in coastal regions of California that are not as highly developed or populated. For example, approximately 22 million people reside in the southern California counties of Santa Barbara, Ventura, Los Angeles, Orange, San Bernardino, Imperial, and San Diego, whereas the population in the South-Central coast counties of Santa Cruz, Santa Clara, Monterey, San Benito, and San Luis Obispo is approximately 2.8 million people (NMFS 2012a; NMFS 2013). Furthermore, almost all Southern SH/RT-bearing watersheds contain dams and water diversions that have blocked access to most historic spawning and rearing habitats. Of the four DPSs sampled by Apgar et al. (2017), the Southern California Steelhead DPS contained the highest average number of partial anthropogenic barriers per watershed (n = 4.7) and the highest total number of complete anthropogenic barriers (n = 8). For context, the neighboring, and more northern South-Central Coast DPS contains a significantly lower average number of partial anthropogenic barriers per watershed (n = 1.6) and complete anthropogenic barriers (n = 1). Moreover, nearly all estuary and lagoon ecosystems in southern California have been severely degraded, thereby limiting the ability of juvenile Southern SH/RT to utilize these critical nursery habitats (Moyle et al. 2017). While these anthropogenic threats are not necessarily unique to the southern California coastal area, the region's highly variable and erratic hydrologic cycle and relatively arid climate, combined with the impacts of climate change, make Southern SH/RT increasingly vulnerable to extinction and less resilient to disturbance events and catastrophic events such as major wildfires and floods.

Gap in Range: Yes. The Department maintains that the loss of Southern SH/RT would result in a significant truncation of the southern range of the taxon along the West Coast of North America. The range of Southern SH/RT encompasses approximately 12,700 square miles with 25,700 miles of streams (NMFS 2012a).

Only Surviving Natural Occurrence: No.

Markedly Different Genetic Characteristics: No. Individuals from populations of Southern SH/RT have been shown to not be genetically isolated from populations of *O. mykiss* in the south-central California coast (Clemento et al. 2009). Evidence of straying has been documented in steelhead in central California (Donohue et al. 2021), and genetic population structure analyses suggest that there was historical exchange of genetic information between coastal populations (Garza et al. 2014). Although many steelhead populations can be partially isolated, at least a small amount of exchange between different populations of steelhead is to be expected due to natural straying. This connectivity results in a level of genetic similarity, which is more pronounced between neighboring populations, and prevents most populations from being completely isolated (Bjorkstedt et al. 2005; Garza et al. 2014; Arciniega et al. 2016).

Nonetheless, allozymes, mitochondrial DNA, and microsatellites have uncovered significant and unique genetic diversity in southern California steelhead, including traits not found in more northern populations. Busby et al. (1996) noted that a mitochondrial DNA type exists in *O. mykiss* populations between the Santa Ynez River and Malibu Creek that is rare in populations to the north, while samples from Santa Barbara County were found to be the most genetically unique of any wild coastal steelhead populations analyzed. Conservation of both neutral and adaptive genetic diversity, such genetic variation associated with migratory life history, is crucial in maintaining the ability of *O. mykiss* populations to adapt to altered environments. Given that Southern SH/RT populations have the lowest frequencies of anadromous genotypes, it is critical to preserve this genetic variation and ensure no more of it is lost.

3.2.3 Conclusion

Southern SH/RT satisfies the first (discreteness) and second (significance) criteria of the joint DPS Policy: i.e., Southern SH/RT is markedly separate and biologically significant to the taxon to which it belongs. Accordingly, the Department concludes that Southern SH/RT is a DPS and hence a subspecies for the purposes of CESA listing.

4. POPULATION TRENDS AND ABUNDANCE

4.1 Structure and Function of Viable Salmonid Populations

In this review, we use the definition of "population" from McElhany et al. (2000): "An independent population is a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place, or in the same place at a different season." In other words, a population as defined by McElhany et al. (2000) is a group of fish that experiences a substantial degree of reproductive isolation.

Steelhead have strong fidelity to their natal stream, which can lead to substantial reproductive isolation and, as a result, create local adaptation within somewhat isolated populations (Waples et al. 2008). Isolation can expose these local populations to varying degrees of genetic drift as well as different environmental pressures that ultimately lead to the development of genetic and phenotypic differences. Although many steelhead populations can be partially isolated, at least a small amount of exchange between different populations of steelhead is to be expected due to natural straying. This connectivity results in a level of genetic similarity, which is more pronounced between neighboring populations, and prevents most populations from being completely isolated (Bjorkstedt et al. 2005; Garza et al. 2014; Arciniega et al. 2016).

The concept of viable salmonid populations was introduced by McElhany et al. (2000). A viable salmonid population is defined as, "an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame," and an independent population is defined as, "any collection of one or more local breeding groups whose population dynamics or extinction risk over a 100-year time period are not substantially altered by exchanges of individuals with other populations."

McElhany et al. (2000) introduced four criteria for assessing viability of salmonid populations: abundance, productivity, population spatial structure, and diversity. These parameters form the foundation for evaluating population viability because they serve as reasonable predictors of extinction risk, reflect general processes important to all populations of species, and are measurable. Abundance is a key parameter because smaller populations are at greater risk of extinction than larger populations. Productivity, which is associated with abundance, serves as an indicator of population growth rate either over an entire life cycle or stage-specific life-history stage. Population spatial structure represents the distribution of individuals in habitats they use throughout their life cycle, as well as the processes that generate that distribution. Spatial structure often reflects the amount of suitable habitat available for a population as well as demographic stability and the level of straying among habitats. Diversity represents variation in traits such as anadromy, run-timing, and spawning behavior and timing. Typically, a more diverse population is more likely to contain individuals that will survive and reproduce in the face of environmental variation (McElhany et al. 2000). In this chapter, we evaluate, to the best of our ability, these four criteria for Southern SH/RT populations.

4.2 Sources of Information

We reviewed many sources of information for this Status Review, including primary research and literature review articles, the CESA listing petition, previous federal status reviews, recovery plans, viability assessments, Department reports and documents, annual reports from ongoing Southern SH/RT monitoring efforts, and historical reports. Agency staff with knowledge of watersheds supporting Southern SH/RT were also consulted for information.

Data limitations and uncertainties associated with historical accounts for Southern SH/RT limits our ability to understand their complete historical abundance and distribution in their range. The majority of available historical data are in reports, technical memos, and other documents that have not undergone a formal peer-review process. These types of historical sources are not necessarily at a high level of scientific rigor and have not been subject to peer review, but they represent the best information available at the time of this review regarding the historical distribution and abundance of Southern SH/RT populations.

Multiple data sources were used to evaluate viability metrics of Southern SH/RT populations. These data are mostly derived from monitoring reports from several single-basin annual survey efforts. For example, data for the Santa Ynez River population was sourced from monitoring reports developed by the Cachuma Operations and Maintenance Board (COMB). Data for the Ventura River was sourced from annual monitoring reports produced by Casitas Municipal Water District (CMWD), and data contained in Booth (2016) for the United Water Conservation District (UWCD) was used for the Santa Clara River population (See Appendices A – D for full data sources). Although data from these monitoring reports represent the best available scientific information in many southern California watersheds, the data may be derived from different monitoring approaches and designs, contain detection bias, and vary in the level of monitoring effort through time and geographic areas. These constraints may limit the power of statistical analyses to assess trends in viability criteria. Therefore, the results of the analyses conducted in subsequent portions of this chapter should be interpreted in the context of these limitations.

Dagit et al. (2020) describes the occurrences of adult steelhead from 1994-2018 and was also used as a source of peer-reviewed information to provide insight into the abundance trends of Southern SH/RT, particularly for the basins south of Los Angeles where historically no monitoring of steelhead occurred. Additional information on the data sources used in this chapter can be found in Appendices A - D. and Dagit et al. (2020).

4.3 Historical and Current Distribution

This section discusses the historical and current distribution of Southern SH/RT within their range. The section is structured on the five BPGs, which are a federal delineation based on a suite of environmental conditions (e.g., hydrology, local climate, geography) and watershed characteristics (i.e., large inland or short coastal streams) (NMFS 2012a). Separate watersheds within each BPG are considered to support individual populations of southern SH and RT; therefore, single BPGs encompass multiple watersheds and populations (Figure 6). Additional information on southern SH/RT distribution in watersheds not included in this section can be found in Good et al. (2005), Becker and Reining (2008) and Titus et al. (2010). In general, estimates of historical population abundance are based on sparse data and assumptions that are plausible but have yet to be adequately verified or tested. While the following historical estimates are likely biased either upward or downward, the examination of historical records of adult run size in southern California show consistent patterns of abundance that are at least two or three orders of magnitude greater in size than in recent years.

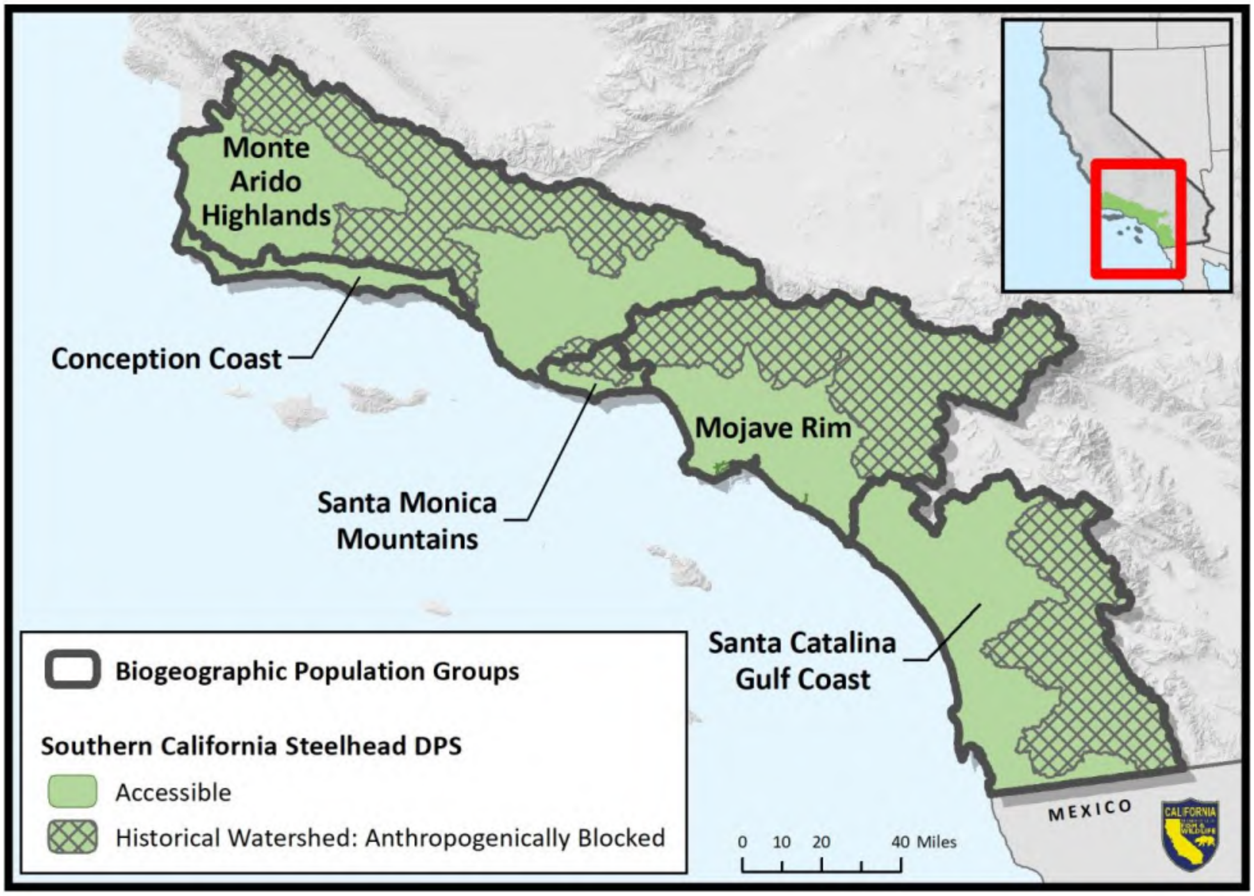


Figure 6. Map of the current and historical distribution of Southern SH/RT. BPGs represented are the Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast.

4.3.1 Monte Arido Highlands Biogeographic Population Group

The Monte Arido Highlands BPG includes four watersheds spanning San Luis Obispo, Santa Barbara, Ventura, and northern Los Angeles counties draining the west side of the Transverse Range and terminating at the Pacific Ocean (NMFS 2012a; Figure 7). Inland stretches of these watersheds are high in elevation and mountainous, but otherwise the watersheds contain different geographic features. Watersheds in this BPG are susceptible to “flashy” flows with seasonal storms and can also dry during the summer even in mainstem reaches. Perennial flows are mainly found in the upper reaches of tributaries that still retain groundwater connection (NMFS 2012a).

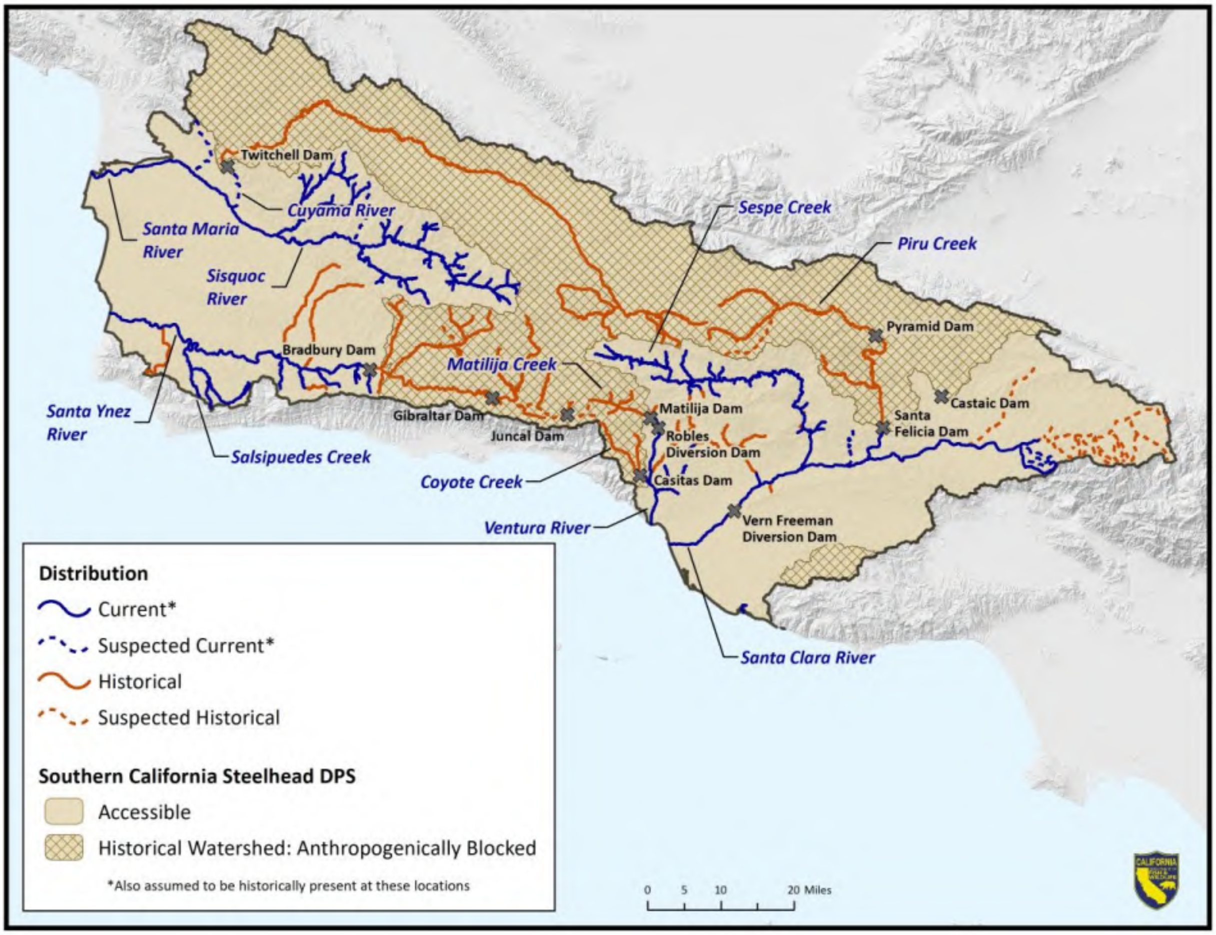


Figure 7. Map of the Monte Arido Highlands BPG depicting known and suspected current and historical distribution.

4.3.1.1 Santa Maria River

The Santa Maria River runs from the confluence of the Cuyama and Sisquoc rivers to the ocean and encompasses 1,790 square miles of watershed (Becker and Reining 2008). Historically, the Santa Maria River served mainly as a corridor for steelhead migrating to and emigrating from the Cuyama and Sisquoc rivers, rather than as habitat for spawning and rearing (Titus et al. 2010).

Hatchery stocking of *O. mykiss* occurred in the early 1930s in the Sisquoc and Cuyama watersheds (Titus et al. 2010). However, local newspaper records from the late 1800's reported abundant harvests of *O. mykiss* in the Sisquoc River watershed well before hatchery stocking occurred (Camm Swift, Emeritus, Section of Fishes, Natural History Museum of Los Angeles County, personal communication). In the early to mid-1940s, juvenile steelhead from the Santa Ynez River were rescued and translocated to the Santa Maria River. Tributaries of the Cuyama

River were stocked with Rainbow Trout in the 1940s to support recreational fishing; however, it is unknown if there was a historical run of anadromous Southern SH/RT in the Cuyama River tributaries (Titus et al. 2010). Starting in 1950, there was essentially no steelhead fishery for at least a decade (Titus et al. 2010).

The Sisquoc River had a robust population of resident *O. mykiss* in 1959 (Becker and Reining 2008) and fish were seen in smaller numbers in 1964 (Titus et al. 2010). Southern SH/RT of multiple age classes were also observed in the upper river during the 1990s (Becker and Reining 2008). In 2005, substantial numbers of young-of-the-year (YOY) *O. mykiss*, as well as some older age classes, were observed in the upper Sisquoc watershed during a population survey (Stoecker 2005).

Other smaller tributaries in the Santa Maria watershed, mostly tributaries of the Sisquoc and Cuyama rivers, have had limited historical and present *O. mykiss* observations from surveys, although some anecdotal sightings have occurred (Becker and Reining 2008). The streams include Deal Canyon Creek, Reyes Creek, Beartrap Creek, Tepusquet Creek, La Brea Creek, North Fork La Brea Creek, Manzana Creek, Davy Brown Creek, Munch Canyon Creek, Sunset Valley Creek, Fish Creek, Abel Canyon Creek, South Fork Sisquoc River, White Ledge Canyon Creek, Rattlesnake Canyon Creek, and Big Pine Canyon Creek. Some of these *O. mykiss* observations were made in tributaries of the Cuyama River post-dam construction (Becker and Reining 2008); however, it is possible that anadromous Southern SH/RT were able to access and inhabit these areas historically. Notably, many of these small tributaries were stocked with thousands of hatchery-raised *O. mykiss* in the mid-1900s for fishery supplementation (Titus et al. 2010).

Twitchell Dam was built on the Cuyama River in the late 1950s, almost 8 miles upstream from the confluence with the Santa Maria River. The dam currently impacts hydrologic function of the Santa Maria system by increasing the frequency of "false positive" migration flows in the Sisquoc River, reducing the frequency of downstream passable migration conditions, increasing the number of days with upstream passable flows that are not followed by additional days of passable flows, and reducing the frequency of long-duration migration flows (Becker and Reining 2008; Stillwater Sciences 2012). Twitchell Dam is a complete barrier to anadromy, and historically, water releases have not been regulated to provide instream flows for upstream and/or downstream steelhead migration in the Santa Maria River during the winter and spring migration periods (Stoecker 2005). Following construction of the dam, the Santa Maria and Cuyama rivers continue to have intermittent flows (Becker and Reining 2008). Currently, the lower mainstem of the Santa Maria River, which serves as a migration corridor for Southern SH/RT, is dry most of the year in most years due to managed aquifer recharge in the Santa Maria Valley (NMFS 2012a). The U.S. Court of Appeals for the Ninth Circuit recently held that under the legislation authorizing construction of Twitchell Dam, the U.S. Bureau of Reclamation and the Santa Maria Water District have discretion to manage and operate Twitchell Dam for the purpose of preventing take of Southern California Steelhead under the federal ESA, which may include adjusting water discharges to support their migration and reproduction (*San Luis Obispo Coastkeeper v. Santa Maria Valley Water Conservation Dist.* (9th Cir. 2022) 49 F.4th 1242, 1244). The case was remanded to the U.S. District Court for the Central District of California (*id.* at 1250), which adopted a pilot project involving supplemental flow releases, to be implemented while consultation under the federal ESA is conducted (*San Luis Obispo Coastkeeper et al. v. Santa Maria Valley Water Conservation Dist. et al.*, Case No. 2:19-CV-08696-AB-JPR, Dkt. No. 167 (October 12, 2023)).

4.3.1.2 Santa Ynez River

The Santa Ynez River is a major watershed spanning approximately 900 square miles and 90 river miles (Becker and Reining 2008). The river is thought to have supported the largest anadromous Southern SH/RT run (Titus et al. 2010). The earliest records of Southern SH/RT in the Santa Ynez occurred in the late 1800s prior to any stocking of the river with hatchery trout (Alagona et al. 2012). Upstream migration of Southern SH/RT past river km 116 was impeded in 1920 resulting from the construction of Gibraltar Dam (Titus et al. 2010). The reservoir supported landlocked steelhead following dam construction and was stocked in the 1930s with hatchery *O. mykiss* as well as steelhead rescued from the Santa Ynez River in 1939, 1940, and 1944 (Titus et al. 2010).

Upstream migration typically occurred from December to March following precipitation events. Southern SH/RT were seen spawning in all tributaries as well as the mainstem below Gibraltar Dam during the spring in the mid-1930s, though flow was observed to limit suitable spawning habitat (Titus et al. 2010). Most spawning in the Santa Ynez River occurred in the upper reaches between Buellton and Gibraltar Dam as well as the tributaries to the mainstem such as Alisal, Santa Cota, Cachuma, Tequepis Canyon, and Santa Cruz creeks. Fish rescues were required during the summer due to intermittent flows and drying of downstream tributary areas as well as the mainstem (DFG 1944).

Tens of thousands of hatchery *O. mykiss* were stocked in Gibraltar Reservoir in the 1930s, and over 100,000 hatchery-reared juvenile steelhead were planted in the Santa Ynez River from 1930-1935. In the 1940s, about 2.5 million juvenile Southern SH/RT were translocated from various areas of the watershed to the lower river (DFG 1944). An approximate run size of at least 13,000 spawners was inferred by a Department staff member based on comparisons with Benbow Dam counts on the South Fork Eel River, California in the 1930s and 1940s (Becker and Reining 2008; Titus et al. 2010). However, it is possible that the Santa Ynez steelhead population may have increased during this period due to ongoing rescue operations that resulted in lower mean mortality rates during the early to mid-1940s (Good et al. 2005). Nonetheless, these estimates may underestimate historical abundance because they were produced 24 years after a significant portion of spawning and rearing habitat had been blocked by Gibraltar Dam.

Construction of Bradbury Dam, originally named Cachuma Dam, downstream of Gibraltar Dam was finished in 1953. Bradbury Dam forms the Lake Cachuma reservoir, blocks Southern SH/RT access to upstream habitat, and alters natural flow regimes and sediment dynamics (Becker and Reining 2008; Titus et al. 2010). Even before the dam was built, the lack of precipitation limited upstream migration due to the sandbar at the mouth of the river remaining intact (Titus et al. 2010). Steelhead run size declined significantly after 1946 and only small numbers were seen in the stream reaches below Bradbury Dam in following decades (Titus et al. 2010). Anadromous Southern SH/RT were effectively extirpated by 1975 due to lack of flows below Bradbury Dam especially during summer months, though steelhead have occasionally been observed over the past few decades (Becker and Reining 2008).

Recently, Reclamation's permit to operate releases from Bradbury Dam was modified to require releases from the dam for purposes of protecting fishery resources in accordance with the 2000 NMFS Biological Opinion during wetter years. This modification also included additional measures to benefit Southern SH/RT, including opportunities to provide fish passage above and below Bradbury Dam, measures to reduce the impacts of predation, and restoration of stream and bankside habitat (SWRCB 2019).

Department staff have monitored steelhead in Salsipuedes Creek, Hilton Creek, and the mainstem Santa Ynez River and have found that most years can support a small steelhead run. However, zero adult steelhead have been found in the Santa Ynez River since 2012 (Boughton et al. 2022a). COMB has conducted uncalibrated, single pass snorkel surveys each year since the 1990s at multiple index sites to determine *O. mykiss* densities in the Santa Ynez River. Until 2012, fish densities were consistent but declined sharply in the following years due to drought conditions (Boughton et al. 2022a). The past few years have seen numbers rebound somewhat in response to wetter conditions. Similar trends were observed in the migrant traps on Hilton and Salsipuedes creeks and the mainstem Santa Ynez River, which have been in operation since 2001 (COMB 2022).

4.3.1.3 Ventura River

The Ventura River watershed encompasses 228 square miles and 16.5 stream miles (Becker and Reining 2008). Matilija Creek and North Fork Matilija Creek intersect to form the headwaters of the Ventura River. Multiple large storage and diversion dams occur in this watershed, altering the natural flow regime and causing negative impacts to Southern SH/RT habitat quantity and quality. About 2 miles downstream of the Ventura River headwaters is the Robles Diversion Dam, which was constructed in 1958 to direct water for storage into Lake Casitas (Becker and Reining 2008; Titus et al. 2010). Both Matilija Dam on Matilija Creek and Casitas Dam on Coyote Creek, are also attributed to population declines of Southern SH/RT on the Ventura River (Titus et al. 2010).

In the 1930s, tens of thousands of juvenile *O. mykiss* were stocked in the Ventura River, as well as thousands of fish that were transplanted from rescues conducted on the Santa Ynez River (Titus et al. 2010). Department staff estimated that the Ventura watershed supported 4,000 to 5,000 steelhead spawners in 1946. In 1973, Department staff estimated a run of between 2,500 and 3,000 steelhead (Becker and Reining 2008). However, the methodologies used to make these estimates were likely based on expert opinion. Similar to the Santa Ynez River, ongoing rescues may have had a small effect on the Ventura River steelhead populations in the 1940s. By the mid-1970s, the steelhead run size was estimated at approximately 100 fish, likely due to limited suitable rearing habitat below Robles Diversion Dam (Becker and Reining 2008).

There are four key tributaries to the Ventura River that historically provided substantial suitable spawning and rearing habitat for *O. mykiss*. These tributaries were Matilija Creek, San Antonio Creek, Coyote Creek, and Santa Ana Creek (Capelli 1974). Coyote Creek likely had a strong run of steelhead with up to 500 adult returns being probable prior to construction of Casitas Dam. Currently, the few returning Southern SH/RT spawners may use the lower reaches of the 13-mile stream for spawning (Becker and Reining 2008; Titus et al. 2010). Matilija Creek, which extends for almost 15 miles from its confluence with the Ventura River, contains ideal spawning and rearing habitat. However, access to the upper reaches of the creek was impeded with the construction of Matilija Dam (Becker and Reining 2008). Before completion of the dam, it is estimated that the creek could have supported runs of 2,000 to 2,500 spawners (Becker and Reining 2008). The removal of Matilija Dam, which is an important element of the Matilija Dam Ecosystem Restoration Project, is currently in the process of environmental review. Tributaries of Matilija Creek contain high quality habitat that continue to support resident *O. mykiss* (Becker and Reining 2008). The removal of Matilija dam will allow access to about 20 miles of stream habitat for Southern SH/RT (MDERP 2022). Historical presence of steelhead in San Antonio Creek is unknown, but the stream is thought to have produced steelhead in the 1980s and 1990s (Titus et al. 2010). Santa Ana Creek was home to *O. mykiss* in the headwater reaches during the 1930s through the 1940s as well as in 1979 (Becker and Reining 2008).

Construction on the Robles Fish Passage Facility, which allows fish passage through the Robles Diversion Dam, was completed in 2006. As a requirement of their federal Biological Opinion, CMWD monitors fish migration through the facility (CMWD 2019). A downstream migrant trap is also operated to evaluate if smolts can pass through the facility without injury (CMWD 2019). A weir trap is then used to evaluate success of smolt migration through the reach downstream of the facility (CMWD 2019). Small numbers of out-migrating smolts have been captured since operation of the weir trap began. However, during the most recent drought (2012-2017), trapping did not occur due to low flow conditions. Since 2017, zero to only a few fish have been observed per year in the vicinity of the passage facility. Presence/absence and redd surveys for *O. mykiss* have also been conducted by CMWD each year and numbers have declined substantially since the beginning of the drought (CMWD 2018).

4.3.1.4 Santa Clara River

The Santa Clara River is a major river that flows into the Pacific Ocean near Ventura, California. The watershed drains an area of approximately 1,600 square miles with 75 stream miles (Becker and Reining 2008). The historical steelhead run was estimated to be around 9,000 fish based on comparisons of habitat suitability metrics produced for the Ventura River (Moore 1980). Numerous instream water diversions have impeded anadromous migration since the 1950s (Becker and Reining 2008; Titus et al. 2010).

In 1991 UWCD built the Vern Freeman Diversion Dam across the Santa Clara River at about 10 river miles from the Pacific Ocean, near the unincorporated community of Saticoy. The Vern Freeman Diversion Dam includes a fish passage facility (Titus et al. 2010), however, in 2019 the U.S. District Court for the Central District of California issued an order that stated, in a factual summary, "the structure and operation of [Vern Freeman Diversion Dam] significantly hampers the migration of steelhead in the Santa Clara River to and from the Pacific Ocean" because it "reduces the availability of water downstream for steelhead migration" and "it is difficult for adult steelhead to successfully pass through the fish ladder" (*Wishtoyo Found., et al. v. United Water Conservation Dist.*, Case No. 2:16-CV-03869-DOC-PLA, Dkt. No. 254 (Mar. 5, 2019); see also NMFS 2012a). Operations of a downstream migrant trap at the Vern Freeman Diversion Dam began in 1993 and typically occur from January to June when flows in the river are sufficient to maintain consistent water levels at the fish trap. A total of 16 adult steelhead and 839 smolts were observed at the Vern Freeman Diversion Dam from 1993-2014 (Booth 2016).

In 2018, the U.S. District Court for the Central District of California issued a judgment in *Wishtoyo Foundation, et al. v. United Water Conservation District* finding that "[UWCD's] operation and maintenance of Vern Freeman Dam ('VFD'), including its operation and maintenance of the fish ladder at the VFD, and [UWCD's] diversion of water from the VFD, constituted 'take' of the Distinct Population Segment of Southern California Steelhead . . . in violation of section 9 of the Endangered Species Act" (Case No. 2:16-CV-03869-DOC-PLA, Dkt. No. 248 (December 1, 2018)). In that judgment, the court issued a permanent injunction requiring UWCD to adhere to the water diversion operating rules set forth in a 2008 NMFS Biological Opinion until such time as UWCD obtains incidental take authorization from NMFS for the maintenance and operation of the Vern Freeman Diversion Dam (*ibid.*). The injunction further requires UWCD to design, construct, and obtain certain permits and authorizations for a new fish passage facility at the Vern Freeman Diversion Dam that is reasonably likely to meet NMFS criteria as specified in the judgment (*ibid.*). In September 2023, UWCD issued a Notice of Preparation under CEQA for an environmental impact report that will identify a hardened ramp structure as the preferred alternative for the project (available at https://www.unitedwater.org/wp-content/uploads/2023/09/Notice-of-Prepration-for-EIR_September-2023.pdf). In a joint stipulation filed with the court in July 2023, the plaintiffs and UWCD jointly proposed an order for the court to sign that would require UWCD to submit complete regulatory applications in February 2024 and submit 90% engineered design plans in June 2024 (*Wishtoyo Found., et al. v. United Water Conservation Dist.*, Case No. 2:16-CV-03869-DOC-PLA, Dkt. No. 590 (July 18, 2023).

Tributaries that intersect the Santa Clara River above the Vern Freeman Diversion Dam historically provided most of the suitable Southern SH/RT spawning and rearing habitat in the watershed. Santa Paula Creek, a tributary to the Santa Clara River, contains high quality suitable *O. mykiss* spawning and rearing habitat. The Harvey Diversion Dam is located on the lower reaches of Santa Paula Creek. While this diversion originally provided fish passage, strong flows rendered the facility irreparable in 2005 (Stoecker and Kelley 2005). More recently, the Harvey Diversion Fish Passage Remediation Project has the goal of restoring fish passage at the facility to reestablish connection to the upstream watershed on Santa Paula and Sisar creeks (California Trout 2018).

Sespe and Piru creeks are the largest tributaries of the Santa Clara River and support higher *O. mykiss* numbers than Santa Paula Creek (Stoecker and Kelley 2005). Sespe Creek contains over 198 km of habitat historically accessible to steelhead and sustains the highest relative abundance of wild *O. mykiss*. It is thought that Sespe Creek offers the highest potential for steelhead recovery because it lacks mainstem migration barriers (Stillwater Sciences 2019). However, Sespe Creek is known to dry in years with low precipitation, leading to a loss of connectivity with the Santa Clara River (Puckett and Villa 1985; Stoecker and Kelley 2005). A recent survey found high abundances of aquatic invasive species throughout most reaches of Sespe Creek downstream of its confluence with Howard Creek, which transports high abundances of invasive species from the Rose Valley Lakes (Stillwater Sciences 2019).

The Piru Creek watershed includes the Santa Felicia and Pyramid Dams. Both dams block access to upstream historical habitat on the Santa Clara River. Reservoir and dam operations also lead to unnatural and diminished flow regimes in the watershed (Moore 1980). Prior to the construction of both dams, adult steelhead were reported to migrate up into Buck and Snowy creeks (Stoecker and Kelley 2005). Piru Creek does not provide spawning and rearing habitat to Southern SH/RT (Moore 1980); however, Aqua Blanca and Fish creeks contain suitable habitat and currently support adfluvial *O. mykiss* populations, which could be important in the future for restoring an anadromous run in this tributary (Stoecker and Kelley 2005).

Various Santa Clara tributaries, including those mentioned above, were stocked in the 1930s through 1950s with hatchery *O. mykiss* as well as those rescued from the Santa Ynez River in 1944 (Titus et al. 2010). Some minor tributaries of the Santa Clara River were also stocked but have no historical records of *O. mykiss* presence. These tributaries include Hopper Canyon, Tom, Pole, and Willard creeks (Titus et al. 2010).

4.3.2 Conception Coast Biogeographic Population Group

Many small coastal watersheds that are relatively uniform in geographic features comprise the Conception Coast BPG, which spans about 50 miles of the southern California coast (NMFS 2012a; Figure 8). Streams in this BPG run north to south and have steep slopes in the upper portions of their watersheds where there is perennial flow. Precipitation can be much higher in the upper watersheds and can lead to “flashy” flows due to the steep stream gradients (NMFS 2012a). Both the Carpinteria Creek and Gaviota Creek watersheds have been the focus of habitat restoration in recent years, as both provide high-quality spawning and rearing habitat for Southern SH/RT and have high recovery potential (NMFS 2012a).

4.3.2.1 Gaviota Creek

Gaviota Creek is about six miles in length, connecting with the Pacific Ocean just south of Las Cruces, California. Steelhead were documented in Gaviota Creek in the 1930s in the winter (Becker and Reining 2008) and multiple ages of *O. mykiss* were observed in the 1990s and early 2000s (Becker and Reining 2008). Steelhead runs in Gaviota Creek, which were historically present in most years, were likely small (Becker and Reining 2008). Livestock grazing is responsible for reductions in suitable habitat for Southern SH/RT in the watershed (Becker and Reining 2008). In recent years, periodic bankside observations conducted by the Department have observed a range of zero to a few hundred *O. mykiss* and no adult steelhead in Gaviota Creek (K. Evans, CDFW, unpublished data).

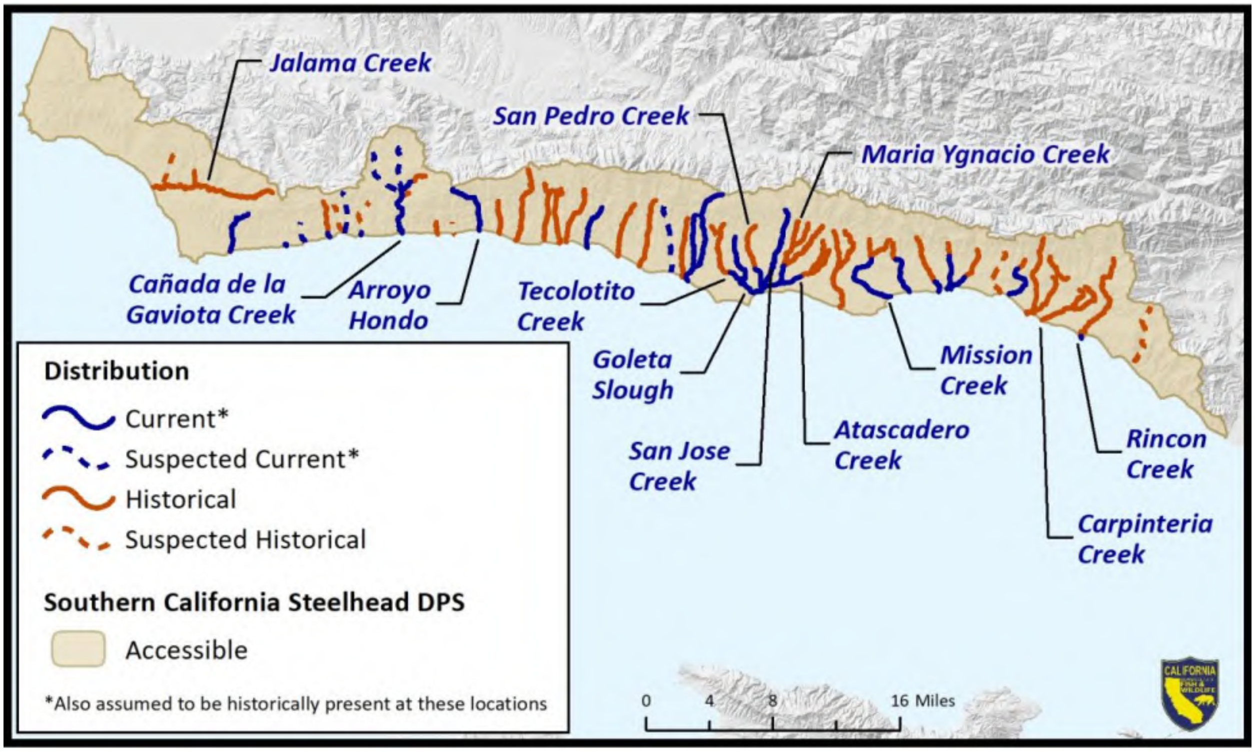


Figure 8. Map of the Conception Coast BPG depicting known and suspected current and historical distribution.

4.3.2.2 Carpinteria Creek

Carpinteria Creek is approximately 6.5 miles long and connects with the Pacific Ocean near Carpinteria, California. Southern SH/RT were observed in the watershed in 1942 (Stoecker et al. 2002) and the stream was understood to have a historical steelhead run (Becker and Reining 2008). Different life stages of *O. mykiss* were seen in the mid-1990s (Becker and Reining 2008), and many were seen in the upper watershed (Becker and Reining 2008) which is known to have suitable habitat (Becker and Reining 2008). A few *O. mykiss* of varying sizes were found in the lower watershed in 2008 (Becker and Reining 2008). In recent years, monitoring conducted by the Department from 2016-2022 have observed few if any individuals of either life-history forms (K. Evans, CDFW, unpublished data).

4.3.2.3 Other Creeks

There are many other creeks flowing into the Pacific Ocean, some of which may have supported Southern SH/RT historically (e.g., Jalama Creek), some where there have been recent observations, and others where *O. mykiss* has not been seen at all. These coastal creeks are typically no longer than 10 stream miles. In addition to Gaviota and Carpinteria creeks, other suitable streams with more recent sightings of Southern SH/RT include Arroyo Hondo Creek and

Rincon Creek (Becker and Reining 2008). Arroyo Hondo Creek contains the least number and severity of threats for Southern SH/RT in the Conception Coast BPG (NMFS 2012a).

4.3.3 Santa Monica Mountains Biogeographic Population Group

There are five watersheds in the Santa Monica Mountains BPG, the majority of which are small with geography resembling that of watersheds in the Conception Coast BPG (NMFS 2012a; Figure 9). Except for Malibu Creek, the headwaters of the streams occur prior to passing through the Santa Monica mountains. Malibu Creek is the largest watershed in the BPG (NMFS 2012a) but is similar to Topanga Creek in stream length (Becker and Reining 2008). There are two substantial anthropogenic migration barriers on Malibu Creek, Rindge Dam and Malibu Lake Dam. Rindge Dam is located a few miles upstream from the mouth and prevents access to nearly all historical Southern SH/RT habitat. The remaining three streams include Big Sycamore Canyon Creek, Arroyo Sequit, and Las Flores Canyon Creek (NMFS 2012a).

4.3.3.1 Malibu Creek

The Malibu Creek watershed encompasses about 105 square miles including 8.5 miles of stream that outflows into the Pacific Ocean at Malibu Lagoon State Beach in Santa Monica Bay (Becker and Reining 2008). Rindge Dam was constructed in 1924 about three miles upstream from the mouth (Becker and Reining 2008; Titus et al. 2010). Before the dam was built, steelhead were able to access spawning habitat in Las Virgenes and Cold creeks (Titus et al. 2010). In 1947, a steelhead run was observed when the sandbar at the mouth was manually opened. In the 1970s, steelhead were observed migrating upstream up to Rindge Dam (Becker and Reining 2008). In 1980, a Department employee counted 61 steelhead immediately downstream of Rindge Dam (Titus et al. 2010). Multiple life stages of *O. mykiss* were observed during a study conducted in the winter and spring of 1986. A total of 158 fish was reported though only one was an adult steelhead. Later in 1986 and in 1987, a handful of adult *O. mykiss* were found below Rindge Dam and a few adult *O. mykiss* were seen just below the dam in 1992 (Titus et al. 2010). The quality of spawning and rearing habitat is the best just below Rindge Dam (Titus et al. 2010), which explains the greater use of that area by juvenile *O. mykiss* (Titus et al. 2010). Stocking of hatchery Rainbow Trout occurred in 1984 at Malibu Creek State Park with additional stockings likely occurring frequently (Titus et al. 2010).

In addition to Rindge Dam and other migration barriers blocking access to historical habitat, the natural flow regime and water quality of Malibu Creek has been modified by operations of the Tapia Water Reclamation Facility (approximately 5 miles upstream from the ocean). Treated water releases from the facility sustain flows in Malibu Creek throughout the year (Titus et al. 2010). Currently, a new recycled wastewater treatment facility is being proposed that would treat effluent from the Tapia Water Reclamation Facility with the purpose of re-distributing the water to the service area rather than releasing it back to Malibu Creek (Las Virgenes-Triunfo Joint Powers Authority 2022). The implementation of this project could lead to less streamflow in Malibu Creek as a result of the repurposing of discharged recycled water that would have previously been released to Malibu Creek.

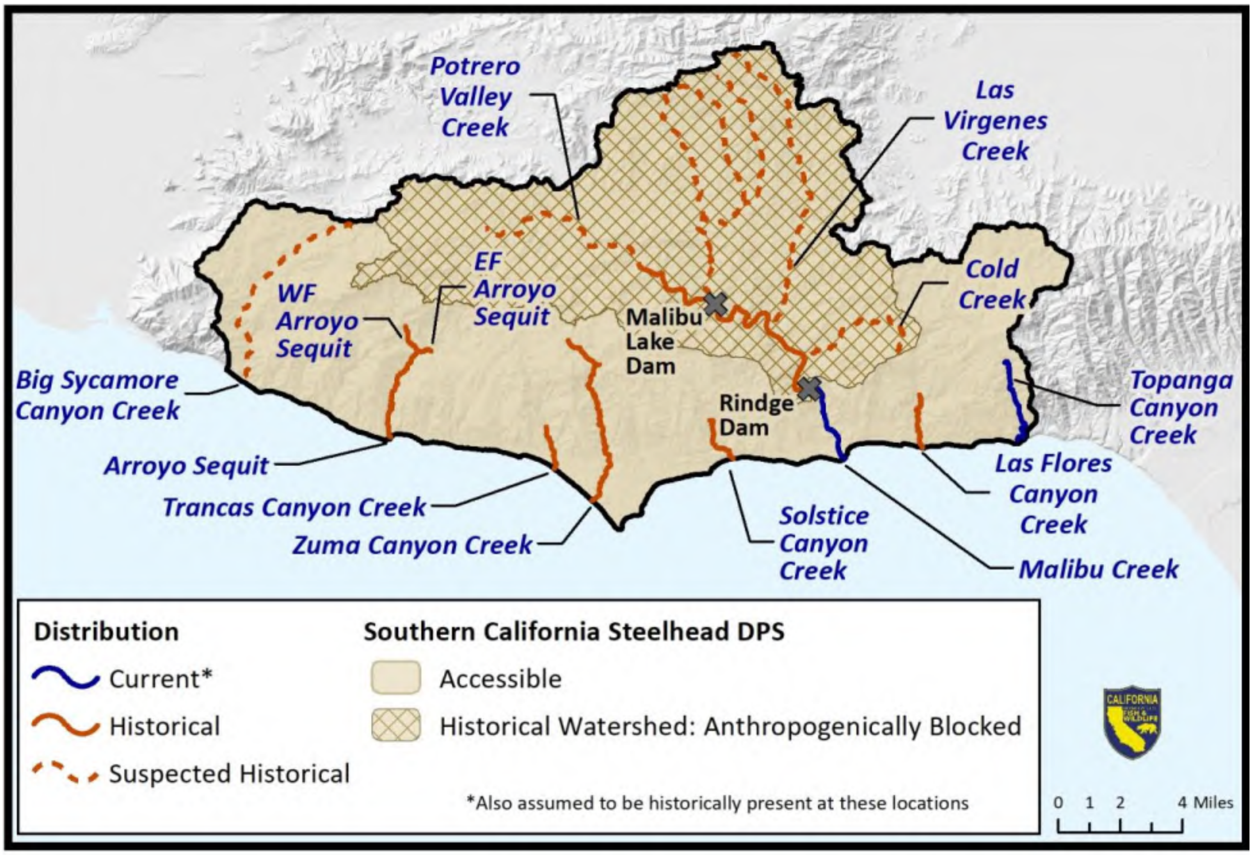


Figure 9. Map of the Santa Monica Mountains BPG depicting known and suspected current and historical distribution. Abbreviations: EF = East Fork, WF = West Fork.

In more recent years, *O. mykiss* have been seen in Malibu Creek below Rindge Dam (Becker and Reining 2008). A die off of about 250 *O. mykiss* occurred in the creek in 2006 after yellowing of the fish was noticed during snorkel surveys (Becker and Reining 2008). Recent drought conditions starting in 2012 have led to reduced abundances of *O. mykiss* in Malibu Creek based on similar observations on Topanga Creek (Dagit et a. 2017)

4.3.3.2 Topanga Creek

Topanga Creek empties into the ocean at Topanga Beach and contains similar stream mileage to Malibu Creek but contains less accessible habitat for Southern SH/RT (Becker and Reining 2008). Some steelhead can access Topanga Creek in years when there is sufficient precipitation (Becker and Reining 2008), and *O. mykiss* of various sizes were observed in the watershed in

1979 (Becker and Reining 2008). Juvenile *O. mykiss* were observed by Department staff in Topanga Creek again in 1982 (Becker and Reining 2008). Unlike in Malibu Creek, the upstream impassable migration barrier for Southern SH/RT is a natural barrier in Topanga Creek (Camm Swift, Emeritus, Section of Fishes, Natural History Museum of Los Angeles County, personal communication).

The Southern SH/RT population in Topanga Creek was recently monitored from 2001-2007, revealing consistent use by spawning steelhead adults and successful smolt production (Becker and Reining 2008). Bell et al. (2011b) characterized the Topanga population as a satellite population that is supported by other populations in the Southern SH/RT range but provides minimal production to other streams. As a satellite population, Topanga Creek *O. mykiss* support the metapopulation in southern California but are more vulnerable to extirpation (Bell et al. 2011b). The effects of the most recent prolonged drought on Southern SH/RT have been severe. Significant reductions for all life-stages were observed from 2012-2016, leading to reductions of the population from 358 individuals in 2008 to less than 50 individuals in 2016 (Dagit et al. 2017).

4.3.3.3 Other Creeks

Big Sycamore Canyon Creek was surveyed in 1989-1990 but no steelhead were observed (Becker and Reining 2008). NMFS (2005) designated the population as extirpated after another survey in 2002.

Arroyo Sequit Creek was reported to have a small historical steelhead run. Steelhead were seen in a 1989-1990 survey of the stream and again in a 1993 survey. From 2000-2007 steelhead were reported utilizing Arroyo Sequit Creek (Becker and Reining 2008).

Overall, from 2005-2019, monitoring in Arroyo Sequit Creek done by the Resource Conservation District of the Santa Monica Mountains (RCDSMM) has observed few *O. mykiss*, primarily due to two instream barriers that were eventually removed in 2016. Two adult observations occurred after the removal of barriers in 2017 (Dagit et al. 2019). There is also limited documentation of steelhead in the West and East forks of Arroyo Sequit Creek (Becker and Reining 2008). Las Flores Canyon Creek is reported to have suitable steelhead habitat but there is no evidence of historical or present use by steelhead (Becker and Reining 2008; Titus et al. 2010).

4.3.4 Mojave Rim Biogeographic Population Group

There are three relatively large watersheds that make up the Mojave Rim BPG (NMFS 2012a; Figure 10). These watersheds include the San Gabriel, Santa Ana, and Los Angeles rivers. The headwaters of these streams are in the San Gabriel and San Bernardino mountains, which experience greater seasonal precipitation than is seen in the neighboring BPGs. Lower watershed areas span the flat coastal plain of the Los Angeles River, which historically contained widespread springs and marshes (Mendenhall 1907). Over time the mouths of these rivers have drifted to different areas along the coast. Currently, the river mouths are each less than 20 miles apart (NMFS 2012a).

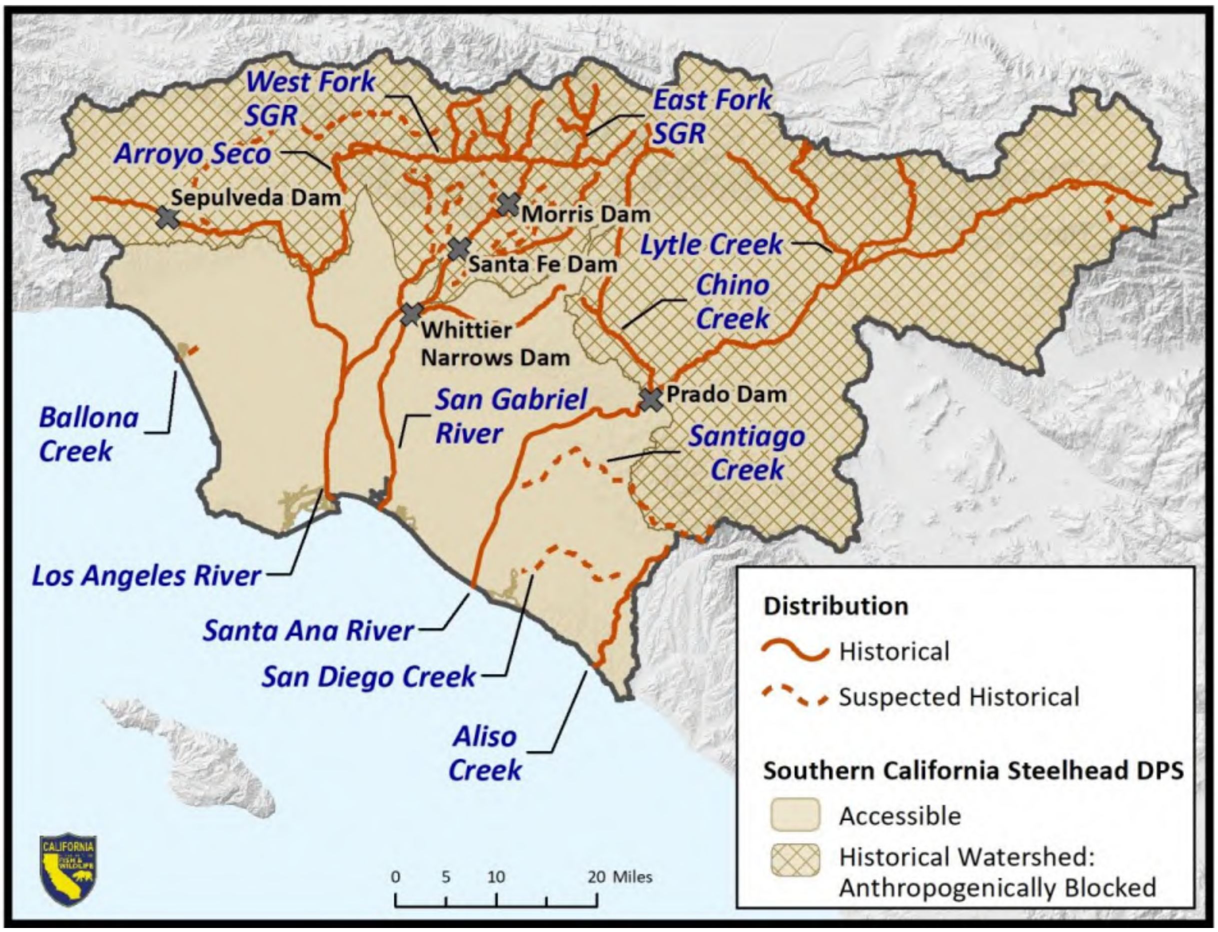


Figure 10. Map of the Mojave Rim BPG depicting known and suspected current and historical distribution. Abbreviations: SGR= San Gabriel River.

4.3.4.1 San Gabriel River

The San Gabriel River encompasses more than 58 stream miles but about half of it is channelized below Santa Fe Dam. Morris Dam and Santa Fe Dam were both constructed in the 1930s (Becker and Reining 2008) and are considered complete barriers to fish migration. Rainbow trout were seen by Department staff in the 1930s, but the river was also stocked during that time (Becker and Reining 2008). Stocking below Morris Dam also occurred on Little Dalton Creek in 1945 (Titus et al. 2010). Rainbow Trout fishing was good from the late 1930s to late 1940s according to various Department stream surveys and in 1951, Department staff noted that natural production was average (Becker and Reining 2008). Fish Canyon Creek and Robert's Canyon Creek, which are mainstem tributaries downstream of Morris Dam, were observed by Department surveyors to have *O. mykiss* in the 1940s, 1950s, and 1973 (Titus et al. 2010).

Southern SH/RT historically occurred in a few tributaries of the San Gabriel River such as San Jose Creek. Many tributaries to the San Gabriel River have been channelized and contain fish passage barriers. Most were stocked for recreational angling in the 1930s and 1940s (Becker and Reining 2008). Southern SH/RT remain in tributaries above the two barrier dams and are known to presently inhabit the East Fork. The ancestry of these fish is unclear and may have genetic influence from stocking *O. mykiss* from other watersheds (Nielsen 1999). There is also a remnant historical population of Rainbow Trout just below Morris Dam that appears to self-propagate (Becker and Reining 2008).

4.3.4.2 Santa Ana River

The Santa Ana River is the largest river within southern California at almost 100 miles long (Becker and Reining 2008). Prado Dam, which is located approximately 30 miles upstream of the river outlet, was constructed in 1941 (O.C. Public Works, n.d.). The lower 24 miles of channelized river below the dam outflows to the Pacific Ocean in Huntington Beach (Becker and Reining 2008). Rainbow Trout were first observed and captured in the upper Santa Ana River drainage in the 1850s (Boughton et al. 2006). Rainbow Trout were also observed in the mountainous upper watershed during the 1930s, coinciding with when stocking occurred (Becker and Reining 2008). A steelhead run was historically present in the lower river (Becker and Reining 2008); however, in 1951 and 1955, no *O. mykiss* were observed in any stream reaches below Prado Dam during Department surveys (Titus et al. 2010). Various water uses have highly altered flows in the Santa Ana River and low numbers of fish in the lower river are attributed to limited water releases from Prado Dam (Titus et al. 2010). Southern SH/RT are thought to be extirpated from the Santa Ana River (Nehlsen et al. 1991), but resident *O. mykiss* remain in the upper watershed above natural and manmade impassable barriers (Boughton et al. 2005).

Southern SH/RT were historically present in Santiago Creek below Prado Dam. Many tributaries upstream of where the dam was built were stocked with *O. mykiss* in the 1930s and fish have been observed reproducing naturally in the decades that followed (Becker and Reining 2008).

4.3.4.3 Los Angeles River

The Los Angeles River is approximately 52 miles long and flows to the Pacific Ocean in Long Beach. Like the San Gabriel River, the Los Angeles River is completely channelized with much of the lower mainstem channel paved with concrete for flood control purposes (Becker and Reining 2008; Titus et al. 2010). Southern SH/RT are assumed to have been present in the watershed but there have been no actual observations to confirm this assumption (Titus et al. 2010). Major tributaries to the Los Angeles River were stocked in the 1930s or 1940s (Becker and Reining 2008; Titus et al. 2010) but some of these tributaries were later channelized and no longer support *O. mykiss*. Due to the highly modified nature of the river basin, Southern SH/RT cannot utilize the mainstem Los Angeles River for spawning or rearing (Titus et al. 2010) and are considered extirpated (Nehlsen et al. 1991). However, resident *O. mykiss* have been observed in the major tributaries of the Los Angeles River, including Arroyo Seco and Big Tujunga Creeks (Becker and Reining 2008). Fish passage by native Southern SH/RT on Arroyo Seco is obstructed by Devil's Gate Dam. Recently, Department-led fish rescues have transplanted Southern SH/RT from the West Fork San Gabriel River and Bear Creek to Arroyo Seco as a result of the Bobcat Fire (Pareti 2020).

4.3.5 Santa Catalina Gulf Coast Biogeographic Population Group

Multiple medium sized watersheds comprise the Santa Catalina Gulf Coast BPG (Figure 11). Most have their headwaters in the Santa Ana or Peninsular Mountain ranges and flow south over coastal terraces (NMFS 2012a). Many watersheds in the BPG have intermittent flow and are seasonally dry due to limited precipitation and groundwater depletion (D. Boughton, NOAA, personal communication). Some smaller drainages within the BPG might occasionally support steelhead. Streams in this BPG have substantial tributary mileage in the upper watershed areas due to the fragmented landscape in the region (NMFS 2012a).

4.3.5.1 San Juan Creek

San Juan Creek is 22-mile stream located in Orange and Riverside Counties. Arroyo Trabuco Creek is a major tributary to San Juan Creek with approximately the same stream length (Becker and Reining 2008). Steelhead were observed in the creek in 1939 (Swift et al. 1993) and in the 1940s as well as in 1968 and 1974 (Becker and Reining 2008). Trout stocking to support fishing in San Juan Creek occurred year-round in 1981 (Becker and Reining 2008) and possibly in other years. San Juan Creek contains suitable habitat for *O. mykiss*, which have been observed in some but not all years in recent decades (Becker and Reining 2008).

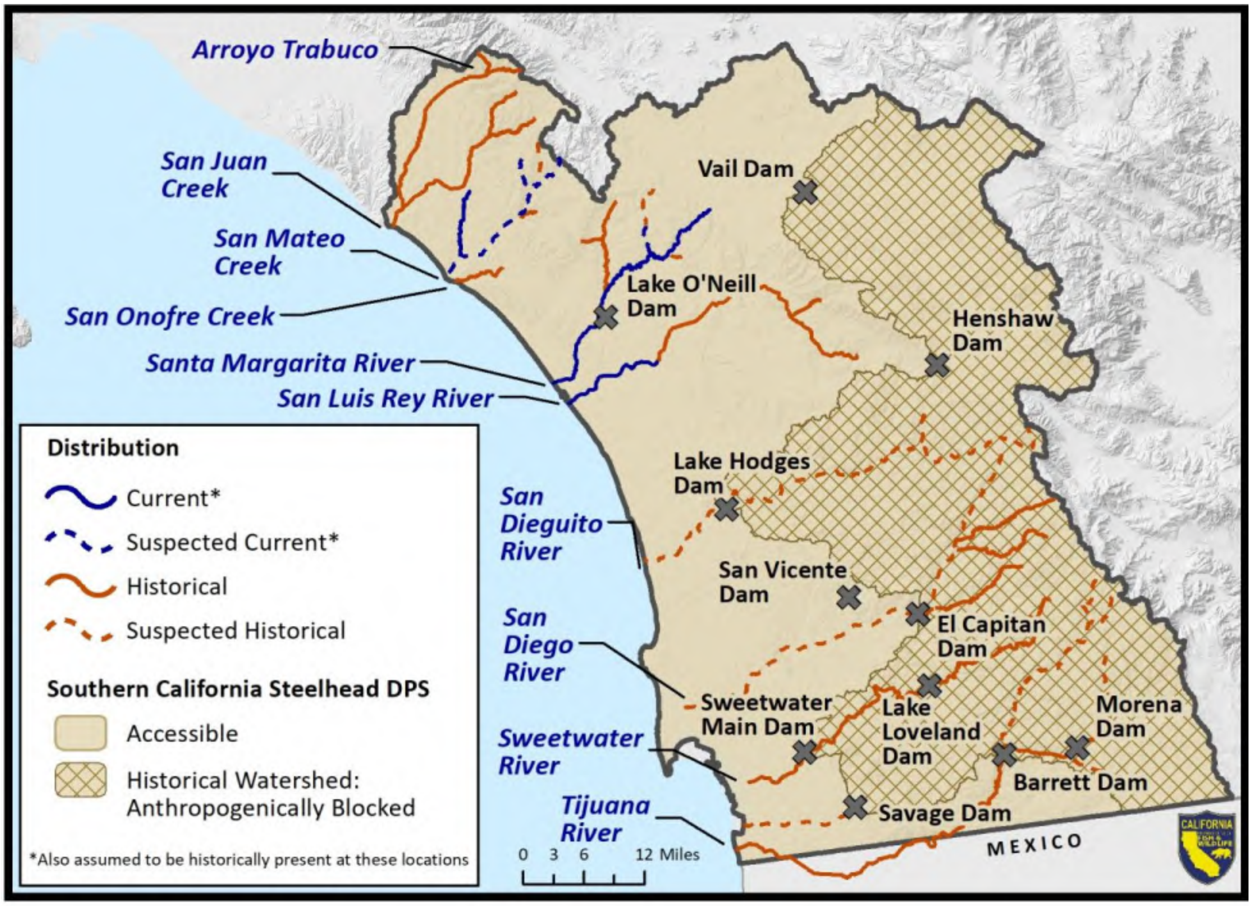


Figure 11. Map of the Santa Catalina Gulf Coast BPG depicting known and suspected current and historical distribution.

Arroyo Trabuco was a historical Southern SH/RT stream; however, there is now a complete barrier to fish migration about 2.4 miles from the confluence with San Juan Creek. Regardless, the stream still appears to contain suitable habitat and steelhead were still thought to be present in 2004 below the barrier (Becker and Reining 2008). Recently, efforts to remediate fish passage at two total barriers to migration on Trabuco Creek are in progress. Completion of this project would provide access to 15 miles of upstream spawning and rearing habitat.

4.3.5.2 San Mateo Creek

San Mateo Creek, which has a similar stream length as San Juan creek, supported a historical steelhead run (Titus et al. 2010). In the early 1900s, anglers were successful in catching Southern SH/RT of greater sizes than in other regional watersheds (Titus et al. 2010). In 1939, juvenile Southern SH/RT were observed and rescued in the thousands from isolated reaches and transferred to the estuary lagoon (Titus et al. 2010). Stocking of the creek began in 1945 (Becker and Reining 2008). Anadromous and resident Southern SH/RT were thought to persist in 1950 (Becker and Reining 2008), though after that year, Southern SH/RT encounters declined (Titus et al. 2010). In 1999, *O. mykiss* sampled by the Department were surmised to be offspring from anadromous Southern SH/RT because of the lack of a resident population (Becker and Reining 2008). Habitat quality in the watershed has been degraded by anthropogenic activities and intermittent streamflow has posed migration issues for Southern SH/RT (Titus et al. 2010). Steelhead were thought to be extirpated from San Mateo Creek (Nehlsen et al. 1991) until more recent monitoring by Hovey (2004) documented a small resident *O. mykiss* population in Devil Canyon Creek, a major tributary to San Mateo Creek. Currently, the San Diego Regional Water Quality Control Board is considered using a draft invasive species Total Maximum Daily Load (TMDL) and plan to certify that actions of other entities will correct impairments to the creek caused by invasive species (Loflen 2022).

4.3.5.3 San Onofre Creek

San Onofre Creek consists of 13 miles of stream in Orange County. Personal observations of annual steelhead runs in the creek prior to 1946 suggest it was a historical Southern SH/RT stream (Becker and Reining 2008). Fletcher Creek, a tributary to San Onofre Creek, was considered a steelhead rearing area in 1950 and *O. mykiss* were observed by Department staff during a survey in 1979 (Titus et al. 2010). By the 2000s, San Onofre Creek was observed to be dry (Boughton et al. 2005), though reaches in the upper watershed may still offer suitable *O. mykiss* habitat (Becker and Reining 2008).

4.3.5.4 Santa Margarita River

The Santa Margarita River is almost 30 miles long, but a diversion weir located approximately ten miles upstream within the boundaries of Camp Pendleton likely acts as a complete barrier to upstream fish migration (Becker and Reining 2008; Titus et al. 2010). This diversion eliminates surface flow during most of the year (Titus et al. 2010). Adult and juvenile steelhead were observed in the river in the 1930s and 1940s and steelhead were thought to migrate upstream to the town of Fallbrook when flows allowed (Becker and Reining 2008). DeLuz Creek, a tributary to the Santa Margarita River, also historically supported steelhead (Becker and Reining 2008). Stocking of *O. mykiss* in the Santa Margarita watershed began in 1941 (Becker and Reining 2008) and occurred most recently in 1984 (Titus et al. 2010). Currently, the reaches downstream of O’Neill Lake do not support Southern SH/RT spawning (Titus et al. 2010) and they are thought to be extirpated (Nehlsen et al. 1991). As part of the Santa Margarita River Conjunctive Use Project, the existing O’Neill weir diversion will be replaced with an inflatable structure that will allow fish passage during most flow events (FPUD 2016). Further upstream, efforts are also underway to replace a fish passage barrier at the Sandia Creek Drive bridge to provide passage to 12 miles of upstream rearing and spawning habitat (Dudek 2021)

4.3.5.5 San Luis Rey River

The San Luis Rey River is a large river in northern San Diego County that runs approximately 69 stream miles from its river mouth near Oceanside, California. Lake Henshaw Dam, which was built in 1924, reduces the downstream flow of the river and blocks steelhead access to the uppermost portion of the drainage (Becker and Reining 2008; Titus et al. 2010). According to Native Americans and other observers of *O. mykiss* in the late 1800s, there was a historical run of steelhead that was able to reach areas above where the dam was constructed (Becker and Reining 2008). Stocking of Rainbow Trout occurred sometime prior to 1946 (Becker and Reining 2008). Although resident Rainbow Trout remain in tributaries of the upper watershed like Pauma Creek and the West Fork San Luis Rey River (Becker and Reining 2008), native Southern SH/RT are extirpated from the lower reaches of the San Luis Rey River (Nehlsen et al. 1991; Becker and Reining 2008).

4.3.5.6 San Dieguito River

The San Dieguito River is a large river in San Diego County that runs for 23 stream miles before entering into the Pacific Ocean north of the City of San Diego. Hodges Dam, which was constructed 12 miles upstream from the mouth in 1918, serves as a complete barrier to anadromy (Becker and Reining 2008). A journal article by Hubbs (1946) mentioned anglers catching possible steelhead in the estuary (Titus et al. 2010). Rainbow trout have been stocked below the dam (Titus et al. 2010); however, those downstream reaches no longer support *O. mykiss* (Becker and Reining 2008). Prior to the construction of the Sutherland Lake dam on Santa Ysabel Creek, a major tributary of the San Dieguito River, Department staff saw *O. mykiss* in a creek upstream of the eventual dam site, though there had been stocking efforts in that creek (Becker and Reining 2008). Black Canyon Creek, another smaller tributary to the San Dieguito River, was also stocked for rainbow trout fishing (Becker and Reining 2008).

4.3.5.7 San Diego River

The San Diego River has a stream length of 52 miles but El Capitan Dam, built in 1934, blocks about 22 miles of historical Southern SH/RT habitat (Becker and Reining 2008). Additionally, channelization of downstream reaches has eliminated suitable habitat below the dam (Titus et al. 2010). Anglers may have caught steelhead historically (Titus et al. 2010) but the population is now thought to be extinct (Nehlsen et al. 1991). Upper watershed tributaries above the dam were stocked in the 1930s and earlier and may still support *O. mykiss* (Becker and Reining 2008; Titus et al. 2010).

4.3.5.8 Sweetwater River

The Sweetwater River is a large river in San Diego County that runs for 55 miles before emptying into San Diego Bay southeast of the City of San Diego. The Sweetwater Reservoir, formed by the construction of the Sweetwater Dam in 1888, serves as a total barrier to anadromy (Becker and Reining 2008; Titus et al. 2010). Although *O. mykiss* were present historically and may still be found in the upper watershed, there are no mentions of a historical anadromous steelhead run in the Sweetwater River (Becker and Reining 2008; Titus et al. 2010). In years leading up to 1946, Cold Stream, a small tributary to Sweetwater River, was stocked with Rainbow Trout and these fish may have continued to naturally reproduce for some time (Becker and Reining 2008).

4.3.5.9 Otay River

The Otay River enters the south end of San Diego Bay near the U.S.-Mexico Border. There are no known historical or current records of Southern SH/RT existing in the Otay River. Fish passage is obstructed by the dam that forms Lower Otay Lake, though there may be *O. mykiss* residing in upper reaches above the reservoir (Titus et al. 2010).

4.3.5.10 Tijuana River

The Tijuana River is the southernmost stream within the Southern SH/RT range and extends for 26 miles from the intersection of Cottonwood Creek (Becker and Reining 2008). Other than one account of a few steelhead seen in 1927 by Department law enforcement, there has been no other documentation of historical use of the mainstem river (Titus et al. 2010). Steelhead were present in Cottonwood Creek in the mid-1930s, which was stocked with *O. mykiss* at that time, but Southern SH/RT are no longer able to pass multiple dams within the creek (Titus et al. 2010). If a steelhead run did exist in the Tijuana watershed, it is now assumed to be extirpated (Titus et al. 2010).

4.4 Abundance and Trends

To provide the best scientific information in our evaluation of Southern SH/RT as required by Fish and Game Code Section 2074.6, we analyzed its status and trends with annual abundance data compiled from a variety of sources (see Section 4.2 for Sources of Information).

Southern SH/RT, as defined in the Petition, include both anadromous and resident forms below complete migration barriers. To account for both life-history forms in our review, our analyses in Sections 4.4-4.8 examine data on anadromous adult Southern SH/RT (Adult SH) separately from data on *O. mykiss* not identified as anadromous adult Southern SH/RT (Other *O. mykiss*), as most existing monitoring efforts produce datasets that use these two categories. This is because it is possible to distinguish anadromous adult Southern SH/RT in rivers and streams due to their larger size (fork length >400m), greater girth, and steel-gray appearance, but it is otherwise difficult to conclude which life history an individual *O. mykiss* that does not have the identifying characteristics of an adult fish has expressed or will express. (Dagit et al. 2020; Moyle et al. 2017).

The analysis presented below is structured on the five BPGs with an emphasis on Core 1 and Core 2 populations within each BPG (NMFS 2012a; Boughton et al. 2007). The BPGs are a federal delineation based on a suite of environmental conditions (e.g., hydrology, local climate, geography) and watershed characteristics (i.e., large inland or short coastal streams). Core 1 and 2 populations occupy watersheds that exhibit the physical and hydrological conditions necessary to sustain self-sufficient viable populations of Southern SH/RT (NMFS 2012a). Datasets were reviewed to ensure that they were collected from monitoring conducted below the upper limit to anadromy in each watershed to remain consistent with the geographic scope of the listing unit proposed in the Petition. Where sufficient data were available for a given population, we present and discuss abundance and long-term population trend estimates for each BPG. The Department was unable to analyze core watersheds in the Mojave Rim and Santa Catalina Gulf Coast BPGs in detail due to data limitations. In these instances, as well as in other cases where data was limiting or unavailable, we provide a qualitative discussion, such as a viability assessment, based on the sources identified in Section 4.2 (Boughton et al. 2022a).

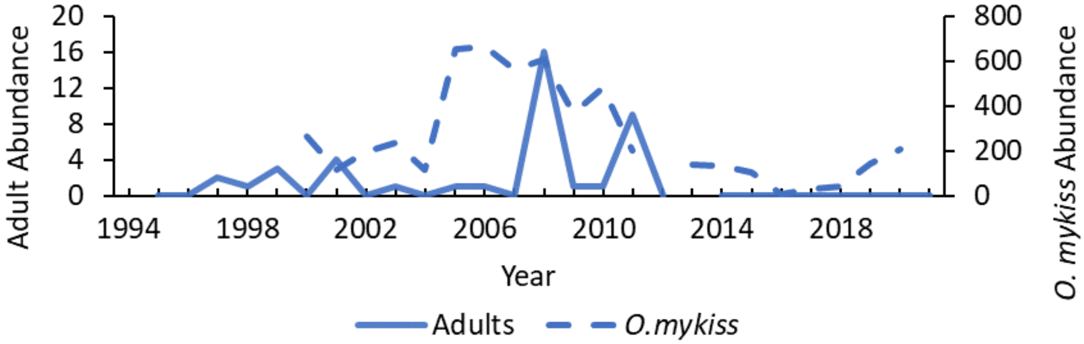
4.4.1 Time Series of Abundance

Southern SH/RT populations in the Monte Arido Highlands BGP have the longest running time-series dating back to the 1990s for the Santa Ynez and Santa Clara rivers (COMB 2022; Booth 2016) and the early 2000s for the Ventura River (CMWD 2005-2021; Dagit et al. 2020) (Figure 12). However, no organized monitoring efforts have been conducted on the Santa Maria River since steelhead were federally listed in 1997. Therefore, no further analysis of the Santa Maria Southern SH/RT populations are conducted in this chapter.

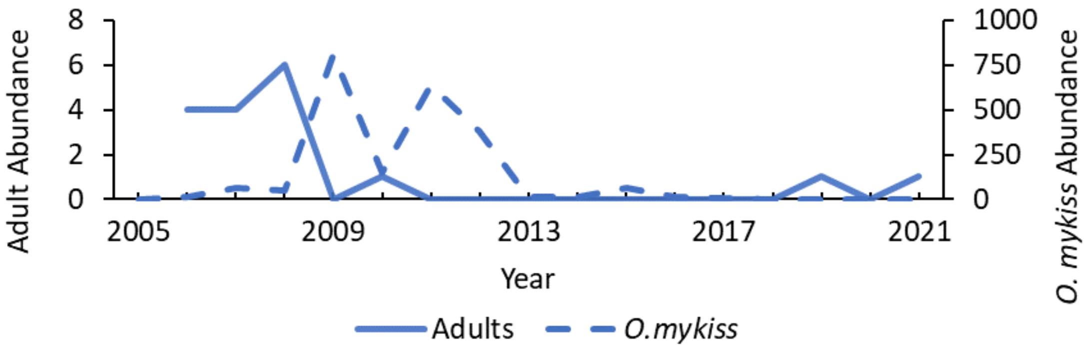
More recently, monitoring has been intermittently conducted on Carpinteria, Mission, and Arroyo Hondo in the Conception Coast BPG by the Department (Boughton et. al 2022a). Malibu, Topanga, and Arroyo Sequit creeks in the Santa Monica Mountains BPG have been actively monitored since the early 2000s (Dagit et al. 2019) (Figure 13). No recent or historical monitoring has been conducted in either the Mojave Rim or Santa Catalina Gulf Coast BPGs.

4.4.1.1 Monte Arido Highlands BPG

A. Santa Ynez River



B. Ventura River



C. Santa Clara River

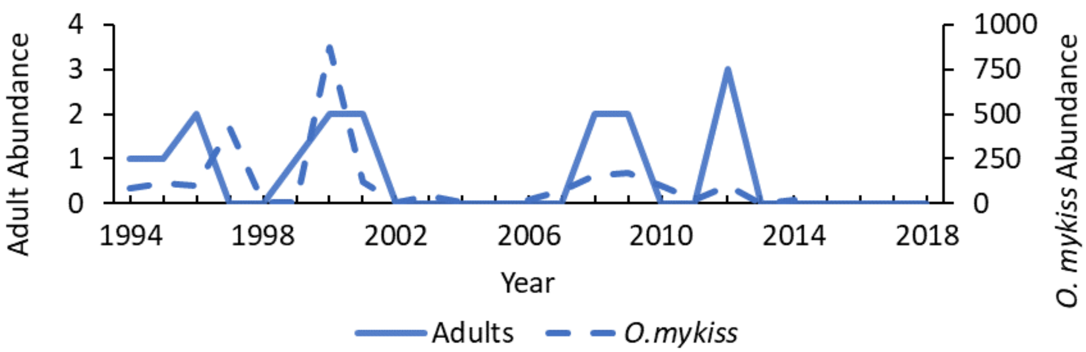


Figure 12. Adult steelhead (Adults) and other O. mykiss (O. mykiss) abundances for the Monte Arido Highlands BPG. A) Santa Ynez River; no data 2013. Biological Opinion Incidental Take provisions have been required since 2014. B) Ventura River. C) Santa Clara River. Adult abundance is on the left -axis with the solid blue line and O. mykiss abundance is on the right axis with the dashed blue line. Note different scales on the Y-axis.

4.4.1.2 Conception Coast BPG

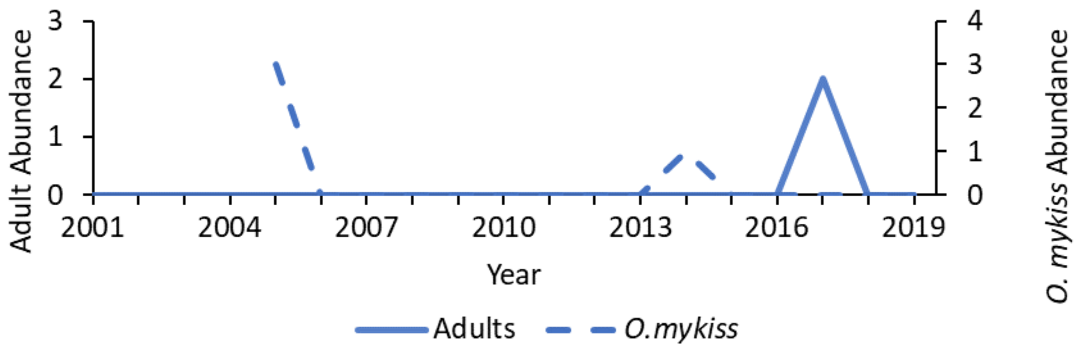
Very few monitoring activities have occurred throughout the Conception Coast BPG, and most of the work that has occurred in more recent years was conducted by the Department. We were unable to develop a full-time series of Southern SH/RT abundance for Conception Coast populations.

Although past monitoring is limited in this BPG, Dagit et. al (2020) documented a total of 42 adult steelhead opportunistic observations from 2000-2018. Two adults were observed in Arroyo Hondo Creek in 2017 and 10 adults were documented in the Goleta Slough Complex with the most recent observation occurring in 2017. For the entirety of Conception Coast BPG, 64% (n=27) of all adult observations occurred in Mission Creek, primarily from 1998-2008. However, from 2018-2022, Department redd and snorkel surveys documented zero adult steelhead in Mission Creek (K. Evans, CDFW, unpublished data). Three adults were observed opportunistically in Carpinteria Creek in 2008 (Dagit et al. 2020); however, from 2008-2019, zero adult steelhead were observed based on recent monitoring conducted by the Department (Boughton et al. 2022a).

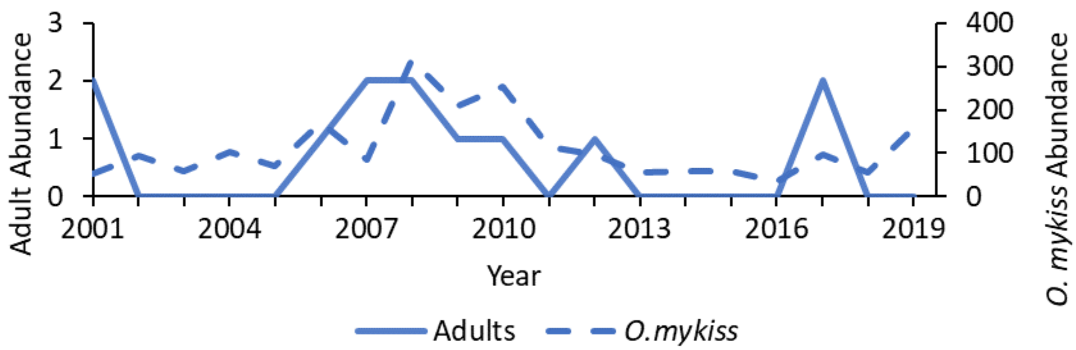
There is also limited data for *O. mykiss* in the Conception Coast BPG. No *O. mykiss* have been documented in Carpinteria Creek since 2016. In Mission Creek, no *O. mykiss* were observed from bankside surveys during the 2018-2019 spawning season (Carmody et al. 2019). In recent years, the largest number of *O. mykiss* observations in this BPG have occurred on Arroyo Hondo Creek, indicating that despite being a small watershed, the creek contains suitable habitat that is relatively undisturbed due to its inclusion in a natural reserve system (NMFS 2012a). Snorkel surveys have documented a total of 2,363 *O. mykiss* in Arroyo Hondo Creek from 2017-2019 (Carmody et al. 2019), while bankside *O. mykiss* observations have documented a total of 12,090 *O. mykiss* from 2015-2022 (K. Evans, CDFW, unpublished data).

4.4.1.3 Santa Monica Mountains BPG

A. Arroyo Sequit Creek



B. Topanga Creek



C. Malibu Creek

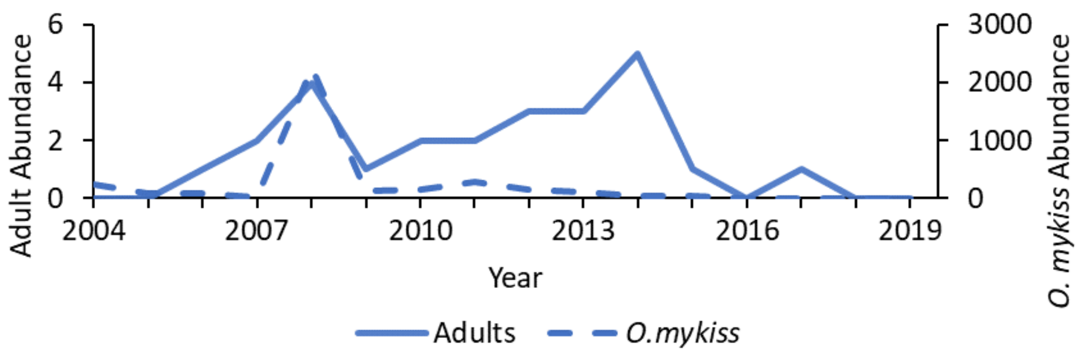


Figure 13. Adult steelhead (Adults) and other O. mykiss (O. mykiss) abundances for the Santa Monica Mountains BPG. A) Arroyo Sequit Creek. B) Topanga Creek. C) Malibu Creek. Adult abundance is indicated on the left -axis and delineated by the solid blue line and O. mykiss abundance is indicated on the right axis and delineated by the dashed blue line. Note different scales on the Y-axis.

4.4.1.4 Mojave Rim BPG

Abundance data is generally not available for this BPG; therefore, we were unable to create a full-time series of Southern SH/RT abundances for the San Gabriel River, Santa Ana River, and Los Angeles River watersheds.

A total of 3 adult steelhead were observed opportunistically in the Mojave Rim BPG from 2000-2018. Two observations occurred on Ballona Creek in 2007, and one observation occurred on the San Gabriel River in 2016 (Dagit et al. 2020). It is generally accepted that all over-summering, rearing, and spawning habitat occurring upstream is no longer accessible to Southern SH/RT due to the presence of extensive physical and velocity related passage barriers located within the lower reaches of each of the three major rivers; therefore, steelhead are not expected to be present in the lower reaches of these watersheds (NMFS 2012a).

4.4.1.5 Santa Catalina Gulf Coast BPG

We were unable to construct a full-time series of Southern SH/RT abundance for these populations because no data series were available to analyze the Santa Catalina Gulf Coast BPG. A total of 15 adult steelhead have been observed in the Santa Catalina Gulf Coast BPG from 2001-2018. Ten of these steelhead observations occurred on either San Juan or San Mateo creeks, and the remainder of observations were distributed throughout the Santa Margarita and San Luis Rey rivers and Los Penasquitos Creek (Dagit et al. 2020).

4.4.2 Geometric Mean Abundance

We calculated the geometric mean of abundance for Southern SH/RT populations (Na) with at least 3-4 generations of data for three time periods. The long-term calculation represents the total available time series. The medium-term calculation represents 12 years or three generations of data, while the short-term calculation is for the most recent 5 years of data. Missing data are noted in the following tables and there was no effort to interpolate or otherwise fill in missing data. Furthermore, we did not substitute values for years in which zero individuals were observed; instead, these values were omitted from the calculation in order to obtain an informative result.

The geometric mean is a useful metric for evaluating species' status because it calculates the central tendency of abundance while minimizing the effect of outliers in the data. Furthermore, the geometric mean is thought to more effectively characterize time series data of abundance based on counts than the arithmetic mean (Good et al. 2005; Spence et al. 2008). We did not calculate arithmetic mean because of its tendency to be overly sensitive to outlier data to a few large counts and can result in the incorrect depiction of central tendency. A range of minimum and maximum abundances were also calculated to provide scale.

Using methods from Spence et al. (2008), we defined the geometric mean of Southern SH/RT abundance as:

$$Na\ (geom) = (\prod Na(i))^{1/n}$$

where $Na(i)$ is the total number of adult steelhead in year *i*, and *n* is the number of years of data available.

4.4.2.1 Monte Arido Highlands BPG

Maximum abundance of adult steelhead in the Monte Arido Highlands BPG has remained consistently low since the mid-1990s and early 2000s (Table 2a-2c). For each population examined, maximum counts from the most recent 5-year period are less than either the medium or long-term time frames. For all three watersheds, years in which zero adults were observed have occurred more frequently than years in which at least one fish was observed.

The highest average abundance in this BPG was during the 12-year time frame (2010-2021) on the Santa Ynez River. Both the Santa Clara and Santa Ynez rivers have higher 12-year averages compared to the long-term average. Overall, all three populations have lower 5-year averages when compared to the long-term average and geometric mean abundances remain low across all time frames (Table 3).

Table 2a. Minimum and maximum adult steelhead abundance for the Santa Ynez River over three-time frames: 1995 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year). No data for 2013. Biological Opinion Incidental Take provisions have been required since 2014.

Abundance	Minimum	Maximum
Long-term	0	16
12-year	0	9
5-year	0	0

Table 2b. Minimum and maximum adult steelhead abundance for the Ventura River over three-time frames: 2006 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year).

Abundance	Minimum	Maximum
Long-term	0	6
12-year	0	1
5-year	0	1

Table 2c. Minimum and maximum adult steelhead abundance for the Santa Clara River over three-time frames: 1994 to 2018 (long-term), 2007 to 2018 (12-year), and 2014 to 2018 (5-year).

Abundance	Minimum	Maximum
Long-term	0	3
12-year	0	3
5-year	0	0

Table 3. Long-term, medium-term, and short-term geometric mean abundance of adult steelhead in the Monte Arido Highlands BPG.

Population	Years	Long-term Mean	Years	12-year mean	Years	5-year mean
Santa Ynez River[1]	1995-2021	2.1	2010-2021	3.0	2017-2021	0.0
Ventura River	2006-2021	2.1	2010-2021	1.0	2017-2021	1.0
Santa Clara River	1994-2018	1.7	2007-2018	2.3	2014-2018	0

[1] No data long-term 2013; Biological Opinion Incidental Take provisions have been required since 2014.

Maximum abundances of *O. mykiss* for all populations in the Monte Arido BPG are considerably less when comparing the 5-year time frame to the long-term time frame (Table 4a-4c). On the Ventura River, a maximum of 807 *O. mykiss* were observed during the long-term time frame compared to just nine individuals being observed during the most recent 5-year time frame. Minimum abundances range from zero to five *O. mykiss* for all three time-periods and populations. All three *O. mykiss* populations have lower 5-year averages compared to the 12-year and long-term time frames (Table 5). The Santa Ynez River has the highest average abundance of the three populations for each time frame. Overall, mean abundances of *O. mykiss* in this BPG have declined to low numbers, especially in the last five years.

Table 4a. Minimum and maximum O. mykiss (Other O. mykiss) abundance for the Santa Ynez River over three-time frames: 2001 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year). No data for 2013. Biological Opinion Incidental Take provisions have been required since 2014.

Abundance	Minimum	Maximum
Long-term	5	665
12-year	5	484
5-year	5	205

Table 4b. Minimum and maximum O. mykiss abundance (Other O. mykiss) for the Ventura River over three-time frames: 2005 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year).

Abundance	Minimum	Maximum
Long-term	0	807
12-year	0	640
5-year	0	9

Table 4c. Minimum and maximum other O. mykiss abundance for the Santa Clara River over three-time frames: 1994 to 2014 (long-term), 2003 to 2014 (12-year), and 2010 to 2014 (5-year). No data for 2005.

Abundance	Minimum	Maximum
Long-term	1	876
12-year	1	170
5-year	1	100

Table 5. Long-term, medium-term, and short-term geometric mean abundance of O. mykiss (Other O. mykiss) in the Monte Arido Highlands BPG.

Population	Years	Long-term Mean	Years	12-year mean	Years	5-year mean
Santa Ynez River[1]	2001-2021	166.4	2010-2021	100.5	2017-2021	43.7
Ventura River	2005-2021	44.7	2010-2021	34.5	2017-2021	3.0
Santa Clara River[2]	1994-2014	39.5	2003-2014	30.5	2010-2014	21

[1] No data long-term 2013; Biological Opinion Incidental Take provisions have been required since 2014.
[2] No data long-term 2005

4.4.2.2 Conception Coast BPG

We were unable to calculate geometric mean abundance estimates for the Conception Coast BPG aside from the Arroyo Hondo Creek *O. mykiss* population due to the lack of long-term data. Based on bankside *O. mykiss* observations as part of spawner redd surveys, the geometric mean abundance was 581 individuals from 2015-2022, the maximum abundance of 8,614 individuals was observed in 2021, and the minimum abundance of zero individuals was observed in 2022 (K. Evans, CDFW, unpublished data).

4.4.2.3 Santa Monica Mountains BPG

Maximum abundance counts of adult steelhead in the Santa Monica Mountains BPG have remained consistently low since the early 2000s (Table 6a-6c). A total of two adult steelhead were observed in Arroyo Sequit Creek in 2017, coinciding with the removal of all instream barriers on the creek below the Mulholland culvert in 2016; however, no adult steelhead have been observed in this creek since 2017. The maximum abundance of adult steelhead in Topanga and Malibu creeks has not been greater than five individuals for any given year during all time periods. For adult steelhead populations in both Topanga and Malibu creeks, the 5-year average is lower than the long-term average (Table 7). Overall, average abundances of adult steelhead for all three populations remain low across all time frames.

Table 6a. Minimum and maximum adult steelhead abundance for Arroyo Sequit Creek over three-time frames: 2005 to 2018 (long-term), 2007 to 2018 (12-year), and 2014 to 2018 (5-year).

Abundance	Minimum	Maximum
Long-term	0	2
12-year	0	2
5-year	0	2

Table 6b. Minimum and maximum adult steelhead abundance for Malibu Creek over three-time frames: 2004 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	0	5
12-year	0	5
5-year	0	1

Table 6c. Minimum and maximum adult steelhead abundance for Topanga Creek over three-time frames: 2001 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	0	2
12-year	0	2
5-year	0	2

Table 7. Long-term, medium-term, and short-term geometric mean abundance of adult steelhead in the Santa Monica Mountains BPG.

Population	Years	Long-term mean	Years	12-year mean	Years	5-year mean
Arroyo Sequit Creek[1]	2005-2019	NA	2008-2019	NA	2015-2019	NA
Topanga Creek	2001-2019	1.4	2008-2019	1.3	2015-2019	1
Malibu Creek	2004-2019	1.9	2008-2019	2.1	2015-2019	1

[1] Insufficient data to produce meaningful results.

For all populations in this BPG, maximum abundances of *O. mykiss* for the 5-year time frame are considerably lower compared to the long-term time frame (Table 8a-8c). Since 2005, a total of four *O. mykiss* were observed in Arroyo Sequit Creek with most years recording zero observations (Table 8a). For the Malibu Creek population, a maximum abundance of 2,245 *O. mykiss* was observed from 2004-2019 compared to just 32 individuals during the 5-year time frame (Table 8b). Topanga Creek appears to support a small but consistent population of *O. mykiss* with a long-term maximum and minimum abundance of 316 and 34 individuals, respectively (Table 8c). Topanga Creek *O. mykiss* have also declined in abundance over the three time periods, but this difference is less pronounced than the decline observed for the Malibu Creek population (Table 9).

Table 8a. Minimum and maximum O. mykiss (Other O. mykiss) abundance for Arroyo Sequit Creek over three-time frames: 2005 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	0	3
12-year	0	1
5-year	0	0

Table 8b. Minimum and maximum O. mykiss (Other O. mykiss) abundance for Malibu Creek over three-time frames: 2004 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	0	2,245
12-year	0	2,245
5-year	0	32

Table 8c. Minimum and maximum O. mykiss (Other O. mykiss) abundance for Topanga Creek over three-time frames: 2001 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	34	316
12-year	34	316
5-year	34	160

Table 9. Long-term, medium-term, and short-term geometric mean abundance of O. mykiss (Other O. mykiss) in the Santa Monica Mountains BPG. Data used are the sum of the average number of O. mykiss observed per month.

Population	Years	Long-term geometric Mean	Years	12-year geometric mean	Years	5-year geometric mean
Arroyo Sequit Creek[1]	2005-2019	NA	2008-2019	NA	2015-2019	NA
Malibu Creek	2004-2019	55.9	2008-2019	52.6	2015-2019	6.1
Topanga Creek	2001-2019	94.2	2008-2019	100.1	2015-2019	70

[1] Insufficient data to produce meaningful results.

4.4.2.4 Mojave Rim and Santa Catalina Gulf Coast BPG

We were unable to calculate geometric mean abundance estimates for either the Mojave Rim or Santa Catalina Gulf Coast BPG due to the lack of long-term data. See Sections 4.3.4, 4.4.1.4, 3.3.5 and 3.4.1.5 for more information on adult steelhead and *O. mykiss* distribution and abundances in these two BPG.

4.4.3 Trend Analysis

Trends were calculated as the slope (β_1) of the regression of log-transformed abundance against years. A value of one was added to the number of Southern SH/RT before the log-transformation to address any zero values if they were present in the dataset [i.e., $ln\ (\bar{N}_a + 1)$]. Using methods from Good et al. (2005), the linear regression can be expressed as:

$$ln\ (\bar{N}_a + 1) = \beta_0 + \beta_1 X + \in$$

Where $\bar{N}_a$ is annual adult steelhead abundance, β_0 is the intercept, β_1 is the slope of the equation, and ∈ represents the random error term. Population trend, *T*, for the specified time series was expressed as the exponentiated slope from the regression above:

$$\exp(\beta_1)$$

with 95% confidence intervals calculated as:

$$\exp(\beta_1) \pm t_{0.05(2),df} s_{b_1}$$

where b_1 is the estimate of the true slope, β_1, $t_{0.05(2),df}$ is the two-sided t-value for a confidence level of 0.95, *df* is equal to *n*-2, *n* is the number of data points in the time series, and s_{b_1} is the standard error of the estimate of the slope, b_1 (Good et al. 2005). We converted the slope to percent annual change (Busby et al. 1996), calculated as:

$$100 * (\exp(\beta_1) - 1)$$

Negative trend values indicate declining abundances over time, whereas positive values indicate growth of the population. Slopes significantly different from zero (P<.05) were noted.

4.4.3.1 Monte Arido Highlands BPG

We calculated adult steelhead and *O. mykiss* population trends for the Santa Ynez, Ventura, and Santa Clara rivers; however, due to lack of monitoring data we were unable to calculate trends for the Santa Maria River adult steelhead and *O. mykiss* populations (Tables 10 and 11). All three adult steelhead populations have declining trends in abundance for their respective data series and the decline in the Ventura River population is statistically significant (p=0.03). Our trend estimates are consistent with other recently reported trend estimates for the Monte Arido Highlands BPG (Boughton et al. 2022a). Similarly, all three *O. mykiss* populations have declining trends in abundance with significant declines observed on the Santa Ynez (p=0.03) and Ventura (p=0.05) rivers (Table 11).

Table 10. Trends in adult steelhead abundance using slope of ln-transformed time series counts for three Monte Arido Highland BPG populations. Missing years of data were eliminated and not interpolated in any way. Bolded trend values were found to be significant (p<0.05).

Population	**Years**	**Trend (%/year)[1]**	**Lower 95% CI**	**Upper 95% CI**
Santa Ynez River[1]	1995-2021	-2.24	-6.12	1.59
Ventura River	2006-2021	**-7.54**	-13.77	-0.86
Santa Clara River	1994-2018	-2.29	-4.99	0.49

[1] No data 2013, Biological Opinion Incidental Take provisions have been required since 2014.

Table 11. Trends in O. mykiss (Other O. mykiss) abundance using slope of ln-transformed time series counts for three Monte Arido Highland BPG populations. Missing years of data were eliminated and not interpolated in any way. Bolded trend values were found to be significant (p<0.05).

Population	Years	Trend (%/year)[1]	Lower 95% CI	Upper 95% CI
Santa Ynez River[1]	1995-2021	**-8.81**	-15.98	-1.03
Ventura River	2006-2021	**-19.39**	-34.89	-0.20
Santa Clara River[2]	1994-2018	-6.09	-18.03	7.58

[1] No data 2013, Biological Opinion Incidental Take provisions have been required since 2014.
[2] No data 2005

4.4.3.2 Santa Monica Mountains BPG

Both Topanga and Malibu Creek populations have a declining but non-significant trend in adult abundance (Table 12). The trend estimates reported here are consistent with recently reported trend estimates for Topanga and Malibu creeks (Boughton et al. 2022a).

The Malibu Creek *O. mykiss* population has experienced a statistically significant (p=0.002) average declining trend in abundance of approximately 26% per year from 2004-2019 (Table 13). The average trend in adult *O. mykiss* abundance for the Topanga Creek population also suggests a decline from 2001-2019; however, the trend is not statistically significant.

Table 12. Trends in adult steelhead abundance using slope of ln-transformed time series counts for the Santa Monica Mountains BPG populations. Missing years of data were not included. Bolded trend values were found to be significant (p<0.05).

Population	Years	Trend (%/year)	Lower 95% CI	Upper 95% CI
Arroyo Sequit[1]	2001-2019	NA	NA	NA
Topanga Creek	2001-2019	-1.70	-5.76	2.54
Malibu Creek	2004-2019	-1.41	-8.49	6.22

[1] Insufficient data to produce meaningful results.

Table 13. Trends in O. mykiss (Other O. mykiss) abundance using slope of ln-transformed time series counts for the Santa Monica Mountains BPG populations. Missing years of data were not included. Bolded trend values were found to be significant (p<0.05).

Population	Years	Trend (%/year)	Lower 95% CI	Upper 95% CI
Arroyo Sequit [1]	2005-2019	NA	NA	NA
Malibu Creek	2004-2019	**-25.56**	-37.19	-11.79
Topanga Creek	2001-2019	-1.24	-6.44	4.25

[1] Insufficient data to produce meaningful results.

4.4.3.3 Conception Coast, Mojave Rim, and Santa Catalina Gulf Coast BPGs

We were unable to calculate trends for populations of Southern SH/RT in the Conception Coast, Mojave Rim, and Santa Catalina Gulf Coast BPGs due to lack of available data, with the exception of Arroyo Hondo Creek *O. mykiss*. The analysis of the Arroyo Hondo Creek *O. mykiss* population counts from seven years of bankside observations conducted during winter redd surveys indicate a declining trend in *O. mykiss* abundance, but the trend is not statistically significant (p=0.71).

Many watersheds in the Mojave Rim and Santa Catalina Gulf Coast BPGs likely supported intermittent Southern SH/RT populations characterized by repeated local extinctions and recolonization events in dry and wet years, respectively (NMFS 2012a). The sporadic and intermittent nature of these populations preclude the ability to effectively analyze trends in abundance. Furthermore, many adult steelhead populations occurring south of the Santa Monica Mountains are considered severely reduced and, in many instances, extirpated (Boughton et al. 2005).

4.5 Productivity

Productivity or population growth rate provides important information on how well a population is “performing” in the habitat it occupies throughout its life cycle. Productivity is a key indicator of a population’s viability in terms of its long-term trends in abundance and the ability for it to recover after short-term disturbances (Boughton et al. 2022b). Productivity and abundance are closely linked metrics as a population’s growth rate should be sufficient to maintain its abundance above viable levels (McElhany et al. 2000).

A population’s cohort replacement rate (CRR) is defined as the rate at which each subsequent cohort or generation replaces the previous one (NOAA 2006). Data for adult steelhead in southern California contain too many years of zero observations to effectively calculate a CRR; therefore, we did not attempt to estimate this ratio. We calculated the CRR for *O. mykiss* populations in the Santa Ynez, Ventura, and Santa Clara rivers, as well as Malibu and Topanga creeks to account for the possibility of some individuals from these populations contributing to the anadromous life-history form. These watersheds were also selected because there was sufficient data (i.e., years with nonzero data) to produce CRR estimates.

The CRR is defined as:

$$CRR = \ln (N_{t+4}/N_t)$$

Natural log transformed CRRs greater than zero indicate that the cohort increased in size that year in relation to the brood year three years earlier, whereas a CRR less than zero indicates that the cohort decreased in size. This analysis assumes a generation time of four years, which has been determined to be reasonable based off our best understanding of the Pacific steelhead fluvial-anadromous life-history (NMFS 2012a; Shapovalov and Taft 1954). However, it is important to note that not all Southern SH/RT will return and spawn at age 4, and there is likely considerable variation in age structure (1-4 years) within individual populations (Boughton et al. 2022b).

Over the entire time series, CRR values for the Santa Ynez, Ventura, and Santa Clara River *O. mykiss* populations were more negative than positive (Figure 13). Negative CRRs most frequently occurred from 2013-2018, which coincide with the most recent extreme drought period and associated drought-related low flow conditions. The Santa Ynez River population may be rebounding, as indicated by a high CRR in 2021. Topanga Creek had more positive CRRs than negative, however, 89% of the years with positive values occurred prior to 2012. The CRRs on Topanga Creek are consistent with a recent study that found a significant decline of the abundance of all life stages of *O. mykiss* due to the 2012-2017 drought (Dagit et al. 2017). Population growth rates on Malibu Creek appear to be declining as CRR values have been negative since 2012.

A.

B.

C.

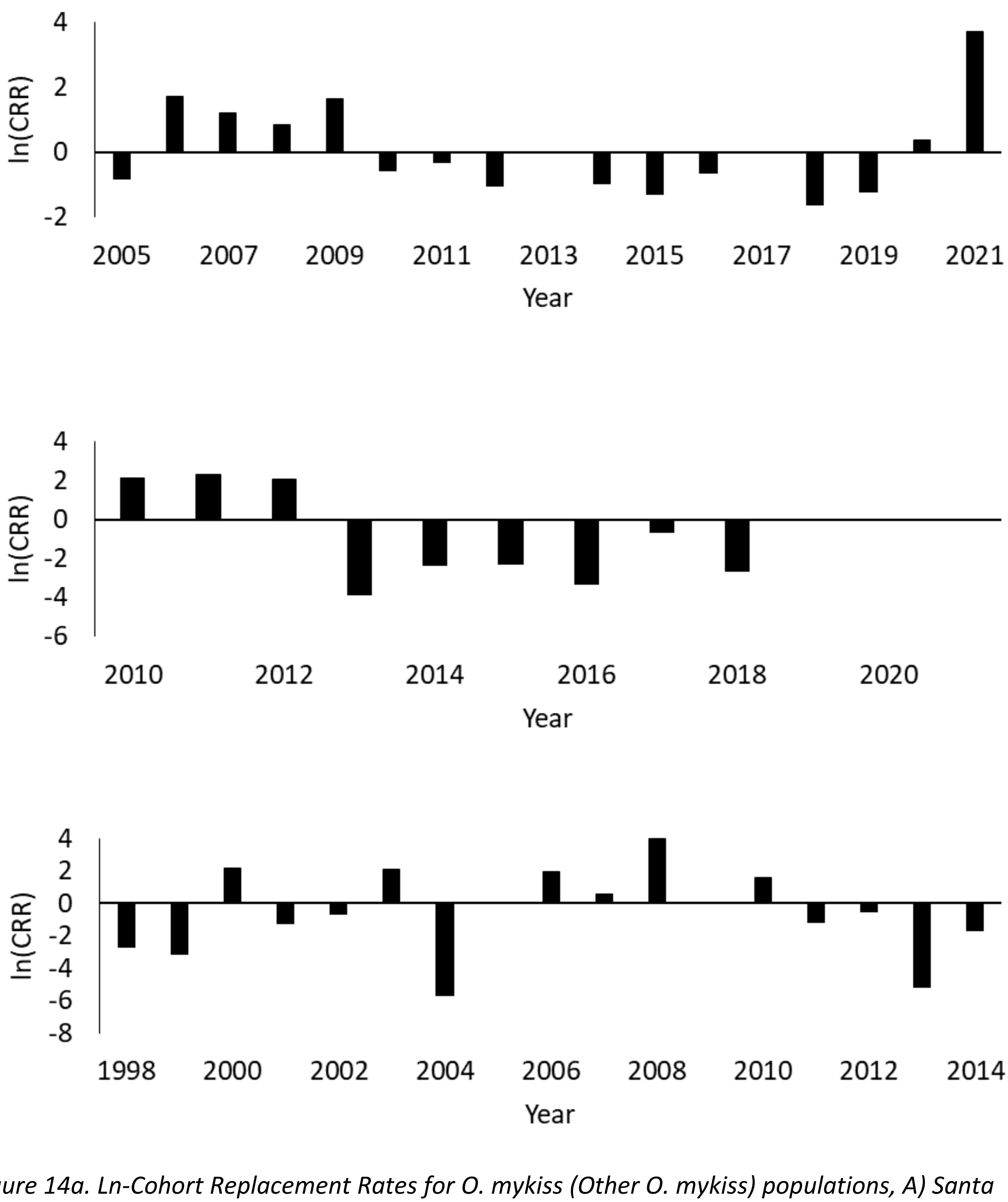
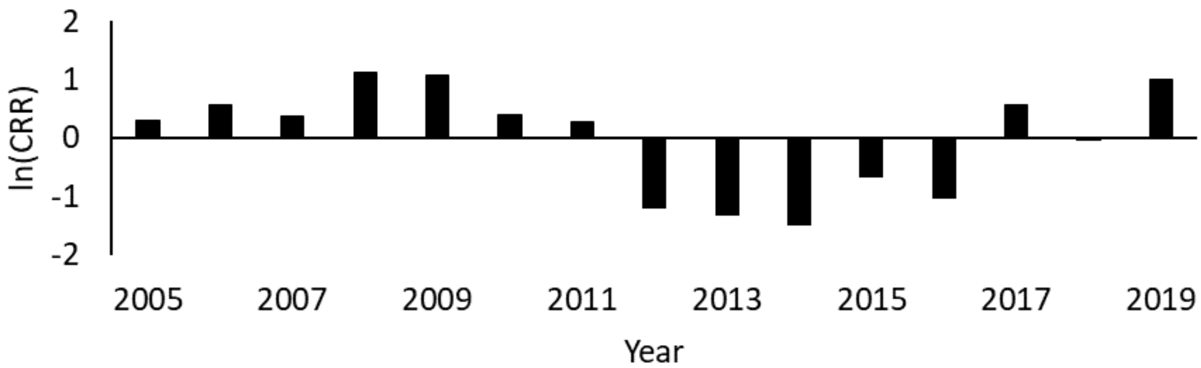


Figure 14a. Ln-Cohort Replacement Rates for O. mykiss (Other O. mykiss) populations, A) Santa Ynez River, B) Ventura River, and C) Santa Clara River; Biological Opinion Incidental Take provisions have been required since 2014. Gaps are a result of missing years of data. Note different scales on the Y-axis.

D.



E.

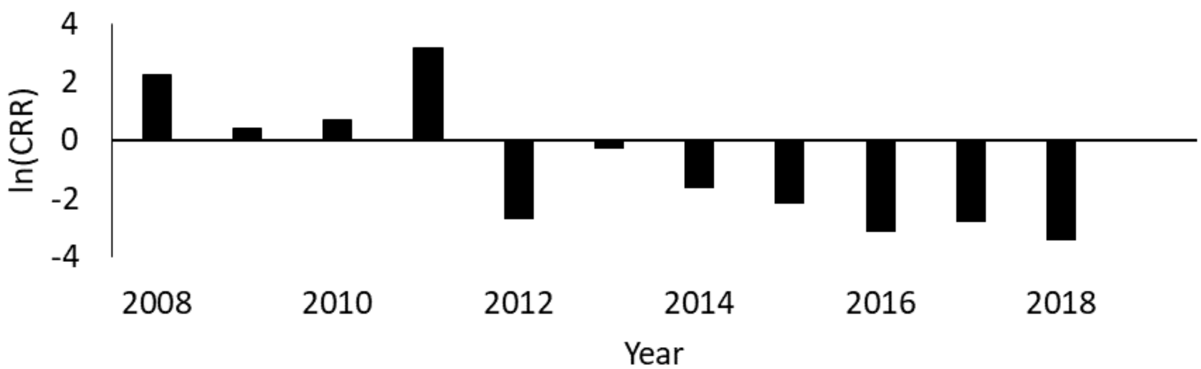


Figure 14b. Ln-Cohort Replacement Rates for O. mykiss (Other O. mykiss) populations, D) Topanga Creek, and E) Malibu Creek. Gaps are a result of missing years of data. Note different scales on the Y-axis.

4.6 Population Spatial Structure

Population spatial structure refers to the spatial distribution of individuals in the population and the processes that generate that distribution. Population spatial structure is a function of habitat quality, spatial configuration, and dispersal rates of individuals within different habitat types. Spatial structure reflects the extent to which a population's abundance is distributed among available or potentially available habitats at any life stage. All else being equal, a population with low abundance is likely to be less evenly distributed within and among watersheds and is more likely to experience extinction from catastrophic events. Furthermore, populations with low abundance have a reduced potential to recolonize extirpated populations.

Numerous discrete and spatially dispersed but connected populations are required to achieve long-term persistence of Southern SH/RT (NMFS 2012a). Though we cannot specifically classify the spatial structure necessary to maintain Southern SH/RT viability with certainty, examining similarities and differences between their historical and current spatial distribution can provide a better understanding of their present extinction risk. Southern SH/RT historically occupied at least 46 watersheds in southern California, but currently, only 37-43% of these watersheds are thought to still be occupied (NMFS 2012a). This finding not only highlights the severe contraction of the distribution and abundance of Southern SH/RT in their range, but also indicates that they are prone to range-wide extinction due to several factors such as low population growth rate, loss of genetic diversity, and the limited number of sparsely distributed individuals that may be necessary to recolonize extirpated neighboring populations.

The truncated Southern SH/RT spatial structure observed today can be attributed to the presence of numerous dams, artificial barriers, other instream structures, and groundwater extraction that have long impeded migration and access to high quality upstream habitat throughout southern California (NMFS 2012a). Dams and other barriers not only restrict access to upstream spawning and rearing habitat, but also prevent important ecological and genetic interactions with *O. mykiss* from occurring both upstream and downstream of the total barrier. Isolated *O. mykiss* populations containing ancestry of native Southern SH/RT continue to persist above barriers in approximately 77% of watersheds where the anadromous component has been lost below the barrier (Nielsen et al. 1997; Boughton et al. 2005; Clemento et al. 2009). The impact of dams and other artificial barriers is especially notable on the large rivers and small coastal streams in the northern portion of Southern SH/RT's range. For example, Cachuma, Gibraltar, and Juncal dams on the Santa Ynez River block access to at least 70% of historical spawning and rearing habitat within the watershed. Matilija and Casitas dams located on Matilija and Coyote creeks, respectively, restrict access to 90% of the available spawning habitat in Ventura River watershed. Similarly, Santa Felicia and Pyramid dams on Piru Creek block access to all upstream spawning habitat on this major tributary of the Santa Clara River. On Malibu Creek, the Rindge Dam and Malibu Lake dam blocks access to over 90% of historical anadromous spawning and rearing habitat within the watershed (NMFS 2012a).

Historically, the lower and middle reaches of streams in southern California were used as both migration corridors to higher quality upstream habitat and juvenile rearing habitat in stream reaches that maintained perennial surface flows (Moore 1980). Today, these reaches are the only remaining accessible spawning habitat for Southern SH/RT and are characterized by high urban densities, channelization, impaired stream flows, instream diversions, groundwater extraction, and habitat that generally favors non-native fishes (NMFS 2012a). Furthermore, habitat loss and fragmentation has led to the loss of habitat diversity (i.e., riparian cover, instream habitat structure), which has prevented fish from utilizing these once connected and intact habitats.

The current distribution of Southern SH/RT across its range is inadequate for their long-term persistence and viability (NMFS 2012a). The majority of watersheds in southern California contain dams and artificial barriers that restrict access to high quality upstream spawning and rearing habitat. Barriers to migration isolate and prevent ecological interactions with upstream native *O. mykiss* that would otherwise have the potential to be anadromous. Population level impacts include increased susceptibility to local extirpation due to natural demographic and environmental variation and the loss of genetic and life-history diversity (NMFS 2012a). Range-wide, the historically widespread Southern SH/RT are now sparsely distributed across the landscape with significant reductions in abundance. The degraded spatial structure of Southern SH/RT threatens the viability of the population because extinction rates of individual sub-basin populations are likely much higher than the rate of the formation of new populations from recolonization (McElhany et al. 2000). This is especially relevant for populations occurring in watersheds south of the Santa Monica Mountains; originally, these watersheds supported infrequent Southern SH/RT populations that were likely characterized by repeated local extinction and recolonization events by either neighboring watersheds or from resident populations in upstream drought refugia in dry and wet cycles.

4.7 Diversity

Diversity refers to the phenotypic (e.g., life-history diversity) and genetic characteristics of a population. Life-history diversity allows populations to utilize a wide array of habitats and confers resilience against short-term spatial-temporal variation in the environment. Genetic diversity affects a population's ability to persist during long-term changes in the environment due to both natural and anthropogenic influences. The variation in the life history characteristics in any given population are typically the result of its genetic diversity interacting with environmental conditions. Populations lacking genetic diversity may not have as many genetic "options" to generate new or modified life history types in the face of changing environmental conditions, since natural selection may favor new or different genetic variants. As such, a genetically depauperate population that may be well adapted to the current steady state could be maladapted to new environmental conditions. The combination of both diversity types in a natural environment provides populations with the ability to adapt to long-term changes and be more resilient to these changes over both short- and long-term time scales (McElhany et al. 2000).

Our analysis in Section 4.4 demonstrates declines in *O. mykiss* populations across much of its southern California coast range and preserving Southern SH/RT life-history strategies and adaptations is a critical component for the recovery of the Southern California Steelhead DPS (NMFS 2012a). Ideally, all three Southern SH/RT life-history types (i.e., fluvial-anadromous, freshwater-resident, lagoon-anadromous) would be expressed within a single population, or the population would harbor the underlying genetic variation to express those life-history types when environmental conditions allow. The freshwater-resident life-history type is still present in many populations of Southern SH/RT; however, this form frequently occurs in the isolated upper reaches of the watershed where opportunities for gene flow with anadromous fish are prevented by barriers to migration. Bond (2006) demonstrated accelerated growth rates of juvenile *O. mykiss* expressing the lagoon-anadromous life-history form. Larger size at ocean entry is thought to enhance marine survival and improve adult returns (Bond 2006); however, it is unlikely that this life-history form is currently viable, because approximately 75% of estuarine habitat in southern California has been lost, and the remaining intact habitats are constrained by agricultural and urban development, highways, and railroads, and threatened by sea level rise and invasive species (NMFS 2012a). The artificial breaching of lagoons also poses a significant threat to the lagoon-anadromous life-history form as a recent study observed considerable mortality of Southern SH/RT directly after artificial breaching (Swift et al. 2018). As presented in Section 4.4, the anadromous form of Southern SH/RT still occurs in very low abundances in a limited portion of their historical range. The preservation of this life-history component will require substantial habitat restoration and modifications or removal of the numerous artificial barriers that currently restrict access to upstream high-quality spawning habitat (NMFS 2012a).

Several recent studies highlight the important role that genetic factors have in determining the life-history expression of coastal steelhead. Pearse et al. (2014) identified two Omy5 haplotypes linked to the anadromous (“A”) and resident (“R”) life-history forms whereby “AA” and “AR” genotype are more likely to be anadromous than the “RR” genotype (Pearse et al. 2019). Rundio et al. (2021) found that age 1+ juveniles with “RR” and “AR” genotypes experienced higher growth rates than fish with the “AA” genotype, and that overall condition was slightly higher in future resident fish than in future smolts, particularly among resident males. The divergence of the “A” and “R” haplotypes in Southern SH/RT populations is influenced by the presence of numerous artificial barriers in southern California, which act as a strong selection pressure against the “A” haplotype in above-barrier populations. For example, on the Santa Clara River, the Vern Freeman Diversion Dam and other instream diversions have limited upstream fish passage to spawning and rearing habitat on its tributaries, Sespe and Santa Paula creeks (NMFS 2012a). Populations of *O. mykiss* from both tributaries were found to display moderately high frequencies of the “R” haplotype (Pearse et al. 2019). Relative frequencies of the “R” and “A” haplotypes can also be altered in populations that have become introgressed with other strains of Rainbow Trout that may have much different haplotype frequencies.

The recognition of the “A” and “R” haplotypes provide insight on the genetic integrity and viability of Southern SH/RT. The frequency of the anadromous haplotype may substantially decline during periods of adverse conditions due to the low predicted survival of migrating smolts (i.e., “AA” and “AR” individuals). Likewise, “RR” and “AR” residents may be favored during adverse conditions, which could eventually lead to declines of the “A” haplotype over time and the gradual loss of the “AA” genotype from the population. Without considerable restoration of habitat connectivity through the removal of artificial barriers, the “A” haplotype in “AR” individuals in isolated populations above barriers is expected to be slowly lost over time (Apgar et al. 2017). While “AR” smolts may produce “AA” individuals when favorable migration conditions continue and retain the “A” haplotype in resident populations, it is unclear that the resident component can reliably produce anadromous fish after prolonged periods of unfavorable conditions in the long term (Boughton et al. 2022a). Furthermore, climate change projections for Southern SH/RT range predict an intensification of typical climate patterns such as more intense cyclic storms, drought, and extreme heat (NMFS 2012a). These projections suggest that Southern SH/RT will likely experience more frequent periods of adverse conditions and continued selection pressure against the anadromous life-history form.

4.8 Conclusions

This section summarizes the abundance, trends, and productivity analyses. Because quantitative analyses were not conducted for population spatial structure and diversity, we do not provide conclusions for these metrics as the qualitative discussions in Sections 4.6 and 4.7 provide sufficient detail and information.

4.8.1 Abundance and Trends

The data evaluated indicate an overall long-term declining trend of Southern SH/RT with critically low range-wide abundances. In the past decade, adult abundance counts have not been greater than ten for any watershed examined, and most streams have observed no adult returns during this time period. For the Monte Arido Highlands BPG, which is thought to be a potential source population for smaller coastal watersheds such as the Conception Coast BPG, only a single adult has been observed returning in the past five years. For each of the three populations analyzed, the data for this BPG shows a long-term declining trend in adult abundance. The steepest decline occurred in the Ventura River population, for which a statistically significant -7.54% per year was observed.

The data evaluated for the Santa Monica Mountains BPG indicate that these watersheds support small but consistent runs of adult steelhead ranging from zero to five individuals per year. However, like other salmonid-supporting streams in the Southern SH/RT range, few adults have been observed in the past five years, and it is unlikely that these streams historically supported large runs of Southern SH/RT due to their small size. The data also show declining but not statistically significant trends in adult abundance for Malibu and Topanga creeks. The Department's South Coast Region staff have not observed any *O. mykiss* in Malibu Creek since before the Woosley fire in 2018, which suggests that Southern SH/RT have been effectively extirpated below Rindge Dam (D. St. George, CDFW, personal communication). A combined total of five adults have been observed for the Conception Coast, Mojave Rim, and Santa Catalina Gulf Coast BPGs since 2017 (Dagit et al. 2020). Our finding of generally declining trends in the abundance of adult steelhead is consistent with the results of a recent viability assessment for the southern California Coast Domain produced by Boughton et al. (2022a).

O. mykiss trends also demonstrate measurable declines in overall abundance. Maximum abundance and long-term averages of *O. mykiss* have declined in all three Monte Arido Highland populations. Similarly, all populations in this BPG show declining trends in O. *mykiss* abundance with statistically significant declines of -8.81% and -19.39% per year on the Santa Ynez and Ventura rivers, and a non-statistically significant decline of -6.09% on the Santa Clara River. Within the Santa Monica Mountains BPG, both Malibu and Topanga creek *O. mykiss* populations have experienced a long-term decline. The *O. mykiss* population in Topanga Creek appears to be more viable than Malibu Creek as our results indicate only a small long-term decline. Our results indicate a trend of -25.56% per year on Malibu Creek, which is the steepest average annual decline for any of the Southern SH/RT populations that we analyzed.

The most recent prolonged drought from 2012-2017 correlates with significant reductions of all life-history forms and stages of Southern SH/RT. Drought conditions are associated with the loss of suitable spawning and rearing habitat, insufficient instream flows required for migration, diminished water quality, reductions in available food supply, and increases in direct mortality due to predation and stranding (Dagit et al. 2017). Our analyses show a relatively consistent range-wide pattern of higher abundances prior to 2012, followed by consecutive years of lower abundances starting at the onset of the drought. It appears that few populations have rebounded from the drought as current abundance estimates remain low relative to pre-drought conditions. The recovery of Southern SH/RT will likely depend on the successful recruitment of downstream migrants from upstream resident populations in refugia habitats. However, virtually all refugia populations are currently above impassable barriers. Furthermore, many southern California watersheds do not contain upstream drought refugia. In these instances, recolonization from source populations in other watersheds is likely the only mechanism for these populations to rebound (Boughton et al. 2022a).

Boughton et al. (2007) established a precautionary run size criteria for the southern California Coast Domain of 4,150 spawners per year to provide a 95% chance of persistence of the watershed's population over the next 100 years. While this goal may not be feasible for many of the smaller coastal watersheds in southern California, NMFS (2012) speculated that this target may be more feasible for the larger watersheds (i.e., Monte Arido Highland BPG). Even if we applied a lower criterion of 834 spawners (Boughton et al. 2022a), the results of our analyses demonstrate that no population is near the criteria necessary to provide resilience from extinction.

It is important to highlight limitations of our analyses. First, our analysis may underestimate the true abundance of adult steelhead because data analyzed for this effort are usually collected during periods of high stream flows and turbidity, making monitoring difficult to conduct (Dagit et al. 2020). Second, the data used in this effort are derived from various single-basin monitoring efforts, each of which utilize different survey designs and approaches. Thus, we were required to interpret the data as reported, while recognizing the potential limitations in making inter-watershed comparisons in instances where the data were from various monitoring efforts that did not necessarily meet standards established by the Department's California Coastal Monitoring Program (CMP). Third, the lack of any monitoring of most watersheds occurring south of the Santa Monica Mountains inhibited our ability to make definitive and comprehensive range wide conclusions on Southern SH/RT abundance and trends. However, it is likely that abundance estimates for many watersheds in the southern portion of the range are so low that obtaining accurate estimates would remain difficult even with increased monitoring.

4.8.2 Productivity

The results of our CRR analysis for *O. mykiss* on the Santa Ynez, Ventura, and Santa Clara rivers show more years of negative than positive CRR values. Negative CRR values were observed during the 2012-2017 drought period for all populations. However, the most recent 2021 estimate for the Santa Ynez population was positive, which may suggest a rebounding population. CRR values for Topanga Creek were more positive than negative; however, most positive values occurred prior to the onset of 2012 drought conditions. In recent years, Malibu Creek CRR values have been negative, particularly during the 2012-2017 drought period.

While the CRR values for *O. mykiss* do not necessarily reflect true spawner to spawner ratios due to the high likelihood that many observed fish were not actually part of the spawning cohort during that year, our results demonstrate that *O. mykiss* populations occurring below the barrier to anadromy in these watersheds do not appear to be viable because abundances are too low to sustain positive population growth rate on a yearly basis. This result is especially concerning given that the long-term resilience of the anadromous component of Southern SH/RT likely depends on the production of anadromous juveniles from the freshwater-resident life-history form.

5. HABITAT THAT MAY BE ESSENTIAL TO THE CONTINUED EXISTENCE OF SOUTHERN SH/RT

5.1 Migration

Southern SH/RT migration into freshwater is linked with seasonal winter and spring high flows that establish connectivity between the ocean and freshwater spawning areas (NMFS 2012a). Adult steelhead require water depths of at least 18 cm depth for upstream movement; however, 21 cm is considered to be more suitable for upstream passage of all possible sizes of individual fish, because it allows sufficient clearance so that contact with the streambed is minimized (Bjornn and Reiser 1991; SWRCB 2014). Low dissolved oxygen (<5 mg/L) and high turbidity can deter migrating salmonids such as steelhead (Bjornn and Reiser 1991). Delayed migration may also occur when stream temperatures are too high or low (Bjornn and Reiser 1991). Disease outbreaks can occur as a result of extreme high temperatures (Bjornn and Reiser 1991; Spence et al. 1996). Salmonids usually migrate when water temperatures are below 14°C (Spence et al. 1996); however, salmonids can adapt to higher thermal limits when slowly exposed to increased water temperatures over time (Threader and Houston 1983).

Instream structure, like waterfalls, sandbars, and debris jams can act as impediments to upstream fish migration. Steelhead are able to jump a maximum of 3.4 m (Spence et al. 1996) and typically, pool depth must be at least 25% greater than barrier height to achieve the required swimming velocity to pass the barrier (Spence et al. 1996). Pool shape can also influence if a barrier is passable by steelhead. For example, water flow over a steep waterfall into a plunge pool may increase jump height capacity due to upward thrust created by the hydrodynamics within the pool (Bjornn and Reiser 1991). Physical structures such as large woody debris and boulders within streams can offer flow and temperature refuge for resting fish during migration to upstream spawning areas (Spence et al. 1996). Wood structures, overhanging banks, and riparian flora can provide cover to steelhead for protection from terrestrial and avian predators. Deep pools provide important holding habitats for migrating adult salmonids (Chubb 1997).

5.2 Spawning

Habitat attributes necessary for successful spawning include cover, appropriate substrate, cool stream temperatures, and adequate streamflow (Reiser and Bjornn 1979). Salmonids select spawning sites in pool-riffle transitional areas where downwelling or upwelling currents occur that create loose gravel with minimal sediment and litter (Bjornn and Reiser 1991). Rainbow Trout can spawn in a relatively wide range of temperatures, from 2 – 22°C, but may respond to abrupt temperature declines with decreased spawning activity and production (Reiser and Bjornn 1979). Steelhead and Rainbow Trout require gravel substrate of 0.5 – 10.2 cm in diameter to construct their redds and a high proportion of the redd substrate must be comprised of smaller-sized gravel within this range (Reiser and Bjornn 1979). Cover habitat, which offers protection from predation, can include overhanging banks, riparian or aquatic vegetation, large and small woody debris, rocks, boulders, and other instream features. Having access to cover close to a redd is advantageous for Southern SH/RT and may influence spawning site selection (Reiser and Bjornn 1979). Minimum water depth must be sufficient to cover the spawning fish and, depending on individual fish size, is likely to range from 6-35cm (Bjornn and Reiser 1991).

Steelhead and Rainbow Trout have been documented to spawn in water velocities ranging from 21-117 cm/s (Reiser and Bjornn 1979; Bovee and Milhous 1978). Under moderate water velocities, increasing streamflow leads to a greater amount of covered gravel substrate for spawning; however, if water velocities and associated stream flows are too high, the additional suitable spawning habitat becomes unusable for salmonids and stream spawning capacity declines (Reiser and Bjornn 1979; Bjornn and Reiser 1991). Total suitable spawning area within a stream is dependent on the density and size of spawning fish, water depth and velocity, and amount of appropriately sized gravel substrate available (Bjornn and Reiser 1991). These factors combined drive habitat suitability for steelhead and other salmonids (Bjornn and Reiser 1991).

5.3 Instream Residency

Temperature, dissolved oxygen, salinity, water flow, and water depth are all factors that determine stream habitat suitability for *O. mykiss*. Water temperature is especially critical for survival in southern California, as stream temperature can vary drastically within the span of a single day, sometimes peaking at over 30°C during summer months (Sloat and Osterback 2013). For Southern SH/RT, changes in behavior occur above 25°C, such as decreased feeding or movement into refugia (Ebersole et al. 2001; Sloat and Osterback 2013) and the estimated mortality threshold is 31.5°C (Sloat and Osterback 2013), which is marginally higher than that of more northern steelhead populations (Rodnick et al. 2004; Werner et al. 2005). This increased temperature tolerance indicates that Southern SH/RT may have acclimated to higher temperature conditions; however, it does not necessarily suggest that they have undergone local adaptation with genetic underpinnings (Sloat and Osterback 2013). Dissolved oxygen levels should generally be at or above 5 mg/L for Southern SH/RT survival (Reiser and Bjornn 1979; Bjornn and Reiser 1991; Moyle et al. 2017) but concentrations greater than 7 mg/L are ideal (Moyle et al. 2017). In cooler temperatures, Rainbow Trout can survive in minimal dissolved oxygen levels of 1.5-2.0 mg/L (Moyle 2002).

Adult Rainbow Trout preferentially select habitat in deeper water and can be found in runs or pools close to swift water (Moyle 2002). In such habitats, fish can move into fast water habitat for feeding and then return to hold and rest in slower water (Moyle 2002). Tobias (2006) found that Southern SH/RT in Topanga Creek exhibited a preference for pools over other habitat types. Trench pools were strongly favored and mid-channel pools and step pools were also selected; however, fish avoided plunge pools, corner pools, and lateral scour pools as well as riffles and cascades. Glides and step runs were neither avoided nor strongly selected.

Resident Rainbow Trout prey on aquatic and terrestrial invertebrates that drift by, both in the water column or on the surface, as well as benthic invertebrates and sometimes smaller fishes (Moyle 2002). Larger stream-dwelling salmonids (>270 mm) often exhibit an ontogenetic niche shift, moving away from consuming invertebrates and depending more on piscivory to achieve efficient growth (Keeley and Grant 2001). Size of invertebrate and fish prey increased with body length (Keeley and Grant 2001). Stomach contents of *O. mykiss* in Topanga Creek revealed that aquatic and terrestrial insects, other invertebrates, and fish comprised most of their diet during fall and spring. Consumption of introduced Arroyo Chub (*Gila orcutti*) by Topanga Creek *O. mykiss* suggests that chub may be an important component of their diet in this stream, particularly during the late fall when aquatic macroinvertebrates may be less available (Krug et al. 2012; Swift et al. 1993).

5.4 Egg and Larval Development and Fry Emergence

Many environmental factors influence salmonid embryo incubation success, including dissolved oxygen, temperature, substrate size and porosity, and extra-gravel and inter-gravel hydrodynamics (Bjornn and Reiser 1991). Inter-gravel dissolved oxygen is particularly important to egg development and insufficient oxygen can lead to high mortality. Dissolved oxygen requirements increase as embryos grow and peaks just prior to hatching (Quinn 2018). Intra-gravel oxygen allows for embryo respiration, and oxygen concentrations of 8 mg/l or more contribute to high survival of steelhead embryos (Reiser and Bjornn 1979).

Water velocity is correlated with the amount of dissolved oxygen available to incubating eggs, and lower water velocity leads to higher embryo mortality (Bjornn and Reiser 1991). Reduced flows can also cause redd dewatering, which may result in egg mortality if there is no subsurface flow (Reiser and White 1983). The settling of fine sediment within gravels used to construct redds can prevent the interstitial flow of water and oxygen, and thus smother and kill embryos and post-hatch alevins (Bjornn and Reiser 1991). Finer sediment particles such as ash from wildfires or dust, are most effective at filling interstitial spaces within the redd substrate and can be a contributor to egg asphyxiation and recruitment failure (Beschta and Jackson 1979; Chapman 1988; Bjornn and Reiser 1991).

In addition to negative impacts from sediment deposition, unsuitable temperatures can have negative effects on embryonic development and survival (Bjornn and Reiser 1991). Higher temperatures are correlated with faster embryonic growth and development (Kwain 1975; Bjornn and Reiser 1991); however, if temperatures exceed upper suitability thresholds, mortality increases (Kwain 1975; Rombough 1988; Melendez and Mueller 2021). The ideal temperature range for incubation is 7-10°C (Kwain 1975) and incubation temperatures surpassing 15°C can result in considerable embryo mortality (Kwain 1975; Rombough 1988). Faster development and early hatching resulting from elevated temperatures can manifest in substantial reductions in body mass and length of newly hatched alevin (Melendez and Mueller 2021). These environmentally driven developmental changes could have negative implications for predation response and survival (Hale 1996; Porter and Bailey 2007). Alternatively, extremely cold water can induce mortality (Reiser and Bjornn 1979), although water temperatures that are below steelhead tolerances are likely a rare occurrence in southern California streams. Fry emerge in late spring or early summer and incubation time is dependent on water temperature (Moyle et al. 2017; Quinn 2018). Cold water temperatures, or those above 21.1°C, can decrease survival of emerging fry by restricting their ability to obtain oxygen from the water (McEwan and Jackson 1996).

5.5 Rearing and Emigration

Suitable rearing habitats for juvenile *O. mykiss* require adequate water temperature, flow velocity, water depth, dissolved oxygen concentrations, and availability of prey items. Juveniles generally occupy cool, clear, higher velocity riffles which provide cover from predators (Moyle 2002). Rearing juveniles require habitat with sufficient food production such as riffles with gravel substrate (Reiser and Bjornn 1979). Juvenile *O. mykiss* in southern California have been found to rear in both perennial and intermittent streams (Boughton et al. 2009). Intermittent streams are common in the southern California region and can in some cases benefit native fishes and other aquatic organisms that have evolved within these conditions. By seasonally fragmenting watersheds and disconnecting populations of introduced warm-water tolerant species, intermittent stream desiccation can reduce potential predation and competition from invasives. However, these same conditions can also negatively affect steelhead survival through loss of wetted habitat or degraded water quality conditions, prevent adult spawning migrations or juvenile/smolt emigration, and otherwise isolate subpopulations (Boughton et al. 2009).

Preferred water temperatures for juvenile *O. mykiss* range between 15 and 18°C (Moyle 2002), although they can tolerate temperatures up to 29°C if dissolved oxygen concentrations are high and there is an abundant food supply (Dressler et al. 2023; Sloat and Osterback 2013). Southern SH/RT have been observed functioning in stream temperatures outside of the preferred range up to the mid to high twenties (Dressler et al. 2023; Moyle et al. 2017; SYRTAC 2000). For example, the Santa Ynez River was determined to be thermally suitable, albeit thermally stressful, for Southern SH/RT in both normal and warm years, with thermal suitability characterized as a maximum daily temperature below 29°C and a mean daily temperature below 25°C (Boughton et al. 2015). Temporary or intermittent exposure to temperatures above the upper tolerance limit for salmonids can be tolerated in some populations (Dressler et al. 2023; Johnstone and Rahel 2003), whereas chronic or long-term exposure to high temperatures is typically lethal (Dickerson and Vinyard 1999; Johnstone and Rahel 2003). Additionally, feeding behavior and activity level are generally reduced when fish are temporarily exposed to warmer temperatures that cause thermal stress (Johnstone and Rahel 2003). However, Spina (2007) found that in Topanga Creek, there were no available daytime thermal refugia available for juvenile *O. mykiss,* yet they were able to tolerate temperatures up to 24.5°C without changes in behavior or activity level. These findings may indicate that Southern SH/RT are acclimated to higher daily stream temperatures than more northern *O. mykiss* populations. Juvenile salmonids acclimated to higher water temperatures, such as those in many Southern SH/RT streams, can sustain higher maximum thermal tolerances than those acclimated at lower temperatures (Lohr et al. 1996).

Metabolic demand increases with higher environmental temperatures. Warmer waters can result in faster growth rates where the forage base is abundant or may slow if food is scarce (Noakes et al 1983.; Brett 1971). Thus, freshwater growth is strongly dependent on primary productivity and food accessibility within the stream (NMFS 2012a). In Topanga Creek, juvenile Southern SH/RT had high growth rates during the summer despite temperatures that frequently surpassed known high temperature tolerances (Bell et al. 2011a).

Thermal refugia are especially important for summer rearing, when Southern SH/RT juveniles must find stream reaches that are sufficiently cool (NMFS 2012a). In southern California streams, higher altitude can provide thermal refuge as well as near-coastal areas that benefit from the ocean acting as a temperature sink (NMFS 2012a). Riparian cover is also important for moderating stream temperatures, as exposed or non-shaded streams are generally warmer than those shaded by riparian canopy (Li et al. 1994). These types of shaded, cool-water stream habitats are most frequently found in headwater reaches within the range of Southern SH/RT (NMFS 2012a).

In Sespe Creek, juvenile Southern SH/RT were observed to occupy the coolest areas of pools during daytime hours in summer months (Matthews and Berg 1997). Fish were consistently found congregating in a seep area that provided cool groundwater during the hottest times of day. The juvenile Southern SH/RT appeared to experience a trade-off between dissolved oxygen and water temperature but chose cooler temperatures, deeper within the temperature stratified pools, over higher levels of dissolved oxygen which were closer to the stream surface. In the spring, *O. mykiss* have been found to emigrate downstream into lower mainstem areas when tributaries may become warmer and/or drier (Spina et al. 2005). As flows increase in the fall and winter, fish may move upstream into tributary habitat to overwinter (Bramblett et al. 2002); however, this behavior has not been confirmed for Southern SH/RT (Spina et al. 2005).

Cover is also an important habitat component for juvenile Southern SH/RT survival, particularly during the winter months. Riparian cover, such as canopy and undercut banks, as well as instream cover like large woody debris (LWD) and deep pools, are important in providing shelter to rearing salmonids (Bjornn and Reiser 1991). Cover quality and availability have been correlated with local instream fish abundance for multiple salmonid species (Bjornn and Reiser 1991). In the mainstem Ventura River, juvenile Southern SH/RT densities were found to be positively correlated with velocity and cover (Allen 2015 p. 133). In western Oregon and Washington streams, juvenile steelhead were found in higher densities in reaches treated with LWD during the winter (Roni and Quinn 2001). Pool formation and enhancement can result from presence of live hardwood or LWD in a stream (Thompson et al. 2008). Instream tree roots can produce scour in high flow conditions leading to long-lasting pools. Trees in the stream channel can also anchor dead LWD and create wood jams. Jams constructed around standing trees are more durable and will last longer in watersheds dominated by hardwood species (Thompson et al. 2008).

Certain substrate types can also provide cover habitat for rearing salmonids. Larger substrate offers interstitial spaces for fish to avoid visual detection from predators. Boulders may be particularly important features in southern California streams, due to the paucity of LWD in these watersheds (Boughton et al. 2009; Tsai 2015). Boulders can assist in the formation of pools and create habitat complexity, which increases habitat suitability for Southern SH/RT (Roni et al. 2006; Tsai 2015). The presence of boulders in streams can also have a significant positive effect on *O. mykiss* survival and abundance due to their role in providing hiding areas and refuge from winter storms and associated flows (Tsai 2015). In contrast, areas with increased stream substrate embeddedness (more compacted stream bottoms) have been associated with lower juvenile salmonid densities (Bjornn and Reiser 1991).

Some Southern SH/RT will remain in freshwater through their life cycle, while those expressing the anadromous life history strategy will begin migrating downstream towards the ocean after two to three years of rearing in freshwater (NMFS 2012a). It is common in southern California for seasonal lagoons to be formed during the summer due to decreased stream flows and the natural accumulation of a sand berm at the point where the stream meets the ocean. Some juveniles take advantage of rearing in the warmer lagoon environment to achieve greater size prior to entering the ocean, which allows them a greater chance of survival (Bond et al. 2008; Hayes et al. 2008).

In Scott Creek (central California), during years when a seasonal lagoon formed, growth rates were 2-6 times greater for steelhead rearing in the estuary-lagoon than those in the cooler, less productive upstream habitat (Hayes et al. 2008). Juvenile *O. mykiss* in central California streams have been observed to exhibit a lagoon-anadromous, or "smolting" twice, life history strategy. These life history variants travel downstream to the closed estuary to rear during the summer, then migrate back upstream into more suitable conditions when the estuary starts to become less hospitable (Hayes et al. 2011; Huber and Carlson 2020). Juvenile *O. mykiss* also preferentially seek out areas with higher water quality when confined within a seasonally closed estuary (Matsubu et al. 2017). However, estuaries in poor condition, including lagoons with poor water quality, may lead to mortality of rearing juveniles if they do not have access to suitable habitat upstream. Seasonal lagoons in southern California typically do not reconnect to the ocean until the first rainfall occurs in the fall or winter (Booth 2020). Juvenile *O. mykiss* benefit from pulse flows initiated by storms and successful emigration is largely dependent on storm flow events matching the timing of *O. mykiss* smolt outmigration (Booth 2020). Smolts in southern California streams, such as the Santa Clara River are largely unable to take advantage of lagoon rearing and its associated benefits due to poor water quality in the estuary and dry reaches upstream (Booth 2020).

5.6 Ocean Growth

Little information exists specific to ocean growth of anadromous Southern SH/RT, but data from other west coast steelhead populations can provide some insight into habitat requirements of this life stage. Steelhead exhibit early ocean migratory behavior that is thought to maximize bioenergetic efficiency (Atcheson et al. 2012). In contrast to other Pacific salmon species, which typically remain relatively close to shore and feed in coastal waters along the continental shelf during their first summer at sea, steelhead quickly leave these productive coastal habitats for the open ocean (Atcheson et al. 2012; Daly et al. 2014). Many California steelhead juveniles spend only a few months feeding in the California Current Ecosystem (CCE) before they migrate northwest to cooler waters offshore (Daly et al. 2014). In the open ocean, steelhead maximize their energy intake by consuming high-energy prey items like fish and squid at moderate rates rather than consuming lower-energy food resources at high rates (Atcheson et al. 2012). Fish and squid make up a substantial portion of the juvenile steelhead diet for those rearing in the Gulf of Alaska, which serves as an important rearing location for west coast steelhead (Atcheson et al. 2012).

While feeding and growing in the ocean, steelhead typically occupy waters within the temperature range of 6-14°C (Hayes et al. 2016; Quinn 2018). Steelhead exhibit strong thermal avoidance, remaining within a narrow range of suitable sea surface temperatures (SSTs) during their ocean foraging and migrations, generally within 20 meters of the surface (Burgner et al.

1992 in Atcheson et al. 2012; Nielsen et al. 2010). Deviations outside of their thermal tolerance have negative consequences for growth and survival in the ocean (Atcheson et al. 2012) and generally poor ocean conditions can negatively affect survival especially during early ocean residence (Kendall et al. 2017). For example, warm SSTs were associated with lower post-smolt survival of Keogh River steelhead off the coast of Alaska (Friedland et al. 2014). In recent years, the CCE experienced a severe marine heatwave (Di Lorenzo and Mantua 2016), which impacted species abundance and distribution at multiple trophic levels, including the prey base for Pacific salmon (Daly et al. 2017; Peterson et al. 2017). During years with anomalously warm ocean conditions, young Chinook Salmon were observed to be much thinner, and their survival rates were depressed compared to years with cooler ocean temperatures, likely resulting from this shift in availability of prey species (Daly and Brodeur 2015; Daly et al. 2017).

Steelhead average a travel distance in the ocean of 2,013 km but have been tracked traveling up to 5,106 km (Quinn 2018). Steelhead are not typically captured in commercial fisheries possibly resulting from their swift movement offshore, and most catches of steelhead in research trawls are in the upper 30 meters of the water column (Moyle et al. 2017; Quinn 2018).

6. FACTORS AFFECTING THE ABILITY TO SURVIVE AND REPRODUCE

6.1 Changes in Ocean Conditions

The long-term relationship between ocean conditions, food web structure, and Southern SH/RT productivity is not well understood; however, these relationships have been examined for steelhead populations in the Pacific Northwest. While the Pacific Northwest coastal rivers are distant from the coastal rivers of southern California in terms of both geography and ecology, these findings still improve our understanding of the relationship between ocean temperatures and the dietary composition and morphology of west coast steelhead populations. Comparisons may also offer insights into similar mechanisms that may potentially influence Southern SH/RT ocean diet compositions. Thalmann et al. (2020) detected significant differences in the prey items consumed by juvenile steelhead during warm ocean years compared to average or cold ocean years. They also found significant interannual variability in stomach fullness, with significantly lower than average stomach fullness associated with warm ocean years. Steelhead sampled during warmer years were thinner, on average, than those sampled during cooler years. In 2015 and 2016, when ocean conditions were anomalously warm, there was limited availability of cold-water prey species with higher energetic and lipid content. Although some level of plasticity was demonstrated in the juvenile steelhead diet, consumption of lower-quality prey items likely led to reduced growth and poorer body condition during those years (Thalmann et al. 2020).

In the North Pacific, the 2013–2020 period was characterized by exceptionally high sea surface temperatures coupled with widespread declines and low abundances for many west coast salmon and steelhead populations (Boughton et al. 2022a). For example, the abundance of southern Chinook salmon and steelhead populations reached very low counts between 2014 and 2019, leading to the designation of many stocks as overfished (PFMC 2020). Increased sea temperatures and associated impacts have resulted in a significant biological response at all trophic levels, from primary producers to marine mammals and birds.

6.2 Effects of Climate Change

The climate of the United States is strongly connected to the changing global climate (USGCRP 2017), and temperatures are projected to continue to rise another 2°F (1.11°C) to 4°F (2.22°C) in most areas of the United States over the next few decades (Melillo et al. 2014). The waters of the United States are projected to lose between 4 and 20% of their capacity to support cold water-dependent fish by the year 2030 and as much as 60% by 2100 due to climate change and its impacts (Eaton and Scheller 1996). The greatest loss of this important aquatic habitat capacity is projected for California, owing to its naturally warm and dry summer climate (O'Neal 2002; Preston 2006; Mote et al. 2018). The recent multidecadal (2000–2021) "megadrought" in the southwestern U.S., including California, has been the driest 22-year period over the past 1,000 years in this region (OEHHA 2022). Severe drought was documented across much of the southwest during this period, with record-breaking low soil moisture, extended heat waves, reduced precipitation, and intensifying weather extremes (Garfin et al. 2013; OEHHA 2022; Williams et al. 2022). These conditions are expected to continue or increase in the region (Gershunov et al. 2013), with predicted outcomes dependent upon the level and extent of human efforts to address and offset CO_2-driven climate change impacts, both within the United States and across the globe (Overpeck et al. 2013; NMFS 2016; USGCRP 2017; OEHHA 2022).

Since 1895, California has warmed more than both the North American and global temperature averages (NOAA 2021; OEHHA 2022). As such, the state is considered one of the most "climate-challenged" areas in North America (Bedsworth et al. 2018), facing increasingly extreme weather patterns and comparatively rapid shifts in regional climate- and local weather-based averages and trends (e.g., Overpeck et al. 2013; Pierce et al. 2018). California's temperatures have paralleled global trends in terms of increasing at an even faster rate since the 1980s (Figure 15; OEHHA 2022). The past decade has been especially warm; eight of the ten warmest years on record for California occurred between 2012 and 2022 (OEHHA 2022). In general, the portions of California with lower latitudes and elevations will be subject to the greatest increase in duration and intensity of higher air and water temperatures due to climate change (Wade et al. 2013). Thus, the southwestern part of California, which includes the range of Southern SH/RT, will likely face disproportionate climate change-related impacts when compared to other regions of the state. Southern SH/RT are, therefore, likely to face more severe and challenging conditions than their northern salmonid relatives.

The broad-scale climatic factors that appear to primarily shape the habitat suitability and population distribution of Southern SH/RT are summer air temperatures, annual precipitation, and severity of winter storms (NMFS 2012a). These factors and their influences on the landscape are predicted to intensify under long-term, synergistically driven conditions brought about by climate change. They are also expected to exacerbate existing stressors for Southern SH/RT and other cold water-dependent native aquatic organisms in stream and river systems in southern California (NMFS 2012b). In a comprehensive rating of California native fish species, Moyle et al. (2013) determined southern California steelhead to be “critically vulnerable” to climate change and likely to go extinct by 2100 without strong conservation measures. This was reaffirmed by an analysis conducted by Moyle et al. (2017).

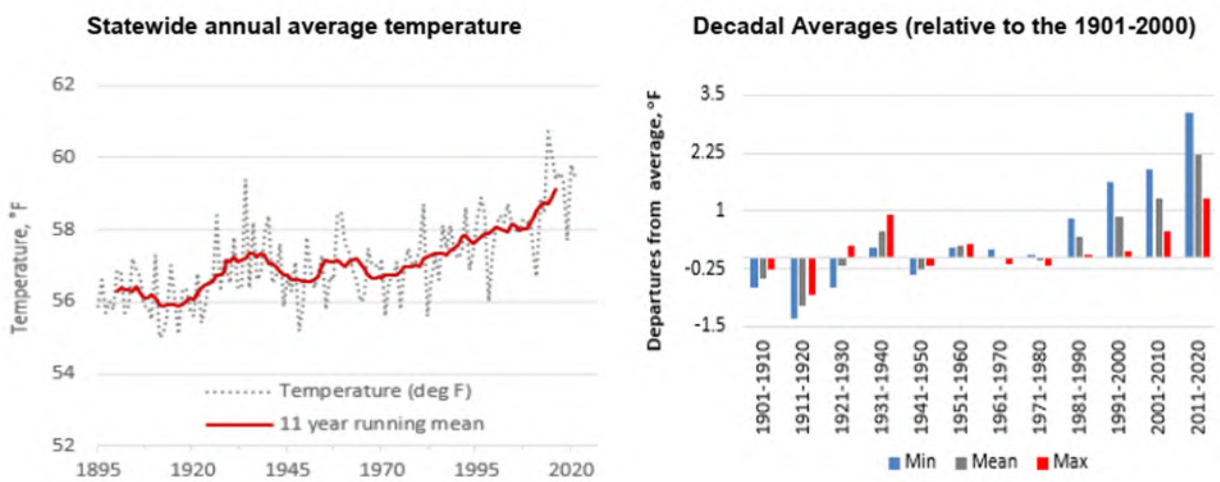


Figure 15. Temperature trend (left) and departure from average (right) graphs for California, from about 1900-2020 (source: OEHHA 2022).

6.2.1 Rising Temperatures

Extreme heat events in California have become more frequent, dating back to the 1950s; however, they have become especially pronounced in the past decade (OEHHA 2022). Heat waves, defined as two or more consecutive heat events (which are characterized by temperatures at or above the highest 5% of historical values), have also become more frequent during this period (OEHHA 2022). For context, over the past 70 years, extreme heat events increased at a rate of about 1 to 3 events per decade at 10 of a set of 14 statewide long-term monitoring sites across California (OEHHA 2022). Further, at several monitoring sites, daytime heat waves increased to as many as 6 events per year, and nighttime heat waves similarly increased to as many as 10 events per year (OEHHA 2022). Long-term regional climate observations for southern California also follow this pattern of long-term, steady temperature increases. Based on analyses of California South Coast National Oceanic and Atmospheric Administration (NOAA) Climate Division temperature records from 1896–2015, He and Gautam (2016) found significant upward trends in annual average, maximum, and minimum temperatures, with an increase of about 0.29°F (0.16°C) per decade. Likewise, every month of the year has experienced significant positive trends in monthly average, maximum, and minimum temperatures, across the same 100-year period (Hall et al. 2018).

Importantly, nighttime temperatures in California, which are reflected as minimum daily temperatures, have increased by almost three times more than daytime temperatures since 2012 (OEHHA 2022). Gershunov et al. (2009) showed that heat waves over California and Nevada are increasing in frequency and intensity while simultaneously changing in character and becoming more humid. This shift toward humid heat waves in the southwestern U.S. is primarily expressed through disproportionate increases in nighttime air temperatures (Garfin et al. 2013). These changes started in the 1980s and appear to have accelerated since the early 2000s (Garfin et al. 2013). Nighttime warming has been more pronounced in the summer and fall, increasing by about 3.5°F (1.94°C) over the last century, and southern California has warmed faster than Northern California (OEHHA 2022). These long-term regional changes will have disproportionate impacts on aquatic habitats due to elevated atmospheric humidity levels and diminished nighttime cooling effects on southern California waterways (Garfin et al. 2013).

In fact, water temperatures in many streams across California have risen for some time and are continuing to do so (Kaushal et al. 2010). Stream temperatures across the state have increased by an average of approximately 0.9–1.8°F (0.5–1.0°C) in the past 20+ years (e.g., Bartholow 2005 in Moyle et al. 2013). While such increases may seem small, they can push already marginal waters over thresholds for supporting cold water-dependent fishes (Moyle et al. 2015; Sloat and Osterback 2013). Summer water temperatures already frequently exceed 68°F (20°C) in many California streams and are expected to keep increasing under all climate change scenarios (Hayhoe et al. 2004; Cayan et al. 2008 in Moyle et al. 2015). Organisms that are adapted to California's traditional nighttime cooling influence on their habitats, including Southern SH/RT, are less prone to recover from extreme and extended periods of excessive daytime heat, particularly when humidity and temperatures remain high at night (Garfin et al. 2013; OEHHA 2022).

6.2.2 Drought

Overall, California has been getting warmer and drier since 1895; as part of this long-term climatic shift, droughts are becoming more frequent, extended, and severe in their impacts (OEHHA 2022). As noted, 2000–2021 was the driest 22-year period in the last millennium in the southwestern United States, including California (Williams et al. 2022). The 2012–2016 drought was one of the warmest and driest on record in California, negatively affecting both aquatic and terrestrial environments across the state (Figure 16; CDFW 2018a). Notable statewide aquatic habitat impacts from this and other prolonged droughts include seasonal shifts in stream hydrographs to earlier peaks with extended summer and fall low flow periods, contraction and desiccation of typically perennial aquatic habitats (Figure 18), poor water quality, elevated water temperatures, changes in migratory cues, spawn timing, and other fish behaviors, stranding, and both direct and indirect mortality of fish, along with estuary and lagoon habitat degradation, among other ecological impacts (CDFW 2018a; Bedsworth et al. 2018).

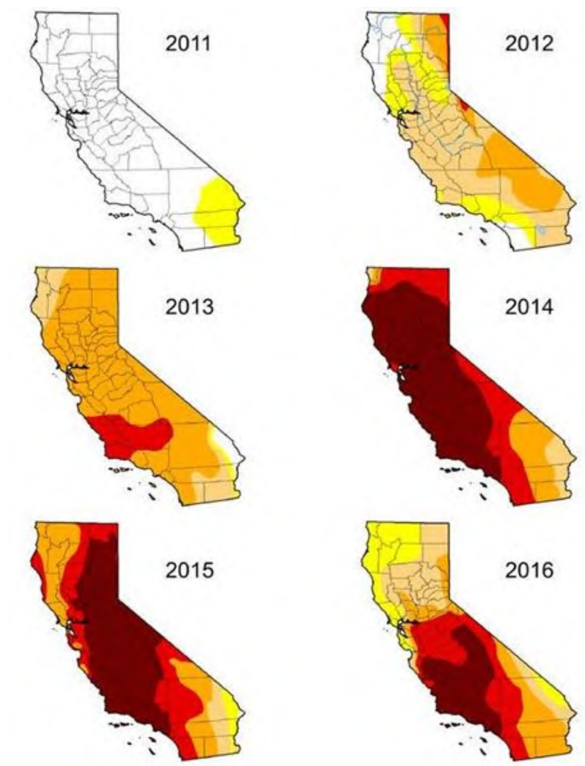


Figure 16. The distribution and progression of drought conditions in California from 2011 to 2016, depicting the level of drought at the beginning of each Water Year (October 1). White indicates no drought conditions, whereas yellow to dark red indicates increasing drought conditions, including duration and intensity (CDFW 2018a, based on U.S. Drought Monitor).

No part of the state has been more impacted by drought than southern California, with significant reductions in precipitation compared to long-term averages, along with record high temperatures, exceptionally dry soils, and low regional snowpack in surrounding mountain ranges in the past decade (Hall et al. 2018). Southern California is naturally arid and already prone to periods of extremely dry conditions (MacDonald 2007; Woodhouse et al. 2010), so increasing drought conditions have amplified many existing ecological stressors while also creating new ones. As an example, during normal water years, many streams in California's south-coastal region maintain perennial flows in their headwaters but become intermittent or dry in lower portions of their watersheds, especially in areas of concentrated urbanization or agriculture. The 2012–2016 drought dramatically exacerbated these conditions, leading to widespread stream drying in this region, even outside of areas that typically experience annual desiccation (Figure 17; CDFW 2018a). Not surprisingly, CDFW (2018a) noted that the two most common causes of fish kills in southern California during the 2012–2016 drought were stream drying and reduced dissolved oxygen levels (impaired water quality).

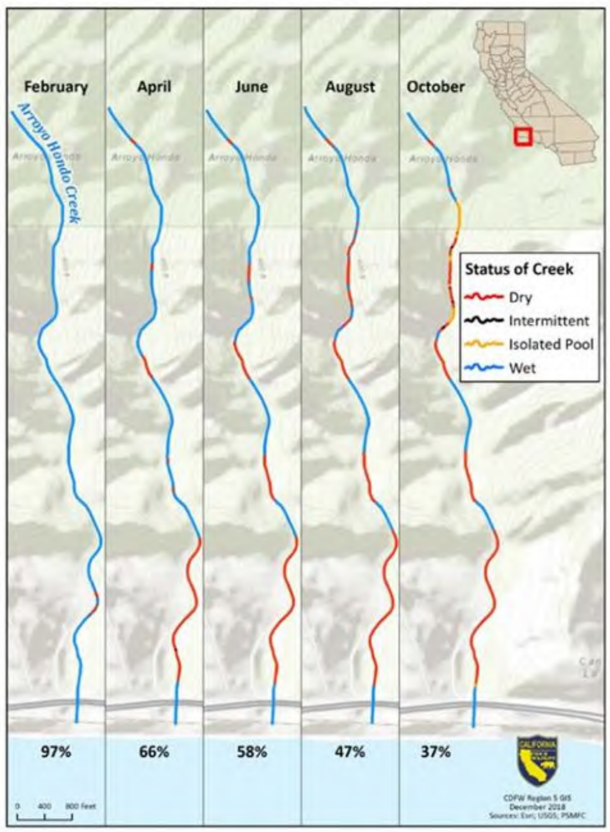


Figure 17. Example southern California stream (Arroyo Hondo Creek, Santa Barbara County), showing seasonal desiccation across 60% of its study area wetted length during February-October 2015 (source: CDFW 2018a). 2015 was a notably bad drought year in California, but the large extent of stream drying in this creek may be an indicator of future climate change-driven conditions in this and other southern California regional streams.

Further desiccation of Southern SH/RT habitats is expected due to climate change, leading to reduced natural spawning, rearing, and migratory habitats for already small and fragmented Southern SH/RT populations. This undesirable future state includes the increasing probability that low-precipitation years continue to align and coincide with warm years, further amplifying the risk of future severe droughts and low snowpack in California, especially in southern latitudes (Difenbaugh et al. 2015; Berg and Hall 2017; Williams et al. 2015).

In their five-year status reviews, NMFS (2016; 2023) concluded that ongoing "hot drought" conditions, among other negative factors, likely reduced salmonid survival across DPSs and ESUs for listed steelhead and salmon in California, including Southern SH/RT. It is likely that these same Southern SH/RT populations, already impacted and diminished in abundance and distribution, will face more frequent and severe drought periods in the future, along with more intense and destructive (albeit less frequent) winter storms, under all predicted scenarios. Both stressors, in combination, will further negatively affect the remaining suitable habitats for Southern SH/RT in California.

6.2.3 Reduced Snowpack

As air temperatures have warmed, more precipitation has been falling as rain instead of snow at high elevations in the western United States, where widespread snowpack declines of 15-30% have been documented since the 1950s (Mote et al. 2018; Siirla-Woodburn et al. 2021). Since 1950, California's statewide snow-water content has been highly variable, ranging from more than 200% of the average in 1952, 1969, and 1983 to 5% in 2015 in the midst of the 2012–2016 drought (OEHHA 2022). The past decade included years that were among the lowest (2013, 2014, 2015, and 2022) and the highest (2011, 2017, 2019) on record for snowpack (OEHHA 2022). These patterns demonstrate increasing variability in the amount of overall precipitation the state receives, the frequency and intensity of storm systems, and the amount of precipitation received as rainfall versus snowfall. Annual snowpack in the Peninsular Ranges of southern California (e.g., Santa Ana Mountains, San Jacinto Mountains, and Laguna Mountains) is expected to continue to diminish, so future stream flows in the range of Southern SH/RT will be increasingly driven by rainfall events (Mote et al. 2018).

Snowmelt attenuates stream flows in basins that usually receive annual snowpack at higher elevations. An increase in the ratio of rain to snow and rain-on-snow events will result in more peak flows during winter and early spring, along with an increasing frequency of high flow events and damaging flooding. With earlier seasonal peak hydrographs, many southern California streams will experience diminished spring pulses and protracted periods of low flows through the summer and fall seasons (Moyle et al. 2015). These conditions will translate into warmer water temperatures at most elevations, reflecting both increases in air temperatures and reduced base flows (Moyle et al. 2017). Future shifts from snow to rain may also negatively impact overwintering rearing habitat for juvenile Southern SH/RT and reduce the availability of cold-water holding habitats as refuges in rivers and streams during the summer and fall months (Williams et al. 2016). Such abiotic shifts will affect the physical habitat availability and suitability for Southern SH/RT and are also anticipated to change species interactions, generally favoring introduced species with broader environmental tolerances (Moyle et al. 2013).

6.2.4 Increasing Hydrologic Variability – Reduced Stream Flows to Catastrophic Flooding

Climate change is likely to increase the impacts of El Niño and La Niña events, which are predicted to become more frequent and intense by the end of the century (OEHHA 2022). Increasingly dramatic swings between extreme dry years (or series of years) and extreme wet years are already occurring in California and are expected to escalate under various climate change scenarios (Swain et al. 2018; Hall et al. 2018). California's recent rapid shifts from drought periods (2012-2016, 2020-2022) to heavy precipitation and flooding (winter 2016-2017, winter 2022-23) exemplify "precipitation whiplash" and its potential for widespread natural habitat and human infrastructure damage and destruction (OEHHA 2022). California's river and stream systems will bear the brunt of these impacts since they are the natural conduits for water conveyance on the state's landscape.

Such precipitation variability and intensity in California is now increasingly influenced by "atmospheric rivers," or long, narrow bands of precipitation originating over ocean bodies from the tropics to the poles that transport large amounts of water vapor (USGCRP 2017; Hall et al. 2018). During the winter months, heavy precipitation associated with landfalling atmospheric rivers can produce widespread flooding in most of the southwestern U.S. states (Garfin et al. 2013). California is especially vulnerable to this source of destructive flooding because of its proximity to the Pacific Ocean, where atmospheric rivers are generated (USGCRP 2017). As a result of these changes, southern California stream flows will almost certainly become more variable and "flashy" on an annual basis. Predictions include likely extreme fluctuations in precipitation, with intermittent heavy winters producing high stream flows, coastal impacts, and extensive flooding during otherwise prolonged periods of drought, with low to no flows in many streams. Changes in seasonal flow regimes (especially flooding and low flow events) may also affect salmonid behavior. Expected behavioral responses include shifts in the seasonal timing of important life history events such as adult migration, spawning, fry emergence, and juvenile migration (NMFS 2016). The outmigration of juvenile steelhead from headwater tributaries to mainstem rivers and their estuaries may be disrupted by changes in the seasonality or extremity of stream hydrographs (NMFS 2016; Figure 18). Flood events can also disrupt incubation and rearing habitats due to increased bed mobility (Fahey 2006). Conversely, low flow periods with elevated water temperatures and impaired water quality can cause direct mortality to steelhead across wide portions of southern California's mountain desert streams (CDFW 2018a). Stream drying can also further isolate and restrict subpopulations, potentially leading to genetic drift, interfering with gene flow and genetic mixing at the larger population/ESU level, and potentially further reducing overall fitness.

6.2.5 Sea Level Rise

Along California's coast, mean sea levels have increased over the past century by about 8 inches (203 mm) at monitoring sites in San Francisco and La Jolla (OEHHA 2022). For the southern California coast, roughly 1-2 feet (0.3 m – 0.6 m) of sea level rise is projected by the mid-century, and the most extreme projections indicate 8–10 feet (2.4 m – 3.0 m) of sea level rise by the end of the century (Hall et al. 2018). Sea level rise is predicted to further alter the ecological functions and dynamics of estuaries and near-shore environments. Rising sea levels may impact estuary hydrodynamics with increased saltwater intrusion, potentially increasing salinity levels in estuaries and shifting the saltwater/freshwater interface upstream (Glick et al. 2007). Loss or degradation of already scarce estuary habitats in southern California's coastal areas due to sea level rise may negatively affect Southern SH/RT survival and productivity, since estuaries and lagoons serve as important nursery habitats for juvenile steelhead (Moyle et al. 2017). Alternatively, sea level rise may potentially increase the amount of available estuary habitat by inundating previously dry areas or creating additional brackish, tidal marsh, or lagoon habitats, which serve as important rearing habitats for juvenile salmonids (NMFS 2016). Overall, however, predictions indicate substantial reductions in southern California's coastal lagoon and estuary habitats, which may reduce steelhead smolt survival and numbers of outmigrants to the ocean, further constraining populations of Southern SH/RT (Moyle et al. 2017).

6.2.6 Ocean Acidification

Ocean acidification occurs when excess carbon dioxide (CO2) is absorbed from the atmosphere, acidifying or lowering the pH of sea water (CDFW 2021b). Ocean acidification is becoming evident along California's central coast, where increases in CO2 and acidity levels in seawater have been measured since 2010 (OEHHA 2022). Coupled with warming ocean waters and reduced dissolved oxygen levels, ocean acidification poses a serious threat to global marine ecosystems (OEHHA 2022). If left unchecked, ocean acidification could dramatically alter the Pacific Ocean's marine food webs and reduce the forage base for California's salmonids. Forage fish, which are a primary prey source for steelhead in the ocean (LeBrasseur 1966; Quinn 2018), may suffer declines in abundance due to reduced biomass of copepods and other small crustaceans resulting from ocean acidification (Busch et al. 2014). Ocean acidification makes it harder for the shells of ecologically and economically important species, including krill, oysters, mussels, and crabs, to form and potentially causes them to dissolve. Reduced seawater pH has also been shown to adversely affect olfactory discrimination in marine fish (Munday et al. 2009), which could result in impaired homing of Southern SH/RT to their natal streams.

6.2.7 Wildfires

Wildfires are a natural and fundamental part of California's ecological history in many parts of the state. Wildfires are an essential ecological process for the periodic renewal of chaparral vegetation communities (Sugihara et al. 2006), which dominate much of the south-coastal part of California. Historical fires were, therefore, important episodic ecological events with generally lower intensity impacts, at smaller geographic scales, and generally positive long-term outcomes for fish habitats (Boughton et al. 2007).

Euro-American influences and activities on the western landscapes of the U.S., coupled with climate change, have made modern western fires more frequent, severe, and catastrophic in nature (e.g., Gresswell 1999; Noss et al. 2006; and Moyle et al. 2017). Future frequency and size of wildfires in the range of Southern SH/RT is expected to increase, driven by rising atmospheric temperatures and prolonged droughts associated with climate change (NMFS 2012a, OEHHA 2022). Potter (2017) examined satellite data for the 20 largest fires that have burned since 1984 in the central and southern coastal portions of California and found that climate and weather conditions at times of ignition were significant controllers of the size and complexity of high-burn severity fire areas. Since 1950, half of California's largest wildfires (10 of 20) occurred between 2020 and 2021 (OEHHA 2022). One study predicted a nearly 70% increase in the area burned in southern California by the mid-21st century, due to warmer and drier climatic conditions (Jin et al. 2015). This study also evaluated southern California's wildfires in terms of their impacts in the presence or absence of regionally prominent Santa Ana winds. This research found that non-Santa Ana fires which occur mostly in June through August affected higher-elevation forests, while Santa Ana-driven fires which occur mostly from September through December spread three times faster and occurred closer to urban areas (Jin et al. 2015). Recent examples of devastating Santa Ana wind-driven fires include the destructive Thomas Fire (approximately 282,000 acres) in Ventura and Santa Barbara counties (December 2017) and the Woolsey Fire (approximately 97,000 acres) in Los Angeles and Ventura counties (November 2018), both of which were also influenced by preceding record-breaking heatwaves and extremely dry fall conditions (Hulley et al. 2020).

Projected increases in precipitation extremes will lead to increased potential for floods, mudslides, and debris flows (Hall et al. 2018). Wildfires and subsequent debris torrents in southern California were demonstrated to have destroyed Southern SH/RT habitats in 2004, 2006, and 2008 (Moyle et al. 2015). More recent events, including mass wasting and debris flows, such as those in Santa Barbara County in early 2018, resulted from heavy rains preceded by wildfires (Livingston et al. 2018). High-intensity wildfires can accelerate the delivery of sediments to streams (Boughton et al. 2007) by stripping the land of vegetative cover and eliminating stabilizing root structure, thereby degrading spawning habitats for salmonids and other fishes. Increased soil friability greatly increases rates of fine soil mobilization, erosion, transport, and deposition into watercourses affected by fire due to the elimination of vegetation, the input of large amounts of dry ash and charcoal, the lack of soil shading, and the associated increased solar warming and drying of soils (NMFS 2012a). These fine materials often become so dry after a fire that they become hydrophobic, making it much easier for runoff water to mobilize and transport. Fine sediments delivered to streams in large amounts have been shown to cover and smother coarser-grained spawning gravels, which are required for salmonid spawning success (Moyle et al. 2015). Largescale sediment mobilization events can also change the channel characteristics of streams, destroy instream and riparian vegetation, and possibly cause direct or indirect mortality to multiple life history stages of Southern SH/RT, while also facilitating the rapid spread of non-native plant and animal species. High flows and floods in fire scars can also scour redds, depending on their seasonal timing, possibly nearly eliminating a Southern SH/RT subpopulation's cohort post-spawn if gravels are mobilized and eggs or juveniles are washed downstream.

6.3 Disease

Numerous diseases caused by bacteria, protozoa, viruses, and parasitic organisms can infect Southern SH/RT in both juvenile and adult life stages. These diseases include bacterial kidney disease (BKD), *Ceratomyxosis*, *Columnaris*, *Furunculosis*, infectious hematopoietic necrosis virus, redmouth and black spot disease, Erythrocytic Inclusion Body Syndrome, and whirling disease (NMFS 2012a). Water quality and chemistry, along with warm stream temperatures, influence infection rates. As water temperatures rise and fish become thermally stressed, lower host resistance aligns with higher pathogen growth rates due to shorter generation times and can lead to a sharp increase in infection rates and associated mortality (Belchik et al. 2004; Stocking and Bartholomew 2004; Crozier et al. 2008). There is little current information available to evaluate the potential impacts of these kinds of infections on Southern SH/RT populations.

6.4 Hatcheries

Extensive stocking of hatchery-origin *O. mykiss* has occurred throughout the southern California region to support recreational fisheries, but no efforts have specifically targeted the conservation and supplementation of Southern SH/RT. Historical stocking records dating back to the 1930s occasionally reference the stocking of "steelhead"; however, it appears that these references represent nomenclature being used interchangeably rather than identification of fish from native migratory populations. Hatchery-origin *O. mykiss* were stocked widely for recreational fisheries up until the late 1990s. Stocking was ceased in the anadromous waters of southern California as a protective conservation measure starting in 1999 (J. O'Brien, CDFW, personal communication).

While restricted stocking of *O. mykiss* has continued in the region above barriers to anadromy, potential remains for the inadvertent introduction of hatchery stocks into anadromous waters due to downstream movement or during reservoir spill events. To mitigate the risk of hatchery-origin fish interbreeding with wild fish, the Department shifted to stocking only triploid hatchery-origin *O. mykiss* in waters above anadromous barriers following the adoption of the Hatchery and Stocking Program Environmental Impact Report (EIR) in 2010 (Jones and Stokes 2010). Triploid *O. mykiss* have been used across the western United States to reduce the risks of introgression and hybridization associated with stocking programs that support recreational fisheries. The application of heat- or pressure-induced "triploiding" on salmonid eggs, including *O. mykiss*, has a proven 91-100% sterilization rate, often at the upper end of that range (Kozfkay et al. 2011). Using triploid hatchery-origin *O. mykiss* for recreational fisheries has mitigated some of the inherent risk of potential hybridization and introgression with native and wild stocks, although some risks to Southern SH/RT may still exist. Competition and predation from hatchery stocks remain of concern since the degree to which triploid *O. mykiss* may compete with or prey upon native *O. mykiss* is not well understood.

Hatchery-origin *O. mykiss* have been tagged prior to stocking into select regional reservoirs to attempt to evaluate if and the extent to which they may be escaping these impoundments and entering anadromous waters below dams. No reservoir spills have occurred across the region since tagging began due to the predominance of drought conditions, except for during the winter and spring of 2023. To date, downstream monitoring has not been conducted since the inception of the tagging study (J. O'Brien, CDFW, personal communication). Due to climate change impacts and the decreased frequency with which many southern California reservoirs are filling or overspilling, it is expected that threats from interactions between hatchery-stocked *O. mykiss* and remaining native stocks of Southern SH/RT will be considerably reduced in the future. However, the large number of atmospheric rivers that impacted much of California during the recent winter of 2022–2023, causing some southern California reservoirs to fill and overspill, is a reminder that such events remain possible.

While exclusively triploid hatchery-origin *O. mykiss* are stocked above barriers to anadromy in southern California, historical regional stocking practices of non-triploid fish have led to introgression, or hybridization with hatchery stocks, in some Southern SH/RT populations. Levels of introgression appear to vary across the landscape, differing between populations and watersheds. Some populations retain high levels of native southern California steelhead ancestry, while others are highly introgressed and exhibit high levels of hatchery-origin genetics (primarily Central Valley *O. mykiss* genetics), while some are in between, with genetic signatures from both native and hatchery origins (Clemento et al. 2008; NMFS 2016; Jacobson et al. 2014). See Section 6.7 in this Status Review for more information.

6.5 Predation

6.5.1 Predation in Freshwater Environments

California's salmonids have evolved under selective pressure from a variety of natural predators, including many species of fish, birds, and mammals; however, a growing number of non-native aquatic species have also become established within the range of Southern SH/RT (Busby et al. 1996; NMFS 2016; Stillwater Sciences 2019; Dagit et al. 2019; COMB 2022). Established populations of non-native fishes, amphibians, and invertebrates, combined with anthropogenic habitat alterations that often favor non-native species, have led to increased impacts from predation, competition, and other stressors on Southern SH/RT across much of its range (NMFS 1996b). Stream habitat alteration can also directly affect predation rates by reducing available cover for prey species, creating flow and velocity regimes that favor non-native predators, and creating obstructions to passage that can lead to migration delays and increased exposure to predators (Moyle et al. 2013; Dagit et al. 2017). Further, stream habitat alterations can influence water temperatures, often increasing them, which may then lead to higher metabolic rates for piscivorous fishes and increased predation pressure (Michel et al. 2020). In addition to physical habitat alterations, chemical habitat alterations in the form of contaminants known to alter fish behavior and reduce avoidance or cover-seeking activities are also likely to increase predation rates, particularly from avian predators (Grossman 2016).

Established populations of non-native catfish and centrarchids occur in the lower reaches of many watersheds throughout the range of Southern SH/RT, leading to widespread predation risk (NMFS 2016; Stillwater Sciences 2019; Dagit et al. 2019; COMB 2022). Grossman (2016) found that non-native Channel Catfish (*Ictalurus punctatus*) may be a primary predator of Central Valley steelhead in the San Joaquin River, suggesting they may pose the same level of risk to Southern SH/RT. Non-native centrarchids have been demonstrated to negatively impact salmonid populations through direct predation on rearing juveniles and resident adult *O. mykiss* (Dill and Cordone 1997; Marks et al. 2010; NMFS 2012a; Bonar et al. 2005).

Abundant populations of non-native fish have been documented in many southern California coastal watersheds, including Malibu Creek, lower Arroyo Trabuco, Santa Margarita, and San Luis Rey rivers. These species include largemouth and redeye bass, green sunfish, mosquito fish, and black bullhead (C. Swift, Emeritus, Section of Fishes, Natural History Museum of Los Angeles County, personal communication; O'Brien et al. 2022).

In addition to piscivorous fishes, non-native invertebrates and amphibians have also been introduced and spread across the Southern SH/RT range. American bullfrogs (*Lithobates catesbeianus*) have become widely established and can prey upon rearing juvenile steelhead (COMB 2022; Cucherousset and Olden 2011; Dagit et al. 2019; Stillwater Sciences 2019). Non-native Red Swamp Crayfish (*Procambarus clarkia*) populations have also increased in some Southern SH/RT waters (Garcia et al. 2015; Dagit et al. 2019). Direct observations of YOY Southern SH/RT being attacked by crayfish in shallow riffle-run habitat suggest that predation poses a threat to the survival of juvenile steelhead (Dagit et al. 2019).

6.5.2 Predation in Marine Environments

Marine predation influences on Southern SH/RT are not well documented or understood. Primary predators of salmonids in the marine environment are pinnipeds, such as harbor seals (*Phoca vitulina*) and California sea lions (*Zalophus californianus*) (Cooper and Johnson 1992; Spence et al. 1996). Although fish are a major dietary component of marine pinnipeds, their predation on Southern SH/RT may be minimal at present, given the very low relative abundances of Southern SH/RT.

6.6 Competition

Competition is the interaction between individuals of the same or different species that compete for a limited supply of a common resource (Holomuzki et al. 2010). The extent to which competition impacts the distribution, abundance, and productivity of Southern SH/RT populations is not well understood. Pacific steelhead typically compete with other salmonid species like Coho and Chinook salmon in freshwater; however, unlike northern populations of steelhead that typically co-occur with other salmonid species, Southern SH/RT are the only salmonids that occur in their range. While inter-specific competition with other salmonids is unlikely to occur, intraspecific competition among Southern SH/RT may be prevalent in southern California watersheds, especially those that are highly degraded. Poor and degrading habitat conditions can contribute to increased competition, which, in turn, can adversely affect fish during the juvenile life-history stage and lead to reduced recruitment and reproductive performance over the entire life cycle (Chilcote et al. 2011; Tatara et al. 2012). Limited habitat space, coupled with high juvenile densities, is associated with reduced growth, premature emigration, increased competition for food, decreased feeding territory sizes, and increased mortality (Kostow 2009).

Juvenile steelhead are habitat generalists, occupying a variety of microhabitat types in streams depending on the size and age of individuals (Spina et al. 2005). Non-native fish species can competitively restrict the spatial distribution of juvenile steelhead to suboptimal habitats such as shallower, higher-velocity rifles, where the energetic cost to forage is higher (Rosenfeld and

Boss 2001). Non-native fish species may also exclude juvenile steelhead from areas of suitable habitat. For example, recent watershed-wide surveys in Sespe Creek, a large and unregulated tributary to the Santa Clara River, documented the absence of Southern SH/RT in several stream reaches with suitable steelhead habitat (i.e., cool water with deep pools) that were dominated by multiple species of non-native juvenile fishes (Stillwater Sciences 2019). According to Krug et al. (2012), Arroyo Chub may also compete with Southern SH/RT juveniles for food resources. Like juvenile steelhead, Arroyo Chub are opportunistic feeders and consume benthic and drift invertebrates, sometimes switching preferences depending on food abundance. Southern SH/RT and Arroyo Chub are frequently part of the same native southern California fish assemblages and generally habitat partition, with juvenile steelhead mostly feeding on drift invertebrates while chub have a more benthic diet. However, periods of diet overlap may lead to strong interspecific competition between the two species. While other native fishes may impose some level of competitive threat to Southern SH/RT, it remains likely that non-native competitors pose the greater threat, especially with these species continued expansion and proliferation (O'Brien and Barabe 2022).

6.7 Genetic Diversity

West coast steelhead have considerable genetic diversity, both within and across populations, including variation in traits linked to anadromy, morphology, fecundity, spawning, and run timing, as well as age at smolting and maturation (McElhany et al. 2000). While some traits are entirely genetically based, the expression of most traits usually varies, due to a combination of both genetic and environmental factors. Species with high genetic diversity typically occupy a wider range of habitats than those with lower diversity and are more resilient to both short-and long-term spatial-temporal fluctuations in the environment such as ecological disturbances (i.e., wildfires, floods, and landslides) and human-caused impacts. Generally, populations need to be large enough to maintain long-term genetic diversity and avoid genetic problems, such as loss of variation, inbreeding depression, bottlenecks, and the accumulation of deleterious mutations, all of which occur more frequently in smaller populations.

A range-wide genetic analysis demonstrated that populations in the southernmost portions of the Southern SH/RT range are dominated by hatchery ancestry, indicating genetic introgression of native lineages with hatchery strains (Jacobson et al. 2014; Abadia-Cardoso et al. 2016). Most of these hybridized wild populations occur above barriers in the upper reaches of the Los Angeles, San Gabriel, Santa Ana, San Juan, San Diego, and Sweetwater rivers. It is unclear whether introgression will decrease the viability of these southern populations, since the introduction of small amounts of novel genetic material, even from hatchery stocks, can lead to increased diversity and the phenomenon known as "hybrid vigor," conferring adaptive resilience to changing environments and the negative impacts of inbreeding. This study also confirmed that the northernmost populations of Southern SH/RT, including all watersheds in the Monte Arido Highlands BPG, contain native steelhead ancestry and generally higher genetic diversity than more southern populations (Clemento et al. 2009; Abadia-Cardoso et al. 2016).

As with other salmonids, natural straying and the resultant gene flow between populations maintain the genetic diversity of Southern SH/RT. A recent study, which examined the otoliths of seven adult steelhead from a small basin on the Big Sur coast of California, revealed that all adults were strays, coming from at least six different source populations, including neighboring ones on the Big Sur coast as well as distant populations such as the Klamath River (Donohoe et al. 2021). As is the case for many coastal steelhead populations, the genetic diversity of Southern SH/RT has been compromised by human impacts on their habitats, such as the blocking of migration corridors by artificial dams and widespread reductions in streamflow, at least partially due to locally and regionally intensive water diversions for municipal, agricultural, and other human consumptive uses (NMFS 2012a).

Measures of genetic diversity, such as heterozygosity and allelic richness, indicate that Southern SH/RT populations have lower diversity than northern coastal populations. Within the range of Southern SH/RT, the northernmost populations in the Santa Maria, Santa Ynez, Ventura, and Santa Clara rivers have higher genetic diversity than the southernmost populations (Abadia-Cardoso et al. 2016). Previous genetic studies have revealed that populations occurring downstream of modern artificial barriers are genetically more similar to above-barrier populations in the same basin than they are to populations below barriers in neighboring basins (Clemento et al. 2009). While above- and below-barrier populations within the same drainage are usually each other's closest relatives, they appear divergent in respect to the frequencies of the anadromous (A) and resident (R) haplotypes found in each subpopulation (see Section 4.7). The A haplotype is more common below dams, while the R haplotype is found more frequently above dams. This evidence of selection against the anadromous genotype is likely a product of artificial dams or other barriers blocking anadromous adults from returning to these upstream areas to reproduce and provide A haplotype genetic influx to the above-barrier population (Pearse et al. 2014; Pearse et al. 2019). Apgar et al. (2017) found that the frequency of the A haplotype is strongly associated with several factors, including the extent of migration barriers present, barrier type (complete, partial, artificial, or natural), barrier age (recent or longstanding), and migration distance. Genetic diversity in above-barrier populations is an important repository of genetic material, serving a similar function as conservation hatcheries do in other parts of the Southern SH/RT range (D. Boughton, NOAA, personal communication; NMFS 2012a)

Because migratory phenotypes are primarily genetically based, variation in the reproductive success of anadromous and resident individuals can influence the tendency of populations to produce anadromous offspring, corresponding to changes in the frequency of the A haplotype. Moreover, environmental factors, such as intra-and inter-annual climate variation, food availability, and water temperature, also influence the expression of anadromy in Southern SH/RT populations (Satterthwaite et al. 2009; Ohms et al. 2014; Kendall et al. 2015). Furthermore, climate change projections for Southern SH/RT range predict an intensification of climate patterns, such as more intense cyclic storms, droughts, and extreme heat (NMFS 2012a). These projections suggest that Southern SH/RT will likely experience more frequent periods of adverse conditions and continued selection pressure against the anadromous life-history form.

6.8 Habitat Conditions

The decline of Southern SH/RT can be attributed to a wide variety of human activities, including, but not limited to, urbanization, agriculture, and water development. These activities have degraded range-wide aquatic habitat conditions, particularly in the lower and middle reaches of most watersheds in the Southern SH/RT range (NMFS 2012a). Southern California is home to over 20 million people and 1.8 million acres of metropolitan, urban, and suburban areas (DWR 2021) which has resulted in highly urbanized watersheds that are impacted by surface and groundwater diversions and associated agricultural, residential, and industrial uses. Major rim dams, instream diversion dams, and other water conveyance infrastructure have significantly reduced or eliminated access to the majority of historical upstream rearing and spawning habitat for southern steelhead. While some of these human activities have been reduced, eliminated, or mitigated, the cumulative impacts of these activities remain throughout most of the Southern SH/RT range, particularly in larger systems such as the Santa Maria, Santa Ynez, Ventura, Santa Clara, Los Angeles, San Gabriel, Santa Ana, and Santa Margarita watersheds, as well as in smaller coastal systems such as Malibu Creek.

6.8.1 Roads

High human population densities in southern California have led to the development of an extensive network of transportation corridors throughout the range of Southern SH/RT. The extensive road and highway networks across much of the Southern SH/RT range, especially in areas proximate to rivers and streams, are attributed to increases in a number of negative habitat impacts. Among these are: non-point pollution (e.g., oil, grease, and copper from braking systems); sedimentation; channel incision due to bankside erosion; substrate embeddedness; floodplain encroachment and loss of floodplain connectivity; loss of channel heterogeneity (e.g., filling of pool habitats); and higher frequencies of flood flows (NMFS 2012a). Additionally, extensive road and highway networks require many road crossings (e.g., culverts and bridges) that are often improperly designed for the volitional passage of aquatic organisms (CalTrans 2007; NMFS 2012a).

NMFS (2012) assessed the impacts of roads and transportation corridors on Southern SH/RT using roads per square mile of watershed and the density of roads within 300 feet of streams per square mile of watershed as metrics. The results of their analysis demonstrated that roads and associated passage barriers have the highest impact on rivers and streams in the Santa Monica Mountains and Conception Coast BPG regions: 60% of watersheds in the Conception Coast BPG ranked “very high” or “high” in severity for roads as a stressor, while 100% of the watersheds that drain the Santa Monica Mountains received the same ranking. Highway 101 and the Union Pacific Railroad cross the mainstem of each watershed along the Conception Coast BPG region (as well as the Monte Arido Highlands BPG region) near their river mouths. At each major transportation crossing, culverts were constructed to allow stream flows to pass through to the Pacific Ocean, but they were not necessarily engineered to allow upstream fish passage. For example, the Highway 101 culvert on Rincon Creek serves as a total barrier to upstream migration, preventing Southern SH/RT from reaching any of its historical habitats upstream of the barrier. Road development, bridges, and other transportation corridors are also partly responsible for the significant (70-90%) reduction of estuarine habitat across all BPGs (Hunt and Associates 2008).

The Mojave Rim and Santa Catalina Gulf Coast BPG regions are home to the highest urban densities across the Southern SH/RT range, and both BPGs are impacted by high road densities. For example, in the Santa Catalina Gulf Coast BPG region, the Rancho Viejo Bridge, Interstate-5 Bridge array, and the Metrolink drop structure are all recognized as total fish passage barriers on Arroyo Trabuco Creek, a tributary to San Juan Creek. On the Santa Margarita River, an outdated box culvert at the Sandia Creek Bridge serves as a significant fish passage barrier on the river (Dudek 2001). Recently, efforts have been undertaken to repair and modify these barriers to provide upstream steelhead passage and again allow access to many miles of historical habitat in these watersheds (see Chapter 6: Influence of Existing Management Efforts).

6.8.2 Dams, Diversions, and Artificial Barriers

A number of anthropogenic impacts, including water diversions, dams, and other artificial barriers, influence stream flows in most Southern SH/RT-supporting watersheds. Municipal and agricultural beneficial uses comprise the majority of water demand in the South Coast region (Mount and Hanak 2019). Surface water diversions can lead to reduced downstream flows, as well as changes to the natural flow regime (e.g., magnitude, timing, and duration of flow events), stream hydrodynamics (e.g., velocity, water depth), and degradation of both habitat quality and quantity needed to support Southern SH/RT (NMFS 2012a; Yarnell et al. 2015). Changes to the natural flow regime can result in elevated downstream water temperatures, reduced water quality, shifts in fish community composition and structure, increased travel times for migrating fish, increased susceptibility of native aquatic organisms to predation, and reduced gravel recruitment from upstream areas of watersheds to the lower reaches of rivers (NMFS 1996b; Axness and Clarkin 2013; Kondolf 1997). Dams physically separate fish populations into upstream and downstream components, leading to population and habitat fragmentation, along with potential changes to population spatial and genetic structure over time (NMFS 2012a). Large dams often trap upstream sediments, which naturally would be transported downstream and deposited, augmenting substrates and improving spawning habitats for salmonids and other fish. It is common for rivers and streams with large dams to exhibit more scouring and streambed degradation downstream of the impoundment (Kondolf 1997; Yarnell et al. 2015). Stream flow reductions also interfere with the downstream transport and influx of freshwater to estuaries. The consequences of reduced inflows to estuaries include wetland and edge habitat loss, changes to the amount and location(s) of suitable habitat for aquatic organisms and accelerated coastal erosion (Nixon et al. 2004).

Many types of artificial stream barriers exist throughout the range of Southern SH/RT, including dams, concrete channels for flood control, gravel and borrow pits, roads and utility crossings, fish passage facilities, and other non-structural features such as velocity barriers. In the South Coast hydrologic region, a total of 164 known total migration barriers were identified as part of a larger effort to inventory fish passage barriers across California's coastal watersheds (California Coastal Conservancy 2004). Of the 164 total barriers, 11 were identified as requiring modification or removal to improve fish passage. Dams were identified as the most numerous barrier type, followed by stream crossings and non-structural barriers. The Santa Maria River, San Antonio Creek, Cuyama River, Santa Ynez River, and Santa Barbara coastal watersheds, which all belong to the Central Coast hydrologic region, also contain hundreds of known barriers scattered throughout the area, with the highest number found along the Santa Barbara coastal area (California Coastal Conservancy 2004).

Artificial barriers act as physical impediments but may also contribute to, or enhance, non-structural barriers to steelhead spawning migrations. For example, the three major watersheds of the Los Angeles basin have channelized concrete aqueducts in their lower reaches, with some extending from their mouths upstream for miles. As a result, adult Southern SH/RT can no longer access the lower reaches of these three major regional rivers (Titus et al. 2010). Furthermore, if Southern SH/RT were to successfully enter into the channelized reaches of these rivers, migration success would be limited because individuals would encounter non-structural velocity barriers that would require greater swimming speeds than could be sustained (Castro-Santos 2004). Other non-structural barriers may exist in the form of low flows, disconnected wetted habitat, and poor or lethal water quality in these largely metropolitan lower river aqueduct reaches.

Most of the large rivers in the Monte Arido Highlands BPG region contain multiple large, impassable dams. Twitchell Dam on the Cuyama River is primarily managed for groundwater recharge in the Santa Maria Valley. Operations of Twitchell Dam limit downstream surface flows into the mainstem Santa Maria River (NMFS 2012a). Cachuma, Gibraltar, and Juncal dams on the mainstem Santa Ynez River prevent upstream migratory access to approximately 70% of historical spawning and rearing habitat in the watershed (NMFS 2012a). In the Ventura River watershed, Matilija and Casitas dams on Matilija Creek and Coyote Creek, respectively, block access to 90% of historical Southern SH/RT spawning and rearing habitat. However, the recent Matilija Dam Ecosystem Restoration Project is aimed at restoring over 20 miles of perennial Southern SH/RT habitat in the Matilija Creek watershed through the removal of Matilija Dam. Santa Felicia Dam and Pyramid Dam on Piru Creek, as well as Castaic Dam on Castaic Creek, block access to historical habitat in the tributaries of the mainstream Santa Clara River. Several of these large dams are operated along with smaller downstream diversion dams: primarily the Robles Diversion Dam on the Ventura River and the Vern Freeman Diversion Dam on the Santa Clara River. The Robles Diversion Dam diverts water from the upper Ventura River into storage at Lake Casitas, while the Vern Freeman Diversion diverts water for groundwater recharge purposes in the Santa Clara Valley.

Two major dams impair habitat connectivity and hydrologic function in the Malibu Creek watershed: Rindge Dam and Malibu Lake Dam. Both dams have created favorable habitat conditions for non-native species, including crayfish, snails, fish, and bullfrogs. As a result, invasive aquatic species have been documented in high abundance in Malibu Creek (NMFS 2012a). Rindge Dam is located only 2 miles upstream of the mouth and is no longer functional, so it is targeted for future removal. The removal of this dam alone would allow Southern SH/RT access to 18 miles of high-quality spawning and rearing habitat in the Malibu Creek watershed.

Dams are ranked “high” or “very high” as a threat in 88% of the component watersheds that comprise the Mojave Rim BPG region (NMFS 2012a). There are also at least 20 jurisdictional-sized dams (i.e., a dam under the regulatory powers of the State of California) within each of the three major watersheds of the Los Angeles basin, owned by federal, state, local, and/or private entities and operated for multiple purposes, including: irrigation, flood control, storm water management, and recreation. The principal impoundments in the San Gabriel River watershed are Whittier Narrows, Santa Fe, Morris, San Gabriel, and Cogswell dams. Sepulveda Dam on the Los Angeles River is operated as a flood control structure approximately 8 miles downstream from the river’s source. Big Tujunga Dam on Big Tujunga Creek, a tributary to the Los Angeles River, is also operated as a flood control structure. Prado Dam on the Santa Ana

River is also primarily operated as a flood risk management project. These dams alter the physical, hydrological, and habitat characteristics of the lower and middle reaches of the mainstem rivers in this BPG. They also create favorable habitat for non-native species such as crayfish, largemouth bass, and bullfrogs, which have all been documented in the Los Angeles, San Gabriel, and Santa Ana rivers. Periodic removal of sediments accumulated behind dams on the San Gabriel River also degrades downstream riparian and instream habitat conditions (Hunt and Associates 2008).

In the Santa Catalina Gulf Coast BPG, dams also ranked “high” or “very high” as a threat in 90% of constituent watersheds. At least 20 major dams and diversions without fish passage facilities occur throughout the BPG’s distribution. Prominent dams in this BPG include Agua Tibia, Henshaw, and Eagles Nest dams in the San Luis Rey watershed; and the O’Neill Diversion and Vail dams in the Santa Margarita River watershed. Dams in this BPG are generally not operated with fish passage as a consideration in flow release schedules, and many of these facilities lack fish passage provisions (NMFS 2012a).

Groundwater extraction for agricultural, industrial, municipal, and private use from coastal aquifers has increased with population growth in southern California since the mid-1850s (Hanson et al. 2009). Currently, around 1.57 million acre-feet of groundwater are used on an annual basis in southern California to meet both urban and agricultural water demands (DWR 2021). Groundwater is an important input for surface flows during the summer low flow period in many southern California watersheds (Hanson et al. 2009). Groundwater contributions can help sustain suitable over-summering Southern SH/RT juvenile rearing habitat in both mainstem and tributary habitats (Tobias 2006). Unsustainable groundwater water diversions have led to the depletion of several large aquifers in the region (NMFS 2012a). Offsite pumping can impact the surface-water to groundwater interactions by intercepting water that would have otherwise discharged to a stream or by lowering the water table, causing a reduction of baseflow derived from groundwater during the summer low flow period. While some riparian species can tolerate reduced groundwater contributions to streams, for many other species, such as Southern SH/RT, adequate surface water depth, velocity, and water quality characteristics must be maintained in order to survive (Tobias 2006). The combination of surface water diversions and groundwater extractions can lead to the complete drying of streams, which can lead to the stranding of Southern SH/RT in isolated pools and direct mortality. On average, 57% of watersheds across the five BPGs ranked “high” or “very high” for groundwater extraction as a threat (NMFS 2012a).

Recently, the Sustainable Groundwater Management Act priority process identified several groundwater basins across the South Coast hydrologic region as either critically over drafted (i.e., Santa Clara River Valley, Cuyama River Valley, and Pleasant Valley) or medium-to-high priority basins for water conservation (e.g., the Coastal Plain of Orange County) based on several metrics such as population growth rates, the total number of wells, and the number of irrigated acres (DWR 2020). Groundwater sustainability agencies overseeing critically overdrafted and medium-to-high priority basins are responsible for developing and realizing groundwater sustainability plans (GSPs) to achieve basin sustainability within a 20-year implementation horizon. However, the benefits provided by SGMA for Southern SH/RT and their habitats are uncertain, as the most commonly cited goal for GSPs thus far has been to increase groundwater storage and not the restoration of interconnected surface water flows (Ulibarri et al. 2021).

6.8.3 Estuarine Habitat

The estuaries of many coastal watersheds in southern California form freshwater lagoons that are seasonally closed to the ocean. Lagoons form when low summer baseflows are unable to displace sand deposition at the mouth of the estuary, which results in the formation of a sandbar that blocks connectivity with the ocean. This closure creates an environment characterized by warmer and slower-moving (i.e., longer residence times) freshwater that is relatively deep (Bond et al. 2008). These habitat characteristics provide important, high-quality nursery conditions for rearing juveniles and transition areas for smolts acclimating to the ocean environment. Adult steelhead also acclimate in these areas prior to upstream migration during the winter months when the estuary is fully open (NMFS 2012a). The importance of such habitats was demonstrated by the observed doubling of growth in juvenile *O. mykiss,* which reared throughout the summer in a typical northern California coastal watershed (Bond et al. 2008). The same study examined scales from returning adult steelhead and found that estuary-reared individuals dominated adult returns, despite comprising only a small part of the annual outmigrating population. Another study conducted in the same watershed also reported higher growth rates for estuary-reared juvenile steelhead than for their cohorts reared in the upper watershed (Hayes et al. 2011). Hayes et al. (2011) also found that the lagoon environment provided warmer water temperatures and a diverse abundance of invertebrate prey resources for rearing juvenile *O. mykiss* to consume. Trade-offs between accelerated growth and survival likely exist in lagoon habitats because they represent a relatively high-risk yet high-reward environment in which accelerated growth may come at the cost of increased metabolic demand and potentially increased predation risk, exposure to poor water quality, and episodic artificial breaching (Osterback et al. 2013; Satterthwaite et al. 2012; Swift et al. 2018).

The southern California Bight, which encompasses the entire southern California coastline, from Point Conception to San Diego, historically supported around 20,000 hectares of estuary habitat (Stein et al. 2014). Over half of all historical estuaries were found in San Diego County (e.g., Mission Bay and San Diego Bay), while Los Angeles and Orange counties contained about 15%

each of the total estimated historical area. Estimates of the amount of estuarine habitat loss from historical levels, based on wetland acreage, range from 48-75% (Brophy et al. 2019; NMFS 2012a; Stein et al. 2014). The magnitude of the loss varies depending on the watershed. For example, the estuaries of the Santa Maria and Santa Ynez rivers in the northern portion of the Southern SH/RT range remain almost entirely intact, while the estuaries of the Los Angeles, San Gabriel, and Santa Ana rivers have been reduced to 0-2% of their historical extent (NMFS 2012a). Overall, estuary habitat loss in southern California is likely underestimated because early landscape modifications (e.g., housing and transportation development and associated filling of wetlands with sediment) had substantially altered the landscape before attempts were made to quantify the extent of historical habitat (Brophy et al. 2019).

The primary cause of estuarine loss in southern California is the conversion of habitat to other land use practices such as agriculture, grazing, and urban development activities, which require the construction of infrastructure and the subsequent filling, diking, and draining of coastal wetlands (NMFS 2012a). Currently, estuary habitats in the range of Southern SH/RT remain highly degraded and prone to further degradation by urban impacts such as point and nonpoint source pollution, coastal development, and dams. These environmental stressors can cause declines in water quality and the proliferation of harmful algal blooms that can lead to the rapid die-off of both aquatic and terrestrial organisms (Lewitus et al. 2012; Smith et al. 2020). Artificial breaching of estuaries also poses a mortality risk to Southern SH/RT. Seven moribund juvenile steelhead were observed in the lagoon at the mouth of the Santa Clara River shortly after the sandbar was artificially breached in 2010 (Swift et al. 2018). The authors of this study noted that the Santa Clara River, upstream of the lagoon, was dry during this time and that the observed fish were relatively large and in robust condition, indicating that favorable rearing conditions existed prior to the artificial breaching.

6.8.4 Water Quality and Temperature

Contaminants and pollutants are well-documented to alter water quality parameters that affect the growth and survival of Pacific salmonids in both freshwater and estuarine environments (Arkoosh et al. 1998; Baldwin et al. 2009; Laetz et al. 2008; Sommer et al. 2007; Sullivan et al. 2000). Both are generally introduced into southern California rivers and streams by urban runoff, agricultural and industrial discharges, wastewater treatment effluent, and other anthropogenic activities. Recent monitoring conducted by the USGS measured between 20 and 22 current-use pesticides in samples collected from urban sites at Salt Creek and the Sweetwater River in Orange and San Diego counties (Sanders et al. 2018). Diminished water quality conditions, including contaminants and associated toxicity, elevated nutrients, low dissolved oxygen, increased temperature, and increased turbidity, can all adversely affect Southern SH/RT as well as other native fish and aquatic organisms. The effects of individual pollutants and combinations thereof can impact populations by altering growth, reproduction, and mortality rates of individual fish (Sommer et al. 2007). These impacts can ultimately manifest in direct mortality due to acute and long-term physiological stress or may act through indirect pathways such as changes to food webs, ecosystem dynamics, increased susceptibility to disease and predation, and more frequent occurrences of harmful algal blooms. Aquatic stressors that impair water quality can also interact with each other in an additive or synergistic fashion, such that they are generally interdependent and can greatly amplify negative impacts on aquatic ecosystems (Sommer et al. 2007). Dissolved oxygen concentrations, turbidity, and water temperatures are all parameters directly influenced by flow management. Lower flows can lead to warmer water temperatures that hold less dissolved oxygen than cold water. Higher water temperatures also increase the metabolic and oxygen consumption rates of aquatic organisms, making these conditions particularly stressful for aquatic life (Myrick and Cech 2000). See Section 6.2.1 in this Status Review for a full description of air and water temperature influences and trends.

Many watersheds that support Southern SH/RT are listed under Section 303(d) of the federal Clean Water Act (CWA). Section 303(d) requires states to maintain a list of waters that do not meet prescribed water quality standards. For waters on this list, states are required to develop TMDLs that account for all sources (i.e., point and non-point sources) of the pollutants that caused the water to be listed as impaired under the CWA. In southern California, there are many impaired water bodies and pollutant combinations listed under Section 303(d). While contaminant and discharge sources have changed over the years and there have been significant improvements in controlling many of these sources, many 303(d)-listed waters do not yet have approved TMDLs (SWRCB 2020). All four of the major rivers in the Monte Arido Highlands BPG region are listed as 303(d)-impaired, and each system contains over five sources of pollutants. Seven Southern SH/RT-supporting watersheds in the Conception Coast BPG region and three in the Santa Monica Mountains BPG region are 303 (d) listed, including Jalama, Gaviota, Mission, Carpinteria, Rincon, Big Sycamore Canyon, Malibu, and Topanga creeks. All three of the major watersheds in the Mojave Rim BPG region, as well as eight out of ten in the Santa Catalina Gulf Coast BPG region, are 303(d)-listed, including the Los Angeles, San Gabriel, Santa Ana, Santa Margarita, San Diego, and Sweetwater rivers and the San Juan, San Mateo, San Luis Rey, and San Dieguito creeks. Essentially, all rivers and streams supporting Southern SH/RT that are 303(d)-listed are impaired by multiple pollutants, including water temperature, benthic community effects, indicator bacteria, trash, toxicity, and invasive species. Furthermore, southern California's coastal and bay shorelines, estuary environments, and tidal wetlands are also frequently 303(d)-listed as impaired. As examples, the estuaries of Malibu, Aliso, San Juan, and Los Penasquitos creeks; the entirety of Santa Monica Bay; and the estuaries of the Los Angeles, Santa Clara, Santa Margarita, and Tijuana rivers are all listed as 303(d)-impaired waterbodies.

6.8.5 Agricultural Impacts

The impacts of agricultural development have lessened over time as farm and pasturelands continue to be converted to urban development in southern California (NMFS 2012a). Historically, the loss of riparian and floodplain habitat was due first to conversion by livestock ranching, followed by irrigated row-crop agriculture, and then urban development. For example, interior portions of the Santa Clara River floodplain were originally converted to agriculture but are now dominated by urban growth and major human population centers, such as the cities of Santa Paula and Fillmore. Today, the South Coast hydrologic region supports approximately 159,000 acres of agricultural land, with avocados, citrus, truck crops, and strawberries comprising the highest agricultural production by acreage (DWR 2021). Approximately 530,000 acre-feet of groundwater are annually pumped from underlying basins to support agricultural production in southern California (DWR 2021). Agricultural activities produce wastewater effluent containing nutrients that can either directly or indirectly be introduced into the rivers, streams, and estuaries that support Southern SH/RT, particularly when agricultural best management practices and water quality objectives have not been established. Agricultural production is prevalent in several watersheds, including the lower Santa Maria and Santa Ynez rivers; many of the smaller coastal watersheds along the Santa Barbara coast, such as the Goleta Slough complex and Rincon Creek; the upper Ventura River and the Ojai basin; and portions of the San Mateo Creek, San Luis Rey, and San Dieguito River tributaries in the southernmost portion of the range. Statewide, the counties of Ventura, Santa Barbara, and San Diego are each ranked in the top fifteen for total value of agricultural production (CDFA 2021).

While the impacts of agricultural development on Southern SH/RT and their habitats have decreased over time due to land use conversion, both activities have resulted in considerable cumulative regional habitat loss and degradation. These changes have led to greatly reduced habitat complexity and connectivity in the lower and middle reaches of many southern California watersheds. Currently, agricultural impacts on Southern SH/RT are most evident during the summer dry season, when agricultural and residential water demands are the highest. This period coincides with the juvenile *O. mykiss* rearing life-history stage, which is dependent on adequate summer base flows to maintain suitable habitat conditions for growth and survival (Grantham et al. 2012). Agricultural groundwater diversions can lead to rapid stream drying by depleting aquifer groundwater that contributes to stream base flows, which limits the extent of summer rearing habitat for fish (Moyle et al. 2017). Naturally occurring surface waters supported only by groundwater recharge can be rapidly dewatered due to excessive groundwater pumping or diversions. These areas have been shown to provide adequate depth, surface area, and habitat for steelhead in streams lacking cold-water refuges (Tobias 2006).

The cultivation, manufacturing, and distribution of cannabis products have increased since recreational use became legal in California in 2016 (Butsic et al. 2018). Threats and stressors on aquatic ecosystems associated with the cultivation of cannabis include stream flow and bank modifications, water pollution, habitat degradation, and species invasions (CDFW 2018b). Cannabis is a water-and nutrient-intensive crop that requires an average of up to 6 gallons of water per day, per plant, during the growing season, which usually spans a total of 150 days from June to October (Zheng et al. 2021). Water diversions can lead to changes in flow regimes, the creation of fish passage barriers, the loss of suitable spawning and foraging habitat, and the rerouting and dewatering of streams, especially during drought years or during the dry season (CDFW 2018b; see Section 6.8.2).

6.8.6 Invasive Species

Invasive and non-native species are abundant and widely distributed in many watersheds that support Southern SH/RT. Non-native species frequently occur in both anadromous and non-anadromous waters that have been extensively stocked by a variety of public and private entities (NMFS 2012a). Most reservoirs contain non-native species, such as largemouth and smallmouth bass, carp, sunfish, bullfrogs, and bullhead catfish, that can all establish reproducing populations in the river and stream reaches above and below the dams. Range-wide habitat alteration has also facilitated the widespread distribution and increased abundance of non-native fish species, which typically favor slower-moving, warmer-water habitats with lower dissolved oxygen concentrations and higher sediment loads (Moyle et al. 2017). While the introduction of non-native game species has historically been viewed as a fishery enhancement, these species can have negative impacts on Southern SH/RT due to predation, competition, disease, habitat displacement and alteration, as well as behavior modifications (Cucherousset and Olden 2011).

Non-native species have recently been documented in high densities in Sespe Creek, an unregulated tributary to the Santa Clara River and a Department-designated Wild Trout Water (Stillwater Sciences 2019). High abundances of invasive species are due to the historic and ongoing stocking of non-native fish in the Rose Valley Lakes on Howard Creek, a tributary to Sespe Creek. In both Malibu and Topanga creeks, red swamp crayfish abundances have increased with recent warmer stream temperatures and lower flow conditions despite regular removal efforts (Dagit et al. 2019). High densities of crayfish likely have a direct (predation) and indirect (competition) effect on Southern SH/RT in both creeks. A variety of warm-water, non-native fish species are frequently observed in the lower Santa Ynez River, including multiple species of sunfish and catfish, carp, and largemouth bass, all of which are known predators of Southern SH/RT early life stages. In the lower Ventura River, annual monitoring efforts have consistently detected higher numbers of non-native fish species than Southern SH/RT in recent years (CMWD 2021).

Non-native plant and amphibian species also occur in several watersheds that support Southern SH/RT. Invasive plants such as giant reed and tamarisk have displaced extensive areas of native riparian vegetation in major drainages, such as the Santa Clara and San Luis Rey rivers (NMFS 2012a). These water-intensive plant species both reduce instream flows through groundwater uptake and severely reduce the extent of riparian cover and shading. These habitat changes often affect stream flow and thermal regimes, potentially increasing susceptibility of Southern SH/RT to predation, disease, and competitive exclusion. Other non-native plant species, such as water primrose and hyacinth, both of which form dense, sprawling mats on the water's surface, can alter the structure and function of aquatic ecosystems by outcompeting native aquatic plants, reducing the amount of open water habitat, altering the composition of invertebrate communities, physically blocking fish movement, and inducing anoxic conditions detrimental to fish (Khanna et al. 2018). In the Santa Clara River watershed, bullfrogs and African clawed frogs are abundant and widespread throughout the mainstem reaches, from the estuary upstream to Fillmore, including tributaries such as Santa Paula Creek and Hopper Canyon Creek (NMFS 2012a). Both species represent a threat to native aquatic communities because they opportunistically consume a variety of native prey, and eradication of either species is unlikely (Wishtoyo Foundation 2008).

6.9 Fishing and Illegal Harvest

Southern SH/RT traditionally supported important recreational fisheries for both winter adults and summer juveniles in coastal streams and lagoons (NMFS 2012a, Swift et al. 1993). Angling-related mortality may have contributed to the decline of some small populations but is generally not considered a leading cause of the decline of the Southern California Steelhead DPS as a whole (Good et al. 2005; Busby et al. 1996; NMFS 1996b). After the southern California steelhead DPS was federally listed as endangered in 1997, Department fishing regulation modifications led to the closure of recreational fisheries for Southern SH/RT in marine and anadromous waters with few exceptions. That closure continues, and there is currently no legal recreational fishery for Southern SH/RT (CDFW 2023).

Southern SH/RT take is primarily from poaching rather than legal commercial and recreational fishing. While illegal harvest rates appear to be very low, the removal of even a few individuals in some years could be a threat to the population because of such low adult abundance in most populations (Moyle et al. 2017). Southern SH/RT are especially vulnerable to poaching due to their high visibility in shallow streams. Estimates of fishing effort from self-report cards for 1993–2014 suggest extremely low levels of angling effort for Southern SH/RT, primarily due to the statewide prohibition of angling in anadromous waters starting in 1998 (NMFS 2016; Jackson 2007). Historic commercial driftnet fisheries may have contributed slightly to localized declines; however, Southern SH/RT are targeted in commercial fisheries, and reports of incidental catch are rare. Commercial fisheries are not thought to be a leading cause of the widespread declines of Southern SH/RT over the past several decades (NMFS 2012a).

7. INFLUENCE OF EXISTING MANAGEMENT EFFORTS

7.1 Federal and State Laws and Regulations

Several state and federal environmental laws apply to activities undertaken in California that provide some level of protection for Southern SH/RT and their habitat. There are also restoration, recovery, and management plans, along with management measures specific to habitat restoration, recreational fishing, research, and monitoring that may benefit Southern SH/RT. The following list of existing management measures is not exhaustive.

7.1.1 National Environmental Policy Act and California Environmental Quality Act

The National Environmental Policy Act (NEPA) was enacted in 1970 to evaluate the environmental impacts of proposed federal actions. The NEPA process begins when a federal agency proposes a major federal action. The process involves three levels of analysis: 1) Categorical Exclusion determination (CATEX); 2) Environmental Assessment (EA) or Finding of No Significant Impact (FONSI); and 3) Environmental Impact Statement (EIS). A CATEX applies when the proposed federal action is categorically excluded from an environmental analysis because it is not deemed to have a significant impact on the environment. If a CATEX does not apply, the lead federal agency for the proposed action will prepare an EA, which concludes whether the action will result in significant environmental impacts. A lead agency will issue a FONSI document if significant impacts are not expected. Alternatively, if the action is determined to have a potentially significant effect on the environment, an EIS containing an explanation of the purpose and need for the proposed action, a reasonable range of alternatives that can achieve the same purpose and need, a description of the affected environment, and a discussion of environmental consequences of the proposed action is required (EPA 2017). The United States Environmental Protection Agency is responsible for reviewing all EIS documents from other federal agencies and must provide NEPA documentation for its own proposed actions. Because the Southern California DPS is listed as endangered under the federal ESA, proposed actions that may impact this population are evaluated as biological resources in the project area concurrently and interdependently with the federal ESA Section 7 consultation process.

The California Environmental Quality Act (CEQA) is similar to NEPA in that it requires environmental review of discretionary projects proposed by state and local public agencies unless an exemption applies (Pub. Resources Code, § 21080). Under CEQA, the lead agency is responsible for determining whether an EIR, Negative Declaration, or Mitigated Negative Declaration is required for a project (Cal. Code Regs., tit. 14, § 15051). When there is substantial evidence that a project may have a significant effect on the environment and adverse impacts cannot be mitigated to a point where no significant effects would occur, an EIR must be prepared that identifies and analyzes environmental impacts and alternatives (Pub. Resources Code, § 21082.2, subds. (a) & (d)). Significant effects for a proposed project may occur if project activities have the potential to substantially reduce the habitat, decrease the number, or restrict the range of any rare, threatened, or endangered species (Cal. Code Regs., tit. 14, §§ 15065, subd. (a)(1) & 15380). CEQA requires public agencies to avoid or minimize significant effects where feasible (Cal. Code Regs., tit. 14, § 15021); NEPA does not include this requirement. Further, CEQA requires that when a lead agency approves a project which will result in significant effects which are identified in the final EIR but are not avoided or substantially lessened, the agency shall make a statement of overriding considerations in which the agency states in writing the specific reasons to support its action based on the final EIR and/or other information in the record (Cal. Code Regs., tit. 14, § 15093).

7.1.2 Federal Endangered Species Act

The ESA was established in 1973 to conserve and protect fish, wildlife, and plants that are listed as threatened or endangered. The ESA provides a mechanism to add or remove federally listed species, cooperate with states for financial assistance, and develop and implement species recovery. The ESA also provides a framework for interagency coordination to avoid take of listed species and for issuing permits for otherwise prohibited activities. The lead federal agencies for implementing the ESA are the USFWS and NMFS. Federal agencies are required to consult with either the USFWS or NMFS to ensure that actions they undertake, fund, or authorize are not likely to jeopardize the continued existence of any listed species or their designated critical habitat. The federal ESA prohibits the take, import, export, or trade in interstate or foreign commerce of ESA-listed species.

NMFS listed the Southern California Steelhead DPS as endangered under the federal ESA in 1997 as part of the South-Central/Southern California Coast recovery domain and designated critical habitat for that DPS in 2005 (NMFS 2012a). The scope of the DPS is naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the

Santa Maria River to the U.S.-Mexico border. NMFS's West Coast Region manages recovery planning and implementation for this domain, and in 2012 the region adopted a Recovery Plan for the Southern California Steelhead DPS, which provides the foundation for recovering populations to healthy levels. The listing of the DPS afforded the DPS ESA protections through the consultation provisions of ESA Section 7(a)(2); habitat protection and enhancement provisions of ESA Section 4 and 5; take prohibitions through ESA Sections 4(d) and 9; cooperation with the State of California through ESA Section 6; and research, enhancement, and species conservation by non-federal actions through ESA Section 10.

Section 7(a)(2) of the ESA requires federal agencies to ensure their actions are not likely to jeopardize the continued existence of the species or adversely modify designated critical habitat. The agency requesting consultation will typically produce and submit a biological assessment that documents potential effects on listed species or their habitats to either the USFWS or NMFS. USFWS or NMFS then produces and submits a Biological Opinion to the requesting agency that contains conservation recommendations and actions to minimize any harmful effects of the proposed action. Currently, NMFS spends a significant amount of its resources and time fulfilling Section 7 consultation requirements for federal actions that may impact the Southern California Steelhead DPS (NMFS 2012a). This includes working with agencies to avoid and minimize the potential impacts of proposed actions and to ensure project activities do not jeopardize the species or destroy critical habitat. NMFS has issued Biological Opinions for several large federally owned and operated projects, including the Santa Felicia Hydroelectric Project on Piru Creek (2008), USBR's operation and maintenance of the Cachuma Project on the Santa Ynez River (2000), USBR's construction and operation of the Robles Diversion Fish Passage Facility on the Ventura River (2003), the U.S Army Corp of Engineer's (USACE) Matilija Dam Removal and Ecosystem Restoration Project on Matilija Creek (2007), USACE's Santa Paula Creek Flood Control Project (2013). However, the application of Section 7(a)(2) is limited in scope because it applies only to federal actions and areas under federal ownership, and without a related federal action it does not apply to the significant areas of public and private ownership in southern California (NMFS 2012a).

7.1.3 Clean Water Act and Porter-Cologne Water Quality Act

The CWA was established in 1972 to regulate the discharge of pollutants into the waters of the United States and create surface water quality standards. Section 401 of the CWA requires any party applying for a federal permit or license for a project that may result in the discharge of pollutants into the waters of the United States to obtain a state water quality certification. This certification affirms that the project adheres to all applicable water quality standards and other requirements of state law. Section 404 of the CWA prohibits the discharge of dredged or fill material into the waters of the United States without a permit from the USACE. Activities regulated under this program include fill for development, water resource projects, infrastructure development, and mining projects. Applicants for a 404 permit must demonstrate that all steps have been taken to avoid impacts to wetlands, streams, and aquatic resources and that compensation is provided for unavoidable impacts prior to permit issuance from the USACE.

Since 1969, the Porter-Cologne Water Quality Act (Porter-Cologne Act) has been the principal law governing water quality in California. The Porter-Cologne Act includes goals and objectives that align with those of the federal CWA, such as water quality standards and discharge regulations. The SWRCB and nine regional water quality control boards share responsibility for the implementation and enforcement of the Porter-Cologne Act. These entities are required to formulate and adopt water quality control plans that describe beneficial uses, water quality objectives, and a program of implementation that includes actions necessary to achieve objectives, a time schedule for the actions to be taken, and monitoring to determine compliance with water quality objectives and the protection of beneficial uses of water.

Under Section 401 of the CWA, a federal agency may not issue a permit or license to conduct any activity that may result in any discharge into waters of the United States unless a Section 401 water quality certification is issued or certification is waived. The SWRCB and the regional water quality control boards administer Section 401 water quality certifications in California.

In accordance with Section 303(d) of the CWA, the U.S. Environmental Protection Agency (EPA) assists the SWRCB and the regional water boards in listing impaired waters and developing TMDLs for waterbodies within the state. TMDLs establish the maximum concentration of pollutants allowed in a waterbody and serve as the starting point for restoring water quality. The primary purpose of the TMDL program is to assure that beneficial uses of water, such as cold freshwater and estuarine habitat, are protected from detrimental increases in sediment, water temperature, and other pollutants defined in Section 502 of the CWA. TMDLs are developed by either the regional water quality control boards or the EPA. TMDLs developed by the regional water quality control boards are included as water quality control plan amendments and include implementation provisions, while those developed by the EPA contain the total load and load allocations required by Section 303(d) but do not contain comprehensive implementation provisions. The EPA is required to review and approve the list of impaired waters and each TMDL. If the EPA cannot approve the list or a TMDL, it is required to develop its own. There can be multiple TMDLs on a particular waterbody, or there can be one TMDL that addresses numerous pollutants. TMDLs must consider and include allocations to both point and non-point sources of the listed pollutants.

Approved TMDLs and their implementation plans are incorporated into water quality control plans required by the Porter-Cologne Act of 1969. For a specified area, a water quality control plan designates the beneficial uses and water quality objectives established for the reasonable protection of those beneficial uses. Such beneficial uses may include warm freshwater habitat; cold freshwater habitat; rare, threatened, or endangered species; and migration of aquatic organisms. The beneficial uses, together with the water quality objectives that are contained in a water quality control plan and state and federal antidegradation requirements, constitute California's water quality standards for purposes of the CWA.

Waters within the range of the Southern SH/RT are under the jurisdiction of the Central, Los Angeles, Santa Ana, and San Diego regional water quality control boards. There are many 303(d)-listed impaired waterbodies within the jurisdiction of each of these regional boards, and most waterbodies have more than one pollutant that exceeds water quality standards designed to protect beneficial uses of water, water quality criteria, or objectives. More information on 303(d) listed waters in southern California can be found at: https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2018_integrated_report.html

The National Pollution Discharge Elimination System (NPDES) delegated implementation responsibility for the regulation of wastewater discharges to the State of California through the SWRCB and the regional water quality control boards. In southern California, tertiary wastewater treatment plants commonly discharge treated water into the rivers, streams, and estuaries that support Southern SH/RT. For example, the Tapia Water Reclamation Facility discharges tertiary treated effluent into Malibu, Las Virgenes, and Arroyo Calabasas creeks. While wastewater effluent is often the primary source of streamflow for southern California rivers and streams during the summer months, the potential impacts of wastewater effluent on adult and juvenile life stages are not well understood (NMFS 2012a). The review, assessment, and potential modification of NPDES wastewater discharge permits is a key recovery action in the federal recovery plan for the Southern California DPS to address the threat of urban effluents (NMFS 2016).

7.1.4 Federal and California Wild and Scenic Rivers Act

In 1968, Congress enacted the National Wild and Scenic Rivers Act (WSRA) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing state. Under the National Wild and Scenic Rivers System, rivers are classified as either wild, scenic, or recreational. Designation neither prohibits development nor gives the government control over private property; recreation, agricultural practices, residential development, and other land uses may continue. However, the WSRA does prevent the federal government from licensing, funding, or otherwise assisting in dam construction or other projects on designated rivers or river segments. Designation does not impact existing water rights or the existing jurisdiction of states and the federal government over waters. In California, approximately 2,000 miles of river are designated as wild and scenic, which comprises about one percent of the state's total river miles. The California Wild and Scenic Rivers Act was passed by the California Legislature in 1972. The state act mandates that "certain rivers which possess extraordinary scenic, recreational, fishery, or wildlife values shall be preserved in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the state." (Pub. Res. Code, § 5093.50). Designated waterways are codified in Public Resources Code Sections 5093.50-5093.70.

The designated state and federal wild and scenic rivers within the range of Southern SH/RT are the Sisquoc River, Piru Creek, and Sespe Creek. The Sisquoc River, which is a tributary of the Santa Maria River, contains 33 miles of designated water from its origin in the Sierra Madre Mountains downstream to the Los Padres National Forest boundary. Piru and Sespe creeks are both tributaries of the Santa Clara River and encompass a combined 38 miles of designated waters. The downstream end of Pyramid Dam and the boundary between Los Angeles and Ventura counties constitute the start and end points of the designated reach for Piru Creek. The designated reach for Sespe Creek is the main stem from its confluence with Rock Creek and Howard Creek downstream, near its confluence with Tar Creek. Both Sespe Creek and the Sisquoc River have comprehensive river management plans that address resource protection, development of lands and facilities, user capacities, and other management practices necessary or desirable to achieve the purposes of the WSRA (USDA 2003a; USDA 2003b).

7.1.5 Lake and Stream Bed Alteration Agreements

Fish and Game Code Section 1602 requires entities to notify the Department prior to beginning any activity that may "divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake." The requirement applies to both intermittent and perennial waterbodies. If an activity will adversely affect an existing fish and wildlife resource, the Department's Lake and Streambed Alteration Program is responsible for issuing a Lake or Streambed Alteration (LSA) Agreement that includes reasonable measures necessary to protect the resource (Fish & G. Code, §1602, subd. (a)(4)(B)). There are several types of LSA agreements that entities can request from the Department, including standard; general cannabis; gravel, sand, or rock extraction; routine maintenance; timber harvest; and master.

Recently, severe storms during the winter of 2023 in southern California caused flooding, landslides, and mudslides within the watersheds that Southern SH/RT occupy. As a result, multiple emergency actions were conducted to protect life and property. In these circumstances, Fish and Game Code Section 1610 exempts entities that conduct certain emergency work from notification requirements prior to the start of any work activity and instead requires them to notify in writing within fourteen days after the work begins.

In the South Coast Region, legal cannabis cultivation is currently focused in Santa Barbara County, with a concentration of the larger notifications in the Santa Ynez River watershed. The Santa Ynez River and its tributaries are a high priority wildlife resource that supports *O. mykiss*, the Southern California Steelhead DPS listed as endangered under the federal ESA; southwestern willow flycatcher, which is listed as endangered under both the federal ESA and CESA; least Bell's vireo, which is listed as endangered under both the federal ESA and CESA; and California red-legged frog, which is listed as threatened under the federal ESA. There are currently about 453 acres of permitted cannabis in the Santa Ynez watershed. Project water use adjacent to the Santa Ynez River can have significant individual and/or cumulative impacts on Southern SH/RT and other species along this reach and adjacent up- and downstream areas. The predominant water source for these large grows along the Santa Ynez River and within the region are well diversions that can be located within or immediately adjacent to the stream. These diversions have the potential to substantially affect surface flows, hydrology, and vegetation within the Santa Ynez River. Where this situation occurs along the Santa Ynez River, Department staff have included appropriate measures to report on water use in any agreements that have been issued. Such measures include having an established protocol for monitoring and reporting water use throughout the season. Permittees must also abide by the SWRCB forbearance period for diversion of surface water during the dry season, from April 1 through October 1 of each calendar year.

7.1.6 Medicinal and Adult-Use Cannabis Regulation and Safety Act

Regulation of the commercial cannabis cultivation industry under the Medicinal and Adult-Use Cannabis Regulation and Safety Act requires that any entity applying for an annual cannabis cultivation license from the California Department of Food and Agriculture include "a copy of any final lake or streambed alteration agreement… or written verification from the California Department of Fish and Wildlife that a lake or streambed alteration agreement is not required" with their license application (Cal. Code Regs., tit. 3, § 8102, subd. (w)). Waste discharge and water diversions associated with cannabis cultivation are regulated by the SWRCB (Cal. Code Reg., tit. 3, § 8102, subd. (p)).

7.1.7 Federal Power Act

The Federal Energy Regulatory Commission (FERC) implements and enforces the Federal Power Act. FERC has the exclusive authority to license most non-federal hydropower projects that are located on navigable waterways, federal lands, or are connected to the interstate electric grid. The term for a hydropower license granted by FERC is typically 30-50 years. FERC must comply with federal environmental laws prior to issuing a new license or relicensing an existing hydropower project, including NEPA and ESA. Section 10(a) of the Federal Power Act instructs FERC to solicit recommendations from resource agencies and tribes (when applicable) on ways to make a project more consistent with federal or state comprehensive plans. Section 10(j) allows NMFS, USFWS, and the Department to submit recommendations to protect, mitigate damage to, and enhance fish and wildlife resources affected by a proposed project. FERC is not required to incorporate these recommendations into a hydropower license if it determines the recommendations are outside the scope of Section 10(j) or inconsistent with the Federal Power Act or any other applicable law.

Pursuant to Section 401 of the CWA, FERC may not issue a FERC license to a project unless a Section 401 water quality certification is issued to that project or that certification is waived. The SWRCB administers 401 water quality certifications for projects that involve a FERC license.

UWCD owns and operates Santa Felicia Dam, which is the main component of the Santa Felicia Project *(FERC Project Number 2153)*. The project is located on Piru Creek, a tributary of the Santa Clara River, in Ventura County. Santa Felicia Dam, which is located five miles north of the town of Piru, impounds Piru Creek to form Lake Piru Reservoir. Lake Piru has a usable storage capacity of 67,997 acre-feet, and the spillway of the Santa Felicia Dam has a capacity of 145,000 cfs. A small powerhouse located on the west embankment of the dam is capable of producing up to 1,420 kilowatts of energy. UWCD owns two appropriative water rights for the project for the purposes of power, domestic, industrial, municipal, irrigation, and recreational uses. The project currently operates under a 2014 water quality certification that contains provisions to protect fish and wildlife beneficial uses in lower Piru Creek, including a reservoir release schedule to protect Southern SH/RT migration flows each year from January 1 through May 31 (see https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/santafelicia_ferc2153.html for more information).

7.1.8 Sustainable Groundwater Management Act

In September 2014, the Governor signed legislation to strengthen the management and monitoring of groundwater basins. These laws, known collectively as the Sustainable Groundwater Management Act (SGMA), established a timeline and process for forming local

GSAs in designated groundwater basins. GSAs are responsible for developing and implementing GSPs to achieve basin sustainability within a 20-year implementation horizon. DWR is the agency responsible for reviewing and approving individual GSPs, while the SWRCB serves as the regulatory backstop for groundwater basins found to be out of compliance with SGMA. Since 2014, the Department's Groundwater Program has developed multiple documents to assist GSAs in developing and implementing effective GSPs, including a groundwater consideration planning document and a habitat-specific document for wetlands (CDFW 2019). These documents highlight scientific, management, legal, regulatory, and policy considerations that should be accounted for during GSP development. DWR is currently in the process of reviewing GSP plans for critically overdrafted and medium-to-high priority basins. Within the range of Southern SH/RT, there are over fifteen GSPs that are currently being reviewed by DWR. SGMA requires GSAs to submit annual reports to DWR each April 1 following the adoption of a GSP. Annual reports provide information on groundwater conditions and the implementation of the GSP for the prior water year (see https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Groundwater-Sustainability-Plans for more information).

7.1.9 State Water Resources Control Board Water Rights Administration

Water rights are a legal entitlement authorizing water to be diverted from a specified source and put to a beneficial, non-wasteful use. Riparian water rights are based on ownership of land bordering a waterway, while appropriative water rights are issued without regard to the relationship of land to water but rather the priority in which the water was first put to beneficial use. The exercise of most water rights (i.e., appropriative water rights) requires a permit or license from the SWRCB. The goal of the SWRCB in making water rights-related decisions is to develop water resources in an orderly manner, prevent waste and unreasonable use of water, and protect the environment. The SWRCB has several other major water rights -related duties, including but not limited to: participating in water rights adjudications; enhancing instream uses for fish and wildlife beneficial uses; approving temporary water transfers; investigating possible illegal, wasteful, or unreasonable uses of water; and revoking or terminating water rights. SWRCB-issued water right permits contain public trust provisions for the protection of instream aquatic resources. While these provisions (i.e., maximum diversion amounts and diversion seasons) are meant to protect aquatic resources, they do not have an explicit regulatory mechanism to implement protections required in other state statutes. Furthermore, prior to recent advancements in groundwater management, the SWRCB generally lacked the authority to regulate groundwater diversions and development. Overlying landowners may extract percolating groundwater without approval from the SWRCB as long as the extracted water is put to beneficial uses and the region in which the groundwater diversion occurs has not been formally adjudicated.

7.1.10 Fish and Game Code Section 5937

Fish and Game Code Section 5937 states “the owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around, or through the dam, to keep in good condition any fish that may be planted or exist below the dam.”

7.2 Recovery Plans and Regional Management Plans

7.2.1 Southern California Steelhead Recovery Plan

The Southern California Steelhead Recovery Plan (Recovery Plan) was adopted in 2012 following the listing of the Southern California Steelhead DPS in 1997. The goal of the Recovery Plan is to prevent the extinction of Southern California Steelhead in the wild; ensure the long-term persistence of viable, self-sustaining populations of steelhead distributed across the DPS; and establish a sustainable sport fishery (NMFS 2012a). Generally, recovery of the DPS, which consists of naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Santa Maria River to the U.S.-Mexico Border, entails the protection, restoration, and maintenance of a range of habitats in the DPS to allow all life-history forms to be fully expressed (e.g., anadromous and resident). The Recovery Plan outlines key objectives that address factors limiting the DPS’s ability to survive and naturally reproduce, including preventing extinction by protecting populations and habitats, maintaining the current distribution of steelhead and restoring distribution to historically occupied areas, increasing abundance, conserving existing genetic diversity, and maintaining and restoring habitat conditions to support all of its life-history stages. NMFS defines a viable population as a population that has a less than 5% risk of extinction due to threats from demographic variation, non-catastrophic environmental variation, and genetic diversity changes over a 100-year time frame (NMFS 2012a).

The Recovery Plan organizes the recovery plan area into five BPGs: Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast. The BPGs were initially divided based on whether individual watersheds within them are ocean-facing systems subject to marine-based climate inversion and orographic precipitation from ocean weather patterns. Secondarily, population groups were then organized based on similarity in physical geography and hydrology. The rationale for this approach is that steelhead populations utilizing unique individual watersheds have different life histories and genetic adaptations that enable the species to persist in a diversity of different habitat types represented by the BPGs. The Recovery Plan’s strategy emphasizes larger watersheds in each BPG that are more capable of sustaining larger and more viable populations than smaller watersheds. Core 1 populations are identified as having the highest priority based on their intrinsic potential for meeting viable salmonid population criteria, the severity of the threats facing the populations, and the capacity of the watershed and population to respond to recovery actions (NMFS 2012a).

Like all federal recovery plans, the Recovery Plan for the Southern California Steelhead DPS contains recovery criteria, recovery actions, and estimates of the time and costs to achieve recovery goals. Recovery criteria are objective, measurable criteria that, when met, would result in a determination that the DPS be delisted. Recovery criteria for the Southern California Steelhead DPS Recovery are based on both DPS-level and population-level criteria. At the population level, criteria include characteristics such as mean annual run-size, spawner density, and anadromous fraction, while the DPS-level criteria are informed by the minimum number of populations that must be restored in each BPG. Recovery actions are site-specific management actions necessary to achieve recovery. Actions for the Southern California DPS are organized based on the BPG and core population approaches. High-priority recovery actions include, but are not limited to, physically modifying passage barriers such as dams to allow natural rates of migration to upstream spawning and rearing habitats, enhancing protection of natural in-channel and riparian habitats, reducing water pollutants, and conducting research to better understand the relationship between resident and anadromous forms (NMFS 2012a).

7.2.2. Forest Plans

Land Management, or Forest Plans, were developed by the United States Department of Agriculture for the southern California National Forests (the Angeles, Cleveland, Los Padres, and San Bernardino National Forests) in 2006 to provide a framework for guiding ongoing land and resource management operations. The southern California Forest Plans contain various protections for Southern SH/RT that occur within national forests. These include, but are not limited to, mitigating the effects of visitor use within watersheds occupied by steelhead, working collaboratively with federal and state agencies and water management entities to restore steelhead trout access to upstream habitat, reducing risks from wildland fires to maintain water quality, and eliminating and limiting the further spread of invasive nonnative species (USDA 2005). For example, in 2014, the Cleveland National Forest initiated an effort to restore Southern SH/RT migratory corridors in the San Juan and Santiago watersheds by removing numerous small, outdated, and non-functional concrete barriers constructed by Orange County to force groundwater to the surface (C. Swift, Emeritus, Section of Fishes Natural History Museum of Los Angeles County, personal communication; Donnell et al. 2017). Thus far, up to 81 passage barriers on Silverado, Holy Jim, Trabuco, and San Juan creeks have been removed. Forest Plans are required to be updated every 10 to 15 years. In recent years, several amendments to the Southern California National Forest Plans have been adopted in response to monitoring and evaluation, new information, and changes in conditions.

7.2.3 Habitat Conservation Plans and Natural Community Conservation Plans

A Habitat Conservation Plan (HCPs) is a planning document that authorizes the incidental take of a federally listed species when it occurs due to an otherwise lawful activity. HCPs are designed to accommodate both economic development and the permanent protection and management of habitat for species covered under the plan. At minimum, HCPs must include an assessment of the impacts likely to result from the proposed taking of one or more federally listed species, the measures that the permit applicant will undertake to monitor, minimize, and mitigate such impacts, the funding available to implement such measures, procedures to deal with unforeseen or extraordinary circumstances, alternative actions to the taking that the applicant analyzed, and the reasons why the applicant did not adopt such alternatives (USFWS 2021).

The Natural Community Conservation Planning Act authorized the Department to develop Natural Community Conservation Plans (NCCPs). NCCPs identify and provide for the regional protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. The development of a NCCP by a local agency requires significant collaboration and coordination with landowners, environmental organizations, and state and federal agencies. Most approved HCP/NCCP documents are joint documents that fulfill the requirements of both Section 10 of the ESA and the Natural Community Conservation Planning Act.

Within the range of the Southern SH/RT, there are at least nine HCP or NCCPs that are either in the implementation phase or the planning phase. The majority of HCP and NCCP plans are for the southern portion of the Southern SH/RT range and include multiple plan subareas. For example, the San Diego County Multiple Species Conservation Program contains six subareas, including the City of San Diego, Poway, Santee, La Mesa, Chula Vista, and South San Diego County. Generally, rivers, streams, and riparian vegetation communities in HCP and NCCP plan areas are considered ecologically important areas that are targeted for conservation. HCP/NCCP plans typically contain provisions to conserve fish and wildlife habitat, including fire management, invasive species control, fencing, trash removal, and annual monitoring.

7.2.4 Other Management and Restoration Plans

The Steelhead Restoration and Management Plan for California is a Department-statewide steelhead management plan that provides guidelines for steelhead restoration and management that can be incorporated into stream-specific project planning (McEwan and Jackson 1996).

https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=3490

7.3 Habitat Restoration and Watershed Management

7.3.1 Fisheries Restoration Grant Program

The goal of the Department's Fisheries Restoration Grant Program (FRGP) is to recover and conserve salmon and steelhead trout populations through restoration activities that reestablish natural ecosystem functions. The FRGP annually funds projects and activities that provide a demonstrable and measurable benefit to anadromous salmonids and their habitat; restoration projects that address factors limiting productivity as specified in approved, interim, or proposed recovery plans; effectiveness monitoring of habitat restoration projects at the watershed or regional scales for anadromous salmonids; and other projects such as outreach, coordination, research, monitoring, and assessment projects that support the goal of the program. Uniquely, the FRGP provides CWA Section 401 certification and CWA Section 404 coverage for all eligible projects funded through the program. In recent years, several FRGP proposals have been funded to support conservation efforts for Southern SH/RT, including the Upper Gaviota Fish Passage Project (2022), Life Cycle Monitoring on Topanga Creek and the Ventura River (2021), Fish Passage Barrier Removal on San Jose Creek, Gaviota Creek, and Maria Ygnacio Creek (2021), and the South Coast Steelhead Coalition (2021) (see https://wildlife.ca.gov/Grants/FRGP for more information.)

7.3.2 Proposition 68 and Proposition 1

The Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1) and the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018 (Proposition 68) authorized both the Wildlife Conservation Board and the Department to award significant grant funding to restoration projects that are intended to benefit Southern SH/RT. Both entities distribute Proposition 68 and Proposition 1 funds on a competitive basis to projects that specifically address river and stream restoration (Proposition 68; Proposition 1), Southern SH/RT habitat restoration (Proposition 68), fish and wildlife habitat restoration (Proposition 68; Proposition 1), or stream flow enhancements (Proposition 1). Proposition 68 funded projects that benefit Southern SH/RT and their habitat include the Harvey Diversion Fish Passage Restoration Project on Santa Paula Creek, the Matilija Dam Ecosystem Restoration Project on Matilija Creek, and the Santa Margarita River Fish Passage Project and Bridge Replacement. Proposition 1 funded projects include, but are not limited to, *Arundo donax* removal at the Sespe Cienega on the Santa Clara River, the Santa Clara River Riparian

Improvement, and the Integrated Water Strategies Project for Flow Enhancement in the Ventura River Watershed (WCB 2021).

7.3.3 Other Habitat Restoration Funding Sources

In addition to funding provided by the Department and Wildlife Conservation Board, Southern SH/RT conservation projects are also supported by numerous other funding sources. These sources include local, state, and federal sources such as the California Coastal Conservancy, Pacific Coastal Salmon Recovery Fund, the National Fish and Wildlife Foundation, the NOAA Restoration Center, the California Department of Water Resources Integrated Regional Water Management Plan grant program (Proposition 50), the California Natural Resources Agencies Parkways Program (Proposition 40), the CalTrans Environmental Enhancement and Mitigation Program, the Santa Barbara County Coastal Resource Enhancement Fund, and the San Diego Association of County Government TransNet Environmental Mitigation Program (NMFS 2016).

7.3.4 California Steelhead Report and Restoration Card

The California Steelhead Report and Restoration Card program has funded various types of conservation projects since 1993, including instream habitat improvement, species monitoring, outreach and education, and watershed assessment and planning. However, no restoration projects within the Southern SH/RT range were funded between 2015 and 2019, as most funds were granted to projects in more northern watersheds (CDFW 2021c).

7.3.5 Non-Governmental Organization (NGOs) Efforts

Several NGOs contribute funding and staff time to implement restoration projects for the benefit of Southern SH/RT, often with the support of federal, state, or local grants. For example, the South Coast Steelhead Coalition under the guidance of California Trout, has received grant funding from the Department's FRGP to implement several restoration projects that benefit Southern SH/RT, including the Harvey Diversion Fish Passage Project on Santa Paula Creek; the Interstate 5 Trabuco Fish Passage Project on San Juan Creek in Orange County, the Santa Margarita River Fish Passage Project on Sandia Creek in San Diego County; the Rose Valley Restoration Project on Sespe Creek; invasive vegetation removal in the Santa Clara River floodplain; and *O. mykiss* protection in the upper Santa Margarita River, West Fork San Luis Rey River, and upper tributaries to the Santa Clara and Ventura rivers (NMFS 2016). Other NGOs that promote funding and implementation of steelhead recovery actions include the Santa Clara River Steelhead Coalition under the direction of California Trout, the Tri-Counties Fish Team, the Environmental Defense Center, the San Gabriel and Lower Los Angeles Rivers Mountain Conservancy, the West Fork San Gabriel River Conservancy, and the Council for Watershed Health (San Gabriel and Los Angeles rivers). Additionally, there are many other groups or agencies that are also involved in Southern SH/RT conservation efforts: Concerned Resource and Environmental Workers; Heal the Ocean; Santa Barbara ChannelKeeper; Matilija Coalition; Ojai Valley Land Conservancy; Friends of the Ventura River; Friends of the Santa Clara River; Friends of the Los Angeles River; Friends of the Santa Monica Mountains; Heal the Bay; Friends of the Santa Margarita River; San Dieguito River Valley Conservancy; and the Endangered Habitat League (NMFS 2016).

7.3.6 Other Regional and Local Public Institution Efforts

The Southern California Wetlands Recovery Project (SCWRP) consists of directors and staff from 18 public agencies, which collectively coordinate to protect, restore, and enhance coastal wetlands and watersheds between Point Conception and the Mexican Border. The SCWRP, which was founded in 1997, is chaired by the California Natural Resources Agency with support from the California State Coastal Conservancy. The mission of the SCWRP is to expand, restore, and protect wetlands in southern California. The SCWRP is guided by long-term goals, specific implementation strategies, and quantitative objectives articulated in its 2018 regional strategy report (SCWRP 2018).

The Southern California Coastal Water Research Project (SCCWRP) is a public research and development agency whose mission is to enhance the scientific foundation for management of southern California's ocean and coastal watersheds. Since its creation in 1969, the focus of the SCCWRP has been to develop strategies, tools, and technologies to improve water quality management for the betterment of the ecological health of the region's coastal ocean and watersheds. SCCWRP research projects are guided by comprehensive annual plans for major research areas, including ecohydrology, climate change, eutrophication, microbial water quality, and stormwater best management practices (SCCWRP 2022). Currently, the SCCWRP, in cooperation with other local and state agencies, is leading the Los Angeles River Environmental Flows Project. The project's goals are to quantify the relationship between flow and aquatic life, account for flow reduction allowances to the river from multiple wastewater reclamation plants during the summer months and develop flow criteria for the Los Angeles River using the California Environmental Flows Framework.

The City of Santa Barbara supports a Creeks Restoration and Water Quality Improvement Division (Creeks Division), whose mission is to improve creek and ocean water quality and restore natural creek systems through storm water and urban runoff pollution reduction, creek restoration, and community education programs. The Creeks Division's goal for restoration includes increasing riparian vegetation and wildlife habitat, removing invasive plants, and improving water quality through shading, bank stabilization, and erosion control. The Division has completed several restoration projects in Santa Barbara County, including the Mission

Creek Fish Passage project, the Arroyo Burro Estuary and Mesa Creek restoration project, and the upper Las Positas Creek restoration project. The Creeks Division also conducts removal efforts of invasive giant reed from the Arroyo Burro, Mission, and Sycamore Creek watersheds and participates in water quality improvement projects, creek and beach cleanups, and education outreach efforts throughout Santa Barbara County.

The California Conservation Corps Fisheries Program gives U.S. military veterans opportunities to develop skills and work experience by restoring habitat for endangered salmon and steelhead and conducting fisheries research and monitoring. The program, which is a partnership between the California Conservation Corps, NMFS, and the Department, trains participants on a variety of fisheries monitoring techniques, including riparian restoration, dual-frequency identification sonar (DIDSON) techniques, adult and juvenile fish identification, downstream migrant trapping, and instream flow and habitat surveys.

7.4 Commercial and Recreational Fishing

California freshwater sport fishing regulations prohibits fishing in virtually all anadromous coastal rivers and streams in southern California that are accessible to adult steelhead. However, recreational angling for *O. mykiss* above impassable barriers is permitted in many coastal rivers and streams (CDFW 2023a). The Department has expanded its use of sterile "triploid" fish to prevent interbreeding of hatchery fish with native Southern SH/RT (NMFS 2016). The freshwater exploitation rates of Southern SH/RT are likely very low given the Department's prohibition of angling within the geographic range of the Southern California Steelhead DPS listed under the federal ESA (NMFS 2016). Additionally, sport and commercial harvest of Southern SH/RT greater than 16 inches in length in the Department's Southern Recreational Fishing Management Zone is prohibited (CDFW 2023b). All incidentally captured steelhead in the ocean must be released unharmed and should not be removed from the water.

7.5 Research and Monitoring Programs

7.5.1 California Coastal Monitoring Program

The purpose of the CMP is to gather statistically sound and biologically meaningful data on the status of California's coastal salmonid populations to inform salmon and steelhead recovery, conservation, and management activities. The CMP framework is based on four viable salmonid population metrics: abundance, productivity, spatial structure, and diversity (Adams et al. 2011; McElhany et al. 2000). Boughton et al. (2022b) updated the CMP approach for the southern coastal region to address the scientific uncertainty on Southern SH/RT ecology due to lower abundances and a more arid climate compared to more northern populations, for which the original CMP framework was designed.

Currently, the Department leads monitoring efforts in the southern coastal region, with most efforts focused on obtaining abundance estimates for anadromous adults in Core 1 and Core 2 populations (NMFS 2016). As of March 2023, Department CMP staff operate fixed-point counting stations and conduct summer-low flow juvenile surveys, redd surveys, and PIT tagging arrays on the Ventura River, Topanga Creek, and Carpinteria Creek, including the various tributaries to these watersheds. Fixed-point counting stations for anadromous adults are also operated on the Santa Ynez River and its primary tributary, Salsipuedes Creek. Redd surveys and juvenile low-flow surveys also occur in coastal watersheds of the Santa Monica Mountains, such as Big Sycamore Creek, Malibu Creek, Arroyo Sequit Creek, and Solstice Creek. Additionally, the Department conducts spawning surveys in the many watersheds of the Conception Coast, including Jalama, Gaviota, Glenn Annie, San Pedro, Maria Ygnacio, and Mission creeks. Department CMP staff anticipate expanding the number of southern coastal watersheds monitored as landowner agreements and available funding increase (K. Evans, CDFW, personal communication).

7.5.2 Other Monitoring Programs

Several special districts or local governments monitor Southern SH/RT on an annual basis in watersheds that contain federally owned or operated infrastructure. Such monitoring is often required for compliance with monitoring and reporting measures set forth in federal ESA Section 7 Biological Opinions. Although the level of monitoring effort and protocol methods vary between monitoring programs, the data produced by these special districts or local governments are often the longest time-series data available for Southern SH/RT.

The Cachuma Operation and Maintenance Board (COMB) has conducted monitoring within the Lower Santa Ynez River and its tributaries since 1994 as part of the assessment and compliance measures required in the Cachuma Project Biological Opinion. Redd and adult spawner surveys typically occur throughout the winter months, while juvenile snorkel surveys are conducted in the spring, summer, and fall months. Estuary monitoring is also periodically conducted to complement upstream trapping during the migration seasons.

Since 2005, the Casitas Mutual Water District (CMWD) has monitored fish migration at the Robles Fish Passage facility (14 miles upstream from the ocean) on the Ventura River using a VAKI Riverwatcher remote fish monitoring system. CMWD also conducts reach-specific spawner and redd surveys and snorkel surveys at index sites throughout the Ventura River watershed from the winter through late spring (Dagit et al. 2020).

The United Water Conservation District (UWCD) monitors both upstream and downstream migration at the Vern Freeman Diversion Dam (approximately 10 miles upstream from the ocean) using both video-based and motion detection surveillance systems. Monitoring occurs from January to June when streamflow in the Santa Clara River is high enough to maintain water levels at the passage facility (Booth 2016).

The Resource conservation District of the Santa Monica Mountains (RCDSMM) has monitored Arroyo Sequit, Malibu, and Topanga creeks since the early 2000s. Monitoring typically occurs from January through May and includes snorkel surveys, spawning and rearing surveys, instream habitat surveys, and periodic lagoon surveys (Dagit et al. 2019). Since 2016, the South Coast Steelhead Coalition, under the direction of California Trout, has conducted post-rain reconnaissance surveys in San Juan Creek, San Mateo Creek, the Santa Margarita River, and the San Luis Rey River (Dagit et al. 2020).

8. SUMMARY OF LISTING FACTORS

The Commission's CESA implementing regulations identify key factors relevant to the Department's analyses and the Commission's decision on whether to list a species as endangered or threatened. A species will be listed as endangered or threatened if the Commission determines that the species' continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities (Cal. Code Regs., tit. 14, § 670.1, subd. (i)). This section provides summaries of information from the preceding sections of this Status Review, arranged under each of the factors to be considered by the Commission in determining whether listing is warranted.

8.1 Present or Threatened Modification or Destruction of Habitat

The decline of Southern SH/RT can be attributed to a wide variety of human activities, including, but not limited to, urbanization, agriculture, and water development. These activities have degraded range-wide aquatic habitat conditions, particularly in the lower and middle reaches of individual watersheds (see Section 6.8). Southern California is home to over 20 million people and 1.8 million acres of urban area (DWR 2021). As a result, the majority of watersheds, currently occupied by Southern SH/RT, are highly urbanized and impacted by surface and groundwater diversions and associated agricultural, residential, and industrial uses.

Although some deleterious activities have been eliminated or mitigated, habitat conditions for Southern SH/RT have continued to deteriorate over time due to numerous stressors associated with human population growth and climate change impacts. Water diversions, storage, and conveyance for agriculture, flood control, and domestic uses have significantly reduced much of their historical spawning and rearing habitat. Water storage facilities, reservoir operations, instream diversions and groundwater extractions have altered the natural flow regime of southern California rivers and streams and have led to warmer water temperatures, shifts in aquatic community structure and composition, and reduced downstream recruitment of gravel and sediments. High road densities and the presence of in-stream artificial barriers have reduced habitat connectivity by impeding and restricting volitional fish passage in many watersheds, especially in the lower reaches. Development activities associated with agriculture, urbanization, flood control, and recreation have also substantially altered Southern SH/RT habitat quantity and quality by increasing ambient water temperatures, increasing nutrient and pollutant loading, degrading water quality, eliminating riparian habitat, and creating favorable conditions for non-native species. Range-wide and coastal estuarine habitat conditions are highly degraded and are at risk of loss and further degradation. Legal cannabis cultivation is a relatively new yet potentially serious threat to Southern SH/RT watersheds if best management practices, instream flow requirements, and diversion season regulations are not complied with. Our review of habitat conditions in southern California supports the conclusions of other review efforts, which conclude that populations continue to be at risk of extinction unless significant restoration and recovery measures are implemented (Moyle et al. 2017; NMFS 2012a).

The Department considers present or threatened modification or destruction of habitat to be a significant threat to the continued existence of Southern SH/RT.

8.2 Overexploitation

Exploitation rates of Southern SH/RT are relatively low across its range (see Section 6.9). While angling-related mortality may have historically contributed to the decline of some small populations, it is generally not considered a leading cause of the decline of the Southern California Steelhead DPS as a whole (Good et al. 2005; Busby et al. 1996; NMFS 1996b). After southern California steelhead was first listed as endangered under the federal ESA as an ESU in 1997, the Commission closed recreational fisheries for Southern SH/RT in California marine and anadromous waters with few exceptions. The closure continues, and there is currently no recreational fishery for Southern SH/RT (CDFW 2023a; CDFW 2023b).

Marine commercial driftnet fisheries in the past may have contributed slightly to localized declines; however, Southern SH/RT are not targeted in commercial fisheries and reports of incidental catch are rare. Commercial fisheries are not thought to be a leading cause of the widespread declines over the past several decades (NMFS 2012a).

Illegal harvest is likely the leading source of exploitation. Southern SH/RT are especially vulnerable to poaching due to their visibility in shallow streams. Estimates of fishing effort from self-report cards for 1993-2014 suggest extremely low levels of angling effort for Southern SH/RT (NMFS 2016; Jackson 2007). Though illegal harvest rates appear to be very low, because of low adult abundance, the removal of even a few individuals in some years could be a threat to the population (Moyle et al. 2017).

The Department does not consider overexploitation to be a substantial threat to the continued existence of Southern SH/RT, but further directed study is warranted to confirm this threat level.

8.3 Predation

Southern SH/RT experience predation in both the freshwater and marine environments, but specific predation rates, particularly in marine environments, are not well understood (see Section 6.5). While Southern SH/RT have evolved to cope with a variety of natural predators, a suite of non-native predators has also become established within its watersheds (Busby et al. 1996; NMFS 2016; Stillwater Sciences 2019; Dagit et al. 2019; COMB 2022). Established populations of non-native fishes, amphibians, and aquatic invertebrates combined with anthropogenic habitat alterations that provide favorable conditions for the persistence of these non-native species have led to increased predation rates in much of its range (NMFS 1996b). Habitat modification and degradation has also likely increased predation rates from terrestrial and avian predators (Grossman 2016; Osterback et al. 2013).

Further directed study is warranted to assess the level of impact of these predation threats on Southern SH/RT.

8.4 Competition

Southern SH/RT populations are subject to competitive forces across their range (see Section 6.6). The extent to which competition impacts the distribution, abundance, and productivity of Southern SH/RT populations is not well understood. Southern SH/RT are the only salmonid that occur in their range. Therefore, the potential for inter-specific competition with other salmonids is unlikely to occur. Interspecific competition with other non-salmonid fishes occurs to varying degrees across the Southern SH/RT range. In addition to competing with juvenile steelhead for food resources, juvenile non-native fish species can limit the distribution and abundance of juvenile steelhead. Non-native fish species can competitively exclude and confine the spatial distribution of juvenile steelhead to habitats such as shallower, higher velocity riffles, where the energetic cost to forage is higher (Rosenfeld and Boss 2001).

Further directed study is warranted to assess the level of impact of competition from non-native fish species.

8.5 Disease

Southern SH/RT survival is impacted by a variety of factors including infectious disease (see Section 6.3). A myriad of diseases caused by bacterial, protozoan, viral, and parasitic organisms can infect *O. mykiss* in both the juvenile and adult life stages (NMFS 2012a). Degraded water quality and chemistry in much of the Southern SH/RT range is likely to increase infection rates and severity (Belchik et al. 2004; Stocking and Bartholomew 2004; Crozier et al. 2008). There is very little current information available to quantify present infection and mortality rates in Southern SH/RT.

The Department does not consider disease to currently be a significant threat to the continued existence of Southern SH/RT, however further directed study is warranted to confirm the level of current and potential future impact.

8.6 Other Natural Occurrences or Human-related Activities

Southern SH/RT populations have evolved notably plastic and opportunistic survival strategies and are uniquely adapted to wide-ranging natural environmental variability, characterized by challenging and dynamic habitat conditions (Moyle et al. 2017). However, combined anthropogenic and climate change-driven impacts may ultimately outpace Southern SH/RT's capacity to adapt and persist, potentially leading to extirpation within the next 25–50-year time frame (Moyle et al. 2017; see Section 6.2). This prediction is underscored by the fact that Southern SH/RT already encounters water temperatures that approach and may, at times, exceed the upper limit of salmonid thermal tolerances, across portions of its current distribution (Moyle et al. 2017). Southern SH/RT has, therefore, been characterized as having potential for severe climate change impacts (Moyle et al. 2017). With increasing exposure to periods of higher water temperatures and flow variability, along with extended droughts, more frequent and intense wildfires, catastrophic flooding and associated sediment movement, sea level rise, and ever-increasing human demands for natural resources, the combined impacts to Southern SH/RT will be interdependent, synergistic, and are expected to intensify without intensive and timely human intervention (NMFS 2012b; Hall et al. 2018; OEHHA 2022).

Human-related activities are considered by the Department to be significant threats to the continued existence of Southern SH/RT.

9. SUMMARY OF KEY FINDINGS

Southern California steelhead (*Oncorhynchus mykiss*) inhabit coastal streams from the Santa Maria River system south to the U.S.-Mexico border. Non-anadromous resident *O. mykiss*, familiar to most as Rainbow Trout, reside in many of these same streams and interbreed with anadromous adults, contributing to the overall abundance and resilience of the populations. Southern SH/RT as defined in the Petition include both anadromous (ocean-going) and resident (stream-dwelling) forms of *O. mykiss* below complete barriers to anadromy in these streams.

Less than half of the watersheds historically occupied by Southern SH/RT remain occupied below complete barriers to anadromy, most commonly with individuals able to express only a freshwater-resident life-history strategy (NMFS et al. 2012). Adult steelhead runs have declined to precariously low levels, particularly over the past five to seven years, with declines in adult returns of 90% or more on major watersheds that historically supported the largest anadromous populations (e.g., the Santa Maria, Santa Ynez, Ventura, and Santa Clara rivers). Additionally, our analysis of resident populations indicates a sharp decline over this same time period.

While recent genetic findings suggest that the anadromous life-history form can be sustained and reconstituted from resident individuals residing in orographic drought refugia, in southern California, nearly all drought refugia habitats are currently above impassable barriers. Therefore, the anadromous phenotype is at an increasingly high risk of being entirely lost from the species within its southern California range, in large part due to the lack of migration corridors between drought refugia and the ocean, and the inability of resident progeny to successfully migrate downstream in years with sufficient rainfall and streamflow.

Southern SH/RT continues to be most at risk from habitat degradation, fragmentation, and destruction resulting from human-related activities. Specifically, dams, surface water diversions, and groundwater extraction activities restrict access to most historical spawning and rearing habitats and alter the natural flow regime of rivers and streams that sustain ecological, geomorphic, and biogeochemical functions and support the specific life history and habitat needs of Southern SH/RT. Agricultural and urban development negatively affect nearby rivers and streams through increased pollution and surface runoff, which degrade water quality and habitat conditions. Furthermore, the rapid rate of climate change and the increasing presence of non-native species present another challenge to the persistence of Southern SH/RT.

Based on the best scientific information available at the time of the preparation of this review, the Department concludes that the Southern SH/RT is in danger of extinction throughout all of its range. Intensive and timely human intervention, such as ecological restoration, dam removal, fish passage improvement projects, invasive species removal, and groundwater management, are required to prevent the further decline of Southern SH/RT. The extinction of Southern SH/RT would represent an insurmountable loss to the *O. mykiss* diversity component in California due to their unique adaptations, life histories, and genetics, which have allowed them to persist at the extreme southern end of the species' West Coast range.

10. RECOMMENDATION FOR THE COMMISSION

CESA requires the Department to prepare this report regarding the status of Southern SH/RT in California based upon the best scientific information available to the Department (Fish & G. Code, § 2074.6). CESA also requires the Department to indicate in this Status Review whether the petitioned action (i.e., listing as endangered) is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

Under CESA, an endangered species is defined as "a native species or subspecies…which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species is defined as "a native species or subspecies…that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067).

Based on the criteria described above, the best scientific information available to the Department indicates that Southern SH/RT is in serious danger of becoming extinct in all of its range due to one or more causes including: 1. present or threatened modification or destruction of habitat; and 2. other natural occurrences or human-related activities. The Department recommends that the Commission find the petitioned action to list Southern SH/RT as an endangered species to be warranted.

11. PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore, and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051, subd. (c)). If listed, unauthorized take of Southern SH/RT would be prohibited under state law. CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). Any person violating the take prohibition would be punishable under state law. The Fish and Game Code provides the Department with related authority to authorize "take" of species listed as threatened or endangered under certain circumstances (see, e.g., Fish & G. Code, §§ 2081, 2081.1, 2086, & 2835). If Southern SH/RT is listed under CESA, take resulting from activities authorized through incidental take permits must be minimized and fully mitigated according to state standards (Fish & G. Code, § 2081, subd. (b)). Take of Southern SH/RT for scientific, educational, or management purposes could be authorized through permits or memorandums of understanding pursuant to Fish and Game Code Section 2081(a).

Additional protection of Southern SH/RT following listing would also occur during required state and local agency environmental review under CEQA. CEQA requires affected public agencies to analyze and disclose project-related environmental effects, including potentially significant impacts on endangered, threatened, and rare special status species. Under CEQA's "substantive mandate," state and local agencies in California must avoid or substantially lessen significant environmental effects to the extent feasible. With that mandate, and the Department's regulatory jurisdiction generally, the Department expects related CEQA review will likely result in increased information regarding the status of Southern SH/RT in California as a result of pre-project biological surveys. Where significant impacts are identified under CEQA, the Department expects project-specific required avoidance, minimization, and mitigation measures will also benefit the species. While CEQA may require analysis of potential impacts to Southern SH/RT regardless of its listing status under CESA, the act contains specific requirements for analyzing and mitigating impacts to listed species. In common practice, potential impacts to listed species are scrutinized more in CEQA documents than are potential impacts to unlisted species. State listing, in this respect, and required consultation with the Department during state and local agency environmental review under CEQA, is expected to benefit the species by reducing impacts from individual projects to a greater degree than may occur absent listing.

CESA listing may prompt increased interagency coordination specific to Southern SH/RT conservation and protection. Listing may also increase the likelihood that state and federal land and resource management agencies will allocate additional funds toward protection and recovery actions.

12. MANAGEMENT RECOMMENDATIONS AND RECOVERY MEASURES

CESA directs the Department to include in its Status Review recommended management activities and other recommendations for recovery of Southern SH/RT (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). Department staff generated the following list of recommended management actions and recovery measures.

1. Implement comprehensive monitoring in all streams with extant Southern SH/RT populations and produce statistically robust population estimates. Fully implement the California Coastal Monitoring Program and integrate the updated south coastal region monitoring strategy (Boughton et al. 2022b) to resolve the various ecological and methodological factors that currently impede monitoring. The main features of this updated strategy are:

- Estimates of average density for each BPG;
- Research on the location and extent of drought refugia in each BPG;

- Adult steelhead abundance estimates in selected populations that are robust enough to evaluate Southern SH/RT resilience to catastrophic events and the ability to adapt over time to long-term environmental changes;
- Adult *O. mykiss* abundance estimates that are sufficient to develop an estimate for total abundance in the region; and
- Greater emphasis on monitoring methods that are unbiased or can be corrected for bias (NMFS 2016).

2. Support and participate in the development of watershed-specific plans to effectively maintain and restore Southern SH/RT habitat by focusing on the combination of factors currently limiting their distribution and abundance, such as dams, agriculture, and water extraction. This includes continuing to coordinate and collaborate with NMFS, NGOs, state and local governments, landowners, and other interested entities to implement recovery actions identified in the 2012 Recovery Plan for the southern California Steelhead DPS and other management and conservation strategies. High priority actions include (NMFS 2012a):

- Remove manmade passage barriers in all population watersheds and re-establish access to upper watersheds in both small coastal streams and the larger interior rivers within each BPG identified in the federal Recovery Plan;
- Establish fishways or assisted migration practices at manmade passage barriers that cannot be removed in the near-term with an emphasis on re-establishing passage for above-barrier populations that still contain significant native ancestry;
- Complete planning and removal of Matilija Dam on Matilija Creek and Rindge Dam on Malibu Creek;
- Provide ecologically meaningful flows below major dams and diversions in all population watersheds by re-establishing adequate flow regimes and restoring groundwater aquifers in dewatered areas to sustain surface flows in both small coastal streams and large interior rivers;
- Reevaluate the efficacy of existing fish passage structures at instream surface water diversions, dams, culverts, weirs, canals, and other infrastructure in all watersheds historically and currently occupied by Southern SH/RT; and
- Minimize the adverse effects of exotic and non-native plant and animal species on aquatic ecosystems occupied by Southern SH/RT through direct removal and control efforts.

3. Improve and expand suitable and preferred habitat used by Southern SH/RT for summer holding, spawning, and juvenile rearing. Prioritize habitat restoration, protection, and enhancement in Southern SH/RT holding, spawning, and rearing areas. Habitat projects should focus on improving habitat complexity, riparian cover, fish passage, and sediment transport, as

well as enhancing essential deep, cold-water habitats for holding adults. Restoration should also be considered in potential habitats not currently occupied by Southern SH/RT.

4. Continue research on *Omy5* haplotypes and other relevant genomic regions to better understand: the mechanism for anadromy in Southern SH/RT, the impact of migration barriers on the frequency of the "A" haplotype in individuals, and the risk of progressively losing the genetic basis for anadromy over time in above-barrier populations despite the current presence of the "A" haplotype.

5. Continue to investigate the population structure and ancestry of Southern SH/RT at the extreme southern end of the species distribution in southern California, including further research on identifying genetically introgressed populations and the potential benefit of these populations for maintaining the persistence of viable networks of Southern SH/RT, given recent findings of limited native ancestry in the region and the importance of variation in adaptation.

6. Initiate research into Southern SH/RT ecology identified in the Southern California Steelhead Recovery Plan (NMFS 2012a). Important research topics include:

- Environmental factors that influence anadromy;
- The relationship between migration corridor reliability and anadromous fraction;
- Identification of nursery habitat types that promote juvenile growth and survival;
- The role of seasonal lagoons and estuaries in the life history of Southern SH/RT and the extent to which these areas are used by juveniles prior to emigration;
- Investigation on the role that mainstem habitats play in the life history of steelhead, including identification of the ecological factors that contribute to mainstem habitat quality;
- The role of naturally intermittent creeks and stream reaches;
- Determining whether spawner density is a reliable indicator of a viable population;
- Determining the frequency of return adult spawners;
- Recolonization rates of extirpated watersheds by source populations;
- Dispersal rates between watersheds, including interactions among and between populations through straying;
- Intra-and interannual variation in diet composition and growth rate; and
- Partial migration and life-history crossovers.

7. Formalize minimization and avoidance measures on a Department-wide basis to minimize incidental take of the CESA-listed species due to otherwise lawful activities resulting from construction, research, management, and enhancement activities. This includes working with federal agencies to coordinate and develop efficient permitting processes for incidental take authorization for actions that contribute to the recovery of Southern SH/RT.

8. Explore other means of conserving individual populations of Southern SH/RT that may face the risk of extirpation due to catastrophic events, such as wildfires, droughts, and oil spills (e.g., conservation translocations to other existing facilities at academic institutions or museums, or natural refugia habitats). This includes ensuring that translocations of Southern SH/RT conducted by the Department for conservation purposes significantly contribute to species and ecosystem conservation and are planned, executed, and supported in a manner consistent with best scientific practices and the Department's Policy and Procedures for Conservation Translocations of Animals and Plants (CDFW 2017).

9. Strengthen law enforcement in areas occupied by Southern SH/RT to reduce threats of poaching, illegal water diversions, and instream work used for cannabis cultivation.

10. Evaluate current fishing regulations to determine any potential changes that could be implemented for further protection of Southern SH/RT, and update regulations, using clear and transparent communication, in response to restoration actions, such as dam removal projects, that could change the sport fishing regulation boundary (e.g., inland anadromous waters).

11. Conduct a robust outreach and education program that works to engage with tribes and interested parties, including federal, state, local, NGOs, landowners, underserved communities, and interested individuals, to promote and implement conservation actions. This includes developing outreach and educational materials to increase public awareness and knowledge of the ecological and societal benefits that can be gained by recovering Southern SH/RT.

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Personal Communication

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APPENDIX A: ANNUAL *O. MYKISS* OBSERVATIONS AND DATA SOURCES FOR THREE EXTANT POPULATIONS IN THE CONCEPTION COAST BPG.

Year	Arroyo Sequit Creek[a]	Topanga Creek[b]	Malibu Creek[b]
2001	0	2	NA
2002	0	95	NA
2003	0	59	NA
2004	0	103	230
2005	0	71	87
2006	0	170	80
2007	0	86	12
2008	0	316	2,245
2009	0	209	130
2010	0	253	160
2011	0	114	281
2012	0	96	156
2013	0	56	99
2014	0	57	31
2015	0	59	32
2016	0	34	7
2017	0	98	6
2018	0	55	1
2019	NA	160	0
Total	0	2,093	3240

"NA" indicates no survey conducted or data not yet available.

[a] Source: Dagit et al. (2019)

[b] Source: Dagit et al. (2019). Sum of the average number of *O. mykiss* observed per month.

APPENDIX B: ANNUAL ADULT STEELHEAD OBSERVATIONS AND DATA SOURCES FOR THREE EXTANT POPULATIONS IN THE CONCEPTION COAST BPG.

Year	Arroyo Sequit Creek[a]	Topanga Creek[b]	Malibu Creek[c]
2001	0	2	NA
2002	0	0	NA
2003	0	0	NA
2004	0	0	0
2005	0 [d]	0	0
2006	0 [d]	1	1
2007	0 [d]	2	2
2008	0 [d]	2	4
2009	0 [d]	1	1
2010	0 [d]	1	2
2011	0 [d]	0	2
2012	0 [d]	1	3
2013	0 [d]	0	3
2014	0 [d]	0	5
2015	0 [d]	0	1
2016	0 [d]	0	0
2017	2	2	1
2018	0	0	0
2019	NA	0	0
Total	2	12	25

"NA" indicates no survey conducted or data not yet available.

[a] Source: Dagit et al. 2020

[b] Source: Dagit et al. (2019; 2020)

[c] Source: Dagit et al. (2019;2020)

[d] Passage barriers prevented access to Arroyo Sequit from 2005-2016. Two adult observations occurred after the removal of barriers (Dagit et al. 2019).

APPENDIX C: ANNUAL *O. MYKISS* OBSERVATIONS AND DATA SOURCES FOR FOUR EXTANT POPULATIONS IN THE MONTE ARIDO HIGHLANDS BPG.

Year	Santa Maria River[a]	Santa Ynez River[b]	Ventura River[c]	Santa Clara River[d]	
1994	NA	NA	NA	87	e
1995	NA	NA	NA	115	e
1996	NA	NA	NA	96	e
1997	NA	NA	NA	422	e
1998	NA	NA	NA	6	e
1999	NA	NA	NA	5	e
2000	NA	NA	NA	876	e
2001	NA	266	NA	124	e
2002	NA	116	NA	3	e
2003	NA	196	NA	41	
2004	NA	238	NA	3	
2005	NA	117	0	NA	
2006	NA	653	17	21	
2007	NA	665	63	74	
2008	NA	561	47	157	
2009	NA	610	807	170	
2010	NA	367	147	100	
2011	NA	484	640	23	
2012	NA	199*	378	96	
2013	NA	NA	17	1	
2014	NA	137*	14	19	
2015	NA	134*	65	NA	
2016	NA	103*	14	NA	
2017	NA	5*	9	NA	
2018	NA	27*	1	NA	
2019	NA	39*	0	NA	
2020	NA	147*	0	NA	
2021	NA	205*	0	NA	

"NA" indicates no survey conducted or data not yet available.

* NMFS Incidental Take provisions in place. Take limits have not been exceeded since 2014.

[a] Source: Santa Maria River does not appear to be monitored for any viability metrics (NMFS 2016)

[b] Source: COMB (2022). Data represent the total number of upstream and downstream migrant captures at three trapping locations in the Lower Santa Ynez River basin for each water year (WY).

[c] Source: CMWD (2005-2021). Data are derived from snorkel counts and bankside observations from index reaches of the Ventura River near the Robles Diversion.

[d] Source: Booth (2016)

[e] Inconsistent monitoring from 1994-2002 (Booth 2016)

APPENDIX D: ANNUAL ADULT STEELHEAD OBSERVATIONS AND DATA SOURCES FOR FOUR EXTANT POPULATIONS IN THE MONTE ARIDO HIGHLANDS BPG.

Year	Santa Maria River[a]	Santa Ynez River[b]	Ventura River[c]	Santa Clara River[d]	
1994	NA	NA	NA	1	e
1995	NA	0	NA	1	e
1996	NA	0	NA	2	e
1997	NA	2	NA	0	e
1998	NA	1	NA	0	e
1999	NA	3	NA	1	e
2000	NA	0	NA	2	e
2001	NA	4	NA	2	e
2002	NA	0	NA	0	e
2003	NA	1	NA	0	
2004	NA	0	NA	0	
2005	NA	1	NA	0	
2006	NA	1	4	0	
2007	NA	0	4	0	
2008	NA	16	6	2	
2009	NA	1	0	2	
2010	NA	1	1	0	
2011	NA	9	0	0	
2012	NA	0	0	3	
2013	NA	NA	0	0	
2014	NA	0	0	0	
2015	NA	0	0	0	
2016	NA	0	0	0	
2017	NA	0	0	0	
2018	NA	0	0	0	
2019	NA	0	1	NA	
2020	NA	0	0	NA	
2021	NA	0	1	NA	

"NA" indicates no survey conducted or data not yet available.

[a] Source: Santa Maria River does not appear to be monitored for any viability metrics (NMFS 2016)

[b] Source: Dagit et al. (2020), COMB (2022)

[c] Source: Dagit et al. (2020), CDFW R5 internal data from DIDSON monitoring (2019, 2021)

[d] Source: Dagit et al. (2020), Booth (2016)

[e] Inconsistent monitoring from 1994-2002 (Booth 2016)

APPENDIX E. COMMENTS FROM TRIBES AND AFFECTED AND INTERESTED PARTIES ON THE PETITIONED ACTION.

Pursuant to Fish and Game Code 2074.4, the California Department of Fish and Wildlife (Department) and the California Fish and Game Commission (Commission) notified Tribes and affected and interested parties and solicited data and comments on the petitioned action to list Southern California steelhead as endangered under the California Endangered Species Act (CESA).

Native American Tribal Engagement

- From July 13, 2022, to July 15, 2022, the Department distributed by email and mail the attached notices to 309 Tribes notifying them of the Southern California steelhead's candidacy and to request information and comments on the petitioned action. From August 17, 2022, to September 1, 2022, the Department sent follow-up emails to 82 Tribes.
- On February 2, 2023, The Department hosted a virtual Tribal listening session.
- The Department responded to 2 requests for government-to-government consultation and 1 request for a meeting presentation.

Public Notification

- On May 11, 2022, the Commission published a Notice of Findings regarding the candidacy and status review of the Southern California steelhead in the California Regulatory Notice Register (Cal. Reg. Notice Register 2022, No. 19-Z, p. 541).
- The Department distributed by email, on July 15, 2022, and mail, on July 20, 2022, the attached public notice to approximately 152 non-governmental organizations, universities, and local, county, state, and federal entities within the range of Southern California steelhead, notifying them of the Southern California steelhead candidacy and to request information and comments on the petitioned action.
- On July 15, 2022, the Department distributed the attached press release to an email listserv maintained by the Department's Office of Communication, Education and Outreach, and posted the press release to the Department's News Room website, notifying the public of Southern California steelhead's candidacy and to request information and comments on the petitioned action.

Summary of Comments Received

The Department received 17 comments from Tribes. The Department received 480 emails from the public, with 464 emails expressing support for the listing of Southern California steelhead under CESA. Of these emails expressing support, 20 were originally drafted non-format letters. The Department received 12 submissions of information, including 35 literature and data sources, and a list of 2 recommended peer reviewers.

All communications are on file with the Department and can be provided on request by emailing SCSH@wildlife.ca.gov.

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Fisheries Branch
P.O. Box 944209
Sacramento, CA 94244-2090
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

July 13, 2022

[redacted]

NOTIFICATION OF STATUS REVIEW FOR SOUTHERN CALIFORNIA STEELHEAD UNDER THE CALIFORNIA ENDANGERED SPECIES ACT

Dear [redacted]:

NOTICE IS HEREBY GIVEN that the California Department of Fish and Wildlife (Department) has initiated a status review for Southern California steelhead (*Oncorhynchus mykiss*) pursuant to Fish and Game Code section 2074.6. The Department is providing this notice pursuant to Fish and Game Code section 2074.4 to solicit data and comments on the petitioned action from your Tribe. The Department is also providing this notice pursuant to the Department's Tribal Communication and Consultation Policy to notify your Tribe of this status review process and offer your Tribe government-to-government consultation.

The Department has initiated this status review following related action by the Fish and Game Commission (Commission). On May 13, 2022, the Commission provided public notice that Southern California steelhead is now a candidate species under the California Endangered Species Act (CESA) and as such, receives the same legal protection afforded to an endangered or threatened species. (Cal. Reg. Notice Register 2022, No. 19-Z, p. 541; Fish & G. Code, §§ 2074.2, 2085.) The listing petition defines Southern California steelhead as all *O. mykiss*, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico Border. The listing petition and the Department's petition evaluation report are available at the following Commission webpage: https://fgc.ca.gov/CESA#SCS.

The Department seeks to understand Tribal interests and work collaboratively to include any data or comments on the petitioned action, including Southern California steelhead ecology, genetics, life history, distribution, abundance, habitat, the degree and immediacy of threats to its reproduction or survival, the adequacy of existing management, or recommendations for management of the species during development of the status review. Please submit such data or comments to the Department via email at SCSH@wildlife.ca.gov and include "Southern California Steelhead" in the subject line. Such data or comments may also be submitted to the Department by mail addressed to "Attn: Southern California Steelhead" at the address in the letterhead of this notification.

The Department has twelve months to review the petition, evaluate the best available scientific information relating to the species, and report back to the Commission on whether the petitioned action is warranted or is not warranted. (Fish & G. Code, § 2074.6.) After the Department transmits the report to the Commission, the Commission will place receipt of the report on the agenda for the next available Commission meeting. The report will be made available to the public for that meeting. Following receipt of the report, the Commission will schedule the petition for further consideration at its next available meeting. Pursuant to Fish and Game Code section 2075.5, the Commission—which is a legally separate entity from the Department—is charged with making the final determination on whether to list a species as endangered or threatened under CESA. The Department serves in an exclusively advisory role to the Commission during this process.

The Department welcomes direct communication and consultation to discuss the status review for Southern California steelhead and to identify any impacts to Tribal interests or cultural resources. The Department is committed to open communication with your Tribe under its Tribal Communication and Consultation Policy, which is available through the Department's Tribal Affairs webpage at: https://www.wildlife.ca.gov/General-Counsel/Tribal-Affairs. If you would like to provide input directly to the final decision makers, the Department encourages you to contact Commission staff about consultation with the Commission and to attend and participate in the Commission's meeting to determine whether to list Southern California steelhead as endangered under CESA. To request formal consultation with the Commission please contact Executive Director Melissa Miller-Henson at [redacted]. For general inquiries and other non-consultation matters, please contact the Commission's Tribal Advisor & Liaison, Chuck Striplen, at [redacted].

To request formal government-to-government consultation with the Department pursuant to the Department's Tribal Communication and Consultation Policy, please contact the Department's Tribal Liaison by email at tribal.liaison@wildlife.ca.gov or by mail at Attention: Tribal Liaison, California Department of Fish and Wildlife, P.O. Box 944209, 94244-2090. Please designate and provide contact information for the appropriate Tribal lead person.

The Department respectfully requests that you respond to this notice expressing your interest in meeting with us or in providing your preliminary input on the petitioned action before September 30, 2022, to allow sufficient time for the Department to evaluate that input in the Department's Southern California steelhead status review. The Department also respectfully requests that if your Tribe intends to request formal government-to-government consultation, your Tribe do so before September 30, 2022. If you would like more information on the status review, please contact Vanessa Gusman, Senior Environmental Scientist (Specialist) at SCSH@wildlife.ca.gov or at the address in the letterhead.

We look forward to your response and input on this status review.

Sincerely,

DocuSigned by:
Jay Rowan
2113A9B7822F42D...

Jay Rowan, Fisheries Branch Chief

ec: California Department of Fish and Wildlife

Chad Dibble
Deputy Director, Wildlife and Fisheries Division
[redacted]

Department Tribal Liaison
tribal.liaison@wildlife.ca.gov

Ed Pert
Regional Manager, South Coast Region
[redacted]

Jonathan Nelson
Environmental Program Manager, Fisheries Branch
[redacted]

Richard Burg
Environmental Program Manager, South Coast Region
[redacted]

Rob Titus
Senior Environmental Scientist (Supervisor), Fisheries Branch
[redacted]

Vanessa Gusman
Senior Environmental Scientist (Specialist), Fisheries Branch
[redacted]

State of California – Natural Resources Agency
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www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

July 13, 2022

[redacted]

NOTIFICATION OF STATUS REVIEW FOR SOUTHERN CALIFORNIA STEELHEAD UNDER THE CALIFORNIA ENDANGERED SPECIES ACT

Dear [redacted]:

NOTICE IS HEREBY GIVEN that the California Department of Fish and Wildlife (Department) has initiated a status review for Southern California steelhead (*Oncorhynchus mykiss*) pursuant to Fish and Game Code section 2074.6. The Department is providing this notice pursuant to Fish and Game Code section 2074.4 to solicit data and comments on the petitioned action from your Tribe. The Department is also providing this notice pursuant to the Department's Tribal Communication and Consultation Policy to notify your Tribe of this status review process and offer your Tribe consultation.

The Department has initiated this status review following related action by the Fish and Game Commission (Commission). On May 13, 2022, the Commission provided public notice that Southern California steelhead is now a candidate species under the California Endangered Species Act (CESA) and as such, receives the same legal protection afforded to an endangered or threatened species. (Cal. Reg. Notice Register 2022, No. 19-Z, p. 541; Fish & G. Code, §§ 2074.2, 2085.) The listing petition defines Southern California steelhead as all *O. mykiss*, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico Border. The listing petition and the Department's petition evaluation report are available at the following Commission webpage: https://fgc.ca.gov/CESA#SCS.

The Department seeks to understand Tribal interests and work collaboratively to include any data or comments on the petitioned action, including Southern California steelhead ecology, genetics, life history, distribution, abundance, habitat, the degree and immediacy of threats to its reproduction or survival, the adequacy of existing management, or recommendations for management of the species during development of the status review. Please submit such data or comments to the Department via email at SCSH@wildlife.ca.gov and include "Southern California Steelhead" in the subject line. Such data or comments may also be submitted to the Department by mail addressed to “Attn: Southern California Steelhead” at the address in the letterhead of this notification.

The Department has twelve months to review the petition, evaluate the best available scientific information relating to the species, and report back to the Commission on whether the petitioned action is warranted or is not warranted. (Fish & G. Code, § 2074.6.) After the Department transmits the report to the Commission, the Commission will place receipt of the report on the agenda for the next available Commission meeting. The report will be made available to the public for that meeting. Following receipt of the report, the Commission will schedule the petition for further consideration at its next available meeting. Pursuant to Fish and Game Code section 2075.5, the Commission—which is a legally separate entity from the Department—is charged with making the final determination on whether to list a species as endangered or threatened under CESA. The Department serves in an exclusively advisory role to the Commission during this process.

The Department welcomes direct communication and consultation to discuss the status review for Southern California steelhead and to identify any impacts to Tribal interests or cultural resources. The Department is committed to open communication with your Tribe under its Tribal Communication and Consultation Policy, which is available through the Department’s Tribal Affairs webpage at: https://www.wildlife.ca.gov/General-Counsel/Tribal-Affairs. If you would like to provide input directly to the final decision makers, the Department encourages you to contact Commission staff about consultation with the Commission and to attend and participate in the Commission’s meeting to determine whether to list Southern California steelhead as endangered under CESA. To request formal consultation with the Commission please contact Executive Director Melissa Miller-Henson at [redacted]. For general inquiries and other non-consultation matters, please contact the Commission’s Tribal Advisor & Liaison, Chuck Striplen, at [redacted].

To request formal consultation with the Department pursuant to the Department’s Tribal Communication and Consultation Policy, please contact the Department’s Tribal Liaison by email at tribal.liaison@wildlife.ca.gov or by mail at Attention: Tribal Liaison, California Department of Fish and Wildlife, P.O. Box 944209, 94244-2090. Please designate and provide contact information for the appropriate Tribal lead person.

The Department respectfully requests that you respond to this notice expressing your interest in meeting with us or in providing your preliminary input on the petitioned action before September 30, 2022, to allow sufficient time for the Department to evaluate that input in the Department’s Southern California steelhead status review. The Department also respectfully requests that if your Tribe intends to request formal consultation, your Tribe do so before September 30, 2022. If you would like more information on the status review, please contact Vanessa Gusman, Senior Environmental Scientist (Specialist) at SCSH@wildlife.ca.gov or at the address in the letterhead.

We look forward to your response and input on this status review.

Sincerely,

DocuSigned by:
Jay Rowan
2113A9B7822F42D...

Jay Rowan, Fisheries Branch Chief

ec: California Department of Fish and Wildlife

Chad Dibble
Deputy Director, Wildlife and Fisheries Division
[redacted]

Department Tribal Liaison
tribal.liaison@wildlife.ca.gov

Ed Pert
Regional Manager, South Coast Region
[redacted]

Jonathan Nelson
Environmental Program Manager, Fisheries Branch
[redacted]

Richard Burg
Environmental Program Manager, South Coast Region
[redacted]

Rob Titus
Senior Environmental Scientist (Supervisor), Fisheries Branch
[redacted]

Vanessa Gusman
Senior Environmental Scientist (Specialist), Fisheries Branch
[redacted]

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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

July 15, 2022

NOTICE OF STATUS REVIEW FOR SOUTHERN CALIFORNIA STEELHEAD UNDER THE CALIFORNIA ENDANGERED SPECIES ACT

NOTICE IS HEREBY GIVEN that the California Department of Fish and Wildlife (Department) has initiated a status review for Southern California steelhead (*Oncorhynchus mykiss*) pursuant to Fish and Game Code section 2074.6. The Department is providing this notice pursuant to Fish and Game Code section 2074.4 to notify affected and interested parties and to solicit data and comments on the petitioned action.

The Department has initiated this status review following related action by the Fish and Game Commission (Commission). On May 13, 2022, the Commission provided public notice that Southern California steelhead is now a candidate species under the California Endangered Species Act (CESA) and as such, receives the same legal protection afforded to an endangered or threatened species. (Cal. Reg. Notice Register 2022, No. 19-Z, p. 541; Fish & G. Code, §§ 2074.2, 2085.) The listing petition defines Southern California steelhead as all *O. mykiss*, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico Border. The listing petition and the Department's petition evaluation report are available at the following Commission webpage: https://fgc.ca.gov/CESA#SCS.

As of May 13, 2022, take of Southern California steelhead (hunt, pursue, catch, capture, or kill, or attempt to do so) is prohibited. (Fish & G. Code, § 86). However, incidental take may be authorized with appropriate permits. (Fish & G. Code, §§ 2081(b), 2080.1, 2089.2 et. seq., or 2086.) Activities conducted for scientific, educational, or management purposes (including research and restoration) that may result in take of this species can be authorized through permits or memorandums of understanding (Fish & G. Code § 2081(a)). For information on potential pathways for authorization to take Southern California steelhead, please contact the Department at SCSH@wildlife.ca.gov.

The Department invites data or comments on the petitioned action, including Southern California steelhead ecology, genetics, life history, distribution, abundance, habitat, the degree and immediacy of threats to its reproduction or survival, the adequacy of existing management, or recommendations for management of the species. Please submit such data or comments to the Department via email at SCSH@wildlife.ca.gov and include "Southern California Steelhead" in the subject line. Such data or comments may also be submitted to the Department by mail addressed to "Attn: Southern California Steelhead" at the address in the letterhead of this notice.

The Department has twelve months to review the petition, evaluate the best available scientific information relating to the species, and report back to the Commission on whether the petitioned action is warranted or is not warranted. (Fish & G. Code, § 2074.6.) After the Department transmits the report to the Commission, the Commission will place receipt of the report on the agenda for the next available Commission meeting. The report will be made available to the public for that meeting. Following receipt of the report, the Commission will schedule the petition for further consideration at its next available meeting.

The Department respectfully requests that you submit any data or comments on the petitioned action before September 30, 2022, to allow sufficient time for the Department to evaluate those data or comments in the Department's Southern California steelhead status review.

If you have any questions regarding this notice, please contact the Department via email at SCSH@wildlife.ca.gov.

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

July 15, 2022

Anthony Spina
Chief, Southern California Branch
National Oceanic and Atmospheric Administration
National Marine Fisheries Service, West Coast Region
[redacted]

NOTIFICATION OF STATUS REVIEW FOR SOUTHERN CALIFORNIA STEELHEAD UNDER THE CALIFORNIA ENDANGERED SPECIES ACT

Dear Mr. Anthony Spina:

The purpose of this letter is to notify the National Oceanic and Atmospheric Administration (NOAA) Fisheries that the California Department of Fish and Wildlife (Department) has initiated a status review for Southern California steelhead (*Oncorhynchus mykiss*) pursuant to Fish and Game Code section 2074.6. The Department is providing this notification pursuant to Fish and Game Code section 2074.4 to notify affected and interested parties and to solicit data and comments on the petitioned action.

The Department has initiated this status review following related action by the California Fish and Game Commission (Commission). On May 13, 2022, the Commission provided public notice that Southern California steelhead is now a candidate species under the California Endangered Species Act (CESA) and as such, receives the same legal protection afforded to an endangered or threatened species. (Cal. Reg. Notice Register 2022, No. 19-Z, p. 541; Fish & G. Code, §§ 2074.2, 2085.) The listing petition defines Southern California steelhead as all *O. mykiss*, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico Border. The listing petition and the Department's petition evaluation report are available at the following Commission webpage: https://fgc.ca.gov/CESA#SCS.

The Department invites NOAA Fisheries to provide data or comments on the petitioned action, including Southern California steelhead ecology, genetics, life history, distribution, abundance, habitat, the degree and immediacy of threats to its reproduction or survival, the adequacy of existing management, or recommendations for management of the species. Please submit such data or comments to the Department contact via email at SCSH@wildlife.ca.gov and include "Southern California Steelhead" in the subject line. Such data or comments may also be submitted by mail addressed to "Attn: Southern California Steelhead" at the address in the letterhead of this notification.

The Department has twelve months to review the petition, evaluate the best available information relating to the species, and report back to the Commission on whether the petitioned action is warranted or is not warranted. (Fish & G. Code, § 2074.6.) After the Department transmits the report to the Commission, the Commission will place receipt of the report on the agenda for the next available Commission meeting. The report will be made available to the public for that meeting. Following receipt of the report, the Commission will schedule the petition for further consideration at its next available meeting.

The Department respectfully requests that you submit any data or comments on the petitioned action before September 30, 2022, to allow sufficient time for the Department to evaluate those data or comments in the Department's Southern California steelhead status review.

If you have any questions regarding this notification or would like more information on the Southern California steelhead status review, please contact Vanessa Gusman, Senior Environmental Scientist (Specialist), at SCSH@wildlife.ca.gov.

We look forward to your response and input on this status review.

Sincerely,

DocuSigned by:
Jay Rowan
2113A9B7822F42D...
Jay Rowan, Fisheries Branch Chief

ec: California Department of Fish and Wildlife

Chad Dibble
Deputy Director, Wildlife Fisheries Division
[redacted]

Ed Pert
Regional Manager, South Coast Region
[redacted]

Jonathan Nelson
Environmental Program Manager, Fisheries Branch
[redacted]

Richard Burg
Environmental Program Manager, South Coast Region
[redacted]

Rob Titus
Senior Environmental Scientist (Supervisor), Fisheries Branch
[redacted]

Vanessa Gusman
Senior Environmental Scientist (Specialist), Fisheries Branch
[redacted]

California Department of Fish and Wildlife News Release

July 15, 2022

Media Contacts:
Kirsten Macintyre, CDFW Communications, [redacted]

Public Invited to Comment on Petition to List Southern California Steelhead as Endangered

The California Department of Fish and Wildlife (CDFW) has initiated a status review for Southern California steelhead and invites data or comments on a petition to list Southern California steelhead as an endangered species under the California Endangered Species Act (CESA).

Southern California steelhead (*Oncorhynchus mykiss*) are found in streams from the Santa Maria River at the southern county line of San Luis Obispo County down to the U.S.-Mexico border. Southern California steelhead as defined in the CESA petition include both anadromous (ocean-going) and resident (stream-dwelling) forms of the species below complete migration barriers in these streams.

Major threats to Southern California steelhead include destruction, modification and fragmentation of habitat due to anthropogenic water use (i.e., dams or diversions for the purposes of providing water for human use) and climate change impacts like increased stream temperatures and intensified drought conditions. Southern California steelhead represent an important steelhead diversity component in California due to their unique adaptations, life histories and genetics.

On June 14, 2021, California Trout submitted a petition to the California Fish and Game Commission to list Southern California steelhead as an endangered species under CESA. On April 21, 2022, the Commission accepted that petition for consideration. On May 13, 2022, the Commission provided public notice that Southern California steelhead is now a candidate species under CESA and as such, receives the same legal protection afforded to an endangered or threatened species. The listing petition and CDFW's petition evaluation report are available on the Commission website.

CDFW invites data or comments on the petitioned action, including Southern California steelhead ecology, genetics, life history, distribution, abundance, habitat, the degree and immediacy of threats to its reproduction or survival, the adequacy of existing management or recommendations for management of the species. Data or comments may be submitted via email to SCSH@wildlife.ca.gov. Please include "Southern California Steelhead" in the subject line. Submissions may also be sent to:

CDFW Fisheries Branch

Attn: Southern California Steelhead
P.O. Box 944209
Sacramento, California 94244-2090

Submissions must be received by Sept. 30. CDFW has 12 months to review the petition, evaluate the best available scientific information relating to Southern California steelhead and make a recommendation to the Commission. The Commission will then place receipt of the report on the agenda for the next available Commission meeting. The report will be made available to the public for that meeting, where the Commission will schedule the petition for further consideration.

For more information on the petition, please visit the Commission website.

###

APPENDIX F: PEER REVIEW SUMMARY

Pursuant to Fish and Game Code Section 2074.6, the review process included independent peer review of the draft Status Review by persons in the scientific/academic community acknowledged to be experts on Southern SH/RT and related topics and possessing the knowledge and expertise to critique the scientific validity of the Status Review contents. This Appendix contains the specific input provided to the Department by the individual peer reviewers, the Department's written response to the input, and any amendments made to the Status Review (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)). Independent experts that reviewed the Status Review are listed in Table 1 below.

Table 1. Status Review Peer Reviewers

Name	**Affiliation**
Dr. David Boughton	National Marine Fisheries Service
Alan Byrne	Idaho Department of Fish and Game
Dr. Devon Pearse	National Marine Fisheries Service
Dr. Matthew Sloat	Wild Salmon Center
Dr. Camm Swift	Emeritus, Section of Fishes, Natural History Museum of Los Angeles County

The following pages of this appendix contain the letters and draft version of this Status Review sent by the Department to peer reviewers. A table of consolidated peer reviewer comments (arranged by page and line number) and Department responses to those comments is also included at the end of this appendix.

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Fisheries Branch
P.O. Box 944209
Sacramento, CA 94244-2090
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

August 21, 2023

Dr. David Boughton
NOAA Fisheries, Southwest Fisheries Science Center
[redacted]

Subject: PEER REVIEW OF THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE'S REPORT ON THE STATUS OF SOUTHERN CALIFORNIA STEELHEAD

Dear Dr. Boughton,

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife's (Department) draft status review report for Southern California steelhead (*Oncorhynchus mykiss*). The Department seeks your input regarding the assessments and conclusions in this draft status review report based on the best scientific information currently available. Please keep the enclosed report and your review of it confidential until the final report is made public upon receipt by the California Fish and Game Commission (Commission) as an agenda item at a public Commission meeting. Please note that your review will be appended to the final status review report and made public upon receipt by the Commission. **The Department requests your review on or before September 20, 2023.**

The Department seeks your scientific peer review as part of formal proceedings pending before the Commission under the California Endangered Species Act (CESA). The Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to add species to or remove species from the endangered or threatened species lists (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, directed by the Fish and Game Code to evaluate the status of the species based on the best scientific information available to the Department and make a recommendation to the Commission as to whether the petitioned action is warranted (Fish & G. Code, § 2074.6).

The Commission first received the petition to list the Southern California steelhead under CESA on June 14, 2021. After considering the Department's evaluation of the petition, the Commission formally accepted the petition for consideration on April 20-21, 2022, thereby designating Southern California steelhead as a candidate for listing as endangered under CESA. As a candidate species, Southern California steelhead currently receives the same protections under CESA as an endangered or threatened species. Formal acceptance of the petition triggered the Department's initiation of the status review.

The draft status review report forwarded to you today reflects the Department's effort to identify and analyze the best scientific information available regarding the status of Southern California steelhead in California. This status review report is not intended to be an exhaustive review of all published literature relevant to the species. Rather, it is intended to summarize the best scientific information available relevant to the status of the species, to provide that information to the Commission, and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted.

The Department's preliminary recommendation is that the petitioned action to list Southern California steelhead is warranted. However, we underscore that scientific peer review plays a critical role in the Department's analysis and effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our analysis and expected recommendation to the Commission may change or be modified following peer review.

During your review, we ask that you assess whether the body of available information supports the Department's listing recommendation. We ask also that you consider CESA and its implementing regulations as summarized in the following paragraphs.

Under CESA, an endangered species is defined as "a native species or subspecies…which is in serious danger of becoming extinct throughout all, or a significant portion of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species is defined as "a native species or subspecies…that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish & G. Code, § 2067).

CESA's implementing regulations state that a species shall be listed as endangered or threatened if the Commission determines that its continued existence is threatened by one or more of the following components: (1) present or threatened modification or destruction of its habitat, (2) overexploitation, (3) predation, (4) competition, (5) disease, or (6) other natural occurrences or human-related activities (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)).

Following receipt and consideration of peer review comments, the Department will prepare and submit its final status review report and related recommendation to the Commission. After at least a 30-day public review period, the Commission will consider the petition, the Department's status review, related recommendations including peer review comments, and public testimony during a regularly scheduled Commission meeting prior to making its decision.

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Thank you again for your contribution to the status review and this important step in the CESA listing process.

Sincerely,

DocuSigned by:
Jay Rowan
2113A9B7822F42D...

Jay Rowan
Branch Chief

Enclosures: status review and comments template Excel table

ec: *California Department of Fish and Wildlife*

Chad Dibble
Deputy Director, Wildlife and Fisheries Division

Sarah Mussulman
Environmental Program Manager

Claire Ingel
Senior Environmental Scientist (Supervisor)

Robin Shin
Senior Environmental Scientist (Specialist)

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www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

August 21, 2023

Alan Byrne
Idaho Department of Fish and Game
[redacted]

Subject: PEER REVIEW OF THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE'S REPORT ON THE STATUS OF SOUTHERN CALIFORNIA STEELHEAD

Dear Alan Byrne,

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife's (Department) draft status review report for Southern California steelhead (*Oncorhynchus mykiss*). The Department seeks your input regarding the assessments and conclusions in this draft status review report based on the best scientific information currently available. Please keep the enclosed report and your review of it confidential until the final report is made public upon receipt by the California Fish and Game Commission (Commission) as an agenda item at a public Commission meeting. Please note that your review will be appended to the final status review report and made public upon receipt by the Commission. **The Department requests your review on or before September 20, 2023.**

The Department seeks your scientific peer review as part of formal proceedings pending before the Commission under the California Endangered Species Act (CESA). The Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to add species to or remove species from the endangered or threatened species lists (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, directed by the Fish and Game Code to evaluate the status of the species based on the best scientific information available to the Department and make a recommendation to the Commission as to whether the petitioned action is warranted (Fish & G. Code, § 2074.6).

The Commission first received the petition to list the Southern California steelhead under CESA on June 14, 2021. After considering the Department's evaluation of the petition, the Commission formally accepted the petition for consideration on April 20-21, 2022, thereby designating Southern California steelhead as a candidate for listing as endangered under CESA. As a candidate species, Southern California steelhead currently receives the same protections under CESA as an endangered or threatened species. Formal acceptance of the petition triggered the Department's initiation of the status review.

The draft status review report forwarded to you today reflects the Department's effort to identify and analyze the best scientific information available regarding the status of Southern California steelhead in California. This status review report is not intended to be an exhaustive review of all published literature relevant to the species. Rather, it is intended to summarize the best scientific information available relevant to the status of the species, to provide that information to the Commission, and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted.

The Department's preliminary recommendation is that the petitioned action to list Southern California steelhead is warranted. However, we underscore that scientific peer review plays a critical role in the Department's analysis and effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our analysis and expected recommendation to the Commission may change or be modified following peer review.

During your review, we ask that you assess whether the body of available information supports the Department's listing recommendation. We ask also that you consider CESA and its implementing regulations as summarized in the following paragraphs.

Under CESA, an endangered species is defined as "a native species or subspecies…which is in serious danger of becoming extinct throughout all, or a significant portion of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species is defined as "a native species or subspecies…that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish & G. Code, § 2067).

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Thank you again for your contribution to the status review and this important step in the CESA listing process.

Sincerely,

DocuSigned by:
Jay Rowan
2113A9B7822F42D...

Jay Rowan
Branch Chief

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ec: *California Department of Fish and Wildlife*

Chad Dibble
Deputy Director, Wildlife and Fisheries Division

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Environmental Program Manager

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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

August 21, 2023

Dr. Devon Pearse
NOAA Fisheries, Southwest Fisheries Science Center
[redacted]

Subject: PEER REVIEW OF THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE'S REPORT ON THE STATUS OF SOUTHERN CALIFORNIA STEELHEAD

Dear Dr. Pearse,

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife's (Department) draft status review report for Southern California steelhead (*Oncorhynchus mykiss*). The Department seeks your input regarding the assessments and conclusions in this draft status review report based on the best scientific information currently available. Please keep the enclosed report and your review of it confidential until the final report is made public upon receipt by the California Fish and Game Commission (Commission) as an agenda item at a public Commission meeting. Please note that your review will be appended to the final status review report and made public upon receipt by the Commission. **The Department requests your review on or before September 20, 2023.**

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During your review, we ask that you assess whether the body of available information supports the Department's listing recommendation. We ask also that you consider CESA and its implementing regulations as summarized in the following paragraphs.

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DocuSigned by:
Jay Rowan
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Jay Rowan
Branch Chief

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ec: *California Department of Fish and Wildlife*

Chad Dibble
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Sarah Mussulman
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

August 21, 2023

Dr. Matthew Sloat
Wild Salmon Center
[redacted]

Subject: PEER REVIEW OF THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE'S REPORT ON THE STATUS OF SOUTHERN CALIFORNIA STEELHEAD

Dear Dr. Sloat,

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife's (Department) draft status review report for Southern California steelhead (*Oncorhynchus mykiss*). The Department seeks your input regarding the assessments and conclusions in this draft status review report based on the best scientific information currently available. Please keep the enclosed report and your review of it confidential until the final report is made public upon receipt by the California Fish and Game Commission (Commission) as an agenda item at a public Commission meeting. Please note that your review will be appended to the final status review report and made public upon receipt by the Commission. **The Department requests your review on or before September 20, 2023.**

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Jay Rowan
Branch Chief

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ec: *California Department of Fish and Wildlife*

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Sarah Mussulman
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

August 21, 2023

Dr. Camm Swift
Natural History Museum of Los Angeles County
[redacted]

Subject: PEER REVIEW OF THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE'S REPORT ON THE STATUS OF SOUTHERN CALIFORNIA STEELHEAD

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Jay Rowan
Branch Chief

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ec: *California Department of Fish and Wildlife*

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Sarah Mussulman
Environmental Program Manager

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Senior Environmental Scientist (Supervisor)

Robin Shin
Senior Environmental Scientist (Specialist)

State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION
CALIFORNIA ENDANGERED SPECIES ACT STATUS REVIEW OF
SOUTHERN CALIFORNIA STEELHEAD (ONCORHYNCHUS MYKISS)

November 2023

Southern California Steelhead Rainbow Trout, CDFW photo

Prepared by
California Department of Fish and Wildlife

Suggested citation:

California Department of Fish and Wildlife (CDFW). 2023. Report to the California Fish and Game Commission. California Endangered Species Act Status Review for Southern California Steelhead (*Oncorhynchus mykiss*). California Department of Fish and Wildlife, 1416 Ninth Street, Sacramento CA 95814, Sacramento CA 95814. [###] pp., with appendices.

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LIST OF ABBREVIATIONS, ACRONYMS, AND TERMS

BEUTI – Biologically Effective Upwelling Transport Index
BPG – Biogeographic Population Group
CATEX – Categorical Exclusion
CCE – California Current Ecosystem
CESA – California Endangered Species Act
CEQA – California Environmental Quality Act
CFS – cubic feet per second
CMP – California Coastal Monitoring Program
CMWD – Casitas Municipal Water District
COMB – Cachuma Operations and Maintenance
Commission – California Fish and Game Commission
Creeks Division – City of Santa Barbara Creeks Restoration and Water Quality Improvement Division
CRR – cohort replacement rate
CUTI – Cumulative Upwelling Transport Index

CWA – Federal Clean Water Act
Department – California Department of Fish and Wildlife
DIDSON - dual-frequency identification sonar
DO – dissolved oxygen
DPS – Distinct Population Segment
DWR – California Department of Water Resources
EA – Environmental Assessment
EIR – Environmental Impact Report
EIS – Environmental Impact Statement
EPA – United States Environmental Protection Agency
ESA – Federal Endangered Species Act
ESU – Evolutionary significant unit
FERC – Federal Energy Regulatory Commission
FONSI – Finding of No Significant Impact
FRGP – Fisheries Restoration Grant Program
GSA – Groundwater sustainability agency
GSP – Groundwater sustainability plan
HCP – Habitat Conservation Plan
LWD – large woody debris
NCCP – Natural Community Conservation Plan
NEPA – National Environmental Policy Act
NGO – Non-Governmental Organization
NMFS – National Marine Fisheries Service
RCDSMM – Resource Conservation District of the Santa Monica Mountains
SCCWRP – Southern California Coastal Water Research Project
SCWRP – Southern California Wetlands Recovery Project
SGMA – Sustainable Groundwater management Act
SNP – single nucleotide polymorphism
SST – sea surface temperature
SWRCB – California State Water Resources Control Board
TMDL – Total Maximum Daily Load
USACE – United States Army Corp of Engineers
USBR – United States Bureau of Reclamation
USFWS – United States Fish and Wildlife Service
UWCD – United Water Conservation District
WSRA – Federal Wild and Scenic Rivers Act
YOY – young-of-the-year

EXECUTIVE SUMMARY

This status review of southern California steelhead (*Oncorhynchus mykiss*) (Status Review) has been prepared by the California Department of Fish and Wildlife (Department) for the California Fish and Game Commission (Commission) pursuant to the requirements of the California Endangered Species Act (CESA; Fish & G. Code, § 2050 et seq.). This Status Review is based on the best scientific information currently available to the Department regarding each of the components listed under Section 2072.3 of the Fish and Game Code and Section 670.1 of Title 14 of the California Code of Regulations. In addition, this Status Review includes a preliminary identification of habitat that may be essential to the continued existence of the species, the Department's recommendations for management activities, and other recommendations for the recovery of the species (Fish & G. Code, § 2074.6.). This Status Review has been independently reviewed by scientific peers pursuant to Fish and Game Code Section 2074.6.

In this Status Review, southern California steelhead are defined as "all *O. mykiss* below manmade and natural complete barriers to anadromy, including anadromous and resident life histories, from and including the Santa Maria River (San Luis Obispo and Santa Barbara counties) to the U.S.-Mexico Border." This range encompasses five biogeographic population groups of *O. mykiss* (from north to south): Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast. To capture the life history variability that is included in the scope of the CESA listing unit evaluated in this Status Review, "southern California steelhead rainbow trout" (Southern SH/RT) is used to describe the CESA listing unit. While at the species level, *O. mykiss* exhibits similar biological and life history characteristics across the range of Coastal Rainbow Trout from Alaska to Baja California (*O. mykiss irideus*), Southern SH/RT are adapted to the climate and habitat features of the southern California region.

The Department recommends that the Commission find the petitioned action to list Southern SH/RT as an endangered species under CESA to be warranted. The Department further recommends implementation of the management recommendations and recovery measures described in this Status Review.

The scientific data available to the Department indicates a long-term declining trend of Southern SH/RT and low range-wide abundances. The impacts of the most recent prolonged period of drought from 2012 – 2017 resulted in significant reductions in all life-history forms and stages of Southern SH/RT, and few populations have recovered as current abundance estimates remain low relative to pre-drought conditions. The decline of Southern SH/RT can be attributed to a wide variety of human activities, including, but not limited to, urbanization, agriculture, and water development. These activities have degraded range-wide aquatic habitat conditions and limited the amount of suitable and accessible spawning and rearing habitats. Dams and other impediments obstruct access to a significant portion of historical Southern SH/RT habitats in many rivers within the proposed listing area, some of which have multiple major dams on a single mainstem. Climate change projections for Southern SH/RT range predict an intensification of typical climate patterns, such as more intense cyclic storms, droughts, and extreme heat. These projections suggest that Southern SH/RT will likely experience more frequent periods of adverse conditions and continued selection pressure against the anadromous life-history form.

1. INTRODUCTION

1.1 Petition History

On June 14, 2021, the California Fish and Game Commission (Commission) received a petition (Petition) from California Trout to list southern California steelhead (*Oncorhynchus mykiss*) as endangered pursuant to the California Endangered Species Act (CESA; Fish & G. Code, § 2050 et seq.).

On June 23, 2021, pursuant to Fish and Game Code Section 2073, the Commission referred the Petition to the California Department of Fish and Wildlife (Department) for evaluation.

On July 16, 2021, pursuant to Fish and Game Code Section 2073.3, the Commission published notice of receipt of the Petition in the California Regulatory Notice Register (Cal. Reg. Notice Register 2021, No. 29-Z, p. 921-922).

On August 18, 2021, pursuant to Fish and Game Code Section 2073.5, the Commission approved the Department's request for a 30-day extension to complete its petition evaluation report.

On October 29, 2021, the Department provided the Commission with a report, "Evaluation of the Petition from California Trout to List Southern California Steelhead (*Oncorhynchus mykiss*) as Endangered under the California Endangered Species Act" (Evaluation). Based upon the information contained in the Petition, the Department concluded, pursuant to Fish and Game Code Section 2073.5, that sufficient information exists to indicate that the petitioned action may be warranted and recommended to the Commission that the Petition be accepted and considered.

On April 21, 2022, at its public meeting pursuant to Fish and Game Code Sections 2074 and 2074.2, the Commission considered the Petition, the Department's Evaluation and recommendation, comments received, and oral testimony. The Commission found that sufficient information exists to indicate the petitioned action may be warranted and accepted the Petition for consideration.

On May 13, 2022, pursuant to Fish and Game Code Section 2074.2, the Commission published its Notice of Findings for southern California steelhead in the California Regulatory Notice Register, designating southern California steelhead as a candidate species (Cal. Reg. Notice Register 2022, No. 19-z, p. 541).

On October 12, 2022, pursuant to Fish and Game Code Section 2074.6, the Commission approved the Department's request for a six-month extension to complete its status review report.

1.2 Status Review Overview

Pursuant to Fish and Game Code Section 2074.6 and the California Code of Regulations, title 14, Section 670.1, the Department has prepared this status review to indicate whether the petitioned action to list southern California steelhead as endangered under CESA is warranted (Status Review). An endangered species under CESA is "a native species or subspecies . . . which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species under CESA is "a native species or subspecies . . . that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (*id.*, § 2067). A species' range for CESA purposes is the species' California range (Cal. Forestry Assn. v. Cal. Fish and Game Com. (2007) 156 Cal.App.4th 1535, 1551).

Using the best scientific information available to the Department, this Status Review includes information on each of the following components pursuant to Fish and Game Code Section 2072.3 and title 14 of the California Code of Regulations Section 670.1: population trend(s), range, distribution, abundance, life history, factors affecting the species' ability to survive and reproduce, the degree and immediacy of threats, the impact of existing management efforts, the availability and sources of information, habitat that may be essential to the continued existence of the species, and the Department's recommendations for future management activities and other recovery measures to conserve, protect, and enhance the species.

Southern California steelhead, as defined in the Petition, means all *O. mykiss*, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from and including the Santa Maria River (San Luis Obispo and Santa Barbara counties) to the U.S.-Mexico Border (CDFW 2021a Petition Evaluation). The Department accepts the taxonomy as published by Behnke (1992) that identifies southern California *O. mykiss* as being included in the range of Coastal Rainbow Trout (*O. mykiss irideus*), which have a broad distribution extending from Alaska to Baja California (Moyle 2002). The Department has long referred to these fish as "steelhead rainbow trout" (Shapovalov and Taft 1954), which captures the life history variability that is included in the scope of this status review for both anadromous and resident forms of the species. Thus, the Department will refer to the Petitioner's proposed listing unit as southern California steelhead rainbow trout (*O. mykiss*;

Southern SH/RT) throughout the remainder of this Status Review. This naming convention is slightly different than what was used by the Petitioner in the Petition, but the Department asserts the importance of recognizing the full scope of life history diversity included in the listing unit.

This Status Review report is not intended to be an exhaustive review of all published scientific literature relevant to the Southern SH/RT. Rather, it is intended to summarize the best scientific information available relevant to the status of the species, provide that information to the Commission, and serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. Specifically, this Status Review analyzes whether there is sufficient scientific information to indicate that the continued existence of Southern SH/RT throughout all or a significant portion of its range is in serious danger or is threatened by one or a combination of the following factors: present or threatened modification or destruction of its habitat; overexploitation; predation; competition; disease; or other natural occurrences or human-related activities (Cal. Code Regs., tit. 14, § 670.1, subd. (i)(1)(A)).

1.3 Federal Endangered Species Act Listing History

The federal Endangered Species Act (ESA) defines "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature" (16 U.S.C. § 1532). In 1991, the National Marine Fisheries Service (NMFS) adopted its policy on how it would apply the definition of "species" to Pacific salmon stocks for listing under the ESA (ESU Policy). Under the ESU Policy, a salmon stock is considered a distinct population segment (DPS) if it constitutes an evolutionary significant unit (ESU) of the biological species (NMFS 1991). In February 1996, the United States Fish and Wildlife Service (USFWS) and NMFS published a joint DPS policy for the purposes of ESA listings (DPS Policy) (NMFS 1996a). Section 3.1 of this Status Review describes the ESU Policy and DPS Policy in greater detail.

In 1997, NMFS listed the Southern California Steelhead ESU as endangered under the federal ESA. The Southern California Steelhead ESU only included naturally spawned populations of anadromous *O. mykiss* (and their progeny) residing below long-term, natural and manmade impassable barriers in streams from the Santa Maria River, San Luis Obispo County (inclusive) to Malibu Creek, Los Angeles County (inclusive) (NMFS 1997). In 2002, NMFS extended the geographic range of the Southern California Steelhead ESU listed under the federal ESA south to the U.S.-Mexico border (NMFS 2002).

In 2001, the United States District Court in Eugene, Oregon, ruled that NMFS improperly excluded certain hatchery stocks from the listing of Oregon Coast Coho Salmon after NMFS had concluded that those hatchery stocks were part of the ESU being considered for listing but not essential for recovery (*Alsea Valley Alliance v. Evans* (D. Or. 2001) 161 F. Supp. 2d 1154, 1162). Based in part on the *Alsea* decision, in 2002 NMFS announced that that it would conduct an updated status review of 27 West Coast salmonid ESUs, including the Southern California Steelhead ESU (NMFS 2006). In 2004, NMFS proposed to continue applying its ESU Policy to the delineation of DPSs of *O. mykiss* and to include resident *O. mykiss* that co-occur with the anadromous form of *O. mykiss* in 10 *O. mykiss* ESUs, including the Southern California Steelhead ESU (NMFS 2006).

In 2005 USFWS wrote to NMFS stating USFWS's "concerns about the factual and legal bases for [NMFS's] proposed listing determinations for 10 *O. mykiss* ESUs, specifying issues of substantial disagreement regarding the relationship between anadromous and resident *O. mykiss*" (NMFS 2006). After discussions with USFWS regarding the relationship between anadromous and non-anadromous *O. mykiss*, in 2006 NMFS decided to depart from their past practice of applying the ESU policy to *O. mykiss* stocks and instead apply the joint DPS Policy (NMFS 2006). Concurrent with that decision, NMFS relisted the Southern California Steelhead ESU as the Southern California Steelhead DPS under the federal ESA (NMFS 2006). As part of its 2006 relisting of southern California steelhead, NMFS concluded that the anadromous life form of *O. mykiss* is markedly separate from the non-anadromous life form of *O. mykiss* within the geographic boundary of the Southern California Steelhead DPS—as well as the geographic boundaries of the other nine *O. mykiss* ESUs that NMFS was relisting as DPSs at that time—due to "physical, physiological, ecological, and behavioral factors" (NMFS 2006). The Southern California Steelhead ESU only includes the anadromous life-history component of *O. mykiss* and is defined as including all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassible barriers in streams from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico border (Table 1) (NMFS 2006).

2. BIOLOGY AND ECOLOGY

2.1 Species Description

The species *O. mykiss* is the most widely distributed of Pacific salmonids, occupying nearly all coastal streams from Alaska to southern California, as well as many lakes and streams above fish passage barriers across California, where they have been widely stocked since the mid- to late-1800s. Steelhead is the common name for the anadromous form of *O. mykiss*, while Rainbow Trout is the common name applied to the freshwater resident form (Behnke 1993; Moyle 2002). *O. mykiss* possess 10–12 dorsal fin rays, 8–12 anal fin rays, 9–10 pelvic fin rays, 11 – 17 pectoral fin rays, and a slightly forked caudal fin (Moyle 2002). They have 9–13 branchiostegal rays and 16–22 gill rakers on each arch (Moyle 2002). Teeth are present on both upper and lower jaws, the tip and shaft of the vomer, as well as on the tip of the tongue (Fry 1973; Moyle 2002). Between 110–180 small, pored scales make up the first row above the lateral line (Fry 1973; Moyle 2002).

The steelhead life history form is thought to be named for the sometimes silvery-metallic appearance of its back and head. The steelhead body profile is fusiform, with typically "bullet-shaped" heads and distinct narrowing at the base of a powerful tail, suited for often-demanding and lengthy upstream spawning migrations. In the marine environment, steelhead body coloration includes a blueish-green dorsum (back) and silver or white coloration over the rest of the body (Fry 1973; Moyle 2002). Black spots typically cover the dorsal, adipose, and caudal fins, as well as the head and back (Fry 1973). When adult steelhead return to spawn in freshwater, their silver sheen fades and a pink or red lateral band develops along the sides and on the opercula, while the silvery-blue coloration on the back transitions to an olive green or brown (Barnhart 1986). These characteristics are very similar to those exhibited by resident Rainbow Trout (Fry 1973); thus, it can be difficult to differentiate the anadromous and resident forms based only on outward appearance. Adult steelhead, however, are generally larger than adult Rainbow Trout in a given stream system since they spend time feeding and growing in the ocean (NWF 2020; USFWS 2020).

Table 1. Common nomenclature for Oncorhynchus mykiss (adapted from Boughton et al. 2022b).

Term	**Description**
Oncorhynchus mykiss	A species of Pacific salmonid composed of both anadromous and freshwater-resident forms, which all spawn in freshwater rivers and streams.
Steelhead	Individuals: *O. mykiss* that are anadromous (individuals that migrate to and spend one or more seasons in the ocean); here used to mean adult steelhead.
Rainbow Trout	Individuals: *O. mykiss* that are freshwater-resident (individuals that complete their life cycle in freshwater), here used to mean adult Rainbow Trout.
Steelhead Rainbow Trout	Population/Evolutionarily Significant Unit (ESU): contain both steelhead individuals and Rainbow Trout individuals.
Juvenile *O. mykiss*	Immature fish whose fate as steelhead or Rainbow Trout cannot yet be established.

Term	Description
Anadromous waters	Stream reaches that are accessible to migrating steelhead (those not blocked by complete natural or artificial barriers). It is important to note that *Oncorhynchus mykiss* individuals, occurring in anadromous waters, may or may not express the anadromous life history type (e.g., smoltification).

Juvenile *O. mykiss* have body coloration similar to that of resident adults, while also exhibiting 5–13 oval parr marks along the lateral line on both sides of the body (Moyle 2002). These parr marks are dark bluish-purple in coloration and are widely spaced, with the marks themselves being narrower than the spaces between them (Moyle 2002). A total of 5–10 dark spots also line the back, typically extending from the head to the dorsal fin. There are usually few to no marks on the caudal fin, and the tips of the dorsal and anal fins are white to orange (Moyle 2002).

After a year or more of development, some *O. mykiss* undergo the transitional process of smolting, which is a series of morphological, physiological, and behavioral changes that prepare the fish for entry into brackish estuaries and then ocean environments (Fessler and Wagner 1969; McCormick 2012). Smolting is the primary characteristic that distinguishes the anadromous life history variant from the resident one within the species. Smolts lose their parr marks and develop silver coloration during the downstream migration process. After entering the ocean, young steelhead will reside in the saltwater environment for 1–4 years while feeding and growing quickly (Moyle 2002). Juvenile Rainbow Trout that do not smolt and remain in freshwater generally lose their parr marks as they grow and develop into adults.

Upon reentering freshwater rivers and streams to spawn, the sexual maturation process for anadromous steelhead involves the development of secondary sex characteristics such as bright coloration and sexual dimorphism, including the development of a hooked snout, or kype, in males. These secondary sex characteristics are typically reabsorbed once spawning is complete, although jaw shape may never fully revert to the pre-spawn condition (Shapovalov and Taft 1954).

Different populations of *O. mykiss* can exhibit variations in growth rate, size, and body shape depending on their life histories and habitats utilized. For example, Bajjaliya et al. (2014) studied morphometric variation between four California steelhead DPSs and found that coastal steelhead (populations with adults migrating less than 160 km from the ocean to their sample site) were significantly larger in size and had a more robust body type than steelhead found in California’s Central Valley drainages and the Klamath-Trinity basin (populations with adults migrating more than 160 km from the ocean to their sample site). These morphological differences provided the basis for recognizing “coastal type” and “inland type” steelhead in California (Bajjaliya et al. 2014).

2.2 Taxonomy and Systematics

Steelhead and Rainbow Trout are members of the bony fish class Osteichthyes, in the order Salmoniformes and family Salmonidae. In 1792, J. J. Walbaum classified Rainbow Trout from populations on the Kamchatka Peninsula in Russia as *Salmo mykiss* (Moyle 2002). During the next century, using J. Richardson’s description of Columbia River steelhead as *S. gairdneri* and Gibbons’s description of juvenile steelhead from San Leandro Creek as *S. iridea*, both the biology and fishing communities began referring to resident Rainbow Trout and steelhead as *S. irideus* and *S. gairdneri*, respectively. It was ultimately discovered that Rainbow Trout and steelhead are the same species, and North American scientists applied the original species name, *mykiss*, to North American populations (Moyle 2002).

In the 1970s, analyses of polymorphic proteins, or allozymes, were utilized to determine the degree of species relatedness and evolutionary divergence among salmonids (Quinn 2018). These studies indicated that Coho and Chinook salmon (*O. kisutch* and *O. tschawytscha*, respectively) were most closely related to Pink, Chum, and Sockeye salmon, and that Rainbow and Cutthroat trout were most closely related to each other (Quinn 2018). This phylogeny was assumed until researchers analyzed relatedness by looking at differences in mitochondrial DNA, which showed that Coho and Chinook salmon were related more closely to steelhead than they were to the other three genera of salmon (Quinn 2018). Based on this study, Smith and Stearley (1989) reorganized the taxonomy to reflect both the use of the name *mykiss* for North American Rainbow Trout and the inclusion of Rainbow and Cutthroat trouts in the Pacific salmon genus *Oncorhynchus*, but with their own distinct lineages.

Pacific salmonid lineages continue to be studied using a variety of genetic and statistical methods (Quinn 2018). There has been debate over the relationship between Rainbow and Cutthroat trouts with regards to genetics versus morphology and behavior. Stearley and Smith (1993) and Esteve and McLennan (2007) found that the idea of monophyly (descending from a common ancestor) of these two trout species is not supported by either morphological or behavioral traits, even though mitochondrial DNA suggests otherwise. Esteve and McLennan (2007) attribute this contradiction to hybridization events that have led to a high rate of genetic introgression between the two species (Chevassus 1979). This introgression can dilute the distinctiveness of these close relatives and convolute phylogenetic reconstruction (Esteve and McLennan 2007). Although some uncertainty remains surrounding these evolutionary relationships, it is now accepted that within the genus *Oncorhynchus*, Coho and Chinook salmon have the closest relationship to each other, with Pink (*O. gorbuscha*), Chum (*O. keta*), and

Sockeye (*O. nerka*) salmon in their own group, and Rainbow (*O. mykiss*) and Cutthroat (*O. clarkii*) trout in another group (Kitano et al. 1997; Quinn 2018; Figure 1).

2.3 Range and Distribution

Range is the general geographical area in which an organism occurs. For purposes of CESA and this Status Review, the range is the species' California range (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal.App.4th 1535, 1551). Distribution describes the actual sites where individuals and populations of the species occur within the species' range.

Oncorhynchus mykiss is native to both coastlines of the Pacific Ocean and spawns in freshwater streams, from the Kuskokwim River, in Alaska, south to Baja California along the eastern Pacific, and from Russia's Kamchatka Peninsula to South Korea, in the western Pacific (Moyle 2002). The species is widely distributed throughout the northern Pacific Ocean during its ocean phase. Coastal steelhead within the state historically occupied all perennial coastal streams, from the Oregon/California border to the U.S.-Mexico border (Moyle 2002). Steelhead are also native to the Central Valley, including both the Sacramento and San Joaquin River basins, and have been found as far upstream as the Pit and McCloud rivers (Moyle 2002). It is likely that most suitable streams in the Sacramento and San Joaquin River basins with ocean access have historically supported runs of steelhead (Moyle 2002).

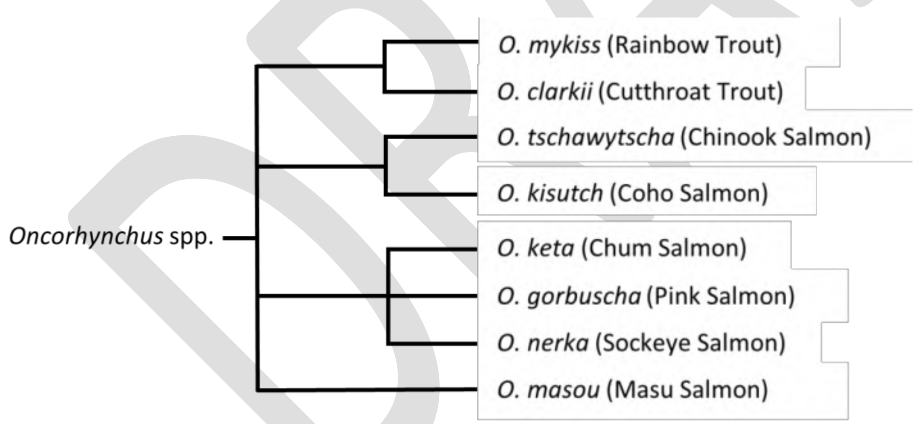


Figure 1. Consensus relationships of Oncorhynchus species from morphological, allozyme, ribosomal RNA, mitochondrial DNA, and short interspersed repetitive elements data across multiple studies. Adapted from Figure 1 in Kitano et al. (1997).

Southern SH/RT currently occupy fluvial habitat from the Santa Maria River at the border of San Luis Obispo and Santa Barbara counties south to the U.S.-Mexico border. This range encompasses five biogeographic population groups (BPGs), collectively described by NMFS as the Southern California steelhead DPS (Boughton et al. 2007; NMFS 2012a). BPGs are steelhead subpopulations within a DPS that occupy contiguous areas that share broadly similar physical geography and hydrology, generally within a single watershed unit. The combinations of these physical characteristics represent the suite of differing natural selective regimes across the watersheds occupied by Southern SH/RT. These varying selective pressures have led to life history and genetic adaptations that enable subpopulations to persist in distinctive and dynamic habitats that have shaped each BPG. The purpose of delineating BPGs for steelhead populations is to ensure the preservation of the range of genetic and natural diversity within each DPS for recovery and conservation purposes (NMFS 2012a). The BPGs that form the Southern SH/RT DPS are (from north to south): Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast.

While some near-coastal populations of Southern SH/RT are small, there are likely dispersal dynamics that contribute to their stability and persistence (Boughton et al. 2007). The movement of spawning adults between BPGs may be an important mechanism for maintaining the viability of steelhead populations (NMFS 2012a). Dams and other impediments obstruct access to a significant portion of historical Southern SH/RT habitats in many rivers within the proposed listing area, some of which have multiple major dams on a single mainstem. There is evidence that loss of access to upstream habitat has resulted in a northward range contraction of anadromous Southern SH/RT (Boughton et al. 2005), whose study also found a strong correlation between steelhead population extirpations and anadromous barriers, as well as urban and agricultural development.

2.4 Life History

An individual fish's genotype, condition, and a variety of environmental factors influence the expression of anadromy versus stream residency (Sloat et al. 2014; Busby et al. 1996; Pascual et al. 2001; Courter et al. 2013). Juvenile *O. mykiss* prior to the smolting life stage are difficult to distinguish without genetic, morphological, or physiological evaluations (Negus 2003; Beeman et al. 1995; Haner et al. 1995; Pearse et al. 2014). Adult steelhead returning to streams from the ocean are often easier to identify due to their larger size relative to most resident Rainbow Trout adults in the same stream system and their overall steel-gray color (Dagit et al. 2020). While anadromy and residency are the two primary life histories, *O. mykiss* life history expression is notably plastic and can be quite variable (Moyle 2002). For example, individuals may exhibit the lagoon-anadromous life history, spending their first or second summer rearing in seasonal lagoons in the estuaries of streams before outmigrating to the ocean (Boughton et al. 2007).

Unlike other Pacific salmonids, which are semelparous and perish almost immediately after spawning, *O. mykiss* can be iteroparous (Moyle 2002), with the potential to spawn up to four times but typically not more than twice (Shapovalov and Taft 1954). Steelhead that spawn and return to the sea are called “kelts.” These fish can either spawn consecutively, returning the next season after their first spawn, or they may return a year later after spending an extra year at sea (Light et al. 1989). Reportedly, females survive spawning events more frequently than males (Shapovalov and Taft 1954; Ward and Slaney 1988; Busby et al. 1996; Marston et al. 2012), although males can repeat spawn in significant numbers, especially in smaller, near-coastal stream systems (Marston et al. 2012).

Steelhead exhibit two seasonal migratory patterns, or run types: 1) winter, also called “ocean-maturing” or “mature-migrating;” and 2) summer, also called “stream-maturing” or “premature-migrating.” The names of these two runs are reflective of the seasonal timing when adult steelhead reenter estuaries and rivers to reproduce (Busby et al. 1996; Moyle 2002). Only the winter-run form of steelhead occurs in southern California streams, consistent with what is believed to be the historical condition (Moyle 2002). Southern SH/RT typically begin migrating upstream from December through May, with returning adults often reliant upon winter rainstorms to breach sandbars at the mouths of stream estuaries and lagoons, providing seasonal upstream spawning passage (California Trout 2019). Steelhead age-at-maturity is dependent on a number of factors, including time spent in either or both freshwater and marine environments; however, adult returning spawners are usually 3 or 4 years old, having spent 1-3 years in freshwater and 1-2 years at sea (Shapovalov and Taft 1954). Southern SH/RT steelhead spawning runs are dominated by age 3+ fish, with 2 years spent in fresh water and 1 year in the ocean, although many smolt after only 1 year in fresh water (Busby et al. 1996). Shapovalov and Taft (1954) found that the average age of male spawners (about 3.5 years) was lower than that of female spawners (close to 4 years) in Waddell Creek, CA. Non-anadromous Rainbow Trout can mature anywhere between 1 and 5 years but are commonly age 2+ or 3+ years, with a fork length of $\geq$13 cm (Moyle 2002). Rainbow Trout typically spawn during the spring months, from February through June (Moyle 2002).

Spawning usually occurs in shallow habitats with fast-flowing water and suitable-sized gravel substrates, often found in riffles, faster runs, or near the tail crests of pool habitats. When female *O. mykiss* are ready to spawn, they will select a suitable spawning site and excavate a nest, or redd, in which they deposit their eggs to incubate (Moyle 2002). Adequate stream flow, gravel size, and low substrate embeddedness are crucial for egg survival, as these conditions allow oxygenated water to permeate through sediments to the egg (Coble 1961). During redd construction, the female may be courted by multiple males. Following completion of the redd, the most dominant males fight for position alongside the female, depositing milt while the female deposits her eggs (Quinn 2018). Immediately following fertilization, females cover their eggs with gravel (Barnhart 1986). Females dig multiple smaller pits within the broader redd where they deposit a portion of eggs into each pocket until all the eggs are expelled (Shapovalov and Taft 1954; Quinn 2018). Adult steelhead are often accompanied by resident male Rainbow Trout during spawning, as they attempt to participate by quickly swimming, or darting, in and out of steelhead redds (Shapovalov and Taft 1954). These fish are sometimes referred to as “egg-eaters,” although it is generally accepted that the main purpose of their presence is to contribute to spawning rather than consume newly laid eggs (Shapovalov and Taft 1954). If adult steelhead cannot emigrate back to the ocean after spawning, they require large, deep pools that provide refuge during the hot summer months (Boughton et al. 2015).

Fecundity, among other biological and environmental factors, contributes substantially to reproductive success. Egg production is positively correlated with fish length, although there is wide variation in female steelhead fecundity at a given size (Shapovalov and Taft 1954; Quinn 2018). Larger females tend to produce larger and greater numbers of eggs; however, energy demands for gonad development create a physiological tradeoff between the number and size of eggs produced (Quinn 2018). Thus, females generally produce either many smaller eggs or fewer larger eggs. Quinn (2018), referencing multiple sources of data, showed that female steelhead of average size produce slightly over 5,000 eggs. Moyle (2002) provides a range of eggs per female from 200 to 12,000 and states that steelhead generally produce about 2,000 eggs per kilogram of body weight. Rainbow Trout less than 30 cm in total length usually have under 1,000 eggs per kilogram of body weight (Moyle 2002).

Multiple factors contribute to egg development and incubation time; however, eggs generally incubate in stream gravels for up to several months. Temperature has the greatest effect on the incubation period; colder water slows development, and warmer water increases the rate of development (Quinn 2018). Incubation can take from 19 days at an average temperature of 60°F (15.6°C) to 80 days at an average temperature of 40°F (4.4°C) (Shapovalov and Taft 1954). Dissolved oxygen (DO) levels in surrounding waters also influence life stage development rates in Southern SH/RT and other salmonids. Higher DO levels lead to more rapid egg development, while eggs exposed to low levels of DO during incubation produce much smaller alevins (yolk-sac fry) than those exposed to high DO (Quinn 2018). Fry emerge from the gravel 2-3 weeks after hatching, once the yolk sac is fully or almost entirely absorbed, at which time they form schools along stream banks (Shapovalov and Taft 1954). During their first year of life, *O. mykiss* juveniles develop small territories and defend them against other individuals in their age class (Shapovalov and Taft 1954; Barnhart 1986). Juvenile *O. mykiss* generally feed on many different species of aquatic and terrestrial insects, sometimes cannibalizing newly emerged fry (Barnhart 1986). Feeding generally peaks during the summer months and is depressed during the winter months; however, *O. mykiss* in California typically have higher growth rates in the winter and spring than summer and fall (Hayes et al. 2008; Sogard et al. 2009; Krug et al. 2012). As they grow, juveniles will move into deeper, faster water and are often found in riffle or swift-run habitats (Shapovalov and Taft 1954; Barnhart 1986). Larger juvenile *O. mykiss* can outcompete and displace their smaller counterparts from ideal habitats, such as deep pools or run complexes, leaving smaller individuals to often inhabit suboptimal habitats, such as riffles (Barnhart 1986).

Parr will ultimately begin transitioning into smolts and migrate downstream to estuaries and lagoons, where they complete the process of smolting. Smolt outmigration to the ocean typically occurs from March–May in southern California but can vary depending on factors such as connectivity between the ocean and estuary or lagoon and streamflow (Booth 2020). Compared to other Pacific salmonids, steelhead have the greatest variability in the timing and duration of freshwater inhabitance, ocean entry, time spent at sea, and return to freshwater (Barnhart 1986). Resident Rainbow Trout early life stages mirror those of anadromous steelhead, up until their life history strategies diverge (Moyle 2002). Rather than migrating out to the ocean like steelhead, resident *O. mykiss* will reside in freshwater for the remainder of their lives.

Little is known regarding steelhead stock-specific utilization of and distribution in the ocean environment. While much is known about the status and abundance of commercially important ocean stocks of Pacific salmon, steelhead-specific research on this topic is lacking and hampered by the inability to differentiate individual stocks using standard sampling methods (Barnhart 1986; Light et al. 1989; Moyle 2002). Unlike Pacific salmon species, steelhead are rarely captured in the ocean; therefore, information specific to Southern SH/RT ocean distribution is not available. Limited tag recoveries by North American fisheries research and management agencies showed no differences in the ocean distribution of steelhead by stock (Light et al. 1989). Attempts to distinguish steelhead population units from one another in terms of ocean distribution are confounded by findings that all steelhead apparently congregate in shared ocean feeding grounds, regardless of their origin or run type (Light et al. 1988).

Pacific steelhead smolts quickly migrate offshore after entry into the ocean (Daly et al. 2014) and, once in the open water, generally move in a northwestern trajectory from spring to summer and follow a southeastern pattern from fall to winter (Okazaki 1983; Light et al. 1989). In the winter, steelhead are found in the eastern North Pacific (Myers et al. 2016) and tend to be closer to shore than during other times of the year (Light et al. 1989). California steelhead do not appear to migrate any farther west than the Gulf of Alaska (Light et al. 1989), and, overall, steelhead migration patterns appear to be strongly tied to “thermal avoidance.” Migratory-based thermal avoidance involves fish movement patterns that remain within a narrow range of tolerable sea surface temperatures, suggesting that steelhead ocean migration may be largely influenced by physiological responses to temperature (Hayes et al. 2016). Ocean steelhead are typically found within seven meters of the sea surface, within the epipelagic zone, although they have been found at more than three times that depth (Light et al. 1989).

Studies addressing steelhead ocean behavior, distribution, and movement are limited; however, as with other salmonids, steelhead tend to exhibit strong homing behavior to their natal streams, with some exceptions. Evidence of straying has been documented in central California steelhead populations (Donohoe et al. 2021), while genetic population structure analyses suggest that historical (natural) exchange of genetic information occurred between coastal populations of steelhead (Garza et al. 2014).

2.5 Genetics and Genomics

2.5.1 Role of Genetics and Genomics in Evaluating Steelhead Population Structure

To date, most genetic studies focused on quantifying the population structure of salmonid species have used neutral genetic markers (e.g., microsatellite DNA). Neutral markers are not directly linked with a particular life history trait, and it is assumed that they are not under direct selection. This class of genetic marker continues to be used to investigate and define salmonid listing units and population structure (e.g., Busby et al. 1996) in both California and across the Pacific Northwest. These types of markers have also been successfully used for decades to delineate populations and ESUs based primarily on reproductively isolated lineages. These markers remain valuable, in that they are the standard for determining the genetic structure and relatedness of species and, thus, their evolutionary histories.

More recently, the advent and rapid development of “adaptive” genetic markers have provided fishery managers and geneticists with a new suite of tools. Adaptive genetic markers provide putative associations with specific life history characteristics, and the “genetic type”, or “variant” infers information about a phenotype of interest. Specific genes, or genomic regions, within individuals or subgroups may vary from the overall pattern exhibited by a species. Of particular relevance to Southern SH/RT is the role that adaptive genetic variation plays in migratory behavior. This relationship is still being evaluated, and uncertainties remain regarding the level of influence genetics may have on migration phenotype. See Section 2.6.5 for more information.

2.5.2 Patterns of O. mykiss Genetic Population Structure

Geography and local environmental factors influence the genetic structure of *O. mykiss* populations, a pattern referred to as "isolation by distance". Evidence of isolation by distance is shown in *O. mykiss* populations throughout their range. Studies based on neutral mitochondrial DNA analysis have demonstrated a pattern of isolation by distance in populations spanning the western coast of the United States, including among coastal California steelhead populations (Hatch 1990; Reisenbichler et al. 1992; McCusker et al. 2000). Nielsen (1999) found a pattern of isolation by distance when looking at the microsatellite loci of southern California and northern

California steelhead populations. Bjorkstedt et al. (2005) suggested that genetic variation in salmonid populations generally increases with greater distances between watersheds. Pearse et al. (2007) analyzed geographic structure within the Klamath-Trinity River basin and consistently found a positive relationship between geographic distance and genetic relatedness—specifically, that genetic divergence between populations increased as a function of geographic distance.

Garza et al. (2004) evaluated population structure across coastal California populations using microsatellite loci to understand the relationship between genetic distance and the geography of coastal steelhead populations. This study's results included a bootstrap consensus tree showing clustering of geographic locations corresponding to five DPS assignments in coastal California steelhead (Figure 2). The long terminal branches in this consensus tree demonstrate that, while migration is important to the populations in this study, the conflicting evolutionary processes of random genetic drift and local adaptation were likely responsible for the genetic differentiation between the populations. The general isolation-by-distance pattern of genetic diversity is also visually apparent.

Aguilar and Garza (2006) found a significant relationship between geographic distance and genetic distance in coastal *O. mykiss* using both major histocompatibility complex genes, which can be helpful in identifying salmonid population structure, and microsatellite loci. This significant relationship represented isolation through distance. Garza et al. (2014) reaffirmed that genetic variation is associated with isolation by distance using microsatellite loci from samples of coastal California steelhead. Across all coastal California steelhead populations sampled, there was evidence that population structure is dependent on geographic distance. Their phylogeographic trees also suggested that population structure was almost entirely consistent with geographic proximity.

Populations within a watershed, even those disconnected by barriers, have been shown through microsatellite DNA analyses to be more genetically similar than those in adjacent watersheds (Clement et al. 2009; Garza et al. 2014). However, anthropogenic impacts including stocking, barrier construction, and habitat destruction have resulted in weaker relationships between geographic proximity and relatedness in modern *O. mykiss* populations (Pearse et al. 2011).

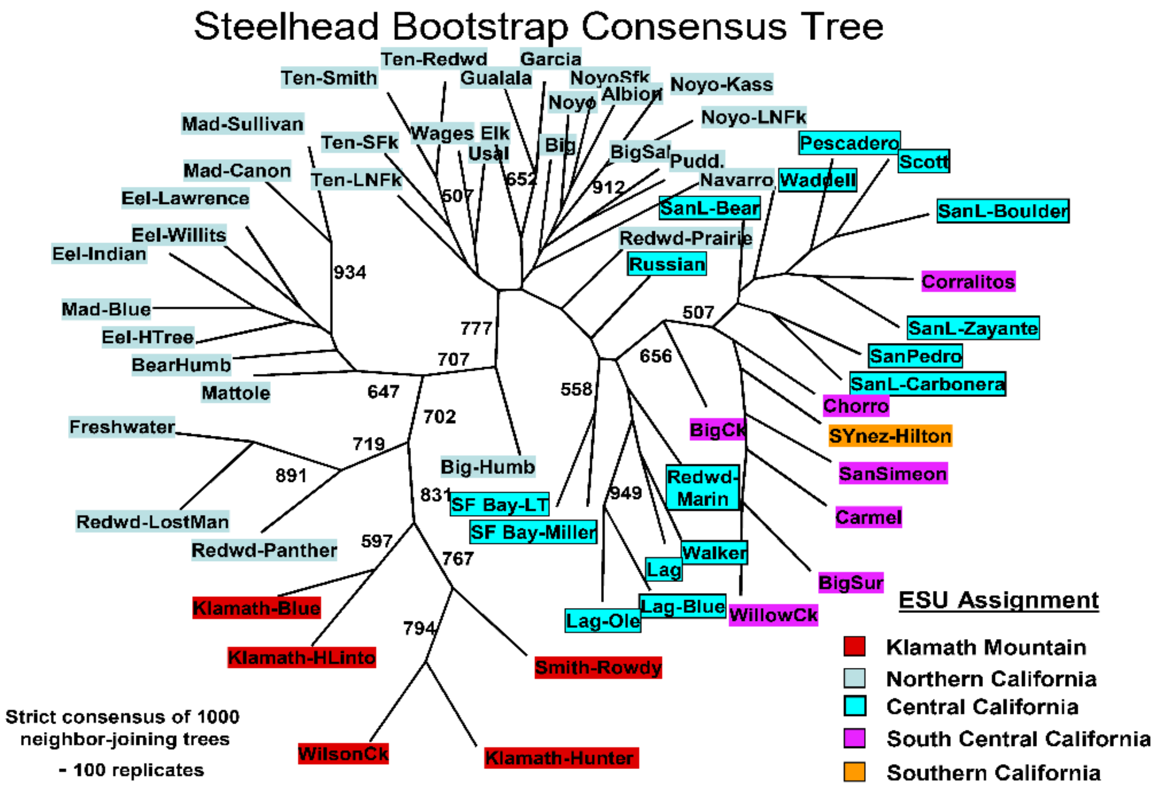


Figure 2. Majority-rule consensus tree, with genetic data bootstrapped 1,000 times, showing chord distances and neighbor-joining trees for 62 coastal California steelhead populations. (from Garza et al. 2004).

2.5.3 Genetics of the Southern California SH/RT

Busby et al. (1996) posited that the extreme environmental conditions found in southern California could result in both substantial local adaptations of and gene flow impediments between *O. mykiss* populations in the region. Nielsen (1999) hypothesized that the substantial interpopulation genetic diversity found in southern California's mostly small and somewhat isolated *O. mykiss* populations could be the result of a transitional ecotone, where two adjacent Pleistocene source populations have met and blended. Allozymes, mitochondrial DNA, and microsatellites have uncovered significant and unique genetic diversity in southern California steelhead, with traits not found in more northern populations. Busby et al. (1996) noted that a mitochondrial DNA type exists in steelhead populations between the Santa Ynez River and Malibu Creek that is rare in populations to the north, and samples from Santa Barbara County were found to be the most genetically unique of any wild coastal steelhead populations analyzed. In general, *O. mykiss* at the extreme southern end of their range have low genetic diversity (Clemento et al. 2009; Pearse et al. 2009; Jacobson et al. 2014; Abadía-Cardoso et al. 2016; Apgar et al. 2017). Loss of genetic diversity is often a consequence of declines in population size (Allendorf et al. 1997), which have been observed in Southern SH/RT populations.

2.5.4 South-Central and Southern California Genetic Relationships

Clemento et al. (2009) conducted a genetic analysis of steelhead populations in California south of Monterey Bay using microsatellite data to elucidate patterns of genetic differentiation and gene flow. In terms of coastwide population structure, the authors found that southern California steelhead populations were grouped with all other steelhead populations south of San Francisco Bay and were well-distanced from populations north of San Francisco Bay. Population genetic structure does not correspond with geographic management boundaries because genetically based population clusters are not separated by current federal-ESA-listed DPS boundaries. Overlap in clustering was detected between populations from nearby watersheds, and genetic differentiation between populations in the South-Central California Coast steelhead DPS and the southern California steelhead DPS could not be detected. Additionally, the construction of phylogeographic trees did not result in the separation of populations from the two DPSs into distinct genetic lineages based on their current ancestry (Figure 3). In populations south of San Francisco Bay, no apparent isolation by distance pattern corresponding with DPS boundaries was detected. This may be a result of metapopulation dynamics occurring between these *O. mykiss* populations. Although a lack of genetic differentiation was observed across these southern DPSs, the Department recognizes other factors that define Southern SH/RT, such as unique regional biogeography, ecology, physiology, and behavior of the population groups (Boughton et al. 2007).

2.5.5 Role of Genetics in Life History Expression

Many *O. mykiss* populations are considered “partially migratory,” meaning they contain both migratory (e.g., anadromous) and non-migratory (e.g., resident) individuals (Chapman et al. 2011). It is widely accepted that migratory behavior and migration-associated traits are heritable in partially migratory populations (Pearse et al. 2014; Hecht et al. 2015; Phillis et al. 2016). In recent years, studies have revealed that important migration-related characteristics in *O. mykiss*, such as maturation, growth, development, and smolting, are linked to specific genomic regions that are under natural selection (Nichols et al. 2008; Martínez et al. 2011; Hecht et al. 2012; Miller et al. 2012; Pearse et al. 2014). Phenotypic expression of anadromy vs. residency has since been found to be strongly associated with a large genomic region on *O. mykiss* chromosome 5 (*Omy5*) (Martínez et al. 2011; Hecht et al. 2012; Pearse et al. 2014; Leitwein et al. 2016; Kelson et al. 2019). This *Omy5* migration-associated region exhibits unique alleles, associated with either anadromy or residency as their phenotypic expression, and these

Omy5 genetic variants are thought to be the result of a chromosomal inversion (Pearse et al. 2014; Leitwein et al. 2016).

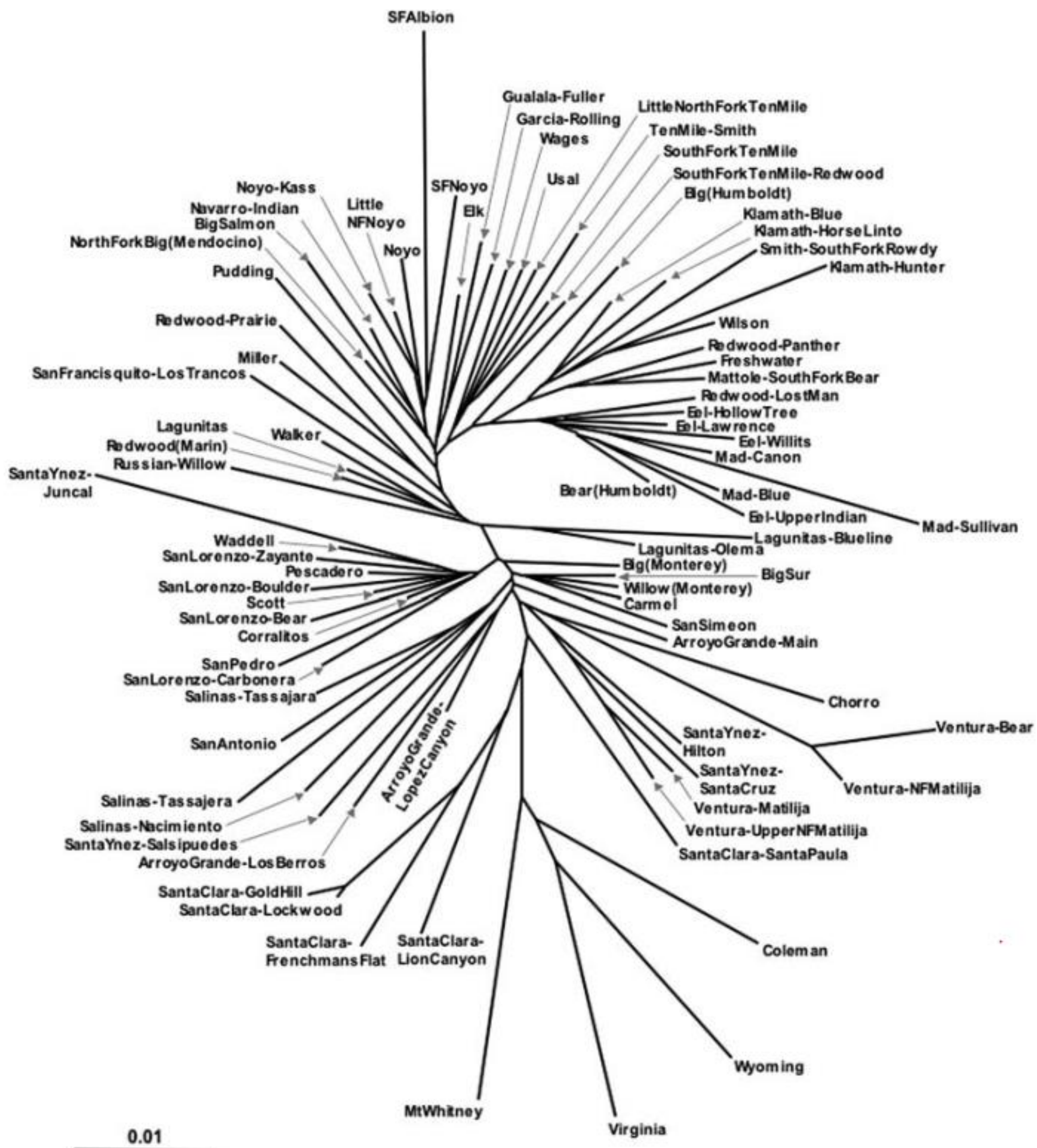


Figure 3. Unrooted neighbor-joining chord distance tree of 84 coastal O. mykiss populations in California (from Clemento et al. 2009).

Chromosome *Omy5* is associated with multiple life history characteristics related to migration vs. residency in *O. mykiss*, explaining morphological and developmental variation between the two life history forms (Nichols et al. 2008; Martínez et al. 2011; Hecht et al. 2012; Rundio et al. 2012). Nichols et al. (2008) used quantitative trait loci analysis to locate specific loci associated with smolting and found several genomic regions that were linked with morphological and physiological smolting indicators. The study was the first of its kind in terms of finding connections between specific genomic loci and the migration characteristics of a species of fish. In addition, Martínez et al. (2011) found multiple microsatellite markers on *Omy5* that were correlated with differential selection between anadromous and resident *O. mykiss*, while Hecht et al. (2012) identified associations between *Omy5*, body morphology, and skin reflectance, which are linked to the smolting process and the anadromous phenotype. Pearse et al. (2014) found that specific *Omy5* loci diverged between above-barrier and below-barrier *O. mykiss* populations that had differing frequencies of the anadromous phenotype.

Populations with a higher population-wide frequency of the anadromous variant of *Omy5* typically have higher proportions of anadromous or migratory individuals compared to populations that have a higher frequency of the resident variant (Pearse et al. 2014; Leitwein et al. 2016). This suggests that utilizing comparative anadromous *Omy5* variant frequency data between steelhead populations may indicate which populations have a higher likelihood of producing anadromous offspring, as well as having utility in identifying above-barrier populations with the genetic potential to support or bolster downstream anadromous populations. Results from Kelson et al. (2020) suggest that the *Omy5* genomic region also regulates physiological traits, such as juvenile growth, which will subsequently influence residency vs. anadromy (Figure 4).

Sex determination has also been genetically linked to the migratory phenotype of *O. mykiss* (Rundio et al. 2012). Migratory ecotype composition within a population is typically female-dominated, a phenomenon that has been observed in multiple salmonid species (Jonsson et al. 1998; Páez et al. 2011; Ohms et al. 2014; Kelson et al. 2019) and may be due to a strong correlation between fecundity and body size (Hendry et al. 2004; Quinn 2018). Female steelhead that migrate to the ocean can grow larger in the highly productive marine environment than their counterparts in the less productive freshwater environment and, as a result, produce greater numbers of embryos. Their genetic traits, which control the anadromous ecotype, are therefore predominant in most populations.

Alternate life history ecotypes within a given watershed are typically more closely related to each other than to their life history stage equivalents in other watersheds (Nielsen and Fountain 1999; Docker and Heath 2003; Narum et al. 2004; Olsen et al. 2006; McPhee et al. 2007; Leitwein et al. 2016). These close genetic relationships indicate some degree of gene flow between sympatric life history forms of *O. mykiss* (Olsen et al. 2006; McPhee et al. 2007; Heath et al. 2008), although the level of gene flow is dependent on environmental, physiological, and genetic factors, such as watershed size and degree of reproductive isolation between life history forms (Heath et al. 2008). Regardless, the close genetic relationships between sympatric populations of steelhead and Rainbow Trout suggest that managing individual fish with different life histories separately is biologically unjustified, and the two life history variants should be considered a single population when found coexisting in streams (McPhee et al. 2007). Additionally, freshwater resident populations can retain alleles associated with anadromy (Nielsen and Fountain 1999; Phillis et al. 2016; Apgar et al. 2017) and can contribute to the viability of anadromous *O. mykiss* populations.

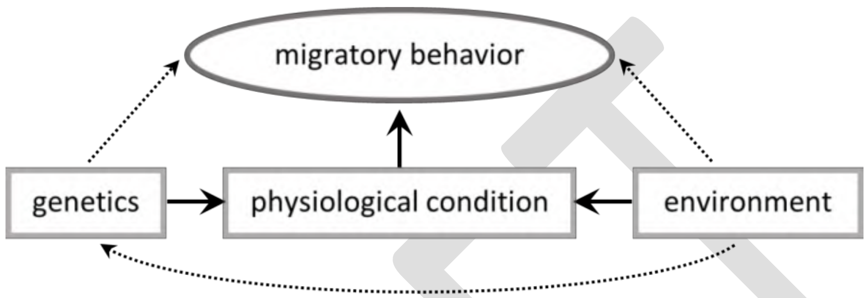


Figure 4. Schematic of indirect genetic control of migratory behavior. Genetic variation and the environment influence physiology, which then impacts migratory behavior (adapted from Kelson et al. 2020).

2.5.6 Above-Barrier vs. Below-Barrier Genetic Relationships

Studies have shown that populations of *O. mykiss,* above and below barriers within the same drainage, are closely related to one another (Heath et al. 2008; Clemento et al. 2009; Pearse et al. 2009; Leitwein et al. 2016; Fraik et al. 2021). Clemento et al. (2009) used microsatellite data to evaluate steelhead population structure above and below barriers in southern California streams and determined that populations separated by barriers are typically a single, monophyletic clade more closely related to each other than to populations in adjacent watersheds, consistent with many previous barrier studies. This relationship had strong bootstrap support, especially for natural-origin steelhead populations. For example, populations from the Santa Clara River formed a monophyletic lineage on the unrooted neighbor-joining tree constructed from samples taken in five main southern California watersheds (Figure 5).

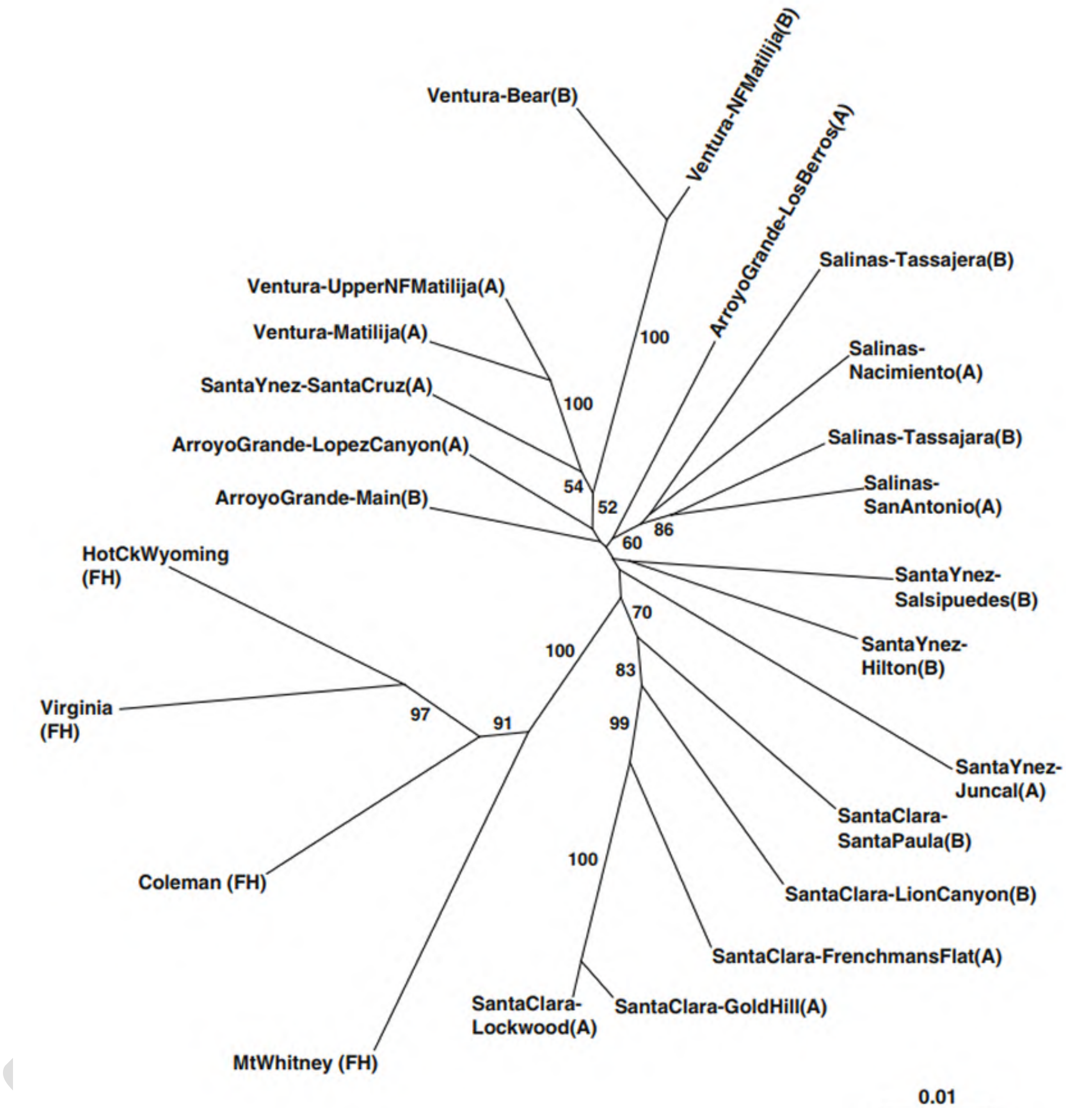


Figure 5. Unrooted neighbor-joining dendogram showing chord distances between 24 sampled naturally spawning populations both above and below barriers, denoted with A and B, respectively. Strains of Rainbow Trout from Fillmore Hatchery used for regional stocking are indicated with FH. Numbers associated with branches indicate percentage >50% of the 10,000 bootstrap replications in which the branch appeared (from Clemento et al. 2009).

Fraik et al. (2021) recently studied patterns of genetic diversity both before and after dam removal on the Elwha River (in Washington state) and determined that populations separated by natural barriers had greater genetic differentiation than those separated by long-standing dams. Following the removal of major artificial dams on the Elwha, they also detected admixture of above- and below-dam lineages and recolonization of upstream areas by steelhead.

While many fish populations separated by barriers within the same watershed have been shown to be closely related (Heath et al. 2008; Clemento et al. 2009; Pearse et al. 2009; Leitwein et al. 2016), major barriers to anadromy, both natural and artificial, have been found to prevent gene flow between populations upstream and downstream of the obstruction (Pearse et al. 2009; Abadía-Cardoso et al. 2019; Fraik et al. 2021). Multiple studies have demonstrated that there is often a discrepancy between life history expression (Nielsen 1999; Pearse et al. 2009) and associated adaptive genetic variation (Leitwein et al. 2016; Phillis et al. 2016; Apgar et al. 2017; Abadía-Cardoso et al. 2019) across major fish passage barriers. In a number of California watersheds, *O. mykiss* populations above major barriers, especially permanent artificial barriers, have shown decreased anadromous allelic frequency when compared with the population below (Leitwein et al. 2016; Phillis et al. 2016; Abadía-Cardoso et al. 2019). Likewise, in San Francisco Bay Area study streams, most above-dam *O. mykiss* populations, have significantly lower frequencies of the anadromous *Omy5* genotype than populations downstream of barriers (Leitwein et al. 2016). Abadía-Cardoso et al. (2019) also found decreased frequencies of anadromous alleles above barrier dams in the American River drainage.

Reduced migratory allelic frequency in fish populations above longstanding natural barriers is the expected condition since the population is fragmented and gene flow is unidirectional. Fish can almost always move, either passively or volitionally, over barriers and downstream, potentially contributing genes to the downstream population. Those that inhabit waters upstream of permanent barriers either assume a resident life history or must migrate downstream, taking migratory alleles with them and further reducing their frequency in the upstream population (Leitwein et al. 2016). It is also important to note that some above-barrier fish populations exhibit less genetic diversity (lower heterozygosity) than their below-barrier counterparts within the same drainage (Martínez et al. 2011). In some cases, however, fish carrying anadromous alleles may not be able to move downstream over barriers, especially large artificial dams and other complete barriers, which may help maintain anadromous *Omy5* variants in some above-dam populations (Leitwein et al. 2016). It also appears that some large, above-barrier reservoirs can act as “surrogate oceans” and may assist in the retention of anadromous genotypes and the expression of the adfluvial life history type (Leitwein et al. 2016).

Apgar et al. (2017) recently investigated the effects of climate, geomorphology, and fish passage barriers on the frequency of migration-associated alleles in *O. mykiss* populations across four California steelhead federal-ESA-listed DPSs (Southern California, South-Central California Coast, Central California Coast, and Northern California). Long-term natural barriers and artificial dams that provide no fish passage had the most pronounced negative impact on migration-associated allele frequency. Southern California DPS populations had the lowest frequency of *Omy5* haplotypes associated with anadromy of all California DPSs sampled. The Southern California DPS also exists in a number of heavily developed watersheds, with the greatest average number of partial and complete artificial barriers of the DPSs sampled. Removal of these barriers was predicted to substantially increase the frequency of anadromous alleles in southern California watersheds (Apgar et al. 2017).

2.5.7 Genetic Impacts of Historical Stocking

Clemento et al. (2009) conducted a genetic analysis using microsatellite loci to elucidate the genetic population structure of *O. mykiss* in southern California, with an emphasis on above- and below-barrier genetic relationships. Their analysis included an evaluation of genetic influences of long-standing Fillmore Hatchery stocking on naturally spawned populations in the region. In regional population structure analysis, Fillmore Hatchery Rainbow Trout strains clustered separately from all other wild populations, both above and below barriers. This dispersal pattern indicates that there was no evidence of hatchery introgression with wild *O. mykiss* within the Southern SH/RT range (Clemento et al. 2009).

More recently, Jacobson et al. (2014) analyzed microsatellite loci and SNP genotypes to determine the ancestry of *O. mykiss* populations in multiple southern California watersheds, expanding the geographic range assessed by Clemento et al. (2009). To the contrary, Jacobson et al. found that southern California steelhead ancestry was of mixed origin, with both hatchery and native coastal steelhead lineages, and most populations had almost complete introgression of hatchery lineages from the Central Valley. Only select populations in the San Luis Rey River, Coldwater Canyon Creek, the Santa Ana River watershed, and the San Gabriel River were found to have significant native coastal steelhead ancestry. Based upon these findings, the authors recommended that conservation planning focus on these populations for the preservation of native coastal lineages. Additionally, although Bear Creek (Santa Ana River) and Devil's Canyon Creek (West Fork San Gabriel River) show signs of strong hatchery introgression, they still have some native ancestry and are self-sustaining populations that could be important sources for restoration and recovery efforts of native southern California *O. mykiss*. The authors noted that introgressive hybridization with hatchery Rainbow Trout in these instances does not necessarily decrease viability and can, sometimes, even enhance adaptive genetic variation in a population exposed to changes in their surrounding environment (the phenomenon known as hybrid vigor). The addition of new alleles to a steelhead population via hatchery genetic lineages can also prevent potential genetic bottlenecks in small populations (Jacobson et al. 2014). However, the trade-off is eventual erosion of the native, ancestral lineage, so it is an option that must be weighed carefully. It is worth noting, however, that most samples collected for this study were from populations above anadromous barriers, which mostly precludes any analysis of Southern SH/RT genetic lineage pertinent to the proposed CESA listing unit, which includes only below barrier *O. mykiss*. It is equally important to note that, while potentially beneficial in some cases, the introduction of genetic variants presented in domesticated hatchery Rainbow Trout may reduce long term viability in wild populations because those genetic variants may be the product of several generations of domestication selection. In the case of southern California *O. mykiss*, the native lineage is much different than the predominant founding lineages of California's domesticated Rainbow Trout strains (e.g., Clemento et al. 2009).

Abadía-Cardoso et al. (2016) used microsatellite and SNP loci to elucidate *O. mykiss* ancestry at the extreme southern extent of its range. Southern California *O. mykiss* populations had lower genetic diversity than more northern populations and, genetically, most resembled hatchery Rainbow Trout. The most northern populations of the Southern SH/RT exist in the Santa Maria, Santa Ynez, and Santa Clara rivers, all of which exhibit genetics associated with the native coastal steelhead lineage, matching the results of Clemento et al. (2009) and Nielsen et al. (1997). Many southern populations have been almost entirely replaced by hatchery produced Rainbow Trout. The southern populations containing significant native coastal Steelhead ancestry were some populations in the San Gabriel River system, Coldwater Canyon Creek in the Santa Ana River, and the West Fork San Luis Rey River. These populations also had shared ancestry with the native coastal *O. m. nelsoni* from Baja California. Secondarily, they identified Bear Creek and Devil's Canyon Creek as high value populations with remnant, detectable levels of native ancestry. Also, in contrast to northern coastal steelhead populations, southern California *O. mykiss* showed low allelic frequency correlated with anadromy at *Omy5* loci, again consistent with extensive introgressive hybridization with hatchery Rainbow Trout and limited opportunities to express the anadromous life history. Low genetic variation, observed in populations with predominantly native ancestry, may not allow them to endure changes in environmental conditions, particularly rapid and dramatic changes like those being driven by escalating climate change impacts to the region. Abadía -Cardosa et al (2016) further recommended a managed translocation strategy between the few remaining southern populations with native ancestry to help slow the erosion of native genetic diversity. They found a high variability in the frequency of alleles associated with anadromy, suggesting that many populations of southern RT/SH maintain the capability to express the anadromous phenotype.

Nuetzel et al (2019) examined population genetic structure of *O. mykiss* populations in the Santa Monica Mountains BPG using a set of SNP markers. Specifically, they conducted genetic analyses of *O. mykiss* from Topanga, Malibu and Arroyo Sequit creeks and compared SNP data to the existing data from the Abadía -Cardosa et al (2016) study, including Omy5 genetic marker data. Their results indicate that Malibu Creek trout are almost entirely of native ancestry. The analysis of Topanga Creek trout was more complex, suggesting that Topanga Creek is a predominantly unique native population with some introgressive hybridization with hatchery

Rainbow Trout. The authors did not have a sufficient sample size from Arroyo Sequit Creek to draw meaningful inferences about the ancestry of that population. Both Malibu and Topanga creeks were also found to have relatively high frequencies of the anadromous Omy5 alleles. Together, both of these populations can be a valuable genetic resource for recovery of southern California native coastal *O. mykiss*.

3. ASSESSMENT OF PROPOSED CESA LISTING UNIT

The Commission has authority to list species or subspecies as endangered or threatened under CESA (Fish and G. Code, §§ 2062, 2067). The Legislature left to the Department and the Commission, which are responsible for providing the best scientific information and for making listing decisions, respectively, the interpretation of what constitutes a “species or subspecies” under CESA (*Cal. Forestry Assn. v. Cal. Fish and G. Com.* (2007) 156 Cal.App.4th 1535, 1548-49). The Department has recognized that similar populations of a species can be grouped for efficient protection of bio- and genetic diversity (*Id.* at 1546-47). Further, genetic structure and biodiversity in California populations are important because they foster enhanced long-term stability (*Id*. at p. 1547). Diversity spreads risk and supports redundancy in the case of catastrophes, provides a range of raw materials that allow adaptation and persistence in the face of long-term environmental change, and leads to greater abundance (*Ibid*.).

Courts should give a “great deal of deference” to Commission listing determinations supported by Department scientific expertise (Central Coast Forest Assn. v. Fish & Game Com. (2018) 18 Cal.App.5th 1191, 1198-99). Courts have held that the term “species or subspecies” includes ESUs (*Id*. at 1236, citing *Cal. Forestry Assn.*, supra, 156 Cal.App.4th at pp. 1542 and 1549). The Commission’s authority to list necessarily includes discretion to determine what constitutes a species or subspecies (*Id.* at p. 1237). The Commission’s determination of which populations to list under CESA goes beyond genetics to questions of policy (*Ibid.*). The Department and Commission’s determinations of what constitutes a species or subspecies under CESA are not subject to the federal ESA, regulations based on the federal ESA, or federal ESA policies adopted by NMFS or USFWS, but those sources may be informative and useful to the Department and Commission in determining what constitutes a species or subspecies under CESA.

The ESU designation has been used for previous Pacific salmon listings under CESA, including the Sacramento River Winter-run Chinook Salmon ESU (Endangered, 1989), the Central Valley Spring-run Chinook Salmon ESU (Threatened, 1999), Southern Oregon-Northern California Coast Coho Salmon ESU (Threatened, 2005), and the Central California Coast Coho Salmon ESU (Endangered, 2005). In 2022, the Commission listed northern California summer steelhead as endangered under CESA. In support of that listing, the Commission determined that the petitioned listing unit qualified as a subspecies under CESA “based on the discreteness (when compared to other ecotypes) and significance of that listing unit within the state of California” (Cal. Fish and G. Com. 2022).

3.1 DPS and ESU Criteria

The federal ESA defines “species” to include “any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature” (16 U.S.C. § 1532). In 1991, NMFS adopted its policy on how it would apply the definition of “species” to Pacific salmon stocks for listing under the ESA. Under the NMFS ESU Policy, a salmon stock is considered a DPS if it constitutes an ESU of the biological species. To be considered an ESU, the salmon stock must meet two criteria (NMFS 1991):

1. “It must be substantially reproductively isolated from other conspecific population units; and
2. It must represent an important component in the evolutionary legacy of the species.”

Generally, reproductive isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different population units (NMFS 1991). The evolutionary legacy of a species refers to whether the population contributes substantially to the ecological and genetic diversity of the species as a whole (NMFS 1991).

In February 1996, USFWS and NMFS published a joint DPS policy for the purposes of ESA listings. Three elements are evaluated in a decision regarding the determination of a possible DPS as endangered or threatened under the ESA. These criteria are (NMFS 1996a):

1. “Discreteness of the population segment in relation to the remainder of the species to which it belongs;
2. The significance of the population segment to the species to which it belongs; and
3. The population segment’s conservation status in relation to the [federal ESA’s] standards for listing (i.e., is the population segment, when treated as if it were a species, endangered or threatened [under the federal ESA’s standards]).”

A population segment is discrete if it meets either of two conditions specified in the DPS Policy (NMFS 1996a):

1. “It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.

2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of Section 4(a)(1)(D) of the [ESA].”

If a population segment is determined to be discrete based on physical, physiological, ecological, or behavioral factors, its significance and status are then evaluated based on several characteristics specified in the joint DPS Policy. These include, but are not limited to (NMFS 1996a):

1. “Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon.
2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon.
3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range.
4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.”

Under the DPS Policy, if a population segment is found to be both discrete and significant, its status is then evaluated for listing based on listing factors established by the federal ESA.

3.2 Southern SH/RT Evaluation under the Joint DPS Policy

The proposed listing unit (Southern SH/RT) in the Petition is “all *O. mykiss* below manmade and natural complete barriers to anadromy, including anadromous and resident life histories, from and including the Santa Maria River (San Luis Obispo and Santa Barbara counties) to the U.S.-Mexico Border.” Southern SH/RT is a subtaxon of the species *O. mykiss*. The anadromous life history of Southern SH/RT is not markedly separate from the non-anadromous life history of Southern SH/RT. To determine whether Southern SH/RT is a subspecies for the purposes of CESA listing, the Department used the joint DPS Policy to determine whether Southern SH/RT is a DPS. The Department evaluated the proposed listing unit by applying the first (discreteness) and second (significance) criteria of the joint DPS Policy but not the third criterion (the population segment’s conservation status in relation to the federal ESA’s standards). The Department did not apply the third criterion because after using the discreteness and significance criteria to determine whether Southern SH/RT is a DPS and hence a subspecies for purposes of CESA, the Department will assess the listing unit’s status in relation to CESA’s standards rather than the federal ESA’s standards.

In 2006 NMFS concluded that application of the joint DPS Policy to West Coast *O. mykiss*, including the Southern California Steelhead DPS, was logical, reasonable, and appropriate (NMFS 2006). Further, NMFS concluded that use of the ESU Policy, which was originally intended for Pacific salmon, should not continue to be applied to *O. mykiss*, a type of salmonid with characteristics not typically exhibited by Pacific salmon (NMFS 2006). The Department finds that the application of the discreteness and significance DPS criteria from the DPS Policy is appropriate, logical, and reasonable for identifying whether Southern SH/RT is a subspecies for purposes of CESA because the taxon exhibits characteristics that are not typically exhibited by other Pacific salmonids, for which the ESU policy was developed.

3.2.1 Discreteness

Markedly Separate: Yes. The Department considers Southern SH/RT to be markedly separate from other populations of the taxon along the West Coast of North America. Point Conception in southern California is a well-studied biogeographic boundary that separates different physical oceanographic processes and the abundance and distribution of many marine species (Horn and Allen 1978; Horn et al. 2006; Miller 2023). The coastal areas north of Point Conception have cooler water temperatures, stronger upwelling, high nutrient concentrations, and the coastline is generally rocky. Within the southern California Bight, water temperatures are warmer, upwelling is weaker, and the coastline is typically sandy. While intraspecific genetic breaks do not always coincide with biogeographic boundaries near Point Conception (Burton 1998), the Department maintains that the DPS standards for discreteness do not require absolute separation of a DPS from other members of this species, because this can rarely be demonstrated in nature for any population of organisms (NMFS 1996a).

The life history of Southern SH/RT relies more heavily on seasonal precipitation than populations of the same taxon occurring farther north (Busby et al. 1996). Because average precipitation is substantially lower and more variable and erratic in southern California than regions to the north, Southern SH/RT are more frequently exposed to adverse environmental conditions in marginal habitats (i.e., warmer water temperatures, droughts, floods, wildfire) (Busby et al. 1996). Morphologically, anadromous forms of Southern SH/RT are typically longer in length and more streamlined in shape than more northern populations to enable passage through southern California’s erratic and low streamflow watersheds (Moyle et al. 2017).

International Border: No.

3.2.2 Significance

Unique Ecological Setting: Yes. The range of Southern SH/RT represents the southernmost region of the taxon’s entire West Coast Range of North America. Within this range, the watersheds that occur south of the Santa Monica Mountains have a semi-arid climate that is characterized by low precipitation, high evaporation rates, and hot and dry summers (CDFW 2021d). This climate type represents a unique ecological setting for Southern SH/RT relative to most *O. mykiss* populations along the West Coast of North America that occur in Mediterranean climates characterized by summer fog.

The ecological setting for Southern SH/RT is characterized by significant urbanization which is unique among other federally listed steelhead DPSs that occur in coastal regions of California that are not as highly developed or populated. For example, approximately 22 million people reside in the southern California counties of Santa Barbara, Ventura, Los Angeles, Orange, San Bernadino, Imperial, and San Diego, whereas the population in the South-Central coast counties of Santa Cruz, Santa Clara, Monterey, San Benito, and San Luis Obispo is approximately 2.8 million people (NMFS 2012a; NMFS 2013). Furthermore, almost all Southern SH/RT-bearing watersheds contain dams and water diversions that have blocked access to most historic spawning and rearing habitats. Of the four DPSs sampled by Apgar et al. (2017), the Southern California Steelhead DPS contained the highest average number of partial anthropogenic barriers per watershed (n = 4.7) and the highest total number of complete anthropogenic barriers (n = 8). For context, the neighboring, and more northern South-Central Coast DPS contains a significantly lower average number of partial anthropogenic barriers per watershed (n = 1.6) and complete anthropogenic barriers (n = 1). Moreover, nearly all estuary and lagoon ecosystems in southern California have been severely degraded, thereby limiting the ability of juvenile Southern SH/RT to utilize these critical nursery habitats (Moyle et al. 2017). While these anthropogenic threats are not necessarily unique to the southern California coastal area, the region’s highly variable and erratic hydrologic cycle and relatively arid climate, combined with the impacts of climate change, make Southern SH/RT increasingly vulnerable to extinction and less resilient to disturbance events and catastrophic events such as major wildfires and floods.

Gap in Range: Yes. The Department believes that the loss of Southern SH/RT would result in a significant truncation of the southern range of the taxon along the West Coast of North America. The range of Southern SH/RT encompasses approximately 12,700 square miles with 25,700 miles of streams (NMFS 2012a).

Only Surviving Natural Occurrence: No.

Markedly Different Genetic Characteristics: No. Individuals from populations of Southern SH/RT have been shown to not be genetically isolated from populations of *O. mykiss* in the south-central California coast (Clemento et al. 2009). Evidence of straying has been documented in steelhead in central California (Donohue et al. 2021), and genetic population structure analyses suggest that there was historical exchange of genetic information between coastal populations (Garza et al. 2014). Although many steelhead populations can be partially isolated, at least a small amount of exchange between different populations of steelhead is to be expected due to natural straying. This connectivity results in a level of genetic similarity, which is more pronounced between neighboring populations, and prevents most populations from being completely isolated (Bjorkstedt et al. 2005; Garza et al. 2014; Arciniega et al. 2016).

Nonetheless, allozymes, mitochondrial DNA, and microsatellites have uncovered significant and unique genetic diversity in southern California steelhead, including traits not found in more northern populations. Busby et al. (1996) noted that a mitochondrial DNA type exists in *O. mykiss* populations between the Santa Ynez River and Malibu Creek that is rare in populations to the north, while samples from Santa Barbara County were found to be the most genetically unique of any wild coastal steelhead populations analyzed. Conservation of both neutral and adaptive genetic diversity, such genetic variation associated with migratory life history, is crucial in maintaining the ability of *O. mykiss* populations to adapt to altered environments. Given that Southern SH/RT populations have the lowest frequencies of anadromous genotypes, it is critical to preserve this genetic variation and ensure no more of it is lost.

3.2.3 Conclusion

Southern SH/RT satisfies the first (discreteness) and second (significance) criteria of the joint DPS Policy: i.e., Southern SH/RT is markedly separate and biologically significant to the taxon to which it belongs. Accordingly, the Department concludes that Southern SH/RT is a DPS and hence a subspecies for the purposes of CESA listing.

4. POPULATION TRENDS AND ABUNDANCE

4.1 Structure and Function of Viable Salmonid Populations

In this review, we use the definition of “population” from McElhany et al. (2000): “An independent population is a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place, or in the same place at a different season.” In other words, a population as defined by McElhany et al. (2000) is a group of fish that experiences a substantial degree of reproductive isolation.

Steelhead have strong fidelity to their natal stream, which can lead to substantial reproductive isolation and, as a result, create local adaptation within somewhat isolated populations (Waples et al. 2008). Isolation can expose these local populations to varying degrees of genetic drift as well as different environmental pressures that ultimately lead to the development of genetic and phenotypic differences. Although many steelhead populations can be partially isolated, at least a small amount of exchange between different populations of steelhead is to be expected due to natural straying. This connectivity results in a level of genetic similarity, which is more pronounced between neighboring populations, and prevents most populations from being completely isolated (Bjorkstedt et al. 2005; Garza et al. 2014; Arciniega et al. 2016).

The concept of viable salmonid populations was introduced by McElhany et al. (2000). A viable salmonid population is defined as, “an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame,” and an independent population is defined as, “any collection of one or more local breeding groups whose population dynamics or extinction risk over a 100-year time period are not substantially altered by exchanges of individuals with other populations.”

McElhany et al. (2000) introduced four criteria for assessing viability of salmonid populations: abundance, productivity, population spatial structure, and diversity. These parameters form the foundation for evaluating population viability because they serve as reasonable predictors of extinction risk, reflect general processes important to all populations of species, and are measurable. Abundance is a key parameter because smaller populations are at greater risk of extinction than larger populations. Productivity, which is associated with abundance, serves as an indicator of population growth rate either over an entire life cycle or stage-specific life-history stage. Population spatial structure represents the distribution of individuals in habitats they use throughout their life cycle, as well as the processes that generate that distribution. Spatial structure often reflects the amount of suitable habitat available for a population as well as demographic stability and the level of straying among habitats. Diversity represents variation in traits such as anadromy, run-timing, and spawning behavior and timing. Typically, a more diverse population is more likely to contain individuals that will survive and reproduce in the face of environmental variation (McElhany et al. 2000). In this chapter, we evaluate, to the best of our ability, these four criteria for Southern SH/RT populations.

4.2 Sources of Information

We reviewed many sources of information for this Status Review, including primary research and literature review articles, the CESA listing petition, previous federal status reviews, recovery plans, viability assessments, Department reports and documents, annual reports from ongoing Southern SH/RT monitoring efforts, and historical reports. Agency staff with knowledge of watersheds supporting Southern SH/RT were also consulted for information.

Data limitations and uncertainties associated with historical accounts for Southern SH/RT limits our ability to understand their complete historical abundance and distribution in their range.

The majority of available historical data are in reports, technical memos, and other documents that have not undergone a formal peer-review process. These types of historical sources are not necessarily at a high level of scientific rigor and have not been subject to peer review, but they represent the best information available at the time of this review regarding the historical distribution and abundance of Southern SH/RT populations.

Multiple data sources were used to evaluate viability metrics of Southern SH/RT populations. These data are mostly derived from monitoring reports from several single-basin annual survey efforts. For example, data for the Santa Ynez River population was sourced from monitoring reports developed by the Cachuma Operations and Maintenance Board (COMB). Data for the Ventura River was sourced from annual monitoring reports produced by Casitas Municipal Water District (CMWD), and data contained in Booth (2016) for the United Water Conservation District (UWCD) was used for the Santa Clara River population (See Appendices A – D for full data sources). Although data from these monitoring reports represent the best available scientific information in many southern California watersheds, the data may be derived from different monitoring approaches and designs, contain detection bias, and vary in the level of monitoring effort through time and geographic areas. These constraints may limit the power of statistical analyses to assess trends in viability criteria. Therefore, the results of the analyses conducted in subsequent portions of this chapter should be interpreted in the context of these limitations.

Dagit et al. (2020) describes the occurrences of adult steelhead from 1994-2018 and was also used as a source of peer-reviewed information to provide insight into the abundance trends of Southern SH/RT, particularly for the basins south of Los Angeles where historically no monitoring of steelhead occurred. Additional information on the data sources used in this chapter can be found in Appendices A - D. and Dagit et al. (2020).

4.3 Historical and Current Distribution

This section discusses the historical and current distribution of Southern SH/RT within their range. The section is structured on the five BPGs, which are a federal delineation based on a suite of environmental conditions (e.g., hydrology, local climate, geography) and watershed characteristics (i.e., large inland or short coastal streams) (NMFS 2012a). Separate watersheds within each BPG are considered to support individual populations of southern SH and RT; therefore, single BPGs encompass multiple watersheds and populations (Figure 6). Additional information on southern SH/RT distribution in watersheds not included in this section can be found in Good et al. (2005), Becker and Reining (2008) and Titus et al. (2010). In general, estimates of historical population abundance are based on sparse data and assumptions that are plausible but have yet to be adequately verified or tested. While the following historical estimates are likely biased either upward or downward, the examination of historical records of adult run size in southern California show consistent patterns of abundance that are at least two or three orders of magnitude greater in size than in recent years.

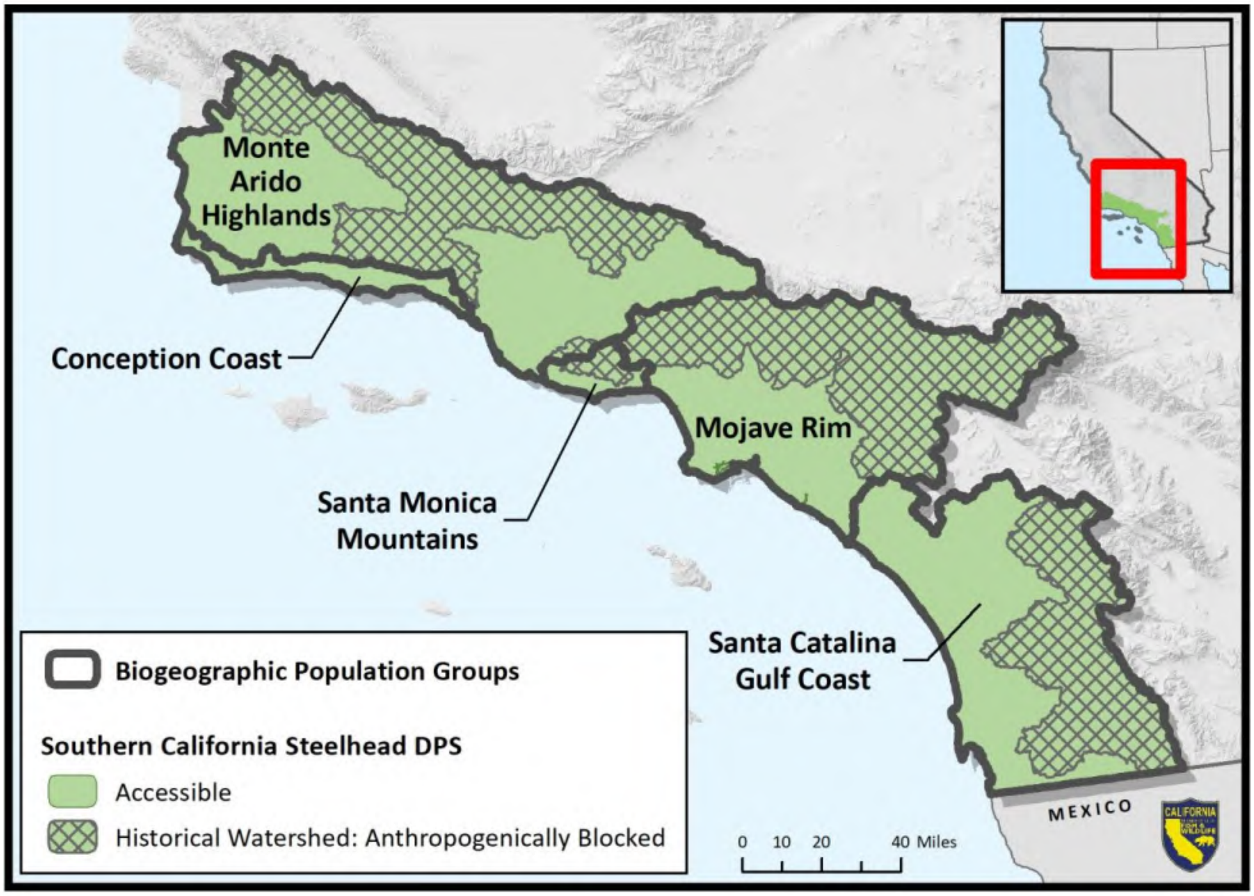


Figure 6. Map of the current and historical distribution of Southern SH/RT. BPGs represented are the Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast.

4.3.1 Monte Arido Highlands Biogeographic Population Group

The Monte Arido Highlands BPG includes four watersheds spanning San Luis Obispo, Santa Barbara, Ventura, and northern Los Angeles counties draining the west side of the Transverse Range and terminating at the Pacific Ocean (NMFS 2012a; Figure 7). Inland stretches of these watersheds are high in elevation and mountainous, but otherwise the watersheds contain different geographic features. Watersheds in this BPG are susceptible to “flashy” flows with seasonal storms and can also dry during the summer even in mainstem reaches. Perennial flows are mainly found in the upper reaches of tributaries that still retain groundwater connection (NMFS 2012a).

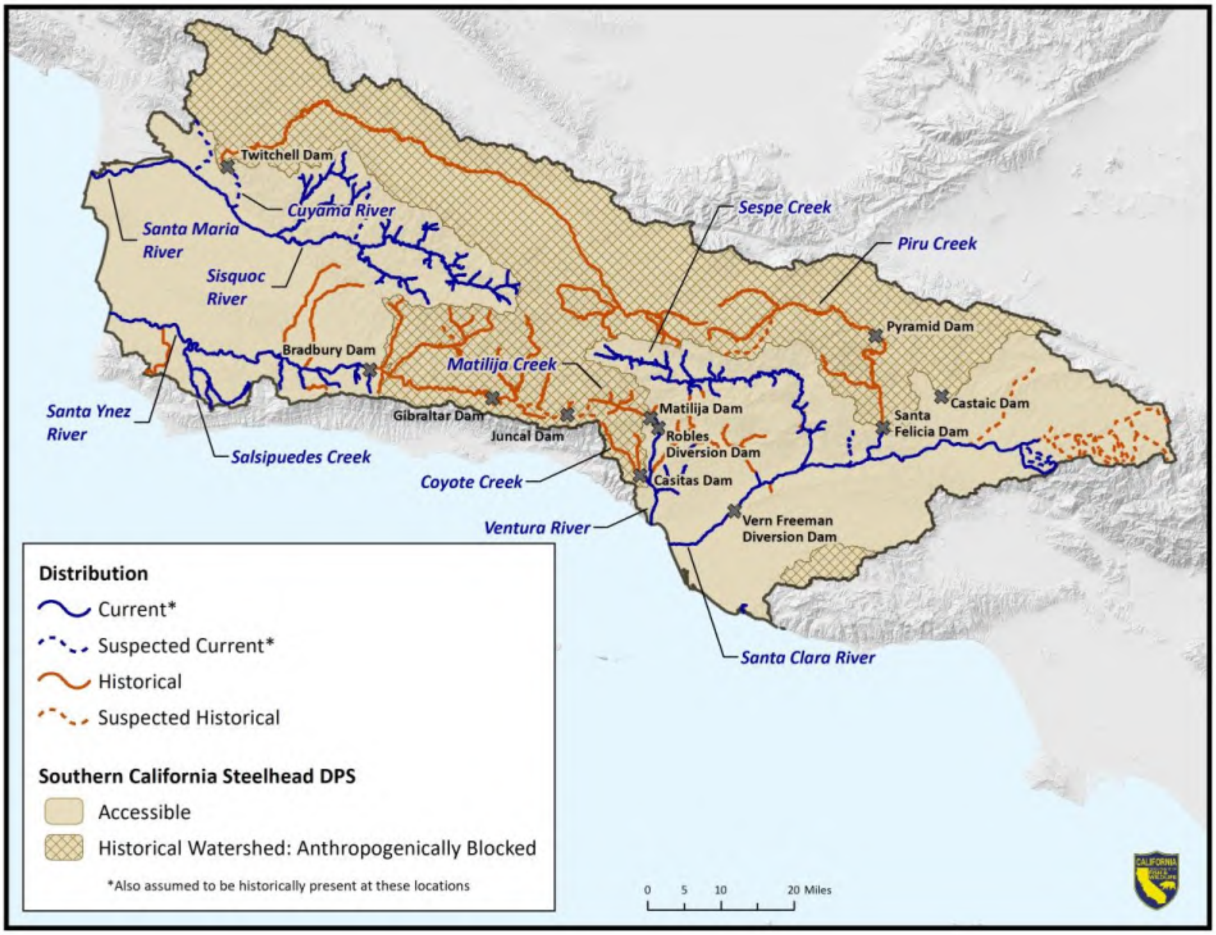


Figure 7. Map of the Monte Arido Highlands BPG depicting known and suspected current and historical distribution.

4.3.1.1 Santa Maria River

The Santa Maria River runs from the confluence of the Cuyama and Sisquoc rivers to the ocean and encompasses 1,790 square miles of watershed (Becker and Reining 2008). Historically, the Santa Maria River served mainly as a corridor for steelhead migrating to and emigrating from the Cuyama and Sisquoc rivers, rather than as habitat for spawning and rearing (Titus et al. 2010).

Hatchery stocking of *O. mykiss* occurred in the early 1930s in the Sisquoc and Cuyama watersheds (Titus et al. 2010). In the early to mid-1940s, juvenile steelhead from the Santa Ynez River were rescued and translocated to the Santa Maria River. Tributaries of the Cuyama River were stocked with Rainbow Trout in the 1940s to support recreational fishing; however, it is unknown if there was a historical run of anadromous Southern SH/RT in the Cuyama River tributaries (Titus et al. 2010). Starting in 1950, there was essentially no steelhead fishery for at least a decade (Titus et al. 2010).

The Sisquoc River had a robust population of resident *O. mykiss* in 1959 (Becker and Reining 2008) and fish were seen in smaller numbers in 1964 (Titus et al. 2010). Southern SH/RT of multiple age classes were also observed in the upper river during the 1990s (Becker and Reining 2008). In 2005, substantial numbers of young-of-the-year (YOY) *O. mykiss*, as well as some older age classes, were observed in the upper Sisquoc watershed during a population survey (Stoecker 2005).

Other smaller tributaries in the Santa Maria watershed, mostly tributaries of the Sisquoc and Cuyama rivers, have had limited historical and present *O. mykiss* observations from surveys, although some anecdotal sightings have occurred (Becker and Reining 2008). The streams include Deal Canyon Creek, Reyes Creek, Beartrap Creek, Tepusquet Creek, La Brea Creek, North Fork La Brea Creek, Manzana Creek, Davy Brown Creek, Munch Canyon Creek, Sunset Valley Creek, Fish Creek, Abel Canyon Creek, South Fork Sisquoc River, White Ledge Canyon Creek, Rattlesnake Canyon Creek, and Big Pine Canyon Creek. Some of these *O. mykiss* observations were made in tributaries of the Cuyama River post-dam construction (Becker and Reining 2008); however, it is possible that anadromous Southern SH/RT were able to access and inhabit these areas historically. Notably, many of these small tributaries were stocked with thousands of hatchery-raised *O. mykiss* in the mid-1900s for fishery supplementation (Titus et al. 2010).

Twitchell Dam was built on the Cuyama River in the late 1950s, almost 8 miles upstream from the confluence with the Santa Maria River. The dam currently impacts hydrologic function of the Santa Maria system by increasing the frequency of “false positive” migration flows in the Sisquoc River, reducing the frequency of downstream passable migration conditions, increasing the number of days with upstream passable flows that are not followed by additional days of passable flows, and reducing the frequency of long-duration migration flows (Becker and Reining 2008; Stillwater Sciences 2012). Twitchell Dam is a complete barrier to anadromy, and historically, water releases have not been regulated to provide instream flows for upstream and/or downstream steelhead migration in the Santa Maria River during the winter and spring migration periods (Stoecker 2005). Following construction of the dam, the Santa Maria and Cuyama rivers continue to have intermittent flows (Becker and Reining 2008). Currently, the lower mainstem of the Santa Maria River, which serves as a migration corridor for Southern SH/RT, is dry most of the year in most years due to managed aquifer recharge in the Santa Maria Valley (NMFS 2012a).

4.3.1.2 Santa Ynez River

The Santa Ynez River is a major watershed spanning approximately 900 square miles and 90 river miles (Becker and Reining 2008). The river is thought to have supported the largest anadromous Southern SH/RT run (Titus et al. 2010). The first record of Southern SH/RT in the Santa Ynez occurred in the late 1800s prior to any stocking of the river with hatchery trout (Alagona et al. 2012). Upstream migration of Southern SH/RT past river km 116 was impeded in 1920 resulting from the construction of Gibraltar Dam (Titus et al. 2010). The reservoir supported landlocked steelhead following dam construction and was stocked in the 1930s with hatchery *O. mykiss* as well as steelhead rescued from the Santa Ynez River in 1939, 1940, and 1944 (Titus et al. 2010).

Upstream migration typically occurred from December to March following precipitation events. Southern SH/RT were seen spawning in all tributaries as well as the mainstem below Gibraltar Dam during the spring in the mid-1930s, though flow was observed to limit suitable spawning habitat (Titus et al. 2010). Most spawning in the Santa Ynez River occurred in the upper reaches between Buellton and Gibraltar Dam as well as the tributaries to the mainstem such as Alisal, Santa Cota, Cachuma, Tequepis Canyon, and Santa Cruz creeks. Fish rescues were required during the summer due to intermittent flows and drying of downstream tributary areas as well as the mainstem (DFG 1944).

Tens of thousands of hatchery *O. mykiss* were stocked in Gibraltar Reservoir in the 1930s, and over 100,000 hatchery-reared juvenile steelhead were planted in the Santa Ynez River from 1930-1935. In the 1940s, about 2.5 million juvenile Southern SH/RT were translocated from various areas of the watershed to the lower river (DFG 1944). An approximate run size of at least 13,000 spawners was inferred by a Department staff member based on comparisons with Benbow Dam counts on the South Fork Eel River, California in the 1930s and 1940s (Becker and Reining 2008; Titus et al. 2010). However, it is possible that the Santa Ynez steelhead population may have increased during this period due to ongoing rescue operations that resulted in lower mean mortality rates during the early to mid-1940s (Good et al. 2005). Nonetheless, these estimates may underestimate historical abundance because they were produced 24 years after a significant portion of spawning and rearing habitat had been blocked by Gibraltar Dam.

Construction of Bradbury Dam, originally named Cachuma Dam, downstream of Gibraltar Dam was finished in 1953. Bradbury Dam forms the Lake Cachuma reservoir, blocks Southern SH/RT access to upstream habitat, and alters natural flow regimes and sediment dynamics (Becker and Reining 2008; Titus et al. 2010). Even before the dam was built, the lack of precipitation limited upstream migration due to the sandbar at the mouth of the river remaining intact (Titus et al.

2010). Steelhead run size declined significantly after 1946 and only small numbers were seen in the stream reaches below Bradbury Dam in following decades (Titus et al. 2010). Anadromous Southern SH/RT were effectively extirpated by 1975 due to lack of flows below Bradbury Dam especially during summer months, though steelhead have occasionally been observed over the past few decades (Becker and Reining 2008).

Recently, Reclamation's permit to operate releases from Bradbury Dam was modified to require releases from the dam for purposes of protecting fishery resources in accordance with the 2000 NMFS Biological Opinion during wetter years. This modification also included additional measures to benefit Southern SH/RT, including opportunities to provide fish passage above and below Bradbury Dam, measures to reduce the impacts of predation, and restoration of stream and bankside habitat (SWRCB 2019).

Department staff have monitored steelhead in Salsipuedes Creek, Hilton Creek, and the mainstem Santa Ynez River and have found that most years can support a small steelhead run. However, zero adult steelhead have been found in the Santa Ynez River since 2012 (Boughton et al. 2022a). COMB has conducted uncalibrated, single pass snorkel surveys each year since the 1990s at multiple index sites to determine *O. mykiss* densities in the Santa Ynez River. Until 2012, fish densities were consistent but declined sharply in the following years due to drought conditions (Boughton et al. 2022a). The past few years have seen numbers rebound somewhat in response to wetter conditions. Similar trends were observed in the migrant traps on Hilton and Salsipuedes creeks and the mainstem Santa Ynez River, which have been in operation since 2001 (COMB 2022).

4.3.1.3 Ventura River

The Ventura River watershed encompasses 228 square miles and 16.5 stream miles (Becker and Reining 2008). Matilija Creek and North Fork Matilija Creek intersect to form the headwaters of the Ventura River. Multiple impassable dams occur in this watershed, altering the natural flow regime and causing negative impacts to Southern SH/RT habitat quantity and quality. About 2 miles downstream of the Ventura River headwaters is the Robles Diversion Dam, which was constructed in 1958 to direct water for storage into Lake Casitas (Becker and Reining 2008; Titus et al. 2010). Both Matilija Dam on Matilija Creek and Casitas Dam on Coyote Creek, are also attributed to population declines of Southern SH/RT on the Ventura River (Titus et al. 2010).

In the 1930s, tens of thousands of juvenile *O. mykiss* were stocked in the Ventura River, as well as thousands of fish that were transplanted from rescues conducted on the Santa Ynez River (Titus et al. 2010). Department staff estimated that the Ventura watershed supported 4,000 to 5,000 steelhead spawners in 1946. In 1973, Department staff estimated a run of between 2,500 and 3,000 steelhead (Becker and Reining 2008). However, the methodologies used to make these estimates were likely based on expert opinion. Similar to the Santa Ynez River, ongoing rescues may have had a small effect on the Ventura River steelhead populations in the 1940s. By the mid-1970s, the steelhead run size was estimated at approximately 100 fish, likely due to limited suitable rearing habitat below Robles Diversion Dam (Becker and Reining 2008).

There are four key tributaries to the Ventura River that historically provided substantial suitable spawning and rearing habitat for *O. mykiss*. These tributaries were Matilija Creek, San Antonio Creek, Coyote Creek, and Santa Ana Creek (Capelli 1974). Coyote Creek likely had a strong run of steelhead with up to 500 adult returns being probable prior to construction of Casitas Dam. Currently, the few returning Southern SH/RT spawners may use the lower reaches of the 13-mile stream for spawning (Becker and Reining 2008; Titus et al. 2010). Matilija Creek, which extends for almost 15 miles from its confluence with the Ventura River, contains ideal spawning and rearing habitat. However, access to the upper reaches of the creek was impeded with the construction of Matilija Dam (Becker and Reining 2008). Before completion of the dam, it is estimated that the creek could have supported runs of 2,000 to 2,500 spawners (Becker and Reining 2008). The removal of Matilija Dam, which is an important element of the Matilija Dam Ecosystem Restoration Project, is currently in the process of environmental review. Tributaries of Matilija Creek contain high quality habitat that continue to support resident *O. mykiss* (Becker and Reining 2008). The removal of Matilija dam will allow access to about 20 miles of stream habitat for Southern SH/RT (MDERP 2022). Historical presence of steelhead in San Antonio Creek is unknown, but the stream is thought to have produced steelhead in the 1980s and 1990s (Titus et al. 2010). Santa Ana Creek was home to *O. mykiss* in the headwater reaches during the 1930s through the 1940s as well as in 1979 (Becker and Reining 2008).

Construction on the Robles Fish Passage Facility, which allows fish passage through the Robles Diversion Dam, was completed in 2006. As a requirement of their federal Biological Opinion, CMWD monitors fish migration through the facility (CMWD 2019). A downstream migrant trap is also operated to evaluate if smolts can pass through the facility without injury (CMWD 2019). A weir trap is then used to evaluate success of smolt migration through the reach downstream of the facility (CMWD 2019). Small numbers of out-migrating smolts have been captured since operation of the weir trap began. However, during the most recent drought (2012-2017), trapping did not occur due to low flow conditions. Since 2017, zero to only a few fish have been observed per year in the vicinity of the passage facility. Presence/absence and redd surveys for *O. mykiss* have also been conducted by CMWD each year and numbers have declined substantially since the beginning of the drought (CMWD 2018).

4.3.1.4 Santa Clara River

The Santa Clara River is a major river that flows into the Pacific Ocean near Ventura, California. The watershed drains an area of approximately 1,600 square miles with 75 stream miles (Becker and Reining 2008). The historical steelhead run was estimated to be around 9,000 fish based on comparisons of habitat suitability metrics produced for the Ventura River (Moore 1980). Numerous instream water diversions have impeded anadromous migration since the 1950s (Becker and Reining 2008; Titus et al. 2010).

Tributaries that intersect the Santa Clara River above the Vern Freeman Diversion historically provided most of the suitable Southern SH/RT spawning and rearing habitat in the watershed. Santa Paula Creek, a tributary to the Santa Maria River, contains high quality suitable *O. mykiss* spawning and rearing habitat. The Harvey Diversion Dam is located on the lower reaches of Santa Paula Creek. While this diversion originally provided fish passage, strong flows rendered the facility irreparable in 2005 (Stoecker and Kelley 2005). More recently, the Harvey Diversion Fish Passage Remediation Project has the goal of restoring fish passage at the facility to reestablish connection to the upstream watershed on Santa Paula and Sisar creeks (California Trout 2018).

Sespe and Piru creeks are the largest tributaries of the Santa Clara River and support higher *O. mykiss* numbers than Santa Paula Creek (Stoecker and Kelley 2005). Sespe Creek contains over 198 km of habitat historically accessible to steelhead and sustains the highest relative abundance of wild *O. mykiss*. It is thought that Sespe Creek offers the highest potential for steelhead recovery because it lacks mainstem migration barriers (Stillwater Sciences 2019). However, Sespe Creek is known to dry in years with low precipitation, leading to a loss of connectivity with the Santa Clara River (Puckett and Villa 1985; Stoecker and Kelley 2005). A recent survey found high abundances of aquatic invasive species throughout most reaches of Sespe Creek downstream of its confluence with Howard Creek, which transports high abundances of invasive species from the Rose Valley Lakes (Stillwater Sciences 2019).

The Piru Creek watershed includes the Santa Felicia and Pyramid Dams. Both dams block access to upstream historical habitat on the Santa Clara River. Reservoir and dam operations also lead to unnatural and diminished flow regimes in the watershed (Moore 1980). Prior to the construction of both dams, adult steelhead were reported to migrate up into Buck and Snowy creeks (Stoecker and Kelley 2005). Piru Creek does not provide spawning and rearing habitat to Southern SH/RT (Moore 1980); however, Aqua Blanca and Fish creeks contain suitable habitat and currently support adfluvial *O. mykiss* populations, which could be important in the future for restoring an anadromous run in this tributary (Stoecker and Kelley 2005).

Various Santa Clara tributaries, including those mentioned above, were stocked in the 1930s through 1950s with hatchery *O. mykiss* as well as those rescued from the Santa Ynez River in 1944 (Titus et al. 2010). Some minor tributaries of the Santa Clara River were also stocked but have no historical records of *O. mykiss* presence. These tributaries include Hopper Canyon, Tom, Pole, and Willard creeks (Titus et al. 2010).

Operations of a downstream migrant trap at the Vern Freeman Diversion Dam began in 1993. Operations typically occur from January to June when flows in the river are sufficient to maintain consistent water levels at the fish trap. A total of 16 adult steelhead and 839 smolts were observed at the Freeman Diversion from 1993-2014 (Booth 2016).

4.3.2 Conception Coast Biogeographic Population Group

Eight small watersheds that are relatively uniform in geographic features comprise the Conception Coast BPG, which spans about 50 miles of the southern California coast (NMFS 2012a; Figure 8). Streams in this BPG run north to south and have steep slopes in the upper portions of their watersheds where there is perennial flow. Precipitation can be much higher in the upper watersheds and can lead to “flashy” flows due to the steep stream gradients (NMFS 2012a). Both the Carpinteria Creek and Gaviota Creek watersheds have been the focus of habitat restoration in recent years, as both provide high-quality spawning and rearing habitat for Southern SH/RT and have high recovery potential (NMFS 2012a).

4.3.2.1 Gaviota Creek

Gaviota Creek is about six miles in length, connecting with the Pacific Ocean just south of Las Cruces, California. Steelhead were documented in Gaviota Creek in the 1930s in the winter (Becker and Reining 2008) and multiple ages of *O. mykiss* were observed in the 1990s and early 2000s (Becker and Reining 2008). Steelhead runs in Gaviota Creek, which were historically present in most years, were likely small (Becker and Reining 2008). Livestock grazing is responsible for reductions in suitable habitat for Southern SH/RT in the watershed (Becker and Reining 2008). In recent years, periodic bankside observations conducted by the Department have observed a range of zero to a few hundred *O. mykiss* and no adult steelhead in Gaviota Creek (K. Evans, CDFW, unpublished data).

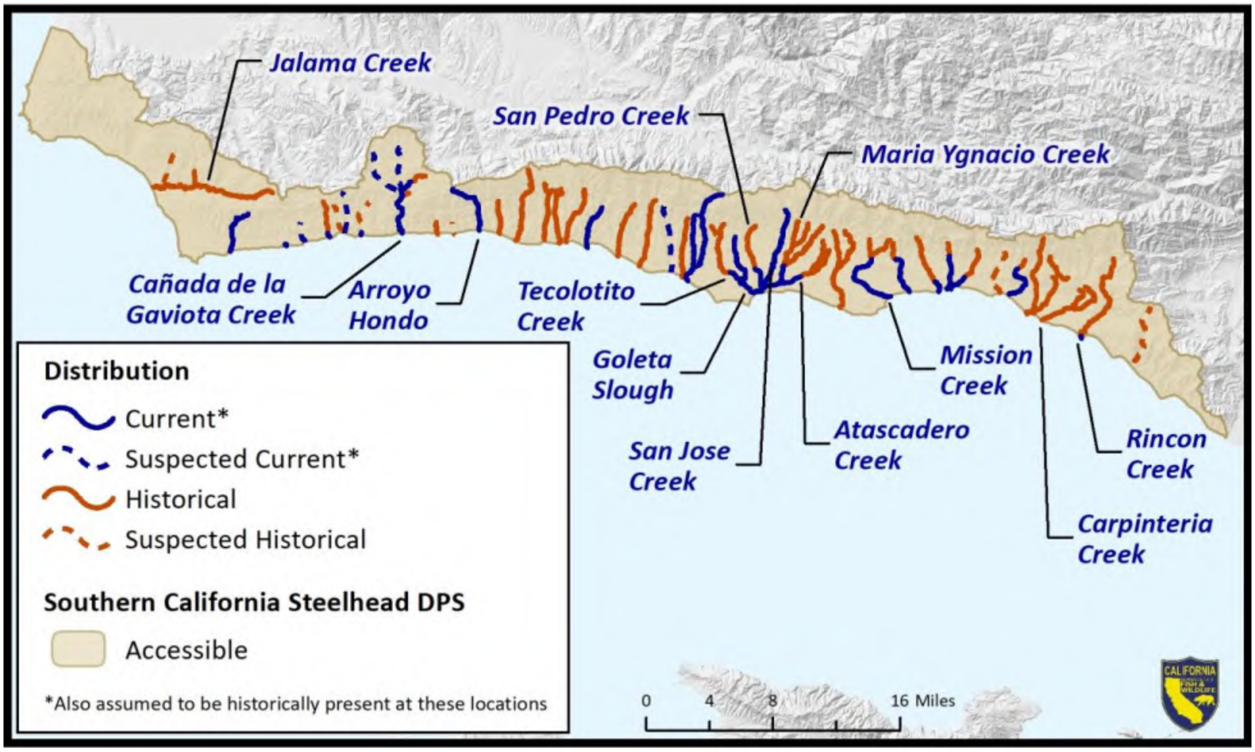


Figure 8. Map of the Conception Coast BPG depicting known and suspected current and historical distribution.

4.3.2.2 Carpinteria Creek

Carpinteria Creek is approximately 6.5 miles long and connects with the Pacific Ocean near Carpinteria, California. Southern SH/RT were observed in the watershed in 1942 (Stoecker et al. 2002) and the stream was understood to have a historical steelhead run (Becker and Reining 2008). Different life stages of *O. mykiss* were seen in the mid-1990s (Becker and Reining 2008) and many were seen in the upper watershed (Becker and Reining 2008) which is known to have suitable habitat (Becker and Reining 2008). A few *O. mykiss* of varying sizes were found in the lower watershed in 2008 (Becker and Reining 2008). In recent years, monitoring conducted by the Department from 2016-2022 have observed few if any individuals of either life-history forms (K. Evans, CDFW, unpublished data).

4.3.2.3 Other Creeks

There are many other creeks flowing into the Pacific Ocean, some of which may have supported Southern SH/RT historically, some where there have been recent observations, and others where *O. mykiss* has not been seen at all. These coastal creeks are typically no longer than 10 stream miles. In addition to Gaviota and Carpinteria creeks, other suitable streams with more recent sightings of Southern SH/RT include Arroyo Hondo Creek and Rincon Creek (Becker and

Reining 2008). Arroyo Hondo Creek contains the least number and severity of threats for Southern SH/RT in the Conception Coast BPG (NMFS 2012a).

4.3.3 Santa Monica Mountains Biogeographic Population Group

There are five watersheds in the Santa Monica Mountains BPG, the majority of which are small with geography resembling that of watersheds in the Conception Coast BPG (NMFS 2012a; Figure 9). Except for Malibu Creek, the headwaters of the streams occur prior to passing through the Santa Monica mountains. Malibu Creek is the largest watershed in the BPG (NMFS 2012a) but is similar to Topanga Creek in stream length (Becker and Reining 2008). There are two substantial anthropogenic migration barriers on Malibu Creek, Rindge Dam and Malibu Lake Dam. Rindge Dam is located a few miles upstream from the mouth and prevents access to nearly all historical Southern SH/RT habitat. The remaining three streams include Big Sycamore Canyon Creek, Arroyo Sequit, and Las Flores Canyon Creek (NMFS 2012a).

4.3.3.1 Malibu Creek

The Malibu Creek watershed encompasses about 105 square miles including 8.5 miles of stream that outflows into the Pacific Ocean at Malibu Lagoon State Beach in Santa Monica Bay (Becker and Reining 2008). Rindge Dam was constructed in 1924 about three miles upstream from the mouth (Becker and Reining 2008; Titus et al. 2010). Before the dam was built, steelhead were able to access spawning habitat in Las Virgenes and Cold creeks (Titus et al. 2010). In 1947, a substantial steelhead run was observed when the sandbar at the mouth was manually opened. At the time, steelhead were able to access about 10-12 stream miles in the basin (Becker and Reining 2008). In the 1970s, steelhead were observed migrating upstream up to Rindge Dam (Becker and Reining 2008). In 1980, a Department employee counted 61 steelhead immediately downstream of Rindge Dam (Titus et al. 2010). Multiple life stages of *O. mykiss* were observed during a study conducted in the winter and spring of 1986. A total of 158 fish was reported though only one was an adult steelhead. Later in 1986 and in 1987, a handful of adult *O. mykiss* were found below Rindge Dam and a few adult *O. mykiss* were seen just below the dam in 1992 (Titus et al. 2010). The quality of spawning and rearing habitat is the best just below Rindge Dam (Titus et al. 2010), which explains the greater use of that area by juvenile *O. mykiss* (Titus et al. 2010). Stocking of hatchery Rainbow Trout occurred in 1984 at Malibu Creek State Park with additional stockings likely occurring frequently (Titus et al. 2010).

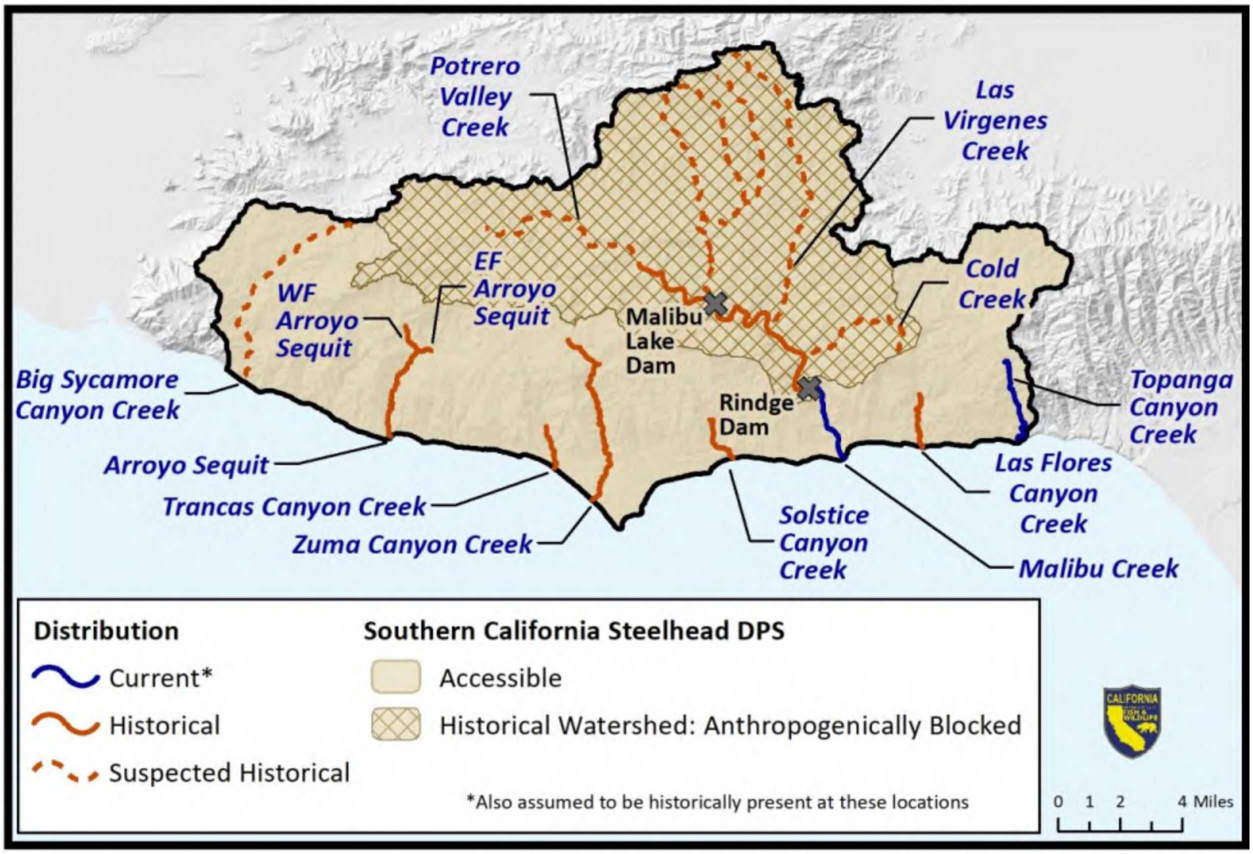


Figure 9. Map of the Santa Monica Mountains BPG depicting known and suspected current and historical distribution. Abbreviations: EF = East Fork, WF = West Fork.

In addition to Rindge Dam and other migration barriers blocking access to historical habitat, the natural flow regime and water quality of Malibu Creek has been modified by operations of the Tapia Water Reclamation Facility (approximately 5 miles upstream from the ocean). Treated water releases from the facility sustain flows in Malibu Creek throughout the year (Titus et al. 2010). Currently, a new recycled wastewater treatment facility is being proposed that would treat effluent from the Tapia Water Reclamation Facility with the purpose of re-distributing the water to the service area rather than releasing it back to Malibu Creek (Las Virgenes-Triunfo Joint Powers Authority 2022). The implementation of this project could lead to less streamflow in Malibu Creek as a result of the repurposing of discharged recycled water that would have previously been released to Malibu Creek.

In more recent years, *O. mykiss* have been seen in Malibu Creek below Rindge Dam (Becker and Reining 2008). A die off of about 250 *O. mykiss* occurred in the creek in 2006 after yellowing of the fish was noticed during snorkel surveys (Becker and Reining 2008). Recent drought conditions starting in 2012 have led to reduced abundances of *O. mykiss* in Malibu Creek based on similar observations on Topanga Creek (Dagit et a. 2017)

4.3.3.2 Topanga Creek

Topanga Creek empties into the ocean at Topanga Beach and contains similar stream mileage to Malibu Creek (Becker and Reining 2008). Some steelhead can access Topanga Creek in years when there is sufficient precipitation (Becker and Reining 2008) and *O. mykiss* of various sizes were observed in the watershed in 1979 (Becker and Reining 2008). Juvenile *O. mykiss* were observed by Department staff in Topanga Creek again in 1982 (Becker and Reining 2008).

The Southern SH/RT population in Topanga Creek was recently monitored from 2001-2007, revealing consistent use by spawning steelhead adults and successful smolt production (Becker and Reining 2008). Bell et al. (2011b) characterized the Topanga population as a satellite population that is supported by other populations in the Southern SH/RT range but provides minimal production to other streams. As a satellite population, Topanga Creek *O. mykiss* support the metapopulation in southern California but are more vulnerable to extirpation (Bell et al. 2011b). The effects of the most recent prolonged drought on Southern SH/RT have been severe. Significant reductions for all life-stages were observed from 2012-2016, leading to reductions of the population from 358 individuals in 2008 to less than 50 individuals in 2016 (Dagit et al. 2017).

4.3.3.3 Other Creeks

Big Sycamore Canyon Creek was surveyed in 1989-1990 but no steelhead were observed (Becker and Reining 2008). NMFS (2005) designated the population as extirpated after another survey in 2002.

Arroyo Sequit Creek was reported to have a small historical steelhead run. Steelhead were seen in a 1989-1990 survey of the stream and again in a 1993 survey. From 2000-2007 steelhead were reported utilizing Arroyo Sequit Creek (Becker and Reining 2008).

Overall, from 2005-2019, monitoring in Arroyo Sequit Creek done by the Resource Conservation District of the Santa Monica Mountains (RCDSMM) has observed few *O. mykiss*, primarily due to two instream barriers that were eventually removed in 2016. Two adult observations occurred after the removal of barriers in 2017 (Dagit et al. 2019). There is also limited documentation of steelhead in the West and East forks of Arroyo Sequit Creek (Becker and Reining 2008). Las Flores Canyon Creek is reported to have suitable steelhead habitat but there is no evidence of historical or present use by steelhead (Becker and Reining 2008; Titus et al. 2010).

4.3.4 Mojave Rim Biogeographic Population Group

There are three relatively large watersheds that make up the Mojave Rim BPG (NMFS 2012a; Figure 10). These watersheds include the San Gabriel, Santa Ana, and Los Angeles rivers. The headwaters of these streams are in the San Gabriel and San Bernardino mountains, which experience greater seasonal precipitation than is seen in the neighboring BPGs. Lower watershed areas span the flat coastal plain of the Los Angeles River, and over time the mouths of these rivers have drifted to different areas along the coast. Currently, the river mouths are each less than 20 miles apart (NMFS 2012a).

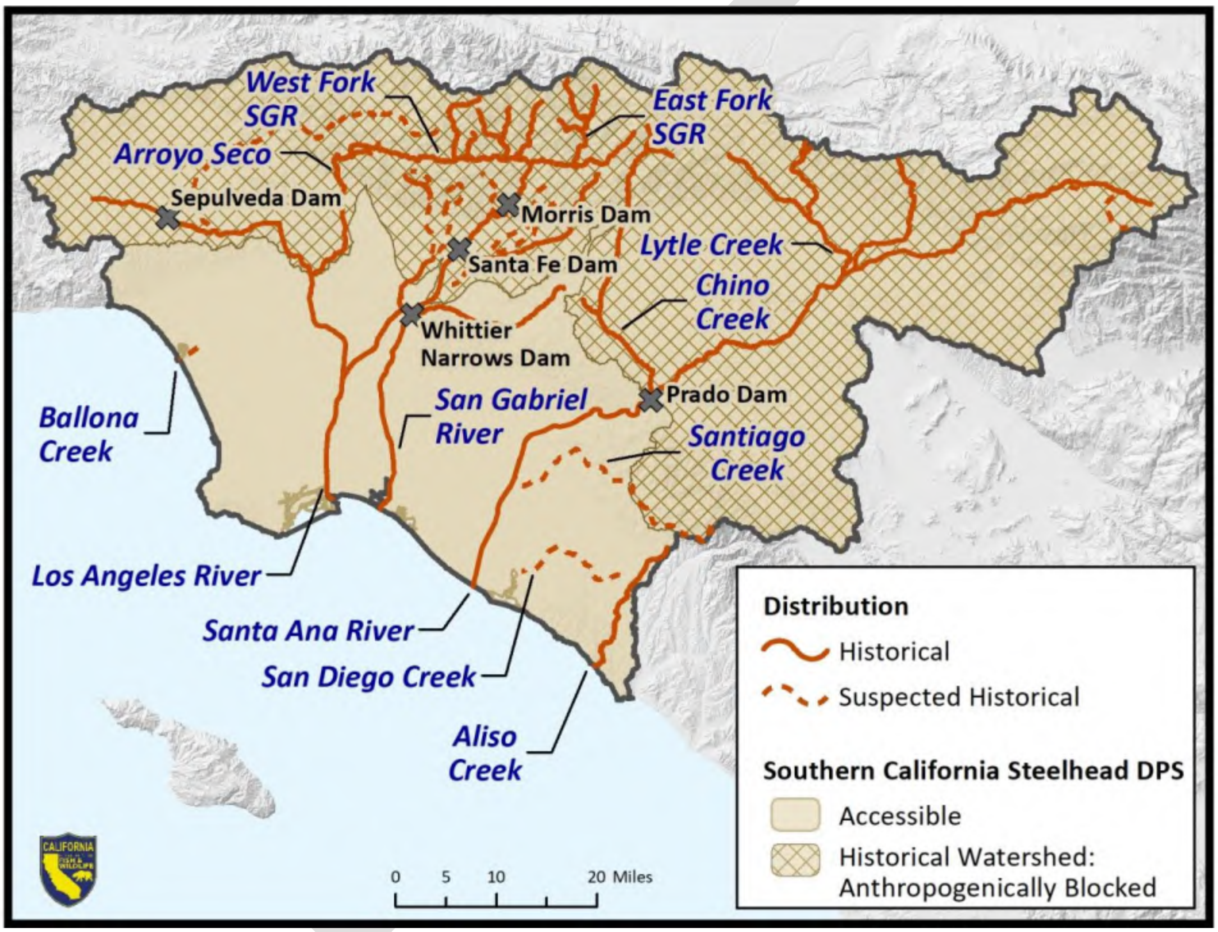


Figure 10. Map of the Mojave Rim BPG depicting known and suspected current and historical distribution. Abbreviations: SGR= San Gabriel River.

4.3.4.1 San Gabriel River

The San Gabriel River encompasses more than 58 stream miles but about half of it is channelized below Santa Fe Dam. Morris Dam and Santa Fe Dam were both constructed in the 1930s (Becker and Reining 2008) and are considered complete barriers to fish migration.

Rainbow trout were seen by Department staff in the 1930s, but the river was also stocked during that time (Becker and Reining 2008). Stocking below Morris Dam also occurred on Little Dalton Creek in 1945 (Titus et al. 2010). Rainbow Trout fishing was good from the late 1930s to late 1940s according to various Department stream surveys and in 1951, Department staff noted that natural production was average (Becker and Reining 2008). Fish Canyon Creek and Robert's Canyon Creek, which are mainstem tributaries downstream of Morris Dam, were observed by Department surveyors to have *O. mykiss* in in the 1940s, 1950s, and 1973 (Titus et al. 2010).

Southern SH/RT historically occurred in a few tributaries of the San Gabriel River such as San Jose Creek. Many tributaries to the San Gabriel River have been channelized and contain fish passage barriers. Most were stocked for recreational angling in the 1930s and 1940s (Becker and Reining 2008). Southern SH/RT remain in tributaries above the two barrier dams and are known to presently inhabit the East Fork. The ancestry of these fish is unclear and may have genetic influence from stocking *O. mykiss* from other watersheds (Nielsen 1999). There is also a remnant historical population of Rainbow Trout just below Morris Dam that appears to self-propagate (Becker and Reining 2008).

4.3.4.2 Santa Ana River

The Santa Ana River is the largest river within southern California at almost 100 miles long (Becker and Reining 2008). Prado Dam, which is located approximately 30 miles upstream of the river outlet, was constructed in 1941 (O.C. Public Works, n.d.). The lower 24 miles of channelized river below the dam outflows to the Pacific Ocean in Huntington Beach (Becker and Reining 2008). Rainbow Trout were observed in the mountainous upper watershed during the 1930s, coinciding with when stocking occurred (Becker and Reining 2008). A steelhead run was historically present in the lower river (Becker and Reining 2008); however, in 1951 and 1955, no *O. mykiss* were observed in any stream reaches below Prado Dam during Department surveys (Titus et al. 2010). Various water uses have highly altered flows in the Santa Ana River and low numbers of fish in the lower river are attributed to limited water releases from Prado Dam (Titus et al. 2010). Southern SH/RT are thought to be extirpated from the Santa Ana River (Nehlsen et al. 1991), but resident *O. mykiss* remain in the upper watershed above natural and manmade impassable barriers (Boughton et al. 2005).

Southern SH/RT were historically present in Santiago Creek below Prado Dam. Many tributaries upstream of where the dam was built were stocked with *O. mykiss* in the 1930s and fish have been observed reproducing naturally in the decades that followed (Becker and Reining 2008).

4.3.4.3 Los Angeles River

The Los Angeles River is approximately 52 miles long and flows to the Pacific Ocean in Long Beach. Like the San Gabriel River, the Los Angeles River is completely channelized with much of the lower mainstem channel paved with concrete for flood control purposes (Becker and Reining 2008; Titus et al. 2010). Southern SH/RT are assumed to have been present in the watershed but there have been no actual observations to confirm this assumption (Titus et al. 2010). Major tributaries to the Los Angeles River were stocked in the 1930s or 1940s (Becker and Reining 2008; Titus et al. 2010) but some of these tributaries were later channelized and no longer support *O. mykiss*. Due to the highly modified nature of the river basin, Southern SH/RT cannot utilize the mainstem Los Angeles River for spawning or rearing (Titus et al. 2010) and are considered extirpated (Nehlsen et al. 1991). However, resident *O. mykiss* have recently been observed in Arroyo Seco, a main tributary to the Los Angeles River, and its tributaries (Becker and Reining 2008). Fish passage by native Southern SH/RT on the creek is obstructed by Devil's Gate Dam. Recently, Department-led fish rescues have transplanted Southern SH/RT from the West Fork San Gabriel River and Bear Creek to Arroyo Seco as a result of the Bobcat Fire (Pareti 2020).

4.3.5 Santa Catalina Gulf Coast Biogeographic Population Group

Multiple medium sized watersheds comprise the Santa Catalina Gulf Coast BPG (Figure 11). Most have their headwaters in the Santa Ana or Peninsular Mountain ranges and flow south over coastal terraces (NMFS 2012a). Many watersheds in the BPG have intermittent flow and are seasonally dry due to limited precipitation. Some smaller drainages within the BPG might occasionally support steelhead. Streams in this BPG have substantial tributary mileage in the upper watershed areas due to the fragmented landscape in the region (NMFS 2012a).

4.3.5.1 San Juan Creek

San Juan Creek is 22-mile stream located in Orange and Riverside Counties. Arroyo Trabuco Creek is a major tributary to San Juan Creek with approximately the same stream length (Becker and Reining 2008). Steelhead were observed in the creek in 1939 (Swift et al. 1993) and in the 1940s as well as in 1968 and 1974 (Becker and Reining 2008). Trout stocking to support fishing in San Juan Creek occurred year-round in 1981 (Becker and Reining 2008) and possibly in other years. San Juan Creek contains suitable habitat for *O. mykiss*, which have been observed in some but not all years in recent decades (Becker and Reining 2008).

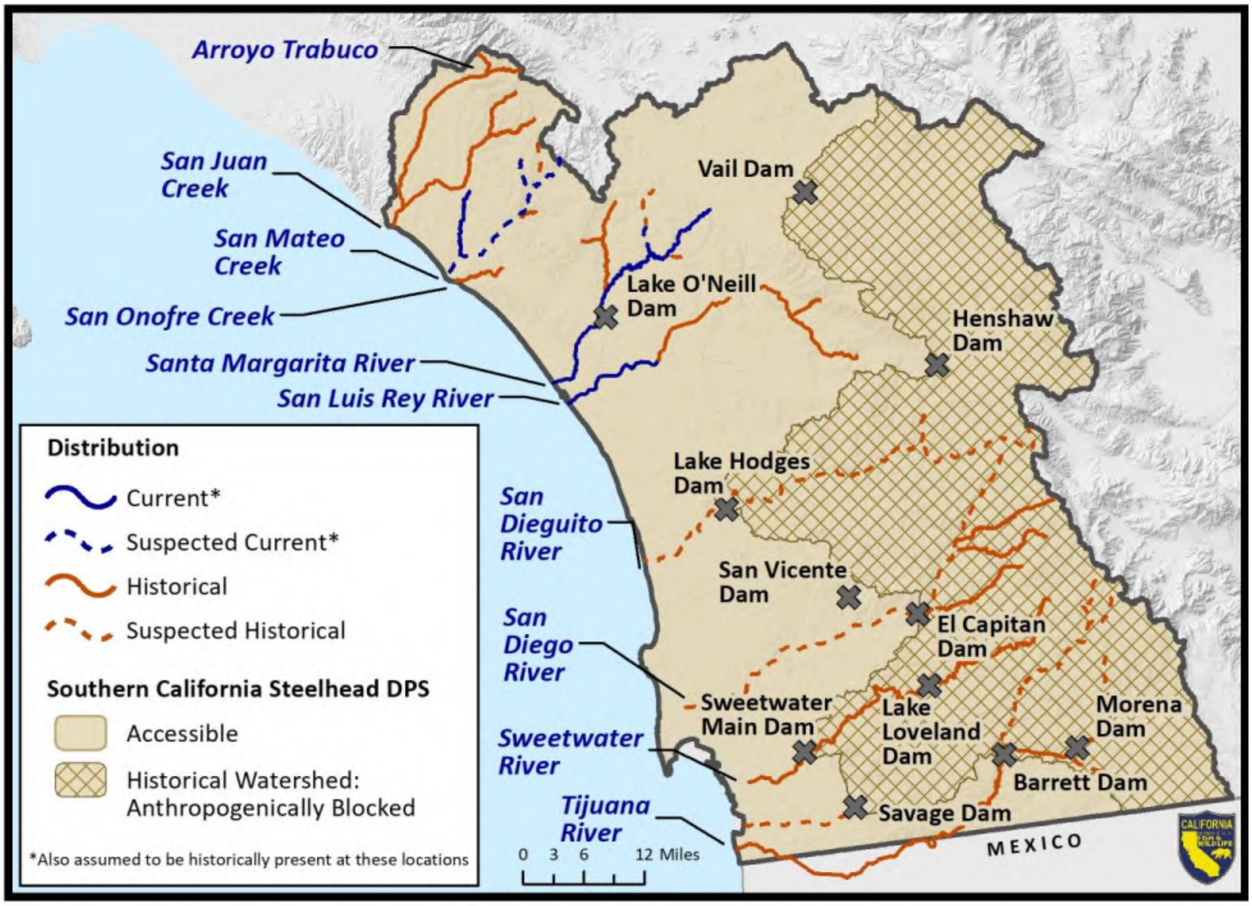


Figure 11. Map of the Santa Catalina Gulf Coast BPG depicting known and suspected current and historical distribution.

Arroyo Trabuco was a historical Southern SH/RT stream; however, there is now a complete barrier to fish migration about 2.4 miles from the confluence with San Juan Creek. Regardless, the stream still appears to contain suitable habitat and steelhead were still believed to be present in 2004 (Becker and Reining 2008). Recently, efforts to remediate fish passage at two total barriers to migration on Trabuco Creek are in progress. Completion of this project would provide access to 15 miles of upstream spawning and rearing habitat.

4.3.5.2 San Mateo Creek

San Mateo Creek, which has a similar stream length as San Juan creek, supported a historical steelhead run (Titus et al. 2010). In the early 1900s, anglers were successful in catching Southern SH/RT of greater sizes than in other regional watersheds (Titus et al. 2010). In 1939, juvenile Southern SH/RT were observed and rescued in the thousands from isolated reaches and transferred to the estuary lagoon (Titus et al. 2010). Stocking of the creek began in 1945 (Becker and Reining 2008). Anadromous and resident Southern SH/RT were thought to persist in 1950 (Becker and Reining 2008), though after that year, Southern SH/RT encounters declined (Titus et al. 2010). In 1999, *O. mykiss* sampled by the Department were surmised to be offspring from anadromous Southern SH/RT because of the lack of a resident population (Becker and Reining 2008). A resident *O. mykiss* population likely does exist in Devil Canyon Creek, a major tributary to San Mateo Creek (Hovey 2004). Habitat quality in the watershed has been degraded by anthropogenic activities and intermittent streamflow has posed migration issues for Southern SH/RT (Titus et al. 2010). Steelhead are thought to be extirpated from San Mateo Creek (Nehlsen et al. 1991). Currently, the San Diego Regional Water Quality Control Board is considered using a draft invasive species Total Maximum Daily Load (TMDL) and plan to certify that actions of other entities will correct impairments to the creek caused by invasive species (Loflen 2022).

4.3.5.3 San Onofre Creek

San Onofre Creek consists of 13 miles of stream in Orange County. Personal observations of annual steelhead runs in the creek prior to 1946 suggest it was a historical Southern SH/RT stream (Becker and Reining 2008). Fletcher Creek, a tributary to San Onofre Creek, was considered a steelhead rearing area in 1950 and *O. mykiss* were observed by Department staff during a survey in 1979 (Titus et al. 2010). By the 2000s, San Onofre Creek was observed to be dry (Boughton et al. 2005), though reaches in the upper watershed may still offer suitable *O. mykiss* habitat (Becker and Reining 2008).

4.3.5.4 Santa Margarita River

The Santa Margarita River is almost 30 miles long, but a diversion weir located approximately ten miles upstream within the boundaries of Camp Pendleton likely acts as a complete barrier to upstream fish migration (Becker and Reining 2008; Titus et al. 2010). This diversion eliminates surface flow during most of the year (Titus et al. 2010). Adult and juvenile steelhead were observed in the river in the 1930s and 1940s and steelhead were thought to migrate upstream to the town of Fallbrook when flows allowed (Becker and Reining 2008). DeLuz Creek, a tributary to the Santa Margarita River, also historically supported steelhead (Becker and Reining 2008). Stocking of *O. mykiss* in the Santa Margarita watershed began in 1941 (Becker and Reining 2008) and occurred most recently in 1984 (Titus et al. 2010). Currently, the reaches downstream of O’Neill Lake do not support Southern SH/RT spawning (Titus et al. 2010) and they are thought to be extirpated (Nehlsen et al. 1991). As part of the Santa Margarita River Conjunctive Use Project, the existing O’Neill weir diversion will be replaced with an inflatable structure that will allow fish passage during most flow events (FPUD 2016). Further upstream, efforts are also underway to replace a fish passage barrier at the Sandia Creek Drive bridge to provide passage to 12 miles of upstream rearing and spawning habitat (Dudek 2021)

4.3.5.5 San Luis Rey River

The San Luis Rey River is a large river in northern San Diego County that runs approximately 69 stream miles from its river mouth near Oceanside, California. Lake Henshaw Dam, which was built in 1924, reduces the downstream flow of the river and blocks steelhead access to the uppermost portion of the drainage (Becker and Reining 2008; Titus et al. 2010). According to Native Americans and other observers of *O. mykiss* in the late 1800s, there was a historical run of steelhead that was able to reach areas above where the dam was constructed (Becker and Reining 2008). Stocking of Rainbow Trout occurred sometime prior to 1946 (Becker and Reining 2008). Although resident Rainbow Trout remain in tributaries of the upper watershed like Pauma Creek and the West Fork San Luis Rey River (Becker and Reining 2008), native Southern SH/RT are extirpated from the lower reaches of the San Luis Rey River (Nehlsen et al. 1991; Becker and Reining 2008).

4.3.5.6 San Dieguito River

The San Dieguito River is a large river in San Diego County that runs for 23 stream miles before entering into the Pacific Ocean north of the City of San Diego. Hodges Dam, which was constructed 12 miles upstream from the mouth in 1918, serves as a complete barrier to anadromy (Becker and Reining 2008). A journal article by Hubbs (1946) mentioned anglers catching possible steelhead in the estuary (Titus et al. 2010). Rainbow trout have been stocked below the dam (Titus et al. 2010); however, those downstream reaches no longer support *O. mykiss* (Becker and Reining 2008). Prior to the construction of the Sutherland Lake dam on Santa Ysabel Creek, a major tributary of the San Dieguito River, Department staff saw *O. mykiss* in a creek upstream of the eventual dam site, though there had been stocking efforts in that creek (Becker and Reining 2008). Black Canyon Creek, another smaller tributary to the San Dieguito River, was also stocked for rainbow trout fishing (Becker and Reining 2008).

4.3.5.7 San Diego River

The San Diego River has a stream length of 52 miles but El Capitan Dam, built in 1934, blocks about 22 miles of historical Southern SH/RT habitat (Becker and Reining 2008). Additionally, channelization of downstream reaches has eliminated suitable habitat below the dam (Titus et al. 2010). Anglers may have caught steelhead historically (Titus et al. 2010) but the population is now thought to be extinct (Nehlsen et al. 1991). Upper watershed tributaries above the dam were stocked in the 1930s and earlier and may still support *O. mykiss* (Becker and Reining 2008; Titus et al. 2010).

4.3.5.8 Sweetwater River

The Sweetwater River is a large river in San Diego County that runs for 55 miles before emptying into San Diego Bay southeast of the City of San Diego. The Sweetwater Reservoir, formed by the construction of the Sweetwater Dam in 1888, serves as a total barrier to anadromy (Becker and Reining 2008; Titus et al. 2010). Although *O. mykiss* were present historically and may still be found in the upper watershed, there are no mentions of a historical anadromous steelhead run in the Sweetwater River (Becker and Reining 2008; Titus et al. 2010). In years leading up to 1946, Cold Stream, a small tributary to Sweetwater River, was stocked with Rainbow Trout and these fish may have continued to naturally reproduce for some time (Becker and Reining 2008).

4.3.5.9 Otay River

The Otay River enters the south end of San Diego Bay near the U.S.-Mexico Border. There are no known historical or current records of Southern SH/RT existing in the Otay River. Fish passage is obstructed by the dam that forms Lower Otay Lake, though there may be *O. mykiss* residing in upper reaches above the reservoir (Titus et al. 2010).

4.3.5.10 Tijuana River

The Tijuana River is the southernmost stream within the Southern SH/RT range and extends for 26 miles from the intersection of Cottonwood Creek (Becker and Reining 2008). Other than one account of few steelhead seen in 1927 by Department law enforcement, there has been no other documentation of historical use of the mainstem river (Titus et al. 2010). Steelhead were present in Cottonwood Creek in the mid-1930s, which was stocked with *O. mykiss* at that time, but Southern SH/RT are no longer able to pass multiple dams within the creek (Titus et al. 2010). If a steelhead run did exist in the Tijuana watershed, it is now assumed to be extirpated (Titus et al. 2010).

4.4 Abundance and Trends

To provide the best scientific information in our evaluation of the candidate species as required by Fish and Game Code Section 2074.6, we analyzed status and trends for Southern SH/RT with annual abundance data compiled from a variety of sources (See Section 4.2 for Sources of Information).

Southern SH/RT, as defined in the Petition, include both anadromous and resident forms of the species below complete migration barriers. To account for both life-history forms in our review, our analyses in Sections 4.4-4.8 examine data on anadromous adult Southern SH/RT (Adult SH) separately from data on *O. mykiss* not identified as anadromous adult Southern SH/RT (Other *O. mykiss*), as most existing monitoring efforts produce datasets that use these two categories. This is because it is possible to distinguish anadromous adult Southern SH/RT in rivers and streams due to their larger size (fork length >400m), greater girth, and steel-gray appearance, but it is otherwise difficult to conclude which life history an individual *O. mykiss* that does not have the identifying characteristics of an adult fish has expressed or will express. (Dagit et al. 2020; Moyle et al. 2017).

The analysis presented below is structured on the five BPGs with an emphasis on Core 1 and Core 2 populations within each BPG (NMFS 2012a; Boughton et al. 2007). The BPGs are a federal delineation based on a suite of environmental conditions (e.g., hydrology, local climate, geography) and watershed characteristics (i.e., large inland or short coastal streams). Core populations are identified as watersheds that exhibit the physical and hydrological conditions that have the highest potential to sustain self-sufficient viable populations of Southern SH/RT (NMFS 2012a). Datasets were reviewed to ensure that they were collected from monitoring conducted below the upper limit to anadromy in each watershed to remain consistent with the geographic scope of the listing unit proposed in the Petition. Where sufficient data were available for a given population, we present and discuss abundance and long-term population trend estimates for each BPG. The Department was unable to analyze core watersheds in the Mojave Rim and Santa Catalina Gulf Coast BPGs in detail due to data limitations. In these instances, as well as in other cases where data was limiting or unavailable, we provide a qualitative discussion, such as a viability assessment, based on the sources identified in Section 4.2 (Boughton et al. 2022a).

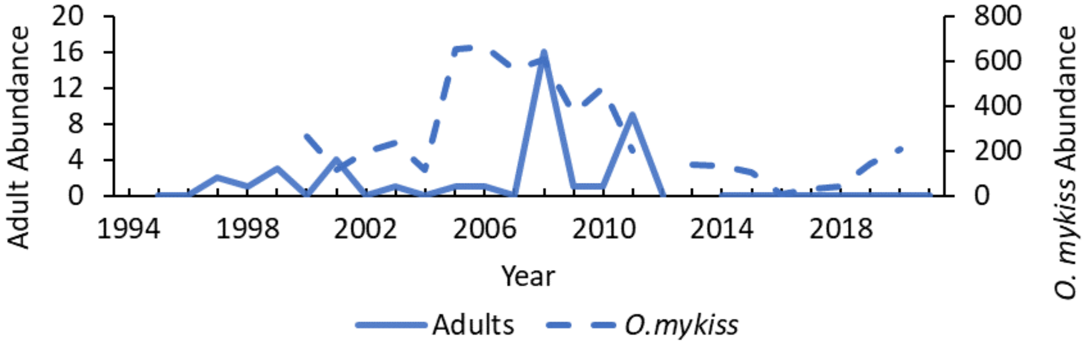
4.4.1 Time Series of Abundance

Southern SH/RT populations in the Monte Arido Highlands BGP have the longest running time-series dating back to the 1990s for the Santa Ynez and Santa Clara rivers (COMB 2022; Booth 2016) and the early 2000s for the Ventura River (CMWD 2005-2021; Dagit et al. 2020) (Figure 12). However, no organized monitoring efforts have been conducted on the Santa Maria River since steelhead were federally listed in 1997. Therefore, no further analysis of the Santa Maria Southern SH/RT populations are conducted in this chapter.

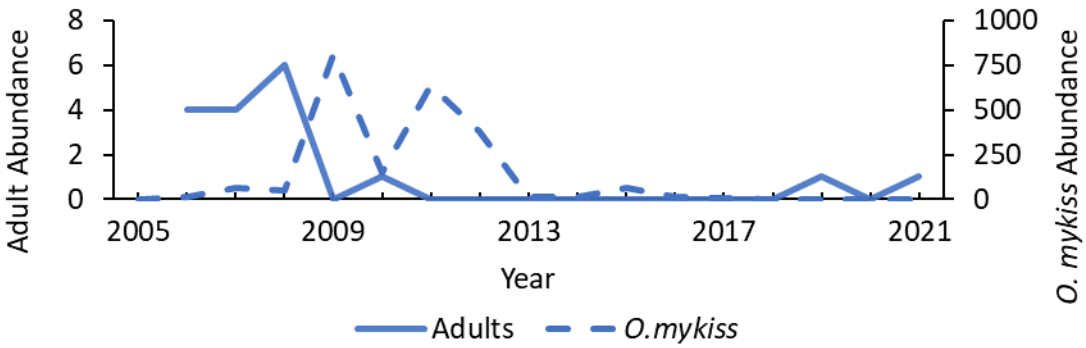
More recently, monitoring has been intermittently conducted on Carpinteria, Mission, and Arroyo Hondo in the Conception Coast BPG by the Department (Boughton et. al 2022a). Malibu, Topanga, and Arroyo Sequit creeks in the Santa Monica Mountains BPG have been actively monitored since the early 2000s (Dagit et al. 2019) (Figure 13). No recent or historical monitoring has been conducted in either the Mojave Rim or Santa Catalina Gulf Coast BPGs.

4.4.1.1 Monte Arido Highlands BPG

A. Santa Ynez River



B. Ventura River



C. Santa Clara River

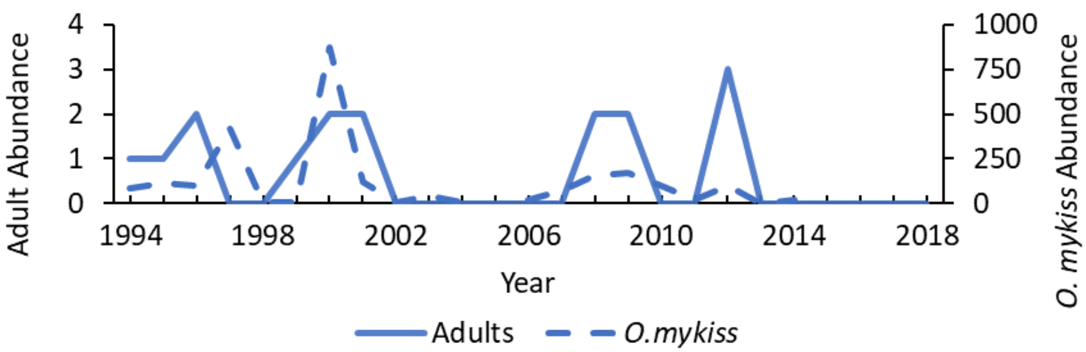


Figure 12. Adult steelhead (Adults) and other O. mykiss (O. mykiss) abundances for the Monte Arido Highlands BPG. A) Santa Ynez River; no data 2013. Biological Opinion Incidental Take provisions have been required since 2014. B) Ventura River. C) Santa Clara River. Adult abundance is on the left -axis with the solid blue line and O. mykiss abundance is on the right axis with the dashed blue line. Note different scales on the Y-axis.

4.4.1.2 Conception Coast BPG

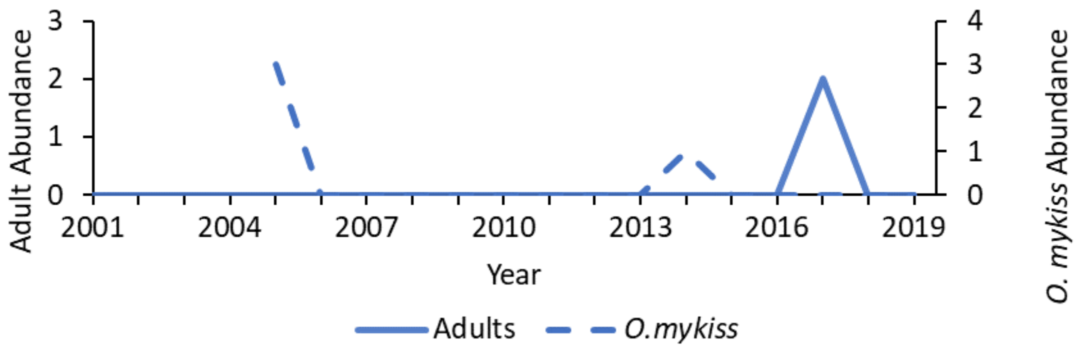
Very few monitoring activities have occurred throughout the Conception Coast BPG, and most of the work that has occurred in more recent years was conducted by the Department. We were unable to develop a full-time series of Southern SH/RT abundance for Conception Coast populations.

Although past monitoring is limited in this BPG, Dagit et. al (2020) documented a total of 42 adult steelhead opportunistic observations from 2000-2018. Two adults were observed in Arroyo Hondo Creek in 2017 and 10 adults were documented in the Goleta Slough Complex with the most recent observation occurring in 2017. For the entirety of Conception Coast BPG, 64% (n=27) of all adult observations occurred in Mission Creek, primarily from 1998-2008. However, from 2018-2022, Department redd and snorkel surveys documented zero adult steelhead in Mission Creek (K. Evans, CDFW, unpublished data). Three adults were observed opportunistically in Carpinteria Creek in 2008 (Dagit et al. 2020); however, from 2008-2019, zero adult steelhead were observed based on recent monitoring conducted by the Department (Boughton et al. 2022a).

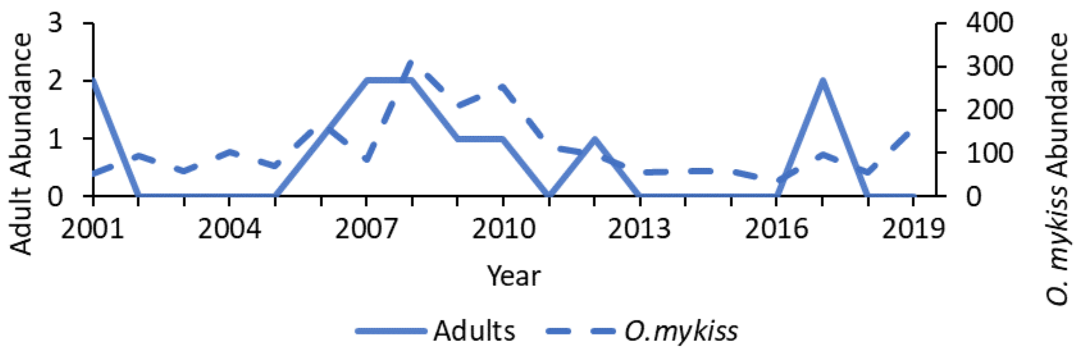
There is also limited data for *O. mykiss* in the Conception Coast BPG. No *O. mykiss* have been documented in Carpinteria Creek since 2016. In Mission Creek, no *O. mykiss* were observed from bankside surveys during the 2018-2019 spawning season (Carmody et al. 2019). In recent years, the largest number of *O. mykiss* observations in this BPG have occurred on Arroyo Hondo Creek, indicating that despite being a small watershed, the creek contains suitable habitat that is relatively undisturbed due to its inclusion in a natural reserve system (NMFS 2012a). Snorkel surveys have documented a total of 2,363 *O. mykiss* in Arroyo Hondo Creek from 2017-2019 (Carmody et al. 2019), while winter redd surveys have documented a total of 12,090 *O. mykiss* from 2015-2022 (K. Evans, CDFW, unpublished data).

4.4.1.3 Santa Monica Mountains BPG

A. Arroyo Sequit Creek



B. Topanga Creek



C. Malibu Creek

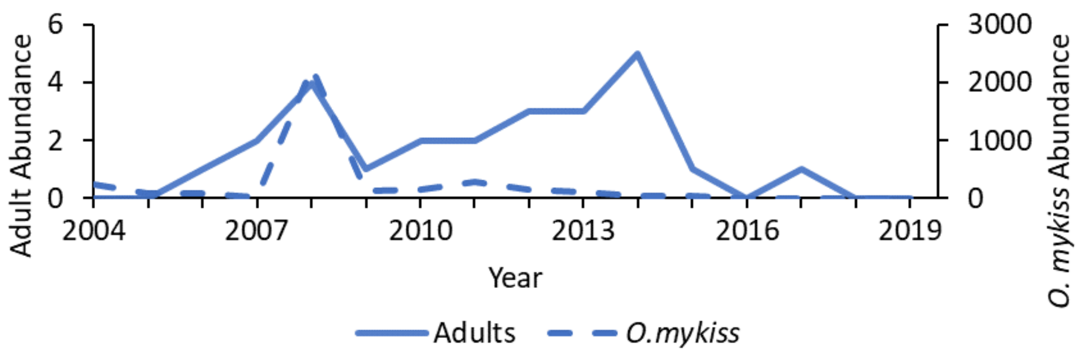


Figure 13. Adult steelhead (Adults) and other O. mykiss (O. mykiss) abundances for the Santa Monica Mountains BPG. A) Arroyo Sequit Creek. B) Topanga Creek. C) Malibu Creek. Adult abundance is indicated on the left -axis and delineated by the solid blue line and O. mykiss abundance is indicated on the right axis and delineated by the dashed blue line. Note different scales on the Y-axis.

4.4.1.4 Mojave Rim BPG

Abundance data is generally not available for this BPG; therefore, we were unable to create a full-time series of Southern SH/RT abundances for the San Gabriel River, Santa Ana River, and Los Angeles River watersheds.

A total of 3 adult steelhead were observed opportunistically in the Mojave Rim BPG from 2000-2018. Two observations occurred on Ballona Creek in 2007, and one observation occurred on the San Gabriel River in 2016 (Dagit et al. 2020). It is generally accepted that all over-summering, rearing, and spawning habitat occurring upstream is no longer accessible to Southern SH/RT due to the presence of extensive physical and velocity related passage barriers located within the lower reaches of each of the three major rivers; therefore, steelhead are not expected to be present in the lower reaches of these watersheds (NMFS 2012a).

4.4.1.5 Santa Catalina Gulf Coast BPG

We were unable to construct a full-time series of Southern SH/RT abundance for these populations because no data series were available to analyze the Santa Catalina Gulf Coast BPG. A total of 15 adult steelhead have been observed in the Santa Catalina Gulf Coast BPG from 2001-2018. Ten of these steelhead observations occurred on either San Juan or San Mateo creeks, and the remainder of observations were distributed throughout the Santa Margarita and San Luis Rey rivers and Los Penasquitos Creek (Dagit et al. 2020).

4.4.2 Geometric Mean Abundance

We calculated the geometric mean of abundance for Southern SH/RT populations (Na) with at least 3-4 generations of data for three time periods. The long-term calculation represents the total available time series. The medium-term calculation represents 12 years or three generations of data, while the short-term calculation is for the most recent 5 years of data. Missing data are noted in the following tables and there was no effort to interpolate or otherwise fill in missing data.

The geometric mean is a useful metric for evaluating species' status because it calculates the central tendency of abundance while minimizing the effect of outliers in the data. Furthermore, the geometric mean is thought to more effectively characterize time series data of abundance based on counts than the arithmetic mean (Good et al. 2005; Spence et al. 2008). We did not calculate arithmetic mean because of its tendency to be overly sensitive to outlier data to a few large counts and can result in the incorrect depiction of central tendency. A range of minimum and maximum abundances were also calculated to provide scale.

Using methods from Spence et al. (2008), we defined the geometric mean of Southern SH/RT abundance as:

$$Na\ (geom) = \left(\prod Na(i)\right)^{1/n}$$

where $Na(i)$ is the total number of adult steelhead in year *i*, and *n* is the number of years of data available.

4.4.2.1 Monte Arido Highlands BPG

Maximum abundance of adult steelhead in the Monte Arido Highlands BPG has remained consistently low since the mid-1990s and early 2000s (Table 2a-2c). For each population examined, maximum counts from the most recent 5-year period are less than either the medium or long-term time frames. For all three watersheds, years in which zero adults were observed have occurred more frequently than years in which at least one fish was observed.

The highest average abundance in this BPG was during the 12-year time frame (2010-2021) on the Santa Ynez River. Both the Santa Clara and Santa Ynez rivers have higher 12-year averages compared to the long-term average. Overall, all three populations have lower 5-year averages when compared to the long-term average and geometric mean abundances remain low across all time frames (Table 3).

Table 2a. Minimum and maximum adult steelhead abundance for the Santa Ynez River over three-time frames: 1995 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year). No data for 2013. Biological Opinion Incidental Take provisions have been required since 2014.

Abundance	**Minimum**	**Maximum**
Long-term	0	16
12-year	0	9
5-year	0	0

Table 2b. Minimum and maximum adult steelhead abundance for the Ventura River over three-time frames: 2006 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year).

Abundance	**Minimum**	**Maximum**
Long-term	0	6
12-year	0	1
5-year	0	1

Table 2c. Minimum and maximum adult steelhead abundance for the Santa Clara River over three-time frames: 1994 to 2018 (long-term), 2007 to 2018 (12-year), and 2014 to 2018 (5-year).

Abundance	Minimum	Maximum
Long-term	0	3
12-year	0	3
5-year	0	0

Table 3. Long-term, medium-term, and short-term geometric mean abundance of adult steelhead in the Monte Arido Highlands BPG.

Population	Years	Long-term Mean	Years	12-year mean	Years	5-year mean
Santa Ynez River[1]	1995-2021	2.1	2010-2021	3.0	2017-2021	0.0
Ventura River	2006-2021	2.1	2010-2021	1.0	2017-2021	1.0
Santa Clara River	1994-2018	1.7	2007-2018	2.3	2014-2018	0

[1] No data long-term 2013; Biological Opinion Incidental Take provisions have been required since 2014.

Maximum abundances of *O. mykiss* for all populations in the Monte Arido BPG are considerably less when comparing the 5-year time frame to the long-term time frame (Table 4a-4c). On the Ventura River, a maximum of 807 *O. mykiss* were observed during the long-term time frame compared to just nine individuals being observed during the most recent 5-year time frame. Minimum abundances range from zero to five *O. mykiss* for all three time-periods and populations. All three *O. mykiss* populations have lower 5-year averages compared to the 12-year and long-term time frames (Table 5). The Santa Ynez River has the highest average abundance of the three populations for each time frame. Overall, mean abundances of *O. mykiss* in this BPG have declined to low numbers, especially in the last five years.

Table 4a. Minimum and maximum O. mykiss (Other O. mykiss) abundance for the Santa Ynez River over three-time frames: 2001 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year). No data for 2013. Biological Opinion Incidental Take provisions have been required since 2014.

Abundance	Minimum	Maximum
Long-term	5	665
12-year	5	484
5-year	5	205

Table 4b. Minimum and maximum O. mykiss abundance (Other O. mykiss) for the Ventura River over three-time frames: 2005 to 2021 (long-term), 2010 to 2021 (12-year), and 2017 to 2021 (5-year).

Abundance	**Minimum**	**Maximum**
Long-term	0	807
12-year	0	640
5-year	0	9

Table 4c. Minimum and maximum other O. mykiss abundance for the Santa Clara River over three-time frames: 1994 to 2014 (long-term), 2003 to 2014 (12-year), and 2010 to 2014 (5-year). No data for 2005.

Abundance	**Minimum**	**Maximum**
Long-term	1	876
12-year	1	170
5-year	1	100

Table 5. Long-term, medium-term, and short-term geometric mean abundance of O. mykiss (Other O. mykiss) in the Monte Arido Highlands BPG.

Population	**Years**	**Long-term Mean**	**Years**	**12-year mean**	**Years**	**5-year mean**
Santa Ynez River[1]	2001-2021	166.4	2010-2021	100.5	2017-2021	43.7
Ventura River	2005-2021	44.7	2010-2021	34.5	2017-2021	3.0
Santa Clara River[2]	1994-2014	39.5	2003-2014	30.5	2010-2014	21

[1] No data long-term 2013; Biological Opinion Incidental Take provisions have been required since 2014.
[2] No data long-term 2005

4.4.2.2 Conception Coast BPG

We were unable to calculate geometric mean abundance estimates for the Conception Coast BPG aside from the Arroyo Hondo Creek *O. mykiss* population due to the lack of long-term data. Based on bankside *O. mykiss* observations as part of spawner redd surveys, the geometric mean abundance was 581 individuals from 2015-2022, the maximum abundance of 8,614 individuals was observed in 2021, and the minimum abundance of zero individuals was observed in 2022 (K. Evans, CDFW, unpublished data).

4.4.2.3 Santa Monica Mountains BPG

Maximum abundance counts of adult steelhead in the Santa Monica Mountains BPG have remained consistently low since the early 2000s (Table 6a-6c). A total of two adult steelhead were observed in Arroyo Sequit Creek in 2017, coinciding with the removal of all instream barriers on the creek below the Mulholland culvert in 2016; however, no adult steelhead have been observed in this creek since 2017. The maximum abundance of adult steelhead in Topanga and Malibu creeks has not been greater than five individuals for any given year during all time periods. For adult steelhead populations in both Topanga and Malibu creeks, the 5-year average is lower than the long-term average (Table 7). Overall, average abundances of adult steelhead for all three populations remain low across all time frames.

Table 6a. Minimum and maximum adult steelhead abundance for Arroyo Sequit Creek over three-time frames: 2005 to 2018 (long-term), 2007 to 2018 (12-year), and 2014 to 2018 (5-year).

Abundance	**Minimum**	**Maximum**
Long-term	0	2
12-year	0	2
5-year	0	2

Table 6b. Minimum and maximum adult steelhead abundance for Malibu Creek over three-time frames: 2004 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	**Minimum**	**Maximum**
Long-term	0	5
12-year	0	5
5-year	0	1

Table 6c. Minimum and maximum adult steelhead abundance for Topanga Creek over three-time frames: 2001 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	**Minimum**	**Maximum**
Long-term	0	2
12-year	0	2
5-year	0	2

Table 7. Long-term, medium-term, and short-term geometric mean abundance of adult steelhead in the Santa Monica Mountains BPG.

Population	Years	Long-term mean	Years	12-year mean	Years	5-year mean
Arroyo Sequit Creek[1]	2005-2019	NA	2008-2019	NA	2015-2019	NA
Topanga Creek	2001-2019	1.4	2008-2019	1.3	2015-2019	1
Malibu Creek	2004-2019	1.9	2008-2019	2.1	2015-2019	1

[1] Insufficient data to produce meaningful results.

For all populations in this BPG, maximum abundances of *O. mykiss* for the 5-year time frame are considerably lower compared to the long-term time frame (Table 8a-8c). Since 2005, a total of four *O. mykiss* were observed in Arroyo Sequit Creek with most years recording zero observations (Table 8a). For the Malibu Creek population, a maximum abundance of 2,245 *O. mykiss* was observed from 2004-2019 compared to just 32 individuals during the 5-year time frame (Table 8b). Topanga Creek appears to support a small but consistent population of *O. mykiss* with a long-term maximum and minimum abundance of 316 and 34 individuals, respectively (Table 8c). Topanga Creek *O. mykiss* have also declined in abundance over the three time periods, but this difference is less pronounced than the decline observed for the Malibu Creek population (Table 9).

Table 8a. Minimum and maximum O. mykiss (Other O. mykiss) abundance for Arroyo Sequit Creek over three-time frames: 2005 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	0	3
12-year	0	1
5-year	0	0

Table 8b. Minimum and maximum O. mykiss (Other O. mykiss) abundance for Malibu Creek over three-time frames: 2004 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	0	2,245
12-year	0	2,245
5-year	0	32

Table 8c. Minimum and maximum O. mykiss (Other O. mykiss) abundance for Topanga Creek over three-time frames: 2001 to 2019 (long-term), 2008 to 2019 (12-year), and 2015 to 2019 (5-year).

Abundance	Minimum	Maximum
Long-term	34	316
12-year	34	316
5-year	34	160

Table 9. Long-term, medium-term, and short-term geometric mean abundance of O. mykiss (Other O. mykiss) in the Santa Monica Mountains BPG. Data used are sum of the average number of O. mykiss observed per month.

Population	Years	Long-term geometric Mean	Years	12-year geometric mean	Years	5-year geometric mean
Arroyo Sequit Creek[1]	2005-2019	NA	2008-2019	NA	2015-2019	NA
Malibu Creek	2004-2019	55.9	2008-2019	52.6	2015-2019	6.1
Topanga Creek	2001-2019	94.2	2008-2019	100.1	2015-2019	70

[1] Insufficient data to produce meaningful results.

4.4.2.4 Mojave Rim and Santa Catalina Gulf Coast BPG

We were unable to calculate geometric mean abundance estimates for either the Mojave Rim or Santa Catalina Gulf Coast BPG due to the lack of long-term data. See Sections 4.3.4, 4.4.1.4, 3.3.5 and 3.4.1.5 for more information on adult steelhead and *O. mykiss* distribution and abundances in these two BPG.

4.4.3 Trend Analysis

Trends were calculated as the slope (β_1) of the regression of log-transformed abundance against years. A value of one was added to the number of Southern SH/RT before the log-transformation to address any zero values if they were present in the dataset [i.e., $ln\ (\bar{N}_a + 1)$]. Using methods from Good et al. (2005), the linear regression can be expressed as:

$$ln\ (\bar{N}_a + 1) = \beta_0 + \beta_1 X + \in$$

Where $\bar{N}_a$ is annual adult steelhead abundance, β_0 is the intercept, β_1 is the slope of the equation, and ∈ represents the random error term. Population trend, *T*, for the specified time series was expressed as the exponentiated slope from the regression above:

$$\exp(\beta_1)$$

with 95% confidence intervals calculated as:

$$\exp(\beta_1) \pm t_{0.05(2),df} s_{b_1}$$

where b_1 is the estimate of the true slope, β_1, $t_{0.05(2),df}$ is the two-sided t-value for a confidence level of 0.95, *df* is equal to *n*-2, *n* is the number of data points in the time series, and s_{b_1} is the standard error of the estimate of the slope, b_1 (Good et al. 2005). We converted the slope to percent annual change (Busby et al. 1996), calculated as:

$$100 * (\exp(\beta_1) - 1)$$

Negative trend values indicate declining abundances over time, whereas positive values indicate growth of the population. Slopes significantly different from zero (P<.05) were noted.

4.4.3.1 Monte Arido Highlands BPG

We calculated adult steelhead and *O. mykiss* population trends for the Santa Ynez, Ventura, and Santa Clara rivers; however, due to lack of monitoring data we were unable to calculate trends for the Santa Maria River adult steelhead and *O. mykiss* populations (Tables 10 and 11). All three adult steelhead populations have declining trends in abundance for their respective data series and the decline in the Ventura River population is statistically significant (p=0.03). Our trend estimates are consistent with other recently reported trend estimates for the Monte Arido Highlands BPG (Boughton et al. 2022a). Similarly, all three *O. mykiss* populations have declining trends in abundance with significant declines observed on the Santa Ynez (p=0.03) and Ventura (p=0.05) rivers (Table 11).

Table 10. Trends in adult steelhead abundance using slope of ln-transformed time series counts for three Monte Arido Highland BPG populations. Missing years of data were eliminated and not interpolated in any way. Bolded trend values were found to be significant (p<0.05).

Population	**Years**	**Trend (%/year)[1]**	**Lower 95% CI**	**Upper 95% CI**
Santa Ynez River[1]	1995-2021	-2.24	-6.12	1.59
Ventura River	2006-2021	**-7.54**	-13.77	-0.86
Santa Clara River	1994-2018	-2.29	-4.99	0.49

[1] No data 2013, Biological Opinion Incidental Take provisions have been required since 2014.

Table 11. Trends in O. mykiss (Other O. mykiss) abundance using slope of ln-transformed time series counts for three Monte Arido Highland BPG populations. Missing years of data were eliminated and not interpolated in any way. Bolded trend values were found to be significant (p<0.05).

Population	Years	Trend (%/year)[1]	Lower 95% CI	Upper 95% CI
Santa Ynez River[1]	1995-2021	**-8.81**	-15.98	-1.03
Ventura River	2006-2021	**-19.39**	-34.89	-0.20
Santa Clara River[2]	1994-2018	-6.09	-18.03	7.58

[1] No data 2013, Biological Opinion Incidental Take provisions have been required since 2014.
[2] No data 2005

4.4.3.2 Santa Monica Mountains BPG

Both Topanga and Malibu Creek populations have a declining but non-significant trend in adult abundance (Table 12). The trend estimates reported here are consistent with recently reported trend estimates for Topanga and Malibu creeks (Boughton et al. 2022a).

The Malibu Creek *O. mykiss* population has experienced a statistically significant (p=0.002) average declining trend in abundance of approximately 26% per year from 2004-2019 (Table 13). The average trend in adult *O. mykiss* abundance for the Topanga Creek population also suggests a decline from 2001-2019; however, the trend is not statistically significant.

Table 12. Trends in adult steelhead abundance using slope of ln-transformed time series counts for the Santa Monica Mountains BPG populations. Missing years of data were not included. Bolded trend values were found to be significant (p<0.05).

Population	Years	Trend (%/year)	Lower 95% CI	Upper 95% CI
Arroyo Sequit[1]	2001-2019	NA	NA	NA
Topanga Creek	2001-2019	-1.70	-5.76	2.54
Malibu Creek	2004-2019	-1.41	-8.49	6.22

[1] Insufficient data to produce meaningful results.

Table 13. Trends in O. mykiss (Other O. mykiss) abundance using slope of ln-transformed time series counts for the Santa Monica Mountains BPG populations. Missing years of data were not included. Bolded trend values were found to be significant (p<0.05).

Population	Years	Trend (%/year)	Lower 95% CI	Upper 95% CI
Arroyo Sequit [1]	2005-2019	NA	NA	NA
Malibu Creek	2004-2019	**-25.56**	-37.19	-11.79
Topanga Creek	2001-2019	-1.24	-6.44	4.25

[1] Insufficient data to produce meaningful results.

4.4.3.3 Conception Coast, Mojave Rim, and Santa Catalina Gulf Coast BPGs

We were unable to calculate trends for populations of Southern SH/RT in the Conception Coast, Mojave Rim, and Santa Catalina Gulf Coast BPGs due to lack of available data, with the exception of Arroyo Hondo Creek *O. mykiss*. The analysis of the Arroyo Hondo Creek *O. mykiss* population counts from seven years of bankside observations conducted during winter redd surveys indicate a declining trend in *O. mykiss* abundance, but the trend is not statistically significant (p=0.71).

Many watersheds in the Mojave Rim and Santa Catalina Gulf Coast BPGs likely supported intermittent steelhead populations characterized by repeated local extinctions and recolonization events in dry and wet years, respectively (NMFS 2012a). The sporadic and intermittent nature of these populations preclude the ability to effectively analyze trends in abundance. Furthermore, many populations occurring south of the Santa Monica Mountains are considered severely reduced and, in many instances, extirpated (Boughton et al. 2005).

4.5 Productivity

Productivity or population growth rate provides important information on how well a population is “performing” in the habitat it occupies throughout its life cycle. Productivity is a key indicator of whether a population is able to replace itself from one generation to the next. Productivity and abundance are closely linked metrics as a population’s growth rate should be sufficient to maintain its abundance above viable levels (McElhany et al. 2000).

A population’s cohort replacement rate (CRR) is defined as the rate at which each subsequent cohort or generation replaces the previous one (NOAA 2006). Data for adult steelhead in southern California contain too many years of zero observations to effectively calculate a CRR; therefore, we did not attempt to estimate this ratio. We calculated the CRR for *O. mykiss* populations in the Santa Ynez, Ventura, and Santa Clara rivers, as well as Malibu and Topanga creeks to account for the possibility of some individuals from these populations contributing to the anadromous life-history form. These watersheds were also selected because there was sufficient data (i.e., years with nonzero data) to produce CRR estimates.

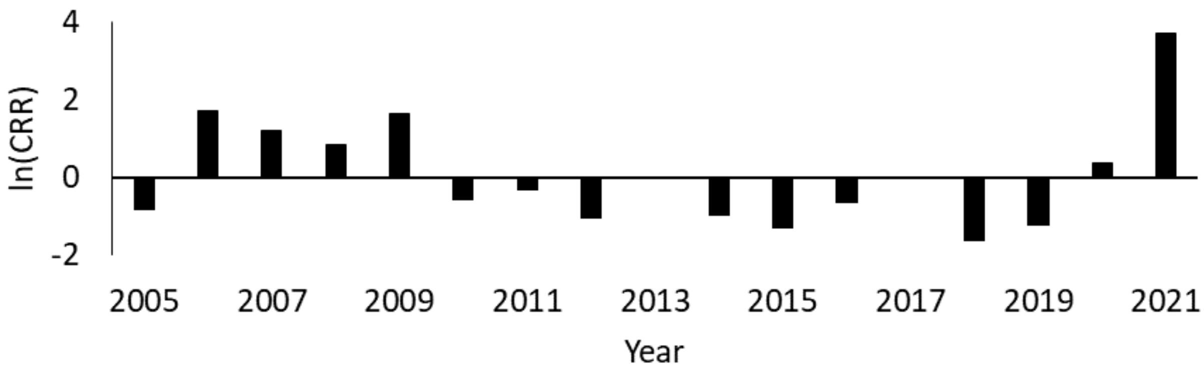
The CRR is defined as:

$$CRR = \ln (Nt+t4/\mathrm{Nt})$$

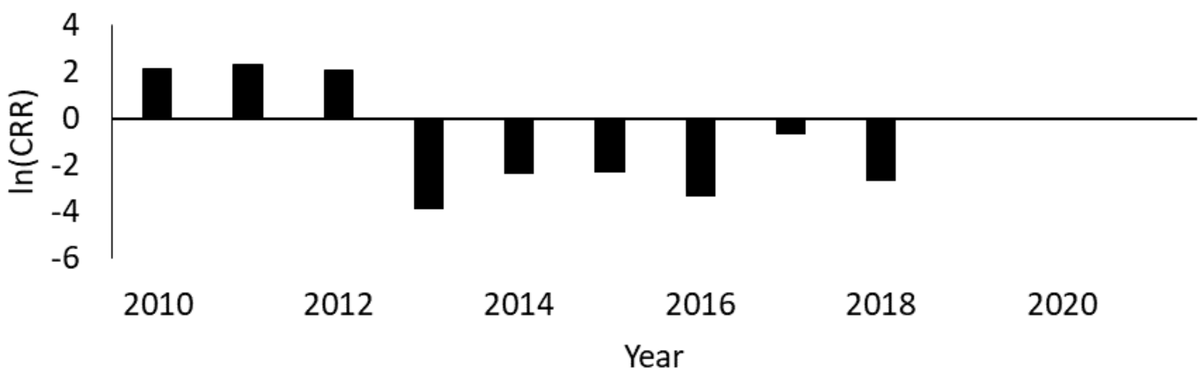
Natural log transformed CRRs greater than zero indicate that the cohort increased in size that year in relation to the brood year three years earlier, whereas a CRR less than zero indicates that the cohort decreased in size. This analysis assumes a generation time of four years, which has been determined to be reasonable based off our best understanding of the Pacific steelhead fluvial-anadromous life-history (NMFS 2012a; Shapovalov and Taft 1954).

Over the entire time series, CRR values for the Santa Ynez, Ventura, and Santa Clara River *O. mykiss* populations were more negative than positive (Figure 13). Negative CRRs most frequently occurred from 2013-2018, which coincide with the most recent extreme drought period and associated drought-related low flow conditions. The Santa Ynez River population may be recovering, as indicated by a high CRR in 2021. Topanga Creek had more positive CRRs than negative, however, 89% of the years with positive values occurred prior to 2012. The CRRs on Topanga Creek are consistent with a recent study that found a significant decline of the abundance of all life stages of *O. mykiss* due to the 2012-2017 drought (Dagit et al. 2017). Population growth rates on Malibu Creek appear to be declining as CRR values have been negative since 2012.

A.



B.



C.

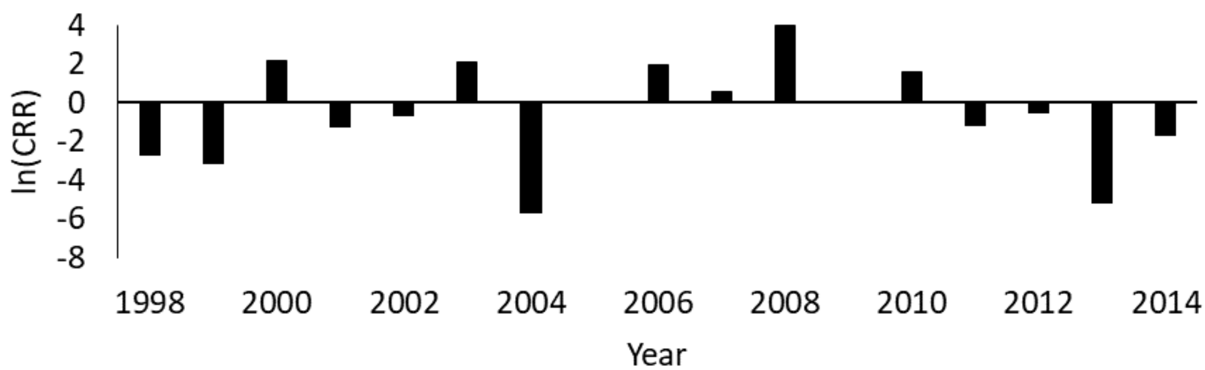
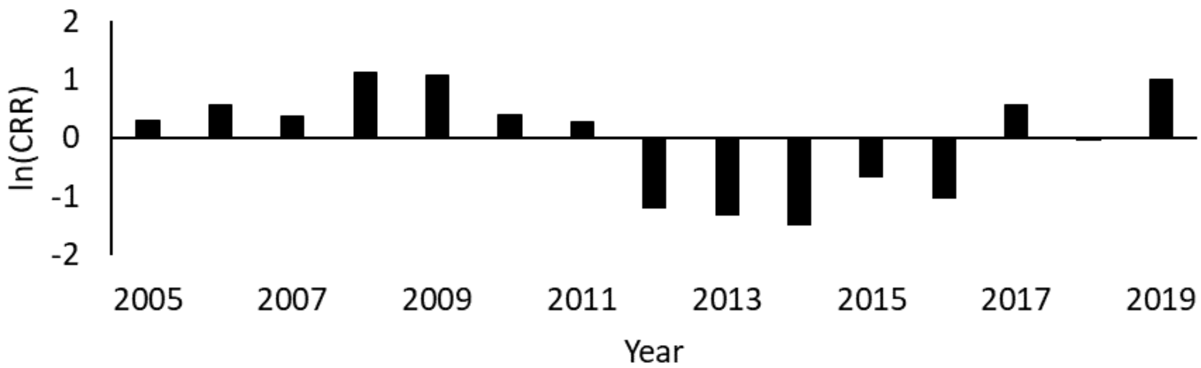


Figure 14a. Ln-Cohort Replacement Rates for O. mykiss (Other O. mykiss) populations, A) Santa Ynez River, B) Ventura River, and C) Santa Clara River; Biological Opinion Incidental Take provisions have been required since 2014. Gaps are a result of missing years of data. Note different scales on the Y-axis.

D.



E.

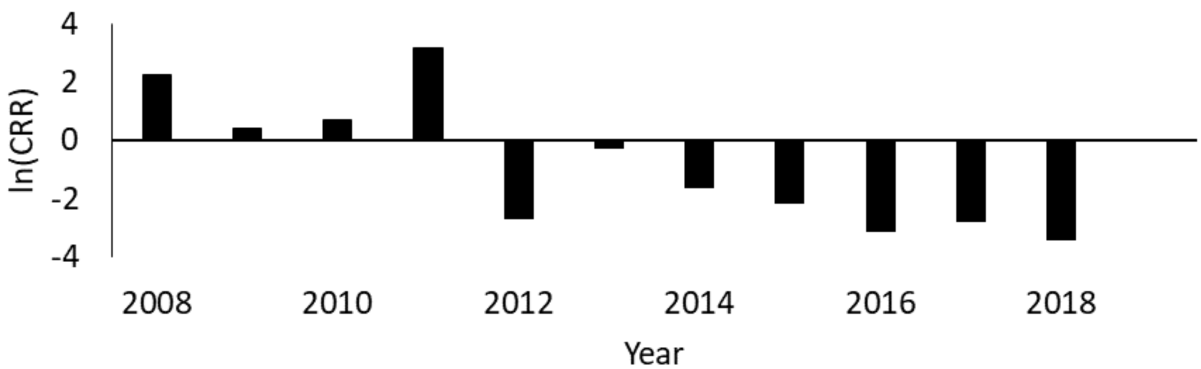


Figure 14b. Ln-Cohort Replacement Rates for O. mykiss (Other O. mykiss) populations, D) Topanga Creek, and E) Malibu Creek. Gaps are a result of missing years of data. Note different scales on the Y-axis.

4.6 Population Spatial Structure

Population spatial structure refers to the spatial distribution of individuals in the population and the processes that generate that distribution. Population spatial structure is a function of habitat quality, spatial configuration, and dispersal rates of individuals within different habitat types. Spatial structure reflects the extent to which a population's abundance is distributed among available or potentially available habitats at any life stage. All else being equal, a population with low abundance is likely to be less evenly distributed within and among watersheds and is more likely to experience extinction from catastrophic events. Furthermore, populations with low abundance have a reduced potential to recolonize extirpated populations.

Numerous discrete and spatially dispersed but connected populations are required to achieve long-term persistence of Southern SH/RT (NMFS 2012a). Though we cannot specifically classify the spatial structure necessary to maintain Southern SH/RT viability with certainty, examining similarities and differences between the species' historical and current spatial distribution can provide a better understanding of their present extinction risk. Southern SH/RT historically occupied at least 46 watersheds in southern California. Currently, only 37-43% of these watersheds are thought to still be occupied by the species (NMFS 2012a). This finding not only highlights the severe contraction of the distribution and abundance of Southern SH/RT in their range, but also indicates that the species is prone to range-wide extinction due to several factors such as low population growth rate, loss of genetic diversity, and the limited number of sparsely distributed individuals that may be necessary to recolonize extirpated neighboring populations.

The truncated Southern SH/RT spatial structure observed today can be attributed to the presence of numerous dams, artificial barriers, and other instream structures that have long impeded migration and access to high quality upstream habitat throughout southern California (NMFS 2012a). Dams and other barriers not only restrict access to upstream spawning and rearing habitat, but also prevent important ecological and genetic interactions with *O. mykiss* from occurring both upstream and downstream of the total barrier. Isolated *O. mykiss* populations containing ancestry of native Southern SH/RT continue to persist above barriers in approximately 77% of watersheds where the anadromous component has been lost below the barrier (Nielsen et al. 1997; Boughton et al. 2005; Clemento et al. 2009). The impact of dams and other artificial barriers is especially notable on the large rivers and small coastal streams in the northern portion of the species' range. For example, Cachuma, Gibraltar, and Juncal dams on the Santa Ynez River block access to at least 70% of historical spawning and rearing habitat within the watershed. Matilija and Casitas dams located on Matilija and Coyote creeks, respectively, restrict access to 90% of the available spawning habitat in Ventura River watershed. Similarly, Santa Felicia and Pyramid dams on Piru Creek block access to all upstream spawning habitat on this major tributary of the Santa Clara River. On Malibu Creek, the Rindge Dam and Malibu Lake dam blocks access to over 90% of historical anadromous spawning and rearing habitat within the watershed (NMFS 2012a).

Historically, the lower and middle reaches of streams in southern California were mainly used as migration corridors to higher quality upstream habitat. Today, these reaches are the only remaining accessible spawning habitat for Southern SH/RT and are characterized by high urban densities, channelization, impaired stream flows, instream diversions, and habitat that generally favors non-native fishes (NMFS 2012a). Furthermore, habitat loss and fragmentation has led to the loss of habitat diversity (i.e., riparian cover, instream habitat structure), which has prevented fish from utilizing these once connected and intact habitats. Because a population's spatial structure is partly a function of the amount of available suitable instream habitat, the loss of habitat below the barrier to anadromy is also attributed to the reduced Southern SH/RT spatial structure observed today.

The current distribution of Southern SH/RT across its range is inadequate for the long-term persistence and viability of the species (NMFS 2012a). The majority of watersheds in southern California contain dams and artificial barriers that restrict access to high quality upstream spawning and rearing habitat. Barriers to migration isolate and prevent ecological interactions with upstream native *O. mykiss* that would otherwise have the potential to be anadromous. Population level impacts include increased susceptibility to local extirpation due to natural demographic and environmental variation and the loss of genetic and life-history diversity (NMFS 2012a). Range-wide, the historically widespread Southern SH/RT are now sparsely distributed across the landscape with significant reductions in abundance. The degraded spatial structure of Southern SH/RT threatens the viability of the population because extinction rates of individual sub-basin populations are likely much higher than the rate of the formation of new populations from recolonization (McElhany et al. 2000). This is especially relevant for populations occurring in watersheds south of the Santa Monica Mountains; originally these watersheds supported infrequent Southern SH/RT populations that were likely characterized by repeated local extinction and recolonization events in dry and wet cycles.

4.7 Diversity

Diversity refers to the life-history (i.e., phenotypic) and genetic characteristics of a population. Life-history diversity allows populations to utilize a wide array of habitats and confers resilience against short-term spatial-temporal variation in the environment. Genetic diversity affects a population's ability to persist during long-term changes in the environment due to both natural and anthropogenic influences. The variation in the life history characteristics in any given population are typically the result of its genetic diversity interacting with environmental conditions. Populations lacking genetic diversity may not have as many genetic "options" to generate new or modified life history types in the face of changing environmental conditions, since natural selection may favor new or different genetic variants. As such, a genetically depauperate population that may be well adapted to the current steady state could be maladapted to new environmental conditions. The combination of both diversity types in a natural environment provides populations with the ability to adapt to long-term changes and be more resilient to these changes over both short- and long-term time scales (McElhany et al. 2000).

Our analysis in Section 4.4 demonstrates declines in *O. mykiss* populations across much of its southern California coast range and preserving Southern SH/RT life-history strategies and adaptations is a critical component for the recovery of the Southern California Steelhead DPS (NMFS 2012a). Ideally, all three Southern SH/RT life-history types (i.e., fluvial-anadromous, freshwater-resident, lagoon-anadromous) would be expressed within a single population, or the population would harbor the underlying genetic variation to express those life-history types when environmental conditions allow. The freshwater-resident life-history type is still present in many populations of Southern SH/RT; however, this form frequently occurs in the isolated upper reaches of the watershed where opportunities for gene flow with anadromous fish are prevented by barriers to migration. Bond (2006) demonstrated accelerated growth rates of juvenile *O. mykiss* expressing the lagoon-anadromous life-history form. Larger size at ocean entry is thought to enhance marine survival and improve adult returns (Bond 2006); however, it is unlikely that this life-history form is currently viable, because approximately 75% of estuarine habitat in southern California has been lost, and the remaining intact habitats are constrained by agricultural and urban development, highways, and railroads, and threatened by sea level rise (NMFS 2012a). The artificial breaching of lagoons also poses a significant threat to the lagoon-anadromous life-history form as a recent study observed considerable mortality of Southern SH/RT directly after artificial breaching (Swift et al. 2018). As presented in Section 4.4, the anadromous form of Southern SH/RT still occurs in very low abundances in a limited portion of their historical range. The preservation of this life-history component will require substantial habitat restoration and modifications or removal of the numerous artificial barriers that currently restrict access to upstream high-quality spawning habitat (NMFS 2012a).

Several recent studies highlight the important role that genetic factors have in determining the life-history expression of coastal steelhead. Pearse et al. (2014) identified two Omy5 haplotypes linked to the anadromous (“A”) and resident (“R”) life-history forms whereby “AA” and “AR” genotype are more likely to be anadromous than the “RR” genotype (Pearse et al. 2019). Rundio et al. (2021) found that age 1+ juveniles with “RR” and “AR” genotypes experienced higher growth rates than fish with the “AA” genotype, and that overall condition was slightly higher in future resident fish than in future smolts, particularly among resident males. The divergence of the “A” and “R” haplotypes in Southern SH/RT populations is influenced by the presence of numerous artificial barriers in southern California, which act as a strong selection pressure against the “A” haplotype in above barrier populations. For example, on the Santa Clara River, the Vern Freeman Diversion Dam and other instream diversions have restricted fish passage to spawning and rearing habitat on its tributaries, Sespe and Santa Paula creeks (NMFS 2012a). Populations of *O. mykiss* from both tributaries were found to display moderately high frequencies of the “R” haplotype (Pearse et al. 2019). Relative frequencies of the “R” and “A” haplotypes can also be altered in populations that have become introgressed with other strains of Rainbow Trout that may have much different haplotype frequencies.

The recognition of the “A” and “R” haplotypes provide insight on the genetic integrity and viability of Southern SH/RT. The frequency of the anadromous haplotype may substantially decline during periods of adverse conditions due to the low predicted survival of migrating smolts (i.e., “AA” and “AR” individuals). Likewise, “RR” and “AR” residents may be favored during adverse conditions, which could eventually lead to declines of the “A” haplotype over time and the gradual loss of the “AA” genotype from the population. Without considerable restoration of habitat connectivity through the removal of artificial barriers, the “A” haplotype in “AR” individuals in isolated populations above barriers is expected to be slowly lost over time (Apgar et al. 2017). While “AR” smolts may produce “AA” individuals when favorable migration conditions continue and retain the “A” haplotype in resident populations, it is unclear that the resident component can reliably sustain the anadromous component in the long term (Boughton et al. 2022a). Furthermore, climate change projections for Southern SH/RT range predict an intensification of typical climate patterns such as more intense cyclic storms, drought, and extreme heat (NMFS 2012a). These projections suggest that Southern SH/RT will likely experience more frequent periods of adverse conditions and continued selection pressure against the anadromous life-history form.

4.8 Conclusions

This section summarizes the abundance, trends, and productivity analyses. Because quantitative analyses were not conducted for population spatial structure and diversity, we do not provide conclusions for these metrics as we believe the qualitative discussions in Sections 4.6 and 4.7 provide sufficient detail and information.

4.8.1 Abundance and Trends

The data evaluated indicate an overall long-term declining trend of Southern SH/RT with critically low range-wide abundances. In the past decade, adult abundance counts have not been greater than ten for any watershed examined, and most streams have observed no adult returns during this time period. For the Monte Arido Highlands BPG, which is thought to be a potential source population for smaller coastal watersheds such as the Conception Coast BPG, only a single adult has been observed returning in the past five years. For each of the three populations analyzed, the data for this BPG shows a long-term declining trend in adult abundance. The steepest decline occurred in the Ventura River population, for which a statistically significant -7.54% per year was observed.

The data evaluated for the Santa Monica Mountains BPG indicate that these watersheds support small but consistent runs of adult steelhead ranging from zero to five individuals per year. However, like other salmonid-supporting streams in the Southern SH/RT range, few adults have been observed in the past five years, and it is unlikely that these streams historically supported large runs of Southern SH/RT due to their small size. The data also show declining but not statistically significant trends in adult abundance for Malibu and Topanga creeks. The Department's South Coast Region staff have not observed any *O. mykiss* in Malibu Creek since before the Woosley fire in 2018 and believe the watershed to be effectively extirpated below Rindge Dam (D. St. George, CDFW, personal communication). A combined total of five adults have been observed for the Conception Coast, Mojave Rim, and Santa Catalina Gulf Coast BPGs since 2017 (Dagit et al. 2020). Our finding of generally declining trends in the abundance of adult steelhead is consistent with the results of a recent viability assessment for the southern California Coast Domain produced by Boughton et al. (2022a).

O. mykiss trends also demonstrate measurable declines in overall abundance. Maximum abundance and long-term averages of *O. mykiss* have declined in all three Monte Arido Highland populations. Similarly, all populations in this BPG show declining trends in O. *mykiss* abundance with statistically significant declines of -8.81% and -19.39% per year on the Santa Ynez and Ventura rivers, and a non-statistically significant decline of -6.09% on the Santa Clara River. Within the Santa Monica Mountains BPG, both Malibu and Topanga creek *O. mykiss* populations have experienced a long-term decline. The *O. mykiss* population in Topanga Creek appears to be more viable than Malibu Creek as our results indicate only a small long-term decline. Our results indicate a trend of -25.56% per year on Malibu Creek, which is the steepest average annual decline for any of the Southern SH/RT populations that we analyzed.

The most recent prolonged drought from 2012-2017 correlates with significant reductions of all life-history forms and stages of Southern SH/RT. Drought conditions are associated with the loss of suitable spawning and rearing habitat, insufficient instream flows required for migration, diminished water quality, reductions in available food supply, and increases in direct mortality due to predation and stranding (Dagit et al. 2017). Our analyses show a relatively consistent range-wide pattern of higher abundances prior 2012 followed by consecutive years of lower abundances starting at the onset of the drought. It appears that few populations have recovered from the drought as current abundance estimates remain low relative to pre-drought conditions. The ability of Southern SH/RT abundances to recover is likely dependent on *O. mykiss* in perennial refugia streams to successfully produce downstream migrants. However, virtually all refugia populations are currently above impassable barriers. Furthermore, many southern California watersheds do not contain upstream drought refugia. In these instances, recolonization from source populations in other watersheds is likely the only mechanism for these populations to rebound (Boughton et al. 2022a).

Boughton et al. (2007) established a precautionary run size criteria for the southern California Coast Domain of 4,150 spawners per year to provide a 95% chance of persistence of the watershed's population over the next 100 years. While this goal may not be feasible for many of the smaller coastal watersheds in southern California, NMFS (2012) speculated that this target may be more feasible for the larger watersheds (i.e., Monte Arido Highland BPG). Even if we applied a lower criterion of 834 spawners (Boughton et al. 2022a), the results of our analyses demonstrate that no population is near the criteria necessary to provide resilience from extinction.

It is important to highlight limitations of our analyses. First, our analysis may underestimate the true abundance of adult steelhead because data analyzed for this effort are usually collected during periods of high stream flows and turbidity, making monitoring difficult to conduct (Dagit et al. 2020). Second, the data used in this effort are derived from various single-basin monitoring efforts, each of which utilize different survey designs and approaches. Thus, we were required to interpret the data as reported, while recognizing the potential limitations in making inter-watershed comparisons in instances where the data were from various monitoring efforts that did not necessary meet standards established by the Department's California Coastal Monitoring Program (CMP). Third, the lack of any monitoring of most watersheds occurring south of the Santa Monica Mountains inhibited our ability to make definitive and comprehensive range wide conclusions on Southern SH/RT abundance and trends. However, it is likely that abundance estimates for many watersheds in the southern portion of the range are so low that obtaining accurate estimates would remain difficult even with increased monitoring.

4.8.2 Productivity

The results of our CRR analysis for *O. mykiss* on the Santa Ynez, Ventura, and Santa Clara rivers show more years of negative than positive CRR values. Negative CRR values were observed during the 2012-2017 drought period for all populations. However, the most recent 2021 estimate for the Santa Ynez population was positive, which may suggest a recovering population. CRR values for Topanga Creek were more positive than negative; however, most positive values occurred prior to the onset of 2012 drought conditions. In recent years, Malibu Creek CRR values have been negative, particularly during the 2012-2017 drought period.

While the CRR values for *O. mykiss* do not necessarily reflect true spawner to spawner ratios due to the high likelihood that many observed fish were not actually part of the spawning cohort during that year, our results demonstrate that *O. mykiss* populations occurring below the barrier to anadromy in these watersheds do not appear to be viable because abundances are too low to sustain positive population growth rate on a yearly basis. This result is especially concerning given that the long-term resilience of the anadromous component of Southern SH/RT likely depends on the production of anadromous juveniles from the freshwater-resident life-history form.

5. HABITAT THAT MAY BE ESSENTIAL TO THE CONTINUED EXISTENCE OF THE SPECIES

5.1 Migration

Southern SH/RT migration into freshwater is linked with seasonal winter and spring high flows that establish connectivity between the ocean and freshwater spawning areas (NMFS 2012a).

Adult steelhead require water depths of at least 18 cm depth for upstream movement; however, 21 cm is considered to be more suitable for upstream passage of all possible sizes of individual fish, because it allows sufficient clearance so that contact with the streambed is minimized (Bjornn and Reiser 1991; SWRCB 2014). Low dissolved oxygen (<5 mg/L) and high turbidity can deter migrating salmonids such as steelhead (Bjornn and Reiser 1991). Delayed migration may also occur when stream temperatures are too high or low (Bjornn and Reiser 1991). Disease outbreaks can occur as a result of extreme high temperatures (Bjornn and Reiser 1991; Spence et al. 1996). Salmonids usually migrate when water temperatures are below 14°C (Spence et al. 1996); however, salmonids can adapt to higher thermal limits when slowly exposed to increased water temperatures over time (Threader and Houston 1983).

Instream structure, like waterfalls, sandbars, and debris jams can act as impediments to upstream fish migration. Steelhead are able to jump a maximum of 3.4 m (Spence et al. 1996) and typically, pool depth must be at least 25% greater than barrier height to achieve the required swimming velocity to pass the barrier (Spence et al. 1996). Pool shape can also influence if a barrier is passable by steelhead. For example, water flow over a steep waterfall into a plunge pool may increase jump height capacity due to upward thrust created by the hydrodynamics within the pool (Bjornn and Reiser 1991). Physical structures such as large woody debris and boulders within streams can offer flow and temperature refuge for resting fish during migration to upstream spawning areas (Spence et al. 1996). Wood structures, overhanging banks, and riparian flora can provide cover to steelhead for protection from terrestrial and avian predators. Deep pools provide important holding habitats for migrating adult salmonids (Chubb 1997).

5.2 Spawning

Habitat attributes necessary for successful spawning include cover, appropriate substrate, cool stream temperatures, and adequate streamflow (Reiser and Bjornn 1979). Salmonids select spawning sites in pool-riffle transitional areas where downwelling or upwelling currents occur that create loose gravel with minimal sediment and litter (Bjornn and Reiser 1991). Rainbow Trout can spawn in a relatively wide range of temperatures, from 2 – 22°C, but may respond to abrupt temperature declines with decreased spawning activity and production (Reiser and Bjornn 1979). Steelhead and Rainbow Trout require gravel substrate of 0.5 – 10.2 cm in diameter to construct their redds and a high proportion of the redd substrate must be comprised of smaller-sized gravel within this range (Reiser and Bjornn 1979). Cover habitat, which offers protection from predation, can include overhanging banks, riparian or aquatic vegetation, large and small woody debris, rocks, boulders, and other instream features. Having access to cover close to a redd is advantageous for Southern SH/RT and may influence spawning site selection (Reiser and Bjornn 1979). Minimum water depth must be sufficient to cover the spawning fish and, depending on individual fish size, is likely to range from 6-35cm (Bjornn and Reiser 1991).

Steelhead and Rainbow Trout have been documented to spawn in water velocities ranging from 21-117 cm/s (Reiser and Bjornn 1979; Bovee and Milhous 1978). Under moderate water velocities, increasing streamflow leads to a greater amount of covered gravel substrate for spawning; however, if water velocities and associated stream flows are too high, the additional suitable spawning habitat becomes unusable for salmonids and stream spawning capacity declines (Reiser and Bjornn 1979; Bjornn and Reiser 1991). Total suitable spawning area within a stream is dependent on the density and size of spawning fish, water depth and velocity, and amount of appropriately sized gravel substrate available (Bjornn and Reiser 1991). These factors combined drive habitat suitability for steelhead and other salmonids (Bjornn and Reiser 1991).

5.3 Instream Residency

Temperature, dissolved oxygen, salinity, water flow, and water depth are all factors that determine stream habitat suitability for *O. mykiss*. Water temperature is especially critical for survival in southern California, as stream temperature can vary drastically within the span of a single day, sometimes peaking at over 30°C during summer months (Sloat and Osterback 2013). For Southern SH/RT, changes in behavior occur above 25°C, such as decreased feeding or movement into refugia (Ebersole et al. 2001; Sloat and Osterback 2013) and the estimated mortality threshold is 31.5°C (Sloat and Osterback 2013), which is marginally higher than that of more northern steelhead populations (Rodnick et al. 2004; Werner et al. 2005). This increased temperature tolerance indicates that Southern SH/RT have acclimated to higher temperature conditions; however, it does not necessarily suggest that they have undergone local adaptation with genetic underpinnings (Sloat and Osterback 2013). Dissolved oxygen levels should generally be at or above 5 mg/L for Southern SH/RT survival (Reiser and Bjornn 1979; Bjornn and Reiser 1991; Moyle et al. 2017) but concentrations greater than 7 mg/L are ideal (Moyle et al. 2017). In cooler temperatures, Rainbow Trout can survive in minimal dissolved oxygen levels of 1.5-2.0 mg/L (Moyle 2002).

Adult Rainbow Trout preferentially select habitat in deeper water and can be found in runs or pools close to swift water (Moyle 2002). In such habitats, fish can move into fast water habitat for feeding and then return to hold and rest in slower water (Moyle 2002). Tobias (2006) found that Southern SH/RT in Topanga Creek exhibited a preference for pools over other habitat types. Trench pools were strongly favored and mid-channel pools and step pools were also selected; however, fish avoided plunge pools, corner pools, and lateral scour pools as well as riffles and cascades. Glides and step runs were neither avoided nor strongly selected.

Resident Rainbow Trout prey on aquatic and terrestrial invertebrates that drift by, both in the water column or on the surface, as well as benthic invertebrates and sometimes smaller fishes (Moyle 2002). Larger stream-dwelling salmonids (>270 mm) often exhibit an ontogenetic niche shift, moving away from consuming invertebrates and depending more on piscivory to achieve efficient growth (Keeley and Grant 2001). Size of invertebrate and fish prey increased with body length (Keeley and Grant 2001). Stomach contents from *O. mykiss* in Topanga Creek revealed that aquatic and terrestrial insects, other invertebrates, and fish comprised most of their diet during fall and spring. Consumption of Arroyo Chub (*Gila orcutti*) by Topanga Creek *O. mykiss* suggests that chub may be an important component of their diet in this stream, particularly during the late fall when aquatic macroinvertebrates may be less available (Krug et al. 2012).

5.4 Egg and Larval Development and Fry Emergence

Many environmental factors influence salmonid embryo incubation success, including dissolved oxygen, temperature, substrate size and porosity, and extra-gravel and inter-gravel hydrodynamics (Bjornn and Reiser 1991). Inter-gravel dissolved oxygen is particularly important to egg development and insufficient oxygen can lead to high mortality. Dissolved oxygen requirements increase as embryos grow and peaks just prior to hatching (Quinn 2018). Intra-gravel oxygen allows for embryo respiration, and oxygen concentrations of 8 mg/l or more contribute to high survival of steelhead embryos (Reiser and Bjornn 1979).

Water velocity is correlated with the amount of dissolved oxygen available to incubating eggs, and lower water velocity leads to higher embryo mortality (Bjornn and Reiser 1991). Reduced flows can also cause redd dewatering, which may result in egg mortality if there is no subsurface flow (Reiser and White 1983). The settling of fine sediment within gravels used to construct redds can prevent the interstitial flow of water and oxygen, and thus smother and kill embryos and post-hatch alevins (Bjornn and Reiser 1991). Finer sediment particles such as ash from wildfires or dust, are most effective at filling interstitial spaces within the redd substrate and can be a contributor to egg asphyxiation and recruitment failure (Beschta and Jackson 1979; Chapman 1988; Bjornn and Reiser 1991).

In addition to negative impacts from sediment deposition, unsuitable temperatures can have negative effects on embryonic development and survival (Bjornn and Reiser 1991). Higher temperatures are correlated with faster embryonic growth and development (Kwain 1975; Bjornn and Reiser 1991); however, if temperatures exceed upper suitability thresholds, mortality increases (Kwain 1975; Rombough 1988; Melendez and Mueller 2021). The ideal temperature range for incubation is 7-10°C (Kwain 1975) and incubation temperatures surpassing 15°C can result in considerable embryo mortality (Kwain 1975; Rombough 1988). Faster development and early hatching resulting from elevated temperatures can manifest in substantial reductions in body mass and length of newly hatched alevin (Melendez and Mueller 2021). These environmentally driven developmental changes could have negative implications for predation response and survival (Hale 1996; Porter and Bailey 2007). Alternatively, extremely cold water can induce mortality (Reiser and Bjornn 1979), although water temperatures that are below steelhead tolerances are likely a rare occurrence in southern California streams. Fry emerge in late spring or early summer and incubation time is dependent on water temperature (Moyle et al. 2017; Quinn 2018). Cold water temperatures, or those above 21.1°C, can decrease survival of emerging fry by restricting their ability to obtain oxygen from the water (McEwan and Jackson 1996).

5.5 Rearing and Emigration

Suitable rearing habitats for juvenile *O. mykiss* require adequate water temperature, flow velocity, water depth, dissolved oxygen concentrations, and availability of prey items. Juveniles generally occupy cool, clear, higher velocity riffles which provide cover from predators (Moyle 2002). Rearing juveniles require habitat with sufficient food production such as riffles with gravel substrate (Reiser and Bjornn 1979). Juvenile *O. mykiss* in southern California have been found to rear in both perennial and intermittent streams (Boughton et al. 2009). Intermittent streams are common in the southern California region and can in some cases benefit native fishes and other aquatic organisms that have evolved within these conditions. By seasonally fragmenting watersheds and disconnecting populations of introduced warm-water tolerant species, intermittent stream desiccation can reduce potential predation and competition from invasives. However, these same conditions can also negatively affect steelhead survival through loss of wetted habitat or degraded water quality conditions, prevent adult spawning migrations or juvenile/smolt emigration, and otherwise isolate subpopulations (Boughton et al. 2009).

Preferred water temperatures for juvenile *O. mykiss* range between 15 and 18°C (Moyle 2002), although they can tolerate temperatures up to 29°C if dissolved oxygen concentrations are high and there is an abundant food supply (Sloat and Osterback 2013). Southern SH/RT have been observed functioning in stream temperatures outside of the preferred range up to the mid to high twenties (Moyle et al. 2017; SYRTAC 2000). For example, the Santa Ynez River was determined to be thermally suitable, albeit thermally stressful, for Southern SH/RT in both normal and warm years, with thermal suitability characterized as a maximum daily temperature below 29°C and a mean daily temperature below 25°C (Boughton et al. 2015). Temporary or intermittent exposure to temperatures above the upper tolerance limit for salmonids can be tolerated in some populations (Johnstone and Rahel 2003), whereas chronic or long-term exposure to high temperatures is typically lethal (Dickerson and Vinyard 1999; Johnstone and Rahel 2003). Additionally, feeding behavior and activity level are generally reduced when fish are temporarily exposed to warmer temperatures that cause thermal stress (Johnstone and

Rahel 2003). However, Spina (2007) found that in Topanga Creek, there were no available daytime thermal refugia available for juvenile *O. mykiss,* yet they were able to tolerate temperatures up to 24.5°C without changes in behavior or activity level. These findings may indicate that Southern SH/RT are acclimated to higher daily stream temperatures than more northern *O. mykiss* populations. Juvenile salmonids acclimated to higher water temperatures, such as those in many Southern SH/RT streams, can sustain higher maximum thermal tolerances than those acclimated at lower temperatures (Lohr et al. 1996).

Metabolic demand increases with higher environmental temperatures. Warmer waters can result in faster growth rates where the forage base is abundant or may slow if food is scarce (Noakes et al 1983.; Brett 1971). Thus, freshwater growth is strongly dependent on primary productivity and food accessibility within the stream (NMFS 2012a). In Topanga Creek, juvenile Southern SH/RT had high growth rates during the summer despite temperatures that frequently surpassed known high temperature tolerances (Bell et al. 2011a).

Thermal refugia are especially important for summer rearing, when Southern SH/RT juveniles must find stream reaches that are sufficiently cool (NMFS 2012a). In southern California streams, higher altitude can provide thermal refuge as well as near-coastal areas that benefit from the ocean acting as a temperature sink (NMFS 2012a). Riparian cover is also important for moderating stream temperatures, as exposed or non-shaded streams are generally warmer than those shaded by riparian canopy (Li et al. 1994). These types of shaded, cool-water stream habitats are most frequently found in headwater reaches within the range of Southern SH/RT (NMFS 2012a).

In Sespe Creek, juvenile Southern SH/RT were observed to occupy the coolest areas of pools during daytime hours in summer months (Matthews and Berg 1997). Fish were consistently found congregating in a seep area that provided cool groundwater during the hottest times of day. The juvenile Southern SH/RT appeared to experience a trade-off between dissolved oxygen and water temperature but chose cooler temperatures, deeper within the temperature stratified pools, over higher levels of dissolved oxygen which were closer to the stream surface. In the spring, *O. mykiss* have been found to emigrate downstream into lower mainstem areas when tributaries may become warmer and/or drier (Spina et al. 2005). As flows increase in the fall and winter, fish may move upstream into tributary habitat to overwinter (Bramblett et al. 2002); however, this behavior has not been confirmed for Southern SH/RT (Spina et al. 2005).

Cover is also an important habitat component for juvenile Southern SH/RT survival, particularly during the winter months. Riparian cover, such as canopy and undercut banks, as well as instream cover like large woody debris (LWD) and deep pools, are important in providing shelter to rearing salmonids (Bjornn and Reiser 1991). Cover quality and availability have been correlated with local instream fish abundance for multiple salmonid species (Bjornn and Reiser 1991). In the mainstem Ventura River, juvenile Southern SH/RT densities were found to be positively correlated with velocity and cover (Allen 2015 p. 133). In western Oregon and Washington streams, juvenile steelhead were found in higher densities in reaches treated with LWD during the winter (Roni and Quinn 2001). Pool formation and enhancement can result from presence of live hardwood or LWD in a stream (Thompson et al. 2008). Instream tree roots can produce scour in high flow conditions leading to long-lasting pools. Trees in the stream channel can also anchor dead LWD and create wood jams. Jams constructed around standing trees are more durable and will last longer in watersheds dominated by hardwood species (Thompson et al. 2008).

Certain substrate types can also provide cover habitat for rearing salmonids. Larger substrate offers interstitial spaces for fish to avoid visual detection from predators. Boulders may be particularly important features in southern California streams, due to the paucity of LWD in these watersheds (Boughton et al. 2009; Tsai 2015). Boulders can assist in the formation of pools and create habitat complexity, which increases habitat suitability for Southern SH/RT (Roni et al. 2006; Tsai 2015). The presence of boulders in streams can also have a significant positive effect on *O. mykiss* survival and abundance due to their role in providing hiding areas and refuge from winter storms and associated flows (Tsai 2015). In contrast, areas with increased stream substrate embeddedness (more compacted stream bottoms) have been associated with lower juvenile salmonid densities (Bjornn and Reiser 1991).

Some Southern SH/RT will remain in freshwater through their life cycle, while those expressing the anadromous life history strategy will begin migrating downstream towards the ocean after two to three years of rearing in freshwater (NMFS 2012a). It is common in southern California for seasonal lagoons to be formed during the summer due to decreased stream flows and the natural accumulation of a sand berm at the point where the stream meets the ocean. Some juveniles take advantage of rearing in the warmer lagoon environment to achieve greater size prior to entering the ocean, which allows them a greater chance of survival (Bond et al. 2008; Hayes et al. 2008).

In Scott Creek (central California), during years when a seasonal lagoon formed, growth rates were 2-6 times greater for steelhead rearing in the estuary-lagoon than those in the cooler, less productive upstream habitat (Hayes et al. 2008). Juvenile *O. mykiss* in central California streams have been observed to exhibit a lagoon-anadromous, or “smolting” twice, life history strategy. These life history variants travel downstream to the closed estuary to rear during the summer, then migrate back upstream into more suitable conditions when the estuary starts to become less hospitable (Hayes et al. 2011; Huber and Carlson 2020). Juvenile *O. mykiss* also preferentially seek out areas with higher water quality when confined within a seasonally closed estuary (Matsubu et al. 2017). However, estuaries in poor condition, including lagoons that do not reconnect to the ocean, may lead to mortality of rearing juveniles if they do not have access to suitable habitat upstream. Seasonal lagoons in southern California typically do not reconnect to the ocean until the first rainfall occurs in the fall or winter (Booth 2020). Juvenile *O. mykiss* benefit from pulse flows initiated by storms and successful emigration is largely dependent on storm flow events matching the timing of *O. mykiss* smolt outmigration (Booth 2020). Smolts in southern California streams, such as the Santa Clara River are largely unable to take advantage of lagoon rearing and its associated benefits due to poor water quality in the estuary and dry reaches upstream (Booth 2020).

5.6 Ocean Growth

Little information exists specific to ocean growth of anadromous Southern SH/RT, but data from other west coast steelhead populations can provide some insight into habitat requirements of this life stage. Steelhead exhibit early ocean migratory behavior that is thought to maximize bioenergetic efficiency (Atcheson et al. 2012). In contrast to other Pacific salmon species, which typically remain relatively close to shore and feed in coastal waters along the continental shelf during their first summer at sea, steelhead quickly leave these productive coastal habitats for the open ocean (Atcheson et al. 2012; Daly et al. 2014). Many California steelhead juveniles spend only a few months feeding in the California Current Ecosystem (CCE) before they migrate northwest to cooler waters offshore (Daly et al. 2014). In the open ocean, steelhead maximize their energy intake by consuming high-energy prey items like fish and squid at moderate rates rather than consuming lower-energy food resources at high rates (Atcheson et al. 2012). Fish and squid make up a substantial portion of the juvenile steelhead diet for those rearing in the Gulf of Alaska, which serves as an important rearing location for west coast steelhead (Atcheson et al. 2012).

While feeding and growing in the ocean, steelhead typically occupy waters within the temperature range of 6-14°C (Hayes et al. 2016; Quinn 2018). Steelhead exhibit strong thermal avoidance, remaining within a narrow range of suitable sea surface temperatures (SSTs) during their ocean foraging and migrations, generally within 20 meters of the surface (Burgner et al. 1992 in Atcheson et al. 2012; Nielsen et al. 2010). Deviations outside of their thermal tolerance have negative consequences for growth and survival in the ocean (Atcheson et al. 2012) and generally poor ocean conditions can negatively affect survival especially during early ocean residence (Kendall et al. 2017). For example, warm SSTs were associated with lower post-smolt survival of Keogh River steelhead off the coast of Alaska (Friedland et al. 2014). In recent years, the CCE experienced a severe marine heatwave (Di Lorenzo and Mantua 2016), which impacted species abundance and distribution at multiple trophic levels, including the prey base for Pacific salmon (Daly et al. 2017; Peterson et al. 2017). During years with anomalously warm ocean conditions, young Chinook Salmon were observed to be much thinner, and their survival rates were depressed compared to years with cooler ocean temperatures, likely resulting from this shift in availability of prey species (Daly and Brodeur 2015; Daly et al. 2017).

Steelhead average a travel distance in the ocean of 2,013 km but have been tracked traveling up to 5,106 km (Quinn 2018). Steelhead are not typically captured in commercial fisheries possibly resulting from their swift movement offshore, and most catches of steelhead in research trawls are in the upper 30 meters of the water column (Moyle et al. 2017; Quinn 2018).

6. FACTORS AFFECTING THE ABILITY TO SURVIVE AND REPRODUCE

6.1 Changes in Ocean Conditions

The long-term relationship between ocean conditions, food web structure, and Southern SH/RT productivity is not well understood; however, these relationships have been examined for steelhead populations in the Pacific Northwest. While the Pacific Northwest coastal rivers are distant from the coastal rivers of southern California in terms of both geography and ecology, these findings still improve our understanding of the relationship between ocean temperatures and the dietary composition and morphology of west coast steelhead populations. Comparisons may also offer insights into similar mechanisms that may potentially influence Southern SH/RT ocean diet compositions. Thalmann et al. (2020) detected significant differences in the prey items consumed by juvenile steelhead during warm ocean years compared to average or cold ocean years. They also found significant interannual variability in stomach fullness, with significantly lower than average stomach fullness associated with warm ocean years. Steelhead sampled during warmer years were thinner, on average, than those sampled during cooler years. In 2015 and 2016, when ocean conditions were anomalously warm, there was limited availability of cold-water prey species with higher energetic and lipid content. Although some level of plasticity was demonstrated in the juvenile steelhead diet, consumption of lower-quality prey items likely led to reduced growth and poorer body condition during those years (Thalmann et al. 2020).

In the North Pacific, the 2013–2020 period was characterized by exceptionally high sea surface temperatures coupled with widespread declines and low abundances for many west coast salmon and steelhead populations (Boughton et al. 2022a). For example, the abundance of southern Chinook salmon and steelhead populations reached very low counts between 2014 and 2019, leading to the designation of many stocks as overfished (PFMC 2020). Increased sea temperatures and associated impacts have resulted in a significant biological response at all trophic levels, from primary producers to marine mammals and birds. For the CCE region, surface water temperatures reached record highs from 2014–2016 (Jacox et al. 2018).

More recently, environmental conditions in 2020–2021 appeared more stable than the previous 5–10 years (NOAA 2022). Coastal productivity in the CCE is driven by upwellings caused by equatorward coastal winds, which drive cold, nutrient-rich water to the surface (NOAA 2022). Upwelling is usually the greatest along the Central California coast, with peaks in June. The vertical flux of water and nutrients in the CCE is measured by the Cumulative Upwelling Transport Index (CUTI) and the Biologically Effective Upwelling Transport Index (BEUTI) (Jacox et al. 2018). Overall, these two indices suggest strong upwelling events occurred in the Southern CCE in 2021, with multiple upwelling events with peaks greater than or equal to one standard deviation above the mean (Figure 15).

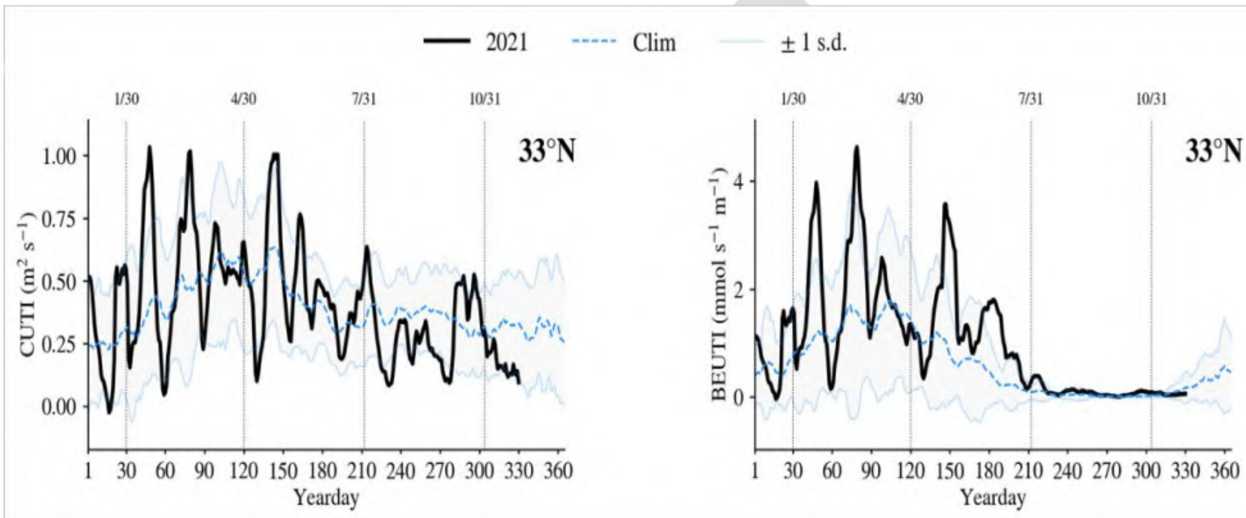


Figure 15. Daily estimates of vertical transport of water (CUTI, left) and nitrate (BEUTI, right) in 2021, relative to the 1988-2021 climatological average (blue dashed line) 1 standard deviation (shaded area) at latitude 33N (San Diego). From NOAA 2022.

Ecological indicators for the CCE suggest average to above-average feeding conditions in 2021, with sustained high abundances of zooplankton, anchovy, and apex predators (NOAA 2022). For the Southern CCE, sea lion production counts and condition at San Miguel Island are positively correlated with prey availability, particularly when prey such as sardines, anchovies, and mackerel are abundant in adult female diets (Melin et al. 2012). The 2021 cohort was the fifth consecutive year of above-average sea lion production, suggesting an abundant availability of prey during the summer months. Southern CCE forage data, which are derived from larval fish surveys, were also characterized by high abundances of anchovies, larval rockfish, and southern mesopelagic fishes. However, similar to previous years, coastal pelagic species such as mackerel and sardine occurred in low abundance. Based on the high abundance of forage fish and sea lions in the Southern CCE, it is likely that ocean conditions are currently favorable for Southern SH/RT and other marine predators.

6.2 Effects of Climate Change

The climate of the United States is strongly connected to the changing global climate (USGCRP 2017), and temperatures are projected to continue to rise another 2°F (1.11°C) to 4°F (2.22°C) in most areas of the United States over the next few decades (Melillo et al. 2014). The waters of the United States are projected to lose between 4 and 20% of their capacity to support cold water-dependent fish by the year 2030 and as much as 60% by 2100 due to climate change and its impacts (Eaton and Scheller 1996). The greatest loss of this important aquatic habitat capacity is projected for California, owing to its naturally warm and dry summer climate (O'Neal 2002; Preston 2006; Mote et al. 2018). The recent multidecadal (2000–2021) "megadrought" in the southwestern U.S., including California, has been the driest 22-year period over the past 1,000 years in this region (OEHHA 2022). Severe drought was documented across much of the southwest during this period, with record-breaking low soil moisture, extended heat waves, reduced precipitation, and intensifying weather extremes (Garfin et al. 2013; OEHHA 2022; Williams et al. 2022). These conditions are expected to continue or increase in the region (Gershunov et al. 2013), with predicted outcomes dependent upon the level and extent of human efforts to address and offset CO_2-driven climate change impacts, both within the United States and across the globe (Overpeck et al. 2013; NMFS 2016; USGCRP 2017; OEHHA 2022).

Since 1895, California has warmed more than both the North American and global temperature averages (NOAA 2021; OEHHA 2022). As such, the state is considered one of the most "climate-challenged" areas in North America (Bedsworth et al. 2018), facing increasingly extreme weather patterns and comparatively rapid shifts in regional climate- and local weather-based averages and trends (e.g., Overpeck et al. 2013; Pierce et al. 2018). California's temperatures have paralleled global trends in terms of increasing at an even faster rate since the 1980s (Figure 16; OEHHA 2022). The past decade has been especially warm; eight of the ten warmest years on record for California occurred between 2012 and 2022 (OEHHA 2022). In general, the portions of California with lower latitudes and elevations will be subject to the greatest increase in duration and intensity of higher air and water temperatures due to climate change (Wade et al. 2013). Thus, the southwestern part of California, which includes the range of Southern SH/RT, will likely face disproportionate climate change-related impacts when compared to other regions of the state. Southern SH/RT are, therefore, likely to face more severe and challenging conditions than their northern salmonid relatives.

The broad-scale climatic factors that appear to primarily shape the habitat suitability and population distribution of Southern SH/RT are summer air temperatures, annual precipitation, and severity of winter storms (NMFS 2012a). These factors and their influences on the landscape are predicted to intensify under long-term, synergistically driven conditions brought about by climate change. They are also expected to exacerbate existing stressors for Southern

SH/RT and other cold water-dependent native aquatic organisms in stream and river systems in southern California (NMFS 2012b). In a comprehensive rating of California native fish species, Moyle et al. (2013) determined southern California steelhead to be "critically vulnerable" to climate change and likely to go extinct by 2100 without strong conservation measures. This was reaffirmed by an analysis conducted by Moyle et al. (2017).

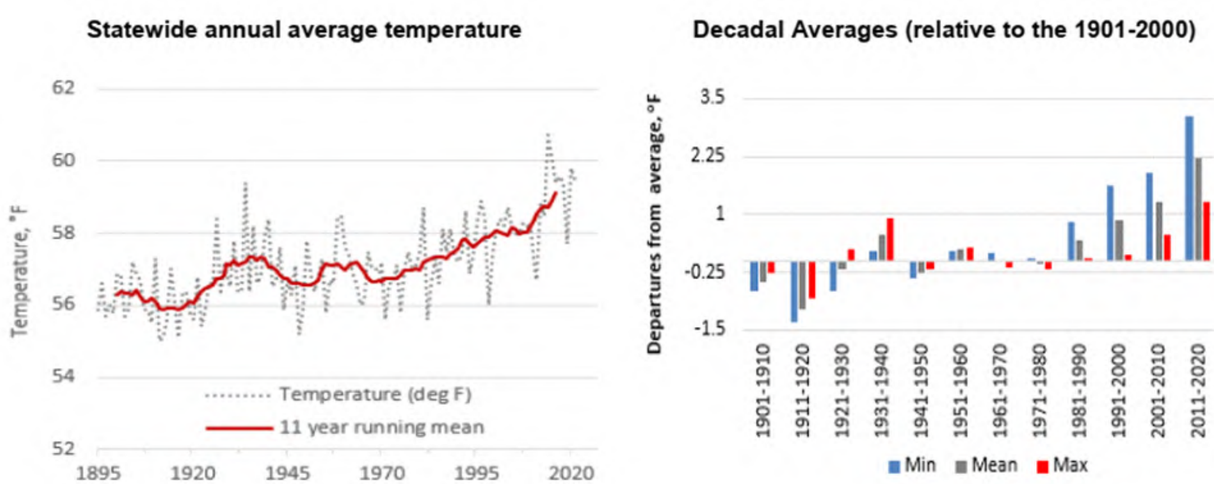


Figure 16. Temperature trend (left) and departure from average (right) graphs for California, from about 1900-2020 (source: OEHHA 2022).

6.2.1 Rising Temperatures

Extreme heat events in California have become more frequent, dating back to the 1950s; however, they have become especially pronounced in the past decade (OEHHA 2022). Heat waves, defined as two or more consecutive heat events (which are characterized by temperatures at or above the highest 5% of historical values), have also become more frequent during this period (OEHHA 2022). For context, over the past 70 years, extreme heat events increased at a rate of about 1 to 3 events per decade at 10 of a set of 14 statewide long-term monitoring sites across California (OEHHA 2022). Further, at several monitoring sites, daytime heat waves increased to as many as 6 events per year, and nighttime heat waves similarly increased to as many as 10 events per year (OEHHA 2022). Long-term regional climate observations for southern California also follow this pattern of long-term, steady temperature increases. Based on analyses of California South Coast National Oceanic and Atmospheric Administration (NOAA) Climate Division temperature records from 1896–2015, He and Gautam (2016) found significant upward trends in annual average, maximum, and minimum temperatures, with an increase of about 0.29°F (0.16°C) per decade. Likewise, every month of the year has experienced significant positive trends in monthly average, maximum, and minimum temperatures, across the same 100-year period (Hall et al. 2018).

Importantly, nighttime temperatures in California, which are reflected as minimum daily temperatures, have increased by almost three times more than daytime temperatures since 2012 (OEHHA 2022). Gershunov et al. (2009) showed that heat waves over California and Nevada are increasing in frequency and intensity while simultaneously changing in character and becoming more humid. This shift toward humid heat waves in the southwestern U.S. is primarily expressed through disproportionate increases in nighttime air temperatures (Garfin et al. 2013). These changes started in the 1980s and appear to have accelerated since the early 2000s (Garfin et al. 2013). Nighttime warming has been more pronounced in the summer and fall, increasing by about 3.5°F (1.94°C) over the last century, and southern California has warmed faster than Northern California (OEHHA 2022). These long-term regional changes will have disproportionate impacts on aquatic habitats due to elevated atmospheric humidity levels and diminished nighttime cooling effects on southern California waterways (Garfin et al. 2013).

In fact, water temperatures in many streams across California have risen for some time and are continuing to do so (Kaushal et al. 2010). Stream temperatures across the state have increased by an average of approximately 0.9–1.8°F (0.5–1.0°C) in the past 20+ years (e.g., Bartholow 2005 in Moyle et al. 2013). While such increases may seem small, they can push already marginal waters over thresholds for supporting cold water-dependent fishes (Moyle et al. 2015; Sloat and Osterback 2013). Summer water temperatures already frequently exceed 68°F (20°C) in many California streams and are expected to keep increasing under all climate change scenarios (Hayhoe et al. 2004; Cayan et al. 2008 in Moyle et al. 2015). Organisms that are adapted to California's traditional nighttime cooling influence on their habitats, including Southern SH/RT, are less prone to recover from extreme and extended periods of excessive daytime heat, particularly when humidity and temperatures remain high at night (Garfin et al. 2013; OEHHA 2022).

6.2.2 Drought

Overall, California has been getting warmer and drier since 1895; as part of this long-term climatic shift, droughts are becoming more frequent, extended, and severe in their impacts (OEHHA 2022). As noted, 2000–2021 was the driest 22-year period in the last millennium in the southwestern United States, including California (Williams et al. 2022). The 2012–2016 drought was one of the warmest and driest on record in California, negatively affecting both aquatic and terrestrial environments across the state (Figure 17; CDFW 2018a). Notable statewide aquatic habitat impacts from this and other prolonged droughts include seasonal shifts in stream hydrographs to earlier peaks with extended summer and fall low flow periods, contraction and desiccation of typically perennial aquatic habitats (Figure 18), poor water quality, elevated water temperatures, changes in migratory cues, spawn timing, and other fish behaviors, stranding, and both direct and indirect mortality of fish, along with estuary and lagoon habitat degradation, among other ecological impacts (CDFW 2018a; Bedsworth et al. 2018).

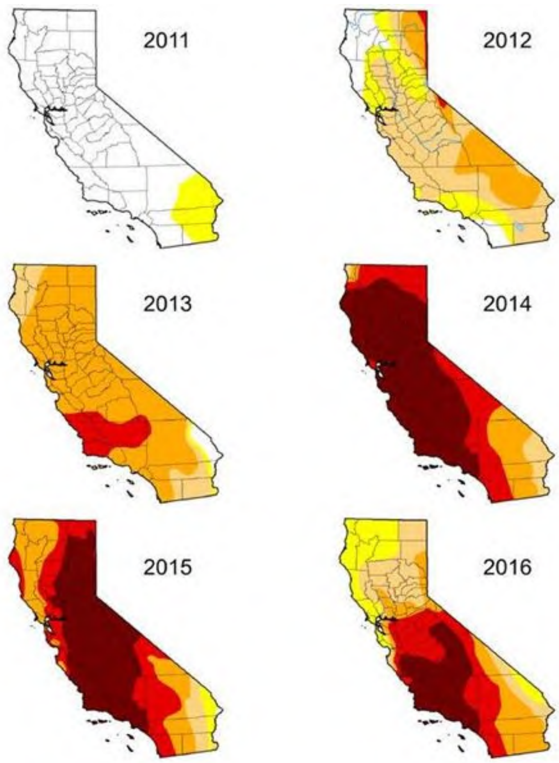


Figure 17. The distribution and progression of drought conditions in California from 2011 to 2016, depicting the level of drought at the beginning of each Water Year (October 1). White indicates no drought conditions, whereas yellow to dark red indicates increasing drought conditions, including duration and intensity (CDFW 2018a, based on U.S. Drought Monitor).

No part of the state has been more impacted by drought than southern California, with significant reductions in precipitation compared to long-term averages, along with record high temperatures, exceptionally dry soils, and low regional snowpack in surrounding mountain ranges in the past decade (Hall et al. 2018). Southern California is naturally arid and already prone to periods of extremely dry conditions (MacDonald 2007; Woodhouse et al. 2010), so increasing drought conditions have amplified many existing ecological stressors while also creating new ones. As an example, during normal water years, many streams in California's south-coastal region maintain perennial flows in their headwaters but become intermittent or dry in lower portions of their watersheds, especially in areas of concentrated urbanization or agriculture. The 2012–2016 drought dramatically exacerbated these conditions, leading to widespread stream drying in this region, even outside of areas that typically experience annual desiccation (CDFW 2018a). Not surprisingly, CDFW (2018) noted that the two most common causes of fish kills in southern California during the 2012–2016 drought were stream drying and reduced dissolved oxygen levels (impaired water quality).

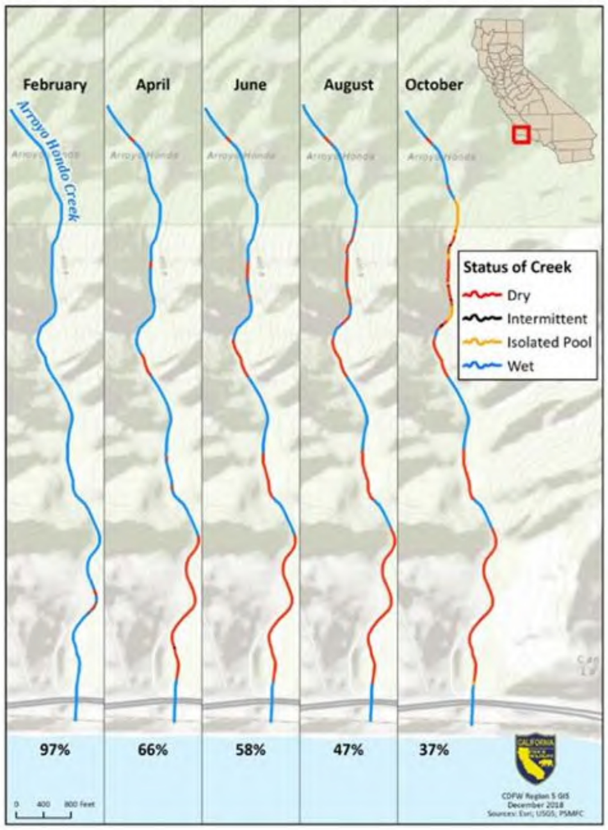


Figure 18. Example southern California stream (Arroyo Hondo Creek, Santa Barbara County), showing seasonal desiccation across 60% of its study area wetted length during February-October 2015 (source: CDFW 2018a). 2015 was a notably bad drought year in California, but the large extent of stream drying in this creek may be an indicator of future climate change-driven conditions in this and other southern California regional streams.

Further desiccation of Southern SH/RT habitats is expected due to climate change, leading to reduced natural spawning, rearing, and migratory habitats for already small and fragmented Southern SH/RT populations. This undesirable future state includes the increasing probability that low-precipitation years continue to align and coincide with warm years, further amplifying the risk of future severe droughts and low snowpack in California, especially in southern latitudes (Difenbaugh et al. 2015; Berg and Hall 2017; Williams et al. 2015).

In their five-year status review, NMFS (2016) concluded that ongoing “hot drought” conditions, among other negative factors, likely reduced salmonid survival across DPSs and ESUs for listed steelhead and salmon in California, including Southern SH/RT. It is likely that these same Southern SH/RT populations, already impacted and diminished in abundance and distribution, will face more frequent and severe drought periods in the future, along with more intense and destructive (albeit less frequent) winter storms, under all predicted scenarios. Both stressors, in combination, will further negatively affect the remaining suitable habitats for Southern SH/RT in California.

6.2.3 Reduced Snowpack

As air temperatures have warmed, more precipitation has been falling as rain instead of snow at high elevations in the western United States, where widespread snowpack declines of 15-30% have been documented since the 1950s (Mote et al. 2018; Siirla-Woodburn et al. 2021). Since 1950, California's statewide snow-water content has been highly variable, ranging from more than 200% of the average in 1952, 1969, and 1983 to 5% in 2015 in the midst of the 2012–2016 drought (OEHHA 2022). The past decade included years that were among the lowest (2013, 2014, 2015, and 2022) and the highest (2011, 2017, 2019) on record for snowpack (OEHHA 2022). These patterns demonstrate increasing variability in the amount of overall precipitation the state receives, the frequency and intensity of storm systems, and the amount of precipitation received as rainfall versus snowfall. Annual snowpack in the Peninsular Ranges of southern California (e.g., Santa Ana Mountains, San Jacinto Mountains, and Laguna Mountains) is expected to continue to diminish, so future stream flows in the range of Southern SH/RT will be increasingly driven by rainfall events (Mote et al. 2018).

Snowmelt attenuates stream flows in basins that usually receive annual snowpack at higher elevations. An increase in the ratio of rain to snow and rain-on-snow events will result in more peak flows during winter and early spring, along with an increasing frequency of high flow events and damaging flooding. With earlier seasonal peak hydrographs, many southern California streams will experience diminished spring pulses and protracted periods of low flows through the summer and fall seasons (Moyle et al. 2015). These conditions will translate into warmer water temperatures at most elevations, reflecting both increases in air temperatures and reduced base flows (Moyle et al. 2017). Future shifts from snow to rain may also negatively impact overwintering rearing habitat for juvenile Southern SH/RT and reduce the availability of cold-water holding habitats as refuges in rivers and streams during the summer and fall months (Williams et al. 2016). Such abiotic shifts will affect the physical habitat availability and suitability for Southern SH/RT and are also anticipated to change species interactions, generally favoring introduced species with broader environmental tolerances (Moyle et al. 2013).

6.2.4 Increasing Hydrologic Variability – Reduced Stream Flows to Catastrophic Flooding

Climate change is likely to increase the impacts of El Niño and La Niña events, which are predicted to become more frequent and intense by the end of the century (OEHHA 2022). Increasingly dramatic swings between extreme dry years (or series of years) and extreme wet years are already occurring in California and are expected to escalate under various climate change scenarios (Swain et al. 2018; Hall et al. 2018). California’s recent rapid shifts from drought periods (2012-2016, 2020-2022) to heavy precipitation and flooding (winter 2016-2017, winter 2022-23) exemplify “precipitation whiplash” and its potential for widespread natural habitat and human infrastructure damage and destruction (OEHHA 2022). California’s river and stream systems will bear the brunt of these impacts since they are the natural conduits for water conveyance on the state’s landscape.

Such precipitation variability and intensity in California is now increasingly influenced by “atmospheric rivers,” or long, narrow bands of precipitation originating over ocean bodies from the tropics to the poles that transport large amounts of water vapor (USGCRP 2017; Hall et al. 2018). During the winter months, heavy precipitation associated with landfalling atmospheric rivers can produce widespread flooding in most of the southwestern U.S. states (Garfin et al. 2013). California is especially vulnerable to this source of destructive flooding because of its proximity to the Pacific Ocean, where atmospheric rivers are generated (USGCRP 2017). As a result of these changes, southern California stream flows will almost certainly become more variable and “flashy” on an annual basis. Predictions include likely extreme fluctuations in precipitation, with intermittent heavy winters producing high stream flows, coastal impacts, and extensive flooding during otherwise prolonged periods of drought, with low to no flows in many streams. Changes in seasonal flow regimes (especially flooding and low flow events) may also affect salmonid behavior. Expected behavioral responses include shifts in the seasonal timing of important life history events such as adult migration, spawning, fry emergence, and juvenile migration (NMFS 2016). The outmigration of juvenile steelhead from headwater tributaries to mainstem rivers and their estuaries may be disrupted by changes in the seasonality or extremity of stream hydrographs (NMFS 2016; Figure 18). Flood events can also disrupt incubation and rearing habitats due to increased bed mobility (Fahey 2006). Conversely, low flow periods with elevated water temperatures and impaired water quality can cause direct mortality to steelhead across wide portions of southern California’s mountain desert streams (CDFW 2018a). Stream drying can also further isolate and restrict subpopulations, potentially leading to genetic drift, interfering with gene flow and genetic mixing at the larger population/ESU level, and potentially further reducing overall fitness.

6.2.5 Sea Level Rise

Along California’s coast, mean sea levels have increased over the past century by about 8 inches (203 mm) at monitoring sites in San Francisco and La Jolla (OEHHA 2022). For the southern California coast, roughly 1-2 feet (0.3 m – 0.6 m) of sea level rise is projected by the mid-century, and the most extreme projections indicate 8–10 feet (2.4 m – 3.0 m) of sea level rise by the end of the century (Hall et al. 2018). Sea level rise is predicted to further alter the ecological functions and dynamics of estuaries and near-shore environments. Rising sea levels may impact estuary hydrodynamics with increased saltwater intrusion, potentially increasing salinity levels in estuaries and shifting the saltwater/freshwater interface upstream (Glick et al. 2007). Loss or degradation of already scarce estuary habitats in southern California's coastal areas due to sea level rise may negatively affect Southern SH/RT survival and productivity, since estuaries and lagoons serve as important nursery habitats for juvenile steelhead (Moyle et al. 2017). Alternatively, sea level rise may potentially increase the amount of available estuary habitat by inundating previously dry areas or creating additional brackish, tidal marsh, or lagoon habitats, which serve as important rearing habitats for juvenile salmonids (NMFS 2016). Overall, however, predictions indicate substantial reductions in southern California's coastal lagoon and estuary habitats, which may reduce steelhead smolt survival and numbers of outmigrants to the ocean, further constraining populations of Southern SH/RT (Moyle et al. 2017).

6.2.6 Ocean Acidification

Ocean acidification occurs when excess carbon dioxide (CO2) is absorbed from the atmosphere, acidifying or lowering the pH of sea water (CDFW 2021b). Ocean acidification is becoming evident along California's central coast, where increases in CO2 and acidity levels in seawater have been measured since 2010 (OEHHA 2022). Coupled with warming ocean waters and reduced dissolved oxygen levels, ocean acidification poses a serious threat to global marine ecosystems (OEHHA 2022). If left unchecked, ocean acidification could dramatically alter the Pacific Ocean's marine food webs and reduce the forage base for California's salmonids. Forage fish, which are a primary prey source for steelhead in the ocean (LeBrasseur 1966; Quinn 2018), may suffer declines in abundance due to reduced biomass of copepods and other small crustaceans resulting from ocean acidification (Busch et al. 2014). Ocean acidification makes it harder for the shells of ecologically and economically important species, including krill, oysters, mussels, and crabs, to form and potentially causes them to dissolve. Reduced seawater pH has also been shown to adversely affect olfactory discrimination in marine fish (Munday et al. 2009), which could result in impaired homing of Southern SH/RT to their natal streams.

6.2.7 Wildfires

Wildfires are a natural and fundamental part of California's ecological history in many parts of the state. Wildfires are an essential ecological process for the periodic renewal of chaparral vegetation communities (Sugihara et al. 2006), which dominate much of the south-coastal part of California. Historical fires were, therefore, important episodic ecological events with generally lower intensity impacts, at smaller geographic scales, and generally positive long-term outcomes for fish habitats (Boughton et al. 2007).

Euro-American influences and activities on the western landscapes of the U.S., coupled with climate change, have made modern western fires more frequent, severe, and catastrophic in nature (e.g., Gresswell 1999; Noss et al. 2006; and Moyle et al. 2017). Future frequency and size of wildfires in the range of Southern SH/RT is expected to increase, driven by rising atmospheric temperatures and prolonged droughts associated with climate change (NMFS 2012a, OEHHA 2022). Potter (2017) examined satellite data for the 20 largest fires that have burned since 1984 in the central and southern coastal portions of California and found that climate and weather conditions at times of ignition were significant controllers of the size and complexity of high-burn severity fire areas. Since 1950, half of California's largest wildfires (10 of 20) occurred between 2020 and 2021 (OEHHA 2022). One study predicted a nearly 70% increase in the area burned in southern California by the mid-21st century, due to warmer and drier climatic conditions (Jin et al. 2015). This study also evaluated southern California's wildfires in terms of their impacts in the presence or absence of regionally prominent Santa Ana winds. This research found that non-Santa Ana fires which occur mostly in June through August affected higher-elevation forests, while Santa Ana-driven fires which occur mostly from September through December spread three times faster and occurred closer to urban areas (Jin et al. 2015). Recent examples of devastating Santa Ana wind-driven fires include the destructive Thomas Fire (approximately 282,000 acres) in Ventura and Santa Barbara counties (December 2017) and the Woolsey Fire (approximately 97,000 acres) in Los Angeles and Ventura counties (November 2018), both of which were also influenced by preceding record-breaking heatwaves and extremely dry fall conditions (Hulley et al. 2020).

Projected increases in precipitation extremes will lead to increased potential for floods, mudslides, and debris flows (Hall et al. 2018). Wildfires and subsequent debris torrents in southern California were demonstrated to have destroyed Southern SH/RT habitats in 2004, 2006, and 2008 (Moyle et al. 2015). More recent events, including mass wasting and debris flows, such as those in Santa Barbara County in early 2018, resulted from heavy rains preceded by wildfires (Livingston et al. 2018). High-intensity wildfires can accelerate the delivery of sediments to streams (Boughton et al. 2007) by stripping the land of vegetative cover and eliminating stabilizing root structure, thereby degrading spawning habitats for salmonids and other fishes. Increased soil friability greatly increases rates of fine soil mobilization, erosion, transport, and deposition into watercourses affected by fire due to the elimination of vegetation, the input of large amounts of dry ash and charcoal, the lack of soil shading, and the associated increased solar warming and drying of soils (NMFS 2012a). These fine materials often become so dry after a fire that they become hydrophobic, making it much easier for runoff water to mobilize and transport. Fine sediments delivered to streams in large amounts have been shown to cover and smother coarser-grained spawning gravels, which are required for salmonid spawning success (Moyle et al. 2015). Largescale sediment mobilization events can also change the channel characteristics of streams, destroy instream and riparian vegetation, and possibly cause direct or indirect mortality to multiple life history stages of Southern SH/RT, while also facilitating the rapid spread of non-native plant and animal species. High flows and floods in fire scars can also scour redds, depending on their seasonal timing, possibly nearly eliminating a Southern SH/RT subpopulation's cohort post-spawn if gravels are mobilized and eggs or juveniles are washed downstream.

6.3 Disease

Numerous diseases caused by bacteria, protozoa, viruses, and parasitic organisms can infect Southern SH/RT in both juvenile and adult life stages. These diseases include bacterial kidney disease (BKD), *Ceratomyxosis*, *Columnaris*, *Furunculosis*, infectious hematopoietic necrosis virus, redmouth and black spot disease, Erythrocytic Inclusion Body Syndrome, and whirling disease (NMFS 2012a). Water quality and chemistry, along with warm stream temperatures, influence infection rates. As water temperatures rise and fish become thermally stressed, lower host resistance aligns with higher pathogen growth rates due to shorter generation times and can lead to a sharp increase in infection rates and associated mortality (Belchik et al. 2004; Stocking and Bartholomew 2004; Crozier et al. 2008). There is little current information available to evaluate the potential impacts of these kinds of infections on Southern SH/RT populations.

6.4 Hatcheries

Extensive stocking of hatchery-origin *O. mykiss* has occurred throughout the southern California region to support recreational fisheries, but no efforts have specifically targeted the conservation and supplementation of Southern SH/RT. Historical stocking records dating back to the 1930s occasionally reference the stocking of "steelhead"; however, it appears that these references represent nomenclature being used interchangeably rather than identification of fish from native migratory populations. Hatchery-origin *O. mykiss* were stocked widely for recreational fisheries up until the late 1990s. Stocking was ceased in the anadromous waters of southern California as a protective conservation measure starting in 1999 (J. O'Brien, CDFW, personal communication).

While restricted stocking of *O. mykiss* has continued in the region above barriers to anadromy, potential remains for the inadvertent introduction of hatchery stocks into anadromous waters due to downstream movement or during reservoir spill events. To mitigate the risk of hatchery-origin fish interbreeding with wild fish, the Department shifted to stocking only triploid hatchery-origin *O. mykiss* in waters above anadromous barriers following the adoption of the Hatchery and Stocking Program Environmental Impact Report (EIR) in 2010 (Jones and Stokes 2010). Triploid *O. mykiss* have been used across the western United States to reduce the risks of introgression and hybridization associated with stocking programs that support recreational fisheries. The application of heat- or pressure-induced “triploiding” on salmonid eggs, including *O. mykiss*, has a proven 91-100% sterilization rate, often at the upper end of that range (Kozfkay et al. 2011). Using triploid hatchery-origin *O. mykiss* for recreational fisheries has mitigated some of the inherent risk of potential hybridization and introgression with native and wild stocks, although some risks to Southern SH/RT may still exist. Competition and predation from hatchery stocks remain of concern since the degree to which triploid *O. mykiss* may compete with or prey upon native *O. mykiss* is not well understood.

Hatchery-origin *O. mykiss* have been tagged prior to stocking into select regional reservoirs to attempt to evaluate if and the extent to which they may be escaping these impoundments and entering anadromous waters below dams. No reservoir spills have occurred across the region since tagging began due to the predominance of drought conditions, except for during the winter and spring of 2023. To date, downstream monitoring has not been conducted since the inception of the tagging study (J. O’Brien, CDFW, personal communication). Due to climate change impacts and the decreased frequency with which many southern California reservoirs are filling or overspilling, it is expected that threats from interactions between hatchery-stocked *O. mykiss* and remaining native stocks of Southern SH/RT will be considerably reduced in the future. However, the large number of atmospheric rivers that impacted much of California during the recent winter of 2022–2023, causing some southern California reservoirs to fill and overspill, is a reminder that such events remain possible.

While exclusively triploid hatchery-origin *O. mykiss* are stocked above barriers to anadromy in southern California, historical regional stocking practices of non-triploid fish have led to introgression, or hybridization with hatchery stocks, in some Southern SH/RT populations. Levels of introgression appear to vary across the landscape, differing between populations and watersheds. Some populations retain high levels of native southern California steelhead ancestry, while others are highly introgressed and exhibit high levels of hatchery-origin genetics (primarily Central Valley *O. mykiss* genetics), while some are in between, with genetic signatures from both native and hatchery origins (NMFS 2016; Jacobson et al. 2014). See Section 6.7 in this Status Review for more information.

6.5 Predation

6.5.1 Predation in Freshwater Environments

California’s salmonids have evolved under selective pressure from a variety of natural predators, including many species of fish, birds, and mammals; however, a growing number of non-native aquatic species have also become established within the range of Southern SH/RT (Busby et al. 1996; NMFS 2016; Stillwater Sciences 2019; Dagit et al. 2019; COMB 2022).

Established populations of non-native fishes, amphibians, and invertebrates, combined with anthropogenic habitat alterations that often favor non-native species, have led to increased impacts from predation, competition, and other stressors on Southern SH/RT across much of its range (NMFS 1996b). Stream habitat alteration can also directly affect predation rates by reducing available cover for prey species, creating flow and velocity regimes that favor non-native predators, and creating obstructions to passage that can lead to migration delays and increased exposure to predators (Moyle et al. 2013; Dagit et al. 2017). Further, stream habitat alterations can influence water temperatures, often increasing them, which may then lead to higher metabolic rates for piscivorous fishes and increased predation pressure (Michel et al. 2020). In addition to physical habitat alterations, chemical habitat alterations in the form of contaminants known to alter fish behavior and reduce avoidance or cover-seeking activities are also likely to increase predation rates, particularly from avian predators (Grossman 2016).

Established populations of non-native catfish and centrarchids occur in the lower reaches of many watersheds throughout the range of Southern SH/RT, leading to widespread predation risk (NMFS 2016; Stillwater Sciences 2019; Dagit et al. 2019; COMB 2022). Grossman (2016) found that non-native Channel Catfish (*Ictalurus punctatus*) may be a primary predator of Central Valley steelhead in the San Joaquin River, suggesting they may pose the same level of risk to Southern SH/RT. Non-native centrarchids have been demonstrated to negatively impact salmonid populations through direct predation on rearing juveniles and resident adult *O. mykiss* (Dill and Cordone 1997; Marks et al. 2010; NMFS 2012a; Bonar et al. 2005). In Washington state, non-native smallmouth bass (*Micropterus dolomieu*) have been a major predator of native salmonids (Poe et al. 1991; Vigg el al. 1991; Tabor et al. 1993; Zimmerman 1999). Interestingly, the smallest bass size classes have been shown to have the highest predation rates on juvenile Chinook salmon (Fritts and Pearsons 2006); therefore, small bass can present a major risk of predation on juvenile salmonids. This is especially true since smaller -sized bass can achieve potentially high densities in altered habitats, leading to increased predation rates. Additionally, largemouth bass (*Micropterus salmoides*) are better thermally adapted to higher temperatures than salmonids. They may also consume salmonids at higher rates as the waters warm (McInturf et al. 2022).

In addition to piscivorous fishes, non-native invertebrates and amphibians have also been introduced and spread across the Southern SH/RT range. American bullfrogs (*Lithobates catesbeianus*) have become widely established and can prey upon rearing juvenile steelhead (COMB 2022; Cucherousset and Olden 2011; Dagit et al. 2019; Stillwater Sciences 2019). Non-native Red Swamp Crayfish (*Procambarus clarkia*) populations have also increased in some Southern SH/RT waters (Garcia et al. 2015; Dagit et al. 2019). Direct observations of YOY Southern SH/RT being attacked by crayfish in shallow riffle-run habitat suggest that predation poses a threat to the survival of juvenile steelhead (Dagit et al. 2019).

6.5.2 Predation in Marine Environments

Marine predation influences on Southern SH/RT are not well documented or understood. Primary predators of salmonids in the marine environment are pinnipeds, such as harbor seals (*Phoca vitulina*) and California sea lions (*Zalophus californianus*) (Cooper and Johnson 1992; Spence et al. 1996). Although fish are a major dietary component of marine pinnepeds, their predation on Southern SH/RT may be minimal at present, given the very low relative abundances of Southern SH/RT.

6.6 Competition

Competition is the interaction between individuals of the same or different species that compete for a limited supply of a common resource (Holomuzki et al. 2010). The extent to which competition impacts the distribution, abundance, and productivity of Southern SH/RT populations is not well understood. Pacific steelhead typically compete with other salmonid species like Coho and Chinook salmon in freshwater; however, unlike northern populations of steelhead that typically co-occur with other salmonid species, Southern SH/RT are the only salmonids that occur in their range. While inter-specific competition with other salmonids is unlikely to occur, intraspecific competition among Southern SH/RT may be prevalent in southern California watersheds, especially those that are highly degraded. Poor and degrading habitat conditions can contribute to increased competition, which, in turn, can adversely affect fish during the juvenile life-history stage and lead to reduced recruitment and reproductive performance over the entire life cycle (Chilcote et al. 2011; Tatara et al. 2012). Limited habitat space, coupled with high juvenile densities, is associated with reduced growth, premature emigration, increased competition for food, decreased feeding territory sizes, and increased mortality (Kostow 2009).

Juvenile steelhead are habitat generalists, occupying a variety of microhabitat types in streams depending on the size and age of individuals (Spina et al. 2005). Non-native fish species can competitively restrict the spatial distribution of juvenile steelhead to suboptimal habitats such as shallower, higher-velocity rifles, where the energetic cost to forage is higher (Rosenfeld and Boss 2001). Non-native fish species may also exclude juvenile steelhead from areas of suitable habitat. For example, recent watershed-wide surveys in Sespe Creek, a large and unregulated tributary to the Santa Clara River, documented the absence of Southern SH/RT in several stream reaches with suitable steelhead habitat (i.e., cool water with deep pools) that were dominated by multiple species of non-native juvenile fishes (Stillwater Sciences 2019). According to Krug et al. (2012), Arroyo Chub may also compete with Southern SH/RT juveniles for food resources. Like juvenile steelhead, Arroyo Chub are opportunistic feeders and consume benthic and drift invertebrates, sometimes switching preferences depending on food abundance. Southern SH/RT and Arroyo Chub are frequently part of the same native southern California fish assemblages and generally habitat partition, with juvenile steelhead mostly feeding on drift invertebrates while chub have a more benthic diet. However, periods of diet overlap may lead to strong interspecific competition between the two species. While other native fishes may impose some level of competitive threat to Southern SH/RT, it remains likely that non-native competitors pose the greater threat, especially with these species continued expansion and proliferation (O'Brien and Barabe 2022).

6.7 Genetic Diversity

West coast steelhead have considerable genetic diversity, both within and across populations, including variation in traits linked to anadromy, morphology, fecundity, spawning, and run timing, as well as age at smolting and maturation (McElhany et al. 2000). While some traits are entirely genetically based, the expression of most traits usually varies, due to a combination of both genetic and environmental factors. Species with high genetic diversity typically occupy a wider range of habitats than those with lower diversity and are more resilient to both short-and long-term spatial-temporal fluctuations in the environment such as ecological disturbances (i.e., wildfires, floods, and landslides) and human-caused impacts. Generally, populations need to be large enough to maintain long-term genetic diversity and avoid genetic problems, such as loss of variation, inbreeding depression, bottlenecks, and the accumulation of deleterious mutations, all of which occur more frequently in smaller populations.

A range-wide genetic analysis demonstrated that populations in the southernmost portions of the Southern SH/RT range are dominated by hatchery ancestry, indicating genetic introgression of native lineages with hatchery strains (Jacobsen et al. 2014; Abadia-Cardoso et al. 2016). Most of these hybridized wild populations occur above barriers in the upper reaches of the Los Angeles, San Gabriel, Santa Ana, San Juan, San Diego, and Sweetwater rivers. It is unclear whether introgression will decrease the viability of these southern populations, since the introduction of small amounts of novel genetic material, even from hatchery stocks, can lead to increased diversity and the phenomenon known as "hybrid vigor," conferring adaptive resilience to changing environments and the negative impacts of inbreeding. This study also confirmed that the northernmost populations of Southern SH/RT within the species range, including all watersheds in the Monte Arido Highlands BPG, contain native steelhead ancestry and generally higher genetic diversity than more southern populations (Clemento et al. 2009; Abadia-Cardoso et al. 2016).

As with other salmonids, natural straying and the resultant gene flow between populations maintain the genetic diversity of Southern SH/RT. A recent study, which examined the otoliths of seven adult steelhead from a small basin on the Big Sur coast of California, revealed that all adults were strays, coming from at least six different source populations, including neighboring ones on the Big Sur coast as well as distant populations such as the Klamath River (Donohoe et al. 2021). As is the case for many coastal steelhead populations, the genetic diversity of Southern SH/RT has been compromised by human impacts on their habitats, such as the blocking of migration corridors by artificial dams and widespread reductions in streamflow, at least partially due to locally and regionally intensive water diversions for municipal, agricultural, and other human consumptive uses (NMFS 2012a).

Measures of genetic diversity, such as heterozygosity and allelic richness, indicate that Southern SH/RT populations have lower diversity than northern coastal populations. Within the range of Southern SH/RT, the northernmost populations in the Santa Maria, Santa Ynez, Ventura, and Santa Clara rivers have higher genetic diversity than the southernmost populations (Abadia-Cardoso et al. 2016). Previous genetic studies have revealed that populations occurring downstream of modern artificial barriers are genetically more similar to above-barrier populations in the same basin than they are to populations below barriers in neighboring basins (Clemento et al. 2009). While above- and below-barrier populations within the same drainage are usually each other's closest relatives, they appear divergent in respect to the frequencies of the anadromous (A) and resident (R) haplotypes found in each subpopulation (see Section 4.7). The A haplotype is more common below dams, while the R haplotype is found more frequently above dams. This evidence of genetic drift is likely a product of artificial dams or other barriers blocking anadromous adults from returning to these upstream areas to reproduce and provide A haplotype genetic influx to the above-barrier population (Pearse et al. 2014; Pearse et al. 2019). Apgar et al. (2017) found that the frequency of the A haplotype in above-barrier populations is strongly associated with several factors, including the extent of migration barriers present, barrier type (complete, partial, artificial, or natural), barrier age (recent or longstanding), and migration distance.

Because migratory phenotypes are primarily genetically based, variation in the reproductive success of anadromous and resident individuals can influence the tendency of populations to produce anadromous offspring, corresponding to changes in the frequency of the A haplotype. Moreover, environmental factors, such as intra-and inter-annual climate variation, food availability, and water temperature, also influence the expression of anadromy in Southern SH/RT populations (Satterthwaite et al. 2009; Ohms et al. 2014; Kendall et al. 2015). Furthermore, climate change projections for Southern SH/RT range predict an intensification of climate patterns, such as more intense cyclic storms, droughts, and extreme heat (NMFS 2012a). These projections suggest that Southern SH/RT will likely experience more frequent periods of adverse conditions and continued selection pressure against the anadromous life-history form.

6.8 Habitat Conditions

The decline of Southern SH/RT can be attributed to a wide variety of human activities, including, but not limited to, urbanization, agriculture, and water development. These activities have degraded range-wide aquatic habitat conditions, particularly in the lower and middle reaches of most watersheds in the Southern SH/RT range (NMFS 2012a). Southern California is home to over 20 million people and 1.8 million acres of metropolitan, urban, and suburban areas (DWR 2021) which has resulted in highly urbanized watersheds that are impacted by surface and groundwater diversions and associated agricultural, residential, and industrial uses. Major rim dams, instream diversion dams, and other water conveyance infrastructure have significantly reduced or eliminated access to the majority of historical upstream rearing and spawning habitat for southern steelhead. While some of these human activities have been reduced, eliminated, or mitigated, the cumulative impacts of these activities remain throughout most of the Southern SH/RT range, particularly in larger systems such as the Santa Maria, Santa Ynez, Ventura, Santa Clara, Los Angeles, San Gabriel, Santa Ana, and Santa Margarita watersheds, as well as in smaller coastal systems such as Malibu Creek.

6.8.1 Roads

High human population densities in southern California have led to the development of an extensive network of transportation corridors throughout the range of Southern SH/RT. The extensive road and highway networks across much of the Southern SH/RT range, especially in areas proximate to rivers and streams, are attributed to increases in a number of negative habitat impacts. Among these are: non-point pollution (e.g., oil, grease, and copper from braking systems); sedimentation; channel incision due to bankside erosion; substrate embeddedness; floodplain encroachment and loss of floodplain connectivity; loss of channel heterogeneity (e.g., filling of pool habitats); and higher frequencies of flood flows (NMFS 2012a). Additionally, extensive road and highway networks require many road crossings (e.g., culverts and bridges) that are often improperly designed for the volitional passage of aquatic organisms (CalTrans 2007; NMFS 2012a).

NMFS (2012) assessed the impacts of roads and transportation corridors on Southern SH/RT using roads per square mile of watershed and the density of roads within 300 feet of streams per square mile of watershed as metrics. The results of their analysis demonstrated that roads and associated passage barriers have the highest impact on rivers and streams in the Santa Monica Mountains and Conception Coast BPG regions: 60% of watersheds in the Conception Coast BPG ranked “very high” or “high” in severity for roads as a stressor, while 100% of the watersheds that drain the Santa Monica Mountains received the same ranking. Highway 101 and the Union Pacific Railroad cross the mainstem of each watershed along the Conception

Coast BPG region (as well as the Monte Arido Highlands BPG region) near their river mouths. At each major transportation crossing, culverts were constructed to allow stream flows to pass through to the Pacific Ocean, but they were not necessarily engineered to allow upstream fish passage. For example, the Highway 101 culvert on Rincon Creek serves as a total barrier to upstream migration, preventing Southern SH/RT from reaching any of its historical habitats upstream of the barrier. Road development, bridges, and other transportation corridors are also partly responsible for the significant (70-90%) reduction of estuarine habitat across all BPGs (Hunt and Associates 2008).

The Mojave Rim and Santa Catalina Gulf Coast BPG regions are home to the highest urban densities across the Southern SH/RT range, and both BPGs are impacted by high road densities. For example, in the Santa Catalina Gulf Coast BPG region, the Rancho Viejo Bridge, Interstate-5 Bridge array, and the Metrolink drop structure are all recognized as total fish passage barriers on Arroyo Trabuco Creek, a tributary to San Juan Creek. On the Santa Margarita River, an outdated box culvert at the Sandia Creek Bridge serves as a significant fish passage barrier on the river (Dudek 2001). Recently, efforts have been undertaken to repair and modify these barriers to provide upstream steelhead passage and again allow access to many miles of historical habitat in these watersheds (see Chapter 6: Influence of Existing Management Efforts).

6.8.2 Dams, Diversions, and Artificial Barriers

A number of anthropogenic impacts, including water diversions, dams, and other artificial barriers, influence stream flows in most Southern SH/RT-supporting watersheds. Surface water diversions can lead to reduced downstream flows, as well as changes to the natural flow regime (e.g., magnitude, timing, and duration of flow events), stream hydrodynamics (e.g., velocity, water depth), and degradation of both habitat quality and quantity needed to support Southern SH/RT (NMFS 2012a; Yarnell et al. 2015). Changes to the natural flow regime can result in elevated downstream water temperatures, reduced water quality, shifts in fish community composition and structure, increased travel times for migrating fish, increased susceptibility of native aquatic organisms to predation, and reduced gravel recruitment from upstream areas of watersheds to the lower reaches of rivers (NMFS 1996b; Axness and Clarkin 2013; Kondolf 1997). Dams physically separate fish populations into upstream and downstream components, leading to population and habitat fragmentation, along with potential changes to population spatial and genetic structure over time (NMFS 2012a). Large dams often trap upstream sediments, which naturally would be transported downstream and deposited, augmenting substrates and improving spawning habitats for salmonids and other fish. It is common for rivers and streams with large dams to exhibit more scouring and streambed degradation downstream of the impoundment (Kondolf 1997; Yarnell et al. 2015). Stream flow reductions also interfere with the downstream transport and influx of freshwater to estuaries. The consequences of reduced inflows to estuaries include wetland and edge habitat loss, changes to the amount and location(s) of suitable habitat for aquatic organisms and accelerated coastal erosion (Nixon et al. 2004).

Many types of artificial stream barriers exist throughout the range of Southern SH/RT, including dams, concrete channels for flood control, gravel and borrow pits, roads and utility crossings, fish passage facilities, and other non-structural features such as velocity barriers. In the South Coast hydrologic region, a total of 164 known total migration barriers were identified as part of a larger effort to inventory fish passage barriers across California’s coastal watersheds (California Coastal Conservancy 2004). Of the 164 total barriers, 11 were identified as requiring modification or removal to improve fish passage. Dams were identified as the most numerous barrier type, followed by stream crossings and non-structural barriers. The Santa Maria River, San Antonio Creek, Cuyama River, Santa Ynez River, and Santa Barbara coastal watersheds, which all belong to the Central Coast hydrologic region, also contain hundreds of known barriers scattered throughout the area, with the highest number found along the Santa Barbara coastal area (California Coastal Conservancy 2004).

Artificial barriers act as physical impediments but may also contribute to, or enhance, non-structural barriers to steelhead spawning migrations. For example, the three major watersheds of the Los Angeles basin have channelized concrete aqueducts in their lower reaches, with some extending from their mouths upstream for miles. As a result, adult Southern SH/RT can no longer access the lower reaches of these three major regional rivers (Titus et al. 2010). Furthermore, if Southern SH/RT were to successfully enter into the channelized reaches of these rivers, migration success would be limited because individuals would encounter non-structural velocity barriers that would require greater swimming speeds than could be sustained (Castro-Santos 2004). Other non-structural barriers may exist in the form of low flows, disconnected wetted habitat, and poor or lethal water quality in these largely metropolitan lower river aqueduct reaches.

Most of the large rivers in the Monte Arido Highlands BPG region contain multiple large, impassable dams. Twitchell Dam on the Cuyama River is primarily managed for groundwater recharge in the Santa Maria Valley. Operations of Twitchell Dam limit downstream surface flows into the mainstem Santa Maria River (NMFS 2012a). Cachuma, Gibraltar, and Juncal dams on the mainstem Santa Ynez River prevent upstream migratory access to approximately 70% of historical spawning and rearing habitat in the watershed (NMFS 2012a). In the Ventura River watershed, Matilija and Casitas dams on Matilija Creek and Coyote Creek, respectively, block access to 90% of historical Southern SH/RT spawning and rearing habitat. However, the recent Matilija Dam Ecosystem Restoration Project is aimed at restoring over 20 miles of perennial

Southern SH/RT habitat in the Matilija Creek watershed through the removal of Matilija Dam. Santa Felicia Dam and Pyramid Dam on Piru Creek, as well as Castaic Dam on Castaic Creek, block access to historical habitat in the tributaries of the mainstream Santa Clara River. Several of these large dams are operated along with smaller downstream diversion dams: primarily the Robles Diversion Dam on the Ventura River and the Vern Freeman Diversion Dam on the Santa Clara River. The Robles Diversion Dam diverts water from the upper Ventura River into storage at Lake Casitas, while the Vern Freeman Diversion diverts water for groundwater recharge purposes in the Santa Clara Valley.

Two major dams impair habitat connectivity and hydrologic function in the Malibu Creek watershed: Rindge Dam and Malibu Lake Dam. Both dams have created favorable habitat conditions for non-native species, including crayfish, snails, fish, and bullfrogs. As a result, invasive aquatic species have been documented in high abundance in Malibu Creek (NMFS 2012a). Rindge Dam is located only 2 miles upstream of the mouth and is no longer functional, so it is targeted for future removal. The removal of this dam alone would allow Southern SH/RT access to 18 miles of high-quality spawning and rearing habitat in the Malibu Creek watershed.

Dams are ranked “high” or “very high” as a threat in 88% of the component watersheds that comprise the Mojave Rim BPG region (NMFS 2012a). There are also at least 20 jurisdictional-sized dams (i.e., a dam under the regulatory powers of the State of California) within each of the three major watersheds of the Los Angeles basin, owned by federal, state, local, and/or private entities and operated for multiple purposes, including: irrigation, flood control, storm water management, and recreation. The principal impoundments in the San Gabriel River watershed are Whittier Narrows, Santa Fe, Morris, San Gabriel, and Cogswell dams. Sepulveda Dam on the Los Angeles River is operated as a flood control structure approximately 8 miles downstream from the river’s source. Prado Dam on the Santa Ana River is also primarily operated as a flood risk management project. These dams alter the physical, hydrological, and habitat characteristics of the lower and middle reaches of the mainstem rivers in this BPG. They also create favorable habitat for non-native species such as crayfish, largemouth bass, and bullfrogs, which have all been documented in the Los Angeles, San Gabriel, and Santa Ana rivers. Periodic removal of sediments accumulated behind dams on the San Gabriel River also degrades downstream riparian and instream habitat conditions (Hunt and Associates 2008).

In the Santa Catalina Gulf Coast BPG, dams also ranked “high” or “very high” as a threat in 90% of constituent watersheds. At least 20 major dams and diversions without fish passage facilities occur throughout the BPG’s distribution. Prominent dams in this BPG include Agua Tibia, Henshaw, and Eagles Nest dams in the San Luis Rey watershed; and the O’Neill Diversion and Vail dams in the Santa Margarita River watershed. Dams in this BPG are generally not operated with fish passage as a consideration in flow release schedules, and many of these facilities lack fish passage provisions (NMFS 2012a).

Municipalities and agricultural beneficial uses comprise the majority of water demand in the South Coast region (Mount and Hanak 2019). Approximately 1.57 million acre-feet of groundwater are used on an annual basis in southern California to meet both urban and agricultural water demands (DWR 2021). Reservoir releases are typically increased during the summer and fall months for the purposes of recharging groundwater for future diversions. Unsustainable water diversions have led to the depletion of several large groundwater aquifers in the region. Recently, the Sustainable Groundwater Management Act priority process identified several groundwater basins across the South Coast hydrologic region as either critically over drafted (i.e., Santa Clara River Valley, Cuyama River Valley, and Pleasant Valley) or medium-to-high priority basins for water conservation (e.g., the Coastal Plain of Orange County) based on several metrics such as population growth rates, the total number of wells, and the number of irrigated acres (DWR 2020). Groundwater sustainability agencies overseeing critically overdrafted and medium-to-high priority basins are responsible for developing and realizing groundwater sustainability plans (GSPs) to achieve basin sustainability within a 20-year implementation horizon.

6.8.3 Estuarine Habitat

The estuaries of many coastal watersheds in southern California form freshwater lagoons that are seasonally closed to the ocean. Lagoons form when low summer baseflows are unable to displace sand deposition at the mouth of the estuary, which results in the formation of a sandbar that blocks connectivity with the ocean. This closure creates an environment characterized by warmer and slower-moving (i.e., longer residence times) freshwater that is relatively deep (Bond et al. 2008). These habitat characteristics provide important, high-quality nursery conditions for rearing juveniles and transition areas for smolts acclimating to the ocean environment. Adult steelhead also acclimate in these areas prior to upstream migration during the winter months when the estuary is fully open (NMFS 2012a). The importance of such habitats was demonstrated by the observed doubling of growth in juvenile *O. mykiss,* which reared throughout the summer in a typical northern California coastal watershed (Bond et al. 2008). The same study examined scales from returning adult steelhead and found that estuary-reared individuals dominated adult returns, despite comprising only a small part of the annual outmigrating population. Another study conducted in the same watershed also reported higher growth rates for estuary-reared juvenile steelhead than for their cohorts reared in the upper watershed (Hayes et al. 2011). Hayes et al. (2011) also found that the lagoon environment provided warmer water temperatures and a diverse abundance of invertebrate prey resources for rearing juvenile *O. mykiss* to consume. Trade-offs between accelerated growth and survival likely exist in lagoon habitats because they represent a relatively high-risk yet high-reward environment in which accelerated growth may come at the cost of increased metabolic demand and potentially increased predation risk (Osterback et al. 2013; Satterthwaite et al. 2012).

The southern California Bight, which encompasses the entire southern California coastline, from Point Conception to San Diego, historically supported around 20,000 hectares of estuary habitat (Stein et al. 2014). Over half of all historical estuaries were found in San Diego County (e.g., Mission Bay and San Diego Bay), while Los Angeles and Orange counties contained about 15% each of the total estimated historical area. Estimates of the amount of estuarine habitat loss from historical levels, based on wetland acreage, range from 48-75% (Brophy et al. 2019; NMFS 2012a; Stein et al. 2014). The magnitude of the loss varies depending on the watershed. For example, the estuaries of the Santa Maria and Santa Ynez rivers in the northern portion of the Southern SH/RT range remain almost entirely intact, while the estuaries of the Los Angeles, San Gabriel, and Santa Ana rivers have been reduced to 0-2% of their historical extent (NMFS 2012a). Overall, estuary habitat loss in southern California is likely underestimated because early landscape modifications (e.g., housing and transportation development and associated filling of wetlands with sediment) had substantially altered the landscape before attempts were made to quantify the extent of historical habitat (Brophy et al. 2019).

The primary cause of estuarine loss in southern California is the conversion of habitat to other land use practices such as agriculture, grazing, and urban development activities, which require the construction of infrastructure and the subsequent filling, diking, and draining of coastal wetlands (NMFS 2012a). Currently, estuary habitats in the range of Southern SH/RT remain highly degraded and prone to further degradation by urban impacts such as point and nonpoint source pollution, coastal development, and dams. These environmental stressors can cause declines in water quality and the proliferation of harmful algal blooms that can lead to the rapid die-off of both aquatic and terrestrial organisms (Lewitus et al. 2012; Smith et al. 2020). Artificial breaching of estuaries also poses a mortality risk to Southern SH/RT. Seven moribund juvenile steelhead were observed in the lagoon at the mouth of the Santa Clara River shortly after the sandbar was artificially breached in 2010 (Swift et al. 2018). The authors of this study noted that the Santa Clara River, upstream of the lagoon, was dry during this time and that the observed fish were relatively large and in robust condition, indicating that favorable rearing conditions existed prior to the artificial breaching.

6.8.4 Water Quality and Temperature

Contaminants and pollutants are well-documented to alter water quality parameters that affect the growth and survival of Pacific salmonids in both freshwater and estuarine environments (Arkoosh et al. 1998; Baldwin et al. 2009; Laetz et al. 2008; Sommer et al. 2007; Sullivan et al. 2000). Both are generally introduced into southern California rivers and streams by urban runoff, agricultural and industrial discharges, wastewater treatment effluent, and other anthropogenic activities. Recent monitoring conducted by the USGS measured between 20 and 22 current-use pesticides in samples collected from urban sites at Salt Creek and the Sweetwater River in Orange and San Diego counties (Sanders et al. 2018). Diminished water quality conditions, including contaminants and associated toxicity, elevated nutrients, low dissolved oxygen, increased temperature, and increased turbidity, can all adversely affect Southern SH/RT as well as other native fish and aquatic organisms. The effects of individual pollutants and combinations thereof can impact populations by altering growth, reproduction, and mortality rates of individual fish (Sommer et al. 2007). These impacts can ultimately manifest in direct mortality due to acute and long-term physiological stress or may act through indirect pathways such as changes to food webs, ecosystem dynamics, increased susceptibility to disease and predation, and more frequent occurrences of harmful algal blooms. Aquatic stressors that impair water quality can also interact with each other in an additive or synergistic fashion, such that they are generally interdependent and can greatly amplify negative impacts on aquatic ecosystems (Sommer et al. 2007). Dissolved oxygen concentrations, turbidity, and water temperatures are all parameters directly influenced by flow management. Lower flows can lead to warmer water temperatures that hold less dissolved oxygen than cold water. Higher water temperatures also increase the metabolic and oxygen consumption rates of aquatic organisms, making these conditions particularly stressful for aquatic life (Myrick and Cech 2000). See Section 6.2.1 in this Status Review for a full description of air and water temperature influences and trends.

Many watersheds that support Southern SH/RT are listed under Section 303(d) of the Federal Clean Water Act (CWA). Section 303(d) requires states to maintain a list of waters that do not meet prescribed water quality standards. For waters on this list, states are required to develop TMDLs that account for all sources (i.e., point and non-point sources) of the pollutants that caused the water to be listed as impaired under the CWA. Approved TMDLs and their implementing regulations are incorporated into water quality control plans required by the Porter-Cologne Act of 1969. In southern California, there are many impaired water bodies and pollutant combinations listed under Section 303(d). While contaminant and discharge sources have changed over the years and there have been significant improvements in controlling many of these sources, many 303(d)-listed waters do not yet have approved TMDLs (SWRCB 2020). All four of the major rivers in the Monte Arido Highlands BPG region are listed as 303(d)-

impaired, and each system contains over five sources of pollutants. Seven Southern SH/RT-supporting watersheds in the Conception Coast BPG region and three in the Santa Monica Mountains BPG region are 303 (d) listed, including Jalama, Gaviota, Mission, Carpinteria, Rincon, Big Sycamore Canyon, Malibu, and Topanga creeks. All three of the major watersheds in the Mojave Rim BPG region, as well as eight out of ten in the Santa Catalina Gulf Coast BPG region, are 303(d)-listed, including the Los Angeles, San Gabriel, Santa Ana, Santa Margarita, San Diego, and Sweetwater rivers and the San Juan, San Mateo, San Luis Rey, and San Dieguito creeks. Essentially, all rivers and streams supporting Southern SH/RT that are 303(d)-listed are impaired by multiple pollutants, including water temperature, benthic community effects, indicator bacteria, trash, toxicity, and invasive species. Furthermore, southern California's coastal and bay shorelines, estuary environments, and tidal wetlands are also frequently 303(d)-listed as impaired. As examples, the estuaries of Malibu, Aliso, San Juan, and Los Penasquitos creeks; the entirety of Santa Monica Bay; and the estuaries of the Los Angeles, Santa Clara, Santa Margarita, and Tijuana rivers are all listed as 303(d)-impaired waterbodies.

6.8.5 Agricultural Impacts

The impacts of agricultural development have lessened over time as farm and pasturelands continue to be converted to urban development in southern California (NMFS 2012a). Historically, the loss of riparian and floodplain habitat was due first to conversion for livestock ranching, followed by irrigated row-crop agriculture, and then urban development. For example, interior portions of the Santa Clara River floodplain were originally converted to agriculture but are now dominated by urban growth and major human population centers, such as the cities of Santa Paula and Fillmore. Today, the South Coast hydrologic region supports approximately 159,000 acres of agricultural land, with avocados, citrus, truck crops, and strawberries comprising the highest agricultural production by acreage (DWR 2021). Approximately 530,000 acre-feet of groundwater are annually pumped from underlying basins to support agricultural production in southern California (DWR 2021). Agricultural activities produce wastewater effluent containing nutrients that can either directly or indirectly be introduced into the rivers, streams, and estuaries that support Southern SH/RT, particularly when agricultural best management practices and water quality objectives have not been established. Agricultural production is prevalent in several watersheds, including the lower Santa Maria and Santa Ynez rivers; many of the smaller coastal watersheds along the Santa Barbara coast, such as the Goleta Slough complex and Rincon Creek; the upper Ventura River and the Ojai basin; and portions of the San Mateo Creek, San Luis Rey, and San Dieguito River tributaries in the southernmost portion of the range. Statewide, the counties of Ventura, Santa Barbara, and San Diego are each ranked in the top fifteen for total value of agricultural production (CDFA 2021).

While the impacts of agricultural development on Southern SH/RT and their habitats have decreased over time due to land use conversion, both activities have resulted in considerable cumulative regional habitat loss and degradation. These changes have led to greatly reduced habitat complexity and connectivity in the lower and middle reaches of many southern California watersheds. Currently, agricultural impacts on Southern SH/RT are most evident during the summer dry season, when agricultural and residential water demands are the highest. This period coincides with the juvenile *O. mykiss* rearing life-history stage, which is dependent on adequate summer base flows to maintain suitable habitat conditions for growth and survival (Grantham et al. 2012). Agricultural groundwater diversions can lead to rapid stream drying by depleting aquifer groundwater that contributes to stream base flows, which limits the extent of summer rearing habitat for fish (Moyle et al. 2017). Naturally occurring surface waters supported only by groundwater recharge can be rapidly dewatered due to excessive groundwater pumping or diversions. These areas have been shown to provide adequate depth, surface area, and habitat for steelhead in streams lacking cold-water refuges (Tobias 2006).

6.8.6 Invasive Species

Invasive and non-native species are abundant and widely distributed in many watersheds that support Southern SH/RT. Non-native species frequently occur in both anadromous and non-anadromous waters that have been extensively stocked by a variety of public and private entities (NMFS 2012a). Most reservoirs contain non-native species, such as largemouth and smallmouth bass, carp, sunfish, bullfrogs, and bullhead catfish, that can all establish reproducing populations in the river and stream reaches above and below the dams. Range-wide habitat alteration has also facilitated the widespread distribution and increased abundance of non-native fish species, which typically favor slower-moving, warmer-water habitats with lower dissolved oxygen concentrations and higher sediment loads (Moyle et al. 2017). While the introduction of non-native game species has historically been viewed as a fishery enhancement, these species can have negative impacts on Southern SH/RT due to predation, competition, disease, habitat displacement and alteration, as well as behavior modifications (Cucherousset and Olden 2011).

Invasive species have recently been documented in high densities in Sespe Creek, an unregulated tributary to the Santa Clara River and a Department-designated Wild Tout Water (Stillwater Sciences 2019). High abundances of invasive species are due to the historic and ongoing stocking of non-native fish in the Rose Valley Lakes on Howard Creek, a tributary to Sespe Creek. In both Malibu and Topanga creeks, red swamp crayfish abundances have increased with recent warmer stream temperatures and lower flow conditions despite regular removal efforts (Dagit et al. 2019). High densities of crayfish likely have a direct (predation) and indirect (competition) effect on Southern SH/RT in both creeks. A variety of warm-water, non-native fish species are frequently observed in the lower Santa Ynez River, including multiple species of sunfish and catfish, carp, and largemouth bass, all of which are known predators of Southern SH/RT early life stages. In the lower Ventura River, annual monitoring efforts have consistently detected higher numbers of non-native fish species than Southern SH/RT in recent years (CMWD 2021).

Non-native plant and amphibian species also occur in several watersheds that support Southern SH/RT. Invasive plants such as giant reed and tamarisk have displaced extensive areas of native riparian vegetation in major drainages, such as the Santa Clara and San Luis Rey rivers (NMFS 2012a). These water-intensive plant species both reduce instream flows through groundwater uptake and severely reduce the extent of riparian cover and shading. These habitat changes often affect stream flow and thermal regimes, potentially increasing susceptibility of Southern SH/RT to predation, disease, and competitive exclusion. Other non-native plant species, such as water primrose and hyacinth, both of which form dense, sprawling mats on the water's surface, can alter the structure and function of aquatic ecosystems by outcompeting native aquatic plants, reducing the amount of open water habitat, altering the composition of invertebrate communities, physically blocking fish movement, and inducing anoxic conditions detrimental to fish (Khanna et al. 2018). In the Santa Clara River watershed, bullfrogs and African clawed frogs are abundant and widespread throughout the mainstem reaches, from the estuary upstream to Fillmore, including tributaries such as Santa Paula Creek and Hopper Canyon Creek (NMFS 2012a). Both species represent a threat to native aquatic communities because they opportunistically consume a variety of native prey, and eradication of either species is unlikely (Wishtoyo Foundation 2008).

6.8.7 Cannabis Cultivation

The cultivation, manufacturing, and distribution of cannabis products have increased since recreational use became legal in California in 2016 (Butsic et al. 2018). Threats and stressors on aquatic ecosystems associated with the cultivation of cannabis include stream flow and bank modifications, water pollution, habitat degradation, and species invasions (CDFW 2018b). Cannabis is a water-and nutrient-intensive crop that requires an average of up to 6 gallons of water per day, per plant, during the growing season, which usually spans a total of 150 days from June to October (Zheng et al. 2021). Water diversions can lead to changes in flow regimes, the creation of fish passage barriers, the loss of suitable spawning and foraging habitat, and the rerouting and dewatering of streams, especially during drought years or during the dry season (CDFW 2018b; see Section 6.8.2).

A number of local and state agencies, including counties, cities, the State Water Resource Control Board (SWRCB), the Department of Cannabis Control, the Department of Pesticide Regulation, and the Department, regulate the legal cannabis cultivation industry in southern California. These entities issue permits and licenses related to cultivation practices, discharge requirements, diversion rules, and environmental protections. The SRWCB, which issues water rights permits to cannabis cultivators, prohibits the diversion of surface water during the dry season from April 1 through October 1 each calendar year. Surface water diversions to off-stream storage are allowed for collection during the wet season and are later used during the dry season. Many Southern SH/RT-bearing streams are regulated by numerical instream flow requirements that must be met in order for cultivation diversions to occur. For example, instream flow requirements for the Santa Ynez River near Lompoc, California, range between 61.1 and 310 cubic feet per second (cfs) from November to March (SWRCB 2020). These wet-season requirements were developed to address the life history needs of threatened and endangered anadromous salmonids, including maintaining the natural abundance and availability of spawning habitat, minimizing adult exposure, stress, predation, and migration delay during the adult spawning season, and sustaining high-quality and abundant juvenile salmonid winter-rearing habitat.

Illegal cannabis cultivation operations are still prevalent on public lands in southern California, despite the now legal status of recreational use of cannabis in the state. The impacts of illegal cultivation sites are similar to those described for legal operations; however, the severity is likely higher due to the illicit nature of illegal cultivation sites, the higher likelihood of point-source pollution and unregulated diversions, along with the use of illegal and/or unauthorized pesticides, which are all common practices observed at illegal grow sites. As of January 2020, the Department's South Coast Regional Cannabis Unit has inspected 143 illegal cultivation sites and identified threats to 303(d)-listed water bodies and Regional Water Quality Control Board priority water systems (Covellone et al. 2020). According to Wengert et al. (2021), illegal cannabis cultivation sites in Northern California typically occur at low to mid-elevations (800 m to 1600 m) in forested areas with moderate slopes. If the same distribution patterns hold true in areas of southern California, illegal grow operations within these elevation ranges could overlap with the upper reaches of watersheds on national forest lands that currently support headwater populations of Southern SH/RT. The impact of these illegal grows could have significant adverse impacts on above-barrier resident populations, which have been shown to retain native steelhead genetics important to conserving the genetic diversity of Southern SH/RT. These isolated headwater populations may offer important conservation tools via native genetic stock that can be utilized to re-establish and support the fluvial-anadromous and lagoon-anadromous life history strategies in restored areas no longer occupied by Southern SH/RT (NMFS 2012a; Clemento et al. 2009).

6.9 Fishing and Illegal Harvest

Southern SH/RT traditionally supported important recreational fisheries for both winter adults and summer juveniles in coastal streams. Angling-related mortality may have contributed to the decline of some small populations but is generally not considered a leading cause of the decline of the Southern California Steelhead DPS as a whole (Good et al. 2005; Busby et al. 1996; NMFS 1996b). After the southern California steelhead DPS was federally listed as endangered in 1997, Department fishing regulation modifications led to the closure of recreational fisheries for Southern SH/RT in marine and anadromous waters with few exceptions. That closure continues, and there is currently no legal recreational fishery for Southern SH/RT (CDFW 2023).

Southern SH/RT take is primarily from poaching rather than legal commercial and recreational fishing. While illegal harvest rates appear to be very low, the removal of even a few individuals in some years could be a threat to the population because of such low adult abundance in most populations (Moyle et al. 2017). Southern SH/RT are especially vulnerable to poaching due to their high visibility in shallow streams. Estimates of fishing effort from self-report cards for 1993–2014 suggest extremely low levels of angling effort for Southern SH/RT, primarily due to the statewide prohibition of angling in anadromous waters starting in 1998 (NMFS 2016; Jackson 2007). Historic commercial driftnet fisheries may have contributed slightly to localized declines; however, Southern SH/RT are targeted in commercial fisheries, and reports of incidental catch are rare. Commercial fisheries are not believed to be a leading cause of the widespread declines of Southern SH/RT over the past several decades (NMFS 2012a).

7. INFLUENCE OF EXISTING MANAGEMENT EFFORTS

7.1 Federal and State Laws and Regulations

Several state and federal environmental laws apply to activities undertaken in California that may provide some level of protection for Southern SH/RT and their habitat. There are also restoration, recovery, and management plans, along with management measures specific to habitat restoration, recreational fishing, research, and monitoring that may benefit Southern SH/RT. The following list of existing management measures is not exhaustive.

7.1.1 National Environmental Policy Act and California Environmental Quality Act

The National Environmental Policy Act (NEPA) was enacted in 1970 to evaluate the environmental impacts of proposed federal actions. The NEPA process begins when a federal agency proposes a major federal action. The process involves three levels of analysis: 1) Categorical Exclusion determination (CATEX); 2) Environmental Assessment (EA) or Finding of No Significant Impact (FONSI); and 3) Environmental Impact Statement (EIS). A CATEX applies when the proposed federal action is categorically excluded from an environmental analysis because it is not deemed to have a significant impact on the environment. If a CATEX does not apply, the lead federal agency for the proposed action will prepare an EA, which concludes whether the action will result in significant environmental impacts. A lead agency will issue a FONSI document if significant impacts are not expected. Alternatively, if the action is determined to have a potentially significant effect on the environment, an EIS containing an explanation of the purpose and need for the proposed action, a reasonable range of alternatives that can achieve the same purpose and need, a description of the affected environment, and a discussion of environmental consequences of the proposed action is required (EPA 2017). The United States Environmental Protection Agency is responsible for reviewing all EIS documents from other federal agencies and must provide NEPA documentation for its own proposed actions. Because the Southern California DPS is listed as endangered under the federal ESA, proposed actions that may impact the species are evaluated as biological resources in the project area concurrently and interdependently with the federal ESA Section 7 consultation process.

The California Environmental Quality Act (CEQA) is similar to NEPA in that it requires environmental review of discretionary projects proposed by state and local public agencies unless an exemption applies (Pub. Resources Code, § 21080). Under CEQA, the lead agency is responsible for determining whether an EIR, Negative Declaration, or Mitigated Negative Declaration is required for a project (Cal. Code Regs., tit. 14, § 15051). When there is substantial evidence that a project may have a significant effect on the environment and adverse impacts cannot be mitigated to a point where no significant effects would occur, an EIR must be prepared that identifies and analyzes environmental impacts and alternatives (Pub. Resources Code, § 21082.2, subds. (a) & (d)). Significant effects for a proposed project may occur if project activities have the potential to substantially reduce the habitat, decrease the number, or restrict the range of any rare, threatened, or endangered species (Cal. Code Regs., tit. 14, §§ 15065, subd. (a)(1) & 15380). CEQA requires public agencies to avoid or minimize significant effects where feasible (Cal. Code Regs., tit. 14, § 15021); NEPA does not include this requirement. Further, CEQA requires that when a lead agency approves a project which will result in significant effects which are identified in the final EIR but are not avoided or substantially lessened, the agency shall make a statement of overriding considerations in which the agency states in writing the specific reasons to support its action based on the final EIR and/or other information in the record (Cal. Code Regs., tit. 14, § 15093).

7.1.2 Federal Endangered Species Act

The ESA was established in 1973 to conserve and protect fish, wildlife, and plants that are listed as threatened or endangered. The ESA provides a mechanism to add or remove federally listed species, cooperate with states for financial assistance, and develop and implement species recovery. The ESA also provides a framework for interagency coordination to avoid take of listed species and for issuing permits for otherwise prohibited activities. The lead federal agencies for implementing the ESA are the USFWS and NMFS. Federal agencies are required to consult with either the USFWS or NMFS to ensure that actions they undertake, fund, or authorize are not likely to jeopardize the continued existence of any listed species or their designated critical habitat. The federal ESA prohibits the take, import, export, or trade in interstate or foreign commerce of ESA-listed species.

NMFS listed the Southern California Steelhead DPS as endangered under the federal ESA in 1997 as part of the South-Central/Southern California Coast recovery domain and designated critical habitat for that DPS in 2005 (NMFS 2012a). The scope of the DPS is naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Santa Maria River to the U.S.-Mexico border. NMFS's West Coast Region manages recovery planning and implementation for this domain, and in 2012 the region adopted a Recovery Plan for the Southern California Steelhead DPS, which provides the foundation for recovering populations to healthy levels. The listing of the DPS afforded the DPS ESA protections through the consultation provisions of ESA Section 7(a)(2); habitat protection and enhancement provisions of ESA Section 4 and 5; take prohibitions through ESA Sections 4(d) and 9; cooperation with the State of California through ESA Section 6; and research, enhancement, and species conservation by non-federal actions through ESA Section 10.

Section 7(a)(2) of the ESA requires federal agencies to ensure their actions are not likely to jeopardize the continued existence of the species or adversely modify designated critical habitat. The agency requesting consultation will typically produce and submit a biological assessment that documents potential effects on listed species or their habitats to either the USFWS or NMFS. USFWS or NMFS then produces and submits a Biological Opinion to the requesting agency that contains conservation recommendations and actions to minimize any harmful effects of the proposed action. Currently, NMFS spends a significant amount of its resources and time fulfilling Section 7 consultation requirements for federal actions that may impact the Southern California Steelhead DPS (NMFS 2012a). This includes working with agencies to avoid and minimize the potential impacts of proposed actions and to ensure project activities do not jeopardize the species or destroy critical habitat. NMFS has issued Biological Opinions for several large federally owned and operated projects, including the Santa Felicia Hydroelectric Project on Piru Creek (2008), USBR's operation and maintenance of the Cachuma Project on the Santa Ynez River (2000), USBR's construction and operation of the Robles Diversion Fish Passage Facility on the Ventura River (2003), the U.S Army Corp of Engineer's (USACE) Matilija Dam Removal and Ecosystem Restoration Project on Matilija Creek (2007), USACE's Santa Paula Creek Flood Control Project (2013). However, the application of Section

7(a)(2) is limited in scope because it applies only to federal actions and areas under federal ownership, and without a related federal action it does not apply to the significant areas of public and private ownership in southern California (NMFS 2012a).

7.1.3 Clean Water Act and Porter-Cologne Water Quality Act

The CWA was established in 1972 to regulate the discharge of pollutants into the waters of the United States and create surface water quality standards. Section 401 of the CWA requires any party applying for a federal permit or license for a project that may result in the discharge of pollutants into the waters of the United States to obtain a state water quality certification. This certification affirms that the project adheres to all applicable water quality standards and other appropriate requirements of state law. Section 404 of the CWA prohibits the discharge of dredged or fill material into the waters of the United States without a permit from the USACE. Activities regulated under this program include fill for development, water resource projects, infrastructure development, and mining projects. Applicants for a 404 permit must demonstrate that all steps have been taken to avoid impacts to wetlands, streams, and aquatic resources and that compensation is provided for unavoidable impacts prior to permit issuance from the USACE.

Since 1969, the Porter-Cologne Water Quality Act (Porter-Cologne Act) has been the principal law governing water quality in California. The Porter-Cologne Act includes goals and objectives that align with those of the federal CWA, such as water quality standards and discharge regulations. The SWRCB and nine regional water quality control boards share responsibility for the implementation and enforcement of the Porter-Cologne Act. These entities are required to formulate and adopt water quality control plans that describe beneficial uses, water quality objectives, and a program of implementation that includes actions necessary to achieve objectives, a time schedule for the actions to be taken, and monitoring to determine compliance with water quality objectives and the protection of beneficial uses of water.

Under Section 401 of the CWA, a federal agency may not issue a permit or license to conduct any activity that may result in any discharge into waters of the United States unless a Section 401 water quality certification is issued or certification is waived. The SWRCB and the regional water quality control boards administer Section 401 water quality certifications in California.

In accordance with Section 303(d) of the CWA, the U.S. Environmental Protection Agency (EPA) assists the SWRCB and the regional water boards in listing impaired waters and developing TMDLs for waterbodies within the state. TMDLs establish the maximum concentration of pollutants allowed in a waterbody and serve as the starting point for restoring water quality. The primary purpose of the TMDL program is to assure that beneficial uses of water, such as cold freshwater and estuarine habitat, are protected from detrimental increases in sediment, water temperature, and other pollutants defined in Section 502 of the CWA. TMDLs are developed by either the regional water quality control boards or the EPA. TMDLs developed by the regional water quality control boards are included as water quality control plan amendments and include implementation provisions, while those developed by the EPA contain the total load and load allocations required by Section 303(d) but do not contain comprehensive implementation provisions. The EPA is required to review and approve the list of impaired waters and each TMDL. If the EPA cannot approve the list or a TMDL, it is required to develop its own. There can be multiple TMDLs on a particular waterbody, or there can be one TMDL that addresses numerous pollutants. TMDLs must consider and include allocations to both point and non-point sources of the listed pollutants.

Waters within the range of the Southern SH/RT are under the jurisdiction of the Central, Los Angeles, Santa Ana, and San Diego regional water quality control boards. There are many 303(d)-listed impaired waterbodies within the jurisdiction of each of these regional boards, and most waterbodies have more than one pollutant that exceeds water quality standards designed to protect beneficial uses of water, water quality criteria, or objectives. More information on 303(d) listed waters in southern California can be found at: https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2018_integrated_report.html

The National Pollution Discharge Elimination System (NPDES) delegated implementation responsibility for the regulation of wastewater discharges to the State of California through the SWRCB and the regional water quality control boards. In southern California, tertiary wastewater treatment plants commonly discharge treated water into the rivers, streams, and estuaries that support Southern SH/RT. For example, the Tapia Water Reclamation Facility discharges tertiary treated effluent into Malibu, Las Virgenes, and Arroyo Calabasas creeks. While wastewater effluent is often the primary source of streamflow for southern California rivers and streams during the summer months, the potential impacts of wastewater effluent on adult and juvenile life stages are not well understood (NMFS 2012a). The review, assessment, and potential modification of NPDES wastewater discharge permits is a key recovery action in the federal recovery plan for the Southern California DPS to address the threat of urban effluents (NMFS 2016).

7.1.4 Federal and California Wild and Scenic Rivers Act

In 1968, Congress enacted the National Wild and Scenic Rivers Act (WSRA) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing state. Under the National Wild and Scenic Rivers System, rivers are classified as either wild, scenic, or recreational. Designation neither prohibits development nor gives the government control over private property; recreation, agricultural practices, residential development, and other land uses may continue. However, the WSRA does prevent the federal government from licensing, funding, or otherwise assisting in dam construction or other projects on designated rivers or river segments. Designation does not impact existing water rights or the existing jurisdiction of states and the federal government over waters. In California, approximately 2,000 miles of river are designated as wild and scenic, which comprises about one percent of the state's total river miles. The California Wild and Scenic Rivers Act was passed by the California Legislature in 1972. The state act mandates that "certain rivers which possess extraordinary scenic, recreational, fishery, or wildlife values shall be preserved in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the state." (Pub. Res. Code, § 5093.50). Designated waterways are codified in Public Resources Code Sections 5093.50-5093.70.

The designated state and federal wild and scenic rivers within the range of Southern SH/RT are the Sisquoc River, Piru Creek, and Sespe Creek. The Sisquoc River, which is a tributary of the Santa Maria River, contains 33 miles of designated water from its origin in the Sierra Madre Mountains downstream to the Los Padres National Forest boundary. Piru and Sespe creeks are both tributaries of the Santa Clara River and encompass a combined 38 miles of designated waters. The downstream end of Pyramid Dam and the boundary between Los Angeles and Ventura counties constitute the start and end points of the designated reach for Piru Creek. The designated reach for Sespe Creek is the main stem from its confluence with Rock Creek and Howard Creek downstream, near its confluence with Tar Creek. Both Sespe Creek and the Sisquoc River have comprehensive river management plans that address resource protection, development of lands and facilities, user capacities, and other management practices necessary or desirable to achieve the purposes of the WSRA (USDA 2003a; USDA 2003b).

7.1.5 Lake and Stream Bed Alteration Agreements

Fish and Game Code Section 1602 requires entities to notify the Department prior to beginning any activity that may "divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake." The requirement applies to both intermittent and perennial waterbodies. If an activity will adversely affect an existing fish and wildlife resource, the Department's Lake and Streambed Alteration Program is responsible for issuing a Lake or Streambed Alteration (LSA) Agreement that includes reasonable measures necessary to protect the resource (Fish & G. Code, §1602, subd. (a)(4)(B)). There are several types of LSA agreements that entities can request from the Department, including standard; general cannabis; gravel, sand, or rock extraction; routine maintenance; timber harvest; and master.

Recently, severe storms during the winter of 2023 in southern California caused flooding, landslides, and mudslides within the watersheds that Southern SH/RT occupy. As a result, multiple emergency actions were conducted to protect life and property. In these circumstances, Fish and Game Code Section 1610 exempts entities that conduct certain emergency work from notification requirements prior to the start of any work activity and instead allows them to notify in writing within fourteen days after the work begins.

In the South Coast Region, legal cannabis cultivation is currently focused in Santa Barbara County, with a concentration of the larger notifications in the Santa Ynez River watershed. The Santa Ynez River and its tributaries are a high priority wildlife resource that supports *O. mykiss*, the Southern California Steelhead DPS listed as endangered under the federal ESA; southwestern willow flycatcher, which is listed as endangered under both the federal ESA and CESA; least Bell's vireo, which is listed as endangered under both the federal ESA and CESA; and California red-legged frog, which is listed as threatened under the federal ESA. There are currently about 453 acres of permitted cannabis in the Santa Ynez watershed. Project water use adjacent to the Santa Ynez River can have significant individual and/or cumulative impacts on Southern SH/RT and other species along this reach and adjacent up- and downstream areas. The predominant water source for these large grows along the Santa Ynez River and within the region are well diversions that can be located within or immediately adjacent to the stream. These diversions have the potential to substantially affect surface flows, hydrology, and vegetation within the Santa Ynez River. Where this situation occurs along the Santa Ynez River, Department staff have included appropriate measures to report on water use in any agreements that have been issued. Such measures include having an established protocol for monitoring and reporting water use throughout the season. Permittees must also abide by the SWRCB forbearance period for diversion of surface water during the dry season, from April 1 through October 1 of each calendar year.

7.1.6 Medicinal and Adult-Use Cannabis Regulation and Safety Act

Regulation of the commercial cannabis cultivation industry under the Medicinal and Adult-Use Cannabis Regulation and Safety Act requires that any entity applying for an annual cannabis cultivation license from the California Department of Food and Agriculture include "a copy of any final lake or streambed alteration agreement… or written verification from the California Department of Fish and Wildlife that a lake or streambed alteration agreement is not required" with their license application (Cal. Code Regs., tit. 3, § 8102, subd. (w)). Waste discharge and water diversions associated with cannabis cultivation are regulated by the SWRCB (Cal. Code Reg., tit. 3, § 8102, subd. (p)).

7.1.7 Federal Power Act

The Federal Energy Regulatory Commission (FERC) implements and enforces the Federal Power Act. FERC has the exclusive authority to license most non-federal hydropower projects that are located on navigable waterways, federal lands, or are connected to the interstate electric grid. The term for a hydropower license granted by FERC is typically 30-50 years. FERC must comply with federal environmental laws prior to issuing a new license or relicensing an existing hydropower project, including NEPA and ESA. Section 10(a) of the Federal Power Act instructs FERC to solicit recommendations from resource agencies and tribes (when applicable) on ways to make a project more consistent with federal or state comprehensive plans. Section 10(j) allows NMFS, USFWS, and the Department to submit recommendations to protect, mitigate damage to, and enhance fish and wildlife resources affected by a proposed project. FERC is not required to incorporate these recommendations into a hydropower license if it determines the recommendations are outside the scope of Section 10(j) or inconsistent with the Federal Power Act or any other applicable law.

Pursuant to Section 401 of the CWA, FERC may not issue a FERC license to a project unless a Section 401 water quality certification is issued to that project or that certification is waived. The SWRCB administers 401 water quality certifications for projects that involve a FERC license.

UWCD owns and operates Santa Felicia Dam, which is the main component of the Santa Felicia Project *(FERC Project Number 2153)*. The project is located on Piru Creek, a tributary of the Santa Clara River, in Ventura County. Santa Felicia Dam, which is located five miles north of the town of Piru, impounds Piru Creek to form Lake Piru Reservoir. Lake Piru has a usable storage capacity of 67,997 acre-feet, and the spillway of the Santa Felicia Dam has a capacity of 145,000 cfs. A small powerhouse located on the west embankment of the dam is capable of producing up to 1,420 kilowatts of energy. UWCD owns two appropriative water rights for the project for the purposes of power, domestic, industrial, municipal, irrigation, and recreational uses. The project currently operates under a 2014 water quality certification that contains provisions to protect fish and wildlife beneficial uses in lower Piru Creek, including a reservoir release schedule to protect Southern SH/RT migration flows each year from January 1 through May 31 (see https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/santafelicia_ferc2153.html for more information).

7.1.8 Sustainable Groundwater Management Act

In September 2014, the Governor signed legislation to strengthen the management and monitoring of groundwater basins. These laws, known collectively as the Sustainable Groundwater Management Act (SGMA), established a timeline and process for forming local

GSAs in designated groundwater basins. GSAs are responsible for developing and implementing GSPs to achieve basin sustainability within a 20-year implementation horizon. DWR is the agency responsible for reviewing and approving individual GSPs, while the SWRCB serves as the regulatory backstop for groundwater basins found to be out of compliance with SGMA. Since 2014, the Department's Groundwater Program has developed multiple documents to assist GSAs in developing and implementing effective GSPs, including a groundwater consideration planning document and a habitat-specific document for wetlands (CDFW 2019). These documents highlight scientific, management, legal, regulatory, and policy considerations that should be accounted for during GSP development. DWR is currently in the process of reviewing GSP plans for critically overdrafted and medium-to-high priority basins. Within the range of Southern SH/RT, there are over fifteen GSPs that are currently being reviewed by DWR. SGMA requires GSAs to submit annual reports to DWR each April 1 following the adoption of a GSP. Annual reports provide information on groundwater conditions and the implementation of the GSP for the prior water year (see https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Groundwater-Sustainability-Plans for more information).

7.1.9 State Water Resources Control Board Water Rights Administration

Water rights are a legal entitlement authorizing water to be diverted from a specified source and put to a beneficial, non-wasteful use. Riparian water rights are based on ownership of land bordering a waterway, while appropriative water rights are issued without regard to the relationship of land to water but rather the priority in which the water was first put to beneficial use. The exercise of most water rights (i.e., appropriative water rights) requires a permit or license from the SWRCB. The goal of the SWRCB in making water rights-related decisions is to develop water resources in an orderly manner, prevent waste and unreasonable use of water, and protect the environment. The SWRCB has several other major water rights -related duties, including but not limited to: participating in water rights adjudications; enhancing instream uses for fish and wildlife beneficial uses; approving temporary water transfers; investigating possible illegal, wasteful, or unreasonable uses of water; and revoking or terminating water rights. SWRCB-issued water right permits contain public trust provisions for the protection of instream aquatic resources. While these provisions (i.e., maximum diversion amounts and diversion seasons) are meant to protect aquatic resources, they do not have an explicit regulatory mechanism to implement protections required in other state statutes, such as Fish and Game Code 5937 (see Section 7.1.10 below). Furthermore, prior to recent advancements in groundwater management, the SWRCB generally lacked the authority to regulate groundwater diversions and development. Overlying landowners may extract percolating groundwater without approval from the SWRCB as long as the extracted water is put to beneficial uses and the region in which the groundwater diversion occurs has not been formally adjudicated.

7.1.10 Fish and Game Code Section 5937

Fish and Game Code Section 5937 states “the owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around, or through the dam, to keep in good condition any fish that may be planted or exist below the dam.”

7.2 Species Recovery Plans and Regional Management Plans

7.2.1 Southern California Steelhead Recovery Plan

The Southern California Steelhead Recovery Plan (Recovery Plan) was adopted in 2012 following the listing of the Southern California Steelhead DPS in 1997. The goal of the Recovery Plan is to prevent the extinction of the species in the wild; ensure the long-term persistence of viable, self-sustaining populations of steelhead distributed across the DPS; and establish a sustainable sport fishery (NMFS 2012a). Generally, recovery of the DPS, which consists of naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Santa Maria River to the U.S.-Mexico Border, entails the protection, restoration, and maintenance of a range of habitats in the DPS to allow all life-history forms of the species to be fully expressed (e.g., anadromous and resident). The Recovery Plan outlines key objectives that address factors limiting the species’ ability to survive and naturally reproduce, including preventing extinction by protecting populations and habitats, maintaining the current distribution of steelhead and restoring distribution to historically occupied areas, increasing abundance, conserving existing genetic diversity, and maintaining and restoring habitat conditions to support all life-history stages of the species. NMFS defines a viable population as a population that has a less than 5% risk of extinction due to threats from demographic variation, non-catastrophic environmental variation, and genetic diversity changes over a 100-year time frame (NMFS 2012a).

The Recovery Plan organizes the recovery plan area into five BPGs: Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim, and Santa Catalina Gulf Coast. The BPGs were initially divided based on whether individual watersheds within them are ocean-facing systems subject to marine-based climate inversion and orographic precipitation from ocean weather patterns. Secondarily, population groups were then organized based on similarity in physical geography and hydrology. The rationale for this approach is that steelhead populations utilizing unique individual watersheds have different life histories and genetic adaptations that enable the species to persist in a diversity of different habitat types represented by the BPGs. The Recovery Plan's strategy emphasizes larger watersheds in each BPG that are more capable of sustaining larger and more viable populations than smaller watersheds. Core 1 populations are identified as having the highest priority based on their intrinsic potential for meeting viable salmonid population criteria, the severity of the threats facing the populations, and the capacity of the watershed and population to respond to recovery actions (NMFS 2012a).

Like all federal recovery plans, the Recovery Plan for the Southern California Steelhead DPS contains recovery criteria, recovery actions, and estimates of the time and costs to achieve recovery goals. Recovery criteria are objective, measurable criteria that, when met, would result in a determination that the species be delisted. Recovery criteria for the Southern California Steelhead DPS Recovery are based on both DPS-level and population-level criteria. At the population level, criteria include characteristics such as mean annual run-size, spawner density, and anadromous fraction, while the DPS-level criteria are informed by the minimum number of populations that must be restored in each BPG. Recovery actions are site-specific management actions necessary to achieve species recovery. Actions for the Southern California DPS are organized based on the BPG and core population approaches. High-priority recovery actions include, but are not limited to, physically modifying passage barriers such as dams to allow natural rates of migration to upstream spawning and rearing habitats, enhancing protection of natural in-channel and riparian habitats, reducing water pollutants, and conducting research to better understand the relationship between resident and anadromous forms of the species (NMFS 2012a).

7.2.2. Forest Plans

Land Management, or Forest Plans, were developed by the United States Department of Agriculture for the southern California National Forests (the Angeles, Cleveland, Los Padres, and San Bernadino National Forests) in 2006 to provide a framework for guiding ongoing land and resource management operations. The southern California Forest Plans contain various protections for Southern SH/RT that occur within national forests. These include, but are not limited to, mitigating the effects of visitor use within watersheds occupied by steelhead, working collaboratively with federal and state agencies and water management entities to restore steelhead trout access to upstream habitat, reducing risks from wildland fires to maintain water quality, and eliminating and limiting the further spread of invasive nonnative species (USDA 2005). For example, in 2014, the Cleveland National Forest initiated an effort to restore Southern SH/RT migratory corridors in the San Juan and Santiago watersheds by removing numerous small, outdated, and non-functional dams constructed by Orange County (Donnell et al. 2017). Thus far, up to 81 small check dams on Silverado, Holy Jim, Trabuco, and San Juan creeks have been removed. Forest Plans are required to be updated every 10 to 15 years. In recent years, several amendments to the Southern California National Forest Plans have been adopted in response to monitoring and evaluation, new information, and changes in conditions.

7.2.3 Habitat Conservation Plans and Natural Community Conservation Plans

A Habitat Conservation Plan (HCPs) is a planning document that authorizes the incidental take of a federally listed species when it occurs due to an otherwise lawful activity. HCPs are designed to accommodate both economic development and the permanent protection and management of habitat for species covered under the plan. At minimum, HCPs must include an assessment of the impacts likely to result from the proposed taking of one or more federally listed species, the measures that the permit applicant will undertake to monitor, minimize, and mitigate such impacts, the funding available to implement such measures, procedures to deal with unforeseen or extraordinary circumstances, alternative actions to the taking that the applicant analyzed, and the reasons why the applicant did not adopt such alternatives (USFWS 2021).

The Natural Community Conservation Planning Act authorized the Department to develop Natural Community Conservation Plans (NCCPs). NCCPs identify and provide for the regional protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. The development of a NCCP by a local agency requires significant collaboration and coordination with landowners, environmental organizations, and state and federal agencies. Most approved HCP/NCCP documents are joint documents that fulfill the requirements of both Section 10 of the ESA and the Natural Community Conservation Planning Act.

Within the range of the Southern SH/RT, there are at least nine HCP or NCCPs that are either in the implementation phase or the planning phase. The majority of HCP and NCCP plans are for the southern portion of the species range and include multiple plan subareas. For example, the San Diego County Multiple Species Conservation Program contains six subareas, including the City of San Diego, Poway, Santee, La Mesa, Chula Vista, and South San Diego County. Generally, rivers, streams, and riparian vegetation communities in HCP and NCCP plan areas are considered ecologically important areas that are targeted for conservation. HCP/NCCP plans typically contain provisions to conserve fish and wildlife habitat, including fire management, invasive species control, fencing, trash removal, and annual monitoring.

7.2.4 Other Management and Restoration Plans

The Steelhead Restoration and Management Plan for California is a Department-statewide steelhead management plan that provides guidelines for steelhead restoration and management that can be incorporated into stream-specific project planning (McEwan and Jackson 1996).

https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=3490

7.3 Habitat Restoration and Watershed Management

7.3.1 Fisheries Restoration Grant Program

The goal of the Department's Fisheries Restoration Grant Program (FRGP) is to recover and conserve salmon and steelhead trout populations through restoration activities that reestablish natural ecosystem functions. The FRGP annually funds projects and activities that provide a demonstrable and measurable benefit to anadromous salmonids and their habitat; restoration projects that address factors limiting productivity as specified in approved, interim, or proposed recovery plans; effectiveness monitoring of habitat restoration projects at the watershed or regional scales for anadromous salmonids; and other projects such as outreach, coordination, research, monitoring, and assessment projects that support the goal of the program. Uniquely, the FRGP provides CWA Section 401 certification and CWA Section 404 coverage for all eligible projects funded through the program. In recent years, several FRGP proposals have been funded to support conservation efforts for Southern SH/RT, including the Upper Gaviota Fish Passage Project (2022), Life Cycle Monitoring on Topanga Creek and the Ventura River (2021), Fish Passage Barrier Removal on San Jose Creek, Gaviota Creek, and Maria Ygnacio Creek (2021), and the South Coast Steelhead Coalition (2021) (see https://wildlife.ca.gov/Grants/FRGP for more information.)

7.3.2 Wildlife Conservation Board, Proposition 68 and Proposition 1

The Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1) and the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018 (Proposition 68) authorized both the Wildlife Conservation Board and the Department to award significant grant funding to restoration projects that are intended to benefit Southern SH/RT. Both entities distribute Proposition 68 and Proposition 1 funds on a competitive basis to projects that specifically address river and stream restoration (Proposition 68; Proposition 1), Southern SH/RT habitat restoration (Proposition 68), fish and wildlife habitat restoration (Proposition 68; Proposition 1), or stream flow enhancements (Proposition 1). Proposition 68 funded projects that benefit Southern SH/RT and their habitat include the Harvey Diversion Fish Passage Restoration Project on Santa Paula Creek, the Matilija Dam Ecosystem Restoration Project on Matilija Creek, and the Santa Margarita River Fish Passage Project and Bridge Replacement. Proposition 1 funded projects include, but are not limited to, *Arundo donax* removal at the Sespe Cienega on the Santa Clara River, the Santa Clara River Riparian

Improvement, and the Integrated Water Strategies Project for Flow Enhancement in the Ventura River Watershed (WCB 2021).

7.3.3 Other Habitat Restoration Funding Sources

In addition to funding provided by the Department, Wildlife Conservation Board and FRGP, Southern SH/RT conservation projects are also supported by numerous other funding sources. These sources include local, state, and federal sources such as the California Coastal Conservancy, Pacific Coastal Salmon Recovery Fund, the National Fish and Wildlife Foundation, the NOAA Restoration Center, the California Department of Water Resources Integrated Regional Water Management Plan grant program (Proposition 50), the California Natural Resources Agencies Parkways Program (Proposition 40), the CalTrans Environmental Enhancement and Mitigation Program, the Santa Barbara County Coastal Resource Enhancement Fund, and the San Diego Association of County Government TransNet Environmental Mitigation Program (NMFS 2016).

7.3.4 California Steelhead Report and Restoration Card

The California Steelhead Report and Restoration Card program has funded various types of conservation projects since 1993, including instream habitat improvement, species monitoring, outreach and education, and watershed assessment and planning. However, no restoration projects within the Southern SH/RT range were funded between 2015 and 2019, as most funds were granted to projects in more northern watersheds (CDFW 2021c).

7.3.5 Non-Governmental Organization (NGOs) Efforts

Several NGOs contribute funding and staff time to implement restoration projects for the benefit of Southern SH/RT, often with the support of federal, state, or local grants. For example, the South Coast Steelhead Coalition under the guidance of California Trout, has received grant funding from the Department’s FRGP to implement several restoration projects that benefit Southern SH/RT, including the Harvey Diversion Fish Passage Project on Santa Paula Creek; the Interstate 5 Trabuco Fish Passage Project on San Juan Creek in Orange County, the Santa Margarita River Fish Passage Project on Sandia Creek in San Diego County; the Rose Valley Restoration Project on Sespe Creek; invasive vegetation removal in the Santa Clara River floodplain; and *O. mykiss* protection in the upper Santa Margarita River, West Fork San Luis Rey River, and upper tributaries to the Santa Clara and Ventura rivers (NMFS 2016). Other NGOs that promote funding and implementation of steelhead recovery actions include the Santa Clara River Steelhead Coalition under the direction of California Trout, the Tri-Counties Fish Team, the Environmental Defense Center, the San Gabriel and Lower Los Angeles Rivers Mountain Conservancy, the West Fork San Gabriel River Conservancy, and the Council for

Watershed Health (San Gabriel and Los Angeles rivers). Additionally, there are many other groups or agencies that are also involved in Southern SH/RT conservation efforts: Concerned Resource and Environmental Workers; Heal the Ocean; Santa Barbara ChannelKeeper; Matilija Coalition; Ojai Valley Land Conservancy; Friends of the Ventura River; Friends of the Santa Clara River; Friends of the Los Angeles River; Friends of the Santa Monica Mountains; Heal the Bay; Friends of the Santa Margarita River; San Dieguito River Valley Conservancy; and the Endangered Habitat League (NMFS 2016).

7.3.6 Other Regional and Local Public Institution Efforts

The Southern California Wetlands Recovery Project (SCWRP) consists of directors and staff from 18 public agencies, which collectively coordinate to protect, restore, and enhance coastal wetlands and watersheds between Point Conception and the Mexican Border. The SCWRP, which was founded in 1997, is chaired by the California Natural Resources Agency with support from the California State Coastal Conservancy. The mission of the SCWRP is to expand, restore, and protect wetlands in southern California. The SCWRP is guided by long-term goals, specific implementation strategies, and quantitative objectives articulated in its 2018 regional strategy report (SCWRP 2018).

The Southern California Coastal Water Research Project (SCCWRP) is a public research and development agency whose mission is to enhance the scientific foundation for management of southern California's ocean and coastal watersheds. Since its creation in 1969, the focus of the SCCWRP has been to develop strategies, tools, and technologies to improve water quality management for the betterment of the ecological health of the region's coastal ocean and watersheds. SCCWRP research projects are guided by comprehensive annual plans for major research areas, including ecohydrology, climate change, eutrophication, microbial water quality, and stormwater best management practices (SCCWRP 2022). Currently, the SCCWRP, in cooperation with other local and state agencies, is leading the Los Angeles River Environmental Flows Project. The project's goals are to quantify the relationship between flow and aquatic life, account for flow reduction allowances to the river from multiple wastewater reclamation plants during the summer months and develop flow criteria for the Los Angeles River using the California Environmental Flows Framework.

The City of Santa Barbara supports a Creeks Restoration and Water Quality Improvement Division (Creeks Division), whose mission is to improve creek and ocean water quality and restore natural creek systems through storm water and urban runoff pollution reduction, creek restoration, and community education programs. The Creeks Division's goal for restoration includes increasing riparian vegetation and wildlife habitat, removing invasive plants, and improving water quality through shading, bank stabilization, and erosion control. The Division has completed several restoration projects in Santa Barbara County, including the Mission Creek Fish Passage project, the Arroyo Burro Estuary and Mesa Creek restoration project, and the upper Las Positas Creek restoration project. The Creeks Division also conducts removal efforts of invasive giant reed from the Arroyo Burro, Mission, and Sycamore Creek watersheds and participates in water quality improvement projects, creek and beach cleanups, and education outreach efforts throughout Santa Barbara County.

The California Conservation Corps Fisheries Program gives U.S. military veterans opportunities to develop skills and work experience by restoring habitat for endangered salmon and steelhead and conducting fisheries research and monitoring. The program, which is a partnership between the California Conservation Corps, NMFS, and the Department, trains participants on a variety of fisheries monitoring techniques, including riparian restoration, dual-frequency identification sonar (DIDSON) techniques, adult and juvenile fish identification, downstream migrant trapping, and instream flow and habitat surveys.

7.4 Commercial and Recreational Fishing

California freshwater sport fishing regulations prohibits fishing in virtually all anadromous coastal rivers and streams in southern California that are accessible to adult steelhead. However, recreational angling for *O. mykiss* above impassable barriers is permitted in many coastal rivers and streams (CDFW 2023a). The Department has expanded its use of sterile "triploid" fish to prevent interbreeding of hatchery fish with native Southern SH/RT (NMFS 2016). The freshwater exploitation rates of Southern SH/RT are likely very low given the Department's prohibition of angling within the geographic range of the Southern California Steelhead DPS listed under the federal ESA (NMFS 2016). Additionally, sport and commercial harvest of Southern SH/RT greater than 16 inches in length in the Department's Southern Recreational Fishing Management Zone is prohibited (CDFW 2023b). All incidentally captured steelhead in the ocean must be released unharmed and should not be removed from the water.

7.5 Research and Monitoring Programs

7.5.1 California Coastal Monitoring Program

The purpose of the CMP is to gather statistically sound and biologically meaningful data on the status of California's coastal salmonid populations to inform salmon and steelhead recovery, conservation, and management activities. The CMP framework is based on four viable salmonid population metrics: abundance, productivity, spatial structure, and diversity (Adams et al. 2011; McElhany et al. 2000). Boughton et al. (2022b) updated the CMP approach for the southern coastal region to address the scientific uncertainty on Southern SH/RT ecology due to lower abundances and a more arid climate compared to more northern populations, for which the original CMP framework was designed.

Currently, the Department leads monitoring efforts in the southern coastal region, with most efforts focused on obtaining abundance estimates for anadromous adults in Core 1 and Core 2 populations (NMFS 2016). As of March 2023, Department CMP staff operate fixed-point counting stations and conduct summer-low flow juvenile surveys, redd surveys, and PIT tagging arrays on the Ventura River, Topanga Creek, and Carpinteria Creek, including the various tributaries to these watersheds. Fixed-point counting stations for anadromous adults are also operated on the Santa Ynez River and its primary tributary, Salsipuedes Creek. Redd surveys and juvenile low-flow surveys also occur in coastal watersheds of the Santa Monica Mountains, such as Big Sycamore Creek, Malibu Creek, Arroyo Sequit Creek, and Solstice Creek. Additionally, the Department conducts spawning surveys in the many watersheds of the Conception Coast, including Jalama, Gaviota, Glenn Annie, San Pedro, Maria Ygnacio, and Mission creeks. Department CMP staff anticipate expanding the number of southern coastal watersheds monitored as landowner agreements and available funding increase (K. Evans, CDFW, personal communication).

7.5.2 Other Monitoring Programs

Several special districts or local governments monitor Southern SH/RT on an annual basis in watersheds that contain federally owned or operated infrastructure. Such monitoring is often required for compliance with monitoring and reporting measures set forth in federal ESA Section 7 Biological Opinions. Although the level of monitoring effort and protocol methods vary between monitoring programs, the data produced by these special districts or local governments are often the longest time-series data available for Southern SH/RT.

COMB has conducted monitoring within the Lower Santa Ynez River and its tributaries since 1994 as part of the assessment and compliance measures required in the Cachuma Project Biological Opinion. Redd and adult spawner surveys typically occur throughout the winter months, while juvenile snorkel surveys are conducted in the spring, summer, and fall months. Estuary monitoring is also periodically conducted to complement upstream trapping during the migration seasons.

Since 2005, the CMWD has monitored fish migration at the Robles Fish Passage facility (14 miles upstream from the ocean) on the Ventura River using a VAKI Riverwatcher remote fish monitoring system. CMWD also conducts reach-specific spawner and redd surveys and snorkel surveys at index sites throughout the Ventura River watershed from the winter through late spring (Dagit et al. 2020).

UWCD monitors both upstream and downstream migration at the Vern Freeman Diversion Dam (approximately 10 miles upstream from the ocean) using both video-based and motion detection surveillance systems. Monitoring occurs from January to June when streamflow in the Santa Clara River is high enough to maintain water levels at the passage facility (Booth 2016).

The RCDSMM has monitored Arroyo Sequit, Malibu, and Topanga creeks since the early 2000s. Monitoring typically occurs from January through May and includes snorkel surveys, spawning and rearing surveys, instream habitat surveys, and periodic lagoon surveys (Dagit et al. 2019). Since 2016, the South Coast Steelhead Coalition, under the direction of California Trout, has conducted post-rain reconnaissance surveys in San Juan Creek, San Mateo Creek, the Santa Margarita River, and the San Luis Rey River (Dagit et al. 2020).

8. SUMMARY OF LISTING FACTORS

The Commission's CESA implementing regulations identify key factors relevant to the Department's analyses and the Commission's decision on whether to list a species as endangered or threatened. A species will be listed as endangered or threatened if the Commission determines that the species' continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities (Cal. Code Regs., tit. 14, § 670.1, subd. (i)). This section provides summaries of information from the preceding sections of this Status Review, arranged under each of the factors to be considered by the Commission in determining whether listing is warranted.

8.1 Present or Threatened Modification or Destruction of Habitat

The decline of Southern SH/RT can be attributed to a wide variety of human activities, including, but not limited to, urbanization, agriculture, and water development. These activities have degraded range-wide aquatic habitat conditions, particularly in the lower and middle reaches of individual watersheds (See Section 6.8). Southern California is home to over 20 million people and 1.8 million acres of urban area (DWR 2021). As a result, the majority of watersheds, currently occupied by Southern SH/RT, are highly urbanized and impacted by surface and groundwater diversions and associated agricultural, residential, and industrial uses.

Although some deleterious activities have been eliminated or mitigated, habitat conditions for Southern SH/RT have continued to deteriorate over time due to numerous stressors associated with human population growth and climate change impacts. Water diversions, storage, and conveyance for agriculture, flood control, and domestic uses have significantly reduced much of the species' historical spawning and rearing habitat. Changes to the natural flow regime of southern California rivers and streams have resulted in lower and less variable stream flows, increased water temperatures, shifts in aquatic community composition, and reduced recruitment of gravel and sediments. High road densities and the presence of many in-stream artificial barriers have reduced habitat connectivity by impeding and restricting volitional fish passage in many watersheds, especially in the lower reaches. Development activities associated with agriculture, urbanization, flood control, and recreation have also substantially altered Southern SH/RT habitat quantity and quality by increasing ambient water temperatures, increasing nutrient and pollutant loading, degrading water quality, eliminating riparian habitat, and creating favorable conditions for non-native species. Range-wide and coastal estuarine habitat conditions are highly degraded and are at risk of loss and further degradation. Legal cannabis cultivation is a relatively new yet potentially serious threat to Southern SH/RT watersheds if best management practices, instream flow requirements, and diversion season regulations are not complied with. Our review of habitat conditions in southern California supports the conclusions of other review efforts, which conclude that populations continue to be at risk of extinction unless significant restoration and recovery measures are implemented (Moyle et al. 2017; NMFS 2012a).

The Department considers present or threatened modification or destruction of habitat to be a significant threat to the continued existence of Southern SH/RT.

8.2 Overexploitation

Exploitation rates of Southern SH/RT are relatively low across its range (See Section 6.9). While angling-related mortality may have historically contributed to the decline of some small populations, it is generally not considered a leading cause of the decline of the Southern California Steelhead DPS as a whole (Good et al. 2005; Busby et al. 1996; NMFS 1996b). After southern California steelhead was first listed as endangered under the federal ESA as an ESU in 1997, the Commission closed recreational fisheries for Southern SH/RT in California marine and anadromous waters with few exceptions. The closure continues, and there is currently no recreational fishery for Southern SH/RT (CDFW 2023a; CDFW 2023b).

Marine commercial driftnet fisheries in the past may have contributed slightly to localized declines; however, Southern SH/RT are not targeted in commercial fisheries and reports of incidental catch are rare. Commercial fisheries are not believed to be a leading cause of the widespread declines over the past several decades (NMFS 2012a).

Illegal harvest is likely the leading source of exploitation. Southern SH/RT are especially vulnerable to poaching due to their visibility in shallow streams. Estimates of fishing effort from self-report cards for 1993-2014 suggest extremely low levels of angling effort for Southern SH/RT (NMFS 2016; Jackson 2007). Though illegal harvest rates appear to be very low, because of low adult abundance, the removal of even a few individuals in some years could be a threat to the population (Moyle et al. 2017).

The Department does not consider overexploitation to be a substantial threat to the continued existence of Southern SH/RT, but further directed study is warranted to confirm this threat level.

8.3 Predation

Southern SH/RT experience predation in both the freshwater and marine environments, but specific predation rates, particularly in marine environments, are not well understood (See Section 6.5). While Southern SH/RT have evolved to cope with a variety of natural predators, a suite of non-native predators has also become established within its watersheds (Busby et al. 1996; NMFS 2016; Stillwater Sciences 2019; Dagit et al. 2019; COMB 2022). Established populations of non-native fishes, amphibians, and aquatic invertebrates combined with anthropogenic habitat alterations that provide favorable conditions for the persistence of these non-native species have led to increased predation rates in much of its range (NMFS 1996b). Habitat modification and degradation has also likely increased predation rates from terrestrial and avian predators (Grossman 2016; Osterback et al. 2013).

The Department considers predation to be a moderate threat to the continued existence of Southern SH/RT based on the available data. Further directed study is warranted to confirm the level of impact of these predation threats on Southern SH/RT.

8.4 Competition

Southern SH/RT populations are subject to competitive forces across their range (See Section 6.6). The extent to which competition impacts the distribution, abundance, and productivity of Southern SH/RT populations is not well understood. Southern SH/RT are the only species of salmonid that occur in their range. Therefore, the potential for inter-specific competition with other salmonids is unlikely to occur. Interspecific competition with other non-salmonid fishes occurs to varying degrees across the Southern SH/RT range. In addition to competing with juvenile steelhead for food resources, juvenile non-native fish species can limit the distribution and abundance of juvenile steelhead. Non-native fish species can competitively exclude and confine the spatial distribution of juvenile steelhead to habitats such as shallower, higher velocity riffles, where the energetic cost to forage is higher (Rosenfeld and Boss 2001).

The Department considers competition with nonnative fish species to be a moderate threat to the continued existence of Southern SH/RT. Further directed study is warranted to confirm the level of impact from competition.

8.5 Disease

Southern SH/RT survival is impacted by a variety of factors including infectious disease (See Section 6.3). A myriad of diseases caused by bacterial, protozoan, viral, and parasitic organisms can infect *O. mykiss* in both the juvenile and adult life stages (NMFS 2012a). Degraded water quality and chemistry in much of the Southern SH/RT range is likely to increase infection rates and severity (Belchik et al. 2004; Stocking and Bartholomew 2004; Crozier et al. 2008). There is very little current information available to quantify present infection and mortality rates in Southern SH/RT.

The Department does not consider disease to currently be a significant threat to the continued existence of Southern SH/RT, however further directed study is warranted to confirm the level of current and potential future impact.

8.6 Other Natural Occurrences or Human-related Activities

Southern SH/RT populations have evolved notably plastic and opportunistic survival strategies and are uniquely adapted to wide-ranging natural environmental variability, characterized by challenging and dynamic habitat conditions (Moyle et al. 2017). However, combined anthropogenic and climate change-driven impacts may ultimately outpace Southern SH/RT's capacity to adapt and persist, potentially leading to extirpation within the next 25–50-year time frame (Moyle et al. 2017; See Section 6.2). This prediction is underscored by the fact that Southern SH/RT already encounters water temperatures that approach and may, at times, exceed the upper limit of salmonid thermal tolerances, across portions of its current distribution (Moyle et al. 2017). Southern SH/RT has, therefore, been characterized as having potential for severe climate change impacts (Moyle et al. 2017). With increasing exposure to periods of higher water temperatures and flow variability, along with extended droughts, more frequent and intense wildfires, catastrophic flooding and associated sediment movement, sea level rise, and ever-increasing human demands for natural resources, the combined impacts to Southern SH/RT will be interdependent, synergistic, and are expected to intensify without intensive and timely human intervention (NMFS 2012b; Hall et al. 2018; OEHHA 2022).

Human-related activities are considered by the Department to be significant threats to the continued existence of Southern SH/RT.

9. SUMMARY OF KEY FINDINGS

Southern California steelhead (*Oncorhynchus mykiss*) inhabit coastal streams from the Santa Maria River system south to the U.S.-Mexico border. Non-anadromous resident *O. mykiss*, familiar to most as Rainbow Trout, reside in many of these same streams and interbreed with anadromous adults, contributing to the overall abundance and resilience of the species. Southern California steelhead as defined in the Petition include both anadromous (ocean-going) and resident (stream-dwelling) forms of *O. mykiss* below complete migration barriers in these streams.

Less than half of the watersheds historically occupied by Southern SH/RT remain occupied, most commonly with individuals able to express only a freshwater-resident life-history strategy (NMFS et al. 2012). Adult steelhead runs have declined to precariously low levels, particularly over the past five to seven years, with declines in adult returns of 90% or more on major watersheds that historically supported the largest anadromous populations (e.g., the Santa Maria, Santa Ynez, Ventura, and Santa Clara rivers). Additionally, our analysis of resident populations indicates a sharp decline over this same time period.

While recent genetic findings suggest that the anadromous life-history form can be sustained and reconstituted from resident individuals residing in orographic drought refugia, in southern California, nearly all drought refugia habitats are currently above impassable barriers. Therefore, the anadromous phenotype is at an increasingly high risk of being entirely lost from the species within its southern California range, in large part due to the lack of migration corridors between drought refugia and the ocean, and the inability of resident progeny to successfully migrate downstream in years with sufficient rainfall and streamflow.

Southern SH/RT continues to be most at risk from habitat degradation, fragmentation, and destruction resulting from human-related activities. Specifically, dams, surface water diversions, and groundwater extraction activities restrict access to most historical spawning and rearing habitats and alter the natural flow regime of rivers and streams that sustain ecological, geomorphic, and biogeochemical functions and support the specific life history and habitat needs of Southern SH/RT. Agricultural and urban development negatively affect nearby rivers and streams through increased pollution and surface runoff, which degrade water quality and habitat conditions. Furthermore, the rapid rate of climate change and the increasing presence of non-native species present another challenge to the persistence of Southern SH/RT.

Based on the best scientific information available at the time of the preparation of this review, the Department concludes that the Southern SH/RT is in danger of extinction throughout all of its range. Intensive and timely human intervention, such as ecological restoration, dam removal, fish passage improvement projects, invasive species removal, and groundwater management, are required to prevent the further decline of the species. The extinction of Southern SH/RT would represent an insurmountable loss to the *O. mykiss* diversity component in California due to their unique adaptations, life histories, and genetics, which have allowed them to persist at the extreme southern end of the species' West Coast range.

10. RECOMMENDATION FOR THE COMMISSION

CESA requires the Department to prepare this report regarding the status of Southern SH/RT in California based upon the best scientific information available to the Department (Fish & G. Code, § 2074.6). CESA also requires the Department to indicate in this Status Review whether the petitioned action (i.e., listing as endangered) is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

Under CESA, an endangered species is defined as "a native species or subspecies…which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species is defined as "a native species or subspecies…that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067).

Based on the criteria described above, the best scientific information available to the Department indicates that Southern SH/RT is in serious danger of becoming extinct in all or a significant portion of its range due to one or more causes including: 1. present or threatened modification or destruction of habitat; and 2. other natural occurrences or human-related activities. The Department recommends that the Commission find the petitioned action to list Southern SH/RT as an endangered species to be warranted.

11. PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore, and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051, subd. (c)). If listed, unauthorized take of Southern SH/RT would be prohibited under state law. CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). Any person violating the take prohibition would be punishable under state law. The Fish and Game Code provides the Department with related authority to authorize "take" of species listed as threatened or endangered under certain circumstances (see, e.g., Fish & G. Code, §§ 2081, 2081.1, 2086, & 2835). If Southern SH/RT is listed under CESA, take resulting from activities authorized through incidental take permits must be minimized and fully mitigated according to state standards (Fish & G. Code, § 2081, subd. (b)). Take of Southern SH/RT for scientific, educational, or management purposes could be authorized through permits or memorandums of understanding pursuant to Fish and Game Code Section 2081(a).

Additional protection of Southern SH/RT following listing would also occur during required state and local agency environmental review under CEQA. CEQA requires affected public agencies to analyze and disclose project-related environmental effects, including potentially significant impacts on endangered, threatened, and rare special status species. Under CEQA's "substantive mandate," state and local agencies in California must avoid or substantially lessen significant environmental effects to the extent feasible. With that mandate, and the Department's regulatory jurisdiction generally, the Department expects related CEQA review will likely result in increased information regarding the status of Southern SH/RT in California as a result of pre-project biological surveys. Where significant impacts are identified under CEQA, the Department expects project-specific required avoidance, minimization, and mitigation measures will also benefit the species. While CEQA may require analysis of potential impacts to Southern SH/RT regardless of its listing status under CESA, the act contains specific requirements for analyzing and mitigating impacts to listed species. In common practice, potential impacts to listed species are scrutinized more in CEQA documents than are potential impacts to unlisted species. State listing, in this respect, and required consultation with the Department during state and local agency environmental review under CEQA, is expected to benefit the species by reducing impacts from individual projects to a greater degree than may occur absent listing.

CESA listing may prompt increased interagency coordination specific to Southern SH/RT conservation and protection. Listing may also increase the likelihood that state and federal land and resource management agencies will allocate additional funds toward protection and recovery actions.

12. MANAGEMENT RECOMMENDATIONS AND RECOVERY MEASURES

CESA directs the Department to include in its Status Review recommended management activities and other recommendations for recovery of Southern SH/RT (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f).). Department staff generated the following list of recommended management actions and recovery measures.

1. Implement comprehensive monitoring in all streams with extant Southern SH/RT populations and produce statistically robust population estimates. Fully implement the CMP and integrate the updated south coastal region monitoring strategy (Boughton et al. 2022b) to resolve the various ecological and methodological factors that currently impede monitoring. The main features of this updated strategy are:

- Estimates of average density for each BPG;
- Research on the location and extent of drought refugia in each BPG;

- Adult steelhead abundance estimates in selected populations that are robust enough to evaluate species' resilience to catastrophic events and the ability to adapt over time to long-term environmental changes;
- Adult *O. mykiss* abundance estimates that are sufficient to develop an estimate for total abundance in the region;
- Routine genetic monitoring to track the *Omy 5* A haplotype and AA genotype as indicators for viability; and
- Greater emphasis on monitoring methods that are unbiased or can be corrected for bias (NMFS 2016).

2. Support and participate in the development of watershed-specific plans to effectively maintain and restore Southern SH/RT habitat by focusing on the combination of factors currently limiting their distribution and abundance, such as dams, agriculture, and water extraction. This includes continuing to coordinate and collaborate with NMFS, NGOs, state and local governments, landowners, and other interested entities to implement recovery actions identified in the 2012 Recovery Plan for the southern California Steelhead DPS and other management and conservation strategies. High priority actions include (NMFS 2012a):

- Remove manmade passage barriers in all population watersheds and re-establish access to upper watersheds in both small coastal streams and the larger interior rivers within each BPG identified in the Recovery Plan;
- Complete planning and removal of Matilija Dam on Matilija Creek and Rindge Dam on Malibu Creek;
- Provide ecologically meaningful flows below major dams and diversions in all population watersheds by re-establishing adequate flow regimes in both small coastal streams and large interior rivers;
- Reevaluate the efficacy of existing fish passage structures at instream surface water diversions, dams, culverts, weirs, canals, and other infrastructure in all watersheds historically and currently occupied by Southern SH/RT; and
- Minimize the adverse effects of exotic and non-native plant and animal species on aquatic ecosystems occupied by Southern SH/RT through direct removal and control efforts.

3. Improve and expand suitable and preferred habitat used by Southern SH/RT for summer holding, spawning, and juvenile rearing. Prioritize habitat restoration, protection, and enhancement in Southern SH/RT holding, spawning, and rearing areas. Habitat projects should focus on improving habitat complexity, riparian cover, fish passage, and sediment transport, as well as enhancing essential deep, cold-water habitats for holding adults. Restoration should also be considered in potential habitats not currently occupied by Southern SH/RT.

4. Continue research on *Omy5* haplotypes and other relevant genomic regions to better understand: the mechanism for anadromy in Southern SH/RT, the impact of migration barriers on the frequency of the "A" haplotype in individuals, and the risk of progressively losing the genetic basis for anadromy over time in above-barrier populations despite the current presence of the "A" haplotype.

5. Continue to investigate the population structure and ancestry of Southern SH/RT at the extreme southern end of the species distribution in southern California, including further research on identifying genetically introgressed populations and the potential benefit of these populations for maintaining the persistence of viable networks of Southern SH/RT, given recent findings of limited native ancestry in the region and the importance of variation in adaptation.

6. Initiate research into Southern SH/RT ecology identified in the Southern California Steelhead Recovery Plan (NMFS 2012a). Important research topics include:

- Environmental factors that influence anadromy;
- The relationship between migration corridor reliability and anadromous fraction;
- Identification of nursery habitat types that promote juvenile growth and survival;
- The role of seasonal lagoons and estuaries in the life history of Southern SH/RT and the extent to which these areas are used by juveniles prior to emigration;
- Investigation on the role that mainstem habitats play in the life history of steelhead, including identification of the ecological factors that contribute to mainstem habitat quality;
- The role of naturally intermittent creeks and stream reaches;
- Determining whether spawner density is a reliable indicator of a viable population;
- Determining the frequency of return adult spawners;
- Recolonization rates of extirpated watersheds by source populations;
- Dispersal rates between watersheds, including interactions among and between populations through straying;
- Intra-and interannual variation in diet composition and growth rate; and
- Partial migration and life-history crossovers.

7. Formalize minimization and avoidance measures on a Department-wide basis to minimize incidental take of the CESA-listed species due to otherwise lawful activities resulting from construction, research, management, and enhancement activities. This includes working with federal agencies to coordinate and develop efficient permitting processes for incidental take authorization for actions that contribute to the recovery of Southern SH/RT.

8. Explore other means of conserving individual populations of *O. mykiss* that may face the risk of extirpation due to catastrophic events, such as wildfires, droughts, and oil spills (e.g.,

conservation translocations to other existing facilities at academic institutions or museums, or natural refugia habitats). This includes ensuring that translocations of Southern SH/RT conducted by the Department for conservation purposes significantly contribute to species and ecosystem conservation and are planned, executed, and supported in a manner consistent with best scientific practices and the Department's Policy and Procedures for Conservation Translocations of Animals and Plants (CDFW 2017).

9. Strengthen law enforcement in areas occupied by Southern SH/RT to reduce threats of poaching, illegal water diversions, and instream work used for cannabis cultivation.

10. Evaluate current fishing regulations to determine any potential changes that could be implemented for further protection of Southern SH/RT, and update regulations, using clear and transparent communication, in response to restoration actions, such as dam removal projects, that could change the sport fishing regulation boundary (e.g., inland anadromous waters).

11. Conduct a robust outreach and education program that works to engage with tribes and interested parties, including federal, state, local, NGOs, landowners, underserved communities, and interested individuals, to promote and implement conservation actions. This includes developing outreach and educational materials to increase public awareness and knowledge of the ecological and societal benefits that can be gained by recovering Southern SH/RT.

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Personal Communication

Kyle Evans, CDFW, personal communication, 03/08/2023

John O'Brien, CDFW, personal communication, 12/05/2022

Dane St. George, CDFW, personal communication, 05/24/2023

APPENDIX A: ANNUAL *O. MYKISS* OBSERVATIONS AND DATA SOURCES FOR THREE EXTANT POPULATIONS IN THE CONCEPTION COAST BPG.

Year	Arroyo Sequit Creek[a]	Topanga Creek[b]	Malibu Creek[b]
2001	0	2	NA
2002	0	95	NA
2003	0	59	NA
2004	0	103	230
2005	0	71	87
2006	0	170	80
2007	0	86	12
2008	0	316	2,245
2009	0	209	130
2010	0	253	160
2011	0	114	281
2012	0	96	156
2013	0	56	99
2014	0	57	31
2015	0	59	32
2016	0	34	7
2017	0	98	6
2018	0	55	1
2019	NA	160	0
Total	0	2,093	3240

"NA" indicates no survey conducted or data not yet available.

[a] Source: Dagit et al. (2019)

[b] Source: Dagit et al. (2019). Sum of the average number of *O. mykiss* observed per month.

APPENDIX B: ANNUAL ADULT STEELHEAD OBSERVATIONS AND DATA SOURCES FOR THREE EXTANT POPULATIONS IN THE CONCEPTION COAST BPG.

Year	Arroyo Sequit Creek[a]	Topanga Creek[b]	Malibu Creek[c]
2001	0	2	NA
2002	0	0	NA
2003	0	0	NA
2004	0	0	0
2005	0[d]	0	0
2006	0[d]	1	1
2007	0[d]	2	2
2008	0[d]	2	4
2009	0[d]	1	1
2010	0[d]	1	2
2011	0[d]	0	2
2012	0[d]	1	3
2013	0[d]	0	3
2014	0[d]	0	5
2015	0[d]	0	1
2016	0[d]	0	0
2017	2	2	1
2018	0	0	0
2019	NA	0	0
Total	2	12	25

"NA" indicates no survey conducted or data not yet available.

[a] Source: Dagit et al. 2020

[b] Source: Dagit et al. (2019; 2020)

[c] Source: Dagit et al. (2019;2020)

[d] Passage barriers prevented access to Arroyo Sequit from 2005-2016. Two adult observations occurred after the removal of barriers (Dagit et al. 2019).

APPENDIX C: ANNUAL *O. MYKISS* OBSERVATIONS AND DATA SOURCES FOR FOUR EXTANT POPULATIONS IN THE MONTE ARIDO HIGHLANDS BPG.

Year	Santa Maria River[a]	Santa Ynez River[b]	Ventura River[c]	Santa Clara River[d]	
1994	NA	NA	NA	87	e
1995	NA	NA	NA	115	e
1996	NA	NA	NA	96	e
1997	NA	NA	NA	422	e
1998	NA	NA	NA	6	e
1999	NA	NA	NA	5	e
2000	NA	NA	NA	876	e
2001	NA	266	NA	124	e
2002	NA	116	NA	3	e
2003	NA	196	NA	41	
2004	NA	238	NA	3	
2005	NA	117	0	NA	
2006	NA	653	17	21	
2007	NA	665	63	74	
2008	NA	561	47	157	
2009	NA	610	807	170	
2010	NA	367	147	100	
2011	NA	484	640	23	
2012	NA	199	378	96	
2013	NA	NA	17	1	
2014	NA	137	14	19	
2015	NA	134	65	NA	
2016	NA	103	14	NA	
2017	NA	5	9	NA	
2018	NA	27	1	NA	
2019	NA	39	0	NA	
2020	NA	147	0	NA	
2021	NA	205	0	NA	

"NA" indicates no survey conducted or data not yet available.

[a] Source: Santa Maria River does not appear to be monitored for any viability metrics (NMFS 2016)

[b] Source: COMB (2022)

[c] Source: CMWD (2005-2021). Data are derived from snorkel counts and bankside observations from index reaches of the Ventura River near the Robles Diversion.

[d] Source: Booth (2016)

[e] Inconsistent monitoring from 1994-2002 (Booth 2016)

APPENDIX D: ANNUAL ADULT STEELHEAD OBSERVATIONS AND DATA SOURCES FOR FOUR EXTANT POPULATIONS IN THE MONTE ARIDO HIGHLANDS BPG.

Year	Santa Maria River[a]	Santa Ynez River[b]	Ventura River[c]	Santa Clara River[d]
1994	NA	NA	NA	1[e]
1995	NA	0	NA	1[e]
1996	NA	0	NA	2[e]
1997	NA	2	NA	0[e]
1998	NA	1	NA	0[e]
1999	NA	3	NA	1[e]
2000	NA	0	NA	2[e]
2001	NA	4	NA	2[e]
2002	NA	0	NA	0[e]
2003	NA	1	NA	0
2004	NA	0	NA	0
2005	NA	1	NA	0
2006	NA	1	4	0
2007	NA	0	4	0
2008	NA	16	6	2
2009	NA	1	0	2
2010	NA	1	1	0
2011	NA	9	0	0
2012	NA	0	0	3
2013	NA	NA	0	0
2014	NA	0	0	0
2015	NA	0	0	0
2016	NA	0	0	0
2017	NA	0	0	0
2018	NA	0	0	0
2019	NA	0	1	NA
2020	NA	0	0	NA
2021	NA	0	1	NA

"NA" indicates no survey conducted or data not yet available.

[a] Source: Santa Maria River does not appear to be monitored for any viability metrics (NMFS 2016)

[b] Source: Dagit et al. (2020), COMB (2022)

[c] Source: Dagit et al. (2020), CDFW R5 internal data from DIDSON monitoring (2019, 2021)

[d] Source: Dagit et al. (2020), Booth (2016)

[e] Inconsistent monitoring from 1994-2002 (Booth 2016)

Table 2. Comments from External Peer Reviewers on the Draft Southern California Steelhead Status Review Report

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
1-193	all	Camm Swift	Overall the case for an endangered listing under the CESA is very well jusified and supported by this draft. It has been heartening to see effort to protect this highly impacted fish come closer to fruition and finally have the genetic justifications for protecting the remnant populations. For a long time the decline and its causes were well known, but it was conjectural the degree to which native vs introduced fish were present, and how resident and anadromous populations were related. Conclusions about these issues are now firmly established with detailed genetic informaion much less subject to alternative explanations. Most, if not all. of my comments to follow will mostly address clarity, mistakes and additions that do not seriously affect the very strongly supported conclusions and recommendation put forward. Some of these address the potential audiences for this document. This reviewer had been steeped in this subject for a long time and understands the issues put forward but a more naive reader may have more difficulty with some issues. These are noted below. The Literature cited or references were not all checked against the text but obvious mistakes are noted.	Comment noted.
1	all	David Boughton	Overall this is a thorough and careful status review. Nicely done. Overall, I find the body of available information supports the Department's recommendation to list southern Steelhead and Rainbow Trout as endangered under the California Endangered Species Act. However, this proposed listing omits the Rainbow Trout subpopulations in southern California that are currently isolated above impassable barriers, many of which in my view are at risk due to climate change and its various knock-on effects (increased drought, intensified wildfire regimes, bigger storms driving mudslide potential, warmer temperatures), combined with inability to be recolonized by Steelhead Rainbow Trout due to impassable barriers. I should note that my own agency (NMFS) has never assessed risk for these subpopulations due to lack of jurisdiction.	Additional information about the proposed listing unit was added to Section 3.2.
1-145	all	Alan Byrne	Good luck. This is a unique population of steelhead occupying the southern end of the range of O. mykiss. As such, there will be unique traits and adaptations in this DPS. From an ecological viewpoint it is important to recover this DPS. However, given the effects of climate change and urban development in southern California, policy choices outside the realm of CDFW are needed. If these populations can not regain access to headwater areas the future is not bright. I would focus on key rivers that have a chance to retain anadromy.	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
9	248	Matthew Sloat	I have reviewed the draft status assessment and my view is that the body of available information supports the Department's listing recommendation. The draft assessment is well written and thorough. I really don't have any substantive recommendations. I found the information well presented and agree that the conclusions are well supported by the best available science presented in this draft. My other comments are very nit picky corrections to a few inaccuracies I noticed in the general description of the species.	Comment noted.
9	255-258	Camm Swift	Essential habitat for the continued existence of the "species" but really mean the later identified Southern California SH/RT which is a subdivision of the subspecies *O. m. irideus* as discussed later, p. 12, line 346	The term "species", used in reference to the Petitioner's listing definition, was changed to "Southern SH/RT" throughout the document to reduce confusion.
12	329	Camm Swift	A native species or subspecies under CESA; only much later do you add that it can be a subpopulation like the Southern California SH/RT and as noted below someone used to thinking species and subspecies always have scientific names this might be confusing.	See Department response for page number 9, line number 255-258.
12	329	Camm Swift	"in California species range," technically the Tijuana River goes in and out of California into Baja California so the Southern California SH/RT could be interpreted as living (or having lived!) slightly in Mexico.	Comment noted.
12	338-345	Camm Swift	The unit being discussed is a species again here	See Department response for page number 9, line number 255-258.
12	353	Camm Swift	Here the allowance for subsets of species to be protected is detailed in the law and compared with the long federally listed entity. This explanation should come earlier to avoid confusion to my mind.	Comment noted.
13	357	Devon Pearse	Here and elsewhere, the issue of how to consider the anadromous and resident life-history forms, and all of the additional variation in migratory life-history patterns within those categories, is challenging. While the language used in the Status Review is slightly different from that in the Petition, both focus on protection of all O. mykiss within a given below-barrier habitat unit. This reflects the interconnected relationships among individuals with different life-histories, as well as the greater need of the anadromous ecotype to have intact migratory corridors and sufficient flows to connect upstream habitats with the ocean. Thus, maintaining habitats that supports viable numbers of anadromous adults will also protect resident individuals. See comment on line 620.	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
13	364	Camm Swift	Part of summary of adverse effects might include priorities of DFGW rumored in "the old days" to have concentrated scarce resources towards northern California and tacitly made southern a lower priority.	Comment noted.
14	413-416	David Boughton	This statement is not quite correct, or at least it refers to the version of the ESU policy that was changed by the referenced FR notice (NMFS 2006). You can fix it by changing "ESU" to "DPS" in this sentence. The NMFS DPS policy as applied to steelhead is confusing and even within NMFS many people misinterpret it in my view. ESU is a scientific concept (Waples 1991) but the ESU policy is to equate DPS (a legal concept) to ESU. Scientifically this means southern California resident adults (Rainbow Trout) must be considered in the same ESU as steelhead. NMFS considers the ESU policy (as opposed to the ESU scientific concept) to be an "extension" of the joint NMFS-USFWS DPS policy suitable for the specific life-history of Pacific salmon, but for steelhead fell back to the more general approach of the joint DPS policy, for two reasons: 1) "Use of the ESU policy--originally intended for Pacific salmon--should not continue to be extended to O. mykiss, a type of salmonid with characteristics not typically exhibited by Pacific salmon" (NMFS 2006, page 834, middle column, bottom), and 2) NMFS considered "that within a discrete group of O. mykiss populations, the resident and anadromous life forms of O. mykiss remain 'markedly separated' as a consequence of physical, physiological, ecological, and behavioral factors, and may therefore warrant delineation as separate DPSs" (NMFS 2006, page 835, middle column). That is, the anadromous form is markedly distinct in terms of phenotype even though it interbreeds with rainbow trout. In my view, we can still talk about O. mykiss ESUs as a scientific concept, and the listed steelhead DPS is the anadromous component of the ESU. This is subtly different from the way you all are implementing the DPS policy. Your implementation explicitly includes rainbow trout in anadromous waters, whereas the NMFS version includes those fish only insofar as they are indistinguishable from anadromous O. mykiss (e.g juveniles whose life history is not yet determined). Confused? Join the crowd.	Changed "ESU" to DPS in the referenced sentence. The Department acknowledges and is aware of the different applications of the DPS Policy used here in the Status Review and in other technical documents by NMFS.
14	416	Camm Swift	It could be more explicitly explained that the anadromous jurisdiction lies with NOAA vs the resident one with the USFWS and both populations of fish are included in this proposed state listing.	Comment noted.
14	419	Matthew Sloat	O mykiss doesn't have the largest range. That distinction belongs to chum salmon.	Edited line 419.
14	419-420	Camm Swift	Range of *O. mykiss* extends to the western Pacific into Russia where *mykiss* was described from	Expanded range to include the western Pacific.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
15	444	David Boughton	Table 1 is adapted from a similar table in our monitoring update, but parts have been omitted and it has been changed a bit. As a scientist, I like your definition of "Steelhead Rainbow Trout" as an ESU, but then you should probably include the definition of ESU itself as well. The ESU concept has an aspect of common descent, meaning that the above-barrier O. mykiss would be included in the ESU; but you don't include them in your DPS, even though your interpretation of DPS (unlike the NMFS version), includes adult rainbow trout. This might cause some confusion, particularly since the above-barrier O. mykiss probably have the capacity to express the anadromous life history and are therefore useful for recovery. In addition, they themselves are threatened by the loss of migration connectivity, because disturbances such as droughts and wildfires might extirpate individual above-barrier populations, and they will not get recolonized due to the dams; or, disturbances may cause bottlenecks that reduce genetic diversity, and gene flow via anadromous migrants is also blocked by the dams.	Removed the term ESU from the definition of Steelhead Rainbow Trout in Table 1. Steelhead Rainbow Trout are populations that contain both steelhead and Rainbow Trout individuals.
16	456	David Boughton	I would say "smolting the primary ***physiological*** characteristic that distinguishes…", because migration to the ocean is the primary characteristic	Suggested edit was made to line 456.
16	460	Devon Pearse	Suggest editing to: "Juvenile >O. mykiss< that do not smolt and remain in freshwater generally lose their parr marks as they grow and develop into adult >Rainbow Trout<"	Suggest edit was made to line 460.
16	462	Devon Pearse	Suggest deleting 'Upon reentering freshwater rivers and streams to spawn,", since the timing of maturation relative to freshwater entry is variable and not relevant to the rest of the paragraph.	Suggested edit was made to line 462.
17	501	David Boughton	monophyly means something a little more restrictive than the definition here; it means the whole set of species descended from a common ancestor.	The definition of monophyly in line 509-510 was edited to improve clarity.
17-18	477-518	Camm Swift	This is a nice informative summary but perhaps too extensive for the purposes of this draft?	Comment noted.
18	513-516	Camm Swift	Does historical range count, this wording implies current range which could differ from historical range.	Comment noted. This sentence defines "range" and "distribution" for the purposes of the status review. These definitions apply to both current and historical descriptions.
18	519	Matthew Sloat	The only native O. mykiss populations in Asia are on the Kamchatka Peninsula and Shantar Islands.	Edited line 519.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
18	527	Matthew Sloat	A more recent and accurate phylogeny is available in: Crete-Lafreniere, A., Weir, L.K. and Bernatchez, L., 2012. Framing the Salmonidae family phylogenetic portrait: a more complete picture from increased taxon sampling.	Added Crete-Lafreniere et al. (2012) as a citation to line 530.
21	620	Devon Pearse	The high fecundity of female steelhead relative to female rainbow trout, combined with the female sex-bias in expression of anadromy (Kendall et al. 2015; Pearse et al. 2019), leads to anadromous females providing a disproportionately large contribution to the total egg and juvenile production below barriers in most systems. This is a consequence of their ability to access marine resources, bringing these nutrients and energy back into freshwater systems. This is stated on page 28, but cannot be overemphasized, and highlights the dependence of O. mykiss populations on the maintenance of diverse interrelated life-history forms.	Comment noted.
21	639	David Boughton	At the beginning of the sentence, add "Further north,"	Suggested edit was made to line 639.
23-34	687-991	Camm Swift	Section 2.5, this seems very well written and is central to much of the core argument for listing as scientific substantiation of many of the claims of endangerment. You need a good genetically proficient reviewer to also assess this section.	Comment noted.
23	699-701	Alan Byrne	The sentence about adaptive markers is based on genome wide association studies and most of the time the function of the gene is inferred. The key (and important) word is "putative".	Comment noted.
23	698-706	Alan Byrne	Move to Section 4.7. Focus on fish and their life histories.	Comment noted. Sections were left in place based on other comments received (page 23-34, lines 687-991)
25	721	Devon Pearse	The peer-reviewed publication Garza et al. 2014 TAFS, represents the same study and should replace Garza et al. 2004 throughout	Comment noted. Figures from Garza et al. 2004 are preferred to represent the information.
26	775-780	Alan Byrne	Information that supports the importance of 'straying' in these populations. This is important point to make. If only a handful of rivers have access to the sea in the winter it makes sense that adults in the ocean will go into those rivers regardless of their origin. It also represents a 'safety net' where rivers can be re-populated with anadromous individuals if there was a prolonged drought that caused the river to be disconnected from the ocean.	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
26-29	786 - 852	Alan Byrne	The Omy5 discussion in Section 2.5.5 should be folded into the haplotype discussion in Section 4.7 except I would retain lines 835-852 (it would be a good introduction to Section 2.5.6). I'd rather see a more high level discussion as presented in section 4.7 than all the detail provided in 2.5.5. Although this is an interesting topic, it's the life history variations that are important--genetics may help explain. Some of the info in this section is not necessary (lines 812-813, 823-825, 826-834)	Comment noted.
27	805	Devon Pearse	Rundio et al. 2012 not an appropriate citation here, delete.	Suggest edit was made to line 805.
28	817	Devon Pearse	The cited papers (Leitwein et al. 2016; Pearse et al. 2014) did not have data to directly support the statement that 'populations with a high frequency of the 'A' Omy05 variant also had higher proportions of individuals phenotypically expressing anadromy', although the data in those papers is consistent with this and statements in the rest of the paragraph. Suggest reversing the sentence and editing to Populations with higher potential to support anadromous or migratory individuals typically have a higher population-wide frequency of the anadromous variant of Omy5 than populations that have a higher frequency of the resident rainbow trout, such as those above waterfall barriers.	Suggest edit was made to line 817.
28	835	Devon Pearse	While accurate regarding the population genetic and evolutionary relationships among populations within versus among watersheds, this paragraph should more strongly enough state that resident and anadromous individuals within a given population or watershed are not just closely related in a population genetic sense, but interbreed, and that close relatives including full siblings may express these alternative phenotypes (or other life-history variation, e.g. adfluvial or lagoon migration).	More information as added to line 854.
28-29	835-852	Alan Byrne	Important point--retain this PP, see comment above.	Comment noted.
29	859	David Boughton	I'm not sure "monophyletic clade" is the right term here, it's usually used for species relationships. Safer to say "more closely related"	Suggested edit was made to line 859.
31	895	David Boughton	Insert "in the downstream direction" after "over barriers"	Suggested edit as made to line 895
31	904	Devon Pearse	Data in Pearse et al. 2014 is also very relevant to this statement, including for So Cal steelhead the Santa Clara and Santa Ynez Rivers.	Added suggested reference to line 904.
31	907	David Boughton	Add sentence: "However, a reservoir environment imposes different selective pressures than migration to the northern Pacific Ocean and therefore we would expect the anadromous genotype to be changed over time and eventually lose its ability to express a successful anadromous phenotype."	Suggested edit was made to line 907.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
31	893-907	Alan Byrne	Most of the points in this PP are made in lines 877-892 except for the last sentence.	Comment noted.
32	945-947	David Boughton	There is an important distinction to be made here between continual vs past or occasional stocking. Past stocking introduced many new genes, many of which were selected against (outbreeding depression), but a few of which may have been selected for, increasing fitness as noted. But for the erosion of native lineage in a way that reduces fitness, you would likely need ongoing stocking so that natural selection is swamped by geneflow from the hatchery stock	Redundant language was removed. See Department response for line 33, page 956.
33	956	Devon Pearse	The CDFW report, Jacobson et al. 2014, presents the same samples and data as Abadia-Cardoso et al. 2016, which was published following additional analyses and peer review. Given that, this paragraph is somewhat redundant with much of the preceding paragraph. Suggest reworking.	Redundant language was removed from Section 2.5 of the report.
33	962	David Boughton	Suggest changing to "Many more southerly populations…" since all the populations are southern.	Suggested edit was made to line 962.
36	1076	Devon Pearse	The statement "The anadromous life history of Southern SH/RT is not markedly separate from the non-anadromous life history of Southern SH/RT" seems incongruous with the rest of this paragraph, but it's meaning becomes clear when reading the next section. Suggest deleting or moving this sentence.	Comment noted.
36	1075-1077	David Boughton	This is the opposite of the NMFS DPS policy, which states that the anadromous form is markedly separate from the non-anadromous form (in terms of physical, physiological, ecological, and behavioral factors), even though the two forms interbreed. So you are applying the DPS policy in a way that is different from the way NMFS applied it. Of course the State of California is free to do what they want, but this may cause confusion. But also, if you are going to apply the DPS policy this way, it seems strange to exclude the above-barrier populations, which are also threatened by the loss of migration access due to the dams (commented on above), and also provide a genetic resource that could aid in the recovery of the below-barrier populations.	Additional information about the proposed listing unit was added to Section 3.2.
36	1077-1081	David Boughton	See above comment	Comment noted.
37	1086-1094	David Boughton	See above comment	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
37	1096-1107	David Boughton	See above comment. There are three kinds of "markedly separate" being lumped here: the geographic separation (which both NMFS and CDFW treat identically), the "marked" separation of anadromous vs resident forms below barriers but within the same geographic area (which NMFS recognizes but CDFW doesn't), and the separation of above-barrier and below-barrier rainbow trout (CDFW treats as one being threatened, the other not; neither are considered threatened by USFWS (who has Federal jurisdiction), and NMFS does not have an approach because the adult rainbow trout are outside their Federal jurisdiction).	Comment noted. The Department acknowledges and is aware of the similarities and differences in the application of the DPS Policy metrics (i.e., markedly separate) used here in the Status Review and in other technical documents by NMFS.
37-38	1116, 1146, 1150	Alan Byrne	I don't know what this is or why its included. If it is referring to ESU criteria on pages 35-36 please be specific.	Comment noted. See section 3.1 (DPS and ESU criteria) for more information.
37	1106	Camm Swift	Southern California SH/RT are distinct from the rest of the species	Comment noted. See Department response for page number 9, line number 255-258.
37	1114	Camm Swift	Southern California SH/RT are distinct from the rest of the populations; it is unclear if these three all mean the same thing [apparently], and the wording needs to be standardized somehow. To me the use of these terms as well as the words species and subspecies outside the zoological taxonomic sense is confusing. Suggest earlier after a concise discussion of the CESA and ESA listings criteria, make some kind of summary statement such as, "The proposed Southern California SH/RT is defined under the CESA as an ecologically, geographically, genetically, and legally distinct (and/or discreet) subdivision of [the subspecies?] *Oncorhynchus mykiss irideus."* And from there on avoid the use of the terms species, subspecies, and taxon in favor of Southern California SH/RT.	Comment noted. See Department response for page number 9, line number 255-258.
37	1118	Camm Swift	The range of Southern California SH/RT is at the southern most of its taxon. True if the taxon is *O. m. irideus* but not if *O. mykiss* that goes into Mexico as *O. m. nelsoni*.	Edited line 1118 to improve clarity of the statement.
38	1130	David Boughton	But what about the Bay Area, which also has steelhead-rainbow trout cohabiting with millions of people?	Edited line 1130 to improve clarity of the statement.
38	1147	Camm Swift	which taxon again	Comment noted.
39	1174-1175	Camm Swift	Southern California SH/RT is a DPS and a subspecies, despite earlier comments about the CESA allowing for designation of species, subspecies, and/or lesser distinct subgroups deemed deserving of protection.	Comment noted. See Department response for page number 9, line number 255-258.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
41	1255	Camm Swift	Becker and Reining (2008) cited here and often later but in list of references has a title restricting it to the Eel River.	Fixed incorrect reference in the Literature Cited section for Becker and Reining (2008).
41-60	1248-1771	Alan Byrne	The loss of habitat depicted in the maps for each BPG is the major reason for the decline of SH in this DPS. Although one can get the sense that a lot of habitat is now inaccessible I recommend that for each BPG you include a table that for each river shown in the BPG maps, list the historical anadromous distribution, the current anadromous distribution, and the percentage of habitat lost and if available the total historical habitat available for the entire BPG, current available for the BPG, and % lost for the BPG. Express habitat/distribution as drainage area or stream length? Make the point that loss of habitat by itself puts SH/RT in serious danger of becoming extinct in this DPS.	Comment noted. Information regarding the extent of current and anadromous habitat for the Ventura and Santa Ynez Rivers can be found in Section 6.8.2. Additional information regarding the range-wide presence and absence of Southern SH/RT in watersheds historically occupied can be found in Chapter 9.
43	1274	Camm Swift	Not sure why San Antonio Creek left out? San Antonio, a short distance north of the Santa Ynez, certainly suspected historically even if on size alone.	Comment noted. *O. mykiss* were determined to be "absent" from the drainage in 2002 based on surveys as part of a steelhead distribution study (Becker and Reining 2008).
44	1290-95	Camm Swift	Newspaper, Lompoc Record, vol. 16, No. 8, May 10, `1890, party of persons to the Sisquoc, creeks alive with mtn trout, No. 9, May 17, 1890, Sisquoc party report 2 persons/2 hrs, 450 fish. Well before stocking up in that area.	Additional information on the historical distribution and abundance of *O. Mykiss* in the Santa Maria River watershed was added to lines 1290-1295.
45	1336-1337	Camm Swift	The earliest years of the Lompoc Record in the Lompoc library from 1875,76 have notes of many one pound trout in San Miguelito creek entering the river from the south in the town of Lompoc, perhaps noted in Algona et al. 2012.	See line 1325-1326.
46	1383	David Boughton	Robles is not impassable, or at least, it depends on how they operate it.	Edited line 1435.
48	1435	David Boughton	I think you mean Santa Clara River, not Santa Maria River	Fixed incorrect river.
49	1470	David Boughton	I'm not sure where you got "eight" from. There are a much larger number of small creeks along this stretch of coast that have had O. mykiss.	Edited line 1470.
50-51	1502-1508	Camm Swift	Jalama Creek had juveniles in May of 1970, specimens at LACM (Natural History Museum of Los Angeles County, Section of Fishes)	Added reference to Jalama Creek in section 4.3.2.3.
51	1509	Camm Swift	Some explanation as to why Calleguas Creek not in Monte Arido or Santa Monica Mtns, another that size alone would predict expectation of steelhead in the past	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
53	1556	Camm Swift	Accessible mileage for Topanga should be much less than Malibu or explain that the upstream barrier is natural in Topanga and artificial in Malibu, the latter at least has more mileage if barrier removal takes place	Suggested edit was made to line 1556.
54	1594-1595	Camm Swift	Figure could include other significant dams? San Gabriel and Cogswell dams on the San Gabriel, Seven Oaks dam on the Santa Ana, and two on Santiago Creek, trib to the Santa Ana, and in text that follows. Some of these are noted much later.	Comment noted.
55	1606	Camm Swift	LACM has records from Fish Canyon for rainbow trout being abundant on 02 July 1986, 15 February 1998 and 16 June 2000. Fish were said to be common or abundant each time below and up into Forest service property. Camm Swift field notes and/or specimens.	Comment noted.
55	1617	Camm Swift	Boughton et al. (2006, Technical Memorandum 394, NMFS-SWFC) noted late 1850s historical accounts of abundant trout in the upper Santa Ana river, City Creek, and Cucamonga Creek of the Santa Ana drainage.	Added information in Boughton et al. 2006.
56	1634	Camm Swift	Should consider Big Tujunga Wash, trib to L. A. River, only place in current L. A. River drainage where native sucker, chub, and dace still occur and supported trout fishery in 1940s with controlled release from Big Tujunga dam.	Added Big Tujunga Creek as a tributary to the Los Angeles River.
56	1654	David Boughton	intermittency also results from groundwater depletion caused by pumping for water extraction. I suspect many dry creeks and rivers stem from groundwater depletion, and it would be good to highlight this problem more throughout this status review. Dams of course are a big part of the problem but so is lowered water tables because aquifers are used as another summertime water storage facility.	Noted groundwater depletion as a cause for stream intermittency.
57	1666	Camm Swift	San Mateo creek, map shows Cristianitos creek, a major northern tributary that is largely ephemeral but does not show upper Devils Canyon where steelhead actually spawned 1998-2000 (Hovey 2004).	Comment noted.
57	1670	David Boughton	If there's an impassable barrier, then shouldn't the sentence say rainbow trout rather than steelhead?	Edited line 1670.
58	1687	David Boughton	This is a bit confusing because Hovey used genetic data to argue that the creek had been colonized by steelhead after the Nehlsen et al paper; suggest rewrite to reflect that the San Mateo/Devil Canyon fish are believed to be descendants of this steelhead colonization event	Restructured lines 1675-1680.
60	1773	Camm Swift	As per earlier comments instead of "…of the candidate species…" use "...of Southern California SH/RT…"	See Department response for page number 9, line number 225-258.
60	1777-1778	Camm Swift	as above, reword to avoid using the word species	See Department response for page number 9, line number 255-258.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
61	1790-1792	David Boughton	The definition of core populations was those receiving highest priority for recovery actions, which is not quite the same as the definition here. For example, a well-protected and healthy population might not be core because it is already protected and thus not a priority.	Edited line 1790-1792 to improve clarity of the sentences.
61-71	1803-2003	Alan Byrne	Section 4.4.1. This is depressing and is all you need to have in the report to arrive at the conclusion that SH in this DPS are in serious danger of becoming extinct	Comment noted.
63	1848	David Boughton	How do redd surveys produce O. mykiss estimates?	Corrected mistake in line 1848.
65	1872	David Boughton	Thus, the observed steelhead were entering sink habitat? Might want to point this out--this situation creates an ecological trap.	Comment noted.
67	1920	David Boughton	According to the equation in line 1896, if any entry is zero, the geometric mean will be zero. How did you get these numbers, which are mostly not zero, even though the three Tables 2 indicate they should be zero? Something seems wrong here.	Added more information to Section 4.4.2.
66-68	1899 - 1946	Alan Byrne	You presented some estimates of steelhead run sizes in Section 4.3.1 for the Santa Ynez, Ventura, and Santa Clara rivers. Can you also show those estimates in this section in Table 3?	Comment noted.
71 - 74	2005 - 2073	Alan Byrne	You are probably required to do a trend analysis but with such low abundance's it does not add much. A population of 2 that goes to 4 is still in a world of hurt. Make that point.	Comment noted.
74	2068-2073	David Boughton	Clarify that you're talking about steelhead specifically here, not O. mykiss, since there are often extant O. mykiss populations in the headwaters	Comment noted.
74 - 77	2075 - 2122	Alan Byrne	You are probably required to do a productivity analysis but with such low abundances it does not add much. You need fish. Same point I made for trend applies here.	Comment noted.
75	2089	David Boughton	Apparently some typos in this equation. The "t+t4" should be "t+4" I think, and should be subscripted, as should the second "t". Also, this CRR estimator completely disregards age structure (not all adult steelhead return at age 4, and there is probably an important role for kelts). These simplifications should be noted. Also, productivity is defined differently in Fish Bulletin 182.	Fixed typo and edited the definition of productivity to align with Fish Bulletin 182.
71-77	2005-2122	Alan Byrne	The most important VSP parameter is abundance. You can not have meaningful positive trend, productivity, diversity metrics at population sizes (especially the anadromous component) as low as those presented in the abundance section	Comment noted.
78	2162-2163	David Boughton	Not necessarily - see Moore, M. R. (1980). Factors influencing the survival of juvenile steelhead rainbow trout (Salmo gairdneri gairdneri) in the Ventura River, California. M.S., Humboldt State University. Also, for the Carmel River a little bit to the north, but very similar in a lot of ways: Arriaza, J. L., D. A. Boughton, K.	Edited line 2162-2163 based on Moore (1980). Reference and citation added.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
			Urquhart and M. Mangel (2017). "Size-conditional smolting and the response of Carmel River steelhead to two decades of conservation efforts." Plos One 12(11). There could be a lot of improvement to these habitats to help spawning and rearing, in my view	
78	2144-2161	Camm Swift	Dams were also built often where the larger downstream reaches began to level out and probably provided considerable spawning sites in larger flows than in the higher tributaries with more bedrock and boulders with much lower flows. Thus they may well have been more than just corridors for migration.	See Department response for page number 78, line 2162-2163.
78	2145	David Boughton	Here is another place where it would be good to include groundwater depletion among the many ills impacting southern steelhead-rainbow trout	Added groundwater extraction to line 2145.
78	2171	David Boughton	This last sentence makes no sense. I think you mean the reverse?	Removed confusing sentence.
79	2186	David Boughton	But there were drought refugia in the mountains, where resident trout could regenerate anadromous fish when conditions were suitable	Added information on drought refugia to line 2186.
79	2188	David Boughton	Diversity - the extended phenotype - includes life-history diversity but potentially other phenotypic traits as well.	Edited line 2188.
79	2203	David Boughton	Comma after "range"	Added comma.
80	2217	David Boughton	Invasive species are also a big problem in many southern lagoons	Added invasive species to line 2217.
80	2220-2223	Camm Swift	While lagoon anadromous are rare or absent in the south, angling for "sundowners," in coastal lagoons like San Mateo creek was common in the 1930s and the Department had specific angling regulations for them (Swift et al. 1993). Given the epemeral nature of some southern California streams, the integrity of the lagoons may have been more important in the south relative to streams (Swift, Mulder et al. 2018; Swift, Holland et al. 2018,).	Comment noted. Added Swift et al. (1993) citation to line 3540.
80	2233	David Boughton	Hyphenate "above-barrier"	Added hyphen.
80	2234	David Boughton	"restricted fish passage to" can be read in two contradictory ways	Revised line 2234 to improve clarity of the sentence.
80-81	2224-2255	Alan Byrne	This is where I would move the Omy5 discussion (at a very high level) that is now in Section 2.5.5.	Comment noted.
81	2225-2227	Alan Byrne	Statement is true for females but "AR" males expressed more resident life history.	Comment noted.
81	2249-2251	Alan Byrne	...."it is unclear whether the resident component can reliably sustain the anadromous component in the long term...." -- I rather think of the resident component as having the ability to produce anadromous fish after prolonged unfavorable conditions (not needing to sustain the "A" life history). The returning anadromous fish can then sustain the "A" life history.	Revised lines 2249-2251 based on suggested revision.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
81	2278	Alan Byrne	another instance of "believe"--please re-write	Revised line 2278.
82	2299	David Boughton	Add "to" after "prior" and commas after "2012"	Suggested edits were made to line 2299.
82	2303	David Boughton	Poor sentence structure	Fixed poor sentence structure in line 2303.
82	2302-2307	Alan Byrne	This is worth repeating in the ES. Also, I find that not listing population's upstream of dams/artificial barriers problematic as, in my view, the only possible way for this DPS to persist is to gain access to their historical range. It's worth explaining the logic of excluding upstream areas somewhere in the report.	Added lines 2302-2307 to the Executive Summary.
83	2323	David Boughton	Change "necessary" to "necessarily"	Changed to neccesarily.
83-91	2346-2606	Alan Byrne	All this info is factual however it could be shortened if it was focused on the Southern SH/RT habitat requirements. Since you cite Bjornn and Reiser, Moyle, and NMFS a lot, I don't think its necessary to cite other studies that confirm what they stated (for example lines 2513 - 2522). As most of these rivers become de-watered all the habitat requirements listed are a moot point. I would make the lack of water the major habitat problem in this section. Fish need water. And it should be cool and clean.	Comment noted.
84	2361-2363	Camm Swift	For surmouning vertical barriers, the 25% pool depth figure applies to relatively low barriers and must be much more for the fish to clear higher barriers.	Comment noted.
86	2426-2430	Camm Swift	While Arroyo Chub may provide food for Southern California SH/RT they also can compete with small individuals in streams (Richards and Soltz 1986, cited in Swift et al. 1993) and are considered introduced in Topanga Creek and many other streams north of Malibu Creek (Swift et al. 1993). Through much of the range non-native species both compete with and prey upon Southern California SH/RT.	Added that Arroyo Chub are considered introduced in Topanga Creek.
87	2479	Devon Pearse	Another reference relevant to adaptation of Southern SH/RT to cite here and elsewhere in the Status Report: Dressler et al. 2023. Thermal tolerance and vulnerability to warming differ between populations of wild Oncorhynchus mykiss near the species’ southern range limit. Scientific Reports 13:145338. https://doi.org/10.1038/s41598-023-41173-7	Added Dressler et al. (2023) as a citation to line 2479 and elswhere in the report where appropriate.
89-90	2555-2571	Camm Swift	Text implies lagoons that do not open to the ocean are in poor condition but lagoons otherwise not impacted can remain in good condition through the fall or even for multiple years during extremely dry years. Even if surface flows do not exist upstream, lagoon are also often fed by groundwater.	Comment noted. Text revised to remove implication that closed lagoons are in poor condition.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
91-92	2609-2658	Alan Byrne	I'm not opposed to keeping this section however it is not focused on the Southern SH. And it has no effect/little on the resident forms. The CCE indicators are close to shore but steelhead don't spend much time there (compared to chinook) as they head to sea after entering the ocean. I would delete line 2632 beginning with ....For the CCE region to 2658 and Figure 15.	Suggested edit was made.
93-102	2659-2940	Alan Byrne	This is a very important Section. I didn't get the sense of its importance when I read the full document. The points in Section 6.2 should be forcefully repeated in a concluding section and the ES. Climate effects should be elevated so that the reader understands that expected changes in climate is a serious threat to the species survival and could ultimately drive it to extinction.	Comment noted.
97	2788	Devon Pearse	Also appropriate to cite new (2023) NMFS status review?	Added NMFS (2023) citation.
100	2866-2875	Camm Swift	In southern California among estuarine types, only lagoons serve as salmonid nursery areas and the much more tidal and saline "created" estuaries apparently do not function as such. The brackish estuaries noted are a phenomenon of systems farther north where larger volume of freshwater inputs much of the year sustain brackish estuarine conditions.	Comment noted.
103	2989	David Boughton	Would be good to write a comment on the above-barrier populations' conservation value, which has been talked about elsewhere.	Comment noted. Conservation value of above-barrier populations discussed in Section 2.5.7.
103	2995	David Boughton	Could cite Clemento et al paper for populations retaining high degree of native ancestry	Added Clemento et al. (2008) citation.
103-105	3000-3048	Camm Swift	Include striped bass, both freshwater estuarine, and marine (Boughton, 2020, Calif. Fish and Wildlife, 106(3):226-257). Also Redeye bass (*Micropterus coosae*) in the prime Southern California SH/RT habitat in the Santa Margarita River gorge	Added information about Redeye bass. Reference provided concludes striped bass are rare in southern California.
104	3024-3033	Alan Byrne	delete everything after …....Bonar, et al.2005).	Suggested edit was made to lines 3024-3033.
104	3040	Alan Byrne	are crayfish native to these streams?? If yes, so what. It's a stretch to conclude that crayfish pose a threat to the survival of juvenile steelhead from 1 study. Predation effects should be assessed at the population scale not individuals.	Red Swamp Crayfish are non-native to southern California waters.
105-106	3074-3083	Camm Swift	Arroyo chub competition noted above, originally very little competition/predation outside L. A. basin since north and south only two or three other species in freshwater like stickleback, prickly sculpin and lampreys.	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
106	3104-3108	Alan Byrne	highlight this.	Comment noted.
107	3134	Devon Pearse	Delete "…in above-barrier populations…", since the statement applies to a comparative analysis among many populations below and above partial and complete barriers to migration.	Suggested edit was made to line 3134.
107	3119-3136	Alan Byrne	not a surprising result given the low population size.	Comment noted.
107	3136	David Boughton	Add a sentence that the above-barrier diversity is an important repository of genetic material, serving a similar function as conservation hatcheries do in other parts of the species range.	Added suggested sentence after line 3136.
107	3137-3139	Alan Byrne	A strong statement. See my earlier comments about Omy5. I don't think this sentence is needed. The previous PP covers the points about A/R haplotypes.	Comment noted.
107	3147	David Boughton	Although the very wet years may select for the anadromous form!	Comment noted.
106-110 or 11		Camm Swift	This seems to repeat much of what was described earlier but is perhaps necessary to expand on it with more detail.	Comment noted.
111	3277	Camm Swift	Mention Big Tujunga dam, which as noted above supported a trout fishery in the 1940s and the stream is the only habitat in the Los Angeles River basin to still support three native Los Angeles basin fishes noted above.	Added Big Tunjunga dam.
112	3297	David Boughton	In my view there should be an expanded section - perhaps a couple paragraphs - on aquifer draw-down, groundwater depletion, and its links to dewatering of surface flows, especially in summer. This tends to get lumped in with dam effects on flows, but it deserves more attention as an important factor in its own right. Many of the dewatered stream channels in southern California may have one been perennial or mostly perennial but are very sensitive to groundwater depletion	Added more information regarding impacts of groundwater depletion.
112	3303	David Boughton	Most groundwater sustainability plans focus on water storage not the restoration of surface flows. See, for example, Ulibarri, N., N. E. Garcia, R. L. Nelson, A. E. Cravens and R. J. McCarty (2021). "Assessing the Feasibility of Managed Aquifer Recharge in California." Water Resources Research 57(3). They found that the goal of protecting surface water was only 1/8th as common as the goal of increasing groundwater storage, and 1/10th as common as the goal of raising the water table, even though all three are explicit intents of the act	Added more information based on Ulibarri et al. (2021) to line 3303.
112	3306	David Boughton	Again, GSPs don't necessarily address surface water - see above comment. One important CESA goal for southern steelhead-rainbow trout might be to get water agencies to include surface water restoration into their GSPs	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
112	3313	Camm Swift	Not sure what deep means in Bond's paper but under natural conditions many coastal lagoons were broad and flat and relatively shallow in relation to their depth. Restriction and channelization has caused deepening of many.	Comment noted.
113	3329	David Boughton	Other risks are poor water quality, stratification (which can cause low DO and fish kills) and episodic breaching by beachgoing humans, etc.	Added these other risks to line 3329.
115	3413-3414	Camm Swift	Habitat was converted "by" livestock rather than for livestock with the well-known loosing of cattle and horses onto the open ranges of southern California by the early Spanish colonists beginning in the late 1700s and subsequently land owners were allowed to own additional land holdings reclaimed from margins of estuaries and wetlands.	Suggested edit was made to line 3413-3414.
116	3446	Camm Swift	Most of the Los Angeles Basin was known as an artesian area with widespread springs and marshes that would have supported salmonids (Mendenhall, W. C. 1907. Ground waters and irrigation enterprises in the foothill belt, Southern California. USGS Water supply Paper 219.	Comment noted. Added information to lines 1591-1592.
116	3462	David Boughton	fix typo for "Trout"	Fixed typo.
117	3486-87	Camm Swift	Clawed frogs originated in the Santa Clara system upstream in Agua Dulce canyon above Santa Clarita in the earliest 1970s.	Comment noted.
117-118	3492-3538.	Alan Byrne	Why does cannabis have more lines than agriculture?? I would retain lines 3492 - 3501 but move it into the Agriculture section. You can delete 3502 - 3538.	Suggested edits were made to the Cannabis Cultivation section.
119	3539-3541	Camm Swift	Southern California SH/RT known as sundowners in coastal lagoons etc. as noted above and quoting retired DFG biologist Richard Croker in Swift, et al. 1993, p. 113.	Added Swift et al. (1993) citation to line 3540.
119-136	3560-4139	Alan Byrne	An exhaustive list of regulations, plans, and programs without any discussion on whether any of these actions are having an effect to prevent the Southern SH/RT from going extinct. Is all this detail needed?? Or can you just list each with short sentence of its intent? Can all these programs be implemented? is there funding to continue them? Programs already in place did not prevent the Southern SH/RT populations from an "endangered" listing.	Comment noted.
126	3802-3815	David Boughton	it’s a little odd that this dam is described in detail, but other important dams aren't.	Comment noted.
129	3810	Camm Swift	Add integration with USFWS recovery plans for federally endangered Unarmored threespine stickleback (Los Angeles Basin and Santa Clara River), (now) northern and southern tidewater goby (many coastal lagoons), and federally threatened Santa Ana sucker (Los Angeles Basin). DFGW now reviewing status of Santa Ana speckled dace as well. And Arroyo chub is California species of special concern.	Comment noted.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
129	3924-25	Camm Swift	Many of these check dams originated as concrete barriers buried in stream sediments to force ground water to the surface and subsequent high flows scoured out the downstream sides making them appear as dams and creating barriers where none were present intitially.	Added reviewer information to lines 3924-3925
135	4119	David Boughton	Spell out COMB in parentheses or something, for the uninitiated	Suggested edit was made to line 4119.
135	4125	David Boughton	Likewise for CMWD	Suggested edit was made to line 4125.
136	4130	David Boughton	Likewise for UWCD	Suggested edit was made to line 4130.
136	4134	David Boughton	Likewise for RCDSMM	Suggested edit was made to line 4134.
136-137	4163-4164	Camm Swift	I thought urbanization made streams more flashy and variable in extremes of flow rather than less variable? Namely from high, rapid runoff from increasing amounts of impervious surfaces.	Revised lines 4163-4164.
137-138	4195-4200	Camm Swift	"Locals" often know fish can be found below impassable barriers like Rindge Dam on Malibu Creek just after large rain events which, as noted, can allow a few anglers to have strong effects.	Comment noted.
138	4204-4218	Alan Byrne	With the SH/RT populations at such low abundances I don't see a compelling argument for whether Predation or Competition are or are not a threat so I would re-assess you're conclusion of "moderate threat". I'd be more comfortable stating something like…adequate data/studies specific to the Southern SH/RT DPS is lacking.	Re-assessed and revised the Department's conclusion for predation and competition.
138	4204-4217	Camm Swift	My opinion is that the effects of predation are usually (or probably) under estimated, partially because little hard data is available for local fish. Its hard to imagine the channel catfish, largemouth bass, striped bass and other do not significantly impact the younger stages of Southern California SH/RT in streams and lagoons. Thus, I would grade them as more than a moderate threat. Particularly since west coast salmonids evolved free of many of these predators and thus would be expected to have have few avoidance behaviors related to them. It may also be unrealistic to expect to rid streams of these popular sport fishes or somehow keep them separated from Southern California SH/RT habitats in many cases, but perhaps not all.	Comment noted. See Department response for page number 138, line number 4204-4218.
138	4221-4222	Camm Swift	Brown trout Is a salmonid with self-sustaining populations within these areas, namely Bear Creek, trib to Santa Ana river and Ice Houses Canyon, trib to San	Comment noted. Brown trout are covered by the non-native category.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
			Antonio Creek, trib to Santa Ana River. Perhaps Brown trout are covered by the non-native category.	
140	4266	David Boughton	To match what you have said elsewhere, you should call them "southern California steelhead-rainbow trout", not southern California steelhead	Suggested edit was made to line 4266.
140	4268	David Boughton	As said elsewhere, this is different from how the Feds define the DPS. I myself have no quibbles with this from a scientific perspective, but it will likely cause even more confusion then there is presently. Also, it seems odd to include rainbow trout below the barriers, but not above the barriers, since they share common descent and could provide important genetic materials for the recovery of the below-barrier steelhead-rainbow-trout. Arguably, the loss of connectivity to the above-barrier rainbow trout endangers them as well, since they can no longer get gene flow (via steelhead) from other stream systems, and also cannot get recolonized if a fire or something extirpates a given population. Why don't you include them in the DPS as well?	Additional information about the proposed listing unit was added to Section 3.2.
140	4269	David Boughton	I think you should clarify this statement that it does not include the above-barrier rainbow trout, which are still present in many systems that have lost O. mykiss from below-barrier parts of the system	Added clarification to line 4269.
140	4292-4299	Camm Swift	given the recommendations above the wording here is excellent sticking with Southern California SH/RT rather than species, subspecies, taxon, etc.	Comment noted.
141	4318	Camm Swift	Thus change this line to "….to list Southern California SH/RT as endangered to be warranted." since this unit was defined earlier and avoiding calling it a species or subspecies. In the explanation leading up to this last sentence it might be optional to add the additional wording from the law about species, subspecies, or subdivisions of these as discussed before.	Suggested edit was made to line 4318. See Department response for page 9, line 255-258.
142-145	4356-4465	Alan Byrne	No major disagreement, however it is likely that many will be difficult and very costly to implement given the current population abundances in most of these rivers. I would recommend selecting priority streams that could serve to retain anadromy and provide "strays" into other rivers when conditions are favorable. Other streams could be assessed on an alternating basis.	Comment noted.
143	4373	Devon Pearse	Genetic monitoring of *Omy 5* variation would not necessarily be informative with respect to viability. Suggest deleting this bullet point, since evaluation of Omy5 is described under action 4.	Suggested edit was made to line 4373.
143	4386	David Boughton	Do you mean the Federal Recovery Plan? If so, you should probably say "Federal," since if this listing goes through there will presumably be a state recovery plan. I would also encourage you to explicitly say that fishways or assisted migration should be established at passage barriers that cannot be removed, at least in the near term.	Added clarification to line 4386.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
143	4391	David Boughton	and also restore aquifers in dewatered areas to sustain surface flows during the dry season whenever possible.	Added suggested recovery measure to line 4391.
143	4392	David Boughton	and establish fish passage at barriers that currently lack it, or where it exists but is ineffective!!! Don't just re-evaluate it! Create it! Create fish passage, especially for above-barrier populations that still have a lot of native ancestry.	Added suggested recovery measure to line 4392.
144	4404-4413	David Boughton	Although the genetic work is very interesting, for recovery it is not nearly as important in my view as establishing passage, improving habitat and streamflows, and the items in paragraph 6.	Comment noted.
144	4437	Camm Swift	Implies a broadening of an effort to the whole species from Russia to Baja California buy using *O. mykiss?*	Revised language in line 4437 to remove the implication.
145	4462	Camm Swift	Literature Cited: citations were not checked against their appearance in the text and in this list. Not being sure of the style for this draft some inconsistencies are pointed out in the following entries. Particularly the multi-authored papers seem to be alphabetized by first author and then chronologically by date regardless of subsequently listed co-authors. Most books and journals alphabetize these by second, or even third or more authors if present and then by date (year). Possibly you have a style manual to standardize citations/references.	Comment noted. Citations were organized chronologically by date of publication, not by second author, consistent with citation styles used in previous status reviews.
145	4464-5644	David Boughton	Some of the references are NOT in alphabetical order, so check them.	See Department response for page number 145, line 4462.
146	4492-4493	Camm Swift	No title to item	Fixed.
147	4516	Camm Swift	No journal indicated	Fixed.
149	4586-4591	Camm Swift	Boughton papers rearranged if alphabetized by second and other authors including additional paper noted above	See Department response for page number 145, line 4462.
153	4695, 4698	Camm Swift	Chapman, B. B. should precede Chapman, D. W.	Fixed
156	4790-4802	Camm Swift	rearrange by 2nd author	Comment noted.
157	4828-4830	Camm Swift	add California Department of Fish and Game, Fish Bulletin 178 (this was before change to Fish and Wildlife)	Comment noted. Citation written as recommended in the article.
161-162	4954-4962	Camm Swift	re-alphabetize	See Department response for page number 145, line 4462.
162	4978-4983	Camm Swift	re-alphabetize, elaborate what G3-2 and G3.5 indicate	Fixed.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
162	4992	Camm Swift	change 903: to 90(3):	Fixed.
164	5041-5047	Camm Swift	re-alphabetize	Comment noted.
165	5070	Camm Swift	give issue number like for Hovey, 2004? Minor issue but consistency is desirable	Comment noted.
166	5086	Devon Pearse	Change to 2017; although first published online in Aug 2016, this paper was in the January 2017 issue.	Fixed.
166	5092-5093	Camm Swift	along, causes misspelled	Fixed.
166	5105	Camm Swift	remove words "Invasive species"?	Comment noted.
168	5161-5162	Camm Swift	need title?	Fixed.
169	5178	Camm Swift	what is Npj?	Comment noted.
169	5184-5192	Camm Swift	re-alphabetize, these three journal titles vary from very completely written out to very abbreviated such as PNAS (Proceedings of the [U. S.] National Academy of Sciences) probably unknown to many outside the scientific community. Should have some standard or consistency	Fixed.
170	5217-5224	Camm Swift	re-alphabetize	Fixed.
170-172	532-5280; 5290-5292	Camm Swift	move up to below Myrick	Fixed.
172	5296	Camm Swift	O'Neal to down below Olsen et al.?	Fixed.
174	5343	Camm Swift	Pearse, Barson, et al. goes above Pearse, Donohoe etc	See Department response for page number 145, line 4462.
174	5354	Camm Swift	Pacific reference should move up unless you are going to alphabetize by the acronym PFMC	Fixed.
176	5398-5404	Camm Swift	re-arrange	See Department response for page number 145, line 4462.
176	5411-5418	Camm Swift	re-arrange	See Department response for page number 145, line 4462.
177	5432-5436	Camm Swift	move down in alphabetical order	Fixed.
177	5444-5451	Camm Swift	reverse order	See Department response for page number 145, line 4462.

Page Number	Line Number	Reviewer	Reviewer Comment	Department Response
179	5505	Camm Swift	Take out Conception Coast from authorship since also listed later on as publisher	Fixed.
180	5523-5524	Camm Swift	to above Stearly and Smith	Fixed.
180	5537-5538	Camm Swift	move up alphabetically or lead with SYRTAC	Fixed.
181	5563	Camm Swift	Masters or Ph.D thesis, which department at Michigan	Fixed.
183	5625-5627	Camm Swift	Move up to above Williams, Seager, et al.	See Department response for page number 145, line 4462.
183	5641	Camm Swift	pages?	Comment noted.
191	5704	Camm Swift	my affiliation should be "Emeritus, Section of Fishes, Natural History Museum of Los Angeles County"	Fixed.

Status Review for Southern California Steelhead

Oncorhynchus mykiss

Presentation to the California Fish and Game Commission

April18 | Robin Shin

Fisheries Branch

Presentation Overview

- Listing Description
- Species Overview
- Information Received
- Abundance and Population Trends
- Threats
- Department Recommendation
- Management and Recovery Measures

Listing Description

- Southern California steelhead means all *O. mykiss*, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from and including the Santa Maria River to the U.S.-Mexico Border.

- Federal listing includes only naturally spawned anadromous adults

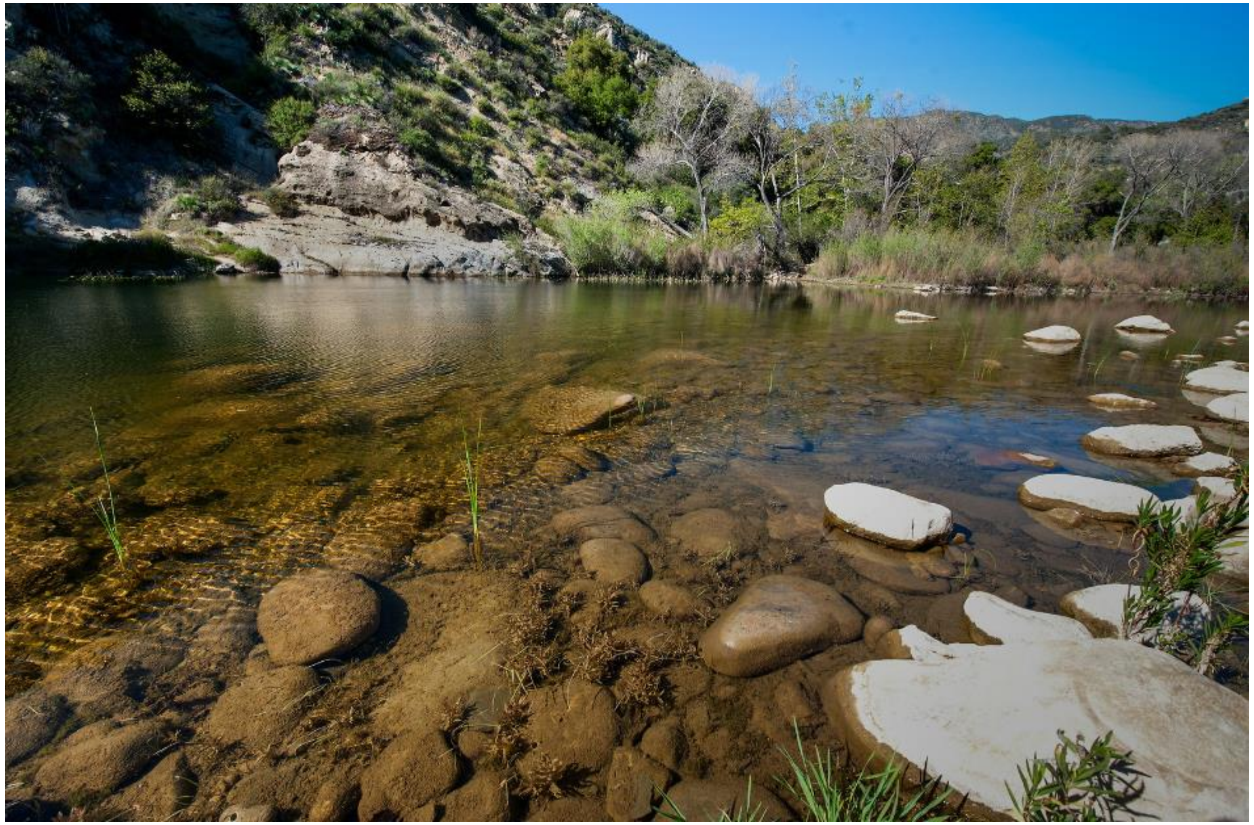
- Department determination that Southern California steelhead is a Distinct Population Segment (DPS) and hence a subspecies for CESA listing purposes.

Species Overview: Life History

- Exhibit an anadromous life-history
- Born and reared in freshwater and mature in saltwater before returning to their natal waters to reproduce
- Variation in the time and location spent at each life-history:
  - Anadromous (freshwater to saltwater migration)
  - Freshwater Resident (remain in freshwater)
  - Lagoon-anadromous (migration to and from brackish lagoons)

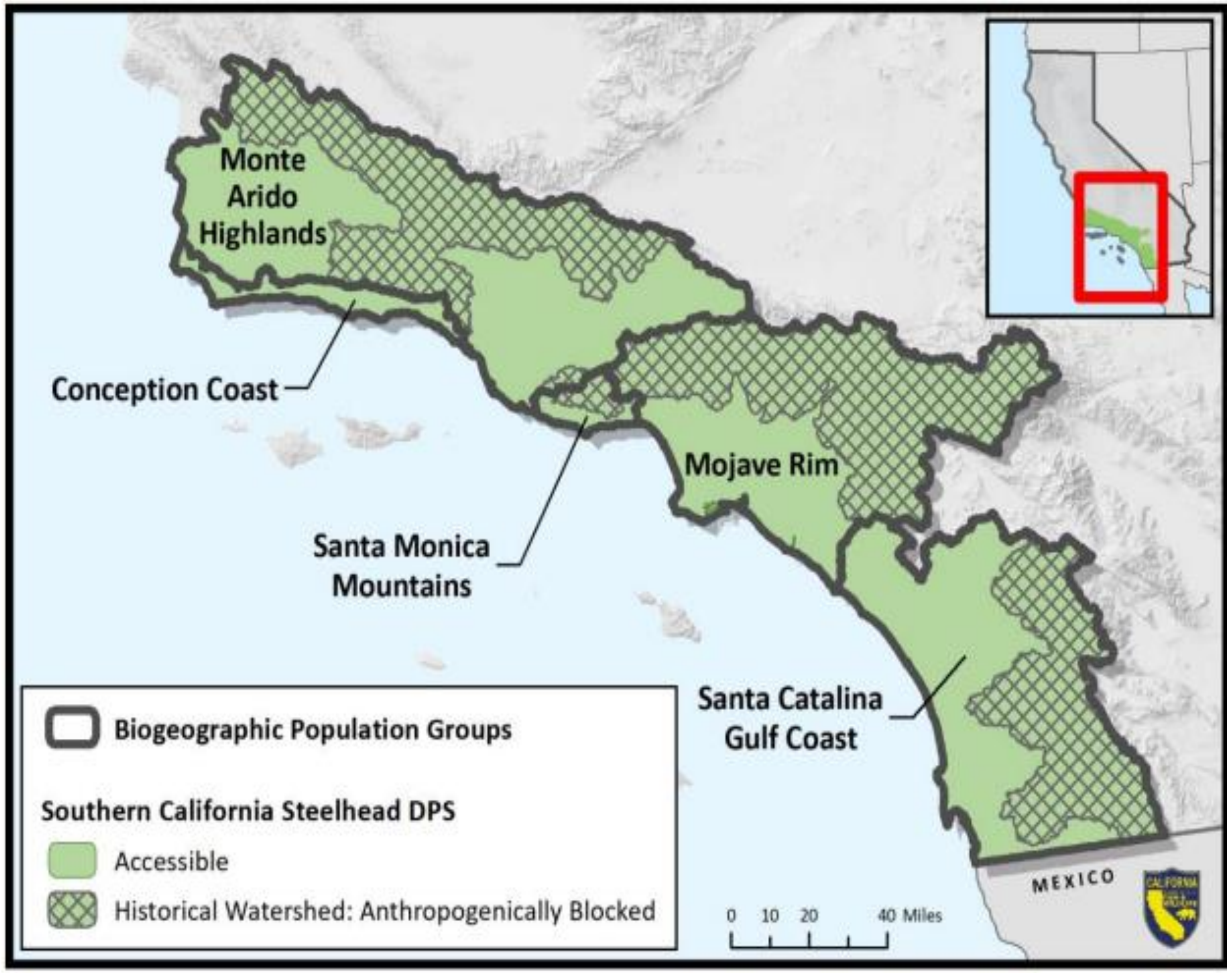
Species Overview: Habitat

- Spawning
  - Clean loose gravel
  - Adequate depth and velocity
- Freshwater Residency
  - Sufficient flow
  - Cool water temperatures
  - Cover habitat
  - Availability of prey items
- Estuarine Rearing
  - Sand berm formation
  - Low degradation



Species Overview: Range and Distribution

- Santa Maria River (San Luis Obispo and Santa Barbara counties)to the U.S.-Mexico Border
- Encompasses 5 biogeographic population groups of *O. mykiss*
- Less than half of 46 watersheds known to support historical populations are still occupied



Map by Janet Brewster, CDFW

Information Received

- During data solicitation period [April 2022 to January 2023]:
  - 17 comments from Tribes
  - 480 emails received
  - 12 submissions of information

- After Status Review delivered to Commission [January 2024]:
  - 39 references
  - Draft technical memo for southern California steelhead life cycle model and graphic user interface

Abundance/Population Trends

Anadromous Adults

- Critically low range-wide abundances
- Counts have not been greater than ten for any watershed examined
- Most streams have observed no adult returns in past 10 years

Population	Years	Trend (%/year)	Minimum Abundance (12-year)	Maximum Abundance (12-year)
Santa Ynez River	1995-2021	-2.24	0	9
Ventura River	2006-2021	**-7.54**	0	1
Santa Clara River	1994-2018	-2.29	0	3
Topanga Creek	2001-2019	-1.7	0	5
Malibu Creek	2004-2019	-1.41	0	2

Abundance/Population Trends

Resident *O.mykiss*

- Measurable declines in population trend and abundances for all populations examined.

Population	Years	Trend (%/year)	Minimum Abundance (12-year)	Maximum Abundance (12-year)
Santa Ynez River	1995-2021	**-8.81**	5	484
Ventura River	2006-2021	**-19.39**	0	640
Santa Clara River	1994-2018	-6.09	1	170
Malibu Creek	2004-2019	**-25.56**	0	2,245
Topanga Creek	2001-2019	-1.41	34	316

Major Threats

- Dams, Diversions, and Artificial Barriers
- Urbanization
- Estuarine Habitat Loss
- Invasive Species
- Wildfires
- Drought
- Climate change

Rindge Dam, Malibu Creek

Department Recommendation

The Department recommends that the Commission find the petitioned action to list Southern California steelhead as an endangered species to be warranted.

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

Management and Recovery Measures

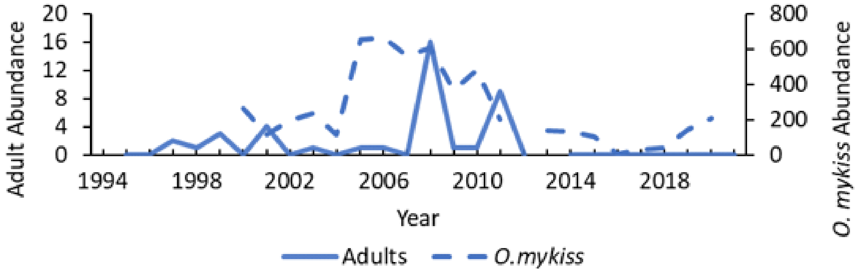
- Implement comprehensive monitoring
- Remove manmade passage barriers and re-establish access to upper watersheds
- Habitat and streamflow restoration

Questions ◇ Thank You

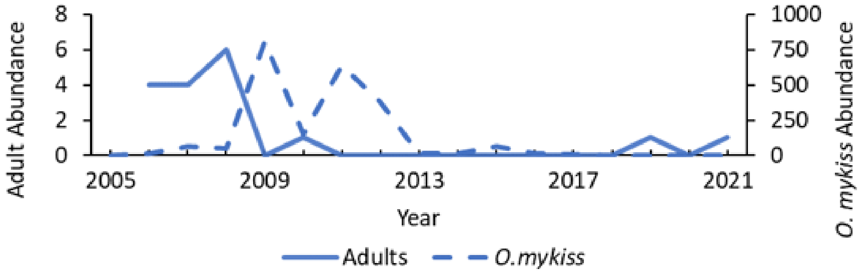
Robin Shin
Senior Environmental Scientist (Specialist)
fisheries@wildlife.ca.gov

Summary

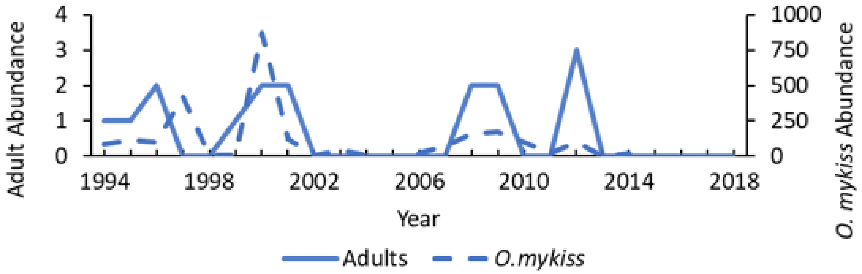
A. Santa Ynez River



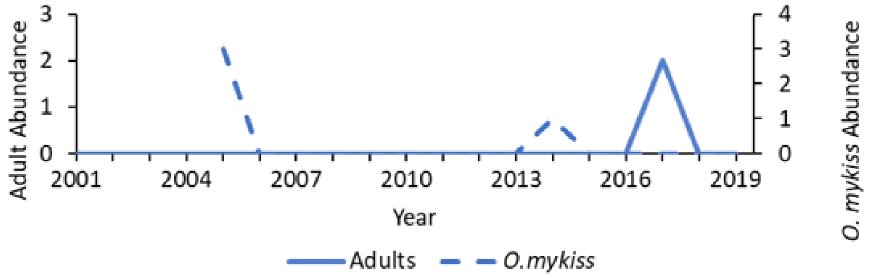
B. Ventura River



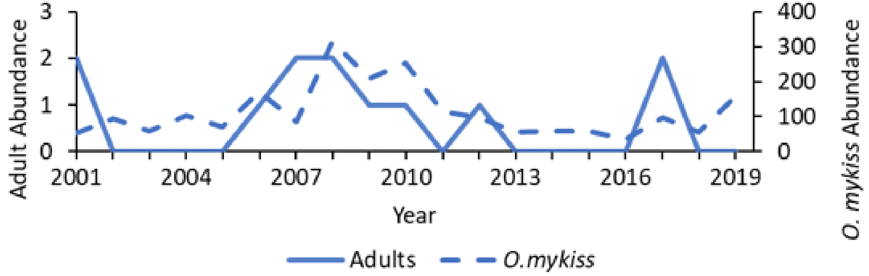
C. Santa Clara River



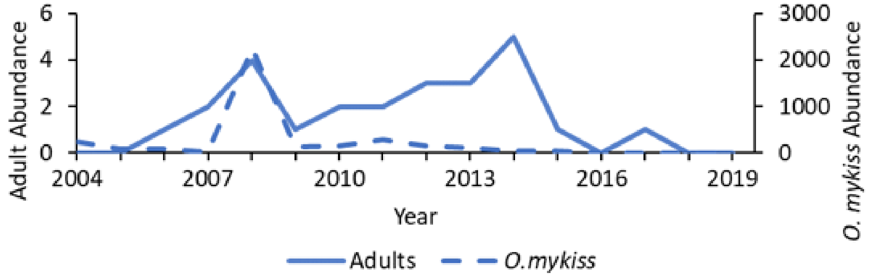
A. Arroyo Sequit Creek



B. Topanga Creek



C. Malibu Creek



ENDANGERED HABITATS LEAGUE
DEDICATED TO ECOSYSTEM PROTECTION AND SUSTAINABLE LAND USE

March 18, 2024

Samantha Murray, Chair
California Fish and Game Commission
P.O. Box 944209
Sacramento, California 94244-2090

RE: California Trout, Inc.'s Petition to list Southern California Steelhead (*Oncorhynchus mykiss*) as Endangered Office - Administrative Law's Notice ID #Z2021-0702-02 and Z2022-0426-01—*Support*

President Murray and Commissioners:

Endangered Habitats League (EHL) fully supports designating the Southern California steelhead as endangered under California's Endangered Species Act. For your reference, EHL is Southern California regional conservation group dedicated to ecosystem protection and sustainable land use.

Returning Southern steelhead to our coastal streams is a longstanding goal of conservationists. Yet, the species is at the brink of extinction. Your Commission should act immediately to prevent the total and irreversible loss of this species.

Recent research tells us that Southern steelhead populations are in danger of extinction within the next 25 to 50 years if current trends persist. Since their listing as endangered under the federal Endangered Species Act in 1997, Southern steelhead numbers have *continued to decline* to dangerously low levels. This is the result of continued urbanization, agriculture, and water development. These activities have compromised and drastically reduced their essential required habitat. The legacy of degradation will only be exacerbated by climate crisis projections of intensified floods, droughts, and extreme heat.

The rivers and streams in Southern California once saw Southern steelhead adults return in the tens of thousands. In the past 25 years, only 177 adult Southern steelhead were documented in their native range. Allowing this species to disappear is not acceptable.

CalTrout's petition, reaffirmed in State Courts as containing sufficient information to warrant a decision, and California Department of Fish and Wildlife's (CDFW) peer-reviewed species status report present you with the best available science and a clear mandate to make the decision to fully list this species immediately.

These fish play a key role in our ecosystems on which we all depend. They are a crucial part of the integrity of watersheds in which they swim. Their continued survival and recovery will reflect the resilience of our communities in the face of growing climate crisis challenges. We can look to them for clues on how California must work to address bigger problems in our Southern California rivers, streams, watersheds, and coastlines. These aquatic ecosystems, extending from summits to the seabed, provide countless environmental, social, and economic benefits for the entire state. We believe that we prosper, now and in the future, when Southern steelhead are thriving in our rivers.

For all these reasons, EHL strongly support listing Southern steelhead as endangered in all waters within historic range below natural or man-made barriers.[1]

Yours truly,

Dan Silver
Executive Director

[1] Please note that, consistent with section 10.5(c) of the Tejon Agreement, EHL is not advocating that state listing of Southern steelhead requires changes to any Tejon Ranch project or project approval. In addition, we wish to confirm that in light of the benefits to important biological resources realized through the Agreement, EHL does not oppose the developments currently proposed on Tejon Ranch.

CALIFORNIA FISH AND GAME COMMISSION
RECEIVED 03/20/2024

To: California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

From: Stephen L. Kanne

President Silva and Commissioners:

As a concerned California resident, I write to you today to express my full support for designating the Southern California steelhead as endangered under California's Endangered Species Act.

Southern steelhead are an iconic native species, but without further protections we risk losing them forever. That's not a California I want to live in. Do you? You must act immediately to put in place all precautions to prevent this species from total loss.

Recent research tells us that Southern steelhead populations are in danger of extinction within the next 25 to 50 years, if current trends persist. Since their listing as an endangered species in 1997 under the federal Endangered Species Act, Southern steelhead numbers have continued to decline to precariously low levels. In the past 25 years, only 177 adult Southern steelhead were documented in their native range! Allowing this species to disappear is not acceptable, and more protections are essential.

These fish play a key role in our ecosystems, and they can give us crucial information about the greater health of the watersheds they swim in (and that our communities rely upon). We can look to them for clues on how California must work to address bigger problems in our southern rivers and streams, watersheds that provide countless societal and economic benefits for the entire state. I believe that we prosper when rivers and waterways in key locations are thriving, and in many of these places there is work to be done.

These fish may also play a role in providing resiliency for ecosystems further north along the coast. Southern steelhead are uniquely adapted to Southern California's warmer Mediterranean climate. As climate change continues to increase water temperatures and alter flow regimes along the entire West Coast, Southern steelhead could be critical to the long-term resiliency of their northern relatives.

For all these reasons, I wholeheartedly support California Trout's recommendation that Southern California steelhead be listed as endangered in all waterways within historic range below natural or man-made barriers. CalTrout chose this delineation thoughtfully, so that fishing and continued management for rainbow trout, the freshwater form of this amazing species, would still be possible above these barriers.

It's not too late to save the Southern California steelhead species from blinking out – but if you don't act urgently, we may very well miss our chance. Please make protection of these amazing and important fish a conservation priority by listing them as endangered under the state's Endangered Species Act.

Sincerely,

Stephen I. Hanna

A Concerned California Resident

3/12/24

Stephen & Claudia Kanne
2708 Wilshire Blvd., #322
Santa Monica, CA 90403

LOS ANGELES CA 90
13 MAR 2024 PM 9

California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

94244-2090

CACHUMA CONSERVATION RELEASE BOARD

March 21, 2024

Submitted via Email

Melissa Miller-Henson
Executive Director
California Fish and Game Commission
715 P Street, 16th Floor
Sacramento, California 95814

Request for a Southern California Location for the Commission's Hearing to Consider Listing Southern California Steelhead as an Endangered Species

Dear Ms. Miller-Henson:

On behalf of the Cachuma Conservation Release Board (CCRB), I am writing to respectfully request that the California Fish and Game Commission's hearing on final consideration of listing Southern California steelhead as an endangered species be held in Southern California, rather than in San Jose.

CCRB is a joint powers agency consisting of the City of Santa Barbara, the Goleta Water District and the Montecito Water District. We have a long history of effective efforts on behalf of steelhead in the Lower Santa Ynez River watershed in Santa Barbara County. In response to the petition, we have submitted timely comments on the proposed listing.

We appreciate that internet access is available for the Commission's hearings. However, we hope the Commission will consider holding this hearing closer to the habitat and natural range of Southern California steelhead and closer to the local and regional agencies working for steelhead, such as CCRB, which would be most affected by such a listing.

Thank you for your kind attention to our request.

Sincerely yours,

Lauren Hanson
Board President

cc: Samantha Murray, Commission President
Erika Zavaleta, Commission Vice President
Jacque Hostler-Carmesin, Commission Member
Eric Sklar, Commission Member
Darius W. Anderson, Commission Member
CCRB Board of Directors
Peter Cantle, CCRB Executive Director

CACHUMA OPERATION AND MAINTENANCE BOARD
3301 Laurel Canyon Road
Santa Barbara, California 93105-2017
Telephone (805) 687-4011 FAX (805)569-5825

Ms. Melissa Miller-Henson
Executive Director
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090
E-mail: fgc@fgc.ca.gov

Ms. Jennifer Bacon
CESA Analyst
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090
E-mail: jennifer.bacon@fgc.ca.gov

March 26, 2024

Re: Comments on CDFW's Use of COMB data related to Fish Abundance - Status Review Report (January 2024) for Listing of the Southern California Steelhead Under the California Endangered Species Act

Dear Ms. Miller-Hensen and Ms. Bacon,

On behalf of the Cachuma Operation and Maintenance Board (COMB), we appreciate the opportunity to provide comments on the Status Review report (Report) for listing of the Southern California Steelhead (Southern SH/RT) under the California Endangered Species Act (CESA). We applaud the efforts of the California Department of Fish and Wildlife (CDFW) in compiling this extensive and comprehensive Report related to the listing of the Southern SH/RT as endangered under CESA. We respectfully submit the following comments regarding your use of COMB's data.

The Fisheries Division (FD) staff at COMB has been monitoring Southern SH/RT within the Santa Ynez River watershed since the mid-1990s. Considering the importance of the CDFW Report and our contribution of data to a portion of its content, we respectfully submit the following comments and recommended changes based on our scientific observations of the data.

COMB's Senior Resources Scientist, Timothy Robinson, PhD, has been managing the FD staff and all related 2000 Biological Opinion requirements and activities for the Cachuma Project and Lower Santa Ynez River system since 2005. Dr. Robinson and our team of Senior Biologists have been deeply involved with data gathering, data analyses and all levels of reporting including those COMB-FD materials which were used in the CDFW Report's analyses. After careful review of the Report, COMB would like to provide the following observations and recommended changes:

- Appendix C (Page 189) provides the base data used in many of the analyses in the Report. For the Ventura River, snorkel survey data were used whereas for the Santa Ynez and Santa Clara rivers, migrant trapping data were used. Based on our scientific expertise, using two separate types of data for the same analysis leads to inaccurate comparison and analysis because migrant trapping data represents a subset of abundance results, where snorkel survey data are more representative of actual abundance.

- The upstream/downstream migrant trapping data for the Lower Santa Ynez River (LSYR, downstream of Bradbury Dam) basin provides a view of the Southern SH/RT abundance which is limited in several ways. First, it only captures movement of fish within the basin and does not represent in any way the total abundance within the basin, which was the objective of the Report's trend analysis and supporting dataset. We recommend using snorkel data that would be more representative of the LSYR basin-wide Southern SH/RT abundance, as was used for the Ventura River over a limited area. Second, the enforcement by the National Marine Fisheries Service (NMFS) of the 2000 Cachuma Project Biological Opinion Incidental Take Statement (ITS) numbers for juveniles and adults started in 2014 and greatly skewed the capture numbers, particularly in 2021 and onward, when the trapping season ended early due to reaching the take limit. This regulatory monitoring limitation for the Santa Ynez River can easily be seen in Appendix C (Page 189) in the presented data from 2014 to 2021 compared to 2001 to 2012. Third, box fyke traps used for monitoring fish migration must be removed during moderate to high flow events to safeguard the fishery, equipment, and staff, resulting in a capture number most likely less than what migrated through that location. Even deployment of a Dual-Frequency Identification Sonar (DIDSON) camera struggles with this limitation. Standardization of the data in the form of catch per unit effort or catch per day would address some of these limitations. These types of metrics are provided in COMB's Annual Monitoring Summaries.

- We highly recommend using snorkel survey data (spring surveys which generally had the highest observations) to represent Southern SH/RT abundance within the LSYR basin and the standing crop of the fishery. By using these data for trend analyses, the result from the beginning of the data record through the prolonged drought period (2001-2016) out to 2021 and beyond exhibit an even stronger recovery from the drought, particularly when adding two more years of data for 2022 and 2023 (Table 1 and Figure 1). Adding a simple linear trendline to the snorkel data results in a flat trajectory through 2021 and a slightly positive sloped line when including 2022 and 2023 data. Our provided analysis indicates that the LSYR basin is sustaining a population and does not follow the same downward trend as other populations within the geographic range of Southern SH/RT. Also, snorkel survey data can underestimate the actual number of fish per habitat. We will be addressing this issue this summer by conducting calibration surveys for our routine snorkel surveys.

Table 1: Migrant trapping and snorkel survey data from 2001 to 2023 for the LSYR basin.

Year	Santa Ynez River	
	Migrant Trapping	Snorkel Surveys (Spring)
2001	266	1595
2002	116	1016
2003	196	647
2004	238	532
2005	117	1719
2006	653	3262
2007	665	1879
2008	561	3407
2009	610	982
2010	367	2373
2011	484	1803
2012	199	3152
2013		1416
2014	137	429
2015	134	141
2016	103	58
2017	5	42
2018	27	29
2019	39	2479
2020	147	1556
2021	205	4064
2022	182	2110
2023	52	2190

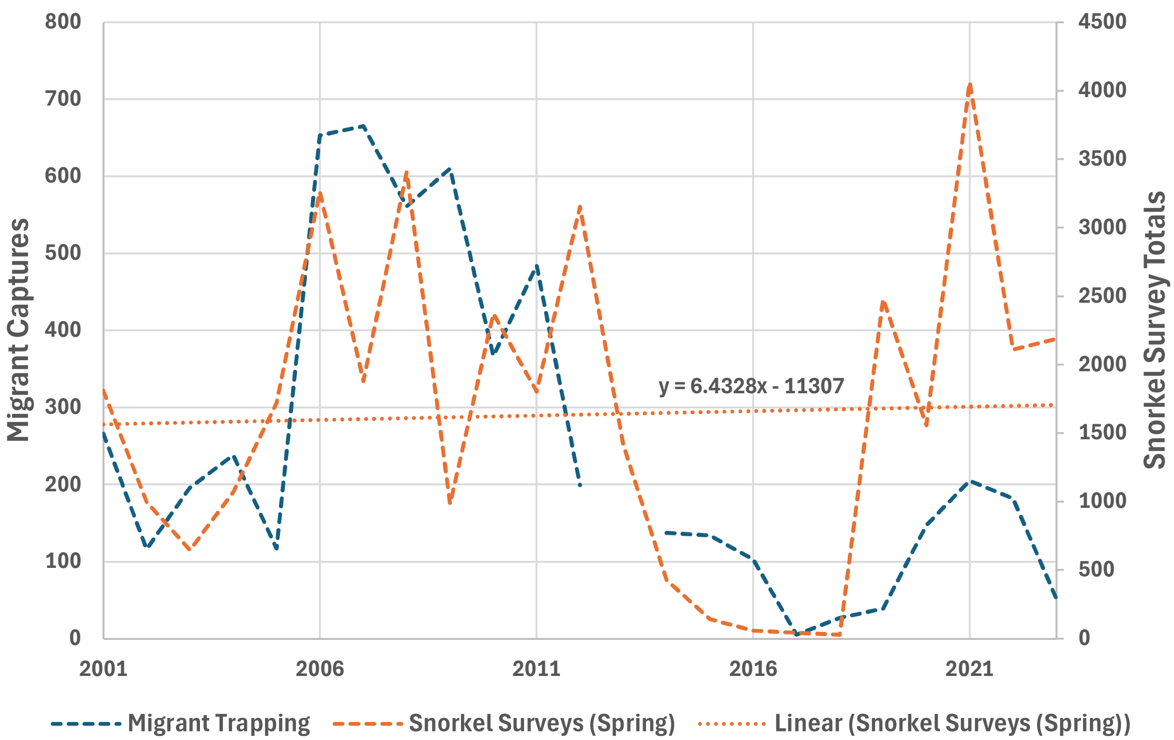


Figure 1: Migrant trapping and snorkel survey data from 2001 to 2023 for the LSYR basin showing a trendline for the snorkel survey data.

- Although no anadromous LSYR fish have been observed during migrant trapping in the LSYR basin since 2011 (partly due to the prolonged drought when the sandbar at the LSYR Lagoon was closed to the ocean), we have documented anadromous redds (identified by size) in 2021 (LSYR mainstem downstream of a beaver dam near the Salsipuedes Creek confluence) and 2023 in El Jaro Creek. Redds were not used in the analyses, but spawner surveys are a means of identifying the presence of anadromous fish and could be used as a surrogate.

- There was no mention of beaver dams possibly inhibiting migration within the LSYR basin. During high flow years, beaver dams are not an issue for fish passage. However, during moderate to low years, they can limit migration considering there can be well over 50 dams (range from 2010 to 2023 is 45 to 132 dams) within the LSYR mainstem of varying sizes to navigate, and often double-digit dams in the tributaries.

- Section 4.3.1.2: Santa Cota Creek, the correct name is Zanja de Cota Creek.

- 4.3.1.2 Page 46: We request the paragraph discussing recent modification in the operation of Bradbury Dam for increased releases be modified for accuracy. For example, the 2000 Biological Opinion contains provisions for dam releases to benefit the downstream fishery both in the LSYR mainstem and Hilton Creek during dry and wet years. The recent Water Rights Order 2019-0148 tiered off those provisions and required higher releases during wet years (determined by inflow to the lake) to benefit the downstream fishery during the year of and year after that determined wet year. The higher releases are referred to as Table 2 flows that have the purpose of supporting migration, spawning, and rearing in the LSYR.

Thank you for considering our observations, comments, and suggestions. Please contact our General Manager, Janet Gingras, at 805 / 687-4011 ext. 201 if you have questions or need additional information.

Sincerely,

Polly Holcombe
Polly Holcombe (Mar 25, 2024 16:54 PDT)

Polly Holcombe
Board President
Cachuma Operation and Maintenance Board

cc: Brian Hennes, CDFW (Brian.Hennes@wildlife.ca.gov)
Claire Ingel, CDFW (Claire.Ingel@wildlife.ca.gov)
SCSH@wildlife.ca.gov

CESA-Status-Review-Report-comment-letter

Final Audit Report 2024-03-25

Created:	2024-03-25
By:	Dorothy Turner (dturner@cachuma-board.org)
Status:	Signed
Transaction ID:	CBJCHBCAABAAriVSicejV9j36slRbpCpBWrHzm_Oq08D

"CESA-Status-Review-Report-comment-letter" History

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- Agreement completed.
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Pasadena Casting Club
P.O. Box 711
Pasadena, CA 91102

28 Mar 2024

To: California Fish and Game Commission

Via Email: fgc@fgc.ca.gov

From: Pasadena Casting Club

Subject: CESA listing for Southern Steelhead

Dear President Murray and Commissioners:

Pasadena Casting Club is a group of fly fishing enthusiasts dedicated to the art of angling and casting, conservation, and education. The club was founded in 1947 and has over 350 members. We participate in conservation activities to maintain healthy streams and fisheries, run programs to introduce veterans, women, and young people to fly fishing, and serve our community by raising awareness of California's fisheries and the habitat that supports them. I am writing on behalf of our Board of Directors and our club to support designating Southern California steelhead as endangered under California's Endangered Species Act.

We appreciate the extensive research performed by California Trout and the work completed to submit the petition for listing in 2021. And we applaud the unanimous decision that the California Fish and Game Commission made in April 2022 that stated listing under CESA "may be warranted". Now that the species status review has been completed by the California Department of Fish and Wildlife, and supports the findings of the petition, we request that the Commission act quickly to save this amazing fish.

Southern steelhead are an iconic native species in our region, and our members have witnessed first-hand the loss of habitat and decline of the species in Southern California. These fish are not just valued for their beauty and incredible toughness, but as an indicator of the state of our watersheds. Although remarkably resilient, continued impacts on our stream systems could result in the complete loss of this species unless they are protected. We believe that protection for the fish will also provide water quality, watershed health, recreation, and other benefits to all Californians.

For these reasons, Pasadena Casting Club supports California Trout's recommendation that Southern steelhead be listed as endangered in all waterways within their historic range below natural or man-made barriers. California Trout chose this delineation thoughtfully, so that fishing and continued management for rainbow trout, the freshwater form of this species, will still be possible above these barriers.

Please act now to make protection of these amazing fish a conservation priority by listing them as endangered under the state's Endangered Species Act.

Sincerely,

Pasadena Casting Club

Edward E. Wallace
Conservation Chair

Cc: PCC Board of Directors

United Water CONSERVATION DISTRICT

April 1, 2024

California Fish and Game Commission
PO Box 944209
Sacramento, CA 94244-2090
Sent via email: fgc@fgc.ca.gov

California Department of Fish and Wildlife
Fisheries Branch
Attn: Southern California Steelhead
P.O. Box 944209
Sacramento, CA 94244-2090
Sent via email: SCSH@wildlife.ca.gov

Subject: United Water Conservation District Comments on the California Department of Fish and Wildlife California Endangered Species Act Status Review of Southern California Steelhead (*Oncorhynchus mykiss*)

Dear Commissioners and Fisheries Branch Staff:

United Water Conservation District (United) submits the following comments to the California Fish and Game Commission (Commission) and California Department of Fish and Wildlife (CDFW) in response to the Status Review of southern California steelhead (*Oncorhynchus mykiss*) (Status Review) prepared by CDFW (2024). In their Status Review, and pursuant to Fish and Game Code (FGC) § 2074.3 and 2074.6, CDFW is required to evaluate the breadth of available scientific literature and develop a summary of the status of southern California steelhead as well as a recommendation to the Commission for listing under the California Endangered Species Act (CESA). United has completed a thorough review of the Status Review and it is clear that CDFW has based key findings on partial sets of data, which in large part is only relevant to the anadromous component of the proposed listing unit of southern California steelhead rainbow trout ("Southern SH/RT"). The comments from United include relevant context regarding the analysis and findings of the Status Review and should inform the Commission's decision at this stage in the listing process. Past comments from United to the Commission and CDFW are included as an attachment to this submittal as they remain applicable and provide useful background regarding the information relied upon through the previous stage of the listing process. Ultimately, the Status Review does not provide an analysis of the status of the species based on the best available science and the recommendation from CDFW to list Southern SH/RT under CESA is premature. The Commission should find that the listing is not warranted at this time and should rather delay the listing decision until after additional data collection to accurately characterize the resident and anadromous life-history variants in the proposed listing unit.

Population Abundance and Trend

The population trend analysis in the Status Review is flawed

Regarding the methods to monitor fish in a given study, CDFW's steelhead monitoring protocol (Fish Bulletin 182) states "The methods likely involve different inherent biases in their estimates; and thus, once a deployment decision is made, a given method should be used consistently for a given population, to support valid trend estimation." In short, the sources of information that CDFW utilized in their analysis of population abundance and trend do not provide consistent and comparable results as these monitoring programs are not designed to support such an assessment. The results included in the Status Review do not meet CDFW's own standards and are, therefore, invalid.

In the Status Review, CDFW completed an analysis of abundance and trends with "annual abundance data compiled from a variety of sources." The sources used include monitoring programs in the Santa Ynez River (COMB 2022), Santa Clara River (Booth 2016), and Ventura River (CMWD 2005-2021 and Dagit et al. 2020) and was limited to data from trapping efforts associated with past and ongoing monitoring in these three watersheds, the populations within which are designated as Core 1 under the federal ESA listing (NMFS 2012). This is problematic for multiple reasons:

1) Monitoring data accounts for those individuals that are biologically motivated to move within the watershed (e.g., based on resource availability) or to migrate, but does not account for *O. mykiss* residents within the watershed. A detailed example of this shortcoming is provided in the 'Proper accounting for resident *O. mykiss* yields different conclusions' section below.
2) Monitoring efforts have changed within the period of analysis, so these results are not directly comparable. Monitoring of adult migration conducted by United at the Freeman Diversion fish ladder has consisted of trapping from 1994-1997 (prior to the federal ESA listing), incidental observation during facility dewatering from 1998-2002, false weir and passive video-based surveillance system (video cameras/ infrared scanner) from 2002-2010, updated computer-based surveillance system (network cameras) in 2010 with additional cameras added between 2011-2014, and further upgrades to the camera systems in 2016 and 2023 to current generation equipment. The current system is triggered to record video footage by an infrared scanning beam and camera–based motion detection. This system is thought to potentially undercount adult steelhead based on collection of several downstream migrating kelts observed in the facility's downstream migrant trap through 2014 that did not match observed upstream migrants. The 2016 upgrades are thought to have addressed these shortcomings, though only one (possibly a second, though not confirmed) adult upstream migrating steelhead has been detected by the surveillance system since 2012 (in 2020). Monitoring efforts at the Freeman Diversion were not consistent over the range of years evaluated by CDFW. Due to permitting restrictions, the downstream migrant trap at the Freeman Diversion was not operated after 2015, a fact the Status Review fails to acknowledge (4.4.1.1, Figure 12.C.) and downstream migrant trapping efficiency has never been assessed. Overall, monitoring data from the Freeman Diversion on the Santa Clara River does not provide the level of detail and consistency necessary to support the analysis completed in the Status Review.

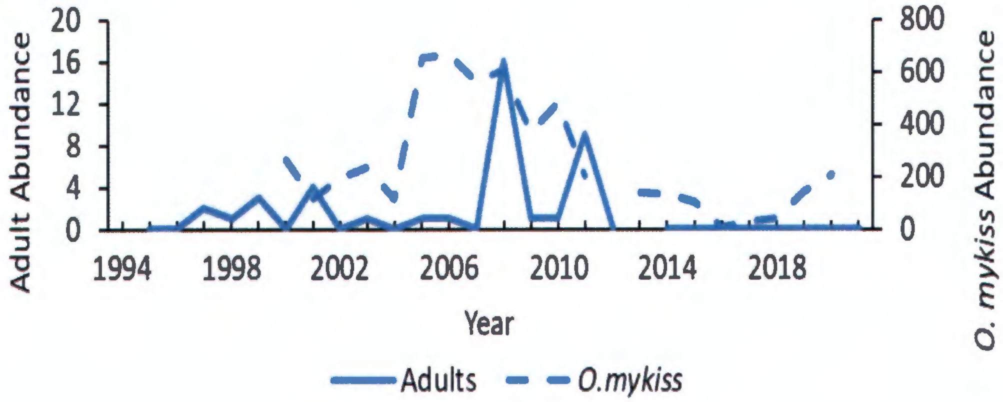
In another example, regarding monitoring data from the Santa Ynez River, the Status Review notes that no data was collected in 2013 and that "Biological Opinion Incidental Take provisions have been required since 2014" (4.4.1.1, Figure 12.A.). However, the Status Review fails to acknowledge that the Biological Opinion Incidental Take provision required a reduced trapping effort (i.e., fewer trapping days) after 2014 compared to previous years, even though the COMB (2022) reference clearly states the reduced trapping efforts from 2014 through 2022. Therefore, monitoring results are not comparable across years. Overall, the data utilized by CDFW in the Status Review to evaluate the abundance and trends of the proposed listing unit does not provide the level of rigor necessary for this analysis and does not meet CDFW's own standards outlined in Fish Bulletin 182.

3) Trapping is limited to periods when flows allow for installation and operation of fish traps (i.e., high flows may preclude trap operation) and/ or based on other facility or flow conditions. As an example, the downstream migrant trap at the Freeman Diversion only operated when United was actively diverting water and only as a conservation tool to rescue fish (and subsequently relocate them to suitable habitat) that would otherwise be discharged downstream to poor river conditions. During high flows, the trap was not operating because United was not diverting water or downstream river conditions were suitable for fish and trapping/ relocating fish was not necessary. Also, notably the downstream migrant trap only sampled a small proportion of the total river discharge at high flows (i.e., the proportion being diverted), the remainder of which was flowing downstream past the diversion facility.
4) Trap data alone is not representative of even the migrating portion of *O. mykiss* without a trap efficiency study. Further, the Status Review failed to include available information from other monitoring studies (e.g., snorkel surveys) conducted as part of these same monitoring efforts, which more accurately characterizes the overall *O. mykiss* population. CDFW failed to use the best available science in their analysis, and therefore, the conclusions drawn are not sufficiently supported. Please see the detailed example of this issue in the 'Proper accounting for resident *O. mykiss* yields different conclusions' section below.

Proper accounting for resident *O. mykiss* yields different conclusions

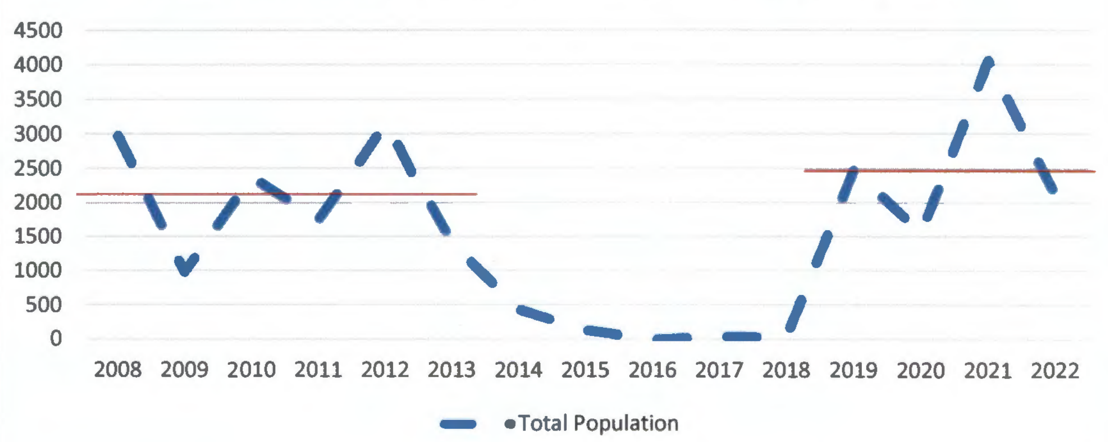
In the Status Review, CDFW omits survey data for resident *O. mykiss,* which in one example below, contradicts the stated conclusions regarding the abundance and trends of the proposed listing unit. The information presented in the Status Review for the Santa Ynez River regarding the abundance of *O. mykiss* is displayed on Figure 12 (A. Santa Ynez River), and is reproduced here for ease of reference:

A. Santa Ynez River



The Status Review figure above indicates that *O. mykiss* abundance never increased above approximately 700 individuals during the period of analysis. However, a review of the monitoring reports referenced by CDFW (COMB 2022) found a total *O. mykiss* abundance within the surveyed reaches varying with the antecedent conditions (i.e., wet/ dry water year cycles), from a low of <100 individuals at the height of the recent drought to a maximum of over 4,000 individuals following drought. It should be noted that these totals represent only the numbers within the surveyed portions of the river, which cover only a small fraction of the overall Santa Ynez River watershed. The totals, therefore, do not represent a characterization of the total population within the watershed. Clearly, the abundance numbers in the Status Review do not account for the full reported values and it is unclear why CDFW omitted a portion of the available data. These totals include all *O. mykiss* surveys (i.e., trapping and snorkel surveys), which more appropriately represents the petitioned listing unit. A closer review of this data finds that the "pre-drought" population from roughly 2008-2013 averaged 2,100 individuals while the "post-drought" population from roughly 2018-2022 averaged 2,500 individuals (Figure 1).

Figure 1. Total *O. mykiss* Abundance
Data from COMB (2022) Annual Monitoring Summary



In the Status Review, CDFW does not properly account for resident *O. mykiss*, and the resulting interpretation of the species status mischaracterizes the overall abundance and trends, as demonstrated by the example on the Santa Ynez River detailed above. The monitoring results on the Santa Ynez do illustrate the species response to drought conditions, with an observed reduction in observations during the historic 2012-2017 drought experienced in the region, presumably due to limitations in available suitable habitat, food resources, etc., which may provide an indication of the overall trends within the watershed. However, the data also shows the expected response post-drought, with a significant population increase following the onset of average to above average precipitation in ensuing water years. This example was selected since the Santa Ynez River has the most complete dataset of the overall *O. mykiss* population within the watersheds analyzed in the Status Review. Further, data from United's Freeman Diversion used in the Status Review is not comparable to data collected in the Santa Ynez River as the Freeman Diversion is located in the lower Santa Calara River, approximately 10 miles from the river mouth, in a reach that has been considered a migration corridor, and not spawning or rearing habitat for *O. mykiss.* More broadly within the region, the available data does not provide a consistent and accurate representation of the *O. mykiss* population, and therefore, the abundance and trends cannot be reliably calculated. Taken together, the abundance and trends analysis in the Status Review is a foundational component of the listing recommendation upon which the Commission is likely to base their decision. However, CDFW's analysis is flawed and not supported by the best available science.

Information relevant to resident *O. mykiss* is lacking or omitted

As United has commented on in the past, the original petition submitted by CalTrout did not address resident *O. mykiss* sufficiently. CDFW's previous petition evaluation report similarly failed to address resident *O. mykiss* sufficiently to accurately characterize the petitioned listing unit, which was defined in CDFW's evaluation report as:

> "All *Oncorhynchus mykiss,* including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico Border with the understanding that anadromous (adult southern steelhead) arise from anadromous and resident naturally spawning adults."

The definition of the proposed listing unit in the Status Review is largely similar to the previous definition, with the primary exception being the removal of the language regarding "anadromous (adult southern steelhead) arise from anadromous and resident naturally spawning adults":

> "all *O. mykiss* below manmade and natural complete barriers to anadromy, including anadromous and resident life histories, from and including the Santa Maria River (San Luis Obispo and Santa Barbara counties) to the U.S.-Mexico Border."

To account for the life history variability, CDFW used the term "southern California steelhead rainbow trout (Southern SH/RT)" to define the proposed listing unit. However, in multiple instances, the Status Review fails to account for resident *O. mykiss* both in the presentation of data as well as in the development of conclusions. For example, in the Historical and Current Distribution Section (4.3), the Status Review states:

> "In general, estimates of historical population abundance are based on sparse data and assumptions that are plausible but have yet to be adequately verified or tested. While the following

historical estimates are likely biased either upward or downward, the examination of historical records of adult run size in southern California show consistent patterns of abundance that are at least two or three orders of magnitude greater in size than in recent years."

The quoted language above mentions the "adult run size," presumably referring to the anadromous portion of the proposed listing unit. However, the resident component is not mentioned, which is concerning given CDFW's ongoing Heritage and Wild Trout Program and/or the Coastal Salmonid Monitoring Program. These Department programs complete surveys on *O. mykiss* in multiple watersheds within the region A separate example of omission of resident *O. mykiss* is in the Trends Analysis section (4.4.3.3) of the Status Review, which states "many populations occurring south of the Santa Monica Mountains are considered severely reduced and, in many instances, extirpated." However, David Boughton, an *O. mykiss* researcher with the National Oceanic and Atmospheric Administration Southwest Fisheries Science Center (NOAA SWFSC) selected by CDFW to peer review the draft Status Review commented that CDFW "clarify that you're talking about steelhead specifically here, not *O. mykiss*, since there are often extant *O. mykiss* populations in the headwaters." CDFW failed to add clarification in the final Status Review, but rather changed the preceding language from "steelhead" to "Southern SH/RT," which contradicts the peer reviewer's comment.

In the original listing of southern California steelhead Environmentally Sensitive Unit (ESU) under the federal ESA and reiterated in the designation of the southern California steelhead Distinct Population Segment (DPS), the U.S. Fish and Wildlife Service (USFWS) disagreed with NMFS' proposal to include resident *O. mykiss* in the listing unit. The 2006 DPS listing (71 FR 833) states that "FWS, the agency with ESA jurisdiction over resident *O. mykiss*, disagreed that resident fish should be included in the steelhead ESUs and advised that the resident fish not be listed". The position of the USFWS was based on the absence of evidence that resident *O. mykiss* needed protection under the federal ESA (62 FR 43937). The information provided in the Status Review is focused on the anadromous component of the proposed listing unit and the lack of evidence regarding the status of residents persists. As United has commented on in the past[1], the available evidence shows that a resilient population of resident *O. mykiss* persist in many watersheds both above and below barriers, and these systems are capable of supporting robust populations that provide a substantial and well documented contribution to the overall species.

NMFS population viability model does not include the resident component

The CalTrout petition included multiple references to National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA-NMFS) assessments of the anadromous component of the overall *O. mykiss* population. In the evaluation of the petition completed by CDFW in November 2021, CDFW referred to the NMFS population viability threshold of 4,150 anadromous spawners per year on average within an individual watershed, which was developed by the NMFS Southwest Fisheries Science Center (Boughton et al. 2007) and included in the NMFS Recovery Plan (NMFS 2012). The Status Review similarly refers to the NMFS viability threshold in the conclusions under the Abundance and Trends section (4.8.1), stating that "the results of our analyses demonstrate that no population is near the criteria necessary to provide resilience from extinction."

Again, the Status Review fails to account for the resident component of *O. mykiss* in key findings and conclusions. The viability criteria developed by NMFS accounts for only the anadromous component of

[1] See attached comment letters and information submittals from United to the Commission and CDFW dated August 17, 2021, December 2, 2021, February 1, 2022, and September 20, 2022

O. mykiss. In Boughton et al. (2007), the authors state the importance of the interchange between resident and anadromous *O. mykiss*; however, the conclusions of their assessment are limited to the anadromous component, stating that "100% of the spawners must be anadromous". In 2023, NMFS released a 5-year review of southern California steelhead (NMFS 2023), which further examines the interchange between resident and anadromous *O. mykiss* and suggests a new population density criterion of 0.3 fish/m^2 to account of residents as an "appropriate provisional population density viability criterion". Ultimately, the NMFS 5-year review does not change the population viability criteria under the federal listing but CDFW does not refer to this information in their Status Review. The statement in the Status Review that "no population is near the criteria necessary to provide resilience from extinction" is therefore, misleading as it is based on information relevant solely to the anadromous component of the listing unit.

New southern California steelhead life-cycle model includes resident life-history

United and other agencies have commented in the earlier stages of the CESA listing process that information presented in the CalTrout petition and evaluated by CDFW in the petition evaluation regarding the population trend of southern California steelhead presented only the anadromous component of the proposed listing unit – not the resident component – including numbers of returning anadromous adults and declines in numbers compared to historic population estimates. In the petition evaluation report, CDFW noted that information on population abundance and trends of resident *O. mykiss* is limited. United disagrees, as information that contributes to the best available science is readily available and would allow for reasonable inference regarding the status of residents as it relates to the proposed listing. United provided information to CDFW at the outset of the Status Review process relevant to the abundance of resident *O. mykiss* in several watersheds within the proposed listing unit boundaries. However, this information was largely ignored and information presented by CDFW in the Status Review regarding resident *O. mykiss* was not utilized in the development of key findings, including the status of the species abundance and population trends over time.

A group of agencies led by the Association of California Water Agencies (ACWA) anticipated that this key information gap would persist through the development of the Status Review. In an effort to fill this gap and demonstrate the complex life-history dynamics contributing to the persistence of *O. mykiss* and inform the listing process ACWA contracted Cramer Fish Sciences (Cramer) to develop a life-cycle model that incorporates the resident and anadromous life-history types. During the petition process through the start of CDFW's status review, the water agencies, including United, provided substantial comments and background references highlighting the available science on the interplay of the resident and anadromous life-history types on the persistence of the species. Notably, the June 2021 CalTrout petition agrees with this, stating in their assessment that "[f]ish that express the resident freshwater life-history strategy play a central role to the continued existence of southern steelhead." This statement is well supported by the available literature; however, a thorough evaluation incorporating the multiple *O. mykiss* life-history strategies and viability metric was not available, and therefore, the development of a life-cycle model is seen as providing new information for consideration by CDFW and the Commission. The Status Review supports the development of such a tool to consider existing information related to the interplay of resident and anadromous *O. mykiss,* stating in section 2.5.5 that "the close genetic relationships between sympatric populations of steelhead and Rainbow Trout suggest that the populations interbreed and that close relatives, including full siblings, may express alternative ecotypes (or other life-history variation, e.g., adfluvial or lagoon migration). Therefore, managing individual fish with different life histories separately is biologically unjustified, and the two life history variants should be considered a single population when found coexisting in streams."

The life-cycle model in its current iteration is intended to inform CDFW and the Commission of the overall trajectory of the proposed listing unit with appropriate consideration of the life-history types, including resident and anadromous O. mykiss. The scope of the life-cycle model is appropriately broad at this stage, encompassing general assumptions based on the available literature about the species within the proposed listing unit, applying local information and reasonable assumptions to parameterize the model and allow for the evaluation of a wide range of scenarios to test those assumptions. As described by Cramer (2023), the life-cycle model parameters are based on the known life-history variability of *O. mykiss* in the proposed listing unit. The model uses empirical data, when available, from the scientific literature to set parameter values, with flexibility to change parameter values as additional data becomes available as well as based on professional judgement. As commented on above, population trends are a key component of the Status Review, and the findings and conclusions are based on incomplete data. The life-cycle model provides a valuable tool, with incorporation of all available information on anadromous and resident *O. mykiss* within the proposed listing unit, to examine the long-term responses to a range of scenarios and reevaluate the conclusions in the Status Review. Integration of the model in the Status Review would allow for the exploration of population dynamics, and the extent to which these dynamics are affected by individual parameters and their values. Cramer (2023) highlights a key advancement provided by the model, noting that "the core dynamics demonstrate that concepts like connectivity and life history variants can have large impacts on a population's trajectories, and that omitting them may not fully capture the population's capabilities." This is one example of the utility of the model, but there are others, including the assessment of other biological variables (e.g., anadromous fraction) and environmental variables (e.g., future climate scenarios) as they contribute to the status of the species.

The life-cycle model was presented to CDFW prior to the submission of the Status Review. On December 12, 2023, a meeting was held to introduce the life-cycle model to CDFW staff, including those working on the Status Review, with an overview on the model development background, methodology used, literature reviewed as the basis for the model parameterization, and initial model outputs. The meeting was also intended to initiate a dialogue between the biologists working for the regulated stakeholders, third-party technical experts (Cramer), and CDFW regarding the information needed to make sound management decisions in the proposed listing unit. ACWA members were represented by biologists Randall McInvale (United), Sarah Mulder (Ventura Water), and Scott Lewis (Casitas Municipal Water District), Environmental Services Manager Marissa Caringella (United), Executive Director of Planning and Natural Resources Lisa Haney (Orange County Water District), and State Relations Advocate Stephen Pang (ACWA). CDFW was represented by Kyle Evans, Chenchen Shen, and Robyn Bilski. Cramer was represented by Kai Ross, PhD and Joe Merz, PhD.

Following the submission of the Status Review, ACWA United and independent scientists have continued to bring the life-cycle model to the attention of CDFW and the Commission. On January 22, 2024, ACWA sent CDFW a link to the life-cycle model giving CDFW full access to use the model. On February 7, 2024, ACWA sent CDFW a copy of Cramer's draft memorandum detailing the model's background and function. And, on February 13, 2024, United and its legal representative met with the Commission's attorney—Supervising Deputy Attorney General Eric Katz. During that meeting, United presented the life-cycle model, demonstrated how the model worked and explained how the model represented an advancement in the scientific tools available to evaluate the long-term survival of *O. mykiss.*

Considering the lack of data in the Status Review to properly characterize the proposed listing unit, and without incorporation of the life-cycle model in the evaluation, CDFW has not demonstrated that they have utilized the best scientific information currently available in developing their conclusions and recommendations. The listing decision should not move forward until there is a more thorough evaluation of the available scientific information, including the life-cycle model, to ensure that the management decisions appropriately characterize the population proposed for listing.

Recommendations for management of the proposed listing unit

United appreciates the opportunity to provide comments on the Status Review. The information summarized herein demonstrates the need for a more transparent analysis of the data available on *O. mykiss* in the proposed listing unit, as well as the need for future data collection using standardized methods to accurately characterize the proposed listing unit population. The decision by the Commission at this stage must be scientifically sound and, as noted in our comments, the analysis completed in the Status Review, and the data used to complete these analyses, raises fundamental questions regarding the validity of the conclusions upon which the recommendations are based. We understand that the Commission must make a decision based on the available information, but as demonstrated in our comments, key questions have yet to be sufficiently addressed. With availability of the new life-cycle model developed for southern California steelhead and provided to CDFW, the conclusions in the Status Review should be reevaluated. As of now, fundamental questions regarding the status of the species remain unanswered and it is evident that the data currently available does not begin to fill the information gap needed to properly evaluate the proposed listing unit. United implores the Commission to find that the listing is not warranted at this time.

Respectfully,

Mauricio E. Guardado, Jr.
General Manager

Enclosures

Attachment 1 – United Water Conservation District letters to the Fish & Game Commission and CDFW dated August 17, 2021, December 2, 2021, February 1, 2022, and September 20, 2022

United Water
CONSERVATION DISTRICT

August 17, 2021

Vanessa Gusman
California Department of Fish and Wildlife
Fisheries Branch
PO Box 944209
Sacramento, CA 94244-2090

Subject: CalTrout petition to list Southern California Steelhead as endangered under the California Endangered Species Act (CESA)

Dear Ms. Gusman:

United Water Conservation District (United) submits the following information in response to the CalTrout petition to list southern California Steelhead as an endangered species under the California Endangered Species Act (CESA) (CalTrout petition). As a California Special District with a vested interest in the conservation of southern California steelhead (*Oncorhynchus mykiss irideus*) (steelhead; *O. mykiss*), United has a well-documented history of monitoring southern California steelhead in the Santa Clara River watershed. The work of United, along with a handful of others in the region, comprises the majority of the monitoring conducted on the species in southern California. Through this monitoring and data analysis, United has developed an understanding of *O. mykiss* in the watershed that has been leveraged in extensive consultations with the regulatory agencies over the years. An information gap regarding *O. mykiss* ecology exists in the region and key research questions remain unanswered, as the information presented below demonstrates. That history and knowledge gap compels the conclusion that the California Department of Fish and Wildlife (CDFW) should study this species – not list it based on the limited information provided in the CalTrout petition.

To aid CDFW's review, United provides additional information and references, formatted to primarily address inaccuracies, or in some cases correct information, presented in the CalTrout petition, followed by a discussion and references to specific documents for consideration in the evaluation of the petition. Specific references included in this submittal are largely focused on steelhead in the Santa Clara River watershed, though reference to the greater geographic region and steelhead population is included as appropriate.

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The CalTrout Petition Misrepresents United's Freeman Diversion.[1]

The CalTrout petition states that United's Freeman Diversion facility has not been remediated. This statement fails to recognize that (1) the existing facility[2] continues to provide passage for steelhead, with two confirmed upstream migrating steelhead observations as recently as 2020, (2) United is continuing to prepare a Habitat Conservation Plan (HCP) pursuant to Section 10 of the federal Endangered Species Act (ESA) associated with the rehabilitation of the fish passage facility at the Freeman Diversion and an updated bypass flow program intended to balance the needs of species and water resources in the region, (3) physical modeling of alternative fish passage designs by the United States Bureau of Reclamation (BOR) is currently underway, and (4) United continues to consult with National Marine Fisheries Service (NMFS) and CDFW on all of the above. The rehabilitated fish passage facility will represent a significant improvement over the existing condition and will provide improved fish passage conditions for steelhead as well as Pacific lamprey (*Entosphenus tridentatus*), design criteria for which is a primary component in the 10+ year alternative fish passage design process underway with NMFS and CDFW's involvement.

The adult steelhead run size estimates[3] are unsubstantiated by quantitative data. Establishment of achievable management and recovery objectives is hampered by the lack of reliable historic and current population data.

The historic run size estimate in the Southern California Steelhead Recovery Plan[4], which is cited by the CalTrout petition, comes from "The Updated Status of Federally listed ESUs of West Coast Salmon and Steelhead" (Good et al. 2005) and includes steelhead estimates for each

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[1] CalTrout Petition. See pg. 13, paragraph 1.

[2] United operates the Freeman Diversion to conserve, maintain, and put to beneficial use the waters of the Santa Clara River watershed, with one of the primary goals being to combat seawater intrusion in the Oxnard Plain. United has diverted water from the Santa Clara River at the Freeman Diversion to provide for surface water deliveries and groundwater recharge in accordance with water right license 10173 and permit 18908. CDFW protested the original application to the water rights permit in 1980, citing a remnant steelhead resource in the river. Through much coordination and consultation between United, CDFW, the State Water Resources Control Board (SWRCB), and the Department of Water Resources (DWR), a steelhead study was completed in the river in the early 1980s, which resulted in the installation of a Denil fish ladder and implementation of bypass flows for fish passage at the request of and based on specifications provided by CDFW. SWRCB issued water right permit 18908 to United in 1987 and subsequently amended it in 1992. The permit incorporated CDFW's recommended fish ladder and bypass flow provisions, which were notably protested by DWR due to the importance of combating the severe seawater intrusion experienced in the Oxnard Plain. Nevertheless, United accepted the fish passage provisions and began implementation when the Freeman Diversion became operational in 1991. Over the years, United has modified bypass flows several times for the benefit of steelhead, each time decreasing diversion yield compared to its water rights license and permit. As a result, the seawater intrusion conditions have been magnified by the ongoing drought conditions and limited diversion yield.

[3] CalTrout Petition. See pg. 2, paragraph 5, pg. pg. 6 paragraph 5, and pg. 7 paragraph 1.

[4] NMFS. 2012. Southern California Steelhead Recovery Plan. See pg. xiii, paragraph 3.

of the major watersheds. Within the Ventura River watershed, the estimate traces back to a 1946 CDFW letter commenting on the future Matilija Dam.[5] Within the Santa Clara River watershed, the 1980 estimate by Moore[6] of the average population traces back to the same 1946 CDFW letter from which Moore extrapolated an estimate in the Santa Clara River by comparing the potential habitat of the two watersheds. This fact is echoed in CDFW's 1996 Steelhead Restoration and Management Plan for California[7] and again by NMFS (2005)[8], which also includes a review of the historical run sizes in the major southern California watersheds. Moore's knowledge of the Santa Clara Watershed comes from the late 1970s and early 1980s, one of the wettest periods on record, causing an overestimation of river miles of suitable steelhead habitat. In the same 1980 report, Moore notes that projecting the average run size can be misleading, particularly in systems subject to extreme flow fluctuations from year-to-year.

In a review of the history of steelhead in the Santa Ynez River, Alagona et al. (2012)[9] acknowledges the natural variation in steelhead run sizes, particularly in the southern California ecosystems, noting that "[a]ll of these perturbations and processes affect steelhead populations, which may have varied by two orders of magnitude annually owing to natural changes alone." The original source of the Santa Ynez River estimate came from a report generated by Shapovalov[10], a CDFW employee, which relied upon the opinion of another CDFW employee (Carl Tegen) who was working as a trapper in the Santa Ynez River watershed. Tegen compared the number of steelhead in the Santa Ynez River to counts in the Eel River and deduced that the Santa Ynez steelhead run during the year in question (1944) was "at least as large" as the Eel River. While it is apparent that there were many adult steelhead in the Santa Ynez in 1944, it would be inaccurate to assume that his estimate was a running average of a natural run of steelhead for the same reason that Moore notes in his 1980 report regarding year-to-year fluctuations in flows within these river systems.

CDFW acknowledges this subjectivity in quoting the U.S. Fish and Wildlife Service (USFWS) in the Fish Species of Special Concern in California.[11] CDFW notes that the estimates of historical run sizes "are highly subjective and probably correct only within an order of magnitude". In Good et al. (2005), NMFS concurs with the earlier CDFW statement and goes a

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[5] Clanton D.A. and Jarvis J.W. 1946. Field inspection trip to the Matilija-Ventura watershed in relation to the construction of the proposed Matilija Dam. California Division of Fish and Game, Field Correspondence.
[6] Moore M. 1980. An Assessment of the Impacts of the Proposed Improvements to the Vern Freeman Diversion on Anadromous Fishes of the Santa Clara River System, Ventura County, California. See pg. 14, paragraph 2.
[7] CDFW. 1996. Steelhead Restoration and Management Plan for California. See pg. 55, paragraph 4.
[8] Good T.P., Waples R.S., Adams P. 2005. The Updated Status of Federally listed ESUs of West Coast Salmon and Steelhead. See pg. 282, paragraph 4.
[9] Alagona P.S., Cooper S.D., Capelli M., Stoecker M., Beedle P. H. A History of Steelhead and Rainbow Trout (*Oncorhynchus mykiss*) in the Santa Ynez River Watershed, Santa Barbara County, California. See pg. 169, paragraph 4.
[10] Shapovalov L. 1944. Preliminary Report on the Fisheries of the Santa Ynez River System, Santa Barbara County, California. See pg. 12, paragraph 2.
[11] CDFW. 1995. Fish Species of Special Concern in California. See pg. 81, paragraph 4.

step further to adjust down the historical run size estimate for the Santa Ynez based on a logical inference regarding Tegen's experience in the Santa Ynez and Eel Rivers. Good et al. (2005) summarizes their review of historical run sizes by stating that "the estimates of historical run sizes for the Southern California steelhead ESU are based on very sparse data and long chains of assumptions that are plausible but have not been adequately tested." Therefore, to properly evaluate southern California steelhead, CDFW must first develop an accurate estimate of adult run size necessary to establish the status of the species and appropriate recovery goals in southern California watersheds.

Furthermore, another concern is that the estimates were based on an artificially stocked population supported during the extensive steelhead planting program implemented by CDFW beginning in the 1890s and continuing up to the 1930s (Bowers 2008). In the 1910s, southern California rivers, including the Santa Clara and Ventura, along with their tributaries, were receiving up to 3 million trout from northern hatcheries per year. The fish planted were predominantly steelhead and a mix of resident with the anadromous form. This topic is discussed further below.

The focus on human induced population decline in steelhead[12] in southern California ignores the influence of artificial steelhead planting by CDFW.

In southern California, the rise and fall of the steelhead population directly correlates with CDFW's planting of northern steelhead in southern California waters. Prior to the planting from northern hatcheries, records of steelhead in the southern California rivers are minimal. For example, records from the missionary period never mention trout or steelhead, which contrasts with the rivers further north, and scarce records from the pre-colonial period. As noted in the review of steelhead in the Santa Ynez River by Alagona et al. (2012)[13], "we found relatively few explicit records of Chumash exploitation of riverine fish, such as steelhead in the Santa Ynez River, from Spanish, Mexican, and early American explorers and settlers," indicating that steelhead were possibly not as prevalent and abundant as previously asserted. Alagona et al. (2012) continues: "At present, the only archaeological evidence for steelhead presence comes from several theses and a museum contribution describing excavations of sites in former inland Chumash villages with associated information on the identity of fish elements… [s]teelhead remains were found at three of four excavated sites… 6 salmonid bone elements found at Xonxon'ata [located on Zaca Creek 6 miles above its confluence with the Santa Ynez River] constituted only 0.2% of the identifiable fish bones recovered at this site, with the rest assignable to marine species, and these bones appeared to come from immature steelhead or rainbow trout." Alagona et al. (2012) acknowledges that more research is necessary to draw conclusions

[12] CalTrout Petition. See pg. 3, paragraph 3

[13] Alagona P.S., Cooper S.D., Capelli M., Stoecker M., Beedle P. H. A History of Steelhead and Rainbow Trout (*Oncorhynchus mykiss*) in the Santa Ynez River Watershed, Santa Barbara County, California

regarding the presence of salmonid bones at the Santa Ynez River archaeological sites; however, the findings provide an indication of limited steelhead presence during the pre-colonial period.

As noted above, large numbers of trout from northern hatcheries were planted in southern California rivers in the 1890s up to the 1930s. The planted fish were predominantly steelhead and a mix of resident with the anadromous form. The history of the steelhead fisheries during this time is well documented.[14,15] By the early 1930s, there was a trend towards planting larger "catchable-sized" trout. In the late 1930s, the focus of the hatcheries had changed to producing and planting "catchables" that were mostly from a resident form of *O. mykiss.*[16] The decline in steelhead in southern California rivers coincided with the change in hatchery practices.

The population decline following the cessation of planting from northern hatcheries is evident in correspondence generated by CDFW officials and numerous newspaper articles at the time (McEachron 2007 and Bowers 2008). Alagona et al. (2012) also cited Spanne (1975), which "noted that runs of anadromous fish in the Santa Ynez River occurred right up to the construction of Bradbury Dam, but that they were much more predictable and frequent in the late nineteenth and early twentieth centuries based on the memories of elderly residents." The late nineteenth and early twentieth century time period is coincident with the steelhead planting program that was underway in southern California at that time. By 1951, the mention of a steelhead fishery in the newspapers had almost ceased to exist. During that year (1951), CDFW biologist Willis Evans stated: "The fisheries value of these drainages lies primarily in the existence of a resident population of rainbow trout in the head waters areas. Their range throughout most of the subject drainages is curtailed by the lack of sustained year long stream flows. High summer water temperatures above the tolerance of trout also prevent trout development in otherwise suitable streams such as lower Piru Creek."[17] "These drainages" referred to the Ventura and Santa Clara River watersheds. The following year (1952), the Santa Paula Chronicle reported that "Steelhead fishing season ended this year without a single catch being made." In 1954, a few steelhead were reported in the Ventura River but no catches were reported. Notably, these statements from CDFW were made prior to any major dams being constructed in the Santa Clara River watershed. Santa Felicia Dam, constructed on Piru Creek in 1955, was the first such dam. More

[14] McEachron M. 2009. A Review of Historical Information Regarding Steelhead Trout in the Piru Creek Watershed, Ventura County, California.
[15] Bowers K. 2008. History of Steelhead and Rainbow Trout in Ventura County: Newsprint Accounts from 1870 to 1955. Vol I.
[16] CDFW. 1970. Fish Bulletin 150 A History of California Fish Hatcheries. See pgs. 50-52.
[17] Evans W.A. 1951. U.S. Department of Agriculture "Report of Survey Santa Clara-Ventura Rivers and Calleguas Creek Watersheds, California" (January 1951). See pg. 1, paragraph 4.

recent records of steelhead in the Santa Clara River, primarily made by fisherman, CDFW, and by United were reported and are also well-documented.[18,19,20]

The CalTrout petition refers to steelhead monitoring at the Freeman Diversion fish ladder, stating that it, in part, "supports the finding that little to no change has been observed in total abundance or spatial structure of Southern steelhead since the initial federal listing." United does not refute this statement. However, it should be noted that it is consistent with previous CDFW surveys in the Santa Clara River watershed, which found low numbers of steelhead going back to the 1950s. Later, CDFW conducted a two year study in coordination with United in 1982-1983 and 1983-1984.[21] It resulted in the trapping and identification of a total of 3 steelhead over the two-year study period. As noted above, monitoring at the Freeman Diversion fish ladder has identified low numbers of adult steelhead, typically 0 to 2 individuals per year, since beginning operation in 1991 up to 2021. Combined with earlier observations, monitoring at the Freeman Diversion indicates that the total abundance of steelhead has remained relatively stable since well before the federal listing.

Further research into the relationship between resident and anadromous life-histories must be included in the analysis[22] of the status of steelhead, species stability, and recovery.

When considering the petition and potential future listing, the contribution of resident rainbow trout must be considered. A document prepared by NOAA-NMFS Southwest Fisheries Science Center supports this approach by stating: "Steelhead and rainbow trout belong to the same species (*O. mykiss*), and steelhead are the ocean-migratory ("anadromous") form and rainbow trout are the freshwater-resident form. There is a growing body of literature showing that steelhead and rainbow trout share freshwater habitat, mate with one another, and their offspring can either undergo physiological changes necessary to migrate to the ocean as a steelhead or undergo freshwater maturation as a rainbow trout."[23] As evidenced by this interplay, the ecology of the species clearly requires close examination by CDFW.

The CalTrout petition states that "[f]ish that express the resident freshwater life-history strategy play a central role to the continued existence of southern steelhead." United agrees with the CalTrout petition regarding this interplay of the freshwater resident and anadromous *O. mykiss* life-histories. NMFS recognizes the importance of the life history plasticity between the resident and the anadromous form of *O. mykiss*. In the recovery plan process, NMFS stated: "It is difficult to envision a successful recovery effort without a better

[18] Stoecker M., Kelley E. 2005. Santa Clara River Steelhead Trout: Assessment and Recovery Opportunities.
[19] Puckett L.K. and Villa N.A. 1985. Lower Santa Clara River Steelhead Study. Final Report.
[20] Entrix. 2000. Results of Fish Passage Monitoring at the Vern Freeman Diversion Facility Santa Clara River 1994-1998
[21] Puckett L.K. and Villa N.A. 1985.
[22] CalTrout Petition. See pg. 8, paragraph 1.
[23] Ohms H.A. and Boughton D.A. 2019. Carmel River Steelhead Fishery Report - 2019.

understanding of the functional relationship between resident and anadromous fish." They go on to explain that "this continuum has a significant implication for viability criteria."[24] The most recent NMFS 5-year review of the species referred to resident *O. mykiss*, their importance to the viability of anadromous steelhead populations, and how viability criteria in the Recovery Plan should be updated to account for the contribution of resident fish, a topic that is discussed in more detail below. Recently, several authors that have worked extensively with the southern California steelhead population published a study[25] that makes a key point: "Resident *O. mykiss* in upper watershed areas outside the designated critical habitat are not protected by either state or federal endangered species acts, despite their documented link in maintaining maximum numbers of [s]teelhead (NMFS 2012)." Dagit et al. (2020) also states that the Southern California Steelhead Recovery Plan (NMFS 2012) and Boughton et al. (2007) proclaim that an important consideration to prevent extinction is "protecting existing populations and all life history expressions."

The current recovery population viability goal of 4,150 spawners per year on average for southern California steelhead comes from Lindley's (2003) "random walk with drift" model using field data from the Central Valley (Boughton et al. 2007; Williams et al. 2016). However, the "random walk" model considers only 100 percent anadromous spawners (thereby disregarding the significant contribution of resident *O. mykiss*). This approach effectively means that in terms of achieving recovery goals, resident trout would not contribute to the anadromous form even though NMFS recognized that the Santa Clara River has maintained a population of smolts emigrating to the ocean while upstream migrant runs were too small to be self-sustaining. The limited consideration of purely anadromous fish for the recovery goal is biologically inappropriate for this species, and contrary to the wide recognition that resident *O. mykiss* play a key role in conservation of native coastal *O. mykiss*, including the steelhead life history strategy – particularly in arid southern California where intermittent flow regimes and prolonged droughts are common (Dagit et al. 2020). The viability studies recognized that the "interchange between resident and anadromous fish groups would almost certainly lower the extinction risk of both groups."[26] They go on to state that during their performance-based criteria analysis the interchange between the resident and anadromous form could have large consequences when determining extinction. Specifically, "we suspect that extinction risk of steelhead fraction is likely to be highly sensitive to the details of this interchange."

In the most recent 5-year review of the species, NMFS states that "the criteria that mean annual spawner abundance 1) be greater than 4,150, and 2) be composed of 100% anadromous individuals, were recommended as a risk-averse approach. It was expected that

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[24] NMFS. 2012. See pg. 14-13, paragraph 7.

[25] Dagit, R., M.T. Booth, M. Gomez, T. Hovey, S. Howard, S.D. Lewis, S. Jacobson, M. Larson, D. Mccanne, and T.H. Robinson. 2020. Occurrences of Steelhead Trout (Oncorhynchus mykiss) in southern California, 1994-2018. California Fish and Wildlife 106(1):39-58.

[26] Boughton. 2007. See pg. 8, paragraph 2.

further scientific work would either support these criteria or allow one or both to be relaxed" depending on the scientific research to fill key knowledge gaps including "uncertainty about the magnitude of normal fluctuations in adult abundance, and… uncertainty about the underlying biological mechanisms for expression of life-history diversity, especially factors triggering anadromous versus resident life-histories within populations."[27] Thus, there is clear acknowledgment that additional research is needed to gain a more complete understanding of steelhead ecology and, among other things, refine the viability goal under the federal ESA. These findings and research questions would also need to be closely considered by CDFW in the evaluation of the petition.

Dagit et al. (2020) also notes that, "[a]s reported by Williams et al. (2016) and confirmed by our observations, at no point since [southern California] steelhead were listed as endangered in 1997 was the preliminary provisional viable population goal of 4,150 annual anadromous spawners observed in any individual watershed, nor through the DPS as a whole."

Finally, Dagit et al. (2020) states that "[b]uilding quantitative models that consider both anadromous and resident fish in the production of smolts, in addition to watershed-specific carrying capacities would be a valuable effort towards refining population goals." United strongly agrees, and points to the last southern California steelhead 5-year review that also stated: "Overall, these results show that resident and anadromous forms are tightly integrated at the population level, suggesting a revision of the viability criterion for 100 [percent] anadromous fraction" (NMFS 2016). Moyle (2017) acknowledges that the life-history trait of "partial anadromy is an active area of research to gain insight into underlying environmental and genetic influences. This multigenic trait has important implications for endangered steelhead recovery and fisheries management strategies."

The CalTrout petition states that "[t]he resident component of the ESU covers a large number of native rainbow trout that are geographically dispersed, but are genetically demonstrable remnant populations of Southern steelhead;" however, the information presented above demonstrates that the interplay between the anadromous and resident life-histories is an open and ongoing area of research with direct implications on the status of the species. A review of the best available scientific information results in numerous findings and conclusions regarding the need for additional research on this topic. Researchers and regulatory agencies acknowledge that further study is necessary to ascertain key data required to make informed management decisions. Therefore, United urges CDFW to evaluate the entire breeding population, including resident fish as well as south-central coast steelhead (discussed below) in their review of the CalTrout petition. Should southern California steelhead become a candidate species, CDFW must again evaluate the entire breeding population in the status review to achieve a more realistic recovery goal that is true

[27] NMFS. 2016. 5-Year Review: Summary and Evaluation of Southern California Coast Steelhead Distinct Population Segment. National Marine Fisheries Service. West Coast Region. California Coastal Office. Long Beach, California. See pg. 20, paragraph 2.

to the biology and genetic structure of the native *O. mykiss* population in southern California. In considering the appropriate population, CDFW can employ a more holistic approach to protecting native *O. mykiss* in southern California, and permit applicants and restoration biologists will be afforded more viable options for project proposals that will lead to meaningful improvements for this population.

The fraction of anadromy must be considered at the sub-watershed level due to highly variable environmental conditions.

Tributaries within the Santa Clara watershed support a healthy population of *O. mykiss*. Stoecker and Kelley (2005) summarized various surveys conducted by CDFW and academic institutions documenting observations of over 100 *O. mykiss* per 100 feet of stream length. Moore, as referenced in Stoecker and Kelley (2005), did an extensive survey of both Santa Paula Creek and Sespe Creek, and their tributaries, reporting "abundant" trout in most of the tributaries. Some of his observations included 15 *O. mykiss* per 100 feet in Lion Creek and 70 *O. mykiss* per 100 ft in Howard Creek. A survey by CDFW, also referenced in Stoecker and Kelley (2005), found *O. mykiss* to be abundant in various tributaries to Sespe Creek in 1994 to 1995. As an example, they observed over 100 *O. mykiss* per 100 feet in Howard Creek. While no estimates were made to calculate the total abundance of *O. mykiss* observed in the Santa Clara River watershed, it would be safe to assume that during these surveys the totals were substantial given that, for example, on Sespe Creek about 47 miles of spawning and rearing habitat *O. mykiss* were reported by CDFW[28]. During this same period, various studies documented the anadromous migration within the watershed. A two-year study conducted by CDFW in 1982-1984 found no smolts migrating out of the Sespe despite trapping, electroshocking, and netting downstream of the Sespe tributary throughout the primary smolt migration period[29]. In the early 1990s, smolts were trapped and counted at the Freeman Diversion. In 1994, for example, United operated a downstream migration trap from February 21 through May 25 and a total of 83 smolts were collected at the trap during this period.[30] It is worth noting that smolts collected at the facility ranged from 0 to approximately 800 during the operation of the downstream migrant trap.

With survey and monitoring results documenting an abundant resident population but relatively few smolts produced from these watersheds, there is a strong indication that *O. mykiss* in the Santa Clara River have a natural low fraction of anadromy. A naturally low fraction of anadromy is expected where the cost to migrate to and from the ocean is high (i.e., low success rate) compared to staying within the watershed as residents. This observed low fraction of anadromy may be explained by the dynamics of many of the rivers in southern California.

As an example, the Santa Clara River is a large watershed (1,625 square miles) dominated by a sandy braided channel in the mainstem. During high flows, suspended sediment levels in the

[28] CDFW. 1996. See pg. 205, paragraph 5
[29] Puckett L.K. and Villa N.A. 1985.
[30] Entrix. 1994. Results of Fish Passage Monitoring at the Vern Freeman Diversion Facility, Santa Clara River, 1994. See pg. 3-10, Table 3-4

Santa Clara River are elevated to a point that is expected to preclude upstream migration opportunity[31]. A key section of the river for emigration to the ocean is well documented by observations dating back to the 1700s to go dry, thus precluding passage. During large portions of the year, portions of the river mainstem remain dry due to percolation to the underlying groundwater basins as surface water is quickly lost in the broad alluvial floodplain.[32]

Kendall et al. (2015) reviewed various studies documenting the factors that may influence the fraction of anadromy. One study found that "migration cost did influence life histories in one model which indicated that emigration survival was one of the critical factors shaping the expression of anadromy."[33] Residency was predicted to increase as emigration survival decreased. Kendall found other studies that concluded that perhaps the southern portions of the species range may be skewed towards residency with the higher cost of anadromy due to seasonally dry stream reaches and lagoon sandbar formations limiting migration opportunities.

Using over 20 years of data collected at the Freeman Diversion from the downstream migrant trap, Booth (2020) concluded that smolt migration timing was correlated with the day length and was less dependent on flow magnitude. Booth found that 95% of all smolts arrived between mid-March and late May with the majority arriving at the collection system in mid-April to mid-May. Most importantly, Booth concluded that "downstream migration in the Santa Clara River often may occur too late in the season to be synchronized with likely opportunities for downstream migration to the estuary and ocean."[34] Upon reviewing the historic hydrology for the system, Booth found that it is a relatively common occurrence for smolts in the Santa Clara River to be unable to successfully migrate to the ocean even with natural hydrology conditions. In summary, *O. mykiss* in the Santa Clara River watershed produce a very small fraction of anadromy, which is expected due to high cost for anadromy and the lack of opportunities for successful emigration and upstream migration. It is likely that the historic planting of steelhead, discussed in more detail above, temporarily modified the fraction of anadromy, thereby increasing the anadromous run size in the system for a short period. Prior surveys have revealed that the resident form of *O. mykiss* are well established within the watershed and are likely to continue to produce the anadromous form. This relationship needs to be studied before a CESA listing determination can be made. As NMFS has stated, the viability of the species would be expected to rise when considering the resident contribution.

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[31] Stillwater Sciences. 2020. Assessment of Suspended Sediment Effects on Adult Steelhead: Implications for Limitations on Steelhead Behavior and Physiology in the Santa Clara River

[32] Beller E.E., R.M. Grossinger, M.N. Salomon, S.J. Dark, E.D. Stein, B.K. Orr, P.W. Downs, T.R. Longcore, G.C. Coffman, A.A. Whipple, R.A. Askevold, B. Stanford, J.R. Beagle. 2011. Historical ecology of the lower Santa Clara River, Ventura River, and Oxnard Plain: an analysis of terrestrial, riverine, and coastal habitats. See pg. 82

[33] Kendall N.W., McMillan J.R., Sloat M.R., Buerhens T.W., Quinn T.P., Pess G.R., Kuzischin K.V., McClure M.M., Zabel R.W. Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns. See pg. 335, paragraph 2

[34] Booth M.T. Patterns and Potential Drivers of Steelhead Smolt Migration in Southern California. See pg. 24, paragraph 2.

Genetics on the population structure. The CalTrout petition discusses nuclear DNA with respect to geography, but fails to consider genetic evidence establishing that there is no differentiation between the southern California and the south-central coast populations of steelhead.

The best available scientific information does not support southern California steelhead being distinct from south-central coast steelhead. In 2008, scientists at National Oceanic and Atmospheric Administration (NOAA) Southwest Fisheries Science Center concluded that "[n]o genetic basis was found for the division of populations [from southern California] into two distinct biological groups, contrary to current classification under the US and California Endangered Species Acts."[35] The Clemento et al. (2008) study analyzed nuclear DNA, representing the best available scientific information and a far superior approach to identifying genetic structure in coastal *O. mykiss* populations compared to the prior studies cited in the original listing that used allozymes (proteins), maternally inherited mitochondrial DNA (Busby et al. 1996), and karyotyping (chromosome sampling). Thus, the more recent – and more reliable – studies from 2008 demonstrate that the two populations should be reclassified as one based on the most updated and most rigorous genetic data.

Other comments on the CalTrout petition:

- The CalTrout petition fails to acknowledge that the language of CESA covers the listing of a "species or subspecies" and not a distinct population segment (DPS).
- While arguing for the listing of the anadromous life-history form, CalTrout recommends not listing the resident life-history form above total barriers even though both forms are genetically identical and comprise a single species, *O. mykiss*. The CalTrout petition stops short of identifying the anadromous life-history form as a species or subspecies, likely owing to the fact that the anadromous and resident life-history forms comprise one species. In the status review of the northern California summer steelhead, CDFW indicated that this ecotype should not be listed under CESA, a recommendation based at least partially on the genetics of the species,[36] which indicated closer relation between localities as opposed to run-timing, and failed to meet the definition of a subspecies, as the petition requested. The same finding should apply to the genetics of anadromous and resident *O. mykiss*.
- The CalTrout petition recommends that catch-and-release fishing with barbless lures only be permitted in waters demonstrated to have steelhead lineage.[37] Catch-and-release

[35] Clemento A.J, Anderson E.C., Boughton D., Garza J.C. 2008. Population genetic structure and ancestry of *Oncorhynchus mykiss* populations above and below dams in south-central California. See pg. 1321, paragraph 1.

[36] CDFW. 2021. California Endangered Species Act Status Review for Northern California Summer Steelhead (*Oncorhynchus mykiss).* See pg. 149, paragraph 4.

[37] CalTrout Petition. See pg. 17, paragraph 1.

fishing results in a percentage of mortality, so the recommendation runs contrary to the arguments presented in the CalTrout petition.

- The CalTrout petition states that the listing of steelhead under CESA is needed to augment the protections provided by the federal ESA listing[38] but the effective protections for the species would not change significantly. Currently, while NMFS administers protections for steelhead under the federal ESA and CDFW administers protections for steelhead under the Fish and Game Code (F&G Code), "take" is already prohibited under the federal ESA without an incidental take permit and is also effectively prohibited by CDFW's interpretation and application of F&G Code.
- It is important that CDFW use the best available scientific information when describing the species' basic life history. The CalTrout petition states that "the timing of out-migration is influenced by a variety of environmental cues including streamflow, temperature, and breaching of the sand berm at the river's mouth."[39] It is important to add that recent new evidence points to day length (also known as photoperiod) as being a major driver of juvenile outmigration timing[40] and potentially as important, if not more so, than the environmental cues listed by CalTrout's petition.
- The CalTrout petition notes that "[e]xcessive sedimentation and turbidity are critical water quality components in all habitat types and impacts how southern California steelhead utilize each habitat type."[41] United agrees, and would note that as part of the Freeman Diversion MSHCP currently in development, United has completed an analysis of the effects of suspended sediment concentrations and turbidity on the behavior of steelhead. United encourages CDFW to evaluate the effects of sedimentation and turbidity as part of their analysis.
- The CalTrout petition notes that "7 inches is considered the minimal water depth needed for successful migration" for adult steelhead.[42] United agrees that the minimum water depth necessary for adult migration in southern California rivers is something other than the 0.7 feet (8.4 inches) referenced in the CDFW critical riffle analysis standard operating procedure,[43] which was developed based on an analysis completed for the SWRCB Policy for Maintaining Instream Flows in Northern Coastal California Streams.[44] United encourages CDFW to evaluate region specific data on fish size and river flows in their analysis to determine more appropriate flow depth criteria.

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[38] CalTrout Petition. See pg. 15, paragraph 3.
[39] CalTrout Petition. See pg. 9, paragraph 1.
[40] Booth M. 2020. Patterns and Potential Drivers of Steelhead Smolt Migration in Southern California. North American Journal of Fisheries Management, Volume 40, Issue 4: pp 1032-1050.
[41] CalTrout Petition. See pg. 10, paragraph 3
[42] CalTrout Petition. See pg. 10, paragraph 2
[43] CDFW 2017. Standard Operating Procedure for Critical Riffle Analysis for Fish Passage in California
[44] Policy for Maintaining Instream Flows in Northern California Coastal Streams. Division of Water Rights. State Water Resources Control Board. February 4, 2014.

The lack of reliable historic and current population data, compounded by artificial planting, and the lack of proper research into resident and anadromous life histories, fraction of anadromy, and genetic differentiation compels further study of southern California steelhead prior to making a CESA listing decision based on CalTrout's petition. The evaluation must consider all available sources of information to reach the best available scientific information threshold, including the information provided herein, and the attached reference documents, as a starting point for this species.

Respectfully,

Anthony Emmert
Assistant General Manager

December 2, 2021

California Fish and Game Commission
P.O. Box 944209
Sacramento, California 94244-2090

Sent via email to: fgc@fgc.ca.gov

Re: CDFW evaluation report on California Trout petition to list Southern California steelhead as endangered pursuant to the California Endangered Species Act (CESA)

Dear California Fish and Game Commission:

In June 2021, California Trout submitted a petition to the California Fish and Game Commission (Commission) to list Southern California steelhead (Oncorhynchus mykis) as endangered pursuant to the California Endangered Species Act (CESA), Fish and Game Code section 2050 et seq. Thereafter, the Commission referred the petition to the California Department of Fish and Wildlife (CDFW) pursuant to Fish and Game Code section 2073 for preparation of an evaluation report on the petition. Pursuant to Fish and Game Code section 2073.4, on August 17, the United Water Conservation District (United) submitted a 13-page written comment letter and supporting evidence to aid CDFW in its review. United's letter provided additional information and supporting evidence directly relevant to CDFW's mandated evaluation, which included corrections of a number of factual and scientific inaccuracies in the petition. We have enclosed a copy of United's letter and supporting evidence. On November 30, CDFW released its written evaluation report to the public.

We have since reviewed the evaluation report and discovered that it contains no discussion of the substance of United's August 17 letter, or, for that matter, a discussion of the substance of any of the other timely submitted comment letters. CDFW, however, is mandated by Fish and Game Code section 2073.5 and Section 670.1 of Title 14 of the California Code of Regulations to consider all relevant information it receives on the petition and to evaluate the petition in light of that information. The obvious purpose of the mandate is to ensure that the Commission receives an objective evaluation report rather than an advocacy piece favoring the petitioner.

Of specific concern in CDFW's evaluation is its clarification of CalTrout's inclusion of both resident and anadromous DPS in their listing petition. As we stated in our previous comments letter: "When considering the petition and potential future listing, the contribution of resident rainbow trout must be considered. A document prepared by NOAA-NMFS Southwest Fisheries Science Center supports this approach by stating: "Steelhead and rainbow trout belong to the same species (O. *mykiss),* and steelhead are the ocean-migratory ("anadromous") form and rainbow trout are the freshwater-resident form . There is a growing body of literature showing that steelhead and rainbow trout share freshwater habitat, mate with one another, and their offspring can either undergo physiological changes necessary to migrate to the ocean as a steelhead or undergo freshwater maturation as a rainbow trout."[1]

1. Ohms H.A. and Boughton D.A. 2019. Carmel River Steel head Fishery Report - 2019

For this reason, it is critical that the Commission consider the whole O.mykiss population when contemplating the validity of the petition to list. This is just one of the numerous comments cited in United's original comment letter of August 17, 2021.

In light of CDFW's failure to include in its evaluation report any discussion of the relevant public comments it received concerning the petition, United respectfully requests that the Commission remand the evaluation report back to CDFW with the direction that it prepare a revised evaluation report that actually evaluates the scientific information discussed and cited in the petition in relation to the public comments CDFW has received.

Respectfully,

Mauricio E. Guardado, Jr., general manager

Attachment: 2021-08-17 UWCD letter to California Fish and Game Commission

United Water CONSERVATION DISTRICT

February 1, 2022

California Fish and Game Commission
PO Box 944209
Sacramento, CA 94244-2090

Subject: California Fish and Game Commission proceedings on California Trout's petition to list southern California steelhead as endangered under the California Endangered Species Act (CESA), and California Department of Fish and Game's evaluation of the petition

Dear California Fish and Game Commission:

Before the California Fish and Game Commission (Commission) reaches its decision regarding whether listing of southern California steelhead under the California Endangered Species Act (CESA) may be warranted, it is necessary for the Commission to consider fatal errors in the California Department of Fish and Wildlife's (CDFW) evaluation of California Trout's (CalTrout) petition. Specifically, despite CalTrout's failure to adequately define southern California steelhead, or sufficiently address resident steelhead, CDFW allowed CalTrout to significantly alter its petition with a dramatically expanded definition of southern California steelhead. CDFW also assumes that CalTrout's assertions without specific support are true. This falls woefully short of the Commission and CDFW's statutory and regulatory requirements, thus compelling the Commission to reject CalTrout's petition.

California Fish and Game Code (FGC) section 2072.3 provides: "To be accepted, a petition shall, at a minimum, include sufficient information that a petitioned action may be warranted." FGC section 2073.5(a) requires CDFW to "evaluate the petition on its face and in relation to other relevant information the department possesses or receives," and California Code of Regulations (CCR), Title 14, section 670.1(b) requires the Commission to return incomplete petitions to the petitioner. However, rather than return CalTrout's deficient petition, CDFW states:

> to the extent the Petitioner makes assertions without citing specific support, the Department assumes these statements to be true for purposes of the Petition Evaluation. If the Commission accepts the Petition for further consideration, the Department will need to verify these statements during the status review period. Petition Evaluation Section III, p. 9.

Also, despite identifying another deficiency in CalTrout's petition, CDFW requested CalTrout's intended definition of southern California steelhead. In response, CalTrout broadly defined southern California steelhead as follows:

> All *Oncorhynchus mykiss,* including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico Border with the understanding that anadromous (adult southern steelhead) arise from anadromous and resident naturally spawning adults.

The inclusion of resident *Oncorhynchus mykiss* (*O. mykiss*), or rainbow trout, below barriers along with anadromous steelhead as part of the listing unit is a significant deviation from the original petition. This clarification also exposes a shortcoming of the petition, specifically, that it does not address resident *O. mykiss* sufficiently, but rather relies on information relevant to anadromous steelhead. As a result, CalTrout's petition and CDFW's evaluation of it are both fundamentally insufficient to substantiate a listing based on CalTrout's definition of southern California steelhead. Notably, FGC section 2074.2(e)(1) and CCR section 670.1(e)(1) provide that "a petition will be rejected by the commission if it fails to include sufficient scientific information" under the statutorily required categories in FGC section 2072.3.

Consideration and evaluation of all readily available information regarding the combined population dynamics and demographics for both resident and anadromous *O. mykiss* is essential to inform the Commission before making a determination on this matter. In fact, readily available data and literature provides evidence that resident *O. mykiss* are significantly more abundant than anadromous *O. mykiss*, have more viable populations than anadromous steelhead in the region (and statewide), and contribute substantially to the persistence of the overall species. Given the larger populations of the resident life history, an evaluation of the combined life histories is more likely to result in a determination that listing is <u>not</u> warranted. Therefore, we strongly urge the Commission to reject the petition pursuant to FGC section 2074.2(e)(1) and CCR section 670.1(e)(1).

General Comments:

United Water Conservation District (United) provided comments on the petition to CDFW on August 17, 2021. In addition to corrections of factual and scientific inaccuracies in the petition, as well as additional references for consideration by CDFW, the comments provided relevant information pertaining to several required components of the petition (see FGC section 2072.3): the population trend, range, abundance, factors affecting the ability to survive and reproduce, the degree and immediacy of threat, impact of existing management, and suggestions for future management.

As indicated in United's December 2, 2021 letter, CDFW's evaluation of the petition did not contain a substantive discussion of United's August 17, 2021 comments. CDFW set a low bar for the petition, disregarding information that is either already available to reviewers or made available through the public review process. This is inconsistent with FGC section 2072.3, FGC section 2073.5 and CCR section 670.1(d).

To determine whether there is sufficient scientific information that a petitioned action may be warranted, the Commission must know whether the information cited in favor of listing is factually true and scientifically accurate and supported, rather than CDFW simply "assuming" that some unsupported statements made by a petitioner about the species are true, even though those statements could, upon further investigation, turn out to be without basis. Knowing the information in the evaluation that is reliable, and that which is not reliable, is critical to the Commission's determination.

Comments on Components of the Evaluation

Population trend

The population trend section of the petition discusses only the anadromous form of *O. mykiss* – not the resident form. And in its evaluation of the petition, CDFW also discusses only the anadromous form of *O. mykiss* when describing the population trend in the region, including providing numbers of returning adults and observed declines in population compared to historic population estimates. CDFW added one reference regarding residents (see the CDFW and Santa Monica Mountains Resource Conservation District (SMMRCD) reference); however, this does not provide any information regarding the population (current or historic), population trend, or a discussion of the status of resident *O. mykiss* in the Santa Monica Mountains specifically or in the overall southern California region. Thus, this component of the petition and CDFW's evaluation is incomplete.

United has compiled readily available survey data and reports from several watersheds within the region; however, it is expected that other data (published or unpublished) is available to CDFW as part of the Heritage and Wild Trout Program and/or the Coastal Salmonid Monitoring Program, which are both led by CDFW.

Regarding the SMMRCD data referenced by CDFW, Moyle et al. (2017)[1] provides a discussion of a portion of the data, indicating a high level of variability in *O. mykiss* numbers from year-to-year. For example, following an observed die-off in Malibu Creek in 2006, the results of subsequent surveys resulted in the observation of five adult steelhead in 2007 and 2,200 *O. mykiss* young of the year (YOY) in 2008. During surveys completed in 2005, 2008, 2011, 2014, and 2015, YOY observations varied from 11 to 590 individuals – the latter surveys completed during the 2012-2016 extreme drought.

Other surveys include those within the Santa Clara River watershed and the CDFW Heritage and Wild Trout Program 2008 report[2] on the Agua Blanca Creek and Fish Creek (tributaries to Piru Creek) yielded estimates of 1,316 and 3,113 *O. mykiss* per mile, with the report noting that "[b]oth Fish and Agua Blanca Creeks contain relatively high densities of coastal rainbow trout, especially given the habitat limitations that salmonids face in this mountainous desert region." Surveys reported in Stoecker and Kelley (2005)[3] within the Sespe Creek drainage found a total of 2,954 *O. mykiss* largely from streambank observations and some snorkel surveys of deeper pools and, of the Santa Clara River sub-watersheds surveyed, the Sespe Creek drainage was found to have the highest relative abundance of *O. mykiss*. It is important to note that the Piru Creek surveys were

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[1] Moyle P.B, Lusardi R.A., Samuel P.J., Katz J.V.E. 2017. State of the Salmonids: Status of California's Emblematic Fishes 2017. August.

[2] CDFG. 2008. Fish Creek and Agua Blanca Creek Summary Report. June 16th-19th, 2008. Heritage and Wild Trout Program. California Department of Fish and Game.

[3] Stoecker M., Kelley E. 2005. Santa Clara River Steelhead Trout: Assessment and Recovery Opportunities.

conducted in tributaries above Lake Piru, a manmade barrier to upstream migration, and the Sespe Creek surveys were conducted in areas above and below natural barriers to upstream migration.

In a study conducted for CDFW in the Ventura River watershed, Allen (2015)[4] reported on extensive *O. mykiss* surveys between 2006 and 2012. In that report, Allen reported that in the lower segment of the river, *O. mykiss* abundance is highly variable with a near zero abundance of fry and juvenile *O. mykiss* observed in 2006 and 2007 but increasing to a maximum of 3,739 juvenile and 2,348 fry *O. mykiss* in 2008 and 2012, respectively. Of the total in the lower river, the vast majority were observed in the study reach near the confluence with San Antonio Creek, known as historically important for *O. mykiss*. In the middle segment of the Ventura River, above the fish ladder on the Robles Diversion, Allen (2015) reported maximum abundance of fry in 2012 totaling 6,637 individuals and maximum abundance of juveniles in 2008 totaling 3,555 individuals. Abundance estimates were higher still in the upper segment, above Matilija Dam, even though total stream length was less than the combined reaches below Matilija Dam (Allen 2015). Overall, *O. mykiss* are generally most abundant in headwater spawning and rearing tributaries across the region and elsewhere.

The results presented above represent only a few examples of the data and findings of relatively recent *O. mykiss* surveys in the region and Attachment A provides a summary of additional *O. mykiss* survey data and reports compiled by United. These references show that there is a resilient and, in favorable years, robust population of resident *O. mykiss* both below and above natural and manmade barriers; however, conclusions regarding population trends and stability are qualitative in nature. For example, Moyle et al. (2017) states that "[o]nly the [resident] coastal rainbow trout (*Oncorhynchus mykiss*) is considered secure in its status" and that "the boundary between [anadromous] steelhead and resident coastal rainbow trout is fuzzy because it is not biologically based, but a distinction of convenience for management." Resident *O. mykiss* are defined by Moyle et al. (2017) as those populations above barriers, though there are populations of residents that are connected to populations below barriers.

When considering whether the listing may be warranted, the Commission should not solely rely upon information contained in the petition and evaluation that is limited to the anadromous life history of *O. mykiss*. The combined population of anadromous and resident *O. mykiss* must be considered to adequately evaluate the petition, which CDFW neglected to incorporate into the evaluation.

Range

As noted in the CDFW evaluation of the petition, Clemento et al. (2008)[5] found that there is no genetic basis for the division of populations (from southern California) into two distinct biological groups (the south-central California coast steelhead and southern California steelhead), contrary to the current classification under the federal Endangered Species Act (ESA). The federal ESA allows for the designation of Distinct Population Segments (DPS) based on metrics other than

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[4] Allen M.A. 2015. Steelhead Population and Habitat Assessment in the Ventura River/ Matilija Creek Basin 2006-2012 Final Report. March 31.

[5] Clemento A.J, Anderson E.C., Boughton D., Garza J.C. 2008. Population genetic structure and ancestry of *Oncorhynchus mykiss* populations above and below dams in south-central California.

genetics; however, CESA allows for the listing of a "species or subspecies" and does not include the same DPS policy. It is unclear what basis CDFW or the Commission could use to justify that the petitioned action may be warranted given the lack of a genetic distinction between the federally designated southern California steelhead DPS and the south-central California coast steelhead DPS, as well as the lack of a genetic distinction of the species *O. mykiss* from across the state.

Distribution

Early in the evaluation (see Executive Summary, pg. 1), CDFW notes that the petition defines southern California steelhead as "all *O. mykiss*, including resident and anadromous life histories, below manmade and natural complete barriers…(hereinafter, all references to 'Southern steelhead' are to this definition of Southern California steelhead)." The CDFW evaluation neglects to clearly and consistently present information describing anadromous versus resident *O. mykiss*, as appropriate.

The CDFW evaluation refers to a statement in the petition that the southern California steelhead DPS has been extirpated from approximately 60% of its historical range; however, CDFW does not acknowledge that this is a reference to the NMFS Recovery Plan for southern California steelhead (NMFS 2012)[6] and refers to the anadromous life history. The Southern Steelhead Resources Evaluation (Becker et al. 2010)[7] provides a detailed account of the habitat for *O. mykiss* throughout the region, including both qualitative and quantitative accounts of *O. mykiss* presence in numerous river mainstems and tributaries. This reference, along with the information presented in Attachment A, shows that resident *O. mykiss* are distributed across many of the watersheds in the region.

CDFW neglected to evaluate the available information to determine the accurate distribution of *O. mykiss* within the region. Without reasonable consideration of this readily available information, the evaluation of the petition is incomplete and insufficient to inform the Commission regarding whether the proposed listing is warranted.

Abundance

The petition and CDFW's evaluation both focus on the anadromous life history. As discussed in more detail in the "Population trend" section above and summarized in Attachment A, resident *O. mykiss* are abundant across many of the watersheds in the region and this information, as well as any additional survey data, were not considered by CDFW in their evaluation.

Regarding residents, the CDFW evaluation includes the statement that "the Petition also notes that shrinking populations of freshwater resident *O. mykiss* are vulnerable to loss of genetic diversity and fitness." A reader could interpret this statement to mean that resident populations are in fact shrinking, which may not be CDFW's intent. The petition language reads that "[e]xcessive loss of local freshwater resident populations can lead to lower genetic variability and fitness," which followed a discussion of risks to resident populations from wildfires, drought, climate change, and anthropogenic factors. To clarify, United's understanding is that the petition is referring to

[6] NMFS. 2012. Southern California Steelhead Recovery Plan.

[7] Becker G.S., Smetak K.M., Asbury D.A. Southern Steelhead Resources Evaluation. Identifying Promising Locations for Steelhead Restoration in Watershed South of the Golden Gate. Cartography by D.A. Asbury. Center for Ecosystem Management and Restoration. Oakland, CA.

potential risks and does not state that resident *O. mykiss* populations are shrinking. United requests that CDFW clarify the statement in the evaluation.

Degree and immediacy of threat
Again, the petition and CDFW's evaluation, including their respective references, focus only on the anadromous life history form of *O. mykiss* and do not take resident *O. mykiss* into consideration. Overall, a discussion of resident *O. mykiss* is lacking and, therefore, this component of the CDFW evaluation is incomplete.

The importance of the resident *O. mykiss* life history contribution to the establishment and persistence of the anadromous life history is best stated by Moyle et al. (2017):

> in southern California many, if not most, returning 'steelhead' likely originate as migratory smolts produced from resident headwater trout populations many of which persist *above* man-made and natural barriers to anadromy. The polygenic nature of the anadromy indicates that the trait can persist for a long time in a large resident population. This has been demonstrated in an Argentina river flowing to the Atlantic, where steelhead have developed from resident fish, apparently of California origin, with resident and migratory fish forming one interbreeding population (Pascual et al. 2001) (emphasis from citation).

Elsewhere, Moyle et al. (2017) states:

> If resident rainbow trout populations are considered part of the southern steelhead complex, then the extinction threat of the overall population is somewhat less. Reconnecting the anadromous and resident forms of the native *O. mykiss* populations, however, is essential for maintaining both the anadromous and resident trout populations in the future.

In some watersheds, the connection of resident and anadromous *O. mykiss* remains intact, and in others, there is active progress toward projects that will reestablish this connection. This is essential for consideration by the Commission given that resident *O. mykiss* are secure in their status and contribute to the anadromous life history.

As discussed in more detail in the "Population trend" section above, a resilient population of resident *O. mykiss* persist in many watersheds both above and below barriers and these systems are capable of supporting robust populations that provide a substantial, yet under-evaluated contribution to the species in the region. Many efforts to improve existing fish passage facilities as well as efforts to reconnect isolated populations are currently underway within the existing regulatory framework that would aid in meeting recovery goals under the NMFS recovery plan (NMFS 2012).

Conclusion
The petition and CDFW's evaluation of the petition provide incomplete and insufficient information to inform the Commission's decision regarding whether the proposed listing may be

warranted. As CDFW identified, the petitioner did not clearly articulate the intended definition of southern California steelhead. Once clarified, the arguments provided by the petitioner were insufficient to support a finding that the requested listing is warranted. In addition, the near complete reliance on the information presented in the petition (without supporting evidence) results in an evaluation report that lacks key considerations, primarily associated with the resident *O. mykiss* life history. Furthermore, CDFW did not follow statutory requirements in conducting its evaluation of the petition. CDFW did not consider readily available data and scientific literature, much of which was collected under oversight of the agency itself, in evaluating the petition, nor did they consider and address the relevant information provided by stakeholders through the public review and comment period.

The Commission's determination has serious consequences. If the species becomes a candidate species, it will be protected by CESA's take prohibition. As a result of the take prohibition, water supply and wastewater treatment agencies may become subject to civil and criminal liability for incidental, unintended take of the species that may occur in connection with their public health and safety activities. When the regulatory consequence of implementing public health and safety activities may be that an agency becomes liable for criminal and civil penalties, it is incumbent on the Commission to assure that high quality information, and not mere conjecture, supports the determination that the species should be a candidate species.

Overall, CDFW used a deeply flawed approach in preparing the evaluation, and one that is inconsistent with its statutory and regulatory requirements. A determination by the Commission that the listing may be warranted based on the information contained in the petition and CDFW's evaluation would not be legally defensible. Therefore, based on the foregoing, we respectfully request that the Commission reject the petition.

Sincerely,

Mauricio E. Guardado, Jr.
General Manager

Attachment: A - *O. mykiss* Survey Data and Results revised

Attachment A. *O. mykiss* Survey Data and Results

Watershed	Sub-watershed	Year	Study lead	Results	Source
Santa Clara River	Piru Creek (middle)	2008	CDFW	Fish Creek - 288 resident *O. mykiss* (est. 3,113 *O. mykiss* per mile) Agua Blanca - 208 resident *O. mykiss* (est. 1,316 *O. mykiss* per mile)	CDFW 2008a
	Piru Creek (upper)	2008	CDFW	Upper Piru Creek - est. 331 *O. mykiss* per mile Buck Creek - est. 953 *O. mykiss* per mile Alamo Creek - est. 2,648 *O. mykiss* per mile Mutau Creek - est. 334 *O. mykiss* per mile	CDFW 2008b
	Sespe Creek	2004	Stoecker	2,954 *O. mykiss* observed	Stoecker and Kelley 2005
	Sespe Creek	2018	USFS	35 *O. mykiss* in Sespe Creek 373 O. mykiss in Lion Creek	USFS 2018
	Sespe Creek	2017	USFS	215 O. mykiss in Lion Creek 44 *O. mykiss* in Tule Creek	USFS 2017
	Santa Paula Creek	2018	USFS	62 *O. mykiss* observed	USFS 2018
	Rock Creek	2018	USFS	1 *O. mykiss* observed	USFS 2018
	Santa Clara mainstem	1994-2020	United	*O. mykiss* observations between 1994-2014 at the Freeman Diversion: 13 adult steelhead (2 hatchery), 2,128 smolts, 210 YOY, 116 resident, 92 hatchery An additional 2 adult steelhead were identified in the fish passage facility in spring 2020	Booth 2016 United unpublished data
Ventura River	Lower Ventura-San Antonio Creek-Matilija Creek-North Fork Matilija Creek	2005-2020	Casitas Municipal Water District	Peak annual snorkel counts during the monitoring period (2005-2020) generally between 350-400 *O. mykiss*. No *O. mykiss* observed in 2020	CWMD 2020
	Lower Ventura	2006-2012	Allen	Near zero abundance of fry and juvenile O. mykiss observed in 2006 and 2007 but increasing to a maximum of 2,348 fry and 3,739 juvenile O. mykiss in 2012 and 2008, respectively	Allen 2015
	Middle Ventura	2006-2012	Allen	Maximum abundance of fry in 2012 totaling 6,637 individuals and maximum abundance of juvenile in 2008 totaling 3,555 individuals	Allen 2015
	Upper Ventura (including Matilija Creek)	2006-2012	Allen	Higher abundance estimates in the upper segment are largely due to the higher average densities of O. mykiss in the reaches above Matilija Dam, which encompass approximately one-half of the stream miles that are currently available for rearing below the dam (not including dry channels)	Allen 2015
	Matilija Creek	2017	USFS	62 *O. mykiss* in Matilija Creek 301 *O. mykiss* in Upper North Fork Matilija Creek	USFS 2017
	Matilija Creek	2018	USFS	1 *O. mykiss* in Matilija Creek 0 *O. mykiss* in Upper North Fork Matilija Creek	USFS 2018
	Murrieta Creek	2018	USFS	10 *O. mykiss* in Murrieta Creek	USFS 2018
Santa Maria River		2005	Stoecker	4 *O. mykiss* in the lower Sisquoc (0.02 fish/ 100 ft) 190 *O. mykiss* in the upper Sisquoc (3.9 fish/ 100ft) 231 *O. mykiss* in Manzana Creek (2.8 fish/ 100ft) 288 *O. mykiss* in Davy Brown Creek (6.8 fish/ 100ft) 122 *O. mykiss* in South Fork Sisquoc (20.4 fish/ 100ft) 6 *O. mykiss* in Rattlesnake Creek (0.6 fish/ 100ft) Total = 841 *O. mykiss* (2.0 fish/ 100ft)	Stoecker 2005
	Sisquoc River	2018	USFS	514 *O. mykiss* in Davy Brown Creek	USFS 2018
	Munch Creek	2018	USFS	69 *O. mykiss* in Munch Creek	USFS 2018
	Malibu Creek	2005-2014	Santa Monica Mountains Resource Conservation District	5 adult *O. mykiss* observed in 2007 and 2,200 *O. mykiss* young of the year (YOY) in 2008. During surveys completed in 2005, 2008, 2011, 2014, and 2015, YOY observations varied from 11 to 590 individuals	Moyle 2017

Santa Monica Mountains	Topanga Creek	2013-2018	Santa Monica Mountains Resource Conservation District	Observed *O. mykiss* of all life stages ranged from 0 to approximately 170 during the study period. Other streams included in the survey (Big Sycamore, Las Flores, Solstice, Trancas, Zuma) were negative for *O. mykiss* during the study period. Note that the study period was largely during the prolonged 2012-2016 drought	SMMRCD 2018
Santa Ynez River	Santa Ynez	1994-2004	Cachuma Operations and Maintenance Board	Annual snorkel surveys between 1994-2004 resulted in identification of between 0-84 adult *O. mykiss* and 0-346 juvenile *O. mykiss* in the lower Santa Ynez River. Annual snorkel surveys during the same period in the tributaries (Salsipuedes, Hilton, Quiota, El Jaro, Nojoqui) yielded between 0-575 adult *O. mykiss* and between 0-909 juvenile *O. mykiss* . Adult and juvenile status was based on size class	SYRAMC 2009
	Santa Ynez	2017	USFS	92 *O. mykiss* in Alder Creek 292 *O. mykiss* in Fox Creek	USFS 2017
Los Angeles River	Pacoima, Lower Big Tujunga, Haines, Alder, Arroyo Seco, Big Santa Anita Creeks	2018	Southwest Resource Management Association	Presence/ absence surveys. *O. mykiss* identified in Lower and Upper Big Tujunga, Lower Alder, Arroyo Seco, Eaton Canyon, and Big Santa Anita Creeks. Of the native species, coastal rainbow trout were the most abundant.	SRMA 2020
San Gabriel River	Buckhorn, Fish Creek, San Gabriel River, Bear, Cattle Canyon, Lower San Dimas, San Antonio,	2018	Southwest Resource Management Association	Presence/ absence surveys. O. mykiss identified in Lower and Upper Buckhorn, Fish, Cattle Canyon, Lower San Dimas, and San Antonio Creeks, as well as the North, East, and West Forks of the San Gabriel River. Of the native species, coastal rainbow trout were the most abundant.	SRMA 2020

September 20, 2022

California Department of Fish and Wildlife
Fisheries Branch
Attn: Southern California Steelhead
P.O. Box 944209
Sacramento, CA 94244-2090
Sent via email: SCSH@wildlife.ca.gov

Subject: United Water Conservation District Comments and Summary of Key Information Regarding the California Department of Fish and Wildlife 12-Month Status Review of Southern California Steelhead (*Oncorhynchus mykiss*)

Dear Fisheries Branch Staff:

United Water Conservation District (United) submits the following comments and attached information for consideration by the California Department of Fish and Wildlife (CDFW) in conducting the 12-month status review associated with the petition to list southern California steelhead (*Oncorhynchus mykiss*) (steelhead; *O. mykiss*) as endangered under the California Endangered Species Act (CESA). On June 14, 2021, California Trout (CalTrout) submitted a petition to the California Fish and Game Commission (Commission) to list southern California steelhead as an endangered species under CESA. On April 21, 2022, the Commission accepted the petition for consideration. On May 13, 2022, the Commission provided public notice that southern California steelhead is now a candidate species under CESA. Pursuant to Fish and Game Code (FGC) § 2074.6, CDFW is in the process of completing a status review of southern California steelhead and has invited the public to submit comments on the petitioned action, including ecology, genetics, life history, distribution, abundance, habitat, the degree and immediacy of threats to its reproduction or survival, and the adequacy of existing management or recommendations for management of southern California steelhead. In its status review, CDFW is required to evaluate the breadth of available scientific literature and develop a summary of the status of southern California steelhead. The petitioned listing unit, as defined in the CDFW evaluation report and contained in the status review:

> All *Oncorhynchus mykiss,* including anadromous and resident life histories, below manmade and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the U.S.-Mexico Border with the understanding that anadromous (adult southern steelhead) arise from anadromous and resident naturally spawning adults.

This comment provides a summary of key information contributing to the best available science relevant to the status of resident and anadromous *O. mykiss* and is intended to inform CDFW's status review. Reference documents cited in this comment are available for download via OneDrive: CESA Status Review Comment References. United requests these documents be included in CDFW's administrative file for its review of listing status.

Relationship Between Resident and Anadromous *O. mykiss*

The petition submitted by CalTrout did not address resident *O. mykiss* sufficiently. Rather the petition relied on information relevant to the anadromous form, specifically in presenting population numbers. This resulted in the characterization of only a portion of the total species population; however, in the status review, consideration and evaluation of *all* readily available information regarding the combined population dynamics and demographics for both resident and anadromous *O. myki*ss is essential. Assessment of both resident and anadromous life-history forms will provide a complete account of the prevalence of *O. mykiss* as well as the contributions and interplay across the life-history forms, which is necessary to determine, based on the best available science, the status of the species.

In the status review of southern California steelhead, as well as in the ultimate listing decision, the status and contribution of resident *O. mykiss* must be considered. A document prepared by the National Oceanic and Atmospheric Administration-National Marine Fisheries Service (NOAA-NMFS) Southwest Fisheries Science Center supports this approach by stating: "Steelhead and rainbow trout belong to the same species (*O. mykiss*), and steelhead are the ocean-migratory ("anadromous") form and rainbow trout are the freshwater-resident form. There is a growing body of literature showing that steelhead and rainbow trout share freshwater habitat, mate with one another, and their offspring can either undergo physiological changes necessary to migrate to the ocean as a steelhead or undergo freshwater maturation as a rainbow trout."[1] As evidenced by this interplay, the status of the species clearly requires close examination of the relationship between resident and anadromous *O. mykiss* in the assessment of their status as well as the viability of the life-history forms.

The CalTrout petition states that "[f]ish that express the resident freshwater life-history strategy play a central role to the continued existence of southern steelhead." United agrees with this statement regarding the interplay of the freshwater resident and anadromous *O. mykiss* life-histories. This submittal offers supporting evidence related to the status of resident *O. mykiss* in the **Population Trend** and **Viability Criteria** sections below, evidence which was absent from the CalTrout petition. Readily available data and literature supports the position that resident *O. mykiss* are significantly more abundant than anadromous *O. mykiss*, have more viable populations than anadromous steelhead in the region (and statewide), and contribute substantially to the persistence and viability of the overall species.

Population Trend

Information presented in the CalTrout petition regarding the population trend of southern California steelhead discussed only the anadromous form of *O. mykiss* – not the resident form – including numbers of returning anadromous adults and declines in numbers compared to historic population estimates (note that historic population estimates are addressed in the **Distribution and Abundance** section below). In the petition evaluation report, CDFW noted that information on population abundance and trends of resident *O. mykiss* is limited. United disagrees, as information that contributes to the best available science is readily available and would allow for reasonable inference regarding the status of residents as it relates to the proposed listing.

In this submittal, we present a compilation of readily available survey data and reports from several watersheds within our region for CDFW's consideration; however, it is expected that other data (published or unpublished) relevant to the status review is available to CDFW as part of the Heritage and Wild Trout Program and/or the Coastal Salmonid Monitoring Program, which are both led by CDFW.

[1] Ohms H.A. and Boughton D.A. 2019. Carmel River Steelhead Fishery Report - 2019.

Regarding the Resource Conservation District of the Santa Monica Mountain (RCDSMM) data referenced by CDFW in the petition evaluation report, Moyle et al. (2017)[2] provides a discussion of a portion of the data, indicating a high level of variability in *O. mykiss* numbers from year-to-year. For example, following low numbers observed in Malibu Creek in 2006, the results of subsequent surveys observed five adult steelhead in 2007 and 2,200 *O. mykiss* young of the year (YOY) in 2008. During surveys completed in 2005, 2008, 2011, 2014, and 2015, YOY observations varied from 11 to 590 individuals – with the latter surveys completed during extreme drought conditions experienced between 2012-2016.

Other surveys include those within the Santa Clara River watershed with the CDFW[3] Heritage and Wild Trout Program 2008 report[4] yielding estimates from Agua Blanca Creek and Fish Creek (tributaries to Piru Creek) of 1,316 and 3,113 *O. mykiss* per mile. The report noted that "[b]oth Fish and Agua Blanca Creeks contain relatively high densities of coastal rainbow trout, especially given the habitat limitations that salmonids face in this mountainous desert region." Surveys reported in Stoecker and Kelley (2005)[5] within the Sespe Creek drainage found a total of 2,954 *O. mykiss* largely from streambank observations and some snorkel surveys of deeper pools and, of the Santa Clara River sub-watersheds surveyed, the Sespe Creek drainage was found to have the highest relative abundance of *O. mykiss*. It is important to note that the Piru Creek surveys were conducted in tributaries above Lake Piru, a manmade barrier to upstream migration, and the Sespe Creek surveys were conducted in areas both above and below natural barriers to upstream migration.

In a study conducted for CDFW in the Ventura River watershed, Allen (2015)[6] reported on extensive *O. mykiss* surveys between 2006 and 2012. In that report, Allen reported that in the lower segment of the river, *O. mykiss* abundance is highly variable, with a near zero abundance of fry and juvenile *O. mykiss* observed in 2006 and 2007 but a document maximum of 3,739 juvenile and 2,348 fry *O. mykiss* in 2008 and 2012, respectively. Of the total in the lower river, the vast majority were observed in the study reach near the confluence with San Antonio Creek, known as historically important habitat for *O. mykiss*. In the middle segment of the Ventura River, above the fish ladder on the Robles Diversion, Allen (2015) reported maximum abundance of fry totaling 6,637 individuals in 2012 with a maximum abundance of juveniles totaling 3,555 individuals in 2008. Abundance estimates were higher still in the upper segment, above Matilija Dam, even though total stream length was less than the combined reaches below Matilija Dam (Allen 2015). Overall, *O. mykiss* are documented to be most abundant in headwater spawning and rearing tributaries across the region and elsewhere.

The information presented above represents only a handful of examples of the data and findings from relatively recent *O. mykiss* surveys in the region. Attachment A provides a summary of additional *O. mykiss* survey data and reports compiled by United for use by CDFW in the status review. These references show that there is a resilient and, in favorable years, robust population of resident *O. mykiss* both below

[2] Moyle P.B, Lusardi R.A., Samuel P.J., Katz J.V.E. 2017. State of the Salmonids: Status of California's Emblematic Fishes 2017. August.

[3] Prior to January 1, 2013, the California Department of Fish and Wildlife (CDFW) was named the California Department of Fish and Game (CDFG) (AB 2402). For simplicity, the name CDFW is utilized throughout this submittal when referring to materials produced prior to 2013.

[4] CDFG. 2008. Fish Creek and Agua Blanca Creek Summary Report. June 16th-19th, 2008. Heritage and Wild Trout Program. California Department of Fish and Game.

[5] Stoecker M., Kelley E. 2005. Santa Clara River Steelhead Trout: Assessment and Recovery Opportunities.

[6] Allen M.A. 2015. Steelhead Population and Habitat Assessment in the Ventura River/ Matilija Creek Basin 2006-2012 Final Report. March 31.

and above natural and manmade barriers; however, conclusions regarding population trends and stability are qualitative in nature. For example, Moyle et al. (2017) states that "[o]nly the [resident] coastal rainbow trout (*Oncorhynchus mykiss*) is considered secure in its status" and that "the boundary between [anadromous] steelhead and resident coastal rainbow trout is fuzzy because it is not biologically based, but a distinction of convenience for management." Resident *O. mykiss* are defined by Moyle et al. (2017) as those populations above barriers; however, populations of residents that are connected to populations below barriers, thus contributing downstream migrants (smolts) to the proposed listing unit, must be factored into the overall population viability. Specific examples of tributaries in the Santa Clara River watershed with a downstream migrant connection above barriers to upstream migration include Sespe Creek and Santa Paula Creek. NMFS recognizes this significant dynamic noting in their 5-year review that persistent returns of anadromous adults "could be maintained either by natural dispersal from some source population located elsewhere and/or from the consistent production of smolts by the local population of freshwater non-anadromous *O. mykiss*, including *O. mykiss* populations currently residing upstream of introduced, long-standing barriers to upstream migration."[7]

The status review should also consider the potential for shifts in the proportion of anadromous and resident *O. mykiss*. Kendall et al. (2017) observed declines in Pacific northwest anadromous steelhead and posited that "declining survival to and from the ocean and in the ocean can lead to an increase in the proportion of resident individuals in *O. mykiss* populations (Kendall et al. 2015). Thus, steelhead population abundance declines may not represent a trend towards the population's extirpation but may instead suggest a change in the dominant life history strategy. Under these conditions it will be important for the resident component to remain viable and capable of producing anadromous offspring."[8]

The Southern Steelhead Resources Evaluation (Becker et al. 2010) includes qualitative and quantitative accounts of *O. mykiss* presence in numerous river mainstems and tributaries including southern California streams located south of the Santa Maria River. And, as noted above, Attachment A provides a summary of *O. mykiss* survey data and reports compiled by United for CDFW's consideration to ensure that its evaluation is based on the best available science.

Viability Criteria

NMFS has documented a recognition of the importance of the life history plasticity between the resident and the anadromous forms of *O. mykiss*. In the Recovery Plan process, NMFS stated: "It is difficult to envision a successful recovery effort without a better understanding of the functional relationship between resident and anadromous fish." They go on to explain that "this continuum has a significant implication for viability criteria."[9] The most recent NMFS 5-year review of the species refers to resident *O. mykiss*, their importance to the viability of anadromous steelhead populations, and how viability criteria in the Recovery Plan should be updated to account for the contribution of resident fish, a key element of the listing evaluation. Recently, several authors that have worked extensively on the southern California steelhead population issue published a study[10] that makes an important point: "Resident *O. mykiss* in upper

[7] NMFS. 2016. 5-Year Review: Summary and Evaluation of Southern California Coast Steelhead Distinct Population Segment. National Marine Fisheries Service. West Coast Region. California Coastal Office. Long Beach, California.
[8] Kendall N.W., Marston G.W., Klungle M.M. 2017. Declining patterns of Pacific Northwest steelhead trout (*Oncorhynchus mykiss*) adult abundance and smolt survival in the ocean.
[9] NMFS. 2012. See pg. 14-13, paragraph 7.
[10] Dagit, R., M.T. Booth, M. Gomez, T. Hovey, S. Howard, S.D. Lewis, S. Jacobson, M. Larson, D. Mccanne, and T.H. Robinson. 2020. Occurrences of Steelhead Trout (Oncorhynchus mykiss) in southern California, 1994-2018. California Fish and Wildlife 106(1):39-58.

watershed areas outside the designated critical habitat are not protected by either state or federal endangered species acts, despite their documented link in maintaining maximum numbers of [s]teelhead (NMFS 2012)." Dagit et al. (2020) also note that the Southern California Steelhead Recovery Plan (NMFS 2012) and Boughton et al. (2007) proclaim that an important consideration to prevent extinction is "protecting existing populations and all life history expressions."

The current NMFS recovery population viability goal of 4,150 spawners per year on average for southern California steelhead comes from Lindley's (2003) "random walk with drift" model using field data from the Central Valley (Boughton et al. 2007; Williams et al. 2016). However, the "random walk" model considers only 100 percent anadromous spawners (thereby disregarding the significant contribution of resident *O. mykiss*). This flawed model forecasts that in terms of achieving recovery goals, resident *O. mykiss* would not contribute to the anadromous form even though NMFS recognizes that the Santa Clara River has maintained a population of smolts emigrating to the ocean while upstream migrant runs were too small to be self-sustaining. The construct of purely anadromous *O. mykiss* for the recovery goal is biologically inappropriate for this species, and contrary to the common recognition among experts that resident *O. mykiss* play a key role in conservation of native coastal *O. mykiss*, including the steelhead life history strategy – particularly in arid southern California where intermittent flow regimes and prolonged droughts are common (Dagit et al. 2020). The viability studies recognized that the "interchange between resident and anadromous fish groups would almost certainly lower the extinction risk of both groups."[11] The authors state that during their performance-based criteria analysis the interchange between the resident and anadromous form could have large consequences when determining extinction. Specifically, "we suspect that extinction risk of steelhead fraction is likely to be highly sensitive to the details of this interchange." Moyle et al. (2017) provides a more definitive conclusion stating, "[i]f resident rainbow trout populations are considered part of the southern steelhead complex, then the extinction threat of the overall population is somewhat less." Moyle et al. (2017) notes that reconnecting resident and anadromous *O. mykiss* is necessary to maintain the overall population in the future. In some watersheds, the connection of resident and anadromous *O. mykiss* remains intact, and in others, there is active progress toward projects that will reestablish this connection and aid in meeting recovery goals under the NMFS Recovery Plan (NMFS 2012). It is essential that CDFW considers the contribution of resident *O. mykiss* in the viability of the overall population given that residents are secure in their status and contribute to the anadromous life history (Moyle et al. 2017).

Dagit et al. (2020) also notes that, "[a]s reported by Williams et al. (2016) and confirmed by our observations, at no point since [southern California] steelhead were listed as endangered in 1997 was the preliminary provisional viable population goal of 4,150 annual anadromous spawners observed in any individual watershed, nor through the [Distinct Population Segment] DPS as a whole." A cursory comparison between the number of anadromous returns within the Santa Clara River watershed prior to and following the 1997 listing results in largely consistent numbers of individuals[12,13]. Indeed, in their 5-year review, NMFS states that the available data "indicate small (<10 fish) but surprisingly persistent annual runs of anadromous *O. mykiss*" within those watersheds currently being monitored (NMFS 2016). These are important observations which indicate that the anadromous *O. mykiss* population has remained stable in the region, supported by a resilient population of resident *O. mykiss* that persist in many watersheds both above and below barriers. These systems are capable of supporting robust populations that provide a substantial, yet under-evaluated contribution to the species in the region.

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[11] Boughton. 2007. See pg. 8, paragraph 2.
[12] CDFW. 1985. Lower Santa Clara River Steelhead Study. Final Report.
[13] Entrix. 2000. Results of Fish Passage Monitoring at the Vern Freeman Diversion Facility Santa Clara River 1994-1998

Finally, Dagit et al. (2020) states that "[b]uilding quantitative models that consider both anadromous and resident fish in the production of smolts, in addition to watershed-specific carrying capacities would be a valuable effort towards refining population goals." United strongly agrees, and points to the last southern California steelhead 5-year review that also stated: "Overall, these results show that resident and anadromous forms are tightly integrated at the population level, suggesting a revision of the viability criterion for 100 [percent] anadromous fraction" (NMFS 2016). Moyle (2017) acknowledges that the life-history trait of "partial anadromy is an active area of research to gain insight into underlying environmental and genetic influences. This multigenic trait has important implications for endangered steelhead recovery and fisheries management strategies." The best available science indicates that the entire breeding population, including resident *O. mykiss* as well as south-central California coast steelhead DPS (discussed in the **Genetics** section below) be evaluated in the status review. This is also necessary to ascertain a recovery goal that is representative of the biology and genetic structure of the native *O. mykiss* population in southern California.

Ecology, Life History, and Habitat

Anadromous *O. mykiss*, resident O. *mykiss*, and lagoon-anadromous *O. mykiss* may interbreed, and the offspring can result in any life history group (Kendall et al. 2015). As stated before, life history trajectories affect the survivorship of an individual, and there are tradeoffs with various life history strategies. For example, an individual exhibiting the anadromous life history strategy in southern California may result in faster growth, a larger individual, and higher fecundity than a resident *O. mykiss* due to the time it spent in the marine environment. However, a steelhead may not have an opportunity to migrate upstream within southern California due to drought conditions, whereas the resident *O. mykiss* may have better accessibility to spawning areas within the natal watershed.

The CalTrout petition states that "the timing of out-migration is influenced by a variety of environmental cues including streamflow, temperature, and breaching of the sand berm at the river's mouth."[14] It is important to add that recent new evidence points to day length (also known as photoperiod) as being a major driver of juvenile outmigration timing. Using over 20 years of data collected at the Freeman Diversion from the downstream migrant trap, Booth (2020) concluded that smolt migration timing was correlated with the day length and was less dependent on flow magnitude. Booth (2020) found that 95% of all smolts arrived between mid-March and late May with the majority arriving at the collection system in mid-April to mid-May. Most importantly, Booth (2020) concluded that "downstream migration in the Santa Clara River often may occur too late in the season to be synchronized with likely opportunities for downstream migration to the estuary and ocean."[15] Upon reviewing the historic hydrology for the system, Booth (2020) found that it is a relatively common occurrence for smolts in the Santa Clara River to be unable to successfully migrate to the ocean even with natural hydrology conditions.

O. mykiss in the Santa Clara River watershed produce a very small fraction of anadromy, likely related to the high cost for anadromy and the lack of opportunities for successful emigration and upstream migration. Kendall et al. (2015) reviewed various studies documenting the factors that may influence the fraction of anadromy. One study found that "migration cost did influence life histories in one model which indicated

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[14] CalTrout Petition. See pg. 9, paragraph 1.

[15] Booth M. 2020. Patterns and Potential Drivers of Steelhead Smolt Migration in Southern California. North American Journal of Fisheries Management, Volume 40, Issue 4: pp 1032-1050. See pg. 24, paragraph 2.

that emigration survival was one of the critical factors shaping the expression of anadromy."[16] Residency was predicted to increase as emigration survival decreased. Kendall et al. (2015) found other studies that indicated the southern portions of the species range may be skewed towards residency with the higher cost of anadromy due to seasonally dry stream reaches and lagoon sandbar formations limiting migration opportunities. For example, the Santa Clara River is a large watershed (1,625 square miles) dominated by a sandy, braided channel in the mainstem. During high flows, suspended sediment levels in the Santa Clara River are elevated to a point that is believed to preclude upstream migration opportunities.[17] A key section of the river for emigration to the ocean is well documented to go dry based on observations dating back to the 1700s, thus precluding passage. During large portions of the year, several reaches of the river mainstem remain dry due to percolation to the underlying groundwater basins as surface water is quickly lost in the broad alluvial floodplain.[18] It is likely that the historic planting of steelhead, discussed in more detail in the **Distribution and Abundance** section below, temporarily modified the fraction of anadromy, thereby increasing the anadromous run size in the system for some period of time. Historic planting is also a cause of genetic mixing among steelhead within the state, a topic discussed in more detail in the **Genetics** section below. As detailed in the **Population Trend** section above, prior surveys have documented that the resident form of *O. mykiss* are well established within the watershed and will continue to produce the anadromous form.

Genetics

In 2008, scientists at the National Oceanic and Atmospheric Administration (NOAA) Southwest Fisheries Science Center concluded that "[n]o genetic basis was found for the division of populations [from southern California] into two distinct biological groups, contrary to current classification under the US and California Endangered Species Acts."[19] A study by Clemento et al. (2009) analyzed nuclear DNA, representing the best available scientific information and a far superior approach to identifying genetic structure in coastal *O. mykiss* populations compared to the prior studies cited in the original listing that used allozymes (proteins), maternally inherited mitochondrial DNA (Busby et al. 1996),[20] and karyotyping (chromosome sampling). Thus, Clemento et al. (2009) demonstrates that the two population segments should be reclassified as one based on the most updated and most rigorous genetic data. In the status review of the Northern California (NC) summer steelhead, CDFW (2021) indicated that the NC summer steelhead should not be listed under CESA, a recommendation based at least partially on the genetics of the species,[21] which indicated closer relation between localities as opposed to run-timing. In the case of NC summer steelhead, CDFW found that the petitioned listing unit failed to meet the definition of a subspecies, as required under CESA.

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[16] Kendall N.W., McMillan J.R., Sloat M.R., Buerhens T.W., Quinn T.P., Pess G.R., Kuzischin K.V., McClure M.M., Zabel R.W. 2015. Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns. See pg. 335, paragraph 2

[17] Stillwater Sciences. 2020. Assessment of Suspended Sediment Effects on Adult Steelhead: Implications for Limitations on Steelhead Behavior and Physiology in the Santa Clara River.

[18] Beller E.E., R.M. Grossinger, M.N. Salomon, S.J. Dark, E.D. Stein, B.K. Orr, P.W. Downs, T.R. Longcore, G.C. Coffman, A.A. Whipple, R.A. Askevold, B. Stanford, J.R. Beagle. 2011. Historical ecology of the lower Santa Clara River, Ventura River, and Oxnard Plain: an analysis of terrestrial, riverine, and coastal habitats. See pg. 82

[19] Clemento A.J, Anderson E.C., Boughton D., Garza J.C. 2009. Population genetic structure and ancestry of *Oncorhynchus mykiss* populations above and below dams in south-central California. See pg. 1321, paragraph 1.

[20] Busby et al. 1996. Status Review: West Coast Steelhead from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS NWFSC-27.

[21] CDFW. 2021. California Endangered Species Act Status Review for Northern California Summer Steelhead (*Oncorhynchus mykiss).* See pg. 149, paragraph 4.

Shifts from the historic composition of *O. mykiss* is another consideration in terms of genetic variation, or lack of variation, across geographies. Pearse et al. (2011) compared *O. mykiss* from historic populations (1897 and 1909 samples obtained from the Smithsonian) with contemporary *O. mykiss* populations to analyze genetic differences across distance. Historic samples showed that genetic differentiation increased based on distance between watersheds. However, contemporary samples led to findings of significant changes from the historic samples but little to no genetic differences as distances between watersheds increased. Pearse et al. states, “[h]ere we show that these steelhead populations had a historically strong correlation between genetic and geographic distance that has been virtually erased in modern populations, suggesting that current relationships among modern steelhead populations are no longer reflective of natural migratory pathways. This demonstrates the critical role of migration in maintaining population relationships of threatened species and highlights the importance of natural history museums in providing historical baseline information.” These results add to the findings of Clemento et al. (2009) and indicate that the *O. mykiss* populations across DPSs, in this case the south-central California coast steelhead DPS and southern California steelhead DPS, are not genetically distinct. One reason posed by Pearse et al. is the historic planting of steelhead by CDFW across various watersheds within the state, which is discussed in more detail in the **Distribution and Abundance** section below.

Another consideration is introgression of hatchery stock with native populations. Abadía-Cardoso et al. (2016) conducted a genetic analysis of *O. mykiss* to evaluate the origins and ancestry of the populations from 10 watersheds spanning the southern California steelhead range. The study found that “In the northern part of this region, nearly all populations appeared to be primarily descendants of native coastal steelhead. However, in the southern, more urbanized part of this region, the majority of the sampled populations were derived primarily from hatchery trout, indicating either complete replacement of native fish or a strong signal of introgression overlaying native ancestry.” Notably, the study examined the genetics of several contemporary hatchery *O. mykiss* strains obtained from the Fillmore Hatchery, American River Hatchery, and Hot Creek Hatchery to determine introgression of native *O. mykiss* with hatchery *O. mykiss*. As shown in the results of Pearse et al. (2011), historic mixing of populations has an effect on the contemporary genetic variation, which would be a factor in the comparison of contemporary native and hatchery *O. mykiss* populations. While their study does not address the relationship of historic versus contemporary populations, Abadía-Cardoso et al. (2016) does present management elements for *O. mykiss* related to introgressed populations stating,“[n]evertheless, these genetically introgressed populations represent potentially critical genetic resources for the continued persistence of viable networks of *O. mykiss* populations, given the limited native ancestry uncovered in this region and the importance of genetic variation in adaptation.”

The **Relationship Between Resident and Anadromous *O. mykiss*** section above addresses the interrelatedness between the various life-histories, which is further supported by genetic information. In a genetic analysis of *O. mykiss* in Hood River, Christie et al. (2011) concluded that “closer to 40% of all steelhead genes come from wild trout each generation.” These findings provide a quantified link between the different life-histories as well as a basis for population viability that account for the entire population when concluding that their results “suggest that wild resident fish contribute substantially to endangered steelhead ‘populations’ and highlight the need for conservation and management efforts to fully account for interconnected *Oncorhynchus mykiss* life histories.” The information regarding *O. mykiss* genetics summarized in this submittal provides further support for the assessment of the entire resident and anadromous *O. mykiss* population, including those within the range of the indistinguishable south-central California coast steelhead DPS, when evaluating the status of the species.

Distribution and Abundance

The historic run size estimate in the NMFS Recovery Plan,[22] comes from "The Updated Status of Federally listed [Evolutionarily Significant Units] ESUs of West Coast Salmon and Steelhead" (Good et al. 2005) and includes steelhead estimates for each of the major watersheds. Within the Ventura River watershed, the estimate traces back to a 1946 CDFW letter commenting on the future Matilija Dam, the basis of which included personal observations and interviews with locals, also noting that a stocking program averaging 70,000 to 100,000 hatchery plantings each year had been ongoing for "the past years".[23] Within the Santa Clara River watershed, the 1980 estimate by Moore (1980)[24] of the average population traces back to the same 1946 CDFW letter from which Moore extrapolated an estimate in the Santa Clara River by comparing the potential habitat of the two watersheds. This fact is echoed in CDFW's 1996 Steelhead Restoration and Management Plan for California[25] and again by NMFS in Good et al. (2005),[26] which also includes a review of the historical run sizes in the major southern California watersheds. Moore's knowledge of the Santa Clara Watershed comes from the late 1970s and early 1980s, one of the wettest periods on record – which resulted in wetted reaches that would be dry in average or dry periods – resulting in an overestimation of river miles of suitable steelhead habitat. In the same 1980 report, Moore notes that projecting the average run size can be misleading, particularly in systems subject to extreme flow fluctuations from year-to-year.

In a review of the history of steelhead in the Santa Ynez River, Alagona et al. (2012)[27] acknowledges the natural variation in steelhead run sizes, particularly in the southern California ecosystems, noting that "[a]ll of these perturbations and processes affect steelhead populations, which may have varied by two orders of magnitude annually owing to natural changes alone." The original source of the Santa Ynez River estimate came from a report generated by Shapovalov,[28] a CDFW employee, and relied upon the opinion of another CDFW employee (Carl Tegen) who was working as a trapper in the Santa Ynez River watershed. Tegen compared the number of steelhead in the Santa Ynez River to counts in the Eel River and deduced that the Santa Ynez steelhead run during the year in question (1944) was "at least as large" as the Eel River. While it is apparent that there were many adult steelhead in the Santa Ynez in 1944, a time period following several years of above average rainfall[29], it would be highly inaccurate to assume that his estimate was a running average of a natural run of steelhead for the same reason that Moore notes in his 1980 report regarding year-to-year fluctuations in flows within these river systems.

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[22] NMFS. 2012. Southern California Steelhead Recovery Plan. Southwest Region, Protected Resources Division, Long Beach, California. See pg. xiii, paragraph 3.

[23] Clanton D.A. and Jarvis J.W. 1946. Field inspection trip to the Matilija-Ventura watershed in relation to the construction of the proposed Matilija Dam. California Division of Fish and Game, Field Correspondence.

[24] Moore M. 1980. An Assessment of the Impacts of the Proposed Improvements to the Vern Freeman Diversion on Anadromous Fishes of the Santa Clara River System, Ventura County, California. See pg. 14, paragraph 2.

[25] CDFW. 1996. Steelhead Restoration and Management Plan for California. See pg. 55, paragraph 4.

[26] Good T.P., Waples R.S., Adams P. (editors). 2005. The Updated Status of Federally listed ESUs of West Coast Salmon and Steelhead. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-66, 598 p. See pg. 282, paragraph 4.

[27] Alagona P.S., Cooper S.D., Capelli M., Stoecker M., Beedle P. H. 2012. A History of Steelhead and Rainbow Trout (*Oncorhynchus mykiss*) in the Santa Ynez River Watershed, Santa Barbara County, California. See pg. 169, paragraph 4.

[28] Shapovalov L. 1944. Preliminary Report on the Fisheries of the Santa Ynez River System, Santa Barbara County, California. See pg. 12, paragraph 2.

[29] County of Santa Barbara. 2022. Santa Maria City College Annual Rainfall. Accessed online at: https://content.civicplus.com/api/assets/10547459-92d1-49d4-83b7-b10c4ef54233?cache=1800

CDFW acknowledges this subjectivity in quoting the U.S. Fish and Wildlife Service (USFWS) in the Fish Species of Special Concern in California.[30] CDFW notes that the estimates of historical run sizes "are highly subjective and probably correct only within an order of magnitude." In Good et al. (2005), NMFS concurs with the earlier CDFW statement and goes a step further to adjust down the historical run size estimate for the Santa Ynez River based on a logical inference regarding Tegen's experience in the Santa Ynez and Eel Rivers. Good et al. (2005) summarizes their review of historical run sizes by stating that "the estimates of historical run sizes for the Southern California steelhead ESU are based on very sparse data and long chains of assumptions that are plausible but have not been adequately tested."

Beginning in the 1890s, CDFW implemented an extensive steelhead planting program that continued until the 1930s (Bowers 2008). In the 1910s, southern California rivers (including the Santa Clara and Ventura) along with their tributaries, received up to 3 million trout per year from northern hatcheries. Planted fish were predominantly a mix of resident and anadromous *O. mykiss*. In southern California, the rise and fall of the anadromous *O. mykiss* population directly correlates with CDFW's planting of northern California steelhead in southern California waters. Prior to the planting from northern hatcheries, records of steelhead in the southern California rivers are minimal. For example, records from the missionary period never mention trout or steelhead, which contrasts with the rivers further north. As noted in the review of steelhead in the Santa Ynez River by Alagona et al. (2012), "we found relatively few explicit records of Chumash exploitation of riverine fish, such as steelhead in the Santa Ynez River, from Spanish, Mexican, and early American explorers and settlers," indicating that steelhead were possibly not as prevalent and abundant as previously asserted. Alagona et al. (2012) continues: "At present, the only archaeological evidence for steelhead presence comes from several theses and a museum contribution describing excavations of sites in former inland Chumash villages with associated information on the identity of fish elements… [s]teelhead remains were found at three of four excavated sites… 6 salmonid bone elements found at Xonxon'ata [located on Zaca Creek 6 miles above its confluence with the Santa Ynez River] constituted only 0.2% of the identifiable fish bones recovered at this site, with the rest assignable to marine species, and these bones appeared to come from immature steelhead or rainbow trout." Alagona et al. (2012) acknowledges that more research is necessary to draw conclusions regarding the presence of salmonid bones at the Santa Ynez River archaeological sites; however, the findings provide an indication of limited steelhead presence during the pre-colonial period.

As noted above, large numbers of trout from northern hatcheries were planted in southern California rivers in the 1890s through the 1930s. The history of the steelhead fisheries during this time is well documented.[31,32] By the early 1930s, there was a trend towards planting larger "catchable-sized" trout. In the late 1930s, the focus of the hatcheries had changed to producing and planting "catchables" that were mostly from a resident form of *O. mykiss.*[33] The decline in the anadromous form of *O. mykiss* in southern California rivers coincided with the change in hatchery rearing and planting practices. The population decline following the cessation of planting from northern hatcheries is evident in correspondence generated by CDFW officials and numerous newspaper articles at the time (McEachron 2007, Bowers 2008). Alagona et al. (2012) also cited Spanne (1975), which "noted that runs of anadromous fish in the Santa Ynez River occurred right up to the construction of Bradbury Dam, but that they were much more

[30] CDFW. 1995. Fish Species of Special Concern in California. See pg. 81, paragraph 4.
[31] McEachron M. 2007. A Review of Historical Information Regarding Steelhead Trout in the Piru Creek Watershed, Ventura County, California.
[32] Bowers K. 2008. History of Steelhead and Rainbow Trout in Ventura County: Newsprint Accounts from 1870 to 1955. Vol I.
[33] CDFW. 1970. Fish Bulletin 150 A History of California Fish Hatcheries. See pgs. 50-52.

predictable and frequent in the late nineteenth and early twentieth centuries based on the memories of elderly residents." The late nineteenth and early twentieth century time period is coincident with the steelhead planting program that was underway in southern California at that time. By 1951, mention of a steelhead fishery in the newspapers had almost ceased to exist. During that same year, CDFW biologist Willis Evans stated: "The fisheries value of these drainages lies primarily in the existence of a resident population of rainbow trout in the head waters areas. Their range throughout most of the subject drainages is curtailed by the lack of sustained year long stream flows. High summer water temperatures above the tolerance of trout also prevent trout development in otherwise suitable streams such as lower Piru Creek."[34] "These drainages" referred to the Ventura and Santa Clara River watersheds. The following year (1952), the Santa Paula Chronicle reported that "[s]teelhead fishing season ended this year without a single catch being made." In 1954, observations of a few steelhead were reported in the Ventura River, but no catches were reported. Notably, these statements from CDFW were made prior to any major dams being constructed in the Santa Clara River watershed. Santa Felicia Dam, constructed on Piru Creek in 1955, was the first such dam. Contemporary records of steelhead in the Santa Clara River, primarily made by fisherman, CDFW, and United are also well-documented.[35,36,37]

In 1979, Moore, as referenced in Stoecker and Kelley (2005), performed extensive surveys in both Santa Paula Creek and Sespe Creek. Moore reported "abundant" trout in most of the tributaries, including 15 *O. mykiss* per 100 feet in Lion Creek and 70 *O. mykiss* per 100 feet in Howard Creek. CDFW conducted a two-year study in coordination with United in 1982-1983 and 1983-1984 (Puckett and Villa 1985). It resulted in the trapping and identification of a total of three adult steelhead over the two-year study period. In Sespe Creek, the CDFW study found no smolts despite trapping, electroshocking, and netting downstream of the Sespe tributary during the primary smolt migration period. As noted above, monitoring at the Freeman Diversion fish ladder has identified low numbers of adult steelhead, typically between 0-2 individuals per year, since beginning operation in 1991 through 2022[38]. Consistent with earlier observations, ongoing monitoring at the Freeman Diversion indicates that the total abundance of steelhead has remained relatively stable since well before the federal listing.

In the early 1990s, smolts were trapped and counted at the Freeman Diversion. In 1994, for example, United operated a downstream migration trap from February 21 through May 25 and a total of 83 smolts were collected at the trap during this period.[39] It is worth noting that smolts collected at the facility ranged from 0 to approximately 800 during the operation of the downstream migrant trap; however, the use of the trap was discontinued in 2015 at the direction of NMFS, and a trap efficiency study was not conducted so an estimation of total smolt production based on the proportion of smolts trapped is unknown.

The **Population Trend** section above provides additional information compiled by United regarding the distribution and abundance of *O. mykiss* in the region. The information and summaries provided in this letter contributes to the best available science on the subject; however, as indicated above, additional information available to CDFW and/ or contributed by other stakeholders is anticipated to further inform the status review.

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[34] Evans W.A. 1951. U.S. Department of Agriculture "Report of Survey Santa Clara-Ventura Rivers and Calleguas Creek Watersheds, California" (January 1951). See pg. 1, paragraph 4.

[35] Stoecker M., Kelley E. 2005. Santa Clara River Steelhead Trout: Assessment and Recovery Opportunities.

[36] Puckett L.K. and Villa N.A. 1985. Lower Santa Clara River Steelhead Study. Final Report.

[37] Entrix. 2000. Results of Fish Passage Monitoring at the Vern Freeman Diversion Facility Santa Clara River 1994-1998

[38] Booth M. 2016. Fish Passage Monitoring at the Freeman Diversion 1993-2014

[39] Entrix. 1994. Results of Fish Passage Monitoring at the Vern Freeman Diversion Facility, Santa Clara River, 1994. See pg. 3-10, Table 3-4

Degree and Immediacy of Threat

As noted by Moyle et al. (2017), resident *O. mykiss* are generally considered to be secure in their status. There are many factors contributing to the status of anadromous *O. mykiss* (NMFS 2016) and the interplay between the resident and anadromous life-histories is key in developing a better understanding of the persistence of southern California steelhead. Numerous studies have pointed to the importance of accurately defining this relationship and information provided in the **Population Trend, Viability Criteria**, and **Genetics** sections above contributes to the best available science on the subject. As stated by Moyle et al. (2017), "[i]f resident rainbow trout populations are considered part of the southern steelhead complex, then the extinction threat of the overall population is somewhat less. Reconnecting the anadromous and resident forms of the native *O. mykiss* populations, however, is essential for maintaining both the anadromous and resident trout populations in the future." Resident and anadromous *O. mykiss* occupy the same watersheds in the region and known contributions of residents to the anadromous life history (and vice versa) indicate that the overall species will persist and improve given the restoration efforts currently underway.

A resilient population of resident *O. mykiss* persists in many watersheds both above and below barriers, and these systems are capable of supporting robust populations that provide a substantial and well documented contribution to the overall species[40]. A recent study of a different steelhead population (California Central Valley Steelhead DPS) concluded that the monitoring of all life-histories, including resident and anadromous, is necessary for comprehensive status assessments as well as for the quantification of watershed capacity to support and improve conditions for the overall species[41]. Given the known interrelatedness of the life-history strategies of *O. mykiss*, these findings can readily be applied to southern California steelhead as part of the status review.

Adequacy of Existing Management or Recommendations for Management of the Species

Existing protections for southern California steelhead, typically applied to both resident and anadromous life-history forms, are primarily afforded by the federal Endangered Species Act (ESA). Southern California steelhead were listed as endangered under the federal ESA in 1997 and as such, "take" and modification of critical habitat is prohibited absent consultation with NMFS and execution of a Biological Opinion/ Incidental Take Statement under Section 7 of the ESA, or a Habitat Conservation Plan/ Incidental Take Permit under Section 10 of the ESA. Other existing regulatory mechanisms that provide a level of protection to southern California steelhead include the National Environmental Policy Act (NEPA), Clean Water Act (CWA), Federal Power Act (FPA), California Environmental Quality Act (CEQA), California Fish and Game Code (FGC) (including §1600, 5901, 5937, etc.) California Water Code, Porter-Cologne Act, Forest Practice Act, federal Wild and Scenic Rivers Act, and California Wild and Scenic Rivers Act.

Under the federal ESA, "take" is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S.C., §1532). Under CESA, "take" is defined as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill" (Fish & G. Code, §86). Notably, the federal ESA includes a broader "take" definition (i.e., including "harass" and "harm")

[40] Kendall N.W., McMillan J.R., Sloat M.R., Buerhens T.W., Quinn T.P., Pess G.R., Kuzischin K.V., McClure M.M., Zabel R.W. 2015. Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns

[41] Eschenroeder J., Peterson M., Hellmair M., Pilger T.J., Demko D., Fuller A. 2022. Counting the Parts to Understand the Whole: Rethinking Monitoring of Steelhead in California's Central Valley.

as well as "take" prohibitions for habitat for the listed species. CESA does not include a comparable habitat take prohibition; however, CDFW applies the Lake or Streambed Alteration Agreement (LSAA) (FGC §1600-1607) process to effectively protect habitat of listed and non-listed species under the jurisdiction of the state.

A listing under CESA would not effectively increase the protections afforded to southern California steelhead. While NMFS administers protections for southern California steelhead under the federal ESA and CDFW administers protections for steelhead under the FGC, "take" is already prohibited under the federal ESA without an incidental take permit and is also effectively prohibited by CDFW's interpretation and application of FGC. Under the federal ESA, impacts to steelhead must be avoided, minimized, and mitigated to fully offset, or offset to the maximum extent practicable, the impacts of the taking. Under CESA, the impacts of the taking must be avoided, minimized, and "fully mitigated", which is typically interpreted by CDFW to require compensatory mitigation beyond what is required under the federal ESA. This represents a possible additional protection afforded by a listing under CESA; however, specifics regarding how this provision of CESA would translate to additional benefits to southern California steelhead are not supported by the best available science.

United appreciates the opportunity to provide comments and information to inform CDFW's status review of southern California steelhead. Along with contributing to the best available science, the information summarized herein demonstrates the need for close examination of all relevant scientific information of the proposed listing unit, which includes both the resident and anadromous life-history forms of *O. mykiss*. Given this, the status review is an opportunity to evaluate all factors related to the status of the overall species, leading to biologically sound and appropriate conclusions. United implores CDFW to continue outreach and engagement with interested stakeholders, as well as the scientific community, during the status review process to ensure that a comprehensive assessment that reflects the complexity of the species is completed.

Respectfully,

Anthony Emmert
Assistant General Manager

Attachment: A. – *O. mykiss* Survey Data and Results

Attachment A. *O. mykiss* Survey Data and Results

Watershed	Sub-watershed	Year	Study lead	Results	Source
Santa Clara River	Piru Creek (middle)	2008	CDFW	Fish Creek - 288 resident *O. mykiss* (est. 3,113 *O. mykiss* per mile) Agua Blanca - 208 resident *O. mykiss* (est. 1,316 *O. mykiss* per mile)	CDFW 2008a
	Piru Creek (upper)	2008	CDFW	Upper Piru Creek - est. 331 *O. mykiss* per mile Buck Creek - est. 953 *O. mykiss* per mile Alamo Creek - est. 2,648 *O. mykiss* per mile Mutau Creek - est. 334 *O. mykiss* per mile	CDFW 2008b
	Sespe Creek	2004	Stoecker	2,954 *O. mykiss* observed	Stoecker and Kelley 2005
	Sespe Creek	2018	USFS	35 *O. mykiss* in Sespe Creek 373 O. mykiss in Lion Creek	USFS 2018
	Sespe Creek	2017	USFS	215 O. mykiss in Lion Creek 44 *O. mykiss* in Tule Creek	USFS 2017
	Santa Paula Creek	2018	USFS	62 *O. mykiss* observed	USFS 2018
	Rock Creek	2018	USFS	1 *O. mykiss* observed	USFS 2018
	Santa Clara mainstem	1994-2020	United	*O. mykiss* observations between 1994-2014 at the Freeman Diversion: 13 adult steelhead (2 hatchery), 2,128 smolts, 210 YOY, 116 resident, 92 hatchery An additional 2 adult steelhead were identified in the fish passage facility in spring 2020	Booth 2016 United unpublished data
Ventura River	Lower Ventura-San Antonio Creek-Matilija Creek-North Fork Matilija Creek	2005-2020	Casitas Municipal Water District	Peak annual snorkel counts during the monitoring period (2005-2020) generally between 350-400 *O. mykiss*. No *O. mykiss* observed in 2020	CWMD 2020
	Lower Ventura	2006-2012	Allen	Near zero abundance of fry and juvenile O. mykiss observed in 2006 and 2007 but increasing to a maximum of 2,348 fry and 3,739 juvenile O. mykiss in 2012 and 2008, respectively	Allen 2015
	Middle Ventura	2006-2012	Allen	Maximum abundance of fry in 2012 totaling 6,637 individuals and maximum abundance of juvenile in 2008 totaling 3,555 individuals	Allen 2015
	Upper Ventura (including Matilija Creek)	2006-2012	Allen	Higher abundance estimates in the upper segment are largely due to the higher average densities of O. mykiss in the reaches above Matilija Dam, which encompass approximately one-half of the stream miles that are currently available for rearing below the dam (not including dry channels)	Allen 2015
	Matilija Creek	2017	USFS	62 *O. mykiss* in Matilija Creek 301 *O. mykiss* in Upper North Fork Matilija Creek	USFS 2017
	Matilija Creek	2018	USFS	1 *O. mykiss* in Matilija Creek 0 *O. mykiss* in Upper North Fork Matilija Creek	USFS 2018
	Murrieta Creek	2018	USFS	10 *O. mykiss* in Murrieta Creek	USFS 2018
Santa Maria River	Sisquoc River	2005	Stoecker	4 *O. mykiss* in the lower Sisquoc (0.02 fish/ 100 ft) 190 *O. mykiss* in the upper Sisquoc (3.9 fish/ 100ft) 231 *O. mykiss* in Manzana Creek (2.8 fish/ 100ft) 288 *O. mykiss* in Davy Brown Creek (6.8 fish/ 100ft) 122 *O. mykiss* in South Fork Sisquoc (20.4 fish/ 100ft) 6 *O. mykiss* in Rattlesnake Creek (0.6 fish/ 100ft) Total = 841 *O. mykiss* (2.0 fish/ 100ft)	Stoecker 2005
		2018	USFS	514 *O. mykiss* in Davy Brown Creek	USFS 2018
	Munch Creek	2018	USFS	69 *O. mykiss* in Munch Creek	USFS 2018
	Malibu Creek	2005-2014	Santa Monica Mountains Resource Conservation District	5 adult *O. mykiss* observed in 2007 and 2,200 *O. mykiss* young of the year (YOY) in 2008. During surveys completed in 2005, 2008, 2011, 2014, and 2015, YOY observations varied from 11 to 590 individuals	Moyle 2017

Santa Monica Mountains	Topanga Creek	2013-2018	Santa Monica Mountains Resource Conservation District	Observed *O. mykiss* of all life stages ranged from 0 to approximately 170 during the study period. Other streams included in the survey (Big Sycamore, Las Flores, Solstice, Trancas, Zuma) were negative for *O. mykiss* during the study period. Note that the study period was largely during the prolonged 2012-2016 drought	SMMRCD 2018
Santa Ynez River	Santa Ynez	1994-2004	Cachuma Operations and Maintenance Board	Annual snorkel surveys between 1994-2004 resulted in identification of between 0-84 adult *O. mykiss* and 0-346 juvenile *O. mykiss* in the lower Santa Ynez River. Annual snorkel surveys during the same period in the tributaries (Salsipuedes, Hilton, Quiota, El Jaro, Nojoqui) yielded between 0-575 adult *O. mykiss* and between 0-909 juvenile *O. mykiss* . Adult and juvenile status was based on size class	SYRAMC 2009
	Santa Ynez	2017	USFS	92 *O. mykiss* in Alder Creek 292 *O. mykiss* in Fox Creek	USFS 2017
Los Angeles River	Pacoima, Lower Big Tujunga, Haines, Alder, Arroyo Seco, Big Santa Anita Creeks	2018	Southwest Resource Management Association	Presence/ absence surveys. *O. mykiss* identified in Lower and Upper Big Tujunga, Lower Alder, Arroyo Seco, Eaton Canyon, and Big Santa Anita Creeks. Of the native species, coastal rainbow trout were the most abundant.	SRMA 2020
San Gabriel River	Buckhorn, Fish Creek, San Gabriel River, Bear, Cattle Canyon, Lower San Dimas, San Antonio,	2018	Southwest Resource Management Association	Presence/ absence surveys. O. mykiss identified in Lower and Upper Buckhorn, Fish, Cattle Canyon, Lower San Dimas, and San Antonio Creeks, as well as the North, East, and West Forks of the San Gabriel RIver. Of the native species, coastal rainbow trout were the most abundant.	SRMA 2020

RANCHO MISSION VIEJO

Via Email: fgc@fgc.ca.gov
April 3, 2024

The Honorable Samantha Murray
President
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

Reference: Agenda Item 22: Southern California Steelhead (*Oncorhynchus mykiss*) CESA Petition

Subject: Rancho Mission Viejo – Additional Comments

Dear President Murray:

Rancho Mission Viejo (RMV) writes in regard to the petition currently pending before the California Fish and Game Commission (Commission) to list Southern California Steelhead (*Oncorhynchus mykiss*) ("Steelhead Petition") as an Endangered Species under the California Endangered Species Act (CESA, Fish and Game Code § 2050 et seq.).

RMV lands are located in Southern Orange County and are owned and managed by the O'Neill family. Since 1882, the O'Neill family has been a responsible steward of these lands ("the Ranch"). We have and continue to actively manage the Ranch to protect the resources on it. We intend to continue this tradition of stewardship into the future through implementation of the Southern Subregion Habitat Conservation Plan (SSHCP), approved by U.S. Fish and Wildlife Service on January 10, 2007.

RMV is the principal permittee under the SSHCP. In summary, the SSHCP Conservation Strategy provides a comprehensive, habitat-based approach to the protection of SSHCP Covered Species and their habitats by focusing on the lands and aquatic resource areas essential for the long-term conservation of these species and by providing for appropriate management for those lands. The SSHCP Habitat Reserve ultimately will conserve approximately 32,818 acres in southern Orange County, comprised of historical RMV lands and three County of Orange wilderness parks.

28811 ORTEGA HIGHWAY • P.O. BOX 9 • SAN JUAN CAPISTRANO, CA 92693 • (949) 240-3363 • FAX (949) 248-1763

RMV previously provided comments on the Steelhead Petition (RMV, August 9, 2022 and September 17, 2021) in which we summarized our actions to protect and manage San Juan Creek within RMV lands through implementation of the SSHCP. In our prior correspondence we noted our plans to remove a large Arizona style crossing of San Juan Creek identified as fish passage barrier in the Southern California Steelhead Recovery Plan and build a bridge downstream of the crossing location. Removal of this barrier (Action #SJT-SCS-3.2) is ranked as 1A in the Southern California Steelhead Recovery Plan. We wish to inform the Commission that RMV has built the bridge (Gibby Bridge) and removed the Arizona style crossing. We are in the process of restoring all areas impacted by either the bridge construction or removal of the crossing. Exhibits 1 and 2 show before and after photos.

As we previously indicated, by protecting potential suitable habitat and implementing management measures thereon, consistent with the SSHCP, RMV has provided suitable habitat conditions for Southern steelhead should it colonize San Juan and/or Arroyo Trabuco creeks upstream of I-5 in the future Thus, if the Southern steelhead is listed under CESA, RMV requests that the SSHCP be recognized as contributing to the protection and management of the Santa Catalina Gulf Coast population such that "Covered Activities" under the SSHCP (including specified development and infrastructure projects) would not be considered "take" pursuant to California Fish and Game Code Section 86 and would not require a Section 2081(b) Incidental Take Permit.

RMV appreciates the opportunity to provide these comments. Should you have any questions regarding our comments, please feel free to contact me at (949) 240-3363 Ext. 297 or via email at lcoleyeisenberg@ranchomv.com.

Sincerely,

Laura Coley Eisenberg
Senior Vice President, Regulatory Compliance & Open Space Management

Attachment A:
Exhibit 1: Before – Arizona Style Crossing
Exhibit 2: After – Gibby Bridge

cc: The Honorable Erika Zavaleta, Vice President, California Fish and Game Commission
The Honorable Jacque Hostler-Carmesin, Member, California Fish and Game Commission
The Honorable Eric Sklar, Member, California Fish and Game Commission
The Honorable Darius W. Anderson, Member, California Fish and Game Commission
Ms. Melissa Miller-Henson, Executive Director, California Fish and Game Commission
Mr. Scott Gardner, Wildlife Branch Chief, California Department of Fish and Wildlife

Attachment A

Exhibit 1: Before – Arizona Style Crossing of San Juan Creek (looking upstream)

Exhibit 2: After – Gibby Bridge over San Juan Creek (looking downstream)

April 4th, 2024

California Fish and Game Commission

P.O. Box 944209

Sacramento, California 94244-2090

RE: California Trout, Inc.'s Petition to list Southern California Steelhead (*Oncorhynchus mykiss*) as Endangered Office - Administrative Law's Notice ID #Z2021-0702-02 and Z2022-0426-01

President Murray and Commissioners,

We express our full support for designating the Southern California steelhead as endangered under California's Endangered Species Act. Southern steelhead are on the brink of extinction. You must act now, without delay, to prevent the total and irreversible loss of this species.

Recent research tells us that Southern steelhead populations are in danger of extinction within the next 25 to 50 years if current trends persist. Since their listing as endangered under the federal Endangered Species Act in 1997, Southern steelhead numbers have continued to decline to dangerously low levels. This is the result of continued urbanization, agriculture, and water development. These activities have compromised and drastically reduced their essential required habitat. The legacy of degradation will only be exacerbated by climate crisis projections of intensified floods, droughts, and extreme heat.

The rivers and streams in Southern California once saw Southern steelhead adults return in the tens of thousands. In the past 25 years, only 177 adult Southern steelhead were documented in their native range. Allowing this species to disappear is not acceptable. CalTrout's petition, reaffirmed in State Courts as containing sufficient information to warrant a decision, and California Department of Fish and Wildlife's (CDFW) peer-reviewed species status report present you with the best available science and a clear mandate to make the decision to fully list this species immediately.

These fish play a key role in our ecosystems on which we all depend. They are a crucial part of the integrity of watersheds in which they swim. Their continued survival and recovery will reflect the resilience of our communities in the face of growing climate crisis challenges. We can look to them for clues on how California must work to address bigger problems in our Southern California rivers, streams, watersheds, and coastlines. These aquatic ecosystems, extending from summits to the seabed, provide countless environmental, social, and economic benefits for the entire state. We believe that we prosper, now and in the future, when Southern steelhead are thriving in our rivers.

For all these reasons, we, without reservation, support listing Southern steelhead as endangered in all waters within historic range below natural or man-made barriers.

Respectfully,

Linda Krop – Chief Counsel
Environmental Defense Center

Richard Smalldon – Director
Santa Barbara Museum of Natural History – Sea Center

Ken Owen – Executive Director
Channel Island Restoration

James Danza – Board Chair
Friends of the Santa Clara River

Candice Meneghin - Executive Director
Coastal Ranches Conservancy

Ted Morton - Executive Director
Santa Barbara Channelkeepers

Paul Jenkin – Chair
Matilija Coalition

Benjamin Pitterle - Director of Advocacy & Field Operations
Los Padres Forest Watch

Anne Burdette - President
Santa Barbara Urban Creeks Council

Jazzari Taylor - Policy Advocate
Latino Outdoors

Katherine Pease, Ph.D. – Director of Science and Policy - Heal the Bay

Peter Massey - Project Manager Water Equity Programs - TreePeople

Claire Schlotterbeck - Executive Director
Hills For Everyone

Rocío Lozano-Knowlton - Executive Director
Merito Foundation

Andria Ventura - Legislative and Policy Director - Clean Water Action

Mati Waiya - Executive Director
Wishtoyo Foundation

Don Chartrand - Executive Director
Creek Lands Conservation

Candice Dickens-Russell - CEO
Friends of the Los Angeles River

Eugenia Ermacora - Chapter Manager
Surfrider Los Angeles

Jeanne Sparks - Co-Executive Director
Santa Barbara County Action Network

Ron Merkord - President
Santa Clara River Conservancy

Benjamin Harris - Senior Staff Attorney
Los Angeles Waterkeepers

Cher Gilmore -- Facilitator
SCV Eco Alliance

Scott Culbertson – Executive Director
Friends of the Ballona Wetlands

Steve Terui - President
Pasadena Casting Club

Melanie Winter - Founder & Director
The River Project

April 4th, 2024

California Fish and Game Commission
P.O. Box 944209
Sacramento, California 94244-2090

RE: California Trout, Inc.'s Petition to list Southern California Steelhead (Oncorhynchus mykiss) as Endangered Office - Administrative Law's Notice ID #Z2021-0702-02 and Z2022-0426-01

President Murray and Commissioners:

As a concerned California resident, I write to you today to express my full support for designating the Southern California steelhead as endangered under California's Endangered Species Act.

Southern steelhead are an iconic native species, but without further protections we risk losing them forever. That's not a California I want to live in. Do you? You must act immediately to put in place all precautions to prevent this species from total loss.

Recent research tells us that Southern steelhead populations are in danger of extinction within the next 25 to 50 years if current trends persist. Since their listing as an endangered species in 1997 under the federal Endangered Species Act, Southern steelhead numbers have continued to decline to precariously low levels. In the past 25 years, only 177 adult Southern steelhead were documented in their native range! Allowing this species to disappear is not acceptable, and more protections are essential.

These fish play a key role in our ecosystems, and they can give us crucial information about the greater health of the watersheds they swim in (and that our communities rely upon). We can look to them for clues on how California must work to address bigger problems in our southern rivers and streams, watersheds that provide countless societal and economic benefits for the entire state. I believe that we prosper when rivers and waterways in key locations are thriving, and in many of these places there is work to be done.

These fish may also play a role in providing resiliency for ecosystems further north along the coast. Southern steelhead are uniquely adapted to Southern California's warmer Mediterranean climate. As climate change continues to increase water temperatures and alter flow regimes along the entire West Coast, Southern steelhead could be critical to the long- term resiliency of their northern relatives.

For all these reasons, I wholeheartedly support California Trout's recommendation that Southern California steelhead be listed as endangered in all waterways within historic range below natural or man-made barriers. CalTrout chose this delineation thoughtfully, so that fishing and continued management for rainbow trout, the freshwater form of this amazing species, would still be possible above these barriers.

It’s not too late to save the Southern California steelhead species from blinking out – but if you don’t act urgently, we may very well miss our chance. Please make protection of these amazing and important fish a conservation priority by listing them as endangered under the state’s Endangered Species Act.

Sincerely,

A Concerned Californians and Individuals All Over

1. **Felino Bautista** (*ZIP code: 91765)*

2. **Steven Hair** (*ZIP code: 90404)*

3. **Angel Castillo** (*ZIP code: 91789)*

4. **Jason Dunn** (*ZIP code: 95648)*

5. **Olympia Foster** (*ZIP code: 95928)*

6. **Pranav Prakash** (*ZIP code: 94539)*

7. **David Blackburn** (*ZIP code: 92058)*
Species becoming extinct is unacceptable as long as there is any way to stop it

8. **kate d** (*ZIP code: 90405)*

9. **Barbara Gibson** (*ZIP code: 92026)*

10. **Joe Mendoza** (*ZIP code: 92688)*
Save the Steelhead!

11. **Stewart Smith** (*ZIP code: 95060)*

12. **Achille Ratti** (*ZIP code: 29123)*

13. **Debbie Frame** (*ZIP code: 91214)*

14. **L. Andrew Alper** (*ZIP code: 90272)*

15. **Aaron Gomperts** (*ZIP code: 90272)*

16. **Aida Ashouri** (*ZIP code: 90027)*
Northern California removed a dam to preserve the fish. We need to do something similar here. These are key animals in our ecosystem.

17. Andrew Becker (*ZIP code: 91601)*

18. Abigail Pratt (*ZIP code: 92064)*

19. Abraham Hidalgo (*ZIP code: 90039)*
Save the steeelyssss

20. Anne Buttyan (*ZIP code: 90404)*

21. Anthony Sheridan (*ZIP code: 90049-5234)*

22. Alec Zapata (*ZIP code: 91324)*

23. Adam Daigian (*ZIP code: 94122)*
Trout are beautiful. Save them!

24. Adam Kilburn (*ZIP code: 94510)*

25. Adam Test (*ZIP code: 92028)*

26. Adam Zamastil (*ZIP code: 93023)*

27. Addae melhuish (*ZIP code: 90016)*

28. Sam Adelson (*ZIP code: 95018)*
Critical to ecosystems and culture. Let's list the SoCal steelhead so they can be better protected and stewarded. Take down unnecessary dams and restore habitat, and include the indigenous community and traditional ecological knowledge.

29. Adry Furchtgott (*ZIP code: 90041)*

30. Andrew Steiger (*ZIP code: 90006)*

31. Kenneth Lee (*ZIP code: 93906)*

32. David Cruze (*ZIP code: 94599)*
Please help save these wonderful creatures.

33. Amy Fieling (*ZIP code: 92028)*

34. alan freisleben (*ZIP code: 92675)*

35. Alicia Torres (*ZIP code: 95688)*

36. Haven Kiers (*ZIP code: 95616-0848)*

37. Angelina Huber (*ZIP code: 97701)*
38. Peter Burnes (*ZIP code: 95945)*

39. Aiden Bradley (*ZIP code: 93834)*

40. Anthony Swentosky (*ZIP code: 97702)*

41. Anthony Bendik (*ZIP code: 94954-2314)*
Please consider listing Southern California steelhead! Every little move helps improve the entire ecosystem.

42. Audrey Kenney (*ZIP code: 80437)*

43. Akane Tada (*ZIP code: 90805)*

44. Alexis Laplante (*ZIP code: G2k1j7)*

45. Windspirit Aum (*ZIP code: 95410)*
Take out the dams!

46. Alden Greathouse (*ZIP code: 93940)*

47. Alec Villanueva (*ZIP code: 95817)*

48. Alejandra Bellavance (*ZIP code: 95037)*

49. Alexander Burke (*ZIP code: 94025)*

50. Alex Wright (*ZIP code: 90068)*

51. Alex Honor (*ZIP code: 93420)*
Please protect the steelhead

52. Alex Macswain (*ZIP code: 94901)*
Save this fish!

53. Alice Feller (*ZIP code: 94705)*

54. Alisan Theodossiou (*ZIP code: 94501)*

55. Alison Lancaster (*ZIP code: 90404)*
Preserve these invaluable members of our SoCal watersheds!

56. Alison Cordera (*ZIP code: 95519)*

57. Alissa Cox (*ZIP code: 95928)*
Save the steelhead!

58. Allen Luce (*ZIP code: 94960)*

59. Allen Osterberg (*ZIP code: 92562)*

60. Allison Bray (*ZIP code: 92026)*

61. Ally Woods (*ZIP code: 96150)*
Steelhead are a major role in any ecosystem and we need to act before it's too late!

62. Amanda Smith (*ZIP code: 90031)*

63. Al Suker (*ZIP code: 93401)*

64. Annette Lucas (*ZIP code: 91321)*
We need to save our endangered species

65. Alyssa Cruz (*ZIP code: 91402)*

66. Amanda Begley (*ZIP code: 90027)*

67. Amanda Riley (*ZIP code: 95451)*
Please protect the native species our society has ruined the environment for.

68. Alix Martin (*ZIP code: 94122)*

69. Cheri Daniels (*ZIP code: 93455)*

70. Kim Mutaw (*ZIP code: 91101)*

71. James Muzzio (*ZIP code: 95003)*

72. Adrianne Nakagawa (*ZIP code: 95820)*

73. Andrew Gottlieb (*ZIP code: 92603)*
I fully support listing Southern steelhead as endangered under California's ESA. Please help save this species.

74. andrew mcdonald (*ZIP code: 91106)*

75. Andrew Youngmeister (*ZIP code: 94608)*

76. Andrew Johansen (*ZIP code: 90042)*

Save them!

77. Andrew Jupina (*ZIP code: 08234)*

78. Andrea Zambrano (*ZIP code: 93103)*
Save the local fish!

79. Angela Romero (*ZIP code: 93033)*

80. Carlos Navarro (*ZIP code: 92544)*

81. Josias Herrera (*ZIP code: 90241)*

82. Anna Kokotovic (*ZIP code: 93117)*

83. Anna Eisenberg (*ZIP code: 84105)*

84. Anna Yoo (*ZIP code: 92883)*

85. Anthony Gilleece (*ZIP code: 94502)*

86. Audie Paulus (*ZIP code: 97211)*

87. Paloma Moreno (*ZIP code: 90280)*

88. Venus Bakhtiari (*ZIP code: 94550)*

89. David Bailey (*ZIP code: 84103)*

90. Allan Poobus (*ZIP code: 98405)*
Save wild steelhead!

91. Araceli Hernandez (*ZIP code: 91345)*

92. Arthur Reifman (*ZIP code: 91901)*

93. John Arensmeyer (*ZIP code: 92647)*

94. Arnold Henry-John (*ZIP code: 91302)*

95. Alaina Murphy (*ZIP code: 93117)*

96. Liz Arroyo (*ZIP code: 90630)*

97. **Arthur Babcock** (*ZIP code: 91390)*

98. **art page** (*ZIP code: 92024)*
As a concerned California resident, I write to you today to express my full support for designating the Southern California steelhead as endangered under California's Endangered Species Act.

99. **Debbie Collins** (*ZIP code: 92593)*

100. **Andrew Sackheim** (*ZIP code: 95825)*

101. **Andrew Schneider** (*ZIP code: 95819)*
Now or never. You exist to protect our resources and once gone they are not coming back. Please act and leave this legacy for California.

102. **Amanda Schuler** (*ZIP code: 96003)*

103. **Alan Colombano** (*ZIP code: 95616)*
Please do not allow Southern Steelhead to go extinct.

104. **Andrew Espinoza** (*ZIP code: 93021)*
Save the damn steelhead in Southern California

105. **Alexia Skrbic** (*ZIP code: 90501)*

106. **Ana-Sofia M** (*ZIP code: 91744)*

107. **Michael Weigand** (*ZIP code: 91360)*
Saving the habitat for steelhead will benefit the environment for us and future generations.

108. **Allen Peters** (*ZIP code: 94947)*

109. **Adam Stein** (*ZIP code: 83702)*

110. **Arthur Strauss** (*ZIP code: 92603)*

111. **Andrea Svenneby** (*ZIP code: 90813)*

112. **Denis Higginson** (*ZIP code: 92602)*
These fish must be protected and helped to renew this species

113. **Audrey Sayer** (*ZIP code: 94117)*

114. **Audrey Jones** (*ZIP code: 98168)*

115. **Derek Flor** (*ZIP code: 90631)*
The dams in place are obsolete in many instances and need to be gone to restore a more natural

habitat for a messy humanity that does not appreciate nature's delicate balance. Malibu's dam comes to mind and too much foot dragging is going on.

116. Tiffany May (*ZIP code: 94122)*

117. Austin Helmer (*ZIP code: 97302)*
Let's help these native beauties!!

118. Autumn Summers (*ZIP code: 95473)*

119. Ava Leupold (*ZIP code: 93023)*

120. Matthew Johnston (*ZIP code: 90638)*

121. Ava Farriday (*ZIP code: 91377)*

122. Anthony Avellino (*ZIP code: 94954)*

123. Andria Ventura, On behalf of Clean Water Action (*ZIP code: 95125)*

124. Avery Edgar (*ZIP code: 95073)*

125. Avery Gonsalves (*ZIP code: 90004)*
Save our steelhead from extinction!

126. Robert Ford (*ZIP code: 93901)*

127. David Miller (*ZIP code: 92082)*

128. Axel Johnson (*ZIP code: 93111)*

129. Ayaana Desai (*ZIP code: 90007)*

130. Richard Ayer (*ZIP code: 92672)*

131. Azsha Sharon (*ZIP code: 92395)*

132. Aidan Zubak (*ZIP code: 92882)*

133. Brian Scholz (*ZIP code: 95065)*

134. BALDOMERO FERNANDEZ (*ZIP code: 90274)*

135. Stanley Backlund (*ZIP code: 95682)*

136. Darren Marshall (*ZIP code: 95928)*

137. Ed & Helen Maurer (*ZIP code: 92691)*

138. Kirk Clague (*ZIP code: 93271)*

139. Barbara Washburn (*ZIP code: 95693-9681)*

140. Alexej Borissenko (*ZIP code: 93527)*

141. Nancy Baron (*ZIP code: 93013)*

142. Barry Thall (*ZIP code: 85750)*

143. Christopher Croom (*ZIP code: 92116)*
Better late than never, by why isn't this species already on the Endangered Species List?

144. Charles Battaglia (*ZIP code: 95695)*

145. Bill Barker (*ZIP code: 93442)*

146. Brett Browning (*ZIP code: 92373)*

147. Bill Bruce (*ZIP code: 93619)*
These fish are worth protecting!

148. Charming Evelyn (*ZIP code: 90020)*
We must act urgently to prevent the irreversible loss of this species and list them as endangered on the Endangered Species List if they are ever to recover.

149. Behzad Compani (*ZIP code: 91001)*

150. Benjamin Croce (*ZIP code: 80439)*

151. Brian Loven (*ZIP code: 93631)*
These fish and their habitats must be protected before it's too late. Once they are gone, all we will be able to do is tell grand stories of the past - is that the legacy we want to leave for our Grandkids??

152. Blair Williams (*ZIP code: 90503)*
Save the Southern California Steelhead.

153. Rebecca Bassak (*ZIP code: 94549)*

154. Belén Bernal (*ZIP code: 91754)*

155. Mari Beltran (*ZIP code: 93003)*

156. Benjamin Hamilton (*ZIP code: 90045)*
Absolute Victory, Nothing Short!

157. Ben Cruz (*ZIP code: 94947)*

158. Ben Ewart (*ZIP code: 93105)*

159. Benjamin Goedert (*ZIP code: 96007)*

160. Ben Bressler (*ZIP code: 98126)*
Please protect steelhead. They are critical to our ecosystem and many people's way of life.

161. Benjamin Thomas (*ZIP code: 14526)*

162. Vincent Benlloch (*ZIP code: 91406)*

163. Ben Sherman (*ZIP code: 93401)*

164. Ben Ward (*ZIP code: 93422)*

165. Bruce Thomson (*ZIP code: 97330)*
Rewild... its what works best! Protect the native southern steelhead, please !!

Allowing this fish species to disappear is not acceptable when there are ways to protect and even increase the number of native fish.

166. Rebecca Keyser (*ZIP code:)*

167. Bruce Fayman (*ZIP code: 92116)*
Please don't let the Southern Steelhead go extinct!

168. Bill Gardner (*ZIP code: 95942)*

169. James Tsuda (*ZIP code: 91505)*

170. brad gee (*ZIP code: 94556)*

171. Bryan Godber (*ZIP code: 92672)*

172. Blake Hayunga (*ZIP code: 94904)*

173. Bruce Harrison Campbell (*ZIP code: 92040)*
Once there were enough to feed the First Nation people, and within my memory I remember seeing as many as 10

in one spot. Now there are none in San Diego County streams, in spite of bringing their status to CDFW

174. **bruce hirayama** (*ZIP code: 90034)*

175. **Beth Holden** (*ZIP code: 90272)*
Please save this endangered fish!

176. **Bianca Berron** (*ZIP code: 92009)*

177. **Brian Ibenthal** (*ZIP code: 92679)*

178. **Jesec Griffin** (*ZIP code: 90026)*
Listen to the scientists! Save the Southern Steelhead.

179. **David Shaw** (*ZIP code: 94515)*

180. **Mike Moreno** (*ZIP code: 97756)*
These fish are the predictors of the future of mankind. They have earned our help. Without it, we're finished.

181. **Charles Perdomo** (*ZIP code: 91351)*

182. **niko Rodriguez** (*ZIP code: 91403)*
Save our California wildlife!

183. **Charlie Schneider** (*ZIP code: 94952)*

184. **Tyler Compton** (*ZIP code: 84653)*

185. **Tyler Compton** (*ZIP code: 90001)*
Please save the fish

186. **William Speck** (*ZIP code: 91011)*
Save the Southern Steelhead! They were once plentiful here, and now are nearly gone. It’s a preventable tragedy!

187. **William Joost Jr** (*ZIP code: 94946)*

188. **Bill Uyeki** (*ZIP code: 94070)*

189. **Bill Baquet** (*ZIP code: 91007)*
Important cause ! These fish are our modern " canary in the coal mine".

190. **William Castellon** (*ZIP code: 94605)*

191. **William Happy** (*ZIP code: 92624)*

192. **Judith Petrick** (*ZIP code: 15017)*

193. **William Potts** (*ZIP code: 94550)*
We can't lose another species.

194. **Karl Rohlin** (*ZIP code: 92595)*

195. **Bill Russ** (*ZIP code: 93103)*

196. **Bill Stagnaro** (*ZIP code: 94116)*

197. **Bill Street** (*ZIP code: 97520)*

198. **Bill Tippets** (*ZIP code: 92037)*
California Fish and Game Commissioners. I fully support the listing of Southern Steelhead as endangered under the CA ESA. This segment of the West Coast steelhead species faces many ongoing threats to its existence from past dams and diversions of its spawning and rearing streams, development of its watersheds, and past and future impacts from climate change.

The listing will heighten the public's awareness of its endangered status, help focus efforts to conserve, restore and manage its critical habitat (streams and their watersheds), and meet California's commitment to provide effective conservation of its natural resources heritage.

199. **BRANDON GOYER** (*ZIP code: 08234)*

200. **Brandon Kalpin** (*ZIP code: 91020)*

201. **Dan Blackburn** (*ZIP code: 95603)*

202. **Blanche Zelko** (*ZIP code: 92651)*

203. **Ryan Blasena** (*ZIP code: 93101)*

204. **Brian Baldauf** (*ZIP code: 90501)*

205. **Ray Lorenson** (*ZIP code: 94555)*

206. **Christopher Gunsky** (*ZIP code: 95128)*

207. **Bryan Matsumoto** (*ZIP code: 91780)*

208. **Bo Adams** (*ZIP code: 90503)*

209. **Robert Kryger** (*ZIP code: 91711)* Do the right thing - Save this species before it is gone forever.

210. Robert Mooney (*ZIP code: 90027)*

211. Robert Nicksin (*ZIP code: 91202)*
I strongly support efforts to protect Southern California steelhead.

212. robert holcomb (*ZIP code: 94546)*

213. Bob Beler (*ZIP code: 92399)*

214. Robert Nicksin (*ZIP code: 91202)*
I support the listing of Southern Steelhead on the California Endangered Species list. I had the opportunity to fish for steelhead on Malibu Creek prior to its closure, and believe it would be terrific if populations of steelhead rebounded to levels that would support catcch and release angling. Thank you.

215. Bob Nydam (*ZIP code: 91024)*

216. Olivia La Via (*ZIP code: 90272)*

217. Robert Redman (*ZIP code: 92808-1637)*
Save our Steelhead!

218. Bobby Maupin (*ZIP code: 84106)*

219. Robert Stefano (*ZIP code: 93536)*
We need to make improvements to help save the California steelhead population

220. Robert Tranter (*ZIP code: 93555-4303)*
Let's do this before it's too late!

221. Bodhi Tippo (*ZIP code: 97402)*

222. Bo Adams (*ZIP code: 90503)*

223. Deborah Carey (*ZIP code: 97333)*

224. Bud Oliveira (*ZIP code: 92027)*

225. Bonnie Felix (*ZIP code: 94956)*

226. Ashley Oki (*ZIP code: 90039)*

227. Craig Bradshaw (*ZIP code: 94553)*

228. Brad Monsma (*ZIP code: 98116)*
In my book The Sespe Wild, I wrote a chapter on the southern steelhead many years ago, and it's disheartening that it has taken so long for the species to be listed under the CA ESA. Please, now!

229. Brad Colgate (*ZIP code: 92108)*

230. Bruce Ajari (*ZIP code: 96145)*

231. Brandon Maraglia (*ZIP code: 93105)*

232. Brandon McGuire (*ZIP code: 92562)*
Work with the Pechanga tribe to save the steelhead!

233. Brandon Herman (*ZIP code: 80207)*

234. Charles Barnhart (*ZIP code: 91103)*

235. Brendan Hanley (*ZIP code: 92679)*

236. Brennan Steffes (*ZIP code: 80631)*
don't kill da fish

237. Brent Ryhlick (*ZIP code: 92679)*

238. Brian Joseph (*ZIP code: 93453)*

239. Brian Kraz (*ZIP code: 93035)*

240. Brian Queen (*ZIP code: 91106)*

241. Brianna Ordung (*ZIP code: 95456-9641)*

242. Brian Rudloff (*ZIP code: 90250)*

243. Brian Waters (*ZIP code: 94563)*

244. Briar Conrey (*ZIP code: 52245)*

245. Brittany Heslin (*ZIP code: 92675)*

246. Brittney Mendez (*ZIP code: 90255)*

247. Brock Peterson (*ZIP code: 95616)*

248. **Brock Vasey** (*ZIP code: 89411)*

249. **Scott Broome** (*ZIP code: 92660)*

250. **bruce sterten** (*ZIP code: 93923)*
I support this effort to save the Southern Steelhead from extinction.

251. **Bruce Bowles** (*ZIP code: 94602)*

252. **Brad Ruddell** (*ZIP code: 93422)*

253. **Bryce Bandish** (*ZIP code: 96161)*
Save the socal steelhead.

254. **Brandon Ignas** (*ZIP code: 93454)*

255. **Brian Leon** (*ZIP code: 91361)*

256. **bruce sterten** (*ZIP code: 93923)*

257. **Michael Lerschen** (*ZIP code: 94542)*

258. **Brian Trautwein** (*ZIP code: 93101)*

259. **Claudia Lopez** (*ZIP code: 91106)*

260. **Stephen Burns** (*ZIP code: 98926)*

261. **Lycia Mann** (*ZIP code: 95928)*

262. **Mike Scalia** (*ZIP code: 91007)*

263. **Harold Knight** (*ZIP code: 96067)*

264. **An anonymous signer** (*ZIP code: 84050)*

265. **Christiane Schlumberger** (*ZIP code: 93101)*

266. **Alexander Broom** (*ZIP code: 94509)*

267. **Ken Teakle** (*ZIP code: 94549)*

268. **Caephren McKenna** (*ZIP code: 94609)*

269. **Cailynne Graham** (*ZIP code: 95501)*

270. **Lynne Hargett** (*ZIP code: 93436)*

271. **Cameron Dobbs** (*ZIP code: 92691)*

272. **Cami Child** (*ZIP code: 93065)*

273. **DONALD CAMPBELL** (*ZIP code: 94521)*

274. **Ken Giannotti** (*ZIP code: 95746)*

275. **Camryn Romo** (*ZIP code: 91361)*

276. **Christopher Anderson** (*ZIP code: 94044)*

277. **Blake Mcleod** (*ZIP code: 90290)*

278. **Johnna Roberts** (*ZIP code: 93940)*

279. **George Barnhill** (*ZIP code: 93611)*

280. **Caren Hanson** (*ZIP code: 92585)*
Please list the steelhead fish to protect it from extinction

281. **Carl Di Giorgio** (*ZIP code: 94549)*
Please protect California steelhead !
Thanks for your help!
Carl

282. **Carlos Valle** (*ZIP code: 94563)*

283. **Carol Lam** (*ZIP code: 92832)*

284. **Carol DiBenedetto** (*ZIP code: 94114)*

285. **Caroline Eva** (*ZIP code: 96001)*

286. **Carol Keator** (*ZIP code: 93101)*
Please protect this species.

287. **carrie davies** (*ZIP code: 90405)*

288. **Michael Carty** (*ZIP code: 93463)*

289. **Sergio Casas** (*ZIP code: 92376)*

290. **Casey OSullivan** (*ZIP code: 94063)*

291. **Matt Kane** (*ZIP code: 94116)*

292. **Cate Baroni** (*ZIP code: 10960)*

293. **Cathy Fletcher** (*ZIP code: 93110)*
Save our environment please!

294. **Raymond Segura** (*ZIP code: 93454)*

295. **Crystal Barajas** (*ZIP code: 90020)*

296. **Craig Beal** (*ZIP code: 97470)*
I support this movement. Lets get it done!

297. **Claire Buchanan** (*ZIP code: 95608)*

298. **Corey Butler** (*ZIP code: 93041)*
I've been a resident of both Northern and Southern California. I've experienced the high-sierras and the costal ranges, and I know, clean clear waters and healthy streams are California's life source. The Salmon and Steelhead run along our entire coastline is vitally important. It provides nutrients and life to predators and streams that many anglers will never see or touch. This is not about sport fishing. This is about trying to retrieve a natural equilibrium in our California ecosystems and making sure our future generations are better off than we are. Protect the runs!

299. **Conrad Calimpong** (*ZIP code: 95536)*

300. **Carson Cox** (*ZIP code: 94940)*

301. **Chris Elisara** (*ZIP code: 92025)*

302. **Gregory Abe** (*ZIP code: 90404-3051)*

303. **Gregory Abe** (*ZIP code: 90404)*

304. **Ellen James** (*ZIP code: 93001)*
As a resident of Ventura who lives a mile from the Ventura River, I know how vitally important it is to protect salmonid habitat: we have regular homeless encampments in the river bottom just upstream from the mouth of the Ventura River (similar situation as the Santa Clara River estuary a few miles south). These estuaries are home to a lot of wildlife, but still get fouled up by human use and no one seems to mention that estuarine habitats for critically endangered species are supposed to be protected by law!

305. **Charles Falchetti** (*ZIP code: 92064)*

306. **Christopher F Allen** (*ZIP code: 94010-6333)*

307. **charles bell** (*ZIP code: 95949)*

308. **charles bell** (*ZIP code: 95949)*

309. **Colleen Fonseca** (*ZIP code: 92592)*

310. **Glenn Cantello** (*ZIP code: 93109)*

311. **Chris Kirby** (*ZIP code: 90292)*

312. **Charles Plopper** (*ZIP code: 96137)*

313. **Chad Bolich** (*ZIP code: 94544)*

314. **Charles Hammerstad** (*ZIP code: 95120)*

315. **Charles Ehm** (*ZIP code: 94960)*

316. **Charles Wood** (*ZIP code: 92595)*

317. **Charles Middleton** (*ZIP code: 92110)*

318. **Charlie Atteberry** (*ZIP code: 60093)*

319. **Chase Smith** (*ZIP code: 92672)*

320. **Paul Seeman** (*ZIP code: 90265)*

321. **Ralph Tingle** (*ZIP code: 95448)*
Save them, large & small.
Catch & Release.

322. **Chelsea Hands** (*ZIP code: 90036)*

323. **Daphne Cheney** (*ZIP code: 95595)*
Don't screw around.

324. **Cheryl Lynn Cline** (*ZIP code: 99501)*
We need to insure the survival of this uniquely adapted fish, particularly to enable diversity during radical climate variation.

325. **Steven Chester** (*ZIP code: 91403)*

326. CL Cruickshank (*ZIP code: 97415)*

327. Chase Higgs (*ZIP code: 80525)*

328. Chip Owen (*ZIP code: 92107)*

329. Charles McKinley (*ZIP code: 94707-1731)*

330. Chris Dunham (*ZIP code: 92673)*

331. Christine Finch (*ZIP code: 94805)*

332. Christopher Wiechert (*ZIP code: 92104)*

333. Chris Worcester (*ZIP code: 96160-2511)*

334. Christopher Chang (*ZIP code: 90028)*
When will we learn?

335. Chris Crofford (*ZIP code: 95364)*

336. Chris Elwell (*ZIP code: 90019)*

337. Chris Lima (*ZIP code: 83544)*

338. Chris Storm (*ZIP code: 95258)*

339. Christine Walker (*ZIP code: 94942)*

340. Christopher Vasil MD (*ZIP code: 95032)*

341. Dayna Barrios (*ZIP code: 93001)*

342. Cierra Sterling (*ZIP code: 91321)*

343. Cindy Charles (*ZIP code: 94107)*

344. Carol Iwafuchi (*ZIP code: 96150)*

345. Christopher Lang (*ZIP code: 92020)*

346. Clayton Dewberry (*ZIP code: 94598)*
don't let the steelhead become extinct.

347. **Cameron McCamy** (*ZIP code: 92116)*

348. **Christian Heslin** (*ZIP code: 93117)*

349. **Patricia Leavitt-Pagaling** (*ZIP code: 93023)*

350. **Claire Robinson** (*ZIP code: 91001)*

351. **Dane Clarke** (*ZIP code: 95948)*

352. **Clarke Michalak** (*ZIP code: 94123)*

353. **Clark Johnson** (*ZIP code: 94954)*

354. **Carl Boling** (*ZIP code: 95136)*
All resources are precious. Restoring our waterways benefits more than just steelhead.

355. **Clint Kelley** (*ZIP code: 95482)*
Please don't let this iconic species disappear in its southern reaches!

356. **Charles Bottino** (*ZIP code: 93405)*

357. **Alan La Pointe** (*ZIP code: 94805-1157)*

358. **Zachary Williams** (*ZIP code: 93001)*

359. **Clyde Langley** (*ZIP code: 32931)*

360. **Chris Manning** (*ZIP code: N2G 0C3)*
Please protect Southern steelhead and list them as endangered under California’s Endangered Species Act

361. **Caroline McCoy** (*ZIP code: 97211)*

362. **CRAIG MCCULLOCH** (*ZIP code: 95818)*

363. **Colleen McNally-Murphy** (*ZIP code: 95062)*

364. **Candice Meneghin** (*ZIP code: 93117)*

365. **Craig Merkin** (*ZIP code: 94121)*

366. **Curtis Kroeker** (*ZIP code: 94941)*
Please take bold action to save this species and restore our rivers. Thank you.

367. **Erwin M Goldbloom** (*ZIP code: 93012)*

368. **Cody Schaaf** (*ZIP code: 92014)*

369. **Chase Holt** (*ZIP code: 93065)*

370. **Jeremy Cole** (*ZIP code: 93001)*

371. **Colleen Fonseca** (*ZIP code: 92592)*

372. **Danny Collins** (*ZIP code: 92590)*
It would be great to have steel head trout return to our great state.

373. **Steven Loiseau** (*ZIP code: 93442)*
would particularly like to see an effort to bring steelhead back to the San Gabriel, which I see as most viable.

374. **JEFF HAYNES** (*ZIP code: 96073)*

375. **Calleen Pardinas** (*ZIP code: 93063)*

376. **Kate C Connell** (*ZIP code: 93103)*

377. **Conner Everts** (*ZIP code: 90405)*

378. **Conor Leighton** (*ZIP code: 90501)*
Thank you for working to save our Native steelhead!

379. **Douglas Lovell** (*ZIP code: 93703)*

380. **Jim Butler** (*ZIP code: 89703)*

381. **Consuelo Kammerer** (*ZIP code: 97369)*

382. **Friends of the LA River** (*ZIP code: 90065)*

383. **James Cook** (*ZIP code: 94611)*

384. **Corbin Woods** (*ZIP code: V0E2S0)*

385. **Bruce Kirbis** (*ZIP code: 91601)*

386. **Corie Littlejohn** (*ZIP code: 92346)*
allowing this species to disappear is not acceptable. I fully support listing Southern steelhead as endangered under

California’s ESA.

387. Timbre Shoemaker (*ZIP code: 92583)*

388. Cory Krug (*ZIP code: 94901)*

389. Richard Hayashi (*ZIP code: 92720)*

390. William Wolcott (*ZIP code: 94117)*
extinction is forever! please designate this mykiss species as endagered so that we can give them the chance to survive that they so desrve

391. V Courtney Broaddus (*ZIP code: 94114)*
Save our Steelhead - SOS

392. Chanae Owens (*ZIP code: 90290)*
Please list Southern steelhead as an endangered species under California’s ESA to protect this species from extinction!

393. Charles Bucaria (*ZIP code: 916/3924583)*

394. Carlos Perez (*ZIP code: 92878)*

395. Carlos Perez (*ZIP code: 92878)*

396. Chase Holt (*ZIP code: 93065)*
Indicator species. Important stuff. These fish matter.

397. Craig Porter (*ZIP code: 93555)*

398. COREY RAFFEL (*ZIP code: 94131)*
What a shame it will be should we lose even one species on anadromous fish.

399. Paul Crafts (*ZIP code: 93402)*

400. Craig Mackay (*ZIP code: 93010)*

401. Craig LaFargue (*ZIP code: 95248)*

402. Craig Lee (*ZIP code: 92037)*

403. Charles Eyler (*ZIP code: 91326)*

404. Cristina Violante (*ZIP code: 94706)*

405. **Christine Jimenez** (*ZIP code: 91776)*

406. **Carol Lewis** (*ZIP code: 91011)*

407. **Chris Rossow** (*ZIP code: 92024)*

408. **Brian Crowder** (*ZIP code: 98116)*

409. **Stephen Crump** (*ZIP code: 91103)*
Save the Steelhead!

410. **Colin Sako** (*ZIP code: 90245)*

411. **Claus Herther** (*ZIP code: 91001)*

412. **Courtney Shreve** (*ZIP code: 91306)*

413. **Eden Myers** (*ZIP code: 92629)*

414. **Corinne Tanner** (*ZIP code: 95973)*

415. **Connor Tushla** (*ZIP code: 93060)*

416. **Connor Tushla** (*ZIP code: 93060)*

417. **Susanne Cumming** (*ZIP code: 90292)*

418. **Curtis Kerick** (*ZIP code: 91016)*

419. **Cameron Weeks** (*ZIP code: 90401)*

420. **Charles West** (*ZIP code: 93546)*
I'm blessed to recreate and live in a state with spectacular beauty. Nature is important to people for more than just recreation though. Natural ecosystems are essential partners to our urban areas. They produce healthy wildlife that supplement our unnatural ecosystems. People are part of nature after all and we can always learn and grow from working together with it. Protecting the future of Californian steelhead in this state is protecting the future of Californian peoples.

421. **Chris Wolken** (*ZIP code: 94025)*
Save rare southern steelhead and preserve diversity of our crucial fish/aquatic life!

422. **Dick Galland** (*ZIP code: 95033)*

423. **Dave Baumgartner** (*ZIP code: 91010)*
I would like to see the land locked progeny of Southern California Steelhead protected as well. Just like is any other

progeny of a protected species.

424. Michael Cooper (*ZIP code: 92008)*

425. Donald Coyne (*ZIP code: 94402)*
Time is running out!

426. Michael Dailey (*ZIP code: 94933)*

427. Dakotah Tilton (*ZIP code: 91601)*

428. Daniel Stofka (*ZIP code: 92010)*

429. Dana Miller (*ZIP code: 95926-3140)*

430. Rae Newman (*ZIP code: 92075)*
Let's do this!

431. Dan Culhane (*ZIP code: 93405)*
Need to preserve this species.

432. Danette Bouzanquet (*ZIP code: 91770)*

433. Daniela Loureiro (*ZIP code: KY12 0JA)*

434. Daniel Ochoa (*ZIP code: 93110)*

435. Daniel Tapanes (*ZIP code: 92373)*

436. Daniella Hawkins (*ZIP code: 94583)*

437. Daniel Kowalski (*ZIP code: 92130)*
The only way this fish gets saved with government help is the endangered species act

438. Daniel Martinez (*ZIP code: 90250)*
Save the steelhead

439. Daniel Phillips (*ZIP code: 92335)*

440. Dan Oliver (*ZIP code: 92627)*

441. Daniel Shetron (*ZIP code: 90041)*

442. Darca Morgan (*ZIP code: 94706)*

443. Darien Vilchez (*ZIP code: 91744)*

444. Darin Takeda (*ZIP code: 93101)*
Please save the steelhead!

445. Darrell Clarke (*ZIP code: 91103)*

446. Vance Veynar (*ZIP code: 92064)*

447. Darwin BondGraham (*ZIP code: 94619)*

448. Clifford Feldheim (*ZIP code: 95815)*
Southern Steelhead need listing to help prevent extinction, I urge you to support the listing!

449. Dave Crane (*ZIP code: 94020)*
Please do everything possible to save this valuable resource.

450. Dave Douglas (*ZIP code: 96145)*
I fully support listing listing Southern steelhead as endangered under California's ESA.

451. David Allen (*ZIP code: 94605)*

452. David Haskell (*ZIP code: 94960)*

453. David Cowell (*ZIP code: 95949)*
Sespe and Malibu Creek are one-of-a-kind streams and their eco-survival is imperative.

454. David Ruddle (*ZIP code: 94550)*
Please protect this valuable species with a listing.

455. David Curran (*ZIP code: 91016)*

456. David Clark (*ZIP code: 94574)*

457. David Lopez (*ZIP code: 90041)*

458. David De La Vega (*ZIP code: 90623)*

459. David Koch (*ZIP code: 95003)*

460. David Lamiquiz (*ZIP code: 95125)*

461. David Long (*ZIP code: 96150)*
It is important to save these iconic fish and to reintroduce them to rehabilitated streams within their historic range.

462. **David Davis** (*ZIP code: 91755)*

463. **David Warren** (*ZIP code: 90608)*

464. **Dawn Murray** (*ZIP code: 93111)*

465. **Daniel Bartee** (*ZIP code: 95472)*

466. **Dale Dalrymple** (*ZIP code: 92117-6310)*

467. **DAVID HOHLER** (*ZIP code: 97330-1733)*
Southern steelhead are a critical genetic component for the species and must be saved.

468. **Donald Fithian** (*ZIP code: 92122)*
I support this petition.

469. **Dan Davis** (*ZIP code: 93465)*

470. **Dominick Delise** (*ZIP code: 94)*

471. **Daniel Donoghue** (*ZIP code: 92067)*

472. **Debra Barlow** (*ZIP code: 92253)*

473. **debbie carty** (*ZIP code: 93463)*

474. **Deb Hinrichsen** (*ZIP code: 50014)*

475. **Deborah Joost** (*ZIP code: 94946)*

476. **Debra Sally** (*ZIP code: 95422)*

477. **David Delprato** (*ZIP code: 92646)*

478. **Demetrio Munoz** (*ZIP code: 94806)*

479. **denise marshall** (*ZIP code: 95503)*
anything to help our native fish
We are responsible for doing more since we created so much devastation.

480. **Denise Revel** (*ZIP code: 95688)*
Save the Steelhead.

481. **Dennis Murphy** (*ZIP code: 95831)*

482. Dennis Rudloff (*ZIP code: 92029)*
Thanks for your leadership and perseverance on this.

483. Dennis Leski (*ZIP code: 90006)*

484. Derek Chan (*ZIP code: 94608)*

485. Derek Laubscher (*ZIP code: 91364)*

486. Ernie Swanson (*ZIP code: 94087)*

487. Devin Hibler (*ZIP code: 93117)*

488. Don DeZurik (*ZIP code: 54961)*

489. David Felix (*ZIP code: 92109)*

490. dylan gasperik (*ZIP code: 90032)*

491. David Geisser (*ZIP code: 94605)*
Think of the future of grandkids

492. Doug Giancoli (*ZIP code: 94708)*

493. David Glanzman (*ZIP code: 90035)*

494. Dennis Pagones (*ZIP code: 94502)*

495. Donald Hennessee (*ZIP code: 90065)*

496. David Ethier (*ZIP code: 95370-9399)*

497. David Hobbs (*ZIP code: 94595)*

498. David Hoffberg (*ZIP code: 91377)*

499. Diane Brink (*ZIP code: 94930)*

500. gabe Abraham (*ZIP code: 90291)*

501. Diego Tamayo (*ZIP code: 91765)*

502. Dina Lasky (*ZIP code: 29842)*

Hi Ella is this in ojai

503. **Patrizia Hironimus** (*ZIP code: 95928)*
Salmon too!

504. **Richard Dow** (*ZIP code: 94904)*

505. **David Jefferson** (*ZIP code: 97304)*
Please save the Southern STEEL HEAD

506. **David Johnson** (*ZIP code: 94526)*
Thank you

507. **DJ Nielsen** (*ZIP code: 90404)*

508. **Daniel Apodaca** (*ZIP code: 91750)*

509. **Denise Lynn Marshall** (*ZIP code: 95540)*
PLease, please do this work to save this watershed and its fish.

510. **Stan Perry** (*ZIP code: 92106)*
We must save this species!

511. **Daniel Carolan** (*ZIP code: 84321)*

512. **David Clausen** (*ZIP code: 90066)*

513. **DAVID HESS** (*ZIP code: 94568)*

514. **David Mierkey** (*ZIP code: 95209)*

515. **David Morrow** (*ZIP code: 91355)*
Steelhead trout are an iconic species up and down the West Coast. The Southern steelhead is close to extinction and needs protection.

516. **Deane Plaister** (*ZIP code: 93101)*
If we don't save them now, we lose our chance forever.

517. **An anonymous signer** (*ZIP code: 90064)*

518. **Dennis Reis** (*ZIP code: 94587)*

519. **megan gamble** (*ZIP code: 92028)*
we live on the Santa Margarita/ Sandia Creek -for over 40 years -we need this!

520. **Don Calegari** (*ZIP code: 95448)*

521. **Donald Chartrand** (*ZIP code: 93402)*
It is unconscionable that CFGC has not yet listed the Southern Steelhead Distinct Population Segment as endangered. There is no question that the changes wrought by human actions have imperiled this iconic representative of California's resilient spirit. For a state whose flag represents poor stewardship of natural resources, flying an extirpated species, California must now take the obvious step of expressing concern for Southern California steelhead.

522. **Don Scott Macdonald** (*ZIP code: 80218)*

523. **Donald Lewis** (*ZIP code: 93101)*
Save the steelhead!

524. **Donald Fuhrer** (*ZIP code: 94208)*

525. **Thomas Donnelly** (*ZIP code: 94556)*

526. **Doug Ballinger** (*ZIP code: 94062)*
Prevent the loss of this species!

527. **douglass armstrong** (*ZIP code: 92627)*

528. **Jordan Mitchell** (*ZIP code: 91208)*

529. **Douglas Ramezane** (*ZIP code: 95032-4456)*

530. **Larry Basham** (*ZIP code: 93111)*

531. **Dan Brugger** (*ZIP code: 95618)*
For generations to come. Extinction is forever

532. **Robert Chacon** (*ZIP code: 94568)*

533. **Dennis Reasoner** (*ZIP code: 96080)*

534. **Andrew Bassak** (*ZIP code: 94549)*

535. **Andrew Summers** (*ZIP code: 80113)*

536. **Summer Driscoll** (*ZIP code: 95945)*
Preserving genetic diversity among steelhead runs is essential to the species.

537. **Brandon Paul** (*ZIP code: 98563)*

538. **Damian Ross** (*ZIP code: 91762)*
People were gathering to fish for them in 1967

539. **W. Preston Lear** (*ZIP code: 90048)*
A life without native salmonids for posterity would be an unforgivable tragedy. In the grand scheme of things, protecting the Southern Steelhead is a small but essential investment.

540. **Wayne Merhoff DVM** (*ZIP code: 96080)*

541. **dustin sawyer** (*ZIP code: 92057)*
Cal trout and other have made good progress over the past 10 years. Keep up the great work!

542. **Devina Schneider** (*ZIP code: 93001)*

543. **Destiny Beltran** (*ZIP code: 32703)*

544. **Olivia Nakamura** (*ZIP code: 92130)*

545. **David Beegan** (*ZIP code: 95864)*

546. **Douglass Vidal Jr** (*ZIP code: 92683)*

547. **David Rosen** (*ZIP code: 90046)*
We must preserve the Southern steelhead from extinction.

548. **Dylan Bothman** (*ZIP code: 95060)*

549. **Dylan Velastegui** (*ZIP code: 92883)*

550. **Erwin Bol** (*ZIP code: 94506)*

551. **Ed Rossi** (*ZIP code: 94901)*

552. **Edward Wallace** (*ZIP code: 91105)*

553. **Elizabeth Moore** (*ZIP code: 93103)*

554. **Earl Jessee** (*ZIP code: 95926)*

555. **Erin Barlow** (*ZIP code: 90027)*

556. **Edward M Barich** (*ZIP code: 95405)*
The Southern Steelhead should be listed as an endangered species now!

557. **Elisabeth Bersin** (*ZIP code: 90403)*

The Trout are vital to our ecosystem

558. Elizabeth Burns (*ZIP code: 93001)*
Southern steelhead need this protection to stop the rapid decline of the species.

559. Ed Filice (*ZIP code: 95476)*

560. Eric DeWitt (*ZIP code: 91501)*
Please protect our trout

561. Ely Phillips (*ZIP code: 90802)*

562. Erin Jones (*ZIP code: 90403)*

563. Ethan Elisara (*ZIP code: 93103)*
Species collapse is no joke. We need to do better and protect our steelhead.

564. Eugenia Ermacora (*ZIP code: 90066)*

565. Erik Hallen (*ZIP code: 95695)*
I caught and released Southern steelies in Malibu Creek back in the mid 70's. It was quite the surprise then as no one really knew they were there at that time.
Like many species of anadromous fish on the west coast these fish all deserve our attention to their survival

566. Erik Gabele (*ZIP code: 95864)*

567. Elliot Grant (*ZIP code: 95060)*

568. Edward Gray (*ZIP code: 92111)*

569. Patrick Crooks (*ZIP code: 93013)*

570. Eric Flores (*ZIP code: 92374)*

571. Evan Larson (*ZIP code: 94501)*
Part of the special beauty of our state is that we are a land of extremes. Nothing captures that more beautifully for me than the southern steelhead - a cold water migratory fish hiding out in the recesses of Southern California. We must protect this unique and beautiful part of our ecosystem - they are a distinct subpopulation that needs its own protections.

572. Evan Kershaw (*ZIP code: 10009)*

573. Ethan Kim (*ZIP code: 94133)*

574. Eric Yamasaki (*ZIP code: 90274)*

575. Elan Powless (*ZIP code: 84105)*

576. Matthew Schwegler (*ZIP code: 94107)*
Keep saving our native fisheries!

577. Laurel Ransom (*ZIP code: 94602)*

578. Elena Rios (*ZIP code: 93023)*

579. Elias Sidney Blood (*ZIP code: 96150)*

580. Eli Nevarez (*ZIP code: 87120)*

581. Elisabeth Bucy (*ZIP code: 81428)*
Thank you

582. Eli Turner (*ZIP code: 95678)*

583. Bill Scrimpsher (*ZIP code: 92646)*
We need our Southern Steelhead

584. Ella Taylor (*ZIP code: 90265)*

585. Ella Bogdanski (*ZIP code: 90026)*

586. Elliot Elisara (*ZIP code: 92025)*

587. James Elmore (*ZIP code: 95612)*

588. Alyssa Clark (*ZIP code: 90026)*

589. Emily Eccles (*ZIP code: 93101)*

590. Emiliano Santin (*ZIP code: NA)*

591. Emilia Roberts (*ZIP code: 90230)*
Protect fish!! Protect indigenous sovereignty!!

592. Emily Kreisberg (*ZIP code: 90704)*

593. Emily Moloney (*ZIP code: 95822)*
In support of listing the southern steelhead and in support of recovery efforts

594. Emily McCormick (*ZIP code: 91362)*

595. Emmett Medrano (*ZIP code: 91411)*
Please Protect the California Southern Steelhead

596. Emily Morrison (*ZIP code: 93117)*

597. Erik Owens (*ZIP code: 95926)*
I saw one in Big Chico creek along Bidwell Ave

598. Ethan Newby (*ZIP code: 94960-2734)*

599. Edward Patten (*ZIP code: 92082)*

600. Enoch Hale (*ZIP code: 95525)*
Please commit to saving this species and biodiversity.

601. Ethan Zubak (*ZIP code: 92881)*

602. Edgar Pierluissi (*ZIP code: 94134)*

603. Eric Pirone (*ZIP code: 94901)*
This is mandatory. We have one chance to stop this decline. Thanks!

604. Ron Melin (*ZIP code: 95570)*
They've been in coastal so. Cal. forever and have survived in an environment
that have been extremely altered by humans to the point they're on the brink. We can't wait any longer to save these amazing fish.

605. Erynn Rebol (*ZIP code: 95403)*

606. Eric Arentsen (*ZIP code: 90266)*
I fully support listing Southern California steelhead as endangered under California's Endangered Species Act

607. Eric Abramson (*ZIP code: 92104)*
The Southern California Steelhead should absolutely be protected under California's Endangered Species Act.

This species is remarkably important to Californians and ecosystem health. Allowing them to go extinct when we completely have the ability to save them is, quite simply, morally wrong.

Protecting them would ensure an important cultural species is around for my kids' generation and beyond. It would also have the add on effect of protecting human communities since classifying them as endangered would promote actions such as removing obsolete dams, securing instream flow, and restoring watersheds; all actions that protect communities from catastrophic flooding and local ecosystem collapse.

Again, it's completely in your power to stop a species from irreversibly going extinct, and I implore you to use that power in the morally and ethically correct way. Thank you

608. Erik Nelson (*ZIP code: 92630)*

I taught at a school a short walk from San Juan creek. I have seen smolts in the estuary at Doheny and in Trabuco creek near Holy Jim. We can do this. Nature will reclaim the watersheds if we just pave the way. That dam on Malibu creek needs to go among other things

609. **Erin Viera** (*ZIP code: 91505)*

610. **Erin Telford** (*ZIP code: 90290)*

611. **Ernesto Anguiano** (*ZIP code: 95062)*

612. **elise roberts** (*ZIP code: 93117)*

613. **Evan Sedlock** (*ZIP code: 94903)*

614. **Ronald Escue** (*ZIP code: 91011)*
Save our steelhead before it's too late

615. **Ed Sozinho** (*ZIP code: 98177)*

616. **Elizabeth Taylor** (*ZIP code: 92672)*

617. **Ethan Nelson** (*ZIP code: 91730)*

618. **Evan Kyser** (*ZIP code: 93001)*

619. **Evan Bryant** (*ZIP code: 95628)*

620. **Sam Cavoulas** (*ZIP code: 92078)*
Save our fish!

621. **Eric Schneider** (*ZIP code: 95667-6051)*

622. **Gene Weber** (*ZIP code: 94123)*

623. **Steve Schiffern** (*ZIP code: 92860-2313)*

624. **Kenneth Walker** (*ZIP code: 30064)*

625. **Carol Pierce** (*ZIP code: 93023)*

626. **Fletcher Chouinard** (*ZIP code: 93001)*

627. **Katie Hawley** (*ZIP code: 95926)*

628. **Ric Martinelli** (*ZIP code: 93637)*

629. **Jeffrey Erickson** (*ZIP code: 90503)*
We can figure out how to balance outdoors with civilization

630. **Finn Seifert** (*ZIP code: 28803)*

631. **David Finn** (*ZIP code: 95224)*

632. **finn yarnes** (*ZIP code: 95694)*

633. **M Ebby** (*ZIP code: 93933)*

634. **Valerie Adams** (*ZIP code: 95628)*

635. **Craig Hanson** (*ZIP code: 94941)*

636. **Gene Gantt** (*ZIP code: 95687)*
Save fish!!

637. **Kazunori Okada** (*ZIP code: 90065)*

638. **Gavin Simmons** (*ZIP code: 92024)*

639. **Frederic Uno** (*ZIP code: 90065-4001)*

640. **Kate Riley** (*ZIP code: 94112)*
save the steelhead !!

641. **Fred Schardt** (*ZIP code: 95667)*
Extinction is forever. And forever is truly hard to fathom for humans

642. **Christopher Boldt** (*ZIP code: 91001)*
Of the utmost importance please protect this fish.

643. **Lawrence Kress** (*ZIP code: 95965)*
Please help save Southern California steelhead by putting them on the endangered species list . Thank you

644. **Rick Russo** (*ZIP code: 91311)*

645. **Irene Hipskind** (*ZIP code: 93015)*

646. **Forrest Oldham** (*ZIP code: 95695)*
Every backup version of our fishes saved better guarantees their future.

647. **Annelisa Moe** (*ZIP code: 91505)*

648. **Frank Emerson** (*ZIP code: 93940)*
The Public and Tribal Trust Resources are gravely affected by potential exinction of important fisheries.

649. **Frank cook** (*ZIP code: 95948)*
We need all the steelhead

650. **Francis Willis** (*ZIP code: 93311)*

651. **Ray Nunez** (*ZIP code: 95765)*

652. **fred Bellero** (*ZIP code: 94903)*

653. **Fred Rinne** (*ZIP code: 94112)*
Southern Steelhead is a crucial part of the ecosystem and key to any future restorations.

654. **Anita Frost** (*ZIP code: 91384)*

655. **Frank Swanson** (*ZIP code: 94402)*

656. **Bruce Lenhart** (*ZIP code: 95133)*

657. **darren mcmillan** (*ZIP code: 92677)*

658. **Ginny Pitchford** (*ZIP code: 91011)*

659. **Gabe Bancock** (*ZIP code: 97370)*
I've lived part time in California for the last ten years and believe steelhead need all the protection they can get. They're an indicator of healthy ecosystems. Thank you

660. **Gabe Ward** (*ZIP code: 93446)*

661. **Gabriel Manzanedo** (*ZIP code: 93722)*

662. **john stokes** (*ZIP code: 95521)*

663. **Gale Gallegos** (*ZIP code: 94576)*

664. **Thomas Galindo** (*ZIP code: 94610)*

665. **John Gallo** (*ZIP code: 07621)*

666. **Graham Gardner** (*ZIP code: 95816)*
I'm a Californian, angler, and father-to-be concerned about the continued destruction of our environment, and

committed to the preservation of threatened species. The loss of southern steelhead would be a (preventable) tragedy. List southern steelhead as endangered.

667. Gary Burrie (*ZIP code: 92082)*

668. Garret Erskine (*ZIP code: 90732)*

669. Garrett Mann (*ZIP code: 92129)*

670. Gary Arabian (*ZIP code: 95448-4754)*

671. Gary Sikkens (*ZIP code: 91106)*

672. Gary Favero (*ZIP code: 91730)*
Please take action to save this species.

673. Gary Grimm (*ZIP code: 94708)*
Please do the maximum to protect the California Southern steelhead!

674. Gary Luoto (*ZIP code: 92007)*

675. Gary McDougal (*ZIP code: 95620)*

676. Gary Morisoli (*ZIP code: 94573)*
Please help save these fish. Thank
You.

677. Gary Barisone (*ZIP code: 94010)*
I am a Northern California steelhead fisherman. I have fished the Klamath and Trinity rivers for 40 plus years and have witnessed the decline of steelhead in these and other California rivers. It would be a shame to lose Southern Steelhead.

678. Gabriel Varela (*ZIP code: 90723)*

679. Gary Crocker (*ZIP code: 91935)*

680. G sweeting (*ZIP code: 97005)*

681. Geoff Coster (*ZIP code: 90405)*
Please save this magnificent So Cal native fish!

682. Geoffrey Garth (*ZIP code: 90803)*

683. Geofrey Wyatt (*ZIP code: 93108)*
These are magnificent creatures! Let's not be the ones who preside over their extinction!

684. **George Gates** (*ZIP code: 92128)*

685. **George Salmas** (*ZIP code: 90067)*
Need to save the steelhead

686. **George Coughlin** (*ZIP code: 94507)*
I support this petition. GC

687. **Gerald Cunha** (*ZIP code: 94404)*
As a concerned California resident, I write to you today to express my full support for designating the Southern California steelhead as endangered under California's Endangered Species Act.

688. **Gerald Ichikawa** (*ZIP code: 93111-1230)*

689. **Geraldine Fontanini** (*ZIP code: 92067)*

690. **Harold Turner** (*ZIP code: 95140)*

691. **Gabe Ethier** (*ZIP code: 95370)*

692. **Carolyn Sue Palmer** (*ZIP code: 91361)*

693. **Giancarlo Alvarado** (*ZIP code: 93546)*

694. **Gien Gip** (*ZIP code: 94117)*

695. **Gil Takemori** (*ZIP code: 95133)*

696. **Ari Gold** (*ZIP code: 92562)*

697. **Cher Gilmore** (*ZIP code: 91321)*
We need more help for this beleaguered species!

698. **Gilbert Munz** (*ZIP code: 94903)*

699. **george Cotsirilos** (*ZIP code: 94707)*

700. **Wayne Johnson** (*ZIP code: 92082)*

701. **Gregory Leitch** (*ZIP code: 94526)*

702. **Gary Applebee** (*ZIP code: 92374)*

703. **Michael A. Glazeski, OD** (*ZIP code: 94611)*

704. Lei Villa (*ZIP code: 93105)*

705. Glenda Nowakowski (*ZIP code: 91384)*

706. Glenn Ueda (*ZIP code: 92648)*

707. Glenn Short (*ZIP code: 91403)*
Sierra Pacific Fly Fishers supports this petition.

708. DARREN MCMILLAN (*ZIP code: 92677)*

709. Geneva Omann (*ZIP code: 96094)*

710. GREG NELSON (*ZIP code: 92677)*

711. Steven Wong (*ZIP code: 90048)*
Bring back the steelhead trout!

712. Bob Gomez (*ZIP code: 92780)*

713. Thomas Rasmussen (*ZIP code: 90505)*

714. Jonathan Wilson (*ZIP code: 93636)*

715. Timothy Y (*ZIP code: 94544)*
Save Our Wild Steelhead and Salmon!

716. Gordon Dow (*ZIP code: 94904)*

717. Gordon Hollingsworth (*ZIP code: 95355)*

718. Garen Pekacheky (*ZIP code: 90401)*

719. George Farrell (*ZIP code: 95834)*
Please save the Southern steelhead!

720. Grace Willett (*ZIP code: 92629)*

721. Bobbie Hawkins (*ZIP code: 91977)*

722. Gill Realon (*ZIP code: 92821)*
We need to protect this endangered fish. Please make every effort to establish a plan and resources to save this species from extinction.

723. George Ream (*ZIP code: 91916)*
Save this fish!!!

724. Jonathan Appelbaum (*ZIP code: 92116)*
Clearly this ESU is long overdue for listing. The ESU is Federally-listed, the State should follow their lead (and the science) and fully protect the southern steelhead ESU and list it as Endangered under CESA.

725. Hardy De La Cruz (*ZIP code: 33033)*

726. Paul Rokich (*ZIP code: 92623)*

727. Ryan Beattie (*ZIP code: 91352)*

728. Greg Dinger (*ZIP code: 96067)*

729. Greg Owsley (*ZIP code: 80524)*

730. GREG NELSON (*ZIP code: 92677)*

731. Gregory Chiate (*ZIP code: 90265)*

732. greg miner (*ZIP code: 99362)*
Please list southern steelhead under ESA .

733. Gregor Andreas (*ZIP code: 94611)*

734. GREGORY ZASTE (*ZIP code: 95482)*
Please save our steelhead

735. Greg Thomson (*ZIP code: 94965)*

736. Gregory Waters (*ZIP code: 94903)*
SOS! Save our Steelhead!

737. Gregg Wrisley (*ZIP code: 95472)*

738. GROVER HOWARD (*ZIP code: 92009)*
This is urgently needed to not only save the Southern Steelhead but to also improve biodiversity.

739. Glen Scrivens (*ZIP code: 90304)*

740. Gary Slade (*ZIP code: 95666)*

741. Gregory Stone (*ZIP code: 92116)*

742. **Gary Thomas** (*ZIP code: 91335)*

743. **Glenn Tochioka** (*ZIP code: 92683)*

744. **Gerrick Yamada** (*ZIP code: 95129)*

745. **Garrett Gunning** (*ZIP code: 93460)*

746. **Guy Ferrante** (*ZIP code: 91770)*

747. **Guy Otoshi** (*ZIP code: 94116)*

748. **Gregg Wrisley** (*ZIP code: 95472)*

749. **Gwyneth Perry** (*ZIP code: 90042)*

750. **Gene Yano** (*ZIP code: 90066)*

751. **Kenneth Haber** (*ZIP code: 91001)*

752. **Hugh Bialecki** (*ZIP code: 92317)*

753. **Hadrian Predock** (*ZIP code: 90405)*

754. **Kelli Hailey** (*ZIP code: 91101)*

755. **Halee Bernard** (*ZIP code: 91214)*

756. **Hye Kim** (*ZIP code: 91602)*

757. **Haley Coffman** (*ZIP code: 84115)*
These fish need to be protected under law!

758. **halli gigante** (*ZIP code: 90601)*

759. **Suzanne Hall-Whitney** (*ZIP code: 94553)*

760. **An anonymous signer** (*ZIP code: 95519)*

761. **John Ferguson** (*ZIP code: 95050)*

762. **CJ Vapenik** (*ZIP code: 90041)*

763. Hanna Hanson (*ZIP code: 94107)*

764. Happy Nguyen (*ZIP code: 95821)*

765. dale harper (*ZIP code: 93527)*
California

766. Jonathan Harrington (*ZIP code: 94043)*

767. Terry Thomas (*ZIP code: 95831)*
Please help us save this precious fish. This could be our last chance.

768. Jamie Higgins (*ZIP code: 92647)*

769. Hannah Cady (*ZIP code: 28411)*

770. Hannah Benharash (*ZIP code: 90272)*

771. Herb Bishop (*ZIP code: 91364)*

772. Patt Healy (*ZIP code: 90265)*

773. Heidi Foubare (*ZIP code: 91350)*

774. He-Lo Ramirez (*ZIP code: 95928)*

775. Kenneth Cullings (*ZIP code: 93035)*
Please prioritize the removal of Matilijah dam. It's a critical step for this area and the Sespe drainage.

776. Stephen Smith (*ZIP code: 94306)*
please save the southern CA steelhead from extinction

777. Jo Ann Herr (*ZIP code: 94602)*

778. Robert Kanne (*ZIP code: 92887)*

779. William Leach (*ZIP code: 93561)*

780. Hiroaki Hayashigatani (*ZIP code: 94403)*

781. Howard Pippen (*ZIP code: 92056)*
Please affirm the findings of California DFW and relevant Federal agencies.
All have clearly documented the urgent need to sustain extensive ongoing restoration efforts for this heritage indicator species.

782. **HEATHER CARMODY** (*ZIP code: 95667)*

783. **Holly Meadors** (*ZIP code: 93023)*

784. **Bob Hogan** (*ZIP code: 94599)*

785. **Ruth Holbrook** (*ZIP code: 94608)*

786. **Del Holland** (*ZIP code: 91355)*

787. **Casey Horgan** (*ZIP code: 93103)*

788. **Helga Conkln** (*ZIP code: 92120)*
save Southern steelhead from extinction!

789. **Howard Sawada** (*ZIP code: 92067)*

790. **Howard Strauss** (*ZIP code: 90232)*

791. **Frank Humberstone** (*ZIP code: 91722)*

792. **Hunter Vaught** (*ZIP code: 93534)*
Give wild steelheads the chance to recover by listing them as an endangered species.

793. **Hunter Mayer** (*ZIP code: V3M3W5)*
As a concerned resident of the pacific coast in British Columbia, where native wild steelhead populations face the same tragic fate, I plead the California Fish and Game Commission to list Southern steelhead on the California ESA. Take this opportunity to show leadership in advancing protections for wild steelhead populations.

Thank you.

794. **Steven Huntley** (*ZIP code: 91104)*

795. **Russell Hunziker** (*ZIP code: 90272)*

796. **Arthur Hurley** (*ZIP code: 94558)*
Please act to save this species from extinction!

797. **David Hurley** (*ZIP code: 94602)*

798. **Hannah Vaughn-Hulbert** (*ZIP code: 93109)*

799. **Harry White** (*ZIP code: 95747)*
Please save these beautiful fish from extinction! Thank you.

800. **Levie Isaacks** (*ZIP code: 95472)*

801. **Illece Buckley Weber** (*ZIP code: 91301)*
Please protect the Southern Steelhead by listing it as endangered under CA's Endangered Species Act.

802. **Isabelle Voler** (*ZIP code: 94109)*

803. **Ivan Castillo** (*ZIP code: 90034-5537)*
It is crucial that we protect the habitat of the Southern Steelhead. Please list the species as endangered so we can protect it's disappearing ecosystem.

804. **ian Douglas** (*ZIP code: 92692)*

805. **Valentin Mendoza** (*ZIP code: 93003)*

806. **Ian** (*ZIP code: 94044)*

807. **Ingrid Serafin** (*ZIP code: 93117)*

808. **Terrence Tinucci** (*ZIP code: 92321)*

809. **Stephen Parry** (*ZIP code: 94558)*

810. **Drew Irby** (*ZIP code: 95648)*
This is an action that should have been taken long ago. The feds have SS as an endangered species, why not the state? What bureaucracy is holding this listing back? Millions have been spent on restoration and planning to remove and or mitigate barriers to sSS passage and this listing needs to be in place fetch to let these projects go forward.

811. **Iris Yuh** (*ZIP code: 93117)*

812. **Nate Irwin** (*ZIP code: 93103)*

813. **Isabella Ponce** (*ZIP code: 93106)*

814. **Isabella Caruso** (*ZIP code: 90291)*

815. **Kris Iverson** (*ZIP code: 92123)*

816. **Ly Yang** (*ZIP code: 90503)*

817. **Justin Andres** (*ZIP code: 91711)*

818. **jeffrey bloch** (*ZIP code: 90018)*

819. **Alex Ceja** (*ZIP code: 95401)*

820. **Jon Barnea** (*ZIP code: 92629)*

821. **Jay Beckstead** (*ZIP code: 97202)*

822. **John M. Shelton** (*ZIP code: 93720)*

823. **Jack Lemein** (*ZIP code: 93001)*

824. **Jack Ackerman** (*ZIP code: 92694)*
Save the Southern Steelhead.

825. **Jack Campbell** (*ZIP code: 95120)*
Immediate action necessary

826. **Jack Neff** (*ZIP code: 90004)*

827. **Jackson Valencia** (*ZIP code: 93460)*

828. **jackson collins** (*ZIP code: 90808)*
:?

829. **Jackson Gould** (*ZIP code: 95814)*

830. **Jacob Jett** (*ZIP code: 93908)*

831. **Jacob Smith** (*ZIP code: 95521)*

832. **Jacob Paul** (*ZIP code: 92583)*

833. **Jacob Roeder** (*ZIP code: 90036)*

834. **Jacob Mullins** (*ZIP code: 94133)*

835. **Jorge Cortez** (*ZIP code: 91001)*

836. **Judith Adams** (*ZIP code: 91381)*

837. **Jade Zounes** (*ZIP code: 91335)*

838. **Jade Tippo** (*ZIP code: 93022)*

839. **Jaime Burrola** (*ZIP code: 91775)*

840. **Anthony Iantosca** (*ZIP code: 94024)*

841. **Jacob DeWald** (*ZIP code: 41075)*

842. **James Avant** (*ZIP code: 94010)*

843. **Mike James** (*ZIP code: 94954)*

844. **James Bading** (*ZIP code: 91030)*

845. **James Burton** (*ZIP code: 94941)*

846. **James Chong** (*ZIP code: 92870)*

847. **James Kampas** (*ZIP code: 92234)*

848. **James Beeson** (*ZIP code: NP8 1AR)*
I support this petition as a European steelheader and regular visiting angler.

849. **James Lynch** (*ZIP code: 95442-0655)*

850. **Jamie De La Vega** (*ZIP code: 92867)*

851. **James Stewart** (*ZIP code: 95405)*

852. **Janin Paine** (*ZIP code: 90291)*

853. **Jann Dorman** (*ZIP code: 95613)*

854. **Sean Jansen** (*ZIP code: 59718)*

855. **Jason Beasley** (*ZIP code: 94618)*

856. **Jason Erbert** (*ZIP code: 94555)*

857. **Jason Lozano** (*ZIP code: 96003)*

858. **Jason Drew** (*ZIP code: 95432)*

859. **jason forman** (*ZIP code: 90032)*

860. **Jason Quan** (*ZIP code: 90274)*

861. **Jason Vang** (*ZIP code: 91801)*

862. **Jeffrey Trafican** (*ZIP code: 93711)*

863. **Jay Kaneshige** (*ZIP code: 94552)*

864. **Judith Chumlea-Cohan** (*ZIP code: 93458)*

865. **Jay Monahan** (*ZIP code: 95818)*
Keep up the good fight!

866. **Jazzari Taylor** (*ZIP code: 91722)*
Latino Outdoors is happy to support the protection of Southern Steelhead from extinction.

867. **John Balestra** (*ZIP code: 90277)*

868. **John Brennan** (*ZIP code: 96094-9752)*

869. **Juan Bautista** (*ZIP code: 95348)*
Save California steel head !!!!

870. **Joseph Benton** (*ZIP code: 94509)*

871. **James Haufler** (*ZIP code: 95747)*
All we are saying is, "Give fish a chance."

872. **Josh C.** (*ZIP code: 90029)*

873. **John Cowan** (*ZIP code: 95973)*

874. **John Willie** (*ZIP code: 92802)*

875. **Jonathan Dadon** (*ZIP code: 91208)*
List the Southern California steelhead as endangered. Save our native fish

876. **Joanne Dow** (*ZIP code: 95409)*

877. **John Deily** (*ZIP code: 92614)*

878. **James Doalson** (*ZIP code: 92673)*
Very important to save this fish!

879. **James Valle-Schwenk** (*ZIP code: 94116)*

880. **Jean Sedar** (*ZIP code: 93101)*

My first fishing memory was as a toddler watching my father fly fish for Steelhead on the Santa Ynez River. I'm now 70. We MUST protect this beautiful, valuable species to enrich our native environment! Jean Sedar, 5th Generation Santa Barbaran

881. Jeffrey Muscatine (*ZIP code: 95247)*

882. Jeffrey Kruger (*ZIP code: 94920-1056)*

883. Jeff Williams (*ZIP code: 92705)*

884. Jeff Lincer (*ZIP code: 92036)*
Please do a better job of protecting this species.

885. Jeff Mazet (*ZIP code: 94970)*

886. Jeff Sermak (*ZIP code: 92010)*

887. Jeffrey Henigan (*ZIP code: 95758)*

888. Jeffrey Coupe (*ZIP code: 95661)*

889. Jeffrey Fairfield (*ZIP code: 94087)*

890. Janet Kubler (*ZIP code: 91355-3116)*

891. Jelly Kahler (*ZIP code: 90292)*

892. Jen Greenberg (*ZIP code: 96150)*

893. Jenifer Yager (*ZIP code: 83702)*

894. Jennifer Cossaboon (*ZIP code: 92103)*

895. Jenn Guess (*ZIP code: 91302)*

896. Jen Stein (*ZIP code: 93117)*

897. Jennifer O'Brien (*ZIP code: 97702)*
Please do the right thing and protect Southern California steelhead under the ESA listing.

898. Jennifer Rudloff (*ZIP code: 92029)*
Protect our CA natives!

899. Jenny Ziesenhenne (*ZIP code: 93105)*

900. **Jeremiah Nicholson** (*ZIP code: 59801)*

901. **Jeremy Bonsall** (*ZIP code: 90065)*

902. **Sherry Ashbaugh** (*ZIP code: 92020)*

903. **Jerome Damian** (*ZIP code: 95327)*
I feel they need to start putting those fish in other locations throughout California. The Pilot Peak cut throat is a perfect example. Same with the marble trout in Sylvania.

904. **Jerry Matthews** (*ZIP code: 92131)*

905. **Jerry Bender** (*ZIP code: 95409)*

906. **Jerry Urban** (*ZIP code: 95355)*

907. **jerry krohn** (*ZIP code: 94044)*
thank you

908. **Jessica Rodriguez** (*ZIP code: 90065)*

909. **Jessi Vannatta** (*ZIP code: 93225)*

910. **Jessica Minucci** (*ZIP code: 91320)*

911. **Brett Jensen** (*ZIP code: 96073)*
Please do the right thing.

912. **Edward Jew** (*ZIP code: 94526)*

913. **Julie Ford** (*ZIP code: 90740)*

914. **James Gill** (*ZIP code: 91030)*

915. **Jacob Gorman** (*ZIP code: 91104)*

916. **Jay Grandon** (*ZIP code: 91001)*

917. **Jaime Calle** (*ZIP code: 93036)*

918. **John Herrera** (*ZIP code: 95437)*

919. **John Simpson** (*ZIP code: 93108)*

920. **Jillian Jaeger** (*ZIP code: 93446)*

921. **jill freeland** (*ZIP code: 93101)*

922. **Jim Ries** (*ZIP code: 904040)*

923. **Jim Arce** (*ZIP code: 94920)*
Let's save this important species.

924. **Jim Nomura** (*ZIP code: 91106)*

925. **James Young** (*ZIP code: 93111)*

926. **James Pon** (*ZIP code: 90631)*

927. **Jim Stewart** (*ZIP code: 90712)*
Please save the steelhead!

928. **James Ahrens** (*ZIP code: 93306)*

929. **Jim Crabtree** (*ZIP code: 95448)*

930. **Jim Fricks** (*ZIP code: 92679)*

931. **James Ells** (*ZIP code: 92325)*
Save the steelhead and save the West Fork of the San Gabriel River!

932. **James Lin** (*ZIP code: 92037)*

933. **James Zelko** (*ZIP code: 94553)*
Save the streams and the Steelhead

934. **Jon Jaeger** (*ZIP code: 93446)*
Save them!

935. **Joe Cech** (*ZIP code: 95616)*

936. **Jeff Havlik** (*ZIP code: 93101)*

937. **Jason Olson** (*ZIP code: 95757)*

938. **John Kaiser** (*ZIP code: 92646)*

939. **John Koene** (*ZIP code: 94965)*

940. **Jeff Kaminski** (*ZIP code: 91307)*
Save the Steelhead, stop destroying our planet and it's inhabitants!

941. **Janet Amundson** (*ZIP code: 55434)*

942. **Jennifer Beatty** (*ZIP code: 90064)*

943. **Jose Luis Carrillo** (*ZIP code: 93105)*

944. **John Hermon** (*ZIP code: 94506)*

945. **Jim Lindland** (*ZIP code: 84092)*
Hello,

I'm currently an Utah resident, but spent my formative years (1988 to 2017) growing up in Southern California. Please list southern steelhead.

Sincerely,
Jim
Lindland

946. **john nesheim** (*ZIP code: 95066)*

947. **James Murdock** (*ZIP code: 15003)*

948. **Joel Martin** (*ZIP code: 91360)*

949. **James Mcguirk** (*ZIP code: 91320)*
This is a critical species of fish that is becoming endangered across the pacific. We must do our very best to allow this species the space and habitat it needs to thrive again.

950. **Jeff Megorden** (*ZIP code: 92130)*

951. **James Mitchell** (*ZIP code: 89519)*
I support efforts to save Southern California Steelhead trout, I support all Conservation Groups working to save the fish by improving the fish's habitat.
James D Mitchell

952. **Jim Molinari** (*ZIP code: 95448)*
Please protect steelhead and other anadromous fish vital to a healthy ecosystem.

953. **John** (*ZIP code: 95469)*

954. **John Murphy** (*ZIP code: 94002)*

955. Jeremy Netka (*ZIP code: 91367)*

956. Judith Nicolaidis (*ZIP code: 92105)*
What a beauty! And what a shame to lose it. We need to save and nurture every part of nature, ultimately part of ourselves!

957. Jon Copeland (*ZIP code: 93405)*

958. Joseph Golightly (*ZIP code: 95667)*

959. Joseph Howard (*ZIP code: 93003)*

960. Joel Cheney (*ZIP code: 95595)*
Please protect these iconic fish.

961. Joseph Valerio (*ZIP code: 90041)*
The Southern Steelhead needs all our help in order to help the species rebound. We as humans have directly impacted their migration to the ocean by building dams and diverting water. Please let's find a way to help the southern steelhead before it's too late.

962. Johanna Moynahan (*ZIP code: 90220)*
Fish Rule!

963. Jayme Ohlhaver (*ZIP code: 94129)*

964. John Chmiola (*ZIP code: 90232)*

965. John Frazer (*ZIP code: 92122)*

966. John Loo (*ZIP code: 92081)*

967. John Pohorsky (*ZIP code: 92337)*
California steelhead and salmon need our help. Please help protect the watershed sand their environment.

968. John Jarve (*ZIP code: 94027)*
Please protect and improve our waterways! Thank you!

969. John Kim (*ZIP code: 91381)*
Thank you for all you do!!!!

970. John Baxter (*ZIP code: 85396)*

971. john moniz (*ZIP code: 95220)*

972. John Charbonneau (*ZIP code: 91977)*

973. John Collins (*ZIP code: 92131)*
Save our steelhead!

974. John Finney (*ZIP code: 92630)*

975. John Frankot (*ZIP code: 60618)*

976. john dorwin (*ZIP code: 93427)*
Bureau of Reclamation, County of Santa Barbara , and Cachuma Operating and Maintenance Board have been evading environmental review of the Cachuma Project for years. They have done nothing to restore the Santa Ynez River Fishery and wasted hundreds of thousands of dollars of taxpayer money in the process. State enforcement outside the Cachuma Project is long overdue to protect the remaining Southern Steelhead Trout below the Bradbury Dam in the River and the critical habitat which can still be preserved.

977. John Mykkanen (*ZIP code: 92706)*
We need steelhead!!!

978. John Stanley (*ZIP code: 95688)*

979. John Pelley (*ZIP code: 93908)*

980. Johann Piff (*ZIP code: 95628)*

981. John Lucas (*ZIP code: 92101)*

982. Miki Nakamura (*ZIP code: 94578)*

983. Jon Boorstin (*ZIP code: 91604)*

984. Jon Bowman (*ZIP code: 95060)*

985. Cory Jones (*ZIP code: 93422)*
They are a representation of health and resilience for our regional watersheds. Let's not lose them and keep them as a symbol for future generations.

986. Jonathan Hubbard (*ZIP code: 95818)*
Restore analogous fish in California!

987. Jordan Hook (*ZIP code: 91303)*
Would love to see steelhead numbers come back!

988. Jorome Cruz (*ZIP code: 80528)*

989. Joseph Davies (*ZIP code: 91702)*
Save the fish!

990. Joseph Moyle (*ZIP code: 97405)*

991. Josh Bolden (*ZIP code: 95476)*
Save nature! It's all we have in this state!!!

992. Joshua Bergan (*ZIP code: 59714)*

993. Joshua Schweitz (*ZIP code: 91803)*
With less and less available habitat and proper streams for these fish to reproduce, it's important to mark them as endangered to help protect them and give them a chance to rebound

994. Josue Penuelas (*ZIP code: 92532)*

995. Joseph Silveira (*ZIP code: 95367)*

996. John Clark (*ZIP code: 90266)*

997. John Davey (*ZIP code: 94027)*
It is no mystery that Steelhead are an endangered species.

998. Justin Peek (*ZIP code: 95926)*

999. Jeff Haas (*ZIP code: 93035)*

1000. J. Pearce Hurley MD (*ZIP code: 94708)*

1001. Jerry Rapier (*ZIP code: 95252)*
No native species should become extinct!

1002. Joseph Colton (*ZIP code: 95864)*

1003. John Reed (*ZIP code: 94024)*

1004. I (*ZIP code: 92117)*

1005. Jinesse Reynolds (*ZIP code: 94960)*

1006. Kathryn Ridgley-Lunetta (*ZIP code: 91364)*

1007. John Rusmisel (*ZIP code: 94542)*

1008. John Thomson (*ZIP code: 93003)*
Stop killing all the fish for a few extra pieces of paper. It's paper not a living thing anymore. It is also dead. Stop with the damming of every water source in the country already. Take them down and let our kids and grandkids have some wild life in their lives. We are all pet of the problem and will feel it more and more in years to follow.

Please let's all work together to protect our world and ourselves.

1009. Jim Deacon (*ZIP code: 93117)*
We've destroyed most of what California was. Surely we can protect the few remaining steelhead.

1010. Jeffrey Caulkins (*ZIP code: 93422)*

1011. Jenna Segal (*ZIP code: 90401)*

1012. Judith E Long Judith E Long (*ZIP code: 93109)*
Please help save this vital resource

1013. John Vogh (*ZIP code: 92130)*

1014. John Sheridan (*ZIP code: 13207)*

1015. James Fousekis (*ZIP code: 94618)*

1016. Jack Ish (*ZIP code: 93619)*
Please save our fish

1017. Jane Tsong (*ZIP code: 91207)*

1018. JUAN ZAMORA (*ZIP code: 90650)*

1019. Judith Blocker (*ZIP code: 90405)*

1020. Jule Baughman (*ZIP code: 90277)* **1021.**

Julie du Bois (*ZIP code: 91304-3049)* **1022. Julian**

Engel (*ZIP code: 94903)*
Save Southern Steelhead

1023. Julie Kelner (*ZIP code: 98312)*

1024. Julie Lumley (*ZIP code: 93108)*

1025. June Lancaster (*ZIP code: 95549)*

1026. Justin Coupe (*ZIP code: 95650)*
I fully support fully support listing Southern steelhead as endangered under California's ESA - by April 4, 2024.

1027. Justin Hopfer (*ZIP code: 90035)*

1028. Justin Goodwater (*ZIP code: 91784-1306)*
Please help save the steelhead!

1029. Justin Rathert (*ZIP code: 95833)*

1030. Justin Christodoulou (*ZIP code: 90701)*

1031. Judith Uthus (*ZIP code: 91302)*

1032. Jonathan Walker (*ZIP code: 94941)*

1033. Justin Ward (*ZIP code: 93422)*

1034. Jonathan Webber (*ZIP code: 92128)*

1035. Josh Wheaton (*ZIP code: 94117)*

1036. Joe Wiederhold (*ZIP code: 98229)*

1037. Joseph Rudolph (*ZIP code: 95826)*
Save southern California steelhead

1038. John Streeter (*ZIP code: 91011)*
I always vote.

1039. John Wylie (*ZIP code: 92106)*

1040. Jim Yarbrough (*ZIP code: 91320)*
It is very important to un-dam the Ventura River and to bring back the Southern steelhead! Time is running out. Southern steelhead must be listed as endangered!

1041. John Zvetina (*ZIP code: 92037)*

1042. Keith Goursky (*ZIP code: 95355)*

1043. Kyle Mendenhall (*ZIP code: 43206)*

1044. Edward Sherlock (*ZIP code: 95831)*
Save the steelhead!!

1045. Kristine Olmstead (*ZIP code: 93455)*

1046. Kaden Ward (*ZIP code: 93422)*

1047. Kaeden Anderson (*ZIP code: 95448)*

1048. Daniel Kagey (*ZIP code: 91436)*

1049. kana lee (*ZIP code: 91755)*

1050. karen wilson (*ZIP code: 94590)*

1051. Kat Selm (*ZIP code: 93001)*

1052. Kathleen Smith (*ZIP code: 90018)*

1053. Katelyn Fansler (*ZIP code: 95928)*

1054. Katherine Daly (*ZIP code: 94062)*

1055. Kathleen Johnson (*ZIP code: 90039)*

1056. Katherine McKenna Rosario (*ZIP code: 94108)*

1057. Kathy Knight (*ZIP code: 90405)*
PLEASE help us save this wonderful fish that has been a big part of our rivers and streams.

1058. Katie Faris (*ZIP code: 93001)*

1059. Katie Zubak (*ZIP code: 92881)*

1060. Kathryn Lindsay (*ZIP code: 95246)*
Please consider the importance of this!

1061. James Kawamura (*ZIP code: 92336-5905)*

1062. Kenneth Lueth (*ZIP code: 95765)*

1063. ken briscoe (*ZIP code: 89703)*

1064. Kanan Beissert (*ZIP code: 95521)*
Saving fish saves humans too.

1065. Keegan Uhl (*ZIP code: 91505)*

1066. Keith Gendler (*ZIP code: 90278)*

1067. L Keith Zandona (*ZIP code: 93105)*
save the southern steelhead

1068. Kelli Frye (*ZIP code: 90401)*

1069. Kelly Barlow (*ZIP code: 94549)*

1070. Kelsey McCurdy (*ZIP code: 94924)*

1071. Kelsey Reckling (*ZIP code: 90031)*

1072. Kelsi Sigurdson (*ZIP code: 96080)*
I have a lot of faith in CalTrout, thank you for all you do to save the salmon!!

1073. Kelven Diehl (*ZIP code: 92310)*

1074. Kenneth Nicholson (*ZIP code: 94117)*

1075. Ken Rasler (*ZIP code: 94539)*
SAVE THE SOUTHERN CALIFORNIA STEELHEAD!!!!!!!

1076. Kern Aughinbaugh (*ZIP code: 92078)*
I fully support the listing of the Southern Steelhead on the California ESA.

1077. Marina Cheney (*ZIP code: 95595)*
Please look out for the longevity of these beautiful fish!

1078. KEVIN EAGLETON (*ZIP code: 92596-8878)*

1079. Capt Kevin S McQuiston (*ZIP code: 90277)*
Please consider!

1080. Kevin Bendian (*ZIP code: 94577)*
My name kevin bendian I support this fully

1081. Kevin Jontz (*ZIP code: 90045)*

1082. Kevin Sheldahl (*ZIP code: 91001)*
Please act now to save Southern California steelhead!! Losing a key ingredient to vital watersheds would be unacceptable. We need to properly share our resources wisely with fish, wildlife, and people.

1083. Kara Glenwright (*ZIP code: 94133)*

1084. Kyle Baker (*ZIP code: 94702)*

1085. Kian Kaeni (*ZIP code: 91784)*

1086. Kieran Campbell (*ZIP code: V0r2z0)*

1087. Christopher Kight (*ZIP code: 95661)*
It is unacceptable to allow ANY wild species to dwindle down to nothing, expecially when humans contributed to the situation.

1088. Killian LeDuke (*ZIP code: 90046)*

1089. Logan Gillingham (*ZIP code: 93437)*

1090. Kim Lloyd (*ZIP code: 95630)*
Now is the time to take action. Every effort is a step in the right direction. No effort increases the loss of the SoCal steelhead. This loss cannot be allowed to happen.

1091. James Wong (*ZIP code: 9134)*

1092. Grace Countryman (*ZIP code: 94611)*

1093. Kyle Kertscher (*ZIP code: 95540)*

1094. Keith Kolischak (*ZIP code: 27196)*

1095. Kevin Kuhn (*ZIP code: 95959)*

1096. Jeffrey Klein (*ZIP code: 91214)*

1097. Kelly Kelly (*ZIP code: 90808)*

1098. Keith Johnson (*ZIP code: 94602)*
I am in full support of saving the steelhead, returning the rivers to their original condition and removing as many dams as possible.

1099. Kerri King (*ZIP code: 92536)*
We are losing tooooo many species! Please do all you can to protect the Southern California Steelheads from extinction!

1100. Kate Stirr (*ZIP code: 94501)*

1101. kent morris (*ZIP code: 92831)*

1102. Kevin Morrison (*ZIP code: 95003)*
Save our Steelhead!!!

1103. Nicole Howell (*ZIP code: 96067)*

1104. Kathleen Komar (*ZIP code: 90066)*
please keep the southern steelhead from going extinct!

1105. August Konrad (*ZIP code: 92122)*

1106. Kirston Koths (*ZIP code: 94530)*

1107. Kathye Armitage (*ZIP code: 91390)*

1108. Katherine Pease (*ZIP code: 90404)*

1109. Kristina Stodder (*ZIP code: 92024)*

1110. Kristin Womack (*ZIP code: 94960)*

1111. Kevin Saul (*ZIP code: 93003)*
Please help my local Steelhead survive.

1112. Kevin Barnard (*ZIP code: 92029)*
Board member of the Escondido Creek Conservancy. It would be a game changer for all of So Cal to see these runs again.

1113. Kristen Schonert (*ZIP code: 90291)*

1114. Kevin Smith (*ZIP code: 95254)*
Thank you for helping

1115. Katie Converso phillips (*ZIP code: 90802)*

1116. Ken Tetzel (*ZIP code: 94551)*

1117. Kamala Tippo (*ZIP code: 97401)*

1118. Katherine Lynch (*ZIP code: 92025)*
For those of us who are native Californians, and for enthusiasts of trout fishing everywhere, the preservation of our Southern steelheads is paramount. Let's add them to the endangered species list and protect the Southern Steelhead so that mankind doesn't lose yet another species to humanity's indifference to the natural world.

1119. Kris Tucker (*ZIP code: 91942)*

1120. Gary Kurashige (*ZIP code: 90503)*

1121. Steven Kwok (*ZIP code: 95404)*

1122. Katherine Carmichael (*ZIP code: 93109)*

1123. Kyle Frank (*ZIP code: 94707)*

1124. Kyle Satterlee (*ZIP code: 93012)*

1125. Kyle O'Connor (*ZIP code: 92116)*

1126. Monica Alvarez (*ZIP code: 90063)*

1127. Kristen Metcalfe (*ZIP code: 95619)*

1128. Lacey Prescott (*ZIP code: 93906)*

1129. Susan Henry (*ZIP code: 90024)*

1130. linda miller (*ZIP code: 92082)*
Please continue your work to see the SoCal steelhead

1131. Johanna Moynahan (*ZIP code: 90220)*

1132. LouAnne Insprucker (*ZIP code: 91011)*
Please give southern Steelheads a chance

1133. Lori Howk (*ZIP code: 97229)*

1134. Eric Edmunds (*ZIP code: 90049)*

1135. Timothy Lambert (*ZIP code: 90815)*

1136. Lance Rava (*ZIP code: 92677)*

1137. Lance Spece (*ZIP code: 95628)*

1138. Lani Wild (*ZIP code: 94708)*

1139. Lani Dinh (*ZIP code: 91709)*

1140. Bernard Yin (*ZIP code: 90401)*
The fish need this additional protection.

1141. Larry Volpe (*ZIP code: 95139)*
Please do it. Before it’s too late.

1142. Larry Nakamura (*ZIP code: 92130)*

1143. Larry Volpe (*ZIP code: 95139)*

1144. GEORGE BROWN (*ZIP code: 94510)*

1145. Lawrence Robison (*ZIP code: 95821)*

1146. Philip Carl (*ZIP code: 94019)*

1147. Dave Schlom (*ZIP code: 96080)*
Please help preserve this wild part of our SoCal heritage.

1148. Jack Hodges (*ZIP code: 90405)*

1149. Laura Ayala-Huntley (*ZIP code: 91104)*

1150. Laura Hampton (*ZIP code: 91942)*

1151. Lauren Hall (*ZIP code: 95961)*

1152. Stacy Lawson (*ZIP code: 93454)*

1153. Lynn Cannady (*ZIP code: 94549)*
When will our politicians actually do something important?!

1154. Richard Louderback (*ZIP code: 90004)*

1155. larry chambers (*ZIP code: 94933)*

1156. Laura Cunningham (*ZIP code: 92323)*
I worked with Southern California Steelhead in the 1990s as a Scientific Aid with the (then) California Department of Fish and Game. The issues facing steelhead then were onerous, and I believe these fish need the maximum level of protection in order to keep populations from slipping into extinction.
Thank you.

1157. Larry Sasscer (*ZIP code: 95120)*

1158. Leanne Ly (*ZIP code: 92069)*

1159. Andrew Vizir (*ZIP code: 90272)*

1160. Lee Leardini (*ZIP code: 94947)*

1161. Lee Morgan (*ZIP code: 44067)*

1162. Mathieu Bonin (*ZIP code: 90011)*
We need to protect wildlife

1163. Lena Goldberg (*ZIP code: 93442)*

1164. William Lenheim (*ZIP code: 96002)*
save the strain for the future

1165. Leon Felus (*ZIP code: 90034)*

1166. leonard Perry (*ZIP code: 95521)*

1167. Leon Martinez (*ZIP code: 92509)*
Please save the Southern California steelhead from extinction

1168. Lucy Fellner (*ZIP code: 94133)*

1169. Lawrence Matson (*ZIP code: 95521)*

1170. Liam Massie (*ZIP code: 93546)*

1171. John Yeakel (*ZIP code: 94609)*

1172. Danielle Dowling (*ZIP code: 91342)*

1173. margaret light (*ZIP code: 90272)*
I caught my first fish at 2 years old (with my Dad - we should all be so lucky). Today I fish for steelhead in northern California and Michigan - they are amazing fish. Please save the southern california steelhead so future generations can benefit and enjoy the "wild".

1174. Alondra Sandoval (*ZIP code: 91732)*

1175. Lili Khosravi (*ZIP code: 91605)*

1176. Rebecca Lee (*ZIP code: 33137)*

1177. Linda Strong (*ZIP code: 90640)*
This important species must not be allowed to go extinct. It is an integral part of the Southern California ecosystem and its importance will increase due to climate change as its range will expand north.

1178. Linda Mondaca (*ZIP code: 92405-4134)*

1179. Lindsey Jurca (*ZIP code: 90065)*

1180. Alberto Cuellar (*ZIP code: 94536)*

1181. Lionel Mares (*ZIP code: 91352)*
Protect vulnerable fish and species!

1182. Lisa Hogan (*ZIP code: 97220)*
1183. Lisa Fimiani (*ZIP code: 90066)*

1184. Dylan Granberg (*ZIP code: 92692)*
California needs to stop acting in favor of the rich & politicians and act on what it has left of non- destroyed land and wildlife!

1185. Valerie Lizarraga (*ZIP code: 90640)*

1186. Elizabeth Dodge (*ZIP code: 94708)*

1187. Liz Wages (*ZIP code: 91214)*

1188. Liz Keitz (*ZIP code: 90032)*

1189. Lizzy Sorce (*ZIP code: 93430)*

1190. Jeff Phillips (*ZIP code: 93109)*

1191. Larry Jindra (*ZIP code: 92056)*

1192. Linnea Wickstrom (*ZIP code: 94306)*
Saving salmon means saving so much for fish, plants, other animals, and ourselves. Do not allow short-term thinking to let salmon go extinct. Instead, take action to save salmonids!!

1193. Lloyd DeArmond (*ZIP code: 93111)*

1194. Lloyd Hackel (*ZIP code: 94550)*
I am also committed to removing the 17-foot barrier on Niles Creek in Fremont

1195. Linda Pankonin (*ZIP code: 96088)*

1196. LAWRENCE KENNEY (*ZIP code: 94901-3410)*
It's way past time to do the right thing! Please get on board.

1197. Landon Neustadt (*ZIP code: 93110)*

1198. Deborah Loehr (*ZIP code: 92116)*

1199. Luca Rakichevich (*ZIP code: 93117)*
Save the steelhead they are an important staple of a healthy ecosystem

1200. Loren Francis (*ZIP code: 90230)*
Save the Californian southern steelhead!

1201. Martina Jacobs (*ZIP code: 90211)*

1202. Logan Lannon (*ZIP code: 90631)*

1203. Jerry Salazar (*ZIP code: 94595)*
Time to save these fish before they are gone!

1204. Lonny Retzloff (*ZIP code: 94553)*

1205. Loretta Keller (*ZIP code: 94114)*

1206. Jonathan Steinberg (*ZIP code: 95060)*
Extinct is forever!

1207. Richard Unger (*ZIP code: 94618)*

1208. Louis Dupuy (*ZIP code: 42153)* **1209.**

Analiza del Rosario (*ZIP code: 91702)* **1210.**

Daniel Lowman (*ZIP code: 93546)*

1211. Lawrence Piepmeier (*ZIP code: 94030-2142)*

1212. Luke Proskine (*ZIP code: 94025)*

1213. Lewis Albright (*ZIP code: 93555)*
It is imperative that we save Southern Steelhead for future generations!!

1214. Leo Marrs (*ZIP code: 94513)*

1215. Lowell Turner (*ZIP code: 14850)*

1216. Luis Santana (*ZIP code: 95485)*

1217. Lew Leichter (*ZIP code: 93455)*

1218. Louis Ternullo (*ZIP code: 93105)*
Southern steelhead are the seminal fish all steelhead originate from. Climate change could wipe out many populations in other areas. Having Southern steelhead in decent numbers could provide strong fish to rebuild stocks effected by these changes. Please give them a chance to return to their native waters where they used to number in the thousands before the interference of humans.

1219. Luis Chaves (*ZIP code: 90503)*

1220. Luis Rincon (*ZIP code: 90031)*

1221. Luke Paterson (*ZIP code: 93110)*
I am an advocate for all wildlife who uses art to try to support organizations. Despite my 13 years of life I have only

seen a steelhead once. I am down to help save them.

1222. Luke Daynard (*ZIP code: 95519)*

1223. LARRY LUNDBERG (*ZIP code: 95112)*
Once gone, they can never be brought back. Please protect them!

1224. Lionel Valley (*ZIP code: 95928)*

1225. Linda Pankonin (*ZIP code: 96088)*

1226. Lynne Plambeck (*ZIP code: 91321)*
Please promote efforts that will save the steelhead. If we save the fish, we will save the people.

1227. Melissa Scalia (*ZIP code: 91007)*

1228. Michael Taylor (*ZIP code: 96027)*

1229. Michael Sarkisian (*ZIP code: 95603)*

1230. marc hogue (*ZIP code: 89704-9019)*

1231. Mark Allen (*ZIP code: 96067)*

1232. Maaya Hensman (*ZIP code: 95062)*

1233. Mac Esters (*ZIP code: 94117)*

1234. Douglas Macbeth (*ZIP code: 43214-1107)*
For our children and grandchildren, and as responsible stewards of a land of vibrant life.

1235. Ian Mahaffey (*ZIP code: 95062)*

1236. Mackenzie Berg (*ZIP code: 98144)*

1237. Julie MacLean (*ZIP code: 94027)*
Our survival depends on our ability to recognize and support, the unity of our physical world. The preservation of species is dependent on the preservation of all species. Protect steelhead while we still have time.

1238. James Kirwan (*ZIP code: 95762)*

1239. Maddy Avila (*ZIP code: 95762)*

1240. madison salinas (*ZIP code: 94510)*

1241. Christopher Gagnon (*ZIP code: 12839-1861)*

1242. Drew Madrigal (*ZIP code: 93003)*
This has been a concern of mine for decades so yew I support the need to protect this treasure of the California.

1243. kenny maier (*ZIP code: 93631)*
please save!!!

1244. Kim Stringfellow (*ZIP code: 92252)*

1245. Malcolm Fea (*ZIP code: 95501)*

1246. Armando Gonzalez Guerra (*ZIP code: 92508)*

1247. Manny Villanueva (*ZIP code: 90304)*

1248. Manfred Antar (*ZIP code: 94122)*

1249. Michael Roosevelt (*ZIP code: 94104)*

1250. Merlin Freitag (*ZIP code: 21423)*
Merlin

1251. Marc Umeda (*ZIP code: 91711)*
This decision is simple: SoCal steelhead are so limited in number, that there is likely no other species as endangered. Add them to the California endangered species list.

1252. Mark Martin (*ZIP code: 92336)*
We need to do everything we can to save steelhead in Southern California. Thank you!

1253. Mareencita Ramos (*ZIP code: 85142)*

1254. Margarita Lopez-Pelayo (*ZIP code: 91342)*

1255. Marie Martin (*ZIP code: 93030)*

1256. Marissa Cupta (*ZIP code: 94920)*

1257. Marjorie Betz (*ZIP code: 92649)*

1258. Mark Moskowitz (*ZIP code: 94507)*

1259. Mark Pinard (*ZIP code: 95762)*

1260. Mark Triska (*ZIP code: 94550-7333)*

1261. Mark GANGI (*ZIP code: 91208)*
One of the most important challenges CalTrout is taking on. Also hard fully grasp the magnitude of how important this is for problems and challenges we will face in the future and the possibility of this Steelhead's role in vibrant, thriving changing ecosystem.

1262. Mark Alexander (*ZIP code: 93003)*

1263. Mark Box (*ZIP code: 94025)*

1264. Mark Utter (*ZIP code: 92075)*

1265. Mark Rangel (*ZIP code: 91733)*

1266. Mark Salcido (*ZIP code: 95032)*
I support

1267. Mark Lesko (*ZIP code: 95112)*
The inaction of the government to save our wildlife is deplorable

1268. Marlee Johnson (*ZIP code: 90245)*

1269. Marlon Harrington (*ZIP code: 91710)*

1270. Marrina Nation (*ZIP code: 93546)*

1271. Marti Smith (*ZIP code: 91320)*
Thank you for your consideration of this request.

1272. Marty Reed (*ZIP code: 92014)*

1273. Mary Jochum (*ZIP code: 93117)*

1274. Mary Rose (*ZIP code: 93101)*

1275. Mary Hamilton (*ZIP code: 93420)*

1276. Maryn Marlow (*ZIP code: 93002)*

1277. Mary Renaker (*ZIP code: 90404)*

1278. Michael Shimokaji (*ZIP code: 92688)*

1279. Matthew Schenone (*ZIP code: 92662)* **1280.**

Mason Ciddio (*ZIP code: P7b 7b7)* **1281. Matt**

Berry (*ZIP code: 95959-9054)*

1282. Matt Cervantes (*ZIP code: 95630)*
Please do your part to save an important species in California.

1283. Matt Benton (*ZIP code: 90066)*

1284. Matthew Biggins (*ZIP code: 91105)*

1285. Matt Brown (*ZIP code: 94960)*

1286. Matt Crawford (*ZIP code: 90046)*

1287. Matt Davidson (*ZIP code: 91436)*

1288. Matt Kane (*ZIP code: 94116)*

1289. Matthew Clague (*ZIP code: PL9 7AZ)*

1290. Matthew Clark (*ZIP code: 90049)*

1291. Matthew Wright (*ZIP code: 94114-1453)*
Save the Trout!!!! Let Nature Thrive!

1292. Matthew Santana (*ZIP code: 93110)*
They need us now more then ever.

1293. Matthew A Little (*ZIP code: 93921)*

1294. MICHAEL WILSON (*ZIP code: 95448)*
protect SoCal steelhead

1295. Maximillian Marvin (*ZIP code: 92107)*
Steelhead are a keystone species and we must take every effort to ensure their existence for future generations. If we loose all our native wonders, appreciation for and conservation of California's unique species will decline! Thank you for your careful consideration

1296. Maya Callaway (*ZIP code: 90290)*
Save the trout! We need them !

1297. Maddie Duda (*ZIP code: 94610)*
Steelhead are an integral part of a holistic ecosystem that we rely on - please put resources to urgently prevent irreversible loss!

1298. Marcus Bole (*ZIP code: 95692-9501)*
Senior Fisheries Biologist, Bole & Associates, Wheatland, CA 95692

1299. Mike Brinkley (*ZIP code: 97405)*

1300. Michael Caparelli (*ZIP code: 90039)*

1301. Michael Cerny (*ZIP code: 94127)*
I live in San Francisco, CA, up in the Mt. Davidson neighborhood. There is a nice mountain called, Mt. Davidson where there is a beautiful eucalyptus forest that could definitely use some restoration work. I already picked up a bag bottle's, can's, and trash from the mountain. It's time to help the Golden State Poppy Orchard by pulling up the unwanted flower's and , weed's.

1302. Mark Cottrell (*ZIP code: 95948)*

1303. Scott McCardell (*ZIP code: 92065)*

1304. Kevin Mclarney (*ZIP code: 95030)*

1305. michael clifton (*ZIP code: 92123)*

1306. michael clifton (*ZIP code: 92123)*
Lets get endangered species status for this fish (and their habitats) as soon as possible!!

1307. Carol McMillan (*ZIP code: 95945)*

1308. Nadine McMillan (*ZIP code: 94602)*

1309. robert mcparland (*ZIP code: 93726)*

1310. Michael Culcasi (*ZIP code: 95125)*

1311. Malachi Curtis (*ZIP code: 95436)*

1312. Michael Driessnack (*ZIP code: 90016)*

1313. Megan Marble (*ZIP code: 93003)*
Please list the California steelhead on the endangered species act these fish need to be protected

1314. Melanie Abrams (*ZIP code: 94949)*

1315. Melissa Racklyeft (*ZIP code: 92011)*

1316. Melissa Bumstead (*ZIP code: 91307)*
I live in SoCal and this is important to me.

1317. Michael Fraser (*ZIP code: 94703)*

1318. maurice walcott (*ZIP code: 94019)*

1319. Mario Ontal (*ZIP code: 90027)*
Please.

1320. Mark Green (*ZIP code: 95409)*
Signing on behalf of Calwild.

1321. Michael Zubak (*ZIP code: 92882)*

1322. Melville Behrendt (*ZIP code: 94610)*

1323. MacKenzie Hein (*ZIP code: 91301)*
I've been trying to think of ways that I can do something about problems that are going on in the world. Signing on to this petition and letting officials know that people care about maintaining California's wildlife seems like the least that I could do.

1324. Michael Meneses (*ZIP code: 91340)*
We must protect our relatives who have done their part to care for this land we call home.

1325. Michael Meyer (*ZIP code: 92260)*

1326. Mike Zeug (*ZIP code: 91301)*
Lets bring these fish back to their home, my home!

1327. Michael Wittman (*ZIP code: 91360)*

1328. Michael Coleman (*ZIP code: 90042)*

1329. Michael Colemab (*ZIP code: 90042)*

1330. michael sieber (*ZIP code: 94062)*

1331. Michael Wellborn (*ZIP code: 92708)*

1332. Michael Meko (*ZIP code: 93420)*

1333. Michael Gassen (*ZIP code: 94941)*

1334. Michael McGannon (*ZIP code: 95003)*

1335. Michelle Reis (*ZIP code: 94619)*

1336. Michelle Velarde (*ZIP code: 94019)*
This is really important.

1337. Midi Berry (*ZIP code: 91301)*

1338. Michael Jon Bessie (*ZIP code: 92110)*
Please let’s reach our goal with signatures

1339. Michael Keller (*ZIP code: 92691)*

1340. Michael Hodgkinson (*ZIP code: 94549)*

1341. Michael Dyer (*ZIP code: 95949)*

1342. Mike Bobbitt (*ZIP code: 95476)*

1343. mike donia (*ZIP code: 92373)*

1344. Charles Michael Edelstein (*ZIP code: 95670)*

1345. Michael Warner (*ZIP code: 90274)*

1346. Mike Pugh (*ZIP code: 93110-4506)*

1347. Mike Stivers (*ZIP code: 92010)*

1348. MIKE FERGUSON (*ZIP code: 92119)*
Let's protect what is here.

1349. Robin Mitchell (*ZIP code: 94530)*

1350. Larry Miller (*ZIP code: 94566)*

1351. Millie Strawn (*ZIP code: 94928)*

1352. Michelle Bowman (*ZIP code: 92024)*

1353. Karen Boyarsky (*ZIP code: 90025)*
We can's save species that have already been extinguished, but we can act to save the steelhead. PLEASE DO SO.

1354. Karen Davis (*ZIP code: 91759)*

1355. Gillian Jacobs (*ZIP code: 90211)*

1356. C P (*ZIP code: 93003)*
Habitat is going away, leaving these fish vulnerable. We need to protect them!

1357. Jessika Mitchell (*ZIP code: 91405)*

1358. Dave Loomis (*ZIP code: 59804)*
Fished for steelies in Malibu Creek and Ventura River in the 70s.

1359. Mike Gilroy (*ZIP code: 91914)*

1360. Michelle Jimenez (*ZIP code: 90255)*

1361. Martin Loomis (*ZIP code: 94588)*

1362. Mary Smith (*ZIP code: 95521)*

1363. Ian Wilson (*ZIP code: 93060)*
Keep up the good work!

1364. Mary Lou Rosczyk (*ZIP code: 92562)*
I am totally supportative of California Department of Fish and Wildlife's study report that Southern California's Steelhead Trout are deserving of protection under the California Endangered Species Act. However, it is not enough to name the trout endangered if their habitat is not also improved.

1365. Michael Marsden (*ZIP code: 94553)*

1366. Michael McDevitt (*ZIP code: 94952)*

1367. Marshall Kilduff (*ZIP code: 94117)*

1368. Michael Montero (*ZIP code: 95066)*

1369. Michael Morgan (*ZIP code: 91355)*

1370. Mark Silbernagel (*ZIP code: 93023)*
Absolutely necessary for the wellbeing of our watersheds for the future.

1371. Mary Stites (*ZIP code: 97217)*

1372. Michael Paisano (*ZIP code: 94601)*

1373. M Obrien (*ZIP code: 94610)*

1374. Monica Campbell (*ZIP code: 91325)*

1375. Rachel Lu (*ZIP code: 90703)*

1376. John Wymore (*ZIP code: 92307)*

1377. Brian Bennett (*ZIP code: 98023)*

1378. Molly Morse (*ZIP code: 93103)*

1379. Molly Russ (*ZIP code: 93101)*

1380. Monique Tejada (*ZIP code: 91331)*

1381. Frank Toriello (*ZIP code: 96064)*

1382. Monique Streit (*ZIP code: 95945)*

1383. Monique Streit (*ZIP code: 95959)*

1384. Thomas Moore (*ZIP code: 95070)*

1385. Tobias Moore (*ZIP code: 97302)*

1386. Morgan Collings (*ZIP code: 95928)*

1387. Morgan Sarno (*ZIP code: 9140)*

1388. Brandon Beck (*ZIP code: 96148)*
Save the steelhead

1389. Marisol Pantoja (*ZIP code: 93313)*

1390. Michael Parrett (*ZIP code: 94901)*

1391. Michael Peratis (*ZIP code: 91311)*

1392. Peter Steinberg (*ZIP code: 91302)*
Save the Steelhead

1393. Mitchell Randall (*ZIP code: 98166)*

1394. Sergio Godoy (*ZIP code: 92703-1610)*

1395. Robert Gregg (*ZIP code: 93004)*

1396. MATTHEW R CLARK (*ZIP code: 94018-0652)*

1397. Larry Hardesty (*ZIP code: 93003)*

1398. Michael Riney (*ZIP code: 96067)*

1399. Dr. C.Mark Rockwell (*ZIP code: 93111)*
These fish have long been on the brink of extinction, and conditions are worse now than ever. It is a must that the state lists them under the CESA. Now is the time to act.

1400. Maricela Rodriguez (*ZIP code: 91010)*

1401. Judy Garrett (*ZIP code: 93454)*

1402. Tate Bankston (*ZIP code: 97701)*

1403. Anthony Castillo (*ZIP code: 90805)*

1404. Michael Welch (*ZIP code: 92092)*

1405. Jane Miller (*ZIP code: 93010)*

1406. Mark Borchert (*ZIP code: 91011)*
Save our steelhead; save our state; save our planet!

1407. Mike Schilling (*ZIP code: 97128)*

1408. Matthew Leyden (*ZIP code: 92596)*

1409. Mark Smithers (*ZIP code: 94574)*
Save ALL FISH. I don't want to eat non-wild farmed fish. That's like eating green pills from the book Soylent Green. Yuck.

1410. Mark Speer (*ZIP code: 95442)*
Put Southern California steelhead on the endangered species act.

1411. Michael Stone (*ZIP code: 90274)*

1412. Michael Tomlinson (*ZIP code: 95818)*

1413. Bill Hughes (*ZIP code: 29508)*
Bring wild fish back and protect them from 'fishers' who want to only eat them.

1414. Melissa Patten (*ZIP code: 95816)*
These fish are incredibly threatened and as a biologist I know how important listing status is for protecting a species. I support the endangered listing status!

1415. Mark Wilhelm (*ZIP code: 90266)*

1416. Mike Woods (*ZIP code: 89706)*

1417. Scott Carden (*ZIP code: 93001)*

1418. Myron Grossman (*ZIP code: 91104)*

1419. Naia Wilcox (*ZIP code: 93117)*

1420. Nancee Murray (*ZIP code: 95818)*
Southern California steelhead are on the brink of extinction and deserve CESA protection. Thank you.

1421. Nancy Pak (*ZIP code: 94598)*

1422. Nancy Ihara (*ZIP code: 95521)*

1423. Nick Deaver (*ZIP code: 94109)*

1424. Natalie Sampo (*ZIP code: 92337)*
save the steelhead!

1425. Nathan Sells (*ZIP code: 95124)*

1426. Nathaniel Ramos (*ZIP code: 95076)*

1427. Mayl (*ZIP code: 33301)*

1428. nathan charpentier (*ZIP code: J2c 6y2)*
protect our home water

1429. Noah Ben-Aderet (*ZIP code: 92037)*

1430. Nancy Babbott (*ZIP code: 93111)*

1431. Nathaniel Whitmill (*ZIP code: 37302)*

1432. neal hoffberg (*ZIP code: 98027)*
The steelhead must be saved.

1433. Neara Russell (*ZIP code: 91103)*

1434. William Flanders (*ZIP code: 91016)*

1435. Nenetzin Rodriguez (*ZIP code: 91702)*

1436. Cris Caldwell (*ZIP code: 95962)*
Please help

1437. Nicholas Barclay (*ZIP code: 96150)*

1438. Nicholas Tumbale (*ZIP code: 92626)*

1439. Nicolas Watson (*ZIP code: 92101)*

1440. Nicole Schager (*ZIP code: 92509)*
I wasn't confident that I would ever seen a SoCal steelhead, but I saw a few in 2017 in Santa Barbara and LA Counties. They are magnificent fish. I was once told that losing a species is like losing a letter in the alphabet. You lose information about life. They might not have huge numbers in Socal, but they are an important reminder of what our waterways used to be. They are a symbol of resilience.

1441. Levon Nishkian (*ZIP code: 94114)*

1442. Nabil Lachgar (*ZIP code: 94109)*

1443. Nicholas Hudson (*ZIP code: 95616)*

1444. Nick Loizeaux (*ZIP code: 94706)*
This is a no-brainer. Use Federal infrastructure funding to fix impediments to upstream migration. Crack down on unpermitted water diversions/aquifer pumping! Give these fish a chance!!!

1445. Noah Herbst (*ZIP code: 95928)*

1446. Noah Herbst (*ZIP code: 92024)*

1447. Garett Gentry (*ZIP code: 94114)*

1448. Kevin McRoberts (*ZIP code: 90278)* **1449.**

Nolan Le Vine (*ZIP code: 95928)* **1450. Jim**

Nomura (*ZIP code: 91106)*

1451. Colin Farrell (*ZIP code: 93003)*
This is the last chance for these fish. They have little habitat left land if there is any hope they need as many protections as possible.

1452. Nico Reyes (*ZIP code: 91106)*

1453. Nancy Krupa (*ZIP code: 92627)*

1454. Nicole Rosenberg (*ZIP code: 93950)*

1455. Nicholas Salle (*ZIP code: 92879)*

1456. Nancy Shrodes (*ZIP code: 90401)*

1457. Nathaniel Wilson (*ZIP code: 90404)*

1458. Mike Ricca (*ZIP code: 92656)*

1459. Orion Good (*ZIP code: 96114)*

1460. Donna Oliver (*ZIP code: 94904)*

1461. Olivia Henderson (*ZIP code: 95973)*

1462. Olivia VanDamme (*ZIP code: 94132)*

1463. Olivia Johnson (*ZIP code: 90034)*

1464. Oliver McGibben (*ZIP code: 93105)*

1465. Sierra Paliaga (*ZIP code: 95522)*

1466. Olwen Thomas (*ZIP code: SK15 3AD)*
I may not live in California but have visited your beautiful state from the UK and intend to as often as I can, it breaks my heart that this beautiful fish could be extinct in the near future, my bucket list number one is to travel the states to fish for all the trout species as they are my favourite fish and conservation is extremely important to me, please please list them on the endangered species list and help efforts to save them from extinction. Thank you deeply from the bottom of my heart, kind regards Olwen

1467. Omar Crook (*ZIP code: 90043)*
Save the steelhead!

1468. Mary Larson (*ZIP code: 90807)*
It's critical that this iconic keystone species be given full protection by the Fish & Game Commission. For southern California coastal watersheds, southern steelhead are the equivalent of a canary in a coal mine. Their presence in our watersheds is indicative of a healthy ecosystem that can sustain aquatic, terrestrial and avian wildlife.

1469. Mark D Brock (*ZIP code: 95252)*
Save the Steelhead!!

1470. Patricia Kowalski (*ZIP code: 92130)*

1471. Oli (*ZIP code: 14512)*

1472. Peter Abrams (*ZIP code: 94949)*
Steelhead are an indicator species!

1473. Hugo Montoya (*ZIP code: 94612)*

1474. Robert Leedy (*ZIP code: 94903)*

1475. KYLE DANIELS (*ZIP code: 90274)*
Let's all work to restore nature's balance for our future generations!

1476. Charles Page (*ZIP code: 94022)*

1477. Page Schult (*ZIP code: 90066)*

1478. Ralph Pagter (*ZIP code: 92706)*

1479. Paige Horvate (*ZIP code: 53202)*

1480. Benjamin Green (*ZIP code: 87025)*

1481. Pam Gates (*ZIP code: 93455)*

1482. Pam Nelson (*ZIP code: 92086-9275)*
steelhead habitat is good for all wildlife

1483. Stuart Park (*ZIP code: 96002)*
These steelhead need all the help they get !!!

1484. PATRICK BURKE (*ZIP code: 93004-2894)*

1485. Patrick McKee (*ZIP code: 98040)*

1486. Patricia Kline (*ZIP code: 92284)*

1487. Patrick Owen (*ZIP code: 91977)*

1488. Paul Jablon (*ZIP code: 90049-6610)*

1489. Paul Backes (*ZIP code: 91214)*
Save the trout for future generations to enjoy.

1490. Paul Bettelheim (*ZIP code: 94549)*

1491. Paul Kelsey (*ZIP code: 92679)*
I implore the state to affirm the listing of Southern Steelhead as endangered, and then make real progress ASAP to save this critical species from extinction!

1492. Paul Kretschmer (*ZIP code: 94044)*

1493. Paul Curtis (*ZIP code: 92029)*

1494. Dave Moore (*ZIP code: 91387)*

1495. Peter Moyle (*ZIP code: 95616)*

1496. Patrick Bock (*ZIP code: 95928)*

1497. Paul Jennings (*ZIP code: 91105)*
Restoring steelhead populations would be a wonderful thing to do, and small steps can make it start to happen.
1498. Phil Costic (*ZIP code: 91343)*

1499. Patrick Cousens (*ZIP code: 94706)* **1500.**

Paige A DeCino (*ZIP code: 92008)* **1501. Penny**

McLain (*ZIP code: 81505)*
I live out-of-state now but come to CA to fly fish with friends, Penny McLain

1502. Penny A Marrs (*ZIP code: 94513)*
Bring back the fish that belong here!

1503. Michael Rettie (*ZIP code: 94501)*
Please save our wild heritage.

1504. Pete Beck (*ZIP code: 95203)*

1505. Peter Galli (*ZIP code: 94960)*

1506. Peter Nistler (*ZIP code: 90505)*

1507. Peter Evans (*ZIP code: 94949)*

1508. Henry Castellanos (*ZIP code: 93101)*

1509. Peter Klingman (*ZIP code: 97223)*

1510. peter dorn (*ZIP code: 98102)*
we need to do what it takes to protect these iconic native fish

1511. Peter Steinhart (*ZIP code: 94301)*

1512. Peter Xander (*ZIP code: 92391-0502)*
In 1984, I was a staff member working on permits in Malibu, and the Tapia Water Treatment Plant came in for a permit to quadruple the size of their treatment capacity from 2 million gallons per day to 8 mgd. I conditioned the permit to require tertiary treatment of the effluent and to discharge all of the water into Malibu Creek, in order to protect the southern steelhead spawning and smolt rearing habitat in Malibu Lagoon and the lower part of Malibu Creek>

Even with Rindge Dam blockig th vast majority =of spawning habitat in Malibu and Cold Creeks, my brother caught and released over 3 dozen smolts EACH the year before, in February, 1983, during a break in that El Nino winter. We used 2# test line, ultralight gear, and 1/32 oz lures with barbless hooks to release all fish we caught. All were smolts, fresh in from the sea, with sea lice still attached to the anal fins -- what Rogue River steelheaders call "half-pounders. My brother hooked and later lost a 6 to 18 lb steelhead that was spawned out and resting, or else it would have towed him out to the Channel Islands.

It is shocking that 40 years after I took that action on the permit that kept the southern steelhead population ALIVE during droughts in the late1980s and early 1990s droughts, in which all streams dried up but for Malibu Creek, that the 75+number of fish my brother caught and released that day represents about the total size of the population of southern steelhead in much of its remaining habitat.

IMMEDIATE protections are needed. The Rindge Dam MUST be removed, the natural sand transport system restored, and the full watershed be available for upstream spawning and rearing habitat. That was my dream and fervent wish in 1984; it saddens and ticks me off that 40 years later, not enough has happened to restore Malibu Creek and other passage-blocking manmade obstructions nd save the species.

Saving the southern steelhead population, with their unique adaptations to the harsh conditions now found in an urbanized, global warming, screwed-up planet, MUST be saved. That very genetic diversity has kept scattered populations of ALL steelhead -- within a few years of reproduction, those survivors can pass on their genes and adaptations to a changing world and altered environment. But they PERSIST, barely, and we MUST protect them for future generations.

I want to show my young grandsons what it was like to catch and released unharmed steelhead that their PAPA had tried to save 4 decades ago. That was one of my very proudest achievements, but a spine injury eight years later ended my career as a resource planner, biologist, and inter- governmental agency negotiator whose Mitigation and Monitoring Program policy I wrote in 1988 to increase the amount of restored riparian habitat on a 4:1 basis and a 5-year monitoring program to ENSURE the viability of restored hanitat is STILL used by the State of California for all projects requiring the preparation of a Environmental Impact Report. The U.S. Fish and Wildlife Service and EPA used those same policies for projects all across the nation, until the SCTUS struck those down on a now disgustingly familiar 6-3 right-wing antigovernment Supreme Court vote that removed virtually ALL protected wetlands through the US, setting the stage for a level of environmental destruction not seen since the Industrial Revolution.

YOU can show the nation how resource management and endangered species protection can and MUST be done. Human are that rare species that does all it can to kill itself off, only instead of lemmings diving into the sea to drown, we're killing the entire damn planet. WE have to stand up for what's right. Please give the southern steelhead the protection it needs under California laws and regulations. Show the nation how to cope with changes wrought by urbanization, pollution, habitat loss, and pure reckless stupidity and show people even a critical "canary in the coal mine" species like the southern steelhead CAN be protected before their extirpation.

The choice is easy: Do the right thing, or kill off another valuable species through man's greed and stupidity. I'd like to think that we here i California are some of the remaining true keepers of the faith: We try to do the right thing, even when the situation is critical. THIS is one of those moments in history when you can DO the right thing.

1513. Peter Xander (*ZIP code: 92391)*
Cont….. When on the staff of the CA Coastal Commission's office in Long Beach, I conditioned a permit for the expansion of the Tapia Sewage Treatment Plant. Its wastewater came from out of the Malibu Creek watershed but discharged into upper Malibu Creek. They expanded from 2 mgd to 8, and I required upgrading to tertiary treatment and to discharge all treated effluent into Malibu Creek. This action made Malibu Creek a perennial stream. When droughts i the late 1980s and early 1990s dried up all other streams from Pt Conception to below the Mexican border, Malibu Creek was THE habitat of last resort for the southern steelhead. The NMFS action to declare populations of steelhead threatened or endangered credited that single permit action for keeping the southern steelhead from extinction.

You have the power to increase the protections for this critically endangered population. Please declare them endangered within the meaning of state law and protect this important population. Steelhead and salmon species and populations all have adaptations specific to their home habitats, and the massive introduction of hatchery-created monoculture "factory" rainbow trout has been one of the greatest threats to species and subspecies of trout and salmon species. Yet this endangered species still clings to life in heavily populated southern California and the devastating alteration to native habitats.

It is YOUR charge, your responsibility, to protect this endangered population of steelhead. Please DO so.

1514. Peter Judkins (*ZIP code: 80305)*

1515. An anonymous signer (*ZIP code: 93454)*

1516. Philip Swett (*ZIP code: 94960)*
Save the steelhead.

1517. Pamela Reagan (*ZIP code: 94044)*

1518. Joseph Knowles (*ZIP code: 91107)*

1519. Milton Reynolds (*ZIP code: 94577)*
Times is wasting, but there are actions we can take to protect this cornerstone species. An important first step in the process of saving these amazing fish is getting them listed as endangered. With this protection, we can begin the process of habitat restoration that will allow these fish an opportunity to rebound. Nature work when we allow it to do so. Please support the listing of the Southern California Steelhead so that future generations can witness this amazing fish and that we can do our part to repair some of the harms we have visited upon this species and its native environment.

1520. Franklin P Johnson Jr. (*ZIP code: 94301)*

1521. Brad Gibson (*ZIP code: 90814)*

1522. Robert Piziali (*ZIP code: 94515)*
Please protect Southern California steelhead

1523. Priscilla Klemic (*ZIP code: 91401)*

1524. Patrick McGaugh (*ZIP code: 92507)*

1525. Paul Lester (*ZIP code: 95632)*

1526. Phil Martin (*ZIP code: 97703)*

1527. Paul Martin (*ZIP code: 90272)*

1528. John Tobin (*ZIP code: 91107)*

1529. Matt Friedman (*ZIP code: 95401)*
Save the fish!!

1530. Roxanne Caudill (*ZIP code: 93536)*

1531. Henry Poett (*ZIP code: 59854)*

1532. Ryan Spaulding (*ZIP code: 95503)*

1533. Douglas Daniels (*ZIP code: 93455)* **1534.**

Patrick Shannon Sr. (*ZIP code: 94610)* **1535. Paul**

Cooley (*ZIP code: 90232)*

1536. Bernie Ecker (*ZIP code: 91335)*

1537. Erica Poppen (*ZIP code: 93446)*

1538. Priscilla Torres (*ZIP code: 91601)*

1539. Kevin Allen (*ZIP code: 94517)*

1540. Josh Pryor (*ZIP code: 92675)*

1541. Philip Salibi (*ZIP code: 95005)*

1542. Paul Finkle (*ZIP code: 94904)*

1543. Pamela Smithers (*ZIP code: 94574)*

1544. Phil Starke (*ZIP code: 95120)*

1545. Peter Kim (*ZIP code: 91307)*

1546. Rick Hordin (*ZIP code: 96150)*
It's rather pathetic that we don't just shut down all salmon & steelhead fisheries for next 5 years, and then open them - say every 3 years - for small windows until a quantitative resurgence is realized.

1547. Carrie Barlow (*ZIP code: 94549)*
Save the fish!

1548. Gina Kelley (*ZIP code: 94062)*
Let's get this
done!!
Gina Kelley

1549. Daniel Dillinger (*ZIP code: 95765)*
Let's work to get Southern Steelheads back!

1550. Peter Weinberger (*ZIP code: 90035)*

1551. Vanessa Perez (*ZIP code: 91387)*

1552. Julie Goldberg (*ZIP code: 90064)*

1553. Quentin Fulsher (*ZIP code: 92122)*

1554. Ronni Burgess (*ZIP code: 92311)*

1555. Rachel Bennett (*ZIP code: 95818)*

1556. Rachel (*ZIP code: 94044)*

1557. Rachel Kinnunen (*ZIP code: 94117)*

1558. J. Bruce Johnson, DDS (*ZIP code: 91011)*
Long overdue!

1559. michelle rainville (*ZIP code: 93101)*
There is no time to waste, please list Southern California Steelhead Trout as an Endangered Species without delay, so that actions can begin to save them!

1560. Ralph Hinton (*ZIP code: 96080)*
Seems obvious

1561. Mike Irwin (*ZIP code: 93101)*

1562. Ramilo Delos Reyes (*ZIP code: 91355)*
1563. Ramona Garcia (*ZIP code: 91355)*

1564. Lazara Ramos (*ZIP code: 94110)*

1565. Randell Gribben (*ZIP code: 95608)*
Yes, I lived in Oceanside CA, and on a few occasions seen the steelhead in 2 marine corps base creeks

1566. randy bender (*ZIP code: 93314)*

1567. Joel Rawlins (*ZIP code: 92653)*
Once they are gone, they are gone.

1568. David Raymaker (*ZIP code: 95037)*
I support adding Southern CA Steelhead to the CA Endangered Species Act. The loss of steelhead and the environment they thrive is a direct result of human impact on the ecosystem. Time to reverse course and do our part to save the steelhead, cleanup the ecosystem and return the steelhead to its once thriving levels.

1569. Ron Zigelhofer (*ZIP code: 95667)*

1570. Roger Backlar (*ZIP code: 93065)*

1571. Rich Moore (*ZIP code: 94402)*
Here's to protecting the Southern Steelhead and to ensuring healthy waterways throughout California.

1572. Dick Neuman (*ZIP code: 87107)*

1573. Robert Brodberg (*ZIP code: 95616)*

1574. Robert Burks (*ZIP code: 83714)*

1575. Robert Abbott (*ZIP code: 95492)*

1576. Robert Caron (*ZIP code: 96150)*

1577. Danielle Picciano (*ZIP code: 91304)*

1578. Ron Coulter (*ZIP code: 93923)*
Please save the southern steelhead species. Put them under the ESA and clean up the southern streams and rivers.

1579. Richard Spott (*ZIP code: 59715-8705)*

1580. Robert Woolery (*ZIP code: 91362-3516)*

1581. Darrell Boyle (*ZIP code: 95032)*

1582. Ronald Dean (*ZIP code: 90272)*

1583. Randy Klein (*ZIP code: 95521)*

1584. Robert Leedy (*ZIP code: 94903)*

1585. Reagan Smail (*ZIP code: 94602)*

1586. Becca Fernandez (*ZIP code: 90640)*
Save the truth! I _ fish

1587. Rebecca Williams (*ZIP code: 94568)*

1588. Ralph Barrett (*ZIP code: 95628)*

1589. Chad Roberts (*ZIP code: 95617)*

1590. STEVE SCHRAMM (*ZIP code: 94952)*

1591. Reid Blaich (*ZIP code: 93001)*

1592. Rob Kilbourne (*ZIP code: 95667)*

1593. Reoh Darwell (*ZIP code: 92021)*
These fish once swam thru the valley behind my house. They dont anymore, but could return one day. They need the protection that could enable that salvation.

1594. Ray Evans (*ZIP code: 93110)*

1595. Richard Gienger (*ZIP code: 95589)*
& on behalf of Forests Forever

1596. Suzanne Rhoades (*ZIP code: 89439)*

1597. Rob Hutsel (*ZIP code: 92106)*

1598. Grant Volk (*ZIP code: 95765)*

1599. Rich Huddleston (*ZIP code: 94010)*

1600. Richard Miller (*ZIP code: 95959)*

1601. Richard Favela (*ZIP code: 91786)*

1602. Richard Harvey (*ZIP code: 93446)*

1603. Richard Harrington (*ZIP code: 97045)*

1604. Richard Roggia (*ZIP code: 95020)*

1605. Richard Riley (*ZIP code: 91711)*

1606. Matt Richardson (*ZIP code: 94123)*
We must do everything we can now to protect these native water diamonds and all State biodiversity esp given accelerating climate change

1607. Rich Burns (*ZIP code: 92886)*

1608. Charles Criswell (*ZIP code: 95062)*

1609. Richard Fricke (*ZIP code: 91405)*

1610. richard robinson (*ZIP code: 92021)*
supporting anything to protect pur fisheries.

1611. Rick Wieloh (*ZIP code: 83001)*
Please work to save and restore S CA steelhead.   Congrats on Klamath reatoration win

1612. Rick Lee (*ZIP code: 96817)*

1613. Rick Manley (*ZIP code: 92110)*
How fabulous it would be to see Steelhead in our river!

1614. Rick Price (*ZIP code: 92024)*

1615. Lee Ricks (*ZIP code: 59602)*
Please list the Southern California steelhead on the state's endangered species list aid this iconic fish's recovery.

1616. Christy Wheatley (*ZIP code: 95521)*

1617. Trevor Ritter (*ZIP code: 91106)*
Please let's save the Steelhead!

1618. Judith Stauffer (*ZIP code: 93427)*

1619. Robert Zasoski (*ZIP code: 95616)*

1620. Richard Kenvin (*ZIP code: 92102)*
Protect watersheds.

1621. Robert Bettinger (*ZIP code: 95616)*

1622. Ryan Hinshaw (*ZIP code: 95468)*
Please protect these fish at all costs

1623. Ron Kammann (*ZIP code: 94115)*

1624. Richard Luczyski (*ZIP code: 91104)*

1625. richard yamasaki (*ZIP code: 91731)*

1626. Rick Macala (*ZIP code: 95608)*

1627. Robert Matlock (*ZIP code: 92104)*

1628. Roy Hedin (*ZIP code: 95519)*

1629. Ron Midyett (*ZIP code: 93420)*

1630. Robert Menard (*ZIP code: 94024)*
Please save the Southern Steelhead

1631. Robert Oliver (*ZIP code: 94904)*

1632. Richard Morrison (*ZIP code: 94904)*

1633. Ronald Yoshiyama (*ZIP code: 95616)*
Southern Steelhead are the southernmost anadromous salmonid in North America and are unique.

1634. Neil Jay Mendoza (*ZIP code: 94590)*

1635. John Gross (*ZIP code: 97478)* **1636.**

Robby O'Hara (*ZIP code: 90290)* **1637. Robert**

Crompton (*ZIP code: 95010)*

1638. Robert Fletcher (*ZIP code: 93110)*
SAVE OUR NATIVE STEELHEAD!!!

1639. Robert Anderson (*ZIP code: 94114)*

1640. Robert Peterson (*ZIP code: 97219)*

1641. Robert Yin (*ZIP code: 92037)*

1642. Bob Zimmerman (*ZIP code: 93105)*

1643. Robin Mccormack (*ZIP code: 91602)*
Save the steelhead!

1644. Rocky Taylor (*ZIP code: 97537)*

1645. Robert Roff Barnett (*ZIP code: 95432)*
Our rivers and the fish and wildlife in them are part our heritage that we cannot afford to loose. We owe it to our children and grandchildren to leave them an intact and sustainable environment that they can enjoy and leave intact for their children and grandchildren .

1646. Ron Gregg (*ZIP code: 92675)*
I support saving the trout and steelhead and support protecting Steelhead under CESA. I can volunteer to help, I live in San Juan Cap near 3 of the projects.   What can I do ?

1647. Ron Merkord (*ZIP code: 93015)*

1648. Rose Lynch (*ZIP code: 95926)*

1649. Rosemary Evans (*ZIP code: 90815)*

1650. Rosi Dagit (*ZIP code: 90290)*

1651. Ross Damman (*ZIP code: 90032)*

1652. Ross Heckmann (*ZIP code: 91006)*

1653. KATHLEEN SCHARTZ (*ZIP code: 93455)*

1654. tom fahey (*ZIP code: 95667)*
Don’t let the fish die off

1655. Antonio Rovira (*ZIP code: 66230)*
A. Rovira

1656. Kathleen Berridge (*ZIP code: 95817)*

1657. Roy LITTLE (*ZIP code: 94920)*
I remember Malibu Creek in the 80's. The LA Times ran pictures of steelhead caught in the Creek. It's not too late.

1658. Ryan Poff (*ZIP code: 95361)*

1659. Richard West (*ZIP code: 94611)*

1660. Robert Silva (*ZIP code: 95252)*

1661. Randy Renick (*ZIP code: 91103)*

1662. Rick Martinez (*ZIP code: 91701)*

1663. Robert Giusti (*ZIP code: 95124)*

1664. Ryan Waldrep (*ZIP code: 28704)*
Save Southern Steelhead and their generic diversity!

1665. Robert Yeager (*ZIP code: 90291)* **1666.**

Ron Tatsui (*ZIP code: 91001)* **1667. Rebecca**

Ramirez (*ZIP code: 90401)*

1668. Rich Terwilliger (*ZIP code: 95742)*

1669. Ruben Alarcon (*ZIP code: 93003)*

1670. Luis Rincon (*ZIP code: 90031)*

1671. Kevin Foley (*ZIP code: 92865)*

1672. Bradley Upton (*ZIP code: 94510)*

1673. Bonnie Randall (*ZIP code: 91381)*

1674. Russell Quistgard (*ZIP code: 961500)*

1675. Ruth Kilday (*ZIP code: 91377)*

1676. Rhys Dapar (*ZIP code: 95066)*

1677. Robert Vogt (*ZIP code: 95501)*

There are no excuses for allowing this species to become extinct. Please do all you can to not let this happen

1678. An anonymous signer (*ZIP code: 93160)*

1679. Ralph Waycott (*ZIP code: 90265)*

1680. Richard Wegman (*ZIP code: 93023)*
Please save our Steelhead!!

1681. Dagwood Smithers (*ZIP code: 92399)*

1682. Ryan Blaich (*ZIP code: 93001)*
I spent a year monitoring populations of Southern California steelhead populations and it was quite apparent that any of these populations are hardly stable. Without proper listing and funding these incredible fish will disappear from places they've called home for thousands and thousands of years.

1683. Ryan Johnson (*ZIP code: 84103)*
Please save the steelhead

1684. Ryan Hoguet (*ZIP code: 94117)*
Yes please steelies

1685. RYAN HITCHINGS (*ZIP code: 93238)*

1686. Ryan Kosh (*ZIP code: 95662)*
Love these fish! Let's do what we can to keep them, including restoring habitat and removing useless dams like Matilija.

1687. Ryan Bullen (*ZIP code: 80204)*

1688. Rylee Walker-patterson (*ZIP code: 96080)*

1689. Stacy Fortner (*ZIP code: 91354)*

1690. Spencer Anenberg (*ZIP code: 91362)*

1691. Sean Starr (*ZIP code: 93312)*

1692. Sabrina Nelson (*ZIP code: 94619)*

1693. Sabrina Lopez (*ZIP code: 91702)*

1694. Sage Boek (*ZIP code: 95472)* **1695.**

Omar A Saleh (*ZIP code: 93110)* **1696. Sam**

Yee (*ZIP code: 95693)*
stop farming saline desert soils to save water for native salmon & steelhead

1697. Sam Norris (*ZIP code: 93923)*

1698. Samantha Luevano (*ZIP code: 90660)*

1699. Samuel Thomas (*ZIP code: 91360)*

1700. Sam weiss (*ZIP code: 80303)*

1701. Medwin Peck (*ZIP code: 92646)*

1702. Sara Waters (*ZIP code: 94553)*

1703. Sarah Walton (*ZIP code: 96002)*

1704. Sarah Brooks (*ZIP code: 95560)*
Please protect these amazing fish!

1705. Sarah Kesty (*ZIP code: 92028)*

1706. Sarah Nava (*ZIP code: 93551)*

1707. Sarah (*ZIP code: 93001)*

1708. Sasha Burik (*ZIP code: 90034)*
Biodiversity is of the utmost importance to our continued existence on this planet.

1709. Esteban Atkinson (*ZIP code: 78526)*
Save the trout!

1710. Reilly Sauer (*ZIP code: 95062)*
This is too important

1711. Tandora Grant (*ZIP code: 92104)*

1712. steve baloff (*ZIP code: 94027)*

1713. Kristi KirkPatrick (*ZIP code: 93110)*
Do this now before it's too late...PLEASE!

1714. Cameron Carey (*ZIP code: 93117)*

1715. Sarah Hearon (*ZIP code: 93105)*

1716. Scott Bivens (*ZIP code: 92692)*

1717. Stephen Black (*ZIP code: 97754)*

1718. Scott Boller (*ZIP code: 91344)*

1719. Scot Butnd (*ZIP code: 93422)*
Save them!!!

1720. Shauni Calhoun (*ZIP code: 92585)*

1721. Sophia Cancelmo (*ZIP code: 93003)* **1722.**

Stephen Caplan (*ZIP code: 95125)* **1723. Shane**

Caudill (*ZIP code: 92395)*
Please help support this!

1724. Steve Curran (*ZIP code: 93546)*

1725. George Sutherland (*ZIP code: 92673)*

1726. Peter Scharnell (*ZIP code: 30024)*

1727. Joel Schilling (*ZIP code: 93514)*

1728. Jeanette Schulz (*ZIP code: 95618)*
Southern California Steelhead thrived in creeks since time immemorial providing a vital source of food for California Tribes. They are a good game fish today. This endemic fish deserves to be protected and listed so that we may enjoy seeing them in an improved ecosystem that benefits everyone.

1729. Elizabeth Schwegler (*ZIP code: 90804)*

1730. Samuel Cohen (*ZIP code: 94952)*
Steelhead a precious resource that shouldn't be lost to future generations. What's good for steelhead is good for riparian habitat and all the species including humans that use California's precious streams.

1731. Scot Gray (*ZIP code: 94510)* **1732. L**

Scott Clark (*ZIP code: 90066)* **1733. Scott**

Harada (*ZIP code: 92603)*

1734. Scott Bennett (*ZIP code: 35226)*

1735. Scott McLeod (*ZIP code: 95442)*

1736. John Moreno (*ZIP code: 96068)*
Save the damn fish!

1737. An anonymous signer (*ZIP code: 95432)*

1738. Syeve Croockewit (*ZIP code: 95833)*

1739. Steve Castles (*ZIP code: 92336)*

1740. Sam Dasher (*ZIP code: 95691)*

1741. steve demetor (*ZIP code: 92325)*

1742. Steve Demetor (*ZIP code: 92325)*

1743. charlene price (*ZIP code: 92037)*

1744. Barrett Edgar (*ZIP code: 95521)*

1745. Genell Fitch (*ZIP code: 95549)*
Please assist with survival of the Southern California steelhead.

1746. Sean O'Brien (*ZIP code: 94563)*

1747. Laura Bermudez (*ZIP code: 95691)*

1748. Makenzie Collins (*ZIP code: 98103)*
No animal should go extinct!

1749. Sebastien Ballesteros (*ZIP code: 90402)*

1750. Sebastian Vazquez (*ZIP code: 94547)*

1751. Abbie Sedillos (*ZIP code: 90275)*

1752. Sarah Flamm (*ZIP code: 49071)*

1753. Steven Esgate (*ZIP code: 91344)*

1754. Seth Blackamore (*ZIP code: 93514)*

1755. Seth Simchowitz (*ZIP code: 92651)*

1756. Stephen Fiduk (*ZIP code: 92708)*

1757. Steven Goodman (*ZIP code: 87506)*

1758. Stephanie Gebhardt Rath (*ZIP code: 90638)*

1759. Jack Cliff (*ZIP code: 92008)*

1760. Patrick Dunn (*ZIP code: 92084)*

1761. Shane Connolly (*ZIP code: 83340)*
The time is now please take action!

1762. Shane Stalling (*ZIP code: 97459)*
These fish are too special to not protect.

1763. Shane Yellin (*ZIP code: 92008)*

1764. Brianna Lopez (*ZIP code: 91702)*

1765. Shea Millan (*ZIP code: 92596)*

1766. Shellie Kirby (*ZIP code: 94563)*

1767. Sherry Butler (*ZIP code: 95928)*

1768. Shirley Lalicker (*ZIP code: 90250)*

1769. Lucie Simmons (*ZIP code: 93q)*

1770. Simon McMahon (*ZIP code: 59802)*

1771. Stephen Ferry (*ZIP code: 93111)*

1772. Sean Herring (*ZIP code: 92646)*
Save the southern steelhead!!

1773. Stephen Karr (*ZIP code: 95616)*

1774. Shawn Kelly (*ZIP code: 93001)*

1775. Scott Mills (*ZIP code: 92673)*

1776. SHARON MURO (*ZIP code: 92503)*
I support this petition.

1777. Mitchell Skpver (*ZIP code: 48002)*

1778. Steve Robb (*ZIP code: 94070)*

1779. Deirdre Black (*ZIP code: 90004)*

1780. Nils Slattum (*ZIP code: 91320)*

1781. Daryl Slawnikowski (*ZIP code: 92307)*
Save Southern California Steelhead and save are Watershed

1782. Stephen Kanne (*ZIP code: 90403)*

1783. Mario Rodriguez (*ZIP code: 90042)*

1784. Robert Watson (*ZIP code: 94566)*

1785. Sylvia Sykora (*ZIP code: 94611)*
How many more species will go to extinction because we fail to act? We must not allow this to happen to the Southern California Steelhead.

1786. Daniel Sullivan (*ZIP code: 96150)*

1787. Steve Merlone (*ZIP code: 94025)*

1788. Vincent Sereno (*ZIP code: 95223)*

1789. Christopher Berry (*ZIP code: 91208)*

1790. steve nelson (*ZIP code: 90274)*
We've lost Enuf of our past already and this would be a great shame!!

1791. Kevin Christian (*ZIP code: 91766)*

1792. Donna Lenahan (*ZIP code: 91103)*

1793. Chris Lewis (*ZIP code: 91741)*

1794. Cece Rubin (*ZIP code: 91361)*

1795. Omer Thompson (*ZIP code: 94037)*

1796. Steven Olivas (*ZIP code: 91104)*

As a southern CA trout angler it is extremely important to me that Southern CA steelhead are protected for future generations.

1797. Shelly Backlar (*ZIP code: 91304)*
No more extirpated species! Let's bring the steelhead back into our rivers and watersheds!

1798. Sophia McGibben (*ZIP code: 93105)*

1799. Sophie Loire (*ZIP code: 93022)*

1800. Jeanne Sparks (*ZIP code: 93455)*

1801. Spencer James (*ZIP code: 132"1 lucky Spur lane corona Ca)*

1802. Spencer Neumann (*ZIP code: 90402)*

1803. John Barrena (*ZIP code: 95503)*
The time is now to save this iconic Californian s subspecies. Let's make it happen for the benefit of all generations to come.

1804. Artin Marootian (*ZIP code: 91206)*

1805. Zachary Spotts (*ZIP code: 94521)*

1806. Steve Reizes (*ZIP code: 91403)*
Save the southern steelhead, an important part of our natural California ecosystem and under a century of pressure from urban centric non-nature flood control infrastructure.

1807. Steven Hager (*ZIP code: 92692)*
It is essential that maximum effort be applied to saving Southern California steelhead! Action is needed now!

1808. Steven Schlegel (*ZIP code: 90248)*

1809. Steve Seville (*ZIP code: 99224)*
List them, save the species

1810. Scott Shaffstall (*ZIP code: 92676)*
I grew up with these trout 25 years ago - now they're gone. Please bring them back so my kids can enjoy a future as rich as our past.

1811. Scott Smith (*ZIP code: 94526)*
Scott Smith

1812. Susan Trolle (*ZIP code: 06611)*

1813. Steve Nakawatase (*ZIP code: 97707)*

1814. Sean Solway (*ZIP code: 94960)*

1815. Stanley Ito (*ZIP code: 91007)*
-

1816. Joel Phillips (*ZIP code: 83833)*
Go Trout

1817. Stanley Ohara (*ZIP code: 95746)*

1818. Karen Hall (*ZIP code: 93060)*
Southern Steelhead are indigenous to So California and uniquely adapted to survive our rounds of heavy rains and drought. Please protect these incredible resilient fish, especially as it has taken decades to remove dams and other obstructions to thier native spawning grounds, inhibiting their annual migrations.

1819. John Sullivan (*ZIP code: 93105)*

1820. Jeff Bright (*ZIP code: 94103)*

1821. JOHN HALE (*ZIP code: 94560)*

1822. Kesley Gallagher (*ZIP code: 91361)*

1823. Stefan Gerard (*ZIP code: 94941)*

1824. Steve Fioretti (*ZIP code: 94025)*
Let's preserve this vital species! Extinction is forever!

1825. Stephen Schmidt (*ZIP code: 92107)*

1826. Steven Mar (*ZIP code: 91030)*

1827. Steven Cates (*ZIP code: 95831)*
Anadromous fish numbers continue to decline. Please take action to protect these fish.

1828. Steven Duever (*ZIP code: 78748)*

1829. Steven Raffin (*ZIP code: 95749)*
Save So. CA steelhead, as best as can be done....

1830. Steven Rudolf (*ZIP code: 06804)*

1831. Steven Ochoa (*ZIP code: 90031)*

1832. Steven Hoffman Hoffman (*ZIP code: 95014-1065)*

1833. Steven Bengis (*ZIP code: 92075)*

1834. Steve Williams (*ZIP code: 90291)*
As a Conservation Biologist for the RCDSMM, I've done snorkel surveys for these fish for 20+ years, and can attest that they are becoming increasingly rare and deserve protection with Endangered status.

1835. Steve Sturken (*ZIP code: 95133)*

1836. Larry Strauss (*ZIP code: 95946)*

1837. Stuart Grusin (*ZIP code: 90405)*
Please act and help us save the Southern California steelhead!

1838. Scott Yamamoto (*ZIP code: 93010)*

1839. Andrew Hall (*ZIP code: 90277)*

1840. Susan Swan (*ZIP code: 92101)*
I am counting on your leadership. We need to keep the steelhead alive.

1841. Sonia Fletcher (*ZIP code: 96067)*

1842. Susan Valle (*ZIP code: 91942)*
We must act urgently to prevent the irreversible loss of Southern California Steelhead!

1843. Susan Divine (*ZIP code: 92101)*

1844. Sherry Vatter (*ZIP code: 90034)*
Please protect the health and viability of California's river ecosystems. We deserve to inhabit an environment full of living things rather than dead human materials.

1845. Stephen Verigin (*ZIP code: 94510)*

1846. Scott Vogelsong (*ZIP code: 90045)*
If you work for fish and game and a steelhead species goes extinct on your watch…what was it for then?

1847. Steven Volski (*ZIP code: 90631)*
I support the efforts to save the steelhead population!!

1848. Steven Waterloo (*ZIP code: 94960)*

1849. Caleb Kleist (*ZIP code: 49801)*

1850. Hector Moreno (*ZIP code: 93065)*
SAVE THE TROUT!!!

1851. Steve Woodward (*ZIP code: 93111)*

1852. Sydney Martinez (*ZIP code: 91006)*

1853. Syl Arena (*ZIP code: 93446)*
Native species deserve our protection and stewardship.

1854. Sylvia Strike (*ZIP code: 90046)*
Today's society must take steps to protect this important species for our children and grandchildren. It is part of their heritage

1855. Tabasa Ozawa (*ZIP code: 90057)*

1856. Adam Franklin (*ZIP code: 95073)*

1857. Greg Takata (*ZIP code: 94024)*

1858. Cindy Mitchell (*ZIP code: 91790)*

1859. tami donnelson (*ZIP code: 95926)*

1860. Vincent Tang (*ZIP code: 90039)*
I support the listing of the Southern California steelhead on the endangered species list.

1861. Johanna Smith (*ZIP code: 95254)*

1862. Tara Saylor (*ZIP code: 93023)*

1863. Terry Roznos (*ZIP code: 90602-2703)*

1864. Tatiana Stanton (*ZIP code: 90043)*

1865. Thomas Woodman (*ZIP code: 93265)*
Southern waters are no less important than any other aquatic system in our beautiful state.

1866. Taylor Christenson (*ZIP code: 84404)*

1867. Taylor Gaw (*ZIP code: 94115)*

1868. Thomas BenzingI (*ZIP code: 95959)*
These fish need a chance to recover. Given the last couple years and additional moisture in Southern California with our help they might just have a chance.

1869. Taylor Bingaman (*ZIP code: 95682)*
Save the steelhead!!!

1870. William Krivan (*ZIP code: 95125)*
The work CalTrout and others have done persuasively show the crisis and the need to real action to save this importance species.

1871. Thomas Pelikan (*ZIP code: 93923)*

1872. Tina Brenza (*ZIP code: 93111)*

1873. Tyler Brewster (*ZIP code: 90603)*

1874. Trygve Sletteland (*ZIP code: 92652)*
We must not allow the Southern steelhead to go extinct as a species!

1875. Timothy Burr (*ZIP code: 92064)*

1876. Thomas Bush (*ZIP code: 94118)*

1877. Thomas Carnessale (*ZIP code: 92020)*

1878. Jeffrey Carr (*ZIP code: 95628)*

1879. CHALMER CAUDILL (*ZIP code: 92295)*
Use some common sense!

1880. Tom Carson (*ZIP code: 95135)*

1881. Tom Simmons (*ZIP code: 93101)*

1882. Daniel Eckhard (*ZIP code: 94960)*
Please do the right thing and protect our Southern California steelhead from extinction. You only get this one chance.

1883. Terry Sternberg (*ZIP code: 94939)*

1884. Terry Manson (*ZIP code: 92592)*

1885. Terry Welsh (*ZIP code: 92626)*

1886. Terry Saucier (*ZIP code: 91356)*
We must move quickly and decisively to save important native species - from the negative impacts of climate change, pollution, and disruption/destruction of habitat. We must protect the Southern California Steelhead and other species before they are gone forever. Future generations are depending on it!

1887. Tevin Schmitt (*ZIP code: 91350)*

1888. TREVOR FAGERSKOG (*ZIP code: 95747)*

This listing is long overdue. Please protect Southern Steelhead from extinction post haste with an endangered listing under CESA.

Thank You,
Trevor S. Fagerskog
Trout Unlimited California Council, Chair

1889. Terry Fernandez (*ZIP code: 93105-2410)*
Please help save this iconic species.

1890. Tony Frascotti (*ZIP code: 02116)*

1891. Barry Temple (*ZIP code: 92374)*

1892. Theresa Acerro (*ZIP code: 91911)*
Southern California Steelhead Trout need to be listed ASAP so projects can get underway to help them survive in our rivers.

1893. Thamar Draper (*ZIP code: 92596)*

1894. Jeff Crenshaw (*ZIP code: 94549)*
Save the steelhead!

1895. Brett Cole (*ZIP code: 95658)*

1896. Joanne Irish (*ZIP code: 90803)*
Please protect this vital natural resource.

1897. Jonathan Kim (*ZIP code: 92128)*
The southern California steelhead is a unique population adapted to environments that other rainbow trout are not found in, and deserve special attention and research to preserve their population.

1898. Jayni Shuman (*ZIP code: 90290)*

1899. Kyle Tzeo (*ZIP code: 97086)*
SAVE THE STEEHEALD!!!

1900. Jay Shields (*ZIP code: 90066)*

1901. Thomas Hofweber (*ZIP code: 48302)*

1902. Thomas Wendorff (*ZIP code: 80016)*

1903. Thomas Brady (*ZIP code: 90027)*

1904. Thomas Weseloh (*ZIP code: 95519)*

1905. Thom Jaquysh (*ZIP code: 94118)*

1906. Thor Darwell (*ZIP code: 92040)*

1907. Tim Wallack (*ZIP code: 93103)*

1908. timothy reuling (*ZIP code: 95436)*
Honestly......The US and CA govts need to be in full support of maintaining...and importantly, restoring the habitat of the So Steelhead. Let's do the best we can ,

1909. Timothy Bartley (*ZIP code: 93514)*

1910. Tim Bosveld (*ZIP code: 91042)*

1911. Tim Howe (*ZIP code: 94611)*
Steelhead are hanging by a thread. Please help them.

1912. Tim Huckaby (*ZIP code: 92008)*

1913. Tim Swan (*ZIP code: 95437)*

1914. Timmarie Hamill (*ZIP code: 95926)*

1915. Tim Rice (*ZIP code: 95010)*

1916. tim polishook (*ZIP code: 94131)*
Thank you

1917. Christima Frazer (*ZIP code: 92122)*

1918. Tina Johnson (*ZIP code: 93003)*
Please and thank you.

1919. Christine Schwartz (*ZIP code: 92845)*

1920. Tina Segura (*ZIP code: 90405)*

1921. Tim Ikeda (*ZIP code: 93612)*

1922. thomas pate (*ZIP code: 95670)*

1923. Thomas Williams (*ZIP code: 86303)*
Born and raised in Santa Barbara. Have seen many steelhead as a youngster, prior to Cachuma Dam and overuse of the aquifer decimating the runs.

1924. Tina Gonzalez (*ZIP code: 91711)*

1925. lily vizcaino (*ZIP code: 90068)*

1926. Todd Rulon-Miller (*ZIP code: 93111)*
Save our fish

1927. George Robinette (*ZIP code: 94010)*

1928. Thomas Farrell (*ZIP code: 93010)*

1929. Tom Burt (*ZIP code: 93110)*
Save these beautiful creatures!

1930. Tom Paplia (*ZIP code: 92630)*

1931. Thomas McGee (*ZIP code: 94044)*

1932. Thomas Curran (*ZIP code: 90720)*
We must save steelhead!

1933. Tom Her (*ZIP code: 53151)*

1934. John Tomlinson (*ZIP code: 91024)*

1935. Steven Woodbury (*ZIP code: 95032)*

1936. Thomas Austin (*ZIP code: 94618)*

1937. Tom Scripps (*ZIP code: 94574)*
Please

1938. Tom Shepherd (*ZIP code: 94928)*

1939. Tom Tartaglione (*ZIP code: 91016)*

1940. Rob Toth (*ZIP code: 93514)*
If not us, who? If not now, when?

1941. mark Towery (*ZIP code: 94549)*
Please let's not let this important species die out. We can protect it.

1942. Thomas Parry (*ZIP code: 94610)*

1943. Tania Pineda (*ZIP code: 90230)*

1944. Tony Quiroz (*ZIP code: 91104)*

Steelhead are important to save.

1945. Tracey Willfong (*ZIP code: 93108)*

1946. Chuck Nelson (*ZIP code: 92647)*

1947. Tim Burwell (*ZIP code: 90275)*

1948. Trevor Thibaut (*ZIP code: 96145)*

1949. Tricia Elisara (*ZIP code: 920236)*
We cannot lose this species!

1950. David Williams (*ZIP code: 92647)*

1951. Jason Muller (*ZIP code: 93003)*

1952. John Triska (*ZIP code: 94062)*

1953. Tristan Woolacott (*ZIP code: 95610)*

1954. Tom Rosenow (*ZIP code: 95973)*

1955. Richard May (*ZIP code: 94127)*
Must save this iconic fish!

1956. Rick Remedi (*ZIP code: 93012)*
Please save the California steelhead

1957. Julia Mitchell (*ZIP code: 94941)*
I fully support listing Southern steelhead as endangered under California's ESA! We must protect our fish!

1958. Douglas Churchill (*ZIP code: 94121)*

1959. T P (*ZIP code: 95726)*

1960. David Carranza (*ZIP code: 93063)*

1961. Tim Haddon (*ZIP code: 96145)*

1962. Alfredo Mascote (*ZIP code: 92582)*

1963. Tim Victor (*ZIP code: 90066)*

1964. Tim Quirante (*ZIP code: 96839)*

1965. Terry Treiber (*ZIP code: 92106)*

1966. Robert Tucker Biorn (*ZIP code: 94301)*

1967. Mike Miller (*ZIP code: 93012)*

1968. Thelma de Castro (*ZIP code: 92115)*

1969. Adam Johnson (*ZIP code: 92057)*

1970. mikey Hanrahan (*ZIP code: 91741)*
save the southern steelhead!!

1971. Timothy Williams (*ZIP code: 92625)*

1972. bruce moore (*ZIP code: 94920)*

1973. Trav Ichinose (*ZIP code: 90807)*

1974. Tyler Isaac (*ZIP code: 93103)*

1975. Tyler Cotton (*ZIP code: 90230)*

1976. Tyler Campbell (*ZIP code: 90731)*

1977. Val Atkinson (*ZIP code: 94122)*
Keep up the great work

1978. Valeree Catangay (*ZIP code: 90034)*

1979. valerie m (*ZIP code: 92833)*

1980. Sheldon Van Oosting (*ZIP code: 92345)*

1981. John Shreve (*ZIP code: 91306)*

1982. Howard Ritchie (*ZIP code: 89074-2856)*

1983. Derek Daley (*ZIP code: 95340)*
Protect southern steelhead!

1984. Veronica Allen (*ZIP code: 90802)*

1985. Victor Garibian (*ZIP code: 91362)*

1986. Victoria Reeder (*ZIP code: 95519)*

1987. Matt Silva (*ZIP code: 92656)*

1988. Vincent La Rocca (*ZIP code: 90640)*

1989. Vince Salazar (*ZIP code: 93022)*

1990. Robert Pope (*ZIP code: 94561)*

1991. Natasha Jivani (*ZIP code: 90063)*

1992. Verna Jigour (*ZIP code: 95311)*
To the above rationale I would add concerns about the likely impacts of climate change and associated wildfire threats to the distinctive watersheds/catchments that have kept southern steelhead hanging on in the context of expanding human land uses. I could not agree more that the genetic heritage of southern steelhead is doubtless critical to sustaining the species as a whole through anticipated environmental changes as our climate gets crazier.

1993. Vincent Narez (*ZIP code: 93110)*
Act now!

1994. Victoria Whitman (*ZIP code: 94602)*

1995. Al Vogel (*ZIP code: 95938)*

1996. Vahan Skenderian (*ZIP code: 92694)*

1997. Vanessa Diaz (*ZIP code: 91606)*

1998. Von Welker (*ZIP code: 92084)*
Save the Southern Steelhead From Extinction!!!

1999. Robert Audibert (*ZIP code: 93444)*

2000. Justin Smith (*ZIP code: 92391)*
We need to do what we can to save this iconic beauty fish.

2001. Harry Goertz (*ZIP code: 95127)*

2002. wade graham (*ZIP code: 90026)*

2003. Wade Gasque (*ZIP code: 90403)*

2004. William Walker (*ZIP code: 94949)*

2005. Andrew Sears (*ZIP code: 93546)*

2006. Walter Finkbeiner (*ZIP code: 95818)*

2007. Betty Joseph (*ZIP code: 90808)* **2008.**

Matt Wapnick (*ZIP code: 90045)* **2009. Bruce**

Rosenblum (*ZIP code: 93422)*

2010. Wayne Ginsburg (*ZIP code: 95695)*

2011. William Brubaker (*ZIP code: 92679)*

2012. Wayne Spencer (*ZIP code: 92116)*

2013. Winston Hurst (*ZIP code: 93117)*

2014. Arthur Webb (*ZIP code: 95020)*

2015. Grant Volk (*ZIP code: 95765)*

2016. Michael Wellborn (*ZIP code: 92708)*

2017. wes lee (*ZIP code: 95409)*
save rare heat adapted stlhead

2018. Wesley Hudson (*ZIP code: 92104)*

2019. Robert Tepper (*ZIP code: 90503)*

2020. Frank Wetmore (*ZIP code: 95501)*

2021. Warren M. Gold (*ZIP code: 94941)*

2022. Jeffrey Beecroft (*ZIP code: 91001-2836)*
We need more of a concentrated effort to save this amazing species. I think our state has no idea how much the impact is financially on the state provided by the multiple sport fisherman that live and visit our state.

2023. William Hoctor (*ZIP code: 92028)*

2024. Gary Wick (*ZIP code: 95682)*
#Saverhefish
#Peopleandfis

h

2025. Norbert Wild (*ZIP code: 92126)*
Saw a small group of steelhead in Penasquitos Creek last year, very heartened by that, but they need protection! Thank you, Norb Wild.

2026. William Bramley (*ZIP code: 92106)*

2027. William Preston Bowling (*ZIP code: 90290)*
Thank you

2028. Jeff Williams (*ZIP code: 91377)*
Now's the time to act before we lose another resource that makes our state great.

2029. Lori Williams (*ZIP code: 93109)*

2030. Allen Williams (*ZIP code: 94925)*
This is a very important issue!!

2031. Will Kluger (*ZIP code: 95501)*

2032. Roger Williams (*ZIP code: 98332)*

2033. Canada Ross (*ZIP code: 96067)*

2034. Wendy Katagi (*ZIP code: 90275)*

2035. William L Martin (*ZIP code: 94112)*
Please save these wonderful fish!

2036. Mark Wells (*ZIP code: 92075)*

2037. William Hossfeld (*ZIP code: 94556)*

2038. Thomas Wright (*ZIP code: 91342)*

2039. Emily Winn (*ZIP code: 80238)*

2040. Michael Borboa (*ZIP code: 93612)*
Save the Southern Steelhead NOW!

2041. William Ellsworth (*ZIP code: 94110)*

2042. Alec Wulff (*ZIP code: 92651)*

2043. Victoria Brandon (*ZIP code: 91325)*

2044. Jason Vail (*ZIP code: 84102)*

2045. Nathan Yancheff (*ZIP code: 92122)*

2046. Aiden Yearta (*ZIP code: 92378)*

2047. Dagwood Smithers (*ZIP code: 92399)*

2048. Zach Edwards (*ZIP code: 90245)*

2049. Zachary Patton (*ZIP code: 94939)*

2050. Laura Cogan (*ZIP code: 93111)*

2051. Ann Bebensee (*ZIP code: 93720)*

2052. Zed Langston (*ZIP code: 97402)*

2053. David Zeff (*ZIP code: 94925)*
Save our species!

2054. Steve Johnston (*ZIP code: 94596)*
Let's save these unicorns.

2055. Zachary Gomez (*ZIP code: 93105)*

2056. Zino Nakasuji (*ZIP code: 90720)*

2057. Zoë Collins (*ZIP code: 90291)*

2058. Liam Zubak (*ZIP code: 92882)*

2059. Dianne Hellrigel (*ZIP code: 91321)*

April 4, 2024

VIA EMAIL fgc@fgc.ca.gov

Ms. Samantha Murray, President & Members
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244

Subject: Comments on the California Department of Fish and Wildlife Status Report submitted for consideration by the Fish and Game Commission regarding the California Endangered Species Act Status Review of Southern California Steelhead

Dear President Murray and Members:

The Santa Clarita Valley Water Agency (SCV Water) is a California Special District providing water supply services to 278,000 people living in the Santa Clarita Valley in northern Los Angeles County. SCV Water, created in 2018 by Senate Bill 634, strives to create a "one watershed" approach and regional perspective on watershed-wide issues. This letter provides comments on the "California Endangered Species Act Status Review for Southern California Steelhead (*Oncorhynchus mykiss*)" (Status Report) prepared and submitted by the California Department of Fish and Wildlife in January 2024 for consideration by the California Fish and Game Commission. We understand that the Status Report has been prepared in anticipation of the Commission's evaluation whether listing of the Southern California Steelhead (*Oncorhynchus mykiss*) is warranted under the California Endangered Species Act (CESA).

In reviewing the Status Report, SCV Water has identified what appears to be an error in Figure 7 (see copy of Figure 7 below, highlighting the area of our concern). The figure shows in blue lines the "current" and "suspected current" distribution of Steelhead extending within the mainstem of the Santa Clara River eastward of the Piru Dry Gap into the upper basin and south fork tributaries of the Santa Clara River within Los Angeles County. A fundamental concern with Figure 7 is that the Status Report does not disclose any references, justification, underlying occurrence or observation data, or basis for the various occurrence determinations depicted in the figure's stream bodies. SCV Water has seen no evidence either within the Status Report or within any other literature that would support the distribution expressed in this figure either for existing populations or historic populations. We have reviewed the text of the Status Report and we have done a deep review of the references identified in the Status Report and other available information and have found no confirmed indication of the presence of Steelhead ever occurring east of Piru Dry Gap. The attached whitepaper prepared by ESA summarizes the investigation of supporting documentation.

Due to the lack of substantiated evidence of steelhead occupation in the upper watershed, we can only surmise that this determination was made based on the absence of man-made passage impediments in the mainstem. However, lack of barriers is not a determination of presence. Further, this same logic is not applied consistently in Figure 7 (or other distribution figures in the Status Report) where numerous other streams have no passage barriers yet are shown only as historically occupied.

We request that the error in Figure 7 (shown in the attached figure) be corrected to indicate no designation for the mainstem or tributaries of the Santa Clara River eastward of the Piru Dry Gap (approximately the Ventura/Los Angeles County line). If CDFW does not concur that Figure 7 is inaccurate, we request an explanation of the following questions prior to proceeding further with the CESA process.

1) We request that data be provided substantiating the “current” and “suspected current” presence of Steelhead anywhere east of the Ventura County line.
2) We request definitions of “current”, “suspected current”, “historical”, and “suspected historical” used in the Status Report.
3) We request a description of the methodology used by CDFW to assign geographies for these distribution categories in the Upper Santa Clara River watershed.
4) We request a meeting with CDFW to discuss the data substantiating the assignment of distribution categories in the Upper Santa Clara River.

Thank you for your consideration of our comments, and we look forward to receiving responses prior to any action being taken by the Commission.

Sincerely,

Stephen L. Cole
Assistant General Manager
Santa Clarita Valley Water Agency

Enclosed

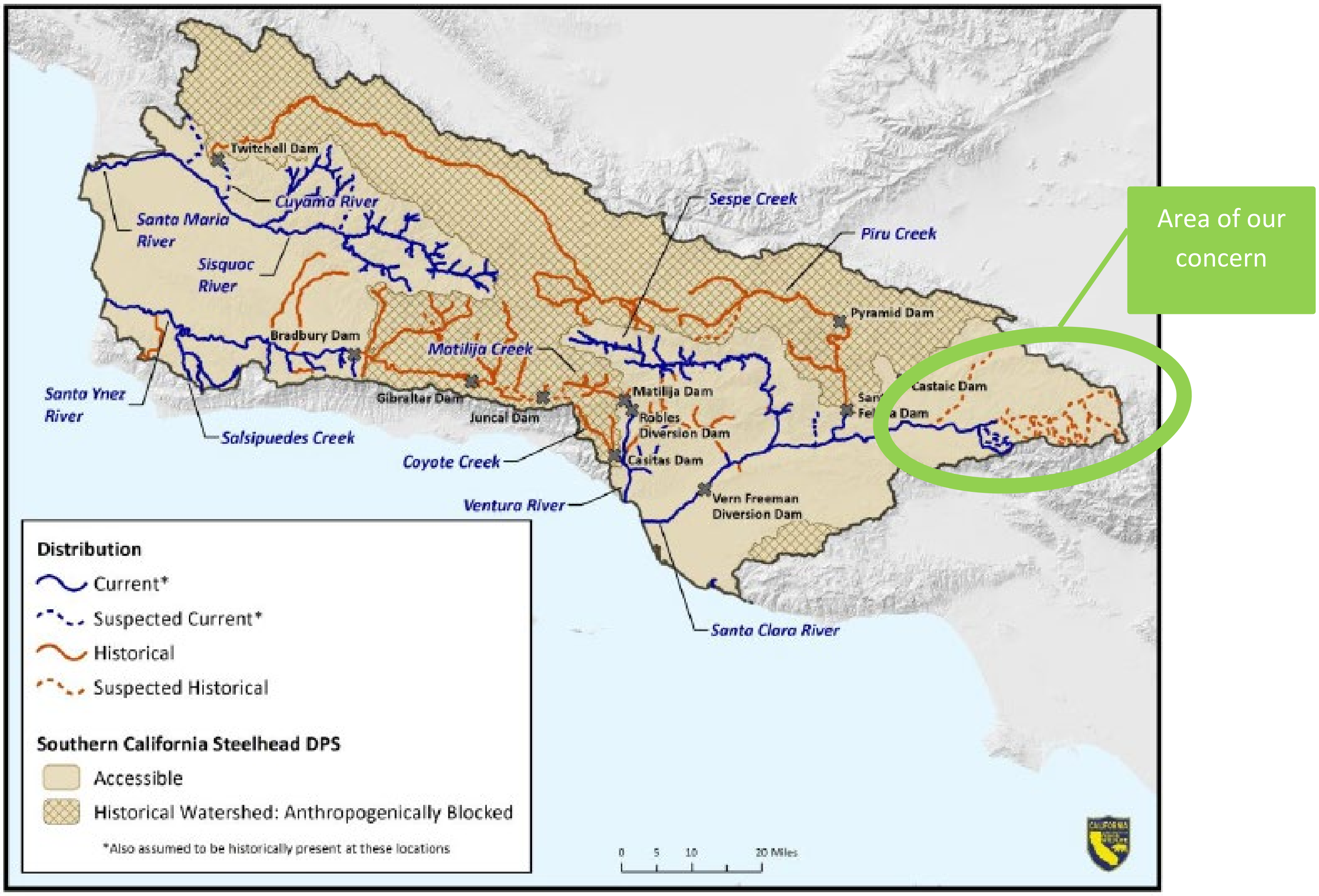

Figure 7. Map of the Monte Arido Highlands BPG depicting known and suspected current and historical distribution.

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ESA

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memorandum

date April 2, 2024

to Santa Clarita Valley Water Agency

cc

from Joel Mulder

subject Review of Current and Historical Oncorhychus mykiss Occurrences in the Upper Santa Clara River Watershed (Los Angeles County)

Purpose

ESA has prepared this technical memorandum (memo) for Santa Clarita Valley Water Agency to review and document available information on the current and historical distribution of *Oncorhynchus mykiss (O. mykiss)*, including both the anadromous (southern California steelhead, referred to as steelhead herein) and resident (rainbow trout) life history forms of the species, in the upper Santa Clara River watershed within Los Angeles County (i.e., the watershed upstream of the Piru Dry Gap[1]). Information from a variety of sources is summarized in this memo, including biogeographic datasets, state and federal documents, peer-reviewed publications, historical source compilations, non-governmental organization information, and survey data.

Biogeographic Datasets

A query of California Department of Fish and Wildlife (CDFW) California Natural Diversity Database data (both processed and unprocessed data) found no documented occurrence of steelhead in the Santa Clara River watershed upstream of the Piru Creek confluence.

The CDFW Biogeographic Information and Observation System online mapping tool (BIOS) layers for steelhead range and distribution offer conflicting mapping of southern Steelhead distribution, as described below.

Winter Steelhead Range (ds699).

This dataset, developed by CDFW, contains all CalWater 2.2.1 Planning Watersheds where CDFW has documented winter run steelhead to be present (representing planning watersheds intersecting the known distribution, which is based on where the species has been observed and reported) during or after 1990. This

[1] Beginning about 3.5 river miles downstream of the Los Angeles - Ventura County line, the Santa Clara River surface flow is infiltrated into the underlying eastern Piru groundwater basin. Surface flow reappears approximately 6 miles downstream, past the confluence of Piru Creek. The river is dry through this reach most of the year, with water present only when rainfall events create sufficient stormwater runoff into the river (GSI 2008, LARWQCB 2007). This dry ephemeral reach of the river is informally known as the “Piru dry gap” in the Santa Clara River.

dataset does not show winter steelhead range as occurring in the Santa Clara River watershed upstream of the Piru Creek confluence.

Winter Steelhead Distribution (ds340)

This dataset, developed by CDFW, depicts observation-based stream-level geographic distribution of anadromous winter-run steelhead in California. It was developed for the express purpose of assisting with steelhead recovery planning efforts. The distributions reported in this dataset were derived from a subset of the data contained in the Aquatic Species Observation Database (ASOD), a Microsoft Access multi-species observation data capture application. Data source contributors, as well as CDFW fisheries biologists, have been provided the opportunity to review and suggest edits or additions during a recent review. Data contributors were notified and invited to review and comment on the handling of the information that they provided. The distribution was then posted to an intranet mapping application, and CDFW biologists were provided an opportunity to review and comment on the dataset. During this review, biologists were also encouraged to add new observation data. The dataset does not show steelhead distribution as occurring in the Santa Clara River watershed upstream of the Piru Creek confluence.

Southern California Steelhead Range (ds1290)

This dataset, developed by the University of California at Davis (U.C. Davis), shows a species extant range layer for steelhead by HUC12 watersheds based on datasets and interpreted by PISCES, which is software and data describing the best-known ranges for California's 133 native fish and numerous non-native fish. PISCES “models” presence, with corresponding probabilities if appropriate, based on expert opinion and observation data. PISCES biogeographic modeling outcomes reflect environmental and anthropogenic variables that “predict” where a given species may occur (Santos et al. 2014). The metadata for the layer describes the references for the datasets interpreted by PISCES as Moyle, Quinines and Bell (expert opinion) and NMFS Southern California Steelhead ESU Current Stream Habitat Distribution Table.pdf. It is not clear what the source is for the NMFS current stream habitat distribution table.

There are two primary layers in the PISCES model for steelhead. One is HUC12 watersheds with observations of *O. mykiss*. No HUC12 watersheds upstream of the Piru Creek confluence are shown as having positive observations. The other layer is a “historical expert” layer, which depicts HUC12 watersheds where steelhead occurred historically based on expert opinion. This layer shows steelhead occurring in the HUC12 watersheds containing the mainstem from Piru Creek upstream to about Soledad Canyon, and Castaic Creek, based on expert opinion but not on observational data.

Coastal Steelhead Trout Watersheds (ds962)

This dataset, developed by CDFW, provides a minimal set of watershed fields used to identify coastal steelhead management units. This data set is an extract of the California Watershed (CalWater) dataset. It has been generalized to hydrologic sub-areas for those watersheds that are considered part of the coastal steelhead range. However, the source data for the inclusion of hydrologic units in the “coastal steelhead trout range” is not cited or referenced in the dataset metadata. The dataset depicts hydrologic units in the upper Santa Clara River basin (upstream of the Piru Creek confluence) as coastal steelhead watersheds.

Federal and State Documents

Federal Endangered Species Act designated critical habitat for southern California steelhead in the Santa Clara River watershed extends from the Pacific Ocean, upstream the main Santa Clara River to the confluence with Piru Creek; critical habitat in the Santa Clara River does not extend beyond the confluence with Piru Creek (70 FR 52487).

In the NMFS population characterization for steelhead recovery planning, the discussion of the Santa Clara River states "The available evidence suggests that steelhead have been limited to the western part of the Santa Clara basin (Kelley 2004)" (Boughton et al. 2006). The document uses Boughton and Goslin's (2006) over-summering habitat model (described below) as the basis for its findings.

Boughton and Goslin (2006) developed a model of potential steelhead over-summering habitat using the method of environmental envelopes. Under the envelope method, predicted habitat is the set of stream segments falling within the same range of conditions that encapsulate the known occurrences of the species. In the discussion of results from the Los Angeles Basin, the authors note "The model predicted a distinct patch of potential habitat in the far eastern end of the Santa Clara basin (upper right quadrant, east of Newhall). This did not conform to expectations. Reports from the area suggested that steelhead were confined to the western end of the Santa Clara system. Visits to the eastern area between Newhall and Palmdale indicated that this area is drier than implied by the model, due to a rain-shadow effect from the San Gabriel Mountains (C. Swift, personal communication, Entrix). It probably did not contain potential habitat in reality". In their discussion of the model's environmental envelope outputs, the authors note that the Southern California Coast ESU[2] may have more false positives (warm areas with no potential for thermal refugia), but that these false positives may occur at a finer resolution than addressed by the model. In other words, the model may indicate suitable habitat in some areas of Southern California where in reality temperatures and lack of thermal refugia preclude steelhead occurrence.

In NMFS' 2023 5-Year Review for the species, there is no mention of areas of the Santa Clara River watershed upstream of the Piru Creek confluence (NMFS 2023). In the Southern California Steelhead Recovery Plan (NMFS 2012) discussion of current watershed conditions the only mention of the Santa Clara River watershed upstream of the Piru Creek confluence is that "Fish passage is further impacted by the operation of Castaic Dam on Castaic Creek". Table 2-1 of the Recovery Plan lists the Santa Clara River watershed as historically occupied by steelhead, citing Becker et al. 2009, Boughton et al. 2005, and Titus et al. 2010 (NMFS 2012). A discussion of those sources is provided below, with a focus on historical occurrences in the upper watershed.

Boughton et al. (2005) assessed the current occurrence of anadromous *O. mykiss* in each coastal basin of southern California in which it occurred historically. While the current and historical occurrences in the Santa Clara River are not described specifically in the memorandum, Figure 4 shows the historic distribution of spawning and rearing basins for steelhead in southern California. The figure shows the Santa Clara River basin up to approximately the Ventura-Los Angeles County line as historically occupied. The figure notes that shading of entire basins implies only that steelhead occurred somewhere, not necessarily everywhere, in a basin. The source

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[2] Listed steelhead are now referred to as a ''distinct population segment'' (DPS), which is not recognized in the scientific literature. In 1991, NMFS issued a policy for delineating Pacific salmon DPS (56 FR 58612; November 20, 1991). Under this policy a group of Pacific salmon populations is considered an ''evolutionarily significant unit'' (ESU) if it is substantially reproductively isolated from other conspecific populations, and it represents an important component in the evolutionary legacy of the biological species. Further, an ESU is considered to be a DPS (and thus a ''species'') under the ESA.

for the historical occurrence data for the figure is noted as Titus et al. 2003, Stoecker et al. 2002, and a third source which was omitted from the figure description (text is cut off). Further discussion of Titus et al. is provided below. Stoecker et al. (2002) is a report on steelhead assessment and recovery opportunities in southern Santa Barbara County as is not relevant to the Santa Clara River.

The Titus et al. 2003 in preparation document cited in Boughton et al. 2005 and Titus et al. 2010 in preparation document cited in the species recovery plan (NMFS 2012) is cited as several sources under different publication years as the document has been in draft form with various updates for some time. As of April 2, 2024, the manuscript is still a draft[3]. The report provides stream-specific information on steelhead in central and southern California gathered from three main sources: (1) A literature search of pertinent journal articles, CDFW (known as California Department of Fish and Game until 2013) administrative reports and fish bulletins, and other resource agency, university, and consultant publications; (2) Resource agency files, especially CDFW stream survey files; (3) Interviews conducted with professional biologists, academicians, and representatives of sportfishing organizations and other special interest groups for information from personal files, and anecdotes based on personal observations. The report's description of the Santa Clara River Headwater Tributaries in Los Angeles County states no historical evidence of steelhead runs. San Francisquito Canyon and Soledad Canyon are noted as two streams for which there are CDFW records for rainbow trout presence and/or stocking dating back to circa 1930.

Non-Governmental Organization Resources

Becker et al. (2009) summarizes historical accounts of *O. mykiss* in streams south of San Francisco Bay based on thousands of documents in public and private collections, and interviews with biologists. Only three areas in the upper Santa Clara River watershed are described in the report as having fish observations. It is important to note that these observations are for fish in general, and not specifically steelhead.

Elizabeth Lake Canyon, tributary to Castaic Creek - Field notes from US Forest Service staff from 1947 indicate that "some fish" were caught in Elizabeth Lake Canyon Creek in the previous season (CDFG 1952). The author noted that the creek was unlikely to support fish life throughout the year, presumably due to low flow.

Fish Canyon, tributary to Castaic Creek - A 1956 CDFW stream inventory for Fish Canyon Creek states, "…some native fish reported in upper reaches" (CDFG 1956b). It adds, "This is definitely a marginal water…"

Bouquet Canyon - According to CDFW records, rainbow trout fry from the Shasta hatchery were planted in Bouquet Canyon Creek in 1943 (CDFG 1943). A 1947 stream survey indicates that *O. mykiss* including a "few fingerlings" were observed in the creek but notes, "Fishing maintained only be frequent plantings" (CDFG 1947b).

In a previous document, Becker et al. (2008) appears to acknowledge the unreliable nature of these observations in Figures 24 and 25 of the report, describing the historic and current, respectively, status of *O. mykiss* in coastal streams of southern Ventura County. In the figures, Castaic Creek and its tributaries, as well as San Francisquito and Bouquet Canyon creeks, are shown as "unknown or insufficient data". Paradoxically, the mainstem Santa Clara River upstream of the Piru Creek confluence is shown as "definite run or population" despite no

[3] Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=10194

documentation in the report of any observations currently or historically in that section of river. CalTrout, an organization focused on healthy waters and resilient wild fish, provides on The Southern Steelhead page of their website[4] as well as their publication "SOS II: Fish in Hot Water: Status, threats and solutions for California salmon, steelhead, and trout" a map of current and historical steelhead range. The source of the map is noted as PISCES (2017). See the discussion above under Biogeographic Datasets - Southern California Steelhead Range (ds1290) for PISCES.

The conservation group Trout Unlimited's website[5] provides maps of the historical and current status of *O. mykiss* in coastal streams of southern Ventura County, California. Both maps show the mainstem of the upper Santa Clara River from the Piru Creek confluence up to about the N3 Angeles Forest Highway as historically and currently having a "definite run or population". However, the cited source for these maps is Becker et al. 2009, described above, which does not appear to substantiate the steelhead historical and current distribution depicted on these figures.

Other Sources

Stoecker and Kelley (2005) analyzed the habitat conditions, population status and barriers to migration for steelhead in the lower Santa Clara River watershed from the Piru Creek tributary downstream, including significant drainages. There is no mention of steelhead resources upstream of the Piru Creek confluence.

Bowers (2008) compiled historical steelhead accounts in Ventura County, primarily from newspaper accounts, personal fishing logs, books, pamphlets, and Ventura County Board of Supervisors' Minutes. Because the report looked at Ventura County, little mention is made of the upper Santa Clara River watershed in Los Angeles County except two articles from the Santa Paula Chronicle. The first, in 1925, noted five thousand "trout" were planted in Bouquet Canyon. The second, in 1943, described Bouquet Canyon as being "in good shape with plenty of good-sized fish left over from last year's plant", presumably referring to planted *O. mykiss.*

Bell (1978) described the fishes of the Santa Clara River and made collections at 46 stations from the river mouth upstream as far as water existed. In the upper watershed, this included San Francisquito Creek, Castaic Creek, Arrastre Canyon, and the mainstem river. No *O. mykiss* were encountered. Bell cites Hubbs (1946) as reporting large and consistent runs of *Salmo gairdneri* (the former scientific name for *O. mykiss*) in the Santa Clara River. However, Bell notes that at the time of his survey, *Salmo* were abundant in Sespe Creek, but Piru Creek and the Santa Clara mainstem were much less suitable habitat, and trout were restricted to a few deep holes in Piru Creek and as escapees to the mainstem from Fillmore fish hatchery. No mention is made of trout in the upper watershed.

Numerous fish sampling events have been conducted in the upper Santa Clara River, particularly the mainstem, in more recent years. Table 1 below presents a list of the sources examined. No *O. mykiss* were encountered in any of the surveys.

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[4] Available at: https://caltrout.org/sos/species-accounts/steelhead/southern-steelhead#:~:text=Southern%20Steelhead%20Distribution&text=They%20are%20most%20abundant%20in,Ventura%2C%20and%20Santa%20Clara%20rivers

[5] Available at: https://www.tu.org/california-coastal-steelhead-data/. Figure 24 -– Historical and current status of Oncorhynchus O. mykiss in coastal streams of southern Ventura County, California; Figure 25 - Current status of Oncorhynchus mykiss in coastal streams of southern Ventura County, California.

TABLE 1
SUMMARY OF FISH SPECIES PRESENCE IN UPPER SANTA CLARA RIVER WAERSHED BASED ON LITERATURE REVIEW

Santa Clara River Reach[a] and Location		Unarmored Three spine Stickleback	Santa Ana Sucker	Arroyo Chub	Prickly Sculpin	Common Carp	Mosquitofish	Black Bullhead	Fathead Minnow	Green Sunfish	Largemouth Bass	Goldfish	Sailfin Molly	Convict cichlid	Source
SCR	SCR Watershed	X	X	X			X		X	X	X				Bell 1978, Swift et al. 1993
6	Bouquet Canyon area			X	X		X							X	Compliance Biology 2010
6	SWRP outfall channel													X	Dellith Pers. Comm. 2023
6	Iron Horse Bridge area	X													CDFW 2021
6	Iron Horse Bridge area		X	X											CDFW 2022
6	Iron Horse Bridge to VWRP	X	X	X											Haglund & Baskin 2000
6	McBean Parkway area	X					X								Hovore et al. 2008
5/6	Bouquet Cyn. to Castaic Ck.	X	X	X											Haglund & Baskin 1995
5/6	Bouquet Cyn. to Castaic Ck.	X	X	X											Impact Sciences Inc. 2003c
5/6	Saugus to Castaic Ck.	X		X			X								Haglund 1989
5	I5 to Castaic Ck.	X		X											Aquatic Consulting Services 2002a
5	Old Road to VWRP	X	X												CDFW 2015
5	Old Road to VWRP	X	X	X			X								Pareti Pers. Comm. 2003
5	VWRP to Salt Ck.		X	X		X	X	X			X				Cardno 2015
5	VWRP to Salt Ck.	X	X	X											ENTRIX Inc. 2006a
5	Commerce Center Dr. to Salt Ck.	X	X	X	X	X					X				ENTRIX Inc. 2010
5	Commerce Center Dr. to Salt Ck.	X	X	X											Dudek 2010
5	Castaic Ck. to u.s. 7.2mi	X	X	X	X		X				X	X	X		Impact Sciences Inc. 2003b
5	Commerce Center Dr. to Castaic Ck.	X	X	X											Aquatic Consulting Services 2002b
5	Commerce Center Dr. to Co. Line	X		X			X				X				Aquatic Consulting Services 2002c
5	Castaic Ck. to d.s. 7mi	X	X	X	X		X				X				Impact Sciences Inc. 2003a
5	Castaic Creek to Long Cyn.	X	X	X			X								ENTRIX Inc. 2006b
5	Castaic Ck. to Long Cyn.	X	X	X											Impact Sciences Inc. 2010
5	u.s. of San Martinez Grande Cyn.	X													USFWS 1980
5	u.s. of San Martinez Grande Cyn.	X	X	X			X	X		X					USFWS 1985

NOTES:
Blue shading = Native species, native to Study Area
Green shading = Native to Southern California
No shading = Not native to California (introduced)
a. Reaches delineated according to LARWQCB water body names

Discussion

In review of the available information, no verifiable or concrete observations of native *O. mykiss* in the upper Santa Clara River watershed have been described or recorded historically or currently. Observations that potentially could have been native *O. mykiss* are described in Becker et al. 2009. However, observations of "some fish" or "some native fish" in Elizabeth Canyon and Fish Canyon do not specifically mention *O. mykiss.* The references could be to other native fish in the upper watershed such as threespine stickleback (*Gasterosteus williamsoni*) which were formerly more common in the upper headwater tributaries (Bell 1978). Titus et al. (*In preparation*) also notes San Francisquito Canyon and Soledad Canyon as two streams for which there are CDFW records for rainbow trout presence and/or stocking dating back to circa 1930.

These observations may all well have been planted trout. As described in Titus et al. (*In preparation*) above and in newspaper accounts (Bowers 2008), extensive stocking was occurring in the upper watershed as early as 1925, and it would have been impossible to distinguish native resident trout or steelhead from stocked trout.

Given these unreliable historic accounts and lack of any other verifiable observations, it is of concern that Becker et al. 2008 and Titus et al. (*In preparation*) appear to be the basis for some historic and current distribution maps for southern California steelhead in the upper Santa Clara River (e.g., Boughton et al. 2005, Trout Unlimited), particularly since Becker et al. 2008 itself shows occurrence maps in upper watershed tributaries where there are questionable fish observations as "unknown or insufficient data". It is also not apparent why the upper watershed is considered to have been historically occupied by experts for the U.C. Davis PISCES model, and historically and currently occupied in Figures 24 and 25 of in Becker et al. 2008 despite the absence of observations. Perhaps the underlying assumption is that because the lower Santa Clara River had a well-documented and robust steelhead run (Hubbs 1946, Stoecker and Kelley 2005, Bowers 2008), fish would have inevitably made their way all the way up the river to the upper basin headwaters. However, an examination of habitat conditions in this area suggests that the habitat in the upper basin may have precluded or greatly limited steelhead migration in most years, and that even in particularly wet years when migration was possible, available upstream spawning and over-summering habitat was and is extremely limited or of poor quality.

The Santa Clara River is a perennial stream from Interstate 5 downstream to just west of the Los Angeles - Ventura County line. Beginning about 3.5 river miles downstream of the county line the entire surface flow is infiltrated into the underlying eastern Piru groundwater basin. Surface flow reappears approximately 6 miles downstream, past the confluence of Piru Creek. The river is dry through this reach most of the year, with water present only when rainfall events create sufficient stormwater runoff into the river (GSI 2008, LARWQCB 2007). This dry ephemeral reach of the river is informally known as the "Piru dry gap" in the Santa Clara River. Flood flows in the Upper Santa Clara River increase, peak, and subside rapidly in response to high-intensity rainfall. The "flashy" hydrograph produced by these conditions shows a rapid increase in discharge over a short time period with a quickly developed peak discharge compared to normal baseflow (Kennedy/Jenks 2014). Thus, migration opportunities through the dry gap for upstream migrating steelhead adults and downstream migrating smolts would have historically been limited to typically brief high flow events. The same is true under current conditions, though flows through the dry gap may be artificially altered in duration due to releases from or withholding in upstream reservoirs (e.g., Castaic Lake).

Habitat conditions in the upper watershed tributaries are described in historic accounts as generally poor for *O. mykiss*. For example, field notes from US Forest Service staff from Elizabeth Lake Canyon Creek in 1952 note that the creek was unlikely to support fish throughout the year "presumably due to low flow", and in 1956 regarding Fish Canyon "This is definitely a marginal water…", and in Bouquet Canyon Creek, 1943, "Fishing maintained only by frequent plantings" (Becker et al. 2009). Boughton and Goslin (2006) acknowledge that the watershed between Newhall and Palmdale is subject to a rain-shadow effect from the San Gabriel Mountains and "probably did not contain potential habitat in reality". No current information or surveys reviewed suggest that suitable habitat for *O. mykiss* is extant in the upper basin tributaries. Becker et al. (2010) analyzed information on rearing habitat to identify regionally significant watersheds, which are those offering the greatest potential for producing steelhead smolts, including over-summering opportunities and conditions favoring high growth rates. Within these watersheds the report identifies "essential" streams or reaches that offer the best habitat resources. Within the upper Santa Clara River watershed, portions of the mainstem and several tributaries are identified as "essential" stream, but no waterbodies in the upper watershed are identified as "available" or "suitable" *O. mykiss* habitat (see Figure 14 in the report).

In conclusion, there is no record of current *O. mykiss* occupation in the upper Santa Clara River watershed (east of the Piru Creek confluence) on which to support any determination of species "presence". Despite extensive fish sampling in the area over the last few decades, no *O. mykiss* have been encountered. Habitat conditions currently do not suggest suitable habitat is present for this species in the area.

There are no verifiable or concrete historical observations of native *O. mykiss* in the upper Santa Clara River watershed, and historical descriptions of habitat conditions do not suggest suitable, perennial habitat was present for *O. mykiss* in the area.

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FGC@FGC

From: Stephen Pang [redacted]
Sent: Thursday, April 4, 2024 1:23 PM
To: FGC <FGC@fgc.ca.gov>
Cc: [redacted]
Subject: ACWA Comment Letter - Southern California Steelhead Petition

Dear California Fish and Game Commission,

The Association of California Water Agencies (ACWA) appreciates the opportunity to provide written comments for consideration on the petition to list southern California steelhead (*Oncorhynchus mykiss*) as endangered. For your reference, you can access Cramer Fish Sciences' (Cramer) cohort-based life cycle simulation model (model) that is discussed in our comment letter here. Our comment letter includes two appendices: (1) a technical memorandum developed by Four Peaks Environmental Science & Data Solutions (Four Peaks) that evaluates Cramer's model and California Department of Fish and Wildlife's status review and (2) a technical memorandum developed by Cramer that discusses their model.

ACWA kindly requests that our comment letter, Cramer's model and technical memorandum, and Four Peaks' technical memorandum be shared with President Samantha Murray, Vice President Erika Zavaleta, and Commissioners Darius Anderson, Jacque Hostler-Carmesin, and Eric Sklar.

Please do not hesitate to contact me if you have any questions regarding our comments.

Thank you,

Stephen Pang
State Relations Advocate
Association of California Water Agencies
(916) 669-2369 | [redacted] www.acwa.com

Submitted via electronic mail to fgc@fgc.ca.gov

April 4, 2024

The Honorable Samantha Murray
President
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

RE: California Department of Fish and Wildlife Southern California Steelhead (*Oncorhynchus mykiss*) Status Review Submission to Commission

Dear President Murray,

The Association of California Water Agencies (ACWA) appreciates the opportunity to provide public comments to the California Fish and Game Commission (Commission) related to the status review of southern California steelhead (*Oncorhynchus mykiss)* (Status Review) submitted by the California Department of Fish and Wildlife (Department)—pursuant to Fish and Game Code § 2074.6. ACWA represents more than 460 public water agencies that collectively deliver approximately 90 percent of the water in California for domestic, agricultural, and industrial uses. ACWA and its members are invested in healthy watersheds and habitats that support robust populations of native fish and wildlife. However, ACWA has significant concerns regarding both the scientific basis for a listing determination and the potential impacts on public water agencies' ability to reliably provide water if southern California steelhead are listed as endangered pursuant to the California Endangered Species Act (CESA). Section 3, below, elaborates on these concerns.

1. Background

On June 14, 2021, California Trout (CalTrout) submitted a petition to the Commission to list southern California steelhead as an endangered species under CESA. On June 23, 2021, the Commission referred the petition to the Department for evaluation. On October 29, 2021, the Department submitted their evaluation report of the petition to the Commission. On April 21, 2022, the Commission accepted the petition for consideration. On May 13, 2022, the Commission provided public notice that southern California steelhead are a candidate species under CESA. On July 15, 2022, the Department noticed that it had initiated a 12-month Status Review of southern California steelhead and invited the public to submit comments, including data and other scientific information related to the species. In its Status Review, the Department was required to evaluate the breadth of available scientific literature and develop a summary of the status of southern California steelhead. The Department was also required to seek independent peer review of its Status Review. On October 12, 2022, the Commission granted a six-month extension to the Department for their Status Review. On January 18, 2024, the Department submitted its Status Review to the Commission.

ACWA and its member agencies have been actively engaged throughout this process, submitting multiple comment letters to both the Commission and Department in response to the CalTrout petition, evaluation report of the petition, and Status Review for southern California steelhead.

2. Standard for Determination

The standard for listing is whether the species' "continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) Present or threatened modification or destruction of its habitat; (2) Overexploitation; (3) Predation; (4) Competition; (5) Disease; or (6) Other natural occurrences or human-related activities"—pursuant to 14 CCR 670.1(i)(1)(A). The Department's Status Review must be "based on the best scientific information available" and the Commission's decision whether to list must be "based solely upon the best available scientific information" pursuant to Fish and Game Code § 2074.6 and Fish and Game Code § 2070, respectively.

3. ACWA Comments

ACWA appreciates the mission of the Commission, which is to ensure that California will have abundant, healthy, and diverse fish and wildlife that thrive within dynamic ecosystems. Public water agencies are intimately involved in the management of watersheds and wildlife habitats and ACWA member agencies have become increasingly involved in the proactive resolution of fishery and other aquatic species resource management issues. ACWA has the following significant concerns regarding the petition to list southern California steelhead pursuant to CESA.

a. <u>The Department's Status Review Does Not Incorporate the Best Available Science</u>

While the Status Review assesses the status and trends of southern California steelhead rainbow trout[1] (Southern SH/RT), the Department evaluates sympatric populations of anadromous and resident *O. mykiss* separately. Because of this

[1] In the Status Review, the Department defines southern California steelhead as "all *O. mykiss* below manmade and natural complete barriers to anadromy, including anadromous and resident life histories". To accurately capture this life history variability, the Department uses "southern California steelhead rainbow trout" to describe the proposed CESA listing unit.

separate treatment, the reproductive contributions of sympatric resident spawners to the production of smolts and anadromous *O. mykiss* are not accounted for in measures of population status or the evaluation of long-term viability of southern California steelhead. In addition, the Department does not consider the potential contributions from above-barrier populations of resident *O. mykiss* to Southern SH/RT populations, resulting from the downstream migration of juvenile rainbow trout over barriers. While above-barrier *O. mykiss* are not included in the petition, a subset of that population may increase the effective population size or rescue below-barrier populations from extirpation, therefore improving the viability and persistence of Southern SH/RT.

This interchange between resident and anadromous fish populations, and the associated "rescue effect", reduces the extinction risk of both groups and allows for recolonization should low steelhead abundance occur.[2] In their Viability Assessment for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Southwest, the National Marine Fisheries Service (NMFS) recognizes that "freshwater-resident (non-anadromous) forms of *O. mykiss* co-occur and appear to interbreed with the anadromous form in many populations" and concludes that "resident (nonanadromus) [sic] *O. mykiss* warrant consideration in managing for the anadromous life history."[3] Similarly, in October 2023, Judge James Chalfant expressed concerns during *United Water Conservation District v. California Fish and Game Commission*, acknowledging that "it may be true that an evaluation of rainbow trout [abundance and] its ability to produce [smolts] is required before [southern California steelhead] can be the subject of stage 2 protection as an endangered species."[4]

The Population Trends and Abundance analysis in Chapter 4 of the Status Review also presents several flaws. First, it utilizes problematic trap data which (1) only account for individuals that are migrating or biologically motivated to move within the watershed (e.g., due to resource availability), (2) are limited to periods when flows allow for the installation and operation of traps—that is, high flow conditions may preclude trap operation <u>when migration is most likely to occur</u>, and (3) are not representative of the trapped portion of *O. mykiss* without a trap efficiency study. Trap efficiency studies are required to develop accurate population estimates from numbers of trapped fish. Unfortunately, the Status Review does not disclose or describe whether trap efficiency studies are available in connection with the different datasets.

Second, while the Status Review acknowledges additional data sources (e.g., snorkel surveys, video-based and surveillance system fish counts), which in some watersheds

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[2] Boughton, D.A., et al. 2007. Viability criteria for steelhead of the South-Central and Southern California coast. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-407.
[3] NMFS. 2023. Viability assessment for Pacific salmon and steelhead listed under the Endangered Species Act: Southwest. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-686. Page 155.
[4] Case No. 22STCP02661. Page 9.

may more accurately characterize the overall *O. mykiss* population, they appear not to have been incorporated into the Population Trends and Abundance analysis consistently.

In addition to statistically inappropriate treatment of the trap data, many of the data presented in the Status Review were not analyzed appropriately. In Section 4.1, the evaluation erroneously compared trap data directly with snorkel survey/bankside observation data (instead of evaluating the different types of survey data separately), evaluated total fish counts per year (instead of fish counts per number of days of trap operation or per distances visually surveyed), and included zero values in some years when monitoring did not occur (instead of consistently excluding all years when monitoring did not occur). Furthermore, in Section 4.3's trend analysis, annual fish count data from the Santa Ynez, Ventura, and Santa Clara Rivers were inappropriately evaluated across the c. 1994 to c. 2021 timeseries without considering methodological changes that occurred within those years—which the Department noted in Appendix C of the Status Review.[5]

Finally, the Department's focus on a 5-year timeframe (i.e., 2013 to 2018) when discussing productivity in the Population Trends and Abundance analysis in Section 4.5 is non-representative and skews their conclusions. This timeframe coincides with the most recent extreme drought period and conditions associated with the loss of suitable spawning and rearing habitat, insufficient instream flows required for migration, diminished water quality, reductions in available food supply, and increases in direct mortality. While most populations do not have enough data available following the drought to determine if rebounding has occurred, the Department does note potential post-drought rebounding in the only population (i.e., Santa Ynez River) with a dataset through 2021. In NMFS' Southern California Steelhead Recovery Plan, Dr. David A. Boughton explains that "steelhead recovery as a form of human stewardship has to be judged over a broader timeline, with multi-year setbacks in population size considered to be a normal and expected event, and progress judged at the scale of multiple decades and even multiple human generations."[6]

b. <u>Consider Information and Data That Use the Best Available Science to Assess the Viability of the Distinct Population Segment (DPS) in the Context of Threats to the DPS</u>

Consistent with the Department's July 15, 2022, solicitation, various water agencies have shared information for the Department's Status Review. The information

[5] Cramer, S.P. and Caldwell, L. 2020. Bias and consequences in attempts to estimate historic salmon abundance. *Canadian Journal of Fisheries and Aquatic Sciences*, 77(1):132-145.
[6] National Marine Fisheries Service. 2012. Southern California Steelhead Recovery Plan. Southwest Region, Protected Resources Division, Long Beach, California. Page 5-1.

submitted contributes to the best available science and highlights the basis for ACWA's concerns with the potential listing of Southern SH/RT.

A new cohort-based life cycle simulation model (model), developed by Cramer Fish Sciences in collaboration with ACWA member agencies, includes the diverse and interrelated life history variants of *O. mykiss*. The model incorporates anadromous, below-barrier resident, and above-barrier resident sub-populations to evaluate population dynamics and assess extinction risk when resident *O. mykiss* are available to contribute to anadromous populations. When appropriately structured and parameterized, the model is a tool for evaluating these contributions and determining whether sympatric resident populations support long-term viability of southern California steelhead populations. The model demonstrates that the contribution of anadromous and resident (below- and above-barrier) life history variants and their connectivity can affect a population's trajectory, and that omitting them may not fully capture the DPS's long-term resiliency. Cramer Fish Sciences, ACWA, and collaborating member agencies met with the Department on December 12, 2023, to discuss and review the model, prior to the Department's submittal of the Status Review to the Commission.

Cramer Fish Sciences' model reflects existing literature indicating freshwater populations of both below- and above-barrier resident *O. Mykiss* improve the viability of the anadromous life history and contribute to the long-term persistence of the overall *O. Mykiss* population across the range of life histories it exhibits. Although anadromous spawners alone could support the DPS, the model predicted that southern California steelhead are always at or close to collapse without reproductive contributions from below- and above-barrier resident spawners under all conditions but the highest ocean survival scenarios. Depending on contributions to anadromous spawning populations in wet years, the resident life histories provide additional population stability and reduced extinction risk that should be accounted for when making regulatory determinations and setting recovery targets.

The model is supported by the extensive research conducted by ACWA member agencies, survey data, and the available scientific literature and fills a key data gap highlighted by water agencies in past comments and information submittals to the Commission and the Department throughout the petition process. The model is formulated using sound logic and consistent with prevailing practices, with its structure and default parameterization informed by the empirical data that align with the current scientific understanding. Therefore, the model—when combined with other data, analyses, and tools—constitutes the best available scientific information. As a consequence, the Department is obliged to utilize the model and model results to inform its Status Review, and the Commission is obliged to consider the model and model results to inform its ultimate listing decision.

c. <u>Consider Ongoing Restoration and Recovery Activities That Contribute to Conservation and Reduce Threats to the Species</u>

The Department, California Department of Transportation, California State Parks, U.S. Forest Service, County of Ventura, City of San Buenaventura, City of Santa Barbara, City of Carpinteria, City of Malibu, Cachuma Operation and Maintenance Board, Casitas Municipal Water District, United Water Conservation District, Santa Monica Mountains Resource Conservation District, South Coast Habitat Restoration, CalTrout, and many other organizations are currently engaged in significant ongoing restoration and recovery work throughout the DPS. Numerous small- and large-scale recovery actions have already been implemented by the agencies listed above while other actions are in the advanced planning phases. These actions include, but are not limited to:

- Robles Fish Passage Facility modifications on the Ventura River
- Matilija Dam Ecosystem Restoration Project on Matilija Creek
- Foster Park Fish Passage Improvement Projects on the Ventura River
- San Antonio Creek fish passage barrier removal
- Freeman Diversion Habitat Conservation Plan and fish passage improvements on the Santa Clara River
- VenturaWaterPure Program for Santa Clara River Estuary habitat improvements
- Rindge Dam decommissioning on Malibu Creek
- Hilton Creek fish passage barrier removal
- Quiota Creek fish passage barrier removals
- Salsipuedes Creek and El Jaro Creek Fish passage barrier structures
- Gaviota Creek fish passage barrier removal
- Tajiguas Creek fish passage barrier removals
- Arryo Burro fish passage barrier removal and Mesa creek restoration project
- Mission Creek fish passage barrier removals
- Carpinteria Creek fish passage barrier removals
- Maria Ignacio Creek fish passage barrier removal
- Arroyo Hondo Creek Fish Passage Project
- Solstice Creek Fish Passage Restoration
- Malibu Creek fish passage barrier removal project and Malibu Lagoon restoration project
- San Juan Creek dams and fish passage barrier removals
- Trabuco Creek Fish Passage Project

These current and anticipated restoration and recovery actions are consistent with NMFS' Southern California Steelhead Recovery Plan and are anticipated to result in a measurable increase in *O. mykiss* abundance within the southern California DPS over a reasonable timeframe.[7] Large-scale recovery actions are underway or have already occurred in the neighboring south-central steelhead DPS (e.g., San Clemente Dam decommissioning, Los Padres dam fish passage design, Arroyo Grande Creek and watershed improvement projects) that may also aid in the recovery of the southern California steelhead DPS.

Some of these restoration and recovery actions have taken, and will continue to take, years to permit and implement. Some of these completed projects may take years to realize population recovery due to the natural stochasticity of populations and the complex chain of effects between the action and the population-level response. Consequently, prematurely dismissing the efficacy of restoration efforts resulting from the federal listing and NMFS' Southern California Steelhead Recovery Plan is unwarranted. Evaluating the success of this work will likely require a decades-long perspective because of the time required for planning and executing recovery projects, as well as realizing their benefits for the species. In addition, external factors such as precipitation patterns, ocean conditions, and stochastic events may cause annual fluctuations in *O. mykiss* abundance, even if the population experiences a positive growth rate over longer timescales. It is a disconcerting reality that a state listing of the population is likely to increase the time and cost incurred to implement restoration and recovery actions to benefit the population.

d. Consider That a State Listing Would Not Trigger Additional California Environmental Quality Act (CEQA) Evaluations or Afford Additional Protection Beyond that Provided by the Federal Endangered Species Act (FESA)

FESA already prohibits steelhead "take" by law, and the federal definition is wider ranging than the "take" definition under the Fish and Game Code (§ 86), and includes "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct," 16 U.S.C. 1532(19), and "harm" is further defined as "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering," 50 C.F.R. 17.3.

Effects to all special-status species and designated critical habitat are evaluated under CEQA. The Status Review, in Section 7.1.1, fails to explain that CEQA is already triggered if a project would affect southern California steelhead because the species is federally listed. In Section 11, the Status Review erroneously claims that: "Additional protection of Southern SH/RT following listing would also occur during required state and local agency environmental review under CEQA. CEQA requires affected public agencies to analyze and disclose project-related environmental effects, including

[7] National Marine Fisheries Service. 2012. Southern California Steelhead Recovery Plan. Southwest Region, Protected Resources Division, Long Beach, California.

potentially significant impacts on endangered, threatened, and rare special status species. Under CEQA's "substantive mandate," state and local agencies in California must avoid or substantially lessen significant environmental effects to the extent feasible. With that mandate, and the Department's regulatory jurisdiction generally, the Department expects related CEQA review will likely result in increased information regarding the status of Southern SH/RT in California as a result of pre-project biological surveys."[8] Because the species is already listed under FESA and it is presumed that "all juvenile *O. mykiss* in streams where listed steelhead occur are listed juvenile steelhead", there would be no additional CEQA reviews or collection of biological information on the species' status due to listing southern California steelhead under CESA.[9]

The Department is typically already included in interagency coordination and project evaluations through the Lake and Streambed Alteration Program, Fish and Game Code § 1600. Section 7(a)(2) of FESA, 16 U.S.C. 1536(a)(2), requires federal agencies to ensure actions are not likely to jeopardize the continued existence of a species or adversely modify its designated critical habitat. The Status Review claims that application of this section of FESA is limited in scope because it applies only to federal actions and areas under federal ownership; however, most or all projects physically affecting streams that support *O. Mykiss* require permitting and approval by the U.S. Army Corp of Engineers, which would trigger Section 7(a)(2). In addition, the take prohibition under FESA applies irrespective of whether there is a federal nexus.

Under FESA, for incidental take to be authorized, impacts to endangered species must be minimized and jeopardy of the species and/or adverse modification of critical habitat must be avoided. The only additional protection afforded by listing the species under CESA would be that impacts and take must be minimized or "fully mitigated"; however, this standard is tempered by the CESA requirement that the mitigation must be "roughly proportional" to the impact of the take, Fish and Game Code § 2081(b)(2). In sum, there is no evidence that CESA would provide additional protections for *O. mykiss* above and beyond that provided by FESA.

e. <u>Minimize Impacts on Water Management and Programs That Benefit Southern California Steelhead</u>

Designation of southern California steelhead as an endangered species could have significant impacts on water management operations in the region that are critical to public health and safety. Long-term water resilience and the successful

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[8] California Department of Fish and Wildlife. 2024. Report to the California Fish and Game Commission. California Endangered Species Act Status Review for Southern California Steelhead (*Oncorhynchus mykiss*). Sacramento, California. Page 142.

[9] National Oceanic and Atmospheric Administration. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead, 71 Fed. Reg. Jan. 5, 2006. Page 841.

implementation of CESA requires that regulatory agencies collaborate with interested parties to develop an approach that accounts for the various and unique needs of the region and balances water supply reliability and ecosystem enhancement.

Steelhead listings under FESA, which already provides protection to the species as a matter of federal law, have resulted in substantial curtailments of water diversions and extractions in southern California coastal streams. A CESA listing could result in infeasible avoidance and minimization measures for water management and water facility operation activities occurring in streams populated or potentially suitable for future population by *O. mykiss*. In addition, instream flow mandates have the potential to diminish local water supplies at the same time the State is requiring local water agencies to reduce reliance on water supplies that flow through the Sacramento-San Joaquin Delta or are derived from the Colorado River. Regionally, this reduction in available water supply would have significant impacts including, but not limited to, increased overdraft of groundwater basins; reductions in water for municipal, agricultural, and industrial users; water quality degradation detrimental to human health (e.g., increased nitrate concentrations); reductions in agricultural production; job losses; and financial stress to disadvantaged communities and their water systems. More broadly, reductions in available water supply from local sources would place added stress on the State Water Project and other regional and state-level water infrastructure. A CESA listing would have significant impacts to water management, water agencies, and water users throughout the region.

These regulatory effects would impact ongoing or planned projects intended to protect and contribute to recovery of the DPS—such as fish passage projects, habitat restoration projects, and multi-benefit water supply projects designed to meet the state's resiliency and sustainability goals. If the Commission decides to designate *O. mykiss* as an endangered species, water agencies will be subject to additional permitting that could delay projects, increase costs, and generate redundancies given that the species is already listed under federal law and given other federal, state, and local environmental protections. The Department is already a partner in federal consultation and recovery efforts and has developed site-specific protection measures through individual permits and agreements in collaboration with NMFS. In addition, a CESA listing could have unanticipated detrimental effects on southern California steelhead if water agencies are reluctant to implement watershed projects with the potential to benefit anadromous *O. mykiss* because of the possibility of incidental take. For example, the planned removal of the Matilija Dam in Ventura County has been delayed, in part, because of concerns over inadvertent take caused by the mass release of sediment into the Ventura River system as a result of the project.

Moreover, in order to allow the Department and other resource agencies to focus their efforts on the recovery of southern California steelhead, and to allow ACWA member agencies to commit resources to meaningful watershed projects that contribute to the recovery of the DPS, it would be prudent for the Commission to exclude from the proposed listing coastal watersheds where the Department had previously identified concrete-lined flood control channels that present hydraulic (i.e., velocity) barriers to steelhead passage. These structures can extend many miles inland from the river mouth and have been recognized throughout California as barriers to successful upstream migration.

Public water agencies in the impacted central and southern coastal watersheds are working diligently to effectively manage limited water supplies and continue efforts to conserve the species, and they are doing so per the existing federal listing of *O. mykiss*. ACWA member agencies should be allowed to continue their work without an additional layer of regulations and prohibitions in watersheds that are not anticipated to ever provide passage for southern California steelhead. Great care should be taken during the listing process to ensure that existing watershed projects, that will ultimately benefit anadromous *O. mykiss* and other riparian species, are not frustrated by a CESA listing—which is indicated herein does not appear to be supported by the best available science. Managing drought emergencies and long-term climate change impacts requires close collaboration between local and state agencies to continue to provide safe, affordable, and reliable water to southern Californians, and the listing in its current form has the potential to frustrate required coordination.

Conclusion

ACWA appreciates the responsibility currently before the Commission in evaluating the petition and Status Review. There are many factors that will determine the current status of southern California steelhead and a thorough review and analysis of the best available science is needed. ACWA's members along California's South Coast are closely following this effort as the Commission's ultimate decision could have significant impacts on water management operations throughout the region and hinder their ability to provide water supplies to their diverse customers in one of the most densely populated parts of the country.

ACWA appreciates the opportunity to comment and the collaboration of Department and Commission staff. If you have any questions regarding these comments, please contact me at StephenP@acwa.com or (916) 669-2369.

Sincerely,

Stephen Pang
State Relations Advocate
Association of California Water Agencies

Cc: The Honorable Erika Zavaleta, Vice President, California Fish and Game Commission
The Honorable Darius Anderson, Member, California Fish and Game Commission
The Honorable Jacque Hostler-Carmesin, Member, California Fish and Game Commission
The Honorable Eric Sklar, Member, California Fish and Game Commission
Ms. Melissa Miller-Henson, Executive Director, California Fish and Game Commission
Mr. Scott Gardner, Wildlife Branch Chief, California Department of Fish and Wildlife
Mr. Dave Eggerton, Executive Director, Association of California Water Agencies
Ms. Cindy Tuck, Deputy Executive Director, Association of California Water Agencies

Appendix 1

Four Peaks Environmental Science & Data Solutions' Technical Memorandum

PO Box 3312
Wenatchee, WA 98807
509.415.3480

TECHNICAL MEMORANDUM

04/03/2024

TO: Stephen Pang, Association of California Water Agencies
FROM: Lucius Caldwell, Elizabeth Ng, and Grant Woodard, Four Peaks Environmental Science & Data Solutions
SUBJECT: Review of Cramer Fish Sciences Southern California Steelhead Life Cycle Model

Executive Summary

The distinct population segment of Southern California steelhead (*Oncorhynchus mykiss*) below impassible migration barriers is currently listed as Endangered under the federal Endangered Species Act (ESA). This federal ESA-listed population, which is managed by the National Marine Fisheries Service (NMFS), includes only anadromous *O. mykiss* and does not protect freshwater resident life histories. However, the interdependencies of sympatric resident and anadromous life histories was acknowledged by NMFS in their 2006 listing determination, and in 1997 NMFS had defined Southern California steelhead to include resident fish.

In 2021, California Trout petitioned the California Fish and Game Commission to list Southern California steelhead (including all *O. mykiss* below impassible barriers to migration) as an endangered species under the California Endangered Species Act. In an evaluation of this petition published in 2021, the California Department of Fish and Wildlife (CDFW) determined listing may be warranted. This prompted a full evaluation of the status of Southern California steelhead populations by CDFW in a January 2024 report.

The Association of California Water Agencies contracted with Four Peaks Environmental Science & Data Solutions (Four Peaks) to provide a critical review and evaluation of the 2024 CDFW Southern California Steelhead Status Report delivered to the California Fish and Game Commission (CDFW Report), as well as a Southern California steelhead life cycle model developed by Cramer Fish Services (CFS LCM). The CFS LCM was designed to address deficiencies in the current population viability assessments by CDFW and NFMS that only include anadromous spawners. The CFS LCM aims to estimate anadromous and freshwater resident Southern California *O. mykiss* dynamics more accurately by including the effects of both resident and anadromous life histories on anadromous population dynamics.

The CDFW Report provides a relatively comprehensive review of the current status of Southern California steelhead but has some key flaws. First, the underlying data used for some of the analyses in the CDFW Report are limited in terms of their duration, spatial extent, and completeness. These data gaps limit the quality of inferences that can be drawn from the resulting analyses. This issue of limited data availability is heightened by the omission of some key sources of available data. Additionally, some of the data presented in the report are not analyzed correctly. Specifically, some count data—which are indices of population abundance and not abundance estimates themselves—are presented as abundance data, resulting in an inaccurate estimate of abundance. Finally, the CDFW Report analyzes the freshwater resident and anadromous life histories separately, despite their documented interbreeding and ability to give rise to one another, raising questions about the validity of their population viability assessment.

The initial draft of the CFS LCM provides a mechanism for assessing population dynamics when including the interrelated life histories of anadromous and freshwater resident *O. mykiss* populations both above and below barriers to migration. The structure of this model is logical, and the initial default parameterization is defensible and based on empirical data. However, it does have limitations that need to be addressed before it can be used to rigorously evaluate Southern California steelhead population dynamics. Notably, key life stage transition rates such as smolt rates and ocean survival are not parameterizable for individual life histories (anadromous versus resident). This does not allow for these rates to vary, as would be expected due to underlying genetic differences between the two life histories. Additionally, the fecundity parameter is not age-specific, even though fecundity tends to be highly correlated with fish size.

To evaluate the influence of certain key parameters, a sensitivity analysis of the CFS LCM was conducted by Four Peaks. The purpose of this effort was to determine the effects on population dynamics that may propagate through the model from inaccuracies around starting values for population size, fecundity rates, smolt rates, and ocean survival rates. Results from this effort indicated that population dynamics were relatively robust to the starting population size; however, fecundity, smolt rate, and ocean survival rates substantially influenced population dynamics, with higher values of the parameters increasing the long-term viability of the anadromous population. In general, anadromous spawners contributed more to the long-term viability of the anadromous population than resident spawners, though the extent was influenced by environmental conditions.

1 Introduction

1.1 Context

The Association of California Water Agencies has contracted with Four Peaks Environmental Science & Data Solutions (Four Peaks) to provide a critical review of documents related to a petition from California Trout (CalTrout) to list Southern California steelhead (*Oncorhynchus mykiss*) as an endangered species under the California Endangered Species Act (CESA) (CalTrout 2021). The petition notably includes freshwater resident *O. mykiss* (rainbow trout) below impassable barriers. In November 2021, the California Department of Fish and Wildlife (CDFW) published their evaluation of the petition to list Southern California steelhead/rainbow trout[1] (Southern SH/RT), which concluded that, "the petition action may be warranted," (CDFW 2021). In May 2022, the California Fish and Game Commission (Commission) published a Notification of Findings indicating they accepted the petition for consideration (CFGC 2022), prompting CDFW to compile a Southern SH/RT status review to determine if the petition action is warranted.

In October 2023, United Water Conservation District (UCWD) challenged the Commission's decision in court (UCWD v. California Fish and Game 2023). During this hearing, Hon. James C. Chalfant, Judge, stated that an evaluation of freshwater resident rainbow trout abundance and the ability of these

[1] To disambiguate the intended treatment of resident fish within the population proposed for listing under the CESA, CDFW refers to the population as Southern California steelhead rainbow trout.

freshwater resident fish to produce smolts (anadromous individuals) would be required to support a decision to protect Southern SH/RT as an endangered species. Chalfant also raised questions about the rate of smolting among freshwater resident rainbow trout and about precise estimates of rainbow trout population[2] abundance that would be needed before listing. These questions about abundance of freshwater resident fish, ability of freshwater resident fish to smolt, and the rate at which freshwater resident fish smolt are pertinent to the ongoing deliberations regarding Southern SH/RT listing.

In January 2024, CDFW published their status review, in which they stated, "The Department recommends that the Commission find the petitioned action to list Southern SH/RT as an endangered species to be warranted," (CDFW 2024). This memorandum provides a review and evaluation of CDFW's Southern California steelhead status review report (2024) and a review of a technical memorandum prepared by Cramer Fish Science describing a life cycle model (CFS LCM) developed to evaluate Southern California steelhead population viability (CFS 2024).[3] The following specific objectives were defined to support this goal:

1. Summarize the key regulatory issues related to CESA-listing of Southern California steelhead
2. Review and critique the CDFW status report
3. Review, summarize, and critique the CFS technical memorandum

The remainder of this technical memorandum presents the following components:

- A summary of the current regulatory status of Southern California steelhead (Section 1.2)
- A summary of the petition to list (Section 1.3)
- Four Peaks' review and evaluation of the CDFW Report (Section 2)
- Four Peaks' review and evaluation of the CFS technical memorandum (Section 3), which includes an Executive Summary of this technical memorandum suitable for dissemination as a standalone document to brief interested parties in advance of future discussions (Section 3.1)
- Results from Four Peaks' sensitivity analysis of the CFS LCM to evaluate the relative influence of model parameter assumptions on model predicted population dynamics for Southern California steelhead (Section 4)

1.2 Current Regulatory Status of Southern California Steelhead

The Southern California steelhead evolutionarily significant unit (ESU) was initially listed as endangered under the federal Endangered Species Act (ESA) in 1997 (NMFS 1997). At that time, the National Marine Fisheries Service (NMFS) listed only the anadromous form of *O. mykiss* within the stated range of Southern California steelhead (NMFS 1997, pg. 43938). In 2002, the southern range limit of Southern California steelhead was extended under the ESA listing (NMFS 2002). The initial 1997 decision by NMFS to list only anadromous *O. mykiss* has been followed in each subsequent listing: in 2006, the ESA listing

[2] Note that the term "population" is used throughout this document to refer to groups of individuals that, in some cases, exist at different hierarchical levels. For example, there is the worldwide population of steelhead, the Southern California steelhead population, populations of Southern California steelhead that exist within each basin, and populations of anadromous and resident fish within those populations of Southern California steelhead within each basin. To maintain readability and avoid introducing excessive terminology, no effort has been made throughout this document to disambiguate these groups except for cases in which a subpopulation is referred to in direct reference to its parent population.

[3] "Viability" in this context implies less than 5% extinction risk over the next 100 years (see NMFS 2023b, pg. 16).

was further modified to relist the Southern California steelhead ESU as a distinct population segment (DPS), further distinguishing between the anadromous and resident forms of *O. mykiss* (NMFS 2006). In the 2006 listing, NMFS reiterated, "Within these geographic boundaries, we further conclude that the anadromous life form is markedly separate from the resident life form… We therefore are delineating… steelhead-only DPSs," (NMFS 2006, pg. 848). In summarizing their status assessment leading to this 2006 listing, NMFS stated, "the BRT [*an expert panel of scientists from several Federal agencies including NMFS, FWS, and the U.S. Geological Survey*] concluded that the contribution of the resident life-history form to the viability of an *O. mykiss* ESU in-total is unknown and may not substantially reduce extinction risks to an ESU in-total," (NMFS 2006, pg. 851). The current understanding, summarized in NMFS's most recent Status Review, is that individuals of the resident life history do contribute to anadromous populations, although the degree to which this affects population dynamics remains unquantified (NMFS 2023a).

1.3 California Trout Petition to List Southern California Steelhead

On June 7, 2021, CalTrout submitted a Petition to the Commission to list Southern California steelhead, including both anadromous and freshwater resident life histories of *O. mykiss*, as endangered under CESA (CalTrout 2021). In their petition, CalTrout states their position as follows,

> *"CalTrout supports following the federal ESA listing coverage for below barrier steelhead, while keeping the above-barrier resident rainbow trout outside the ESA listing coverage."*

However, the CalTrout Petition deviates from the ESA listing by including freshwater resident fish below barriers within the listed steelhead distinct population segment (DPS).

On June 23, 2021, the petition to list Southern California steelhead under CESA was referred to CDFW for an evaluation of the scientific information presented therein and a recommendation whether to list, which was published in November 2021 (CDFW 2021). In their evaluation, CDFW (2021) notes that CalTrout (2021) defined Southern California steelhead as, "all *O. mykiss*, including anadromous and freshwater resident life histories, below manmade and natural complete barriers to anadromy" (CDFW 2021).

CDFW highlighted the fact that this proposed state designation differs from the ESA listing of a DPS of steelhead with the same geographic range that includes, "only naturally spawned anadromous *O. mykiss*," (CDFW 2021), referring to NMFS's 2006 listing of Southern California steelhead cited above. This deviation in the treatment of freshwater resident fish under the proposed state designation and existing federal designation raised uncertainty regarding the intent of the initial CalTrout Petition, which was resolved in a series of unpublished emails between CDFW and CalTrout in October 2021 confirming,

> *"CalTrout defines Southern California steelhead as all Oncorhynchus mykiss, including anadromous and resident life histories, below manmade and natural complete barriers to anadromy… with the understanding that anadromous (adult southern steelhead) arise from anadromous and resident naturally spawning adults," (as quoted in CDFW 2021).*

At the heart of this confusion between CalTrout—the listing organization—and CDFW—the regulatory agency tasked with providing the best scientific information to inform CESA listing by the Commission—is the issue of appropriate treatment of freshwater resident *O. mykiss* in an evaluation of sympatric (occupying the same geographic areas) anadromous *O. mykiss*. That keystone issue led to the development of the CFS LCM reviewed here, to address NMFS's and CDFW's lack of inclusion of the effects of freshwater life histories on anadromous Southern California steelhead population dynamics.

2 Review of California Department of Fish and Wildlife Status Report

2.1 Summary

2.1.1 Purpose and Context

CDFW's Status Review (CDFW 2024) evaluates whether there is sufficient scientific information to indicate that the continued existence of Southern SH/RT, throughout all or a significant portion of its range, is endangered or threatened. Although the federal ESA listing for the Southern California steelhead DPS includes only the anadromous life-history component, CDFW recommends the Commission list Southern SH/RT, which includes freshwater resident fish below barriers, under CESA. CDFW asserts legal authority to interpret what constitutes a species, justifying their departure from the federal listing.

2.1.2 Life History Considerations

Southern SH/RT enacts both freshwater and ocean migratory (anadromous) life history forms. The enacted life history depends on genetic factors, as well as environmental conditions such as freshwater rearing habitat availability, hydrologic conditions, and ocean access. CDFW provides evidence that the preservation of existing life history diversity within Southern SH/RT is important to foster long-term population stability, as this diversity provides a measure of redundancy that distributes risk, buffering populations from local extirpation or population-level extinction (collapse). They summarize their position regarding the importance of this life history diversity as follows:

> *"Ideally, all three Southern SH/RT life-history types (i.e., fluvial-anadromous, freshwater-resident, lagoon-anadromous) would be expressed within a single population, or the population would harbor the underlying genetic variation to express those life-history types when environmental conditions allow,"*
> *(CDFW 2024, pg. 80).*

CDFW states that, "it is unclear that the resident component can reliably produce anadromous fish after prolonged periods of unfavorable conditions in the long term."[4] A recent viability assessment includes the statements of NMFS's understanding regarding the contributions of resident *O. mykiss* to steelhead populations:

- "We recognize that there may be situations where reproductive contributions from non-anadromous *O. mykiss* may mitigate short-term extinction risk for some steelhead DPSs," (NMFS 2023b, pg. 5).
- "Freshwater-resident (non-anadromous) forms of O*. mykiss* co-occur and appear to interbreed with the anadromous form in many populations, and new research has improved our understanding of the genetic architecture of the populations exhibiting both nonanadromous and anadromous forms (Pearse et al. 2014, Pearse et al. 2019). Thus, while not formally considered part of the DPS, resident

[4] In support of this statement, CDFW cites "Boughton et al. 2022a," which is listed in their references as Boughton 2022. The Boughton or Boughton et al. 2022 document listed in the references of CDFW 2024 could not be located. It appears the correct citation for this statement is NMFS (2023): "Viability Assessment for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Southwest."

(nonanadromous) *O. mykiss* warrant consideration in managing for the anadromous life history" (NMFS 2023b, pg. 155).

- "To meet criteria for life-history expression, viable populations would need to consistently exhibit both the resident and anadromous life history, as well as a third life history of anadromous fish that rear in estuaries for a significant time prior to smolting," (NMFS 2023b, pg. 176).

2.1.3 Life Histories Included in the Proposed Listing and Associated Assessments

CDFW states that,

> *"Non-anadromous resident O. mykiss… reside in many of these same streams and interbreed with anadromous adults, contributing to the overall abundance and resilience of the populations. Southern SH/RT as defined in the Petition include both anadromous (ocean-going) and resident (stream-dwelling) forms of O. mykiss below complete barriers to anadromy in these streams," (CDFW 2024, pg. 139).*

In fact, this proposition to include freshwater resident fish harkens back to NMFS's initial position of including this life history within the listed DPS,[5] which was retracted only after considering the substantial comments advocating against this approach, including comments from the U.S. Fish and Wildlife Service (FWS).[6] Although the freshwater resident form is not considered in NMFS's ESA listing, NMFS did include co-occurring freshwater resident *O. mykiss* in population assessments, where data were available. An expert panel of scientists from several federal agencies initially concluded the contribution of the freshwater resident life-history form to the viability of an *O. mykiss* ESU in-total is unknown and may not substantially reduce extinction risks to an ESU in-total (NMFS 2006). However, more recent science indicates that these resident life histories are likely to provide some mitigation to anadromous population viability, but the extent remains unquantified (NMFS 2023a).

2.1.4 Population Status and Trends

CDFW states that populations of freshwater resident and anadromous *O. mykiss* have both experienced drastic reductions in their abundances and ranges since the early 20th century, with declines in anadromous returns estimated to be over 90%. They further assert that available data indicate that populations of both the anadromous and nonmigratory life histories have remained critically low in the 21st century and have not recovered since listing under the ESA.

2.1.5 Departmental Position on Listing

Given the continued low abundances of freshwater resident and steelhead *O. mykiss* populations, CDFW believes consideration for CESA listing is justified. CDFW identifies multiple primary actions for protecting and restoring Southern SH/RT populations.

[5] "While conclusive evidence does not yet exist regarding the relationship of resident and anadromous *O. mykiss*, NMFS believes available evidence suggests that resident rainbow trout should be included in listed steelhead ESUs in certain cases," (NMFS 1997, pg. 43941).

[6] "However, the FWS, which has ESA authority for resident fish, maintains that behavioral forms can be regarded as separate DPSs… and that absent evidence suggesting resident rainbow trout need ESA protection, the FWS concludes that only the anadromous forms of each ESU should be listed under the ESA," (*ibid*).

2.2 Critical Evaluation of California Department of Fish and Wildlife Findings

The CDFW report provides an assessment of the status and trends of Southern California SH/RT, as well as the probable reasons for their decline and current obstacles to recovery. However, this assessment is based on limited data that may be incomplete and appear to have been inappropriately analyzed in certain cases. Moreover, while CDFW acknowledges interbreeding between sympatric populations of anadromous adult steelhead and freshwater resident rainbow trout, the populations are evaluated separately, with no accounting for the contributions of freshwater resident fish to steelhead population viability.

2.2.1 Data That Were Omitted from Analysis

Although a complete review of available data was beyond the scope of this evaluation, information provided by UCWD indicates that CDFW (2024) may have omitted important *O. mykiss* monitoring data from their assessment. For example, camera data from a diversion on the Santa Clara (Booth 2016) are mentioned by CDFW (2024) in Section 7.5.2 of their report (Other Monitoring Programs), but apparently not included in their analysis of steelhead population status and trends. Additional sources of data are mentioned in Section 7.5.2 of CDFW's report that appear not to have been incorporated into their status and trends analyses include snorkel surveys of fish abundance in the Santa Ynez River and video-based fish counts in the Ventura River.

2.2.2 Data That Were Inappropriately Analyzed

To paraphrase John G. Sheperd, Emeritus Professor at University of Southampton and former principal scientific adviser to the UK government on marine fisheries management, counting fish is like counting trees, except that you cannot see them and they keep moving around.[7] Observed counts of a sample of animals or plants do not provide accurate estimates of population abundance unless they are statistically analyzed to account for the methods under which these data were collected (Cormack 1964; Jolly 1965; Seber and Le Cren 1967). Such treatment is needed to expand count data into an accurate estimate of population size. Abundance estimations derived from appropriate statistical treatment are less affected by the inevitable undercounting and double counting that occurs when counting individuals. Without this treatment, count data are observations that, at best, provide an index of total population abundance, but do not provide a robust estimate or quantify uncertain around that estimate.

However, count data from fish passage monitoring on the Santa Clara River (Booth 2016) are presented in CDFW's report as an estimate of *O. mykiss* abundance in the Santa Clara system. These observations of juvenile and adult *O. mykiss* presented in the Booth (2016) report have not been statistically analyzed to derive a robust estimate of overall population size (e.g., see Carlson et al. 1998; Macdonald and Smith 1980). Such analyses are required to account for trap efficiency, periods when gear was not operational, and differences in the overall level of effort associated with gear deployment.

After reviewing Section 4.2 (Sources of Information) in CDFW's report, it is not clear if any trap data or other fish enumeration data were treated statistically to develop the estimates of population size used in their Abundance and Trends Section (4.4).

[7] The original quote is, "Managing fisheries is hard: it's like managing a forest, in which the trees are invisible and keep moving around," – John G Sheperd. Source: https://jgshepherd.com/thoughts/.

2.2.3 No Acknowledgment of Interbreeding

Within the CDFW (2024) report, abundance and trend data are presented separately for anadromous adults and "other" *O mykiss* (i.e., freshwater resident forms). Because of this separate treatment, the reproductive contributions of sympatric freshwater adult spawners to the production of smolts and future adult steelhead are not accounted for in measures of population status or the evaluation of long-term viability of Southern California steelhead.

Similarly, CDFW does not consider the potential contributions from above barrier populations of rainbow trout to the number of smolts resulting from downstream migration over barriers that can occur in some systems:

> *"The Department also considers Southern SH/RT to be markedly separate from above-barrier populations of O. mykiss in watersheds that are within the geographic scope of the proposed listing unit, because these above-barrier populations do not contribute substantially to the below-barrier populations of Southern SH/RT," (CDFW 2024, pg. 37).*

A more specific definition of what CDFW considers to be an "impassable" barrier would enable a more thorough evaluation of CDFW's approach. Depending on the level of contribution from above barrier populations to smolt production and anadromous adult spawners via downstream migration, these above barrier populations might also merit inclusion and protection under the CESA if they are measurably contributing to the anadromous populations.

3 Cramer Fish Sciences Life Cycle Model Technical Memorandum Review

3.1 Executive Summary

Cramer Fish Sciences (CFS) developed a technical memorandum in which they present a mathematical model (CFS LCM) for evaluating Southern California steelhead viability (CFS 2024). The CFS LCM was developed to address the California Department of Fish and Wildlife's lack of inclusion of the effects of freshwater resident life histories on anadromous Southern California steelhead population dynamics in their assessment of overall Southern California steelhead population viability, by accounting for freshwater resident contributions to the anadromous population. The model was constructed to accommodate variable environmental conditions and population demographics, enabling the exploratory evaluation of alternative scenarios.

3.1.1 Background

Within the petition to list under the California Endangered Species Act, Southern California steelhead is defined to include, "all *O. mykiss* below manmade and natural complete barriers to anadromy, including anadromous and resident life histories," from five biogeographical population groups.

The National Marine Fisheries Service (NMFS) has established a recovery goal for Southern California steelhead based on the number of adult anadromous spawners. NMFS acknowledges that freshwater resident trout and anadromous steelhead interbreed, but NMFS has not accounted for contributions to anadromous spawners from offspring of freshwater resident parents in the development of their recovery goal. Accounting for these contributions may change conclusions about population viability, as viability is assessed in relation to a recovery goal stated in terms of anadromous spawners.

To evaluate this possibility, CFS developed the CFS LCM, which is a "cohort-based life cycle simulation model" that includes both freshwater resident and anadromous life histories. The purpose of the CFS LCM is to simulate population dynamics (changes in abundance over time) and thereby evaluate extinction risk when freshwater life histories are available to contribute to anadromous populations.

3.1.2 Model Approach and Overview

The CFS LCM includes freshwater resident and anadromous populations and evaluates the effects of reproductive contributions from freshwater residents on the overall population viability of Southern California steelhead. The model has been initially parameterized using data compiled from a literature review and from a similar model developed by CFS for the Central California Coast steelhead DPS (the "Suisun Creek LCM").

The structure of the CFS LCM draws from the following simulation models developed for salmonids:

- NOAA's Habitat Restoration Planning (HARP) model (Jorgensen et al. 2021)
- The Shiraz model, developed collaboratively by researchers from NOAA, the University of Washington, Snohomish County Public Utility District, and the Tulalip Tribe (Scheuerell et al. 2006)
- CFS's Nooksack and Suisun Creek models

The CFS LCM simulates population dynamics over a modifiable time period (default of 125 years) for ten subpopulations of Southern California steelhead. The dynamics of all ten subpopulations are then aggregated to estimate overall Southern California steelhead DPS population dynamics.

The CFS LCM includes the following three life histories for each modeled subpopulation of Southern California steelhead:

1. Below-barrier anadromous populations
2. Below-barrier freshwater resident populations[8]
3. Above-barrier (perched) freshwater resident populations

The number of adults within each life history group are modeled separately, but the number of juveniles is modeled collectively for life history groups that are connected, with connection being based on environmental conditions. Offspring both from anadromous adults and from below-barrier freshwater resident adults always contribute to a collective pool of juveniles that either "smolt" in preparation for an anadromous life cycle or develop into freshwater resident adults (rainbow trout). Depending on the annual hydrologic regime (wet, average, or dry), offspring from perched freshwater resident adults may also contribute to this collective pool of juveniles that can smolt. Annual environmental conditions also affect juvenile survival and the proportion of below barrier juveniles that smolt. The CFS LCM follows cohorts of each life history group as they develop through distinct life stages (e.g., eggs, fry, smolts). The model accounts for survival associated with the transitions between these life stages and among the three modeled life history groups (Table 1). The default model settings for these transition rates are informed by empirical data that align with the current scientific understanding, but they can be adjusted individually by the user, for example, to simulate environmental scenarios.

Table 1. List of life stages and transitions included in the Cramer Fish Sciences life cycle model for Southern California steelhead

Life Stage or Transition Process	Description and Notes
Returns to Spawners	Determines the number of spawners for each life history group
Spawners to Eggs	Determines the number of eggs produced by adult females of each group
Egg to Fry	Determines the number of early-stage juvenile fish (fry)
Fry Rearing and Colonization (Survival)	An estimate of fry survival to the point of their initial winter
Winter Rearing Capacity and Survival	A density-dependent function for imposing fry mortality during winter
Summer Rearing Capacity and Survival	A density-dependent function for imposing parr mortality during summer
Smolt Rate	Rate that freshwater fish convert to anadromous life strategies.
Lagoon Rearing	Rate at which lagoon rearing occurs for smolts; alternative to estuary/ocean rearing
Estuary Survival	Rate at which anadromous smolts survive during estuary phase; default conditions for anadromous smolt rearing
Ocean Survival	Rate at which anadromous smolts survive during ocean phase; default conditions for anadromous smolt rearing
Maturation	Rate at which fish mature to spawners
Iteroparity	Rate at which spawners return and spawn again next year

[8] CFS refers to this population as "Resident."

3.1.3 Impact of Environmental Conditions on Model Rates

The model includes three types of annual hydrological conditions: wet, regular[9], and dry. The reference condition is regular water availability, which is based on an average of historical records of the last 40 years of streamflow data.

During regular years, anadromous connection is maintained so that smolts can emigrate and anadromous adults can return to spawn. Perched populations do not contribute to below-barrier freshwater resident populations, and thus cannot contribute to anadromous populations through smolts.

During dry years, several adjustments are made to the regular year baseline. Perched and below-barrier freshwater resident populations experience reduced carrying capacity, smolt rate is reduced, and stray rate is increased. Perched populations do not contribute to below barrier freshwater populations.

During wet years, several adjustments are made to the regular year baseline. In wet years during which the perched freshwater resident population exceeds its carrying capacity, perched freshwater resident fish contribute to downstream (below-barrier) freshwater resident populations. These below-barrier freshwater residents can then contribute to the anadromous population by smolting.

The model also allows parameterization of a reduction event, which simulates a catastrophic die-off. This can be used to model a decrease in the number of spawners that can be applied for a set number of years to simulate drastic negative environmental impacts to the populations.

3.1.4 Four Peaks' Assessment of the Value of the Cramer Fish Sciences Life Cycle Model

When appropriately structured and parameterized, the CFS LCM will provide a tool for evaluating contributions from freshwater resident fish to the anadromous adult population. The model provides a logical mechanism for evaluating whether sympatric freshwater rainbow trout populations can support long-term viability of steelhead populations.

3.2 Critical Evaluation

3.2.1 Model Summary

The CFS LCM simulates transition rates among a set of model states to represent the transitions among various life stages of a developing fish (Table 2). The model simulates how eggs and parr mature and smolt to capture the interplay between anadromous and resident populations. Adults from the below-barrier freshwater resident group (referred to by CFS simply as the "Resident" group in the model framework and associated Shiny application) can contribute to anadromous adult returns, because all below barrier juveniles are "available" for smolting. Adults from the perched freshwater resident fish (referred to by CFS simply as the "Perched" group in the model framework and associated Shiny application) can contribute to below-barrier freshwater resident populations in wet years when the perched population density exceeds carrying capacity. The simulation-based framework allows users to account for uncertainty by entering different values for certain parameters (e.g., sequence of wet and dry years, survival rates).

[9] CFS alternatively refers to average, medium, and normal environmental conditions. For the purposes of this evaluation, these three terms are assumed to refer to the same "Regular Years" condition described in CFS's technical memorandum.

Table 2. Description of life stages and transitions included in the CFS LCM for Southern California steelhead

Life Stage or Transition Process	Description and Notes
Returns to Spawners	• Determines the number of spawners for each life history group • Estimated as the total number of spawners within each group, multiplied by pre-spawn mortality and harvest rates for that group • Parameterizable for each of the three life histories
Spawners to Eggs	• Determines the number of eggs produced by adult females of each group • Estimated as 50% of the total number of spawners (assuming half are female) times the fecundity value (the average number of eggs produced per female), which is parameterizable for each of the three life histories
Egg to Fry	• Determines the number of early-stage juvenile fish (fry) • Estimated by multiplying the number of eggs times the egg to fry survival parameter • Egg to fry survival is parameterizable for both above- and below-barrier freshwater populations
Fry Rearing and Colonization (Survival)	• An estimate of fry survival to the point of their initial winter • Estimated by multiplying the number of fry times the fry survival rate parameter • Separate estimates for perched and below barrier resident populations • Reduced in dry years
Winter Rearing Capacity and Survival	• A density-dependent function for imposing mortality during winter • This is parameterizable for each of the two freshwater life histories. • Uses a Beverton-Holt function (density dependent asymptotic function) so that incremental increases in rearing capacity/survival approach 0 as fry density increases • The Beverton-Holt function is dependent on habitat capacity and productivity, which differ among watersheds • This function assumes capacities by age account for effects of other age classes
Summer Rearing Capacity and Survival	• A density-dependent function for imposing mortality during summer • Otherwise, as above for Winter Rearing Capacity and Survival
Smolt Rate	• Rate that freshwater fish convert to anadromous life strategies • Each freshwater juvenile age class has an associated smolt rate that determines the proportion of that age class that will migrate to the ocean • Age and watershed dependent, only juveniles up to age 4 have the capacity to smolt, individuals older than this enact a fully freshwater life history
Lagoon Rearing	• Rate at which lagoon rearing occurs for smolts • Accounts for a strategy of anadromous smolts that provides greater survival for individuals rearing in lagoons compared to estuary and nearshore rearing • Density dependent function calculating amount of smolts that can rear in the lagoon, with the others being relegated to the estuary
Estuary Survival	• Default conditions for anadromous smolt rearing • Age specific survival rate times the number of estuary rearing smolts
Ocean Survival	• Default conditions for anadromous smolt rearing • Age-specific survival rate times the number of estuary rearing smolts
Maturation	• Rate at which fish mature to spawners • Separate rates for each life history group and age • Estimates of spawners within each life history group determined by multiplying age specific maturation rates times the number of fish in each age class for each life history and watershed • Also, anadromous spawners may stray to neighboring watersheds and contribute to the number of spawners via a straying rate
Iteroparity	• Rate at which spawners return and spawn again next year • Determines the number of adults that will repeat-spawn • Number of repeat spawners is calculated by multiplying number of spawners times the proportion of fish that respawn (iteroparity rate) and their probability of surviving spawning (respawn survival rate) • Assumes fish cannot change life histories once it is determined • Separate value for each life history

CFS has developed a reasonable and logically sound foundation for a cohort-based LCM to assess the role of environmental conditions and freshwater resident trout contributions on anadromous steelhead population dynamics. The CFS LCM was developed to address CDFW's lack of inclusion of the effects of freshwater life histories on anadromous Southern California steelhead population dynamics. If freshwater resident contributions to anadromous returns change population dynamics enough to affect viability, population recovery targets may benefit from a reevaluation. The modular nature of the cohort-based model provides a high degree of flexibility. Individual parameters can be used for different life stages, life histories, age classes, watersheds, and sub-watersheds. This means the CFS LCM can be used to evaluate knowledge gaps, test the effects of environmental and demographic conditions, and be updated as more information becomes available.

The CFS LCM is designed to evaluate relative differences in population outcomes as a consequence of changes to environmental or life history parameters relative to some baseline, providing guidance for future management and research actions. It is not designed to forecast accurate population abundances or develop recovery targets. However, it can be used to evaluate the assumptions used to determine recovery targets. While the basic model structure is adequate for examining Southern California steelhead population dynamics, key additions to the model structure are needed for the model to adequately address the questions posed by Association of California Water Agencies regarding current population abundance and the rate at which freshwater resident fish contribute to the anadromous population.

3.2.2 Strengths

- The CFS LCM is built on a flexible framework that incorporates relevant, recent, empirical data and information about Southern California steelhead.
- The CFS LCM includes components for resident and perched life history types, whose impacts were not included previously in CDFW's and NMFS's minimum viable population size assessments.
- The interactive GUI facilitates exploratory analyses and simple simulations.
- The model provides a framework for evaluating complex population dynamics that emerge from the interaction of freshwater resident, anadromous, and perched populations. The model incorporates effects of environmental variability, for example by modifying the contribution of perched fish and fry survival under different hydrologic conditions (i.e., "wet year" versus "dry year").
- Perched *O. mykiss* may contribute to below barrier populations and provide a buffering effect. Including a model structure with this phenomenon allows users to parameterize the magnitude of this effect based on professional opinion or emerging empirical data.
- Systematic simulations (e.g., sensitivity analyses) can be used to explore the ramifications of variance in these biological factors (see Section 4 for results from a set of these simulations).
- Other environmental factors that vary across years (e.g., ocean survival) are included in the model, but cannot be parameterized dynamically, to allow for differences among years.
- Systematic simulations can be used to explore the ramifications of variance in these environmental factors (see Section 4 for results from a set of these simulations).

3.2.3 Limitations

3.2.3.1 Summary of Limitations

While the current iteration of the CFS LCM uses sound logic and science, it does have several key flaws and limitations. One potentially important limitation of the model is that two key transition rates—the smolting rate and the ocean survival rate—are not life history specific. Offspring from anadromous parents and those from below-barrier freshwater resident parents are grouped together and share one set of transition rates between successive juvenile life stages (i.e., egg, fry, parr, smolt). While the framework accounts for contributions from freshwater resident adults to the number of returning anadromous adults, it does not support individually setting model parameters for these groups separately. This omission limits the range of simulations that can be analyzed and has implications for the accuracy of model output. Also, the fecundity rate for anadromous adults does not vary with age, to reflect the fact that older fish are larger and produce more eggs.

These flaws and other minor additional limitations are discussed in the following sections. These flaws and limitations should be addressed before the model is used in scientifically rigorous assessments of Southern California steelhead population dynamics and viability. However, upon incorporation of the revisions suggested below, the model would likely be an appropriate model of potential Southern California steelhead population dynamics.

3.2.3.2 Key Transition Rates Are Shared Between Life History Groups

The smolt rate is not individually parameterizable for offspring of each life history group. Smolt rate determines the relative occurrence of anadromy within the population being modeled, and thus the number of anadromous adult returns in the model's next step. In some ways, grouping all below-barrier juveniles is a strength of the model, as it considers all these fish to be freshwater residents, until they smolt. This approach enables a comprehensive Southern SH/RT viability assessment based on abundance of all juveniles, regardless of parentage. However, this identical treatment of all juveniles does not accurately reflect current scientific understanding.

Substantial evidence indicates that there are important genetic differences between populations of anadromous, below-barrier freshwater resident, and perched freshwater resident *O. mykiss*. A review of this evidence is presented in CDFW's recent Southern California steelhead Status Review (CDFW 2024). Key for this critical evaluation of the CFS LCM, the relative contributions to returning anadromous spawners differ among the different life histories, with anadromous spawners producing the highest proportion of future anadromous spawners (Abadía-Cardoso et al. 2019; Fraik et al. 2021). Thus, one set of smolt rates for all life histories is not appropriate in modeling the effects of these different life histories on anadromous steelhead abundance. The structure of the CFS LCM does not capture any reproductive isolation or reflect the genetic underpinnings of smoltification that may lead to different smolt rates between offspring of freshwater resident rainbow trout parents and those of steelhead parents.

The model also lacks the ability to set different rates of ocean survival for offspring of freshwater resident parents and those of anadromous parents. The size at which fish within a population smolt (size threshold) differs among life history groups, reflecting a heritable genetic component to smoltification (Phillis et al. 2016). Different size thresholds for smolting may translate into differences in size at ocean entry among smolts that originate from parents with different life histories. Size at ocean entry has been shown to be affect marine growth rate—and, importantly, ocean survival—of smolts (Weitkamp 2015). Different ocean survival rates can contribute to differences in smolt-to-adult return ratios between life history groups, which would affect their respective ability to meaningfully contribute to returning adult steelhead abundance.

While this structure does not represent a "fatal flaw" in the CFS LCM, the model could be improved by including age-specific smolt rates for each life history, with a default parameterization that established offspring of anadromous fish having higher smolt rates than offspring of non-anadromous fish.

3.2.3.3 Fecundity of Anadromous Adults Does Not Vary Among Ages

The fecundity parameter within the model appears to be an average value (numbers of eggs) per female. All salmonids exhibit "size dependent fecundity," meaning larger females produce more eggs (Fleming 1998), and *O. mykiss* are no exception (Jenkins et al. 2018; Schill et al. 2010). *O. mykiss* spawn at different ages and are capable of repeat-spawning over a range of ages, a process called kelting among steelhead that do so. Salmonids also exhibit "indeterminate growth," meaning they continue to grow throughout their lifespan, and older fish are larger than younger fish (Mommsen 2001). Taken together this means that older *O. mykiss* are larger and produce more eggs than younger *O. mykiss*.

The range of size variation across age classes, and therefore fecundity, may not be very large in spawning female freshwater resident *O. mykiss* (Schill et al. 2010). However, the range in size at spawning for anadromous steelhead can be very large, leading to dramatic differences in fecundity (Jenkins et al. 2018). For example, adult steelhead kelts continue to grow after their first spawning, which has been shown to lead to an approximately 10% increase in fecundity between subsequent spawning events (Seamons and Quinn 2010). The CFS LCM could be improved by including an age-dependent fecundity parameter for all life history groups, especially the anadromous life history.

3.2.3.4 Additional Considerations

In addition to the model limitations described in Sections 3.2.3.2 and 3.2.3.3, the CFS technical memorandum could be improved by addressing the following concerns. These are less critical but addressing them would enable a more thorough evaluation of the mechanics of the model.

First, mathematical equations are not included in the memorandum or on the Shiny application. Equations should be included in all modeling efforts to enable evaluation of model assumptions. Similarly, the baseline parameterization of density dependent relationships is unclear. In several places (e.g., spawner to egg, winter rearing, summer rearing), baseline transition rates are unclear.

The choice of functional relationships and rationale for selection are not explained. Decisions regarding the type of functional relationships may be appropriate, but these are difficult to evaluate without an explanation of the rationale. Density dependent relationships can have strong effects on simulation trajectories. It is unclear why the "hockey stick" function is used to calculate egg production from spawners, but the Beverton-Holt function is used to calculate other metrics of density dependence such as winter rearing capacity and summer rearing capacity, and the lack of consistency was not explained.

Parameterization of Beverton-Holt and other density-dependent functions is not documented or described in the technical memorandum. These parameters of the density dependent relationships should be modifiable within the CFS LCM to best suit the system and population, as the level of density dependence could have a strong impact on simulation results. Additionally, the fry rearing calculations do not appear to incorporate any density dependent dynamics. This is odd, because fry should also be subjected to similar density dependent phenomena as the other juvenile rearing populations. Further, while the lagoon rearing dynamics mention they are subject to density dependence, the memorandum does not indicate what mathematical function is being used (i.e., Beverton-Holt, hockey stick, or something else).

CFS's intention to publish the model in peer-reviewed scientific literature would provide an opportunity to subject the details of the model's structure, parameterization, and justification to a high level of scientific rigor. These details could also be included in an appendix to the Shiny application, but must be available somewhere, whether in peer-reviewed literature or the Shiny application for reference and evaluation.

3.3 Conclusions from Review of Life Cycle Model

Depending on contributions to anadromous spawning populations by below barrier freshwater resident populations and above barrier freshwater resident populations in wet years, the freshwater life histories may provide additional population stability and reduced extinction risk that should be accounted for when setting recovery targets. When appropriately structured and parameterized by addressing the aforementioned limitations, the CFS LCM will provide a tool for evaluating these contributions and determining whether sympatric freshwater rainbow trout populations support long-term viability of steelhead populations.

4 Cramer Fish Sciences Life Cycle Model Sensitivity Analysis for Southern California Steelhead

4.1 Sensitivity Analysis Introduction

Sensitivity analysis is a technique used to evaluate the performance of complex models and to understand the relative effect that individual model inputs or assumptions (parameters) exert on determining model outputs (predictions). In sensitivity analysis, critical parameters are identified and then varied systematically. The robustness of model predictions is evaluated by observing the change in model output that results from adjusting each parameter. Insights can be gleaned about the relative importance of each parameter by evaluating the range and distribution of outcomes.

In this way, the model's overall "sensitivity" to the value of individual parameters (sometimes referred to as parameterization, or parameter settings) can be evaluated, to identify the parameters that have the greatest effects on model results. The model is understood to be "sensitive" to the values of those parameters, which are thus considered important in determining the accuracy of model predictions. Those important parameters to which the model is highly sensitive then become a research priority to improve the accuracy of model predictions. This is particularly important for model parameters with high uncertainty. Highly uncertain parameters that strongly influence model results provide important caveats for model interpretation, and these should be prioritized when developing future research.

Four Peaks conducted a sensitivity analysis to test the influence of both basic model assumptions (robustness to starting population size) and uncertainty in important life history parameters including smolt rate, fecundity, and ocean survival. The following sections present a summary approach for the analyses, the results from these simulations, and finally a discussion of the implications of the findings. Of note, as it constitutes a point of departure from language used in the preceding sections, CFS's terminology regarding life history groups has been retained. Thus, in the subsections that follow, "Resident" refers specifically to the below-barrier freshwater resident group, while "Perched" refers to the above-barrier freshwater resident group.

4.1.1 General Approach

To evaluate the CFS LCM's sensitivity to individual parameters, a series of scenarios were constructed by systematically varying individual parameters while holding others constant. The parameters that were varied included initial abundance, fecundity, smolt rate, and ocean survival rate. This approach enabled an assessment of the differences in population trajectories under different values of that specific parameter.

Because the CFS LCM depends on the sequence of annual environmental conditions (wet, dry, or normal), Four Peaks ran all simulation scenarios under the following four different sets of environmental conditions:

1. All dry years
2. All normal years
3. Normal and dry (repeating sequence of normal, dry, dry, dry, normal)
4. Normal, wet, and dry (repeating sequence of normal, wet, dry, dry, normal)

These environmental conditions were chosen to represent potential proportions of wet, dry, and average moisture years. Table 3 presents a summary of the default conditions used for the eight model scenarios (varying initial abundance, varying fecundity, varying smolt rate, varying ocean survival).

Table 3. Default parameter values used in the eight model scenarios

Scenario	Life History	Initial Abundance (Number of Spawners)	Fecundity (Number of Eggs)	Smolt Rate	Ocean Survival
Default	Perched, resident, and anadromous	1,000 for all life histories	2,000 for anadromous populations 1,000 for freshwater populations	0.15, 0.5, 0.25, and 0.25 for ages 0 through 3 respectively	0.6, 0.36, 0.3, 0.3, 0.3, and 0.4 for ages 1 through 7 respectively
Vary starting abundance	All life histories simultaneously	0,500, 1000, 1500, 2000 for all life histories	Default Parameter Setting	Default Parameter Setting	Default Parameter Setting
Vary fecundity	All life histories simultaneously	Default Parameter Setting	0, 500, 1,000, 1,500, 2,000 for freshwater life histories 0, 1,000, 2,000, 3,000, 4,000 for anadromous life history	Default Parameter Setting	Default Parameter Setting
Vary fecundity	Resident/perched spawners only	1,000 for freshwater life histories, 0 for the anadromous life history	0, 500, 1,000, 1,500, 2,000 for freshwater life histories 0 for the anadromous life history	Default Parameter Setting	Default Parameter Setting
Vary fecundity	Anadromous spawners only	1,000 for anadromous life histories, 0 for the freshwater life history	0, 1,000, 2,000, 3,000, 4,000 for the anadromous life history 0 for freshwater life histories	Default Parameter Setting	Default Parameter Setting
Vary smolt rate	Resident/perched spawners only	1,000 for freshwater life histories, 0 for anadromous life history	1,000 for freshwater life histories 0 for anadromous life history	Defaults times factors of between 0 and 2	Default Parameter Setting
Vary smolt rate	Anadromous spawners only	1,000 for anadromous life history, 0 for freshwater life history	1,000 for anadromous life history 0 for freshwater life histories	Defaults times factors of between 0 and 2	Default Parameter Setting
Vary ocean survival	Resident/perched spawners only	1,000 for freshwater life histories, 0 for the anadromous life history	1,000 for the freshwater life histories 0 for the anadromous life history	Default Parameter Setting	Defaults times factors of between 0 and 2
Vary ocean survival	Anadromous spawners only	1,000 for anadromous life histories, 0 for the freshwater life history	2,000 for the anadromous life history 1,000 for the freshwater life histories	Default Parameter Setting	Defaults times factors of between 0 and 2

4.1.2 Vary Initial Abundance Simulations

A basic assumption of the CFS LCM is that the model's final population abundance estimates (and thus, the overall assessment of population viability) are robust to small differences in starting abundance. This assumption has implications regarding the importance of accurate estimates of current population size. To evaluate this assumption, Four Peaks ran scenarios that varied initial population abundances from the default of 1,000 spawners for each life history type by a factor from 0 to 2, in increments of 0.5 (e.g., [0, 1,000, 2,000, 3,000, 4,000] for anadromous spawners and [0, 500, 1,000, 1,500, 2,000] for freshwater spawners). The population trajectories for the 150-year time series were then averaged across all watersheds. Varying the initial population sizes was not expected to substantially affect model results because of the relative predictive nature of the model.

4.1.3 Vary Fecundity Simulations

Typically, age and life stage-structured models are sensitive to fecundity and other state transition rates. These parameters may also have the highest uncertainty. Simulations were constructed to evaluate variance in the fecundity parameter. Four Peaks ran scenarios that used the default initial population sizes for all life history groups, and varied fecundity estimates from the default of 1,000 eggs per spawner for resident fish and 2,000 eggs per spawner for anadromous fish, by a factor from 0 to 2, in increments of 0.5. The population trajectories for the 150-year time series were then averaged across all watersheds. Varying fecundity was expected to affect model results because fecundity has a direct impact on the number of progeny produced by spawners in each generation, which can affect the minimum number of spawners required to prevent population collapse (minimum viable population), a common recovery target that has been applied to Southern California steelhead.

4.1.4 Anadromous Contribution Simulations (Vary Smolt Rate and Vary Ocean Survival)

One of the major questions regarding the anadromous steelhead recovery target—quantified as the minimum viable population—is the degree to which resident and perched freshwater populations contribute to the anadromous spawning population. As discussed in Section 3.2.3.1, anadromous spawners have a higher probability than resident spawners of producing future returning anadromous adults. Two potential mechanisms of action for this have been identified: 1) a difference in smolt rates between the two life histories, or 2) a difference in ocean survival between the two life histories. Differences in smolting and other behavioral and physiological aspects of an anadromous life history are determined in part by genetics (Pearse et al. 2014). Survival after smolting is greater among larger sized smolts (Tatara et al. 2017), and anadromous parents generally give rise to larger offspring (Kendall et al. 2015). As currently formulated, the CFS LCM does not allow life history specific smolt rates (to specify a higher probability of smolting for offspring of anadromous parents) or ocean survival rates (to specify a higher probability of surviving in the ocean for offspring of anadromous parents).

To evaluate freshwater parent contributions to the anadromous population within the current structure of the CFS LCM, Four Peaks ran a scenario that set the anadromous starting population size and fecundity to 0, while maintaining the resident and perched starting population sizes and fecundities at the defaults (1,000 for both parameters). In this scenario, anadromous fish must arise from offspring of freshwater parents, so this tests the ability of the combined resident population to wholly support an anadromous population without any reproductive contributions from those anadromous adults.

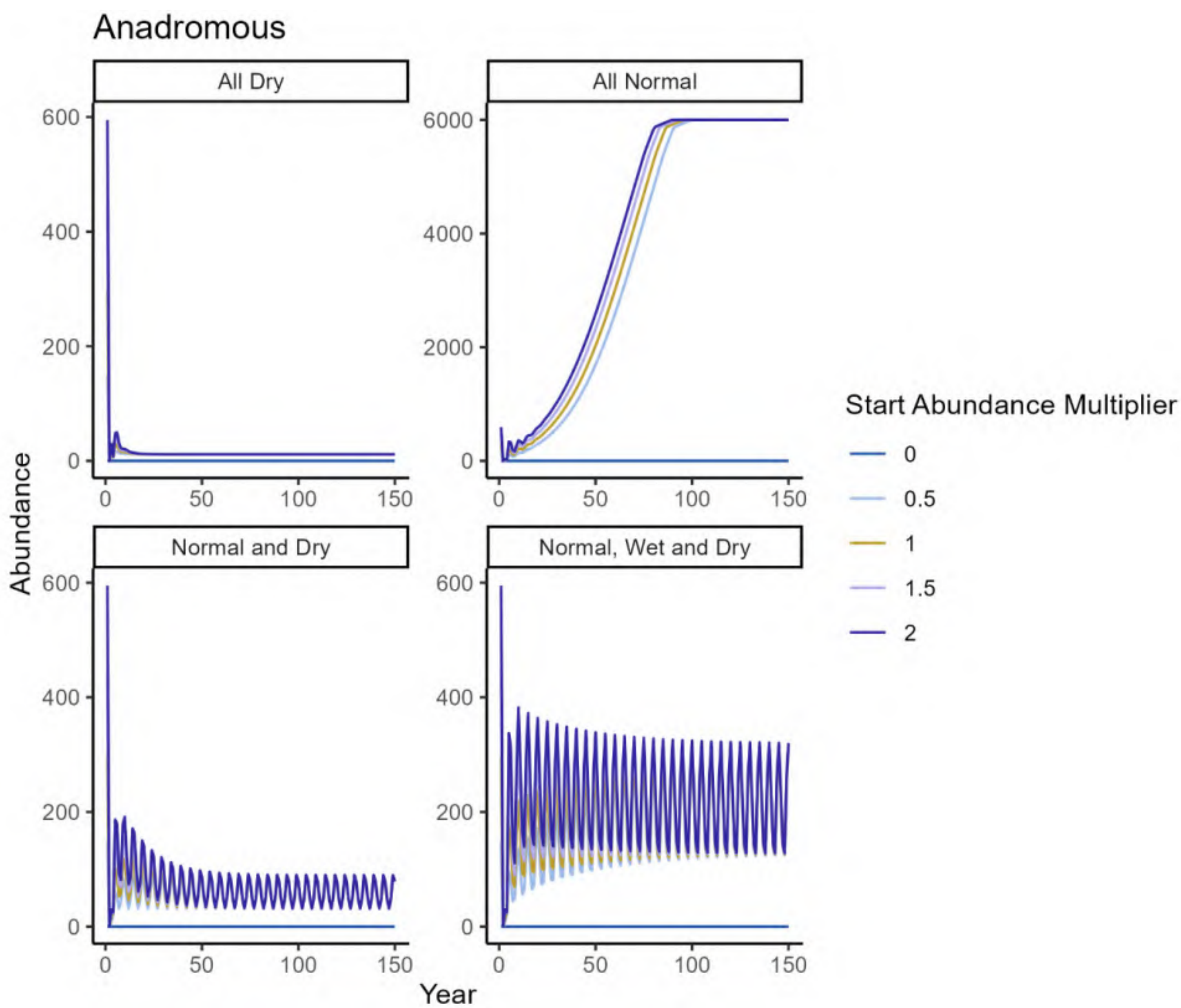
The converse of this scenario was also run, setting freshwater fecundities and starting populations at 0, the anadromous population fecundity at the default 2,000, and anadromous population size at the default 1,000. This scenario tests the ability of the anadromous population to support itself without any reproductive contributions from the resident adults.

Two sets of these scenarios were run: one that varied the smolt rate and one that varied ocean survival. These two parameter sets were varied from the default by factors between 0 and 2 with a step size of 0.5. Default smolt rates were 0.15, 0.5, 0.25, and 0.25 for ages 0 through 3, respectively. Default ocean survival rates from one age class to the next (starting at age 1 and ending at age 7) were 0.6, 0.36, 0.3, 0.3, 0.3, and 0.4, respectively. This allowed an assessment of the consequences of overestimation or underestimation of the unknown true parameter value.

4.2 Sensitivity Analysis Results

4.2.1 Vary Starting Abundance Simulations

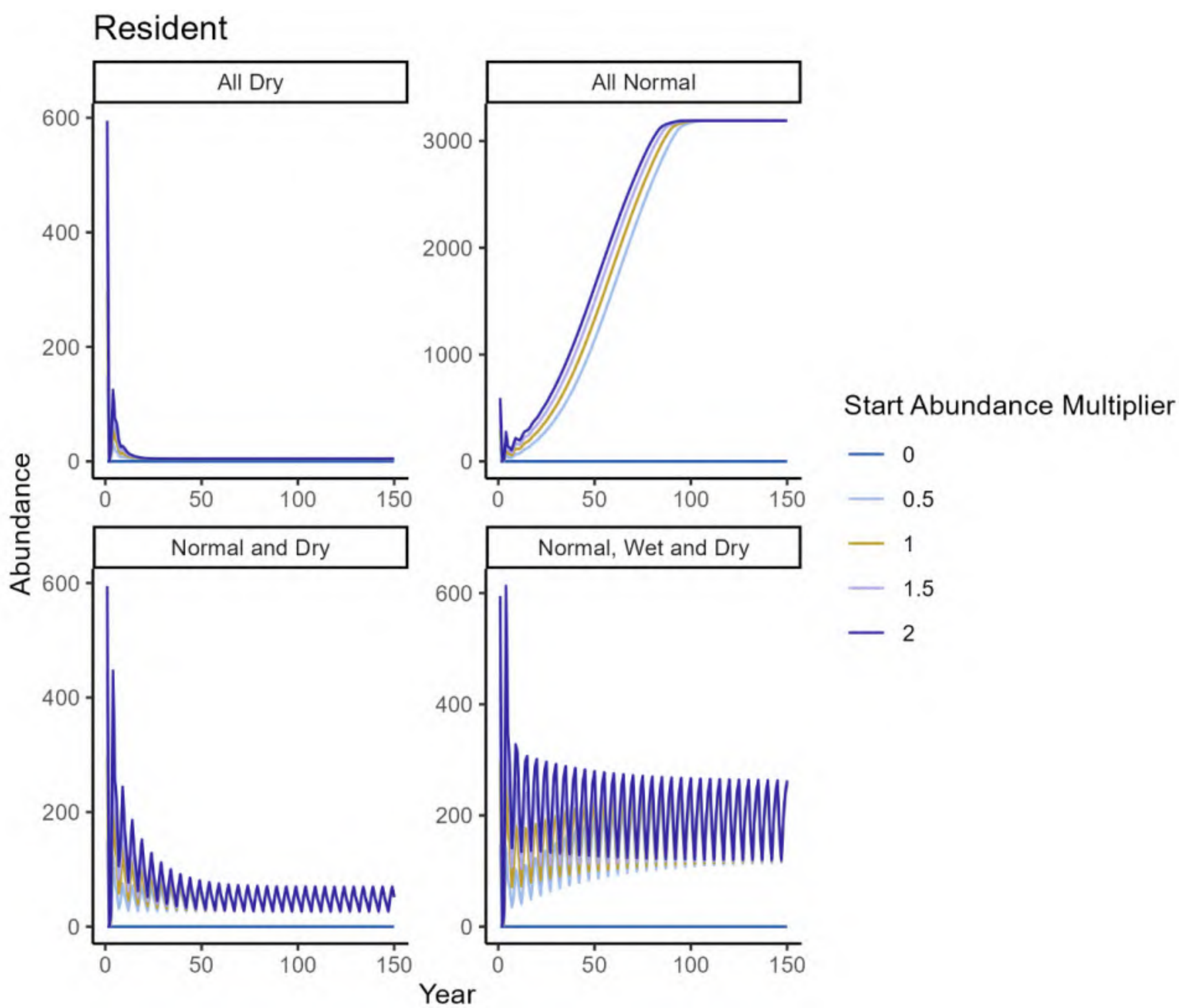
As expected, model results (i.e., ending abundance estimates and overall conclusions about population viability) were robust to starting population abundances (Figure 1 through Figure 3). Abundances towards the ends of the time series were similar among different starting abundances, provided the starting abundances were not extremely small. Only when wet years were included did the starting abundance make a noticeable but small difference in the average ending population abundances. Under scenarios with wet years and higher starting abundance, ending populations sizes were also slightly larger.



Notes:

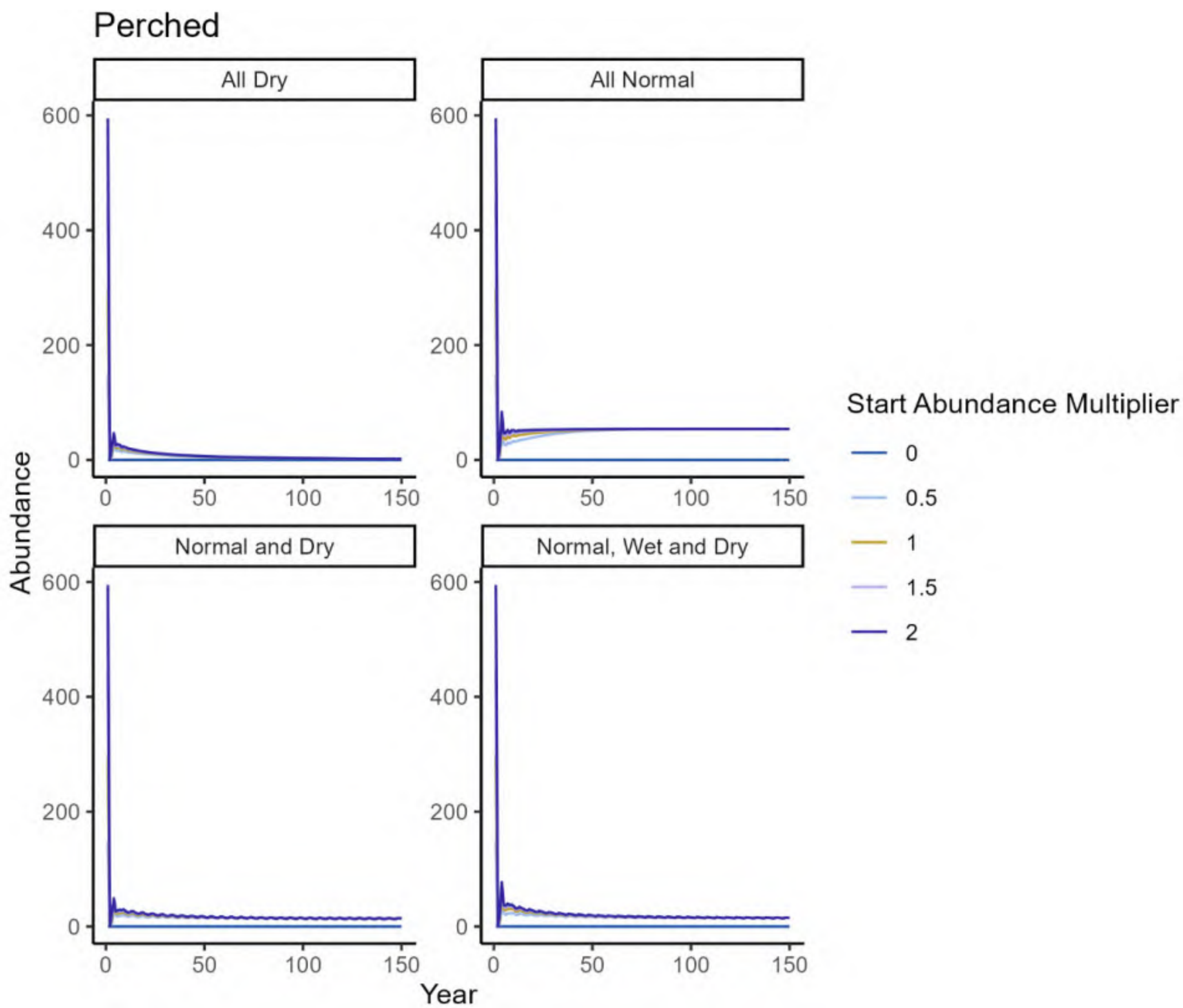
- Multiplier 0: Anadromous Start Abundance = 0, Resident and Perched Start Abundance = 0
- Multiplier 0.5: Anadromous Start Abundance = 500, Resident and Perched Start Abundance = 500
- Multiplier 1: Anadromous Start Abundance = 1000, Resident and Perched Start Abundance = 1000
- Multiplier 1.5: Anadromous Start Abundance = 1500, Resident and Perched Start Abundance = 1500
- Multiplier 2: Anadromous Start Abundance = 2000, Resident and Perched Start Abundance = 2000

Figure 1. Vary starting abundances, all life histories simulation: anadromous population trajectory using default fecundities of 1,000 eggs for resident and perched life histories and 2,000 eggs for anadromous life histories



Notes: See Figure 1 notes for multiplier ranges.

Figure 2. Vary starting abundances, all life histories simulation: resident population trajectory using default fecundities of 1,000 eggs for resident and perched life histories and 2,000 eggs for anadromous life histories



Notes: See Figure 1 notes for multiplier ranges.

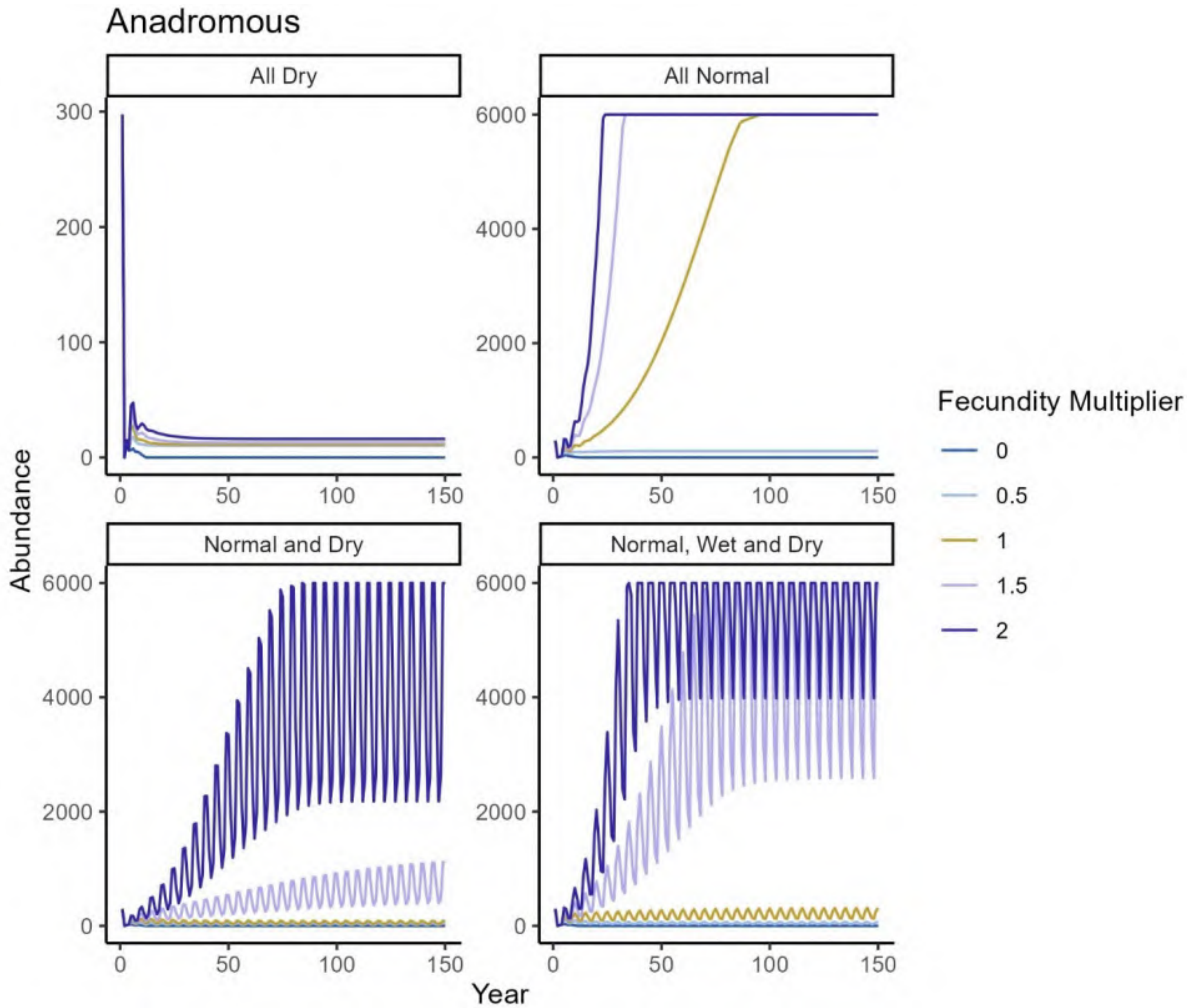
Figure 3. Vary starting abundances, all life histories simulation: perched population trajectory using default fecundities of 1,000 eggs for resident and perched life histories and 2,000 eggs for anadromous life histories

4.2.2 Vary Fecundity Simulations

4.2.2.1 Varying Fecundity for All Life History Groups

4.2.2.1.1 Effect on Anadromous Abundance

The effect of varying fecundity on model predicted ending abundance of anadromous adults depended on the environmental conditions of that model run (Figure 4). Under all dry conditions (top left panel in Figure 4), over- or under-estimation of the fecundity parameters for all three life histories had a relatively small impact on the model predicted average anadromous population abundance, because the model predicted average abundance is small regardless of fecundity. Under normal conditions (top right panel in Figure 4), overestimating the fecundity parameters increases the rate of population increase but has no impact on model predicted ending abundance, because abundance is limited by the carrying capacity parameter. However, underestimating anadromous fecundity resulted in sharp reductions in model predicted ending abundance. Under normal and dry conditions (bottom left panel in Figure 4), if the default fecundity parameter estimate is an overestimate for each of the life history groups, it will have little impact because the model predicted ending abundances are already so low. However, if the current fecundity parameter estimate is below the true value, the model substantially underestimates the population abundance. Under normal, wet, and dry conditions (bottom right panel in Figure 4), if the current fecundity value is overestimated it will have little impact (populations are already very small), but if it is underestimated, the model may severely underpredict anadromous population abundances.



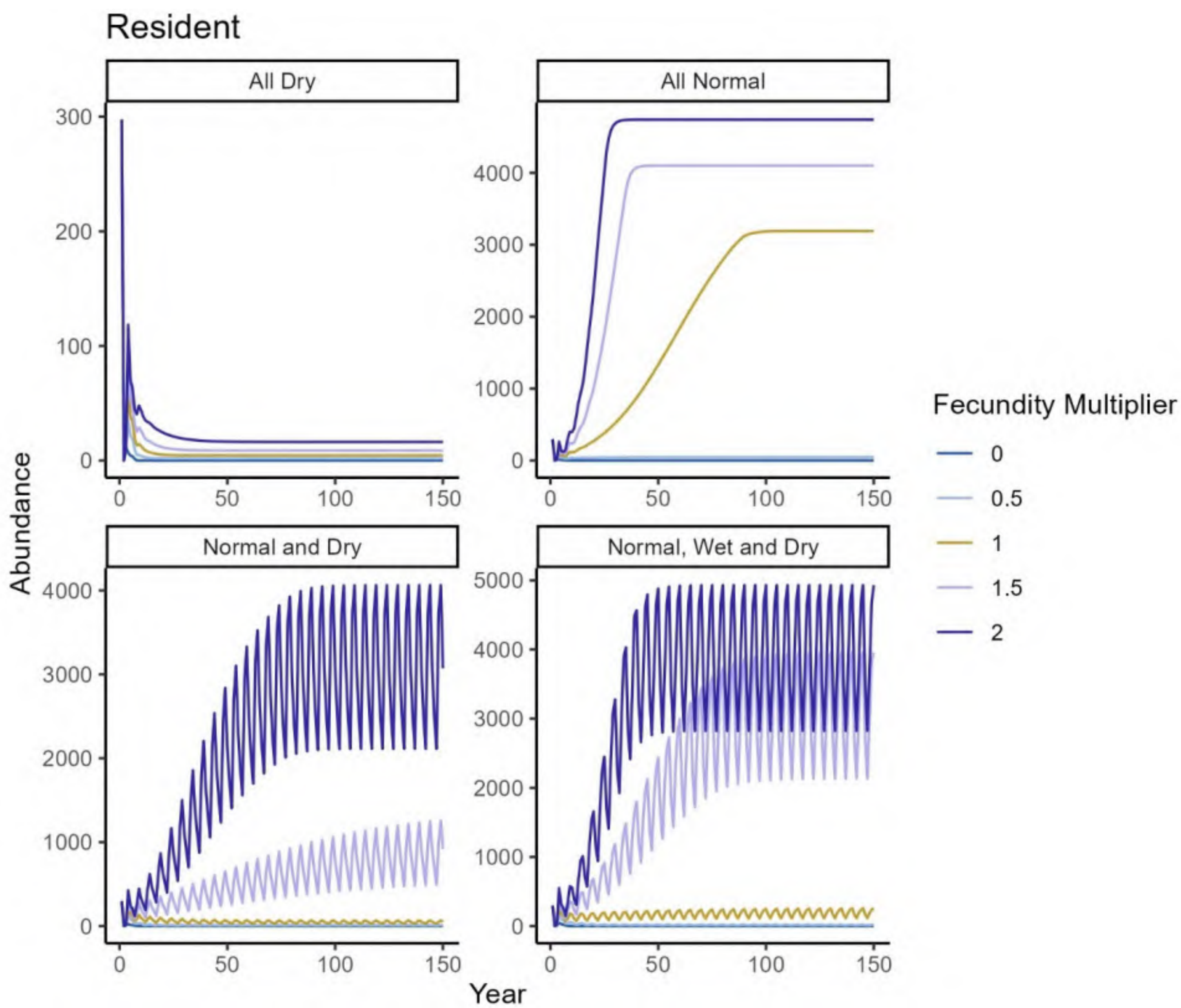
Notes: Starting population abundances were 1,000 for all life histories.

- Multiplier 0: Anadromous Fecundity = 0, Resident and Perched Fecundity = 0
- Multiplier 0.5: Anadromous Fecundity = 1000, Resident and Perched Fecundity = 500
- Multiplier 1: Anadromous Fecundity = 2000, Resident and Perched Fecundity = 1000
- Multiplier 1.5: Anadromous Fecundity = 3000, Resident and Perched Fecundity = 1500
- Multiplier 2: Anadromous Fecundity = 4000, Resident and Perched Fecundity = 2000

Figure 4. Vary Fecundity, all life histories simulation: anadromous population trajectory (averaged across watersheds) when varying fecundity for each life history group relative to the default of 2,000 for the anadromous population and 1,000 for the freshwater populations

4.2.2.1.2 Effect on Resident Abundance

The effect of varying fecundity on model predicted ending abundance of resident adults also depended on the environmental conditions of that model run (Figure 5). Under all dry conditions (top left panel in Figure 5), bias in the estimate of population fecundity would minimally impact model predicted ending freshwater population abundance. Under these conditions, extremely low population abundance reduces the potential variation in population abundance overall, and all scenarios result in near population collapse.



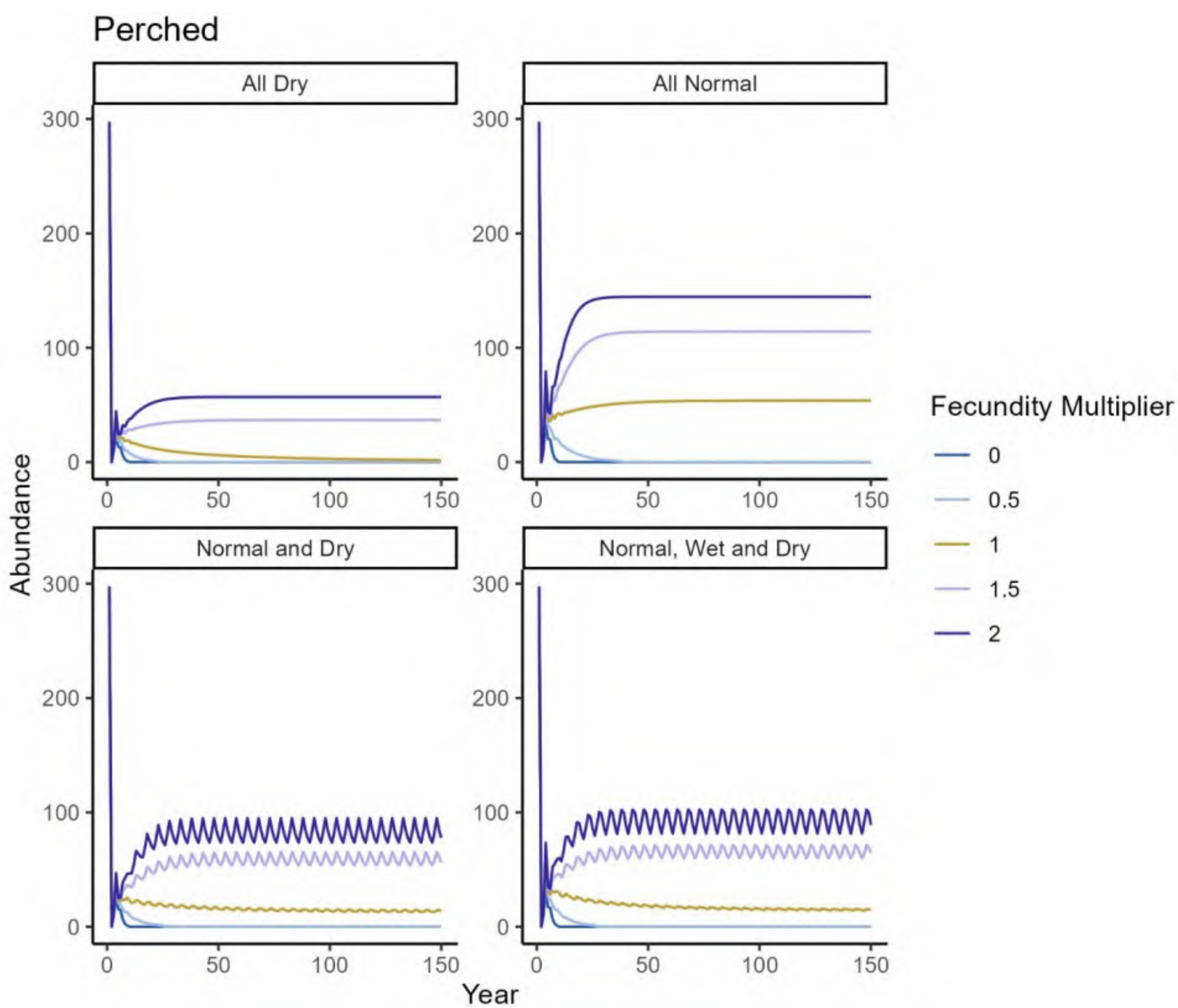
Notes: Starting population abundances were 1,000 for all life histories. See Figure 4 notes for multiplier ranges.

Figure 5. Vary fecundity, all life histories simulations: resident population trajectory (averaged across watersheds) when varying fecundity relative to the default of 1,000 for freshwater life histories and 2,000 for anadromous life histories

Under all normal conditions (top right panel in Figure 5), if current fecundity parameters are overestimated, the model would severely overestimate the model predicted ending population abundance. If the model's default fecundity is an underestimate, the model would only moderately underestimate the model predicted ending population abundance. Under normal and dry conditions (bottom left panel in Figure 5) or normal, wet, and dry conditions (bottom right panel in Figure 5), if the current fecundity value is an overestimate it would have little impact, but if the current fecundity estimate is an underestimate the model could be drastically underestimating the model predicted ending abundance of the freshwater below barrier populations.

4.2.2.1.3 Effect on Perched Abundance

The effect of varying fecundity on model predicted ending abundance of perched adults was similar regardless of the environmental conditions of that model run (Figure 6). Generally, if the current perched fecundity is an underestimate, the impacts are more substantial on the average model predicted ending perched population abundance than if it is an overestimate. If the default perched population fecundity is overestimated, these populations are already relatively low, so the difference is small. If it is an underestimate, the model will underestimate the perched population size potentially substantially (though at a declining rate as the degree of underestimation increases).

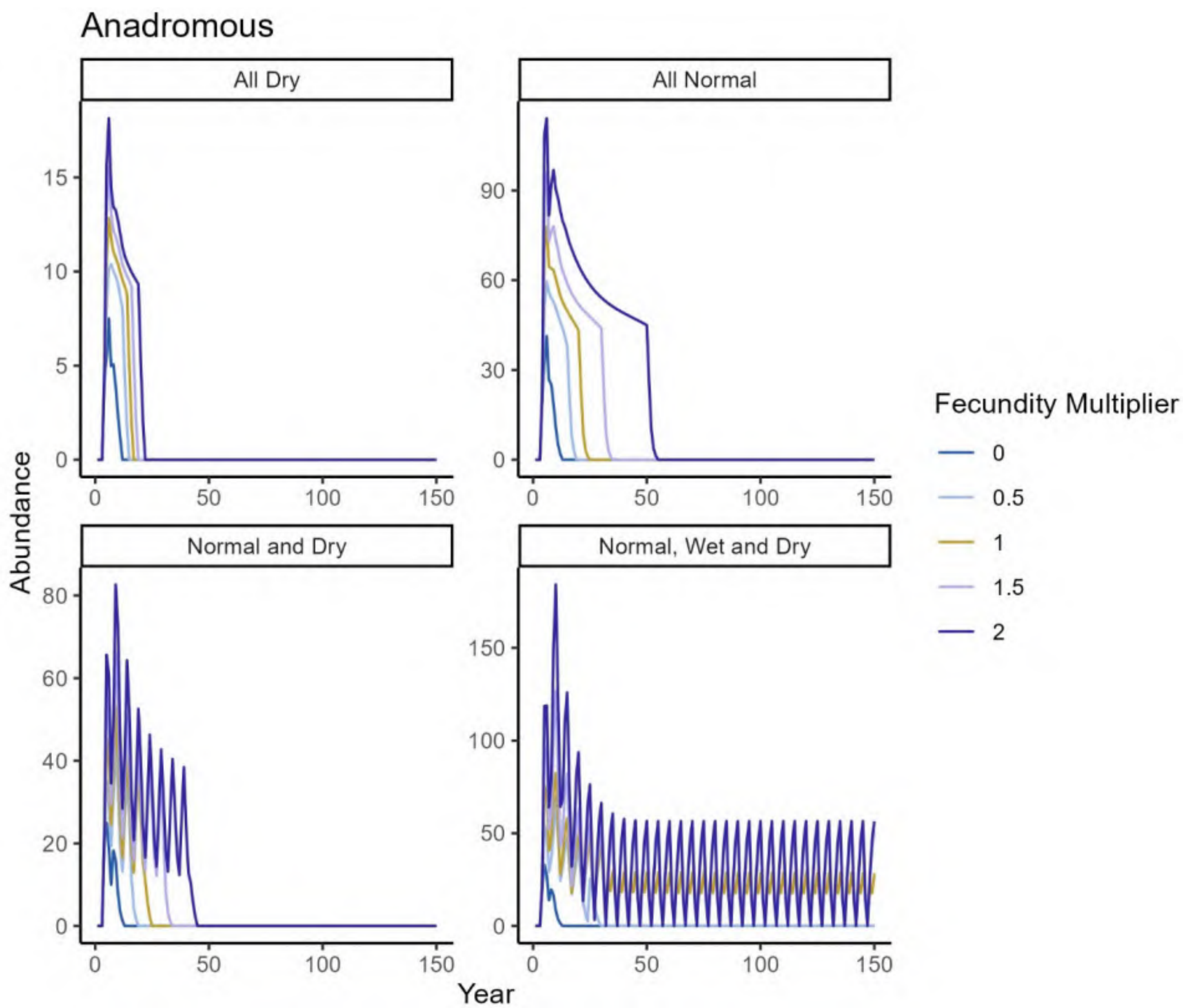


Note: Starting population abundances were 1,000 for all life histories. See Figure 4 notes for multiplier ranges.

Figure 6. Vary fecundity, all life histories simulations: perched population trajectories (averaged across watersheds) when varying fecundity relative to the default of 1,000 eggs for freshwater life histories and 2,000 eggs for anadromous life histories

4.2.2.2 Varying Fecundity for Resident and Perched Life History Groups Only

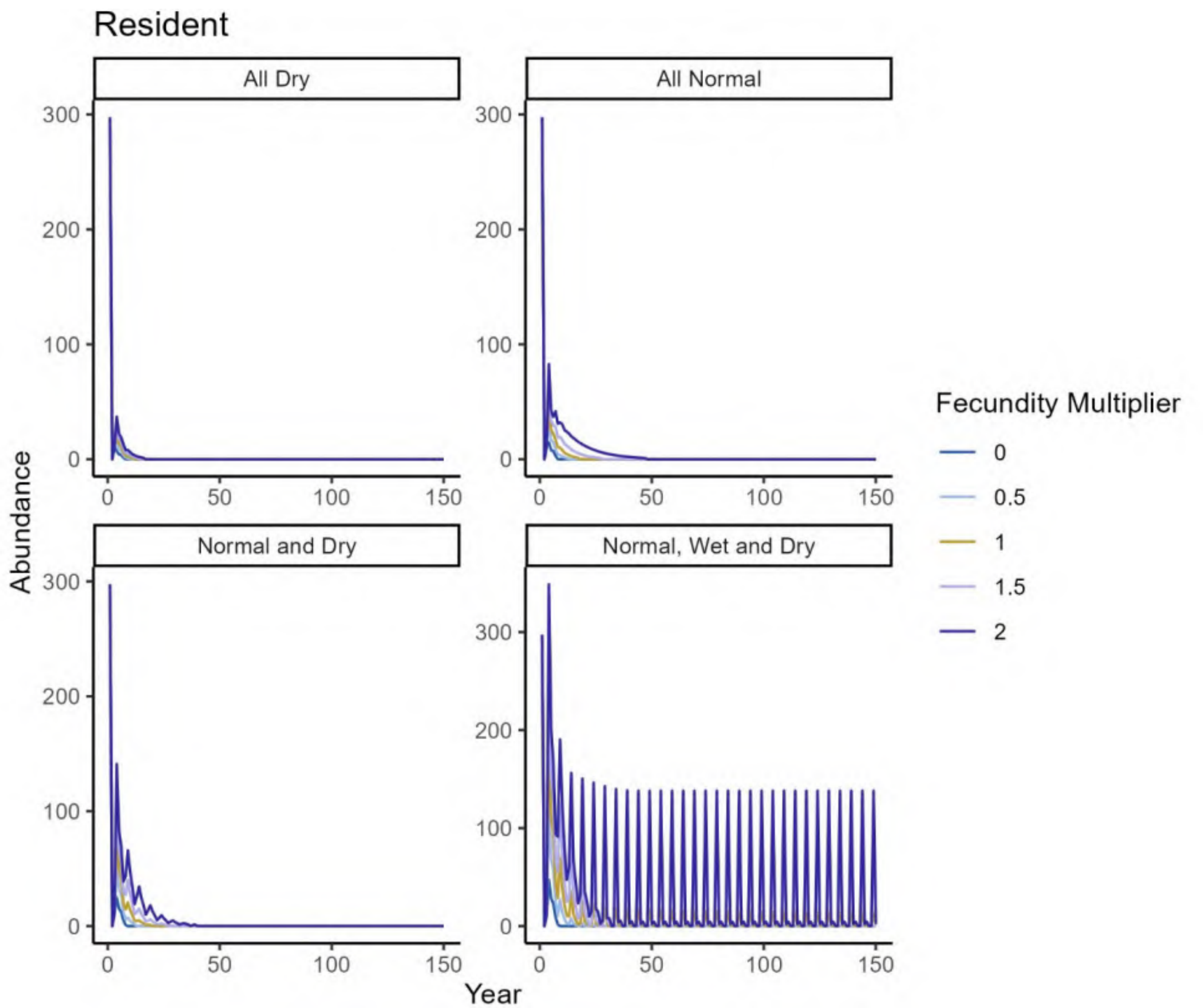
When anadromous adults are prevented from reproducing (i.e., fecundity is set to zero), under all dry, all normal, and normal and dry conditions, the anadromous population collapses (Figure 7). The freshwater populations are only capable of supporting the anadromous population when wet years are included, highlighting the importance of contributions from the perched population to downstream migrants in wet years (lower right panel in Figure 7). Even under these conditions, the model predicted average abundance is low at the end of the time series for the anadromous population.



Notes: See Figure 4 notes for multiplier ranges.

Figure 7. Vary fecundity, resident and perched spawners only simulation: anadromous population trajectory (averaged across watersheds) when omitting anadromous fecundity contributions and varying perched and below barrier freshwater fecundity relative to the default of 1,000 for all populations

As the anadromous population declines, so too does the below barrier freshwater population (Figure 8), which eventually collapses unless wet years that allow support from the perched population are included (bottom right panel in Figure 8). This is an indicator that the below barrier freshwater and anadromous populations appear to be supporting each other. A collapse in one facilitates a collapse in the other under climatic conditions that do not include wet years. Thus, only under the most optimistic conditions can freshwater populations maintain steelhead populations by themselves.



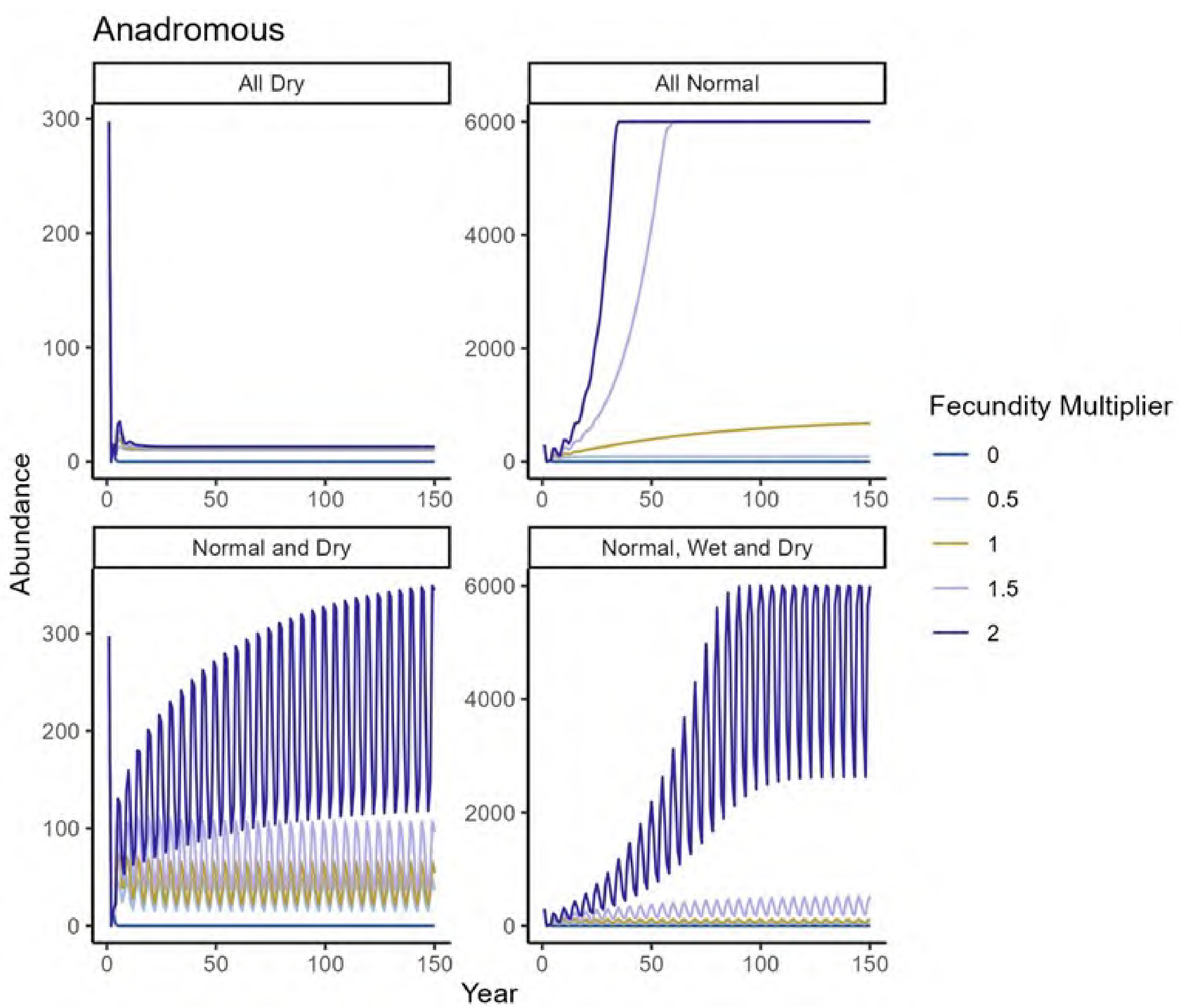
Notes:

- Multiplier 0: Anadromous Fecundity = 0, Resident and Perched Fecundity = 0
- Multiplier 0.5: Anadromous Fecundity = 0, Resident and Perched Fecundity = 500
- Multiplier 1: Anadromous Fecundity = 0, Resident and Perched Fecundity = 1000
- Multiplier 1.5: Anadromous Fecundity = 0, Resident and Perched Fecundity = 1500
- Multiplier 2: Anadromous Fecundity = 0, Resident and Perched Fecundity = 2000

Figure 8. Vary fecundity, resident and perched spawners only simulation: below barrier freshwater population trajectory (averaged across watersheds) when omitting anadromous fecundity contributions and varying perched and below barrier freshwater fecundity relative to the default of 1,000 for all populations

Varying Fecundity for Anadromous Life History Groups Only

Anadromous populations are capable of preventing their population's collapse without reproductive contributions from freshwater populations in all but the most adverse all dry scenario, but maintaining a robust population size required fecundity to be higher than the default model setting (Figure 9).



Notes:

- Multiplier 0: Anadromous Fecundity = 0, Resident and Perched Fecundity = 0
- Multiplier 0.5: Anadromous Fecundity = 1000, Resident and Perched Fecundity = 0
- Multiplier 1: Anadromous Fecundity = 2000, Resident and Perched Fecundity = 0
- Multiplier 1.5: Anadromous Fecundity = 3000, Resident and Perched Fecundity = 0
- Multiplier 2: Anadromous Fecundity = 4000, Resident and Perched Fecundity = 0

Figure 9. Vary fecundity, anadromous spawners only simulation: anadromous population trajectory (averaged across watersheds) when omitting resident and perched spawner fecundity contributions and varying anadromous fecundity relative to the default of 2,000 for all populations

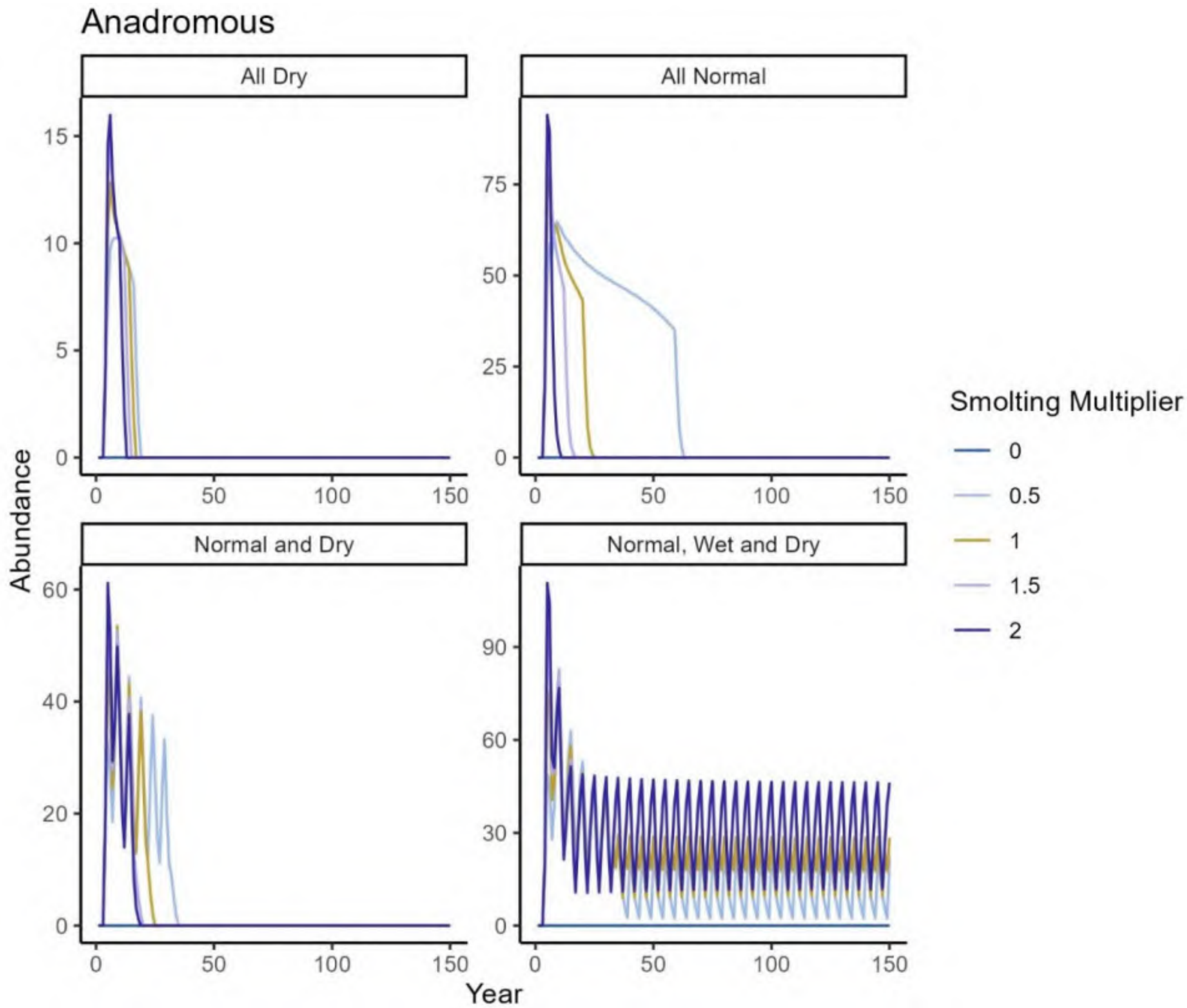
4.2.3 Anadromous Contribution Simulations (Vary Smolt Rate and Vary Ocean Survival)

4.2.3.1 Vary Smolt Rate

4.2.3.1.1 Resident and Perched Life History Groups Only

When anadromous fish starting population abundance and fecundity are set to 0, meaning all juvenile fish are offspring of resident adults, varying the smolt rate did not prevent the anadromous population from collapsing under all environmental conditions except the normal, wet, and dry conditions scenario

(Figure 10). Under these conditions, varying the smolt rate leads to a proportional difference in the model predicted ending abundance of anadromous adults. Regardless, even under these improbable future environmental conditions, the average anadromous population abundance is extremely low.



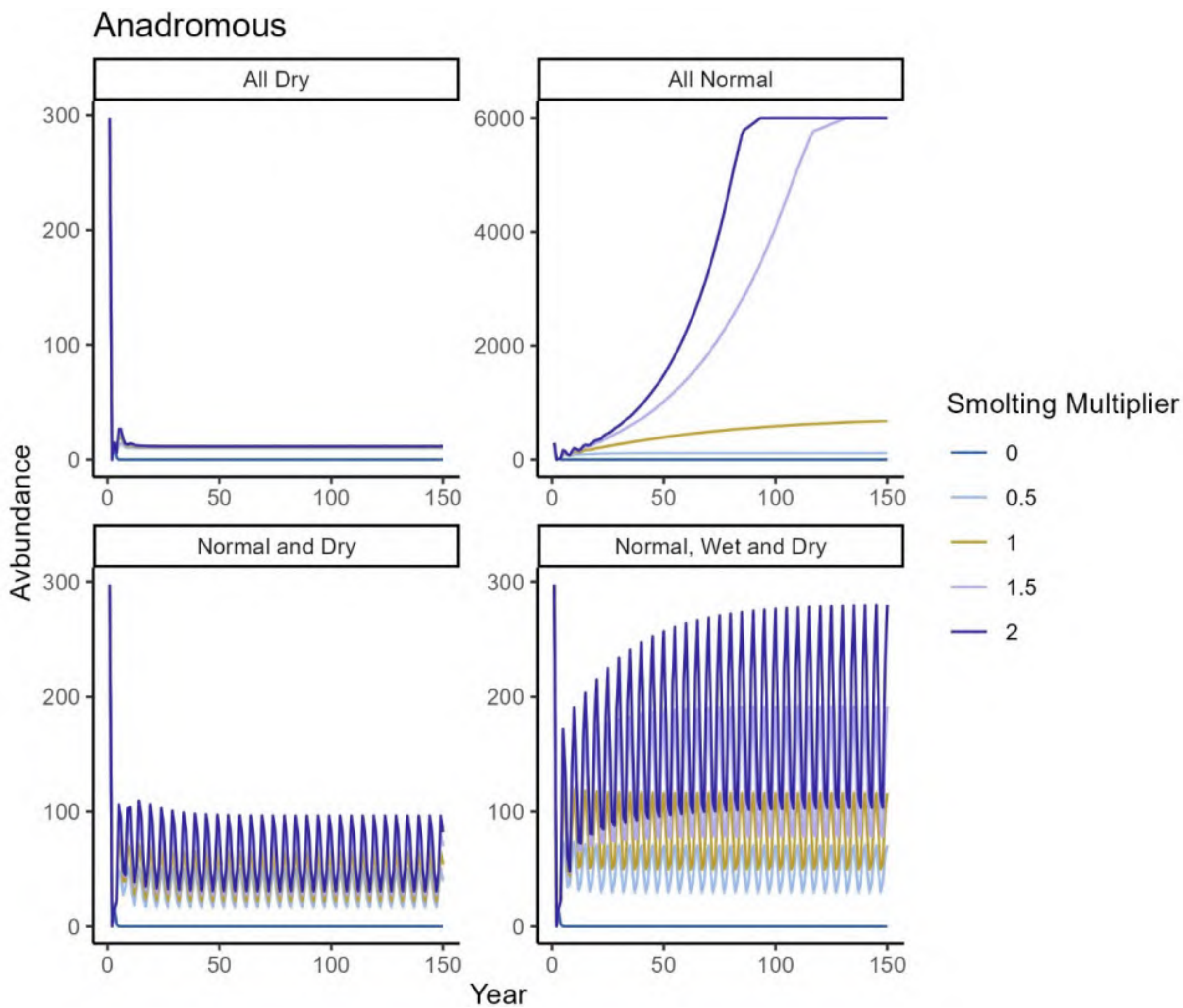
Notes:

- Multiplier 0: Smolt Rates (Ages 0 through 3) = 0
- Multiplier 0.5: Smolt Rates (Ages 0 through 3) = 0.075, 0.250, 0.125, and 0.125
- Multiplier 1: Smolt Rates (Ages 0 through 3) = 0.15, 0.5, 0.25, and 0.25
- Multiplier 1.5: Smolt Rates (Ages 0 through 3) = 0.225, 0.750, 0.375, and 0.375
- Multiplier 2: Smolt Rates (Ages 0 through 3) = 0.3, 1.0, 0.5, and 0.5

Figure 10. Vary smolt rates, resident and perched spawners only simulation: anadromous population trajectory (averaged across watersheds) when omitting anadromous fecundity contributions and varying smolt rates relative to the defaults of 0.15, 0.5, 0.25, and 0.25 for ages 0 through 3

4.2.3.1.2 Anadromous Spawners Only

Conversely, the anadromous population can maintain itself and avoid collapse without reproductive contributions from freshwater spawners in most environmental conditions, depending on the rate of smolting (Figure 11). Based on current default smolting estimates, the anadromous population is able to maintain itself in all tested environmental sequences except the all dry sequence (top left panel in Figure 11). If smolt rates are higher than the default estimate, they are able to maintain a small population even in all dry years. Under other environmental conditions, the model predicted ending abundance varies with smolt rate. This effect is greatest under all normal year conditions (top right panel in Figure 11) and least under normal and dry year conditions (bottom left panel in Figure 11).



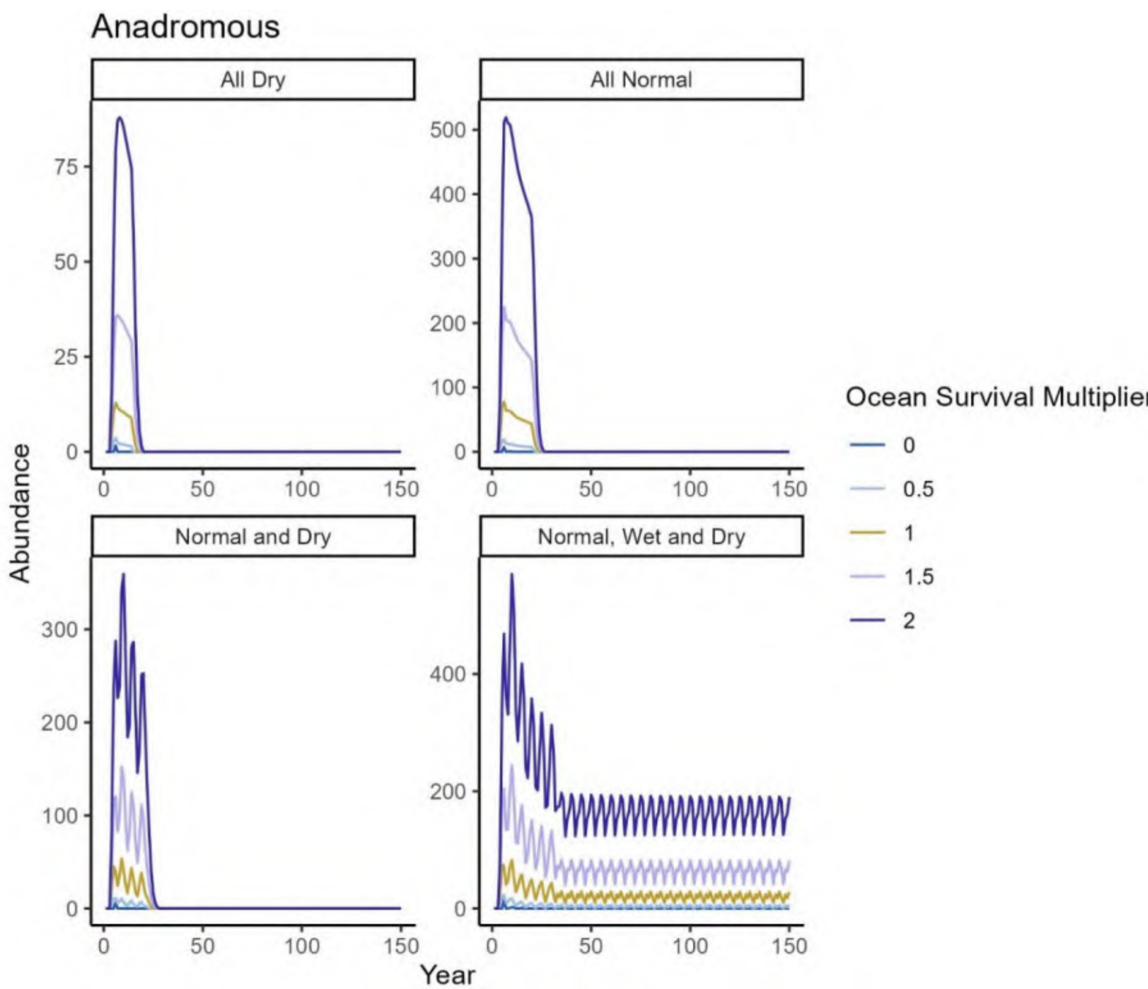
Notes: See Figure 10 notes for multiplier ranges.

Figure 11. Vary smolt rates, anadromous spawners only simulation: anadromous population trajectory (averaged across watersheds) when omitting freshwater fecundity contributions and varying smolt rates relative to the defaults of 0.15, 0.5, 0.25, and 0.25 for ages 0 through 3

4.2.3.2 Vary Ocean Survival

4.2.3.2.1 Resident and Perched Life History Groups Only

When excluding anadromous reproductive contributions, and only freshwater perched and below barrier fish are allowed to contribute to the population, varying ocean survival had a substantial impact on model predicted ending anadromous abundance in years and under conditions when the population did not collapse (Figure 12). However, the anadromous population collapsed within the first 25 years (essentially, during model burn-in) under all tested environmental conditions except under the normal, wet, and dry sequence (lower right panel in Figure 12). Under this scenario, if the current ocean survival estimate is an overestimate, the impact on model predicted average anadromous abundance is minimal because the population is already so low. However, if the current ocean survival parameter estimate is an underestimate, it would severely underestimate the true anadromous population abundance. This scenario of 1 in every 5 years being wetter than average is improbable when most climate change projections predict the drier environmental condition to become more common. Given that the resident and perched populations could not support an anadromous population under the less favorable drier scenarios (and even under all normal years), it is unlikely the resident and perched populations alone will be able to contribute meaningfully to anadromous spawner populations in the future.



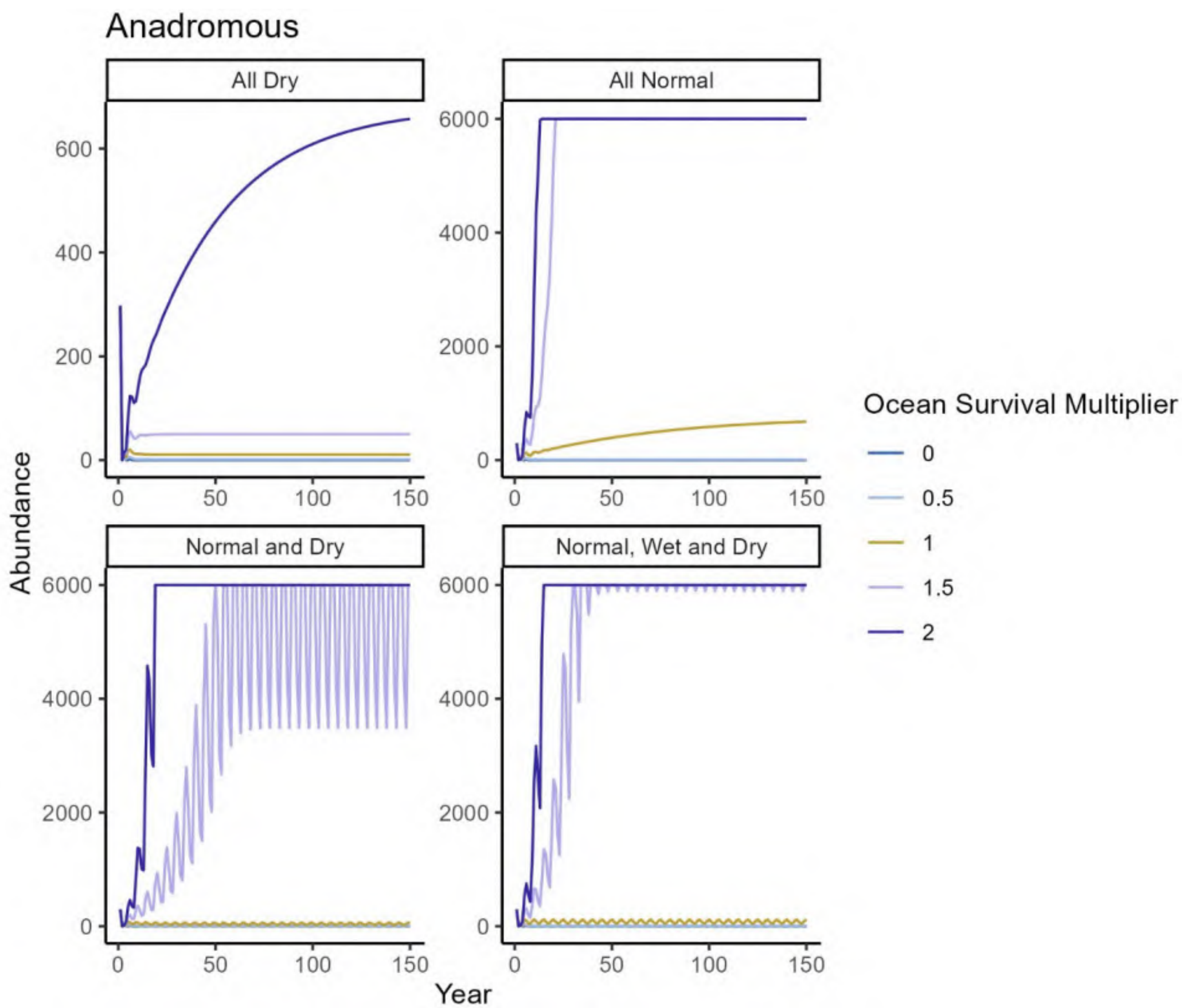
Notes:

- Multiplier 0: Smolt Rates (Ages 1 through 7) = 0
- Multiplier 0.5: Smolt Rates (Ages 1 through 7) = 0.30 0.18 0.15 0.15 0.15, and 0.20
- Multiplier 1: Smolt Rates (Ages 1 through 7) = 0.6, 0.36, 0.3, 0.3, 0.3, and 0.4
- Multiplier 1.5: Smolt Rates (Ages 1 through 7) = 0.90 0.54 0.45 0.45 0.45, and 0.60
- Multiplier 2: Smolt Rates (Ages 1 through 7) = 1.20 0.72 0.60 0.60 0.60, and 0.80

Figure 12. Vary ocean survival, resident and perched spawners only simulation: anadromous population trajectory (averaged across watersheds) when omitting anadromous fecundity contributions and varying ocean survival relative to the age specific defaults 0.6, 0.36, 0.3, 0.3, 0.3, and 0.4 for ages 1 through 7

4.2.3.2.2 Anadromous Spawners Only

Once again, the anadromous population can maintain itself without perched and resident reproductive contributions under all four tested environmental sequences depending on the ocean survival rate (Figure 13). However, under all environmental conditions, when ocean survival is at or below current default estimates, the population is frequently at or close to collapse without reproductive contributions from resident and perched spawners. Only if ocean survival rates are higher than the current default estimate, would anadromous populations alone be capable of supporting themselves without perched and resident reproductive contributions.



Notes: See Figure 12 notes for multiplier ranges.

Figure 13. Vary ocean survival, anadromous spawners only simulation: anadromous population trajectory (averaged across watersheds) when omitting resident and perched fecundity contributions and varying ocean survival relative to the age specific defaults 0.6, 0.36, 0.3, 0.3, 0.3, and 0.4 for ages 1 through 7

4.3 Conclusions from Model Sensitivity Analysis

- Importance of Starting Abundances
  - The CFS LCM is robust to starting abundances, provided they are not extremely small (less than 50% of default starting abundance estimates).
  - Populations fared better with more normal or wet years compared to more dry years.
- Importance of Fecundity
  - Model results are sensitive to fecundity estimates, particularly if fecundity is truly higher than the current default estimate.
  - If only resident and perched populations contribute to reproduction—even if the fecundity for these freshwater life history groups was set to be double the default model value—the anadromous population is predicted to collapse or to oscillate near collapse, and the freshwater life history groups also decline, due to less support from the alternate life history groups.
  - Only if anadromous fecundity was 50-100% greater than the default model estimate could anadromous spawning support a robust anadromous population without reproductive support from resident and perched spawners.
  - Model simulations lend support for the conclusion that maintaining robust populations of both anadromous steelhead and freshwater populations of both resident and perched fish will be important to maintaining viability of the anadromous life history.
  - Fecundity is an influential model parameter that is sensitive to parameterization
  - Four Peaks recommends that future model iterations prioritize accurate estimation of fecundity, particularly for anadromous spawners, to minimize uncertainty around this parameter; this may include age-specific fecundity rates that account for different numbers of year spent maturing in the ocean and kelting.
- Importance of Smolt Rates
  - If relying solely on resident contributions, the anadromous population persisted only in the presence of wet years with moderate to high smolt rates; even under these conditions, ending anadromous population abundances were still low.
  - However, under most environmental conditions, the anadromous population could sustain itself without reproductive support from resident and perched spawners, provided smolt rate is moderate to high.
  - Smolt rates were less influential than ocean survival rates on model predicted ending abundance.
- Importance of Ocean Survival
  - Resident and perched spawners alone (i.e., assuming no anadromous spawners) could support an anadromous population only under the improbable future scenario of high ocean survival and an environmental regime that included 1 of every 5 years being wetter than average.
  - Similarly, although anadromous spawners alone could support an anadromous population, under all conditions but the highest ocean survival scenarios, the model predicted ending anadromous population abundances were low if resident and perched spawners did not contribute to reproduction.

- Thus, high ocean survival could contribute to population viability regardless of the mixture of adult spawner life histories, but maintaining spawner populations of all life histories will provide the best chance of maintaining a robust population of the anadromous life history over the long term.
- Ocean survival was an influential parameter that is sensitive to parameterization.
- Four Peaks recommends that future research prioritize accurate estimation of age specific ocean survival to minimize uncertainty around this parameter, despite its difficulty.

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Appendix 2

Cramer Fish Sciences' Technical Memorandum

Southern California Steelhead Lifecycle Model

Draft technical memo on the lifecycle model developed by Cramer Fish Sciences for Association of California Water Agencies

Background

California Trout petitioned the California Fish and Game Commission (Commission) to list Southern California steelhead (*Oncorhynchus mykiss*; SCS) as endangered under the California Endangered Species Act (CESA). The petitioner defined SCS as all *O. mykiss*, including anadromous and resident life histories, below artificial and natural complete barriers to anadromy from the Santa Maria River, San Luis Obispo County (inclusive) to the United States-Mexico Border. The petition states that remaining SCS populations are in danger of extinction within the next 25-50 years. It also states that based on available abundance estimates, presence/absence data, and various threats within SCS range, populations appear extremely depressed or extirpated, and remaining populations are likely in immediate danger of extirpation. Therefore, the petitioner requested the Commission list SCS as endangered under the CESA. The Commission found that the petition contains sufficient scientific information to indicate action may be warranted.

The current National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) recovery population viability goal for SCS is 4,150 spawners per year on average, based on a "random walk with drift" model (Lindley 2003) and parameterized using Central Valley field data (Boughton et al. 2007; Williams et al. 2016).The NMFS report acknowledges interchange between the anadromous and resident populations, but does not include these effects in their viability goal. Viability studies recognize that genetic exchange between resident and anadromous groups would lower extinction risks of both groups and interchange between resident and anadromous forms could have consequences when determining extinction risk. In fact, the recovery plan for SCS (NMFS 2012) specifically states that recovery of the distinct population segment (DPS) will require "…protection, restoration, and maintenance of habitats of sufficient quantity, quality, and natural complexity throughout the SCS Recovery Planning Area so that the full range of all life history forms of *O. mykiss* (e.g., switching between resident and anadromous forms, timing and frequency of anadromous runs, and dispersal rates between watersheds) are able to successfully use a wide variety of habitats in order to overcome the natural challenges of a highly variable physical and biological environment."
Therefore, it is important to assess if SCS extinction risk is sensitive to the details of the exchange between resident and anadromous life histories.

Model Purpose

The purpose of this work was to develop an adaptive lifecycle model that incorporates the proposed SCS listing population goals and allows for assessment of listing proposal improvements to better protect and manage SCS into the future. We developed and enhanced this model to simulate various recovery goals, strategies, and what-if scenarios that also allow managers to manipulate specific portfolio parameters to understand how changes to key vital rates might influence population trajectories, under explicit model assumptions. Specifically, this model can be employed to understand how strengthening or weakening portfolios, including residency in the proposed goals, or inclusion of above barrier populations, influences the implied probability of future SCS extinction risk.

A goal of the Southern California steelhead life-cycle model (SCS LCM) is to better understand the influence of source-sink dynamics between resident and anadromous *O. mykiss* on population viability (i.e., the 100-year extinction risk) for Southern California DPS populations, as well as the potential for long-term Southern California DPS persistence as a whole. The model is meant to simulate various strategies including ratios of anadromy and residency, and various migration strategies that support each *O. mykiss* life stage along entire watershed corridors accessible to anadromous fish (including assumption of fish passage at artificial barriers). This exercise facilitates identification of key strategy alternative(s), and combinations thereof, and how they might best be implemented to support viable SCS population goals over various time periods (e.g., 20, 50, 100 years). To support this endeavor, this model was developed to simulate population trajectories under various SCS life history strategies (e.g., anadromy, residency, potamodromy, etc.), including management of a healthy SCS population into the future. This undertaking follows a general process for determining what combination of resident and anadromous strategies may support viable SCS population goals.

This lifecycle modeling effort incorporates well accepted modeling components to test key hypotheses and assumptions related to the proposed listing unit for SCS. It includes components of the Lindley (2003) and other models, such as the NOAA Habitat Assessment and Restoration Planning model (Jorgensen et al. 2021) or the Shiraz model (Scheuerell et al. 2006) which both rely on a multistage Beverton-Holt function to model production across the entire salmonid life cycle under a unified conceptual framework. In addition, the model is fully transparent, and is linked to well accepted functional relationships from population dynamics theory with the best available data to drive model outcomes. The model is also adaptable, so that as new data are available or outcomes from future hypotheses tests are received, they can be incorporated into the model. To facilitate collaborative stakeholder engagement in exploring model scenarios, we developed a user-friendly dashboard (or graphical user interface). By linking a state-of-the-science modeling framework with a user-friendly front-end, this effort provides a fully transparent, accessible modeling tool for assessing the conservation status of SCS and offers sound scientific guidance to discuss strategies and scenarios for future SCS population viability. This graphical user interface (GUI) provides a transparent tool with the ability to easily adjust parameters relevant to conservation.

Model Development Methods

Task 1: Gather and review background information

The goal of Task 1 was to gather and review background information relevant to the construction of a life cycle model (LCM) for Southern California steelhead (SCS). A literature search (e.g., Google Scholar, Web of Science) was used to identify, screen, and compile relevant biological information to inform and parameterize the life cycle model with empirical data where available. The following keywords were used to conduct the initial literature search:

> Steelhead **OR** *Oncorhynchus mykiss* **OR** *O. mykiss* **OR** Rainbow trout
> **AND** California **OR** Southern California **OR** Santa Maria **OR** Santa Ynez **OR** Santa Clara **OR** San Gabriel **OR** Santa Ana **OR** San Luis Rey **OR** San Diego **OR** Piru Creek **OR** Sisquoc River **OR** Cuyama River **OR** Ventura River **OR** San Mateo Creek **OR** Los Angeles River
>
> **AND** Egg **OR** egg-to-fry **OR** larval **OR** emergent fry **OR** fry **OR** parr **OR** smolt **OR** adult **OR** spawning **OR** spawner **OR** half-pounder **OR** resident **OR** resident life history **OR** life history
>
> **AND** freshwater **OR** delta-bay **OR** delta **OR** estuary **OR** lagoon **OR** ocean **OR** marine
>
> **AND** survival **OR** mortality **OR** smolt-to-adult ratio **OR** SAR **OR** escapement
> **AND** Reproduction **OR** fecundity **OR** fertility **OR** spawning success **OR** eggs **OR** stock-recruit **OR** redd **OR** redd size **OR** redd distribution **OR** recruits per spawner **OR** spawners per recruit
>
> **AND** iteroparity **OR** iteroparous **OR** semelparity **OR** semelparous
>
> **AND** Migration **OR** immigration **OR** emigration **OR** straying **OR** residency
>
> **AND** Rate **OR** speed **OR** proportion **OR** probability
>
> **AND** temperature **OR** drought **OR** flow **OR** instream flow **OR** El Niño **OR** La Niña **OR** Pacific Decadal Oscillation **OR** PDO **OR** North Pacific Gyre Oscillation **OR** NPGO **OR** upwelling **OR** sea surface temperature **OR** SST

Objective 1.1 Quantify minimum viable steelhead population

Source-sink dynamics is an established ecological theory which describes how dispersal between habitats of variable quality and connectivity can explain patterns in population viability and persistence (i.e., long-term viability) over large spatial or temporal scales (Pulliam 1988; Dias 1996). In source-sink theory, population viability can be maintained via the exchange of organisms between geographically separate meta-populations in a network of “source” populations (exhibiting positive population growth rates), and “sink” populations (exhibiting negative population growth rates). Habitat fragmentation, in part due to installation of dams and diversions, has blocked upstream migration in much of Southern California and has geographically divided *O. mykiss* spawning populations by life-history types (Boughton et al. 2015; Fejtek 2017; Abadía-Cardosa et al. 2016). Non-anadromous *O. mykiss* frequently co-occur with anadromous *O. mykiss* within the same watersheds in Southern California and can co-occur within the same below-barrier stream reaches, but are often geographically separated where fish passage barriers block migration, thus forming potential source (above barrier) and sink (below barrier) populations. Genetic analyses of microsatellite data have concluded that geographically separated *O. mykiss* populations within the same watersheds (above and below barriers) are closer relatives than populations between watersheds (Clemento et al. 2009; Leitwein et al. 2017). Closer genetic distance and potential for population spillover implies that resident populations above barriers could mediate population viability and long-term persistence.

A viable individual population is defined in the 2012 Southern California Steelhead Recovery Plan (hereafter; the SCS Recovery Plan) as having less than a 5% risk of extinction due to threats from demographic, environmental, and genetic variation over the next 100 years (NMFS 2012). Similarly, a viable distinct population segment (DPS) is defined by a sufficient number of **spatially dispersed**, yet **genetically connected** populations to maintain long-term (1000+ years) persistence and evolutionary potential (McElhany et al. 2000; NMFS 2012). A “random-walk-with-drift” model was used in the SCS Recovery Plan to determine population-level biological recovery criteria based on a minimum viable population (MVP) size of individual populations for SCS steelhead, as well as DPS-level recovery criteria based on viable individual minimum populations within each Biogeographic Population Group, and other considerations (Lindley 2003; Boughton et al. 2007; NMFS 2012). This approach recommended an MVP of 4,150 annual anadromous spawners, on average, for an individual population. However, the approach assumed no empirical data were available for specific local populations, thus it is highly generalized and may not be well suited for every watershed (Boughton et al. 2007). A NMFS (2016) report also proposes using a 20-year window to evaluate the population, as opposed to simple annual check (Figure 1). Further, due to a lack of data on life history polymorphism and inability to estimate the magnitude of a “rescue effect” between resident and anadromous populations, the prescriptive criteria assumed that such a rescue effect is negligible; a 100 percent anadromous fraction was required of the mean annual run size criterion, and resident spawner life history variants (i.e., Rainbow Trout) were not considered in the MVP size criteria developed by NMFS (Boughton et al. 2007).

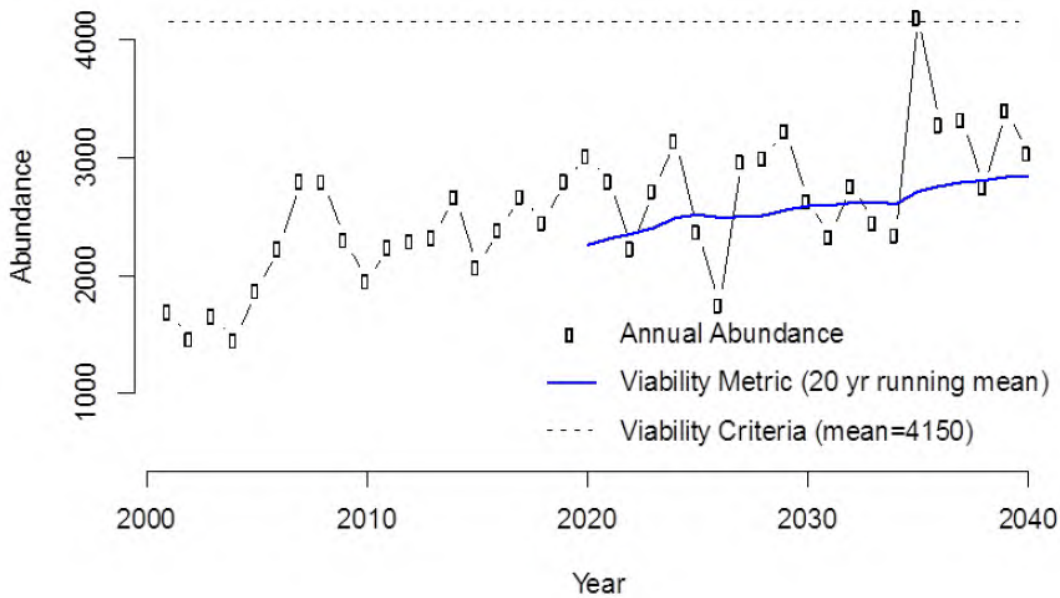

Figure 1. Concept of viability metric and a viability criterion applied to a hypothetical population. Figure 2 in NMFS 2016.

Objective 1.2 Identify population goals and dispersal amongst key watersheds

There is limited data to speak to potential and historical population demographics of steelhead in each watershed and basin. The literature has provided wide variations in estimated contributions to the population between basins. For example, Titus et al. (2002) estimated historical capacity of 20,000 for the Santa Ynez, but only 4,000 for the Ventura. Henke (1994) proposed between 7,000—9,000 for the Santa Clara, while Clanton and Jarvis (1946) only estimated 2,000—2,500 for the Matilija. Similarly, we have observed that smolt rates differ between basins, which again emphasizes the need to model the resident life history simultaneously to the anadromous population (Sogard et al. 2012). Although the SCS population is currently thought to be under capacity, these estimates help us determine the potential watershed population goals, the allocations that could contribute to the spawners needed for a MVP, if 4,150 anadromous spawners are appropriate and how resident spawners should be accounted for (e.g., less than a 100 percent anadromous fraction recovery criterion).

Objective 1.3 Southern California steelhead life history

Cramer Fish Sciences previously compiled data on 92 steelhead population parameters across 10 categories from 23 unique sources for the Suisun Creek LCM (Central California Coast DPS). Where data and parameter estimates from the Southern California DPS were not available, we used the information compiled for the Suisun Creek LCM to help inform parameterization. The following information on life histories, periodicity, and other demographic parameters from the literature review were completed as part of this project.

Migration and Spawning

Migration and spawn timing data from the Mokelumne River (California Central Valley DPS) shows entry into freshwater beginning in October and extending through April the following year, and spawning ranging from December to April (Figure 2) (East Bay Municipal Utility District, unpublished data).

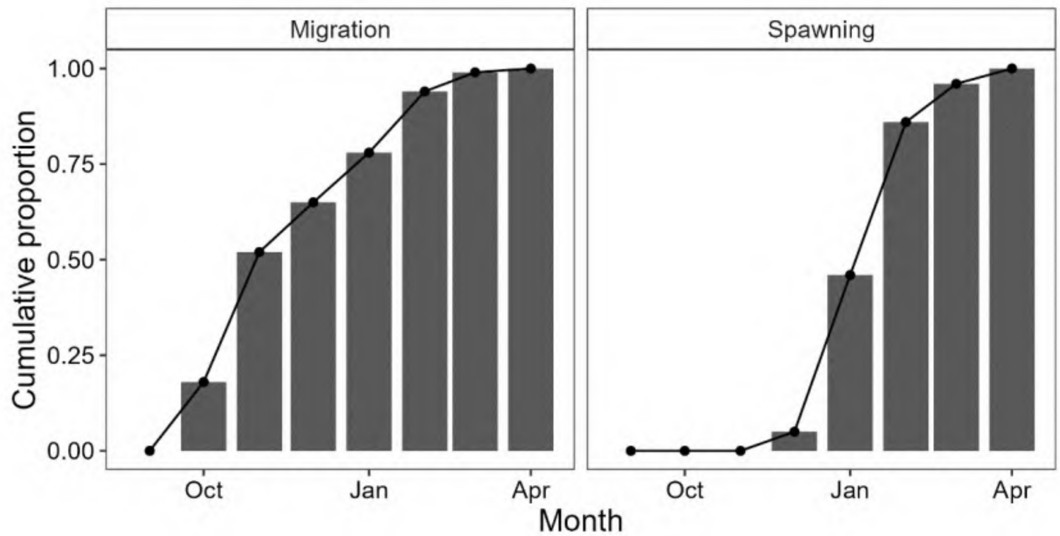

Figure 2. Cumulative proportion curves for migrating and spawning steelhead adults from the Mokelumne River (East Bay Municipal Utility District, unpublished data).

We assumed a 1:1 spawner sex ratio (Shapovalov and Taft 1954). Egg deposition assumes an average of 1,000 eggs per female, an optimistic estimate determined through a power-law relationship with fork length (Figure 3) (Shapovalov and Taft 1954).

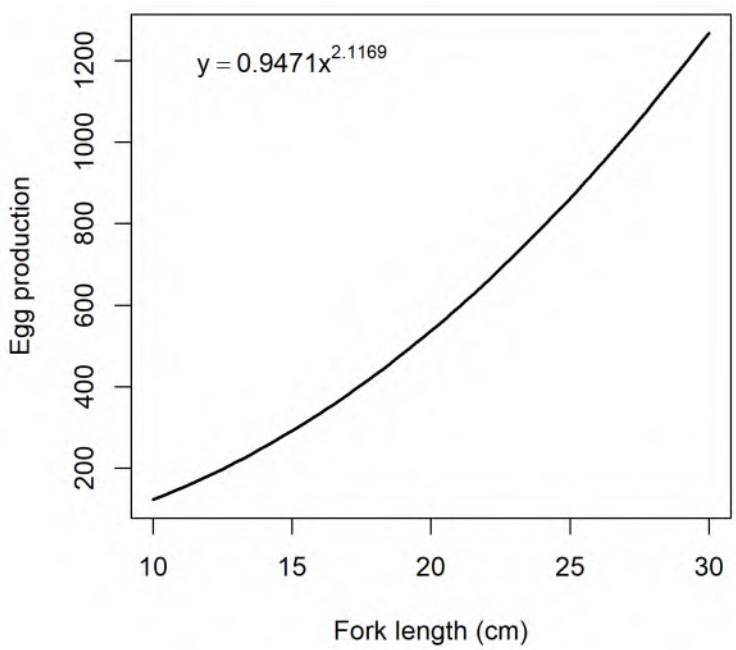

Figure 3. Relationship between female fork length and egg production from Scott Creek, CA (Shapovalov and Taft 1954).

The model assumes 1 redd per female spawner at an average size of 1.78 m^2 (SE = 0.14) (Gallagher and Gallagher 2005). Total spawning capacity is calculated within the model using a spawning habitat ratio requirement of 4:1 (Burner 1951); however, this calculation will assume uniform distribution of suitable spawning habitat within streams. We applied a hockey-stick function to limit spawners to spawning capacity and omit superposition or competition for spawning habitat.

Straying

According to Thorpe (1994), salmonids are famous for their homing precision and straying is usually regarded as a failure of individuals to achieve the population norm. However, without straying there would be no salmonid populations throughout much of their present range, as much of that area has been colonized by modern salmonids over the past 8000–15000 years (Thorpe 1994). Straying not only occurs in episodic pulses but also at relatively low and steady levels. Straying is important because it enables salmonids to colonize new areas over a relatively short time frame (Hendry et al. 2004; Quinn 2005), and is the behavior that has allowed salmonid populations over the course of thousands of years to colonize their existing habitats (Quinn 1984; Hendry et al., 2004), including establishing themselves within decades of glacial retreat (Milner and Bailey 1989; Milner and York 2001). Homing and straying are typically viewed as population-scale phenomena. According to Sandercock (1991), a return to the parental spawning ground provides a mechanism for enhancing survival by the repeat usage of good sites. Straying can also be a survival mechanism in that it may protect against the loss of an entire stock due to some environmental catastrophe in the home stream (Lieder 1989). It is clear that straying buffers against spatial and temporal variation in habitat quality and allows colonization of new habitats (Milner and Bailey 1989; Burger et al. 1997; Quinn et al. 2001; Stephenson 2006). Adults generally return to their natal streams to spawn, and stray rates are low in steelhead compared to other *Oncorhynchus* spp. (Westley et al. 2013). Straying rate estimates range from 1.2% to 11% in the Columbia River Basin and along the Oregon Coast (Keefer et al. 2005; Westley et al. 2013). The majority of straying occurs in non-natal tributaries within natal watersheds, however long-distance straying events (100 – 650km) can occur (Schroeder et al. 2001; Donohoe et al. 2021). Annual straying rates for the model were set to 5% (2.5% in either direction along the coast) with options to select values between 0% and 10%. For more detailed straying information, see the Natal Straying section withing Task 3.

Incubation

An estimated 97.5% of deposited eggs are successfully fertilized (Briggs 1953; Shapovalov and Taft 1954). Egg-to-fry survival estimates have ranged from 30% to 90% under controlled laboratory conditions (Shapovalov 1937; Shapovalov and Taft 1954) and 15% to 100% for steelhead in an in-river study of Central Valley steelhead (Merz et al. 2004); however, *in situ* estimates have been observed as low as 12% (Bley and Moring 1988). By default, egg-to-fry survival was set to 65%, based on populations in Humboldt County, CA (Briggs 1953), with options to reduce the survival to as low as 15% or as high as 90%.

Juvenile Rearing, Growth, and Outmigration

Juvenile steelhead typically rear in freshwater for 1 to 3 years after emergence (Shapovalov and Taft 1954). Estimated spring (February – April) growth for age-0 steelhead in Topanga Creek, CA is at least 24 mm and annually 61mm average (0.17 mm/day; Bell et al. 2011). These results are similar to estimates from the California Central Coast (Scott and Soquel creeks; Sogard et al. 2012) and but less than observed in the California Central Valley (Mokelumne and American rivers) (Sogard et al. 2012; Merz et al. 2016). Inhospitable conditions (e.g., low flows, high temperatures) in southern California can force early outmigration or encourage greater dependence on coastal lagoons or nearshore rearing (Moyle et al. 2008). Higher productivity in lagoons often leads to more rapid growth and increased survival (Smith 1990; Bond 2006; Hayes et al. 2008, 2011). A tagging study and analysis of scale morphology of returning adult steelhead in Scott Creek, CA showed that between 87% and 95.5% returning adults had reared in the lagoon, despite comprising less than half of the initial downstream outmigrants (Bond et al. 2008). For watersheds that form seasonal freshwater lagoons, an estimated 20% of fish are trapped when lagoons form and experience higher growth for an additional ~6 months, or until sandbars erode reconnecting the stream to the ocean (Smith 1990; Bond 2006; Hayes et al. 2008, 2011). Higher growth rates confer a survival advantage onto lagoon-reared fish by increasing their size at ocean entry (Bond 2006). Specific daily growth rates (% change in FL/day) for steelhead in Scott Creek, CA was 0.36 (SD = 0.20) in the lagoon compared to 0.06 (SD = 0.09) in riverine only individuals (Figure 4).

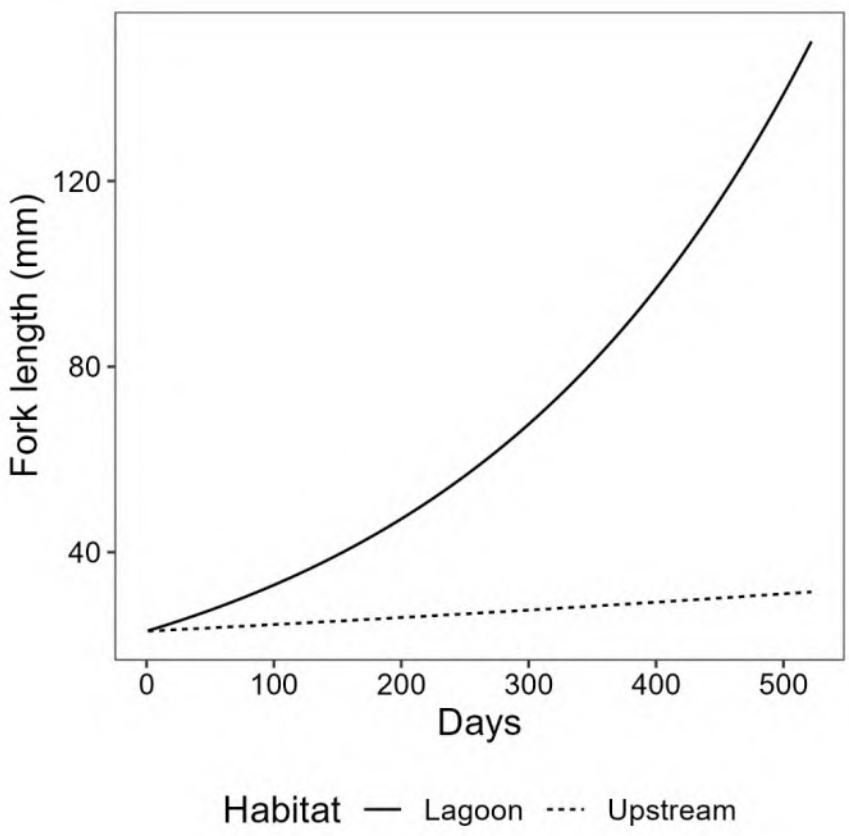

Figure 4. Simulated growth curves for juvenile steelhead rearing in lagoon and upstream habitats in Scott Creek, CA based on specific daily growth rates (Lagoon = 0.36 %FL/day, Upstream = 0.06%FL/day) presented in Bond (2006).

Data from an Above-Barrier Perched Resident population (see model framework for description) in middle Piru Creek also suggests populations dominated by younger age classes, with more than 90% of observations consisting of year-0 and year-1 juveniles and virtually no observations of age-5 or older individuals (Figure 5).

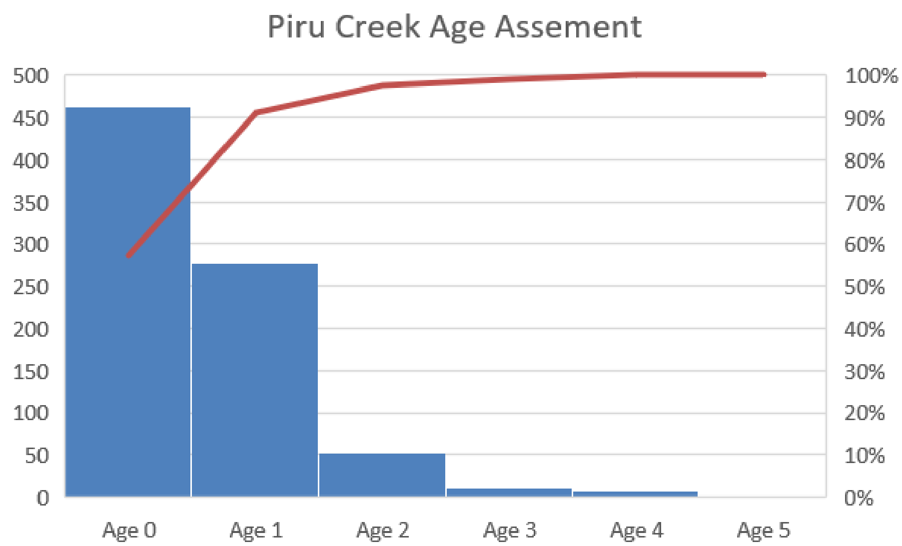

Figure 5. Age distribution of sampled fish at Piru Creek. United unpublished data from pre-implementation study.

Task 2: Identify and review available relevant models

Cramer Fish Sciences reviewed existing salmonid life cycle modeling frameworks to prepare for the development of the SCS Life Cycle Model. The purpose of reviewing existing modeling frameworks was to ensure the SCS LCM would be on par with the current existing life cycle modeling methods for Pacific salmonids. We drew heavily on examples from the Pacific Northwestern United States, where Chinook and steelhead life cycle models feature prominently in state and federal population management programs. The following sections summarize each of the different life cycle models we considered during development of the SCS Life Cycle Model.

Objective 2.1: Summarize/Evaluate general strengths and weaknesses

We identified four models previously built to evaluate salmonid population responses to management actions. Except for the Suisun Creek LCM, the models we reviewed were built specifically for Pacific Northwest rivers. Nonetheless, these LCMs provide a good general framework considering salmonid life cycle modeling.

Random Walk with Drift Model (Lindley, 2003)

The “random walk with drift” model (hereafter: the “Lindley model”), based on Lindley (2003) and parameterized with Central Valley field data for the 2007 and 2016 NMFS population viability criteria analyses (Boughton et al. 2007; Williams et al. 2016), is essentially a state-space model based on a simple exponential growth function (Equation 1).

Equation 1

$$N_t = N_{t-1}e^{r+\epsilon_t}$$

Where the number of individuals at time (N_t) is a function of the number of individuals in the previous time step (N_{t-1}) and the mean population growth rate (r). Random deviates (ϵ_t) in the mean population growth rate are added in each time step to create the "random walk" effect in population growth trajectories to represent process variance. The model can be modified (see Boughton et al. 2007) to simulate density-dependent growth.

State-space models are powerful modeling frameworks in ecology which link one or more mechanistic models (the process model) to an observation model (Patterson et al. 2008). The process model is usually some deterministic process which predicts the future state of some variable based on its current state. The predictions from the process model are then weighted by the likelihood of some observed data. Because the observation model essentially estimates the probability of observing some state, conditional on the 'true' state determined by the process model, state-space models offer a powerful way to handle uncertainty. Additionally, the process model can be parameterized with environmental data, providing an avenue for encoding realistic biological relationships into the model.

The Lindley model is broadly applicable; however, there are several drawbacks to the model and to the state-space modeling approach that should be considered. First, its process model (Equation 1) is fairly simple and assumes that population growth is not sensitive to age or stage-structure (Lindley 2003). Furthermore, the Lindley model does not consider alternative life history strategies (e.g., resident Rainbow Trout) or environmental influences. The Lindley model is capable of being expanded to include additional states and covariates; however, such an endeavor would require an advanced modeling approach and may include nested models. The parameters in state-space models (and in nested models generally) can be difficult to estimate, requiring maximum likelihood estimation (MLE) or a Bayesian Markov Chain Monte Carlo (MCMC) sampler (Patterson et al. 2008). Building the SCS LCM as a state-space model would provide a powerful tool for interrogating SCS population dynamics while explicitly incorporating uncertainty into the model; however, the current template (Lindley model) needs to be modified considerably to be able to incorporate all the desired life history stages, stage-transition processes, and environmental covariates. Thus, the model is liable to increase in complexity quickly and require advanced parameter estimation techniques (e.g., Kalman filtering, Bayesian MCMC).

Shiraz Model

The Shiraz model is based on a Beverton-Holt mortality function which adjusts life stage survival depending on life-stage specific relationships with environmental parameters. Movement between life stages can either follow an ideal free distribution to maximize fitness in the population, based on relative survival rates in different habitats, or occur in fixed fractions of the population. The Shiraz model also simulates hatchery operations and harvest policy and provides estimates of four important population criteria: abundance, productivity, spatial structure, and life-history diversity. Furthermore, it provides a general modeling framework upon which many subsequent life cycle models have been at least partially based, including the NOAA HARP model and the CFS Nooksack LCM. The Shiraz model has several limitations, some of which have been addressed in subsequent modeling efforts, including a limited ability to model restoration actions, inability to predict increases in habitat quality as a consequence of increased habitat quantity, and reliance on fixed values for several model parameters. The Shiraz model therefore provides a foundation for model conceptualization, particularly in ensuring that the SCS LCM will be capable of properly assessing steelhead population viability.

NOAA Habitat Restoration Planning Model

The NOAA Habitat Restoration Planning (HARP) model is a multistage population dynamics model developed for Chinook, Coho, and steelhead in Pacific Northwest rivers that includes spatial, habitat, and life history components (Jorgensen et al. 2021). The NOAA HARP model receives spatial data as input, which are processed into habitat data layers to inform salmonid life-stage capacity and productivity relationships. Capacity is defined as the number of individuals a given habitat can support while productivity refers to population growth parameters such as fecundity and survival. Life-stage specific capacities and productivities depend on the habitat conditions present within the study system and may take on either fixed values or adjust dynamically according to either statistical or theoretical relationships to habitat-related variables (e.g., temperature, flow, fine sediments). The ensemble of data and functional relationships are then used to simulate cohort-based population growth on an annual time-step.

The model tracks annual cohorts as they move through individual subbasins and transition through various life-stages. The freshwater component of the model included nine life-stages: upstream migration, spawning, egg incubation, and age-0+ through age-2+ summer and winter rearing (Figure 6). Alternative pathways for smoltification occur within the model at age-1, age-2, or age-3 at which point smolts are subject to a delta-bay survival multiplier. Delta-bay survival is difficult to estimate *in situ*. Therefore, delta-bay productivity was back-calculated from smolt-to-adult return (SAR) rates reported in the literature by dividing the SAR by the age-weighted average ocean survival estimate.

Iteroparity in steelhead is handled in the NOAA HARP model by determining the cumulative respawn rate, determined by the product of the kelt rate, the ocean reconditioning rate, and the return rate.

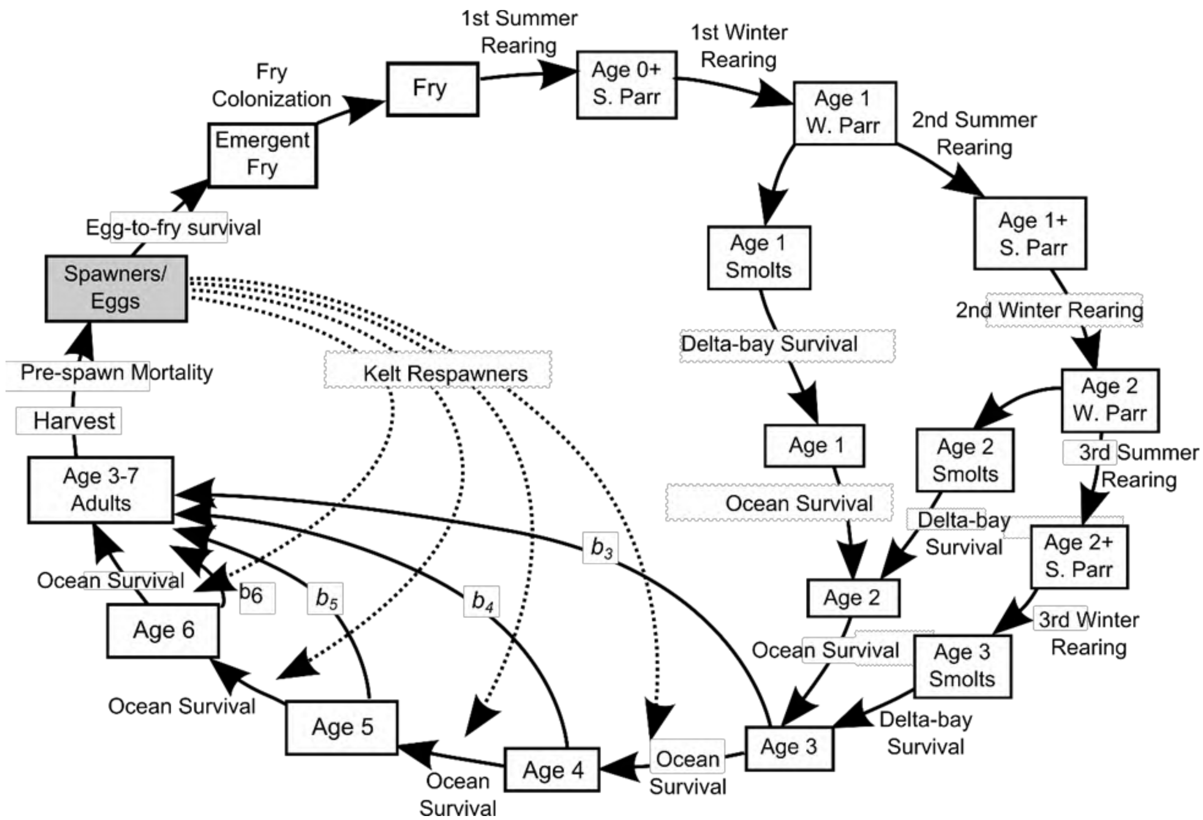

Figure 6. Steelhead life-cycle diagram developed for the Chehalis River basin (Jorgensen et al. 2021).

The NOAA HARP Model does not include a resident life history component and the capacities and productivities are tuned to reflect Pacific Northwest stream conditions. Nonetheless, it is one of the most comprehensive and transparent steelhead life cycle models and offers a solid frame upon which to base the SCS LCM.

CFS Nooksack Life Cycle Model

The CFS Nooksack LCM is largely based on the NOAA HARP model but includes several unique features. First, it utilizes a weighted connectivity matrix to account for spatial variation among populations and life stages, which allows for variable outmigration speeds in juveniles. Second, the CFS Nooksack LCM incorporates a highly detailed spatial layer of its watershed delineated at the reach scale for freshwater, estuary, and nearshore habitats. The CFS Nooksack LCM differs from the NOAA HARP model in the level of spatially explicit habitat detail built into the model, which allows for precise evaluation of life-stage specific population dynamics in response to habitat management scenarios and allows for complex population behaviors like straying. It is worth noting that this functionality was added to address specific issues observed within the Nooksack system that had previously been identified by regional experts and those familiar with the system.

CFS Suisun Creek Life Cycle Model

The CFS Suisun Creek Life Cycle Model is a cohort-based Steelhead LCM parameterized for a central California watershed. The focus was to determine the minimum spawning and rearing habitat requirements needed to support a viable steelhead population in using a life cycle model approach. The model was parameterized with data from nearby central California watersheds whenever possible, and helped to highlight data gaps that would limit / improve the modeling effort over time. The LCM was automated as both a workbook model in MS Excel, as well as an R Shiny application to facilitate use, and help highlight model behaviors (E.g., loss of a population cohort). The model is simplified, and lacks spatial components for spawning, incubation etc. and relies on coarse assumptions, omitting flow, season, and habitat quality. That being said, the components are well described and identify areas of potential enhancement. This model serves as a good example of a focused LCM used to explore specific questions about known (potential) limiting factors, like available habitat, and provides many data sources that will be relevant for this work.

Objective 2.2: Pull together useful pieces into the best model framework

Models are most useful when they are developed to address specific questions (Rose et al. 2011). It follows that the technical details of modeling (e.g., scale and complexity) must be informed by the question(s) being asked. To that end, the SCS LCM is being developed to shed light on two key questions; the first question is asked at a population scale, the second at the watershed or subbasin scale:

1. How much does freshwater residency (e.g., Rainbow Trout) contribute to the overall population dynamics of SCS?
2. How does connectivity and/or drought affect population dynamics?

Here, it is important to distinguish between **prediction** and **forecast** modeling and between **relative** and **absolute** results (see Rose et al. 2011 for detailed discussion). **Prediction** models are used to determine some expectation under a specific set of conditions, which can be modified and compared across alternative scenarios. The results of such models are typically interpreted **relative** to a null model or some baseline modeling results. By contrast, **forecast** models are used to obtain the “best guess” results, and may be extrapolated beyond the range of observed data in an anticipatory manner. Such results can be considered **absolute** because they are supposed to represent an actual expected value. Because the two key questions posed are primarily concerned with understanding the relative contributions of freshwater residency and connectivity/drought to SCS population dynamics and not with estimating actual population abundances, prediction modeling is the most appropriate path forward.

We recommended that the SCS LCM be developed at the finest level of detail necessary to fully address the questions posed, but we caution against excessive complexity where it is unwarranted. The Lindley modeling framework is somewhat general, aimed at setting minimum viable population targets for the entire region, is not age- or stage-specific, and does not explicitly model life cycle processes. Furthermore, the Lindley model is more well suited for forecasting population abundances than it is for addressing the influence of life history and environmental factors on population dynamics. By contrast, the conceptual foundation established by the Shiraz model and adopted by the NOAA HARP and CFS Nooksack LCMs (from here forward, we refer to this suite of models as the “cohort-based life cycle simulation models") provides a flexible modeling approach well suited for addressing the key questions posed. The cohort-based simulation LCM approach merely requires a set of well defined, connected functional relationships and some initial conditions. Model results can be generated under alternative scenarios, potentially representing competing hypotheses, and compared relative to one another. An additional advantage of cohort-based simulation LCMs is that that they require less empirical data to produce useful results. Data-poor watersheds may produce imprecise or biased results; however, if the model and all its components are properly specified, its results can nonetheless provide valuable insights into the question being asked when interpreted properly (i.e., relative to a baseline). The Suisun Creek LCM serves as a good example of the application of a cohort-based simulation LCM.

We recommended adopting a modeling approach similar to that used in the Shiraz, NOAA HARP model, and CFS Nooksack LCM, all of which provide an appropriate scaffolding upon which to build the SCS LCM. The modular nature of cohort-based simulation LCMs means that model components can be easily tuned to specific study systems by incorporating data and parameter estimates from regional monitoring and/or studies. Further, the cohort-based simulation LCM framework allows for flexibility in spatial scale, which will enable us to build the model at the appropriate level of detail required to address the key questions without introducing unnecessary complexity. For example, the CFS Nooksack LCM incorporates a very fine level of habitat detail (reach-scale) beyond what is necessary given the purpose of this modeling study; however, the backbone of the model, and others like it, are its functional relationships representing the various life history stages and transitions which typically do not have any influence on scale. Because each process in a cohort-based simulation LCM runs in isolation, functional relationships can be easily added or removed representing productivity and survival at specific life histories and stages, and data can be leveraged from disparate sources to parameterize those relationships. Furthermore, existing code from the CFS Nooksack LCM, while currently built for Pacific Northwest Chinook, can be easily adapted, modified, and expanded in order to satisfy the goals and objectives of this study.

Task 3. Quantitative Life Cycle Model

Model Framework:

The goal of the Southern California steelhead life-cycle model (SCS LCM) is to understand the influence of source-sink dynamics between resident and anadromous *O. mykiss* on population viability (i.e., the 100-year extinction risk) for Southern California DPS populations, as well as the potential for long-term Southern California DPS persistence as a whole. The SCS LCM links individual life-cycle sub-models parameterized for three distinct life-history variants (Figure 7), The Anadromous population (A), Below-Barrier Freshwater Resident (R), and Above-Barrier Perched Resident (P) *O. mykiss* to a state-space model simulating exchange between populations and life-history variants (see definitions below). Exchange is dependent on habitat connectivity determined by instream flow and fish passage barrier ratings. The potential for spillover between populations within and between watersheds, and between life-history variants, is an important life-cycle dynamic not reflected in current SCS MVP size estimates for individual watersheds (i.e., 4,150 anadromous spawners per year on average; NMFS 2012). Our model improves upon previous efforts to quantify the SCS MVP by considering the contributions of alternative life-history variants to the anadromous spawner population. By including a watershed scale spatial framework, MVP estimates can be obtained for individual watersheds to demonstrate their potential contributions to the population as a whole.

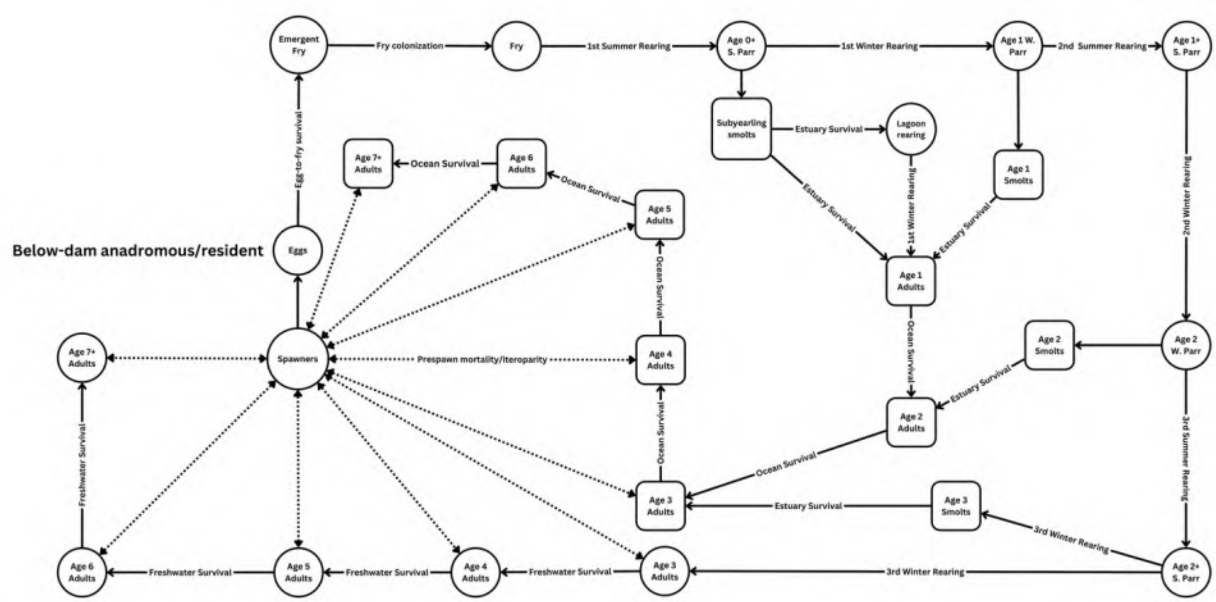

Figure 7. Conceptual life cycle diagram for Southern California steelhead which includes both freshwater (circles) and anadromous (squares) life stages.

Modeled Life Histories

As previously mentioned, this model considers three distinct life history variants that interact with each other to create the overall dynamics observed for the SCS population:
Anadromous (A) – Often referred to as the steelhead life history, these fish leave their natal basins and head out to the estuary and marine environment, where they rear for <1 to several years, before returning to spawn. They are affected by estuary and nearshore conditions, as well as the overall ocean conditions, and can exhibit straying behavior (see "Natal Straying" below).

Freshwater Resident (R) – The freshwater life history is often referred to as "Rainbow Trout" and represent fish that fully rear in freshwater. The Freshwater Resident population serves as the source of the Anadromous population, as all juveniles are considered freshwater residents until they smolt and head to the ocean.

Perched Freshwater Resident (P) – The perched freshwater life history represents freshwater residents that have no consistent connection to ocean, and therefore, cannot exhibit anadromous life histories outside of specific conditions (see Wet and Dry year effects below). Although this population does not directly affect the anadromous population, it can increase the freshwater resident population via spillover (R) which, in turn, effects the anadromous population (A).

By modeling all three life history variants simultaneously we are able to demonstrate complex population dynamics like reseeding and recolonization of extirpated habitats. When combined, we can demonstrate how *O. mykiss* adaptations, through life history variation, can extend the fitness and longevity of the overall population.

Modeled Basins

The SCS LCM considers multiple Basins within the DPS listing of SCS. The model is structured around the following river basins: Santa Maria River (Cuyama River and Sisquoc River as separate sub-basins), Santa Ynez River, Ventura River, Santa Clara River (with Piru Creek as a separate sub-basin), Los Angeles River, San Gabriel River, Santa Ana River, San Mateo Creek, San Luis Rey River, and San Diego River (Figure 8). Although each of the basins contribute to the population, the specific habitat and capacities vary widely, and necessitate separate parametrizations.

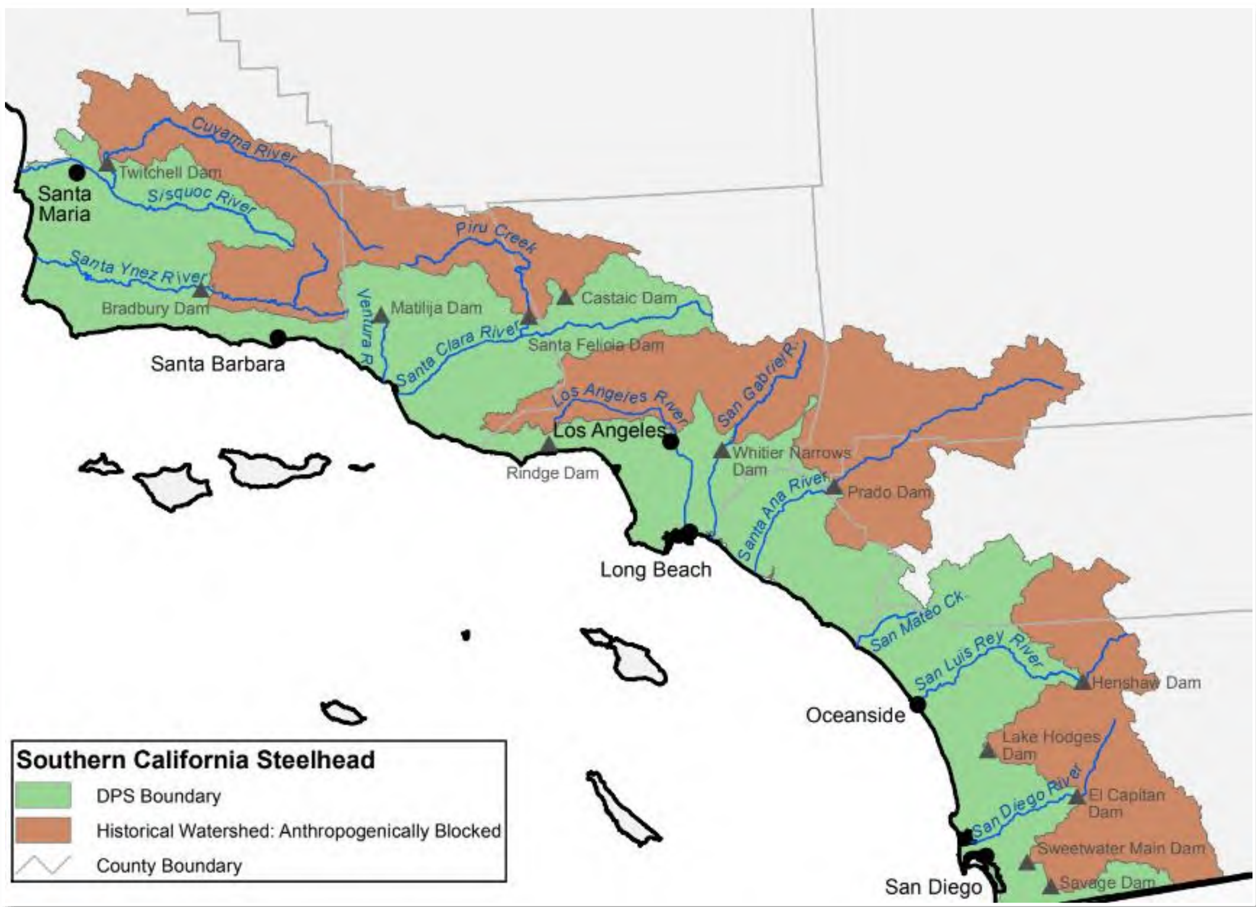

Figure 8. Basins modeled, and approximate extent of historical habitat. From NMFS 2016.

Natal Straying

Straying is typically defined as adult migration to—and attempted reproduction at—non-natal sites (Quinn 1993). Natal straying refers to the phenomenon where spawners do not return to their natal basin, but instead return to a nearby watershed to spawn. This process is responsible for recolonizing areas with previously extirpated populations and has been widely documented amongst many species as an adaptation to density dependence or overall lack of quality habitat. For the SCS we model straying using a transition matrix that determines how much of a population might stray each year, and where they stray to. The transition matrix is an *n x n* matrix that represents all *n* watersheds. Each row represents a watershed, and values indicate what other watersheds (columns) receive straying. The diagonal of this matrix represents the amount of spawners that successfully return to their natal basin. Given limited data to parameterize the matrix, we have assumed small amounts of straying occur up and down the coast to adjacent watersheds, and that this rate may adjust based on available habitat (see dry year effects below).

Wet and Dry year effects

The model assumes three broad categories representing the overall hydrological conditions across the year: Wet, Regular, and Dry. These categories were determined by looking at historical records and binning model components and data into equal quantiles. Although this is aggregated and simplified classification, it allows us to incorporate and explore how wet and dry years can affect the population overall.

Regular Years- The model's default state assumes regular conditions. These conditions allow for anadromous connection and rely on the full reach capacities to drive density dependence. Perched populations have no emigration below blockages and remain "perched".

Wet Years- In wet years, we assume there is the opportunity for spill-over and downstream connection to anadromy for perched populations. In these years, we model volitional movement downstream of blockages by allocating the overage from the density dependent survival downstream into the resident population. This increase in resident population then also contributes to an increase in the anadromous population via the resident population smolt rate.

Dry years- In dry years, several adjustments are made. First, there is reduction in capacity for Freshwater and Perched populations representing both disconnection from habitat, as well as reduction of available habitat. Second, there are reduced smolting rates from resident populations to model the effect of disconnection to anadromous waters that can occur. Overall, these processes combine to have an overall negative effect on all three populations (perched, resident, and anadromous). Finally, following the assumptions of Quinn (1984) related to less stable streams in that we model an increase in straying rates in dry years to represent the potential disconnection from natal streams.

LCM Stages:

The state-space model moves fish through life stages (Figure 7) and records and reports metrics on an annual time step. Following is a brief description of how each transition occurs, and what values control it in the model.

(A) Returns to Spawners: Represents moving back to the natal spawning range and preparing to spawn. Reductions from both pre-spawn mortality, and harvest rate. Both factors are separated by LHP as well as region.

(B) Spawner to Eggs: Shifts successful return into spawners. Calculated using the Female ratio (fixed), as well as a hockey stick function for spawning capacity (separate for each LHP and region). Successful spawners are then converted to eggs via the fecundity parameter. Note, that successful spawners are not all removed from their population, see “Iteroparity” below.

(C) Egg to Fry: Egg survival and successful hatching into fry. Controlled by the ‘Egg to Fry’ parameter. Separate for freshwater and perched populations.

(D) Fry Rearing and Colonization: Fry survival to initial winter rearing. Controlled by the ‘Fry Survival’ parameter that represents the proportion of fry that survive. Separate for Resident and Perched populations. Reduced value in dry years.

(E) Winter Rearing: Density dependent reduction using Beverton-Holt based on capacity and productivity. Separate for Resident and Perched populations. Capacity and productivities by watershed and age. We assumed that the capacities by age account for effects of other age classes (NOAA HARP Model).

(F) Summer Rearing: Density dependent reduction using Beverton-Holt based on capacity and productivity. Separate for Resident and Perched populations. Capacity and productivities by watershed and age.

(G) Smolting: Rate that freshwater fish convert to Anadromous life strategies. Determined by smolt rates. Rates vary by age and potential to adjust for each watershed. Reduced values in dry years to represent disconnection to the anadromous floor. Only applied up to age 4.

(H) Lagoon Rearing: Specific adaptation strategy observed for anadromous population. Provides greater survival compared to estuary and nearshore rearing. Limited by lagoon capacity. Relies on density dependent curve to allocate population to lagoon (preferred), with overage rearing in estuary. Reduced lagoon capacities in dry years. We assume similar dynamics are at play for perched populations where reservoirs are present (Leidy 2004).

(I) Estuary Survival: Default conditions for anadromous rearing when lagoon area is unavailable/ occupied. Fixed rate that depends on age.

(J) Ocean Survival: Represents annual survival in the ocean using a fixed proportion. Separate values by age.

(K) **Maturation**: Rate that fish mature to spawners. Determined by maturation rates with separate rates for each LHP and age (fixed proportion).

(L) **Adult Freshwater Annual Survival**: Represents annual survival of freshwater adults. fixed rate. Separate value for resident and perched populations

(M) **Iteroparity**: Ability for spawners to return and spawn again next year. Controlled by iteroparity rate and respawn survival factor. Separate values for Resident and Perched populations. Assumes that a spawner's LHP is fixed and does not change on repeat spawning.

Initial conditions

The model requires initial conditions to seed the various populations. Long term dynamics are controlled by functional relationships and capacities, and are somewhat robust to initial conditions, however, the ramp up time to stable conditions will depend on the initial seeding and should not be overlooked. Given the potential for a 7-year anadromous return, we would not expect to hit stable dynamics in less than 10 years for most initial values. For this reason, the default model length is set to 125 years to account for the model's "warm up" time.

Demonstrated Population Dynamics – Useful tool without exact empirical data

As mentioned in the modeling section, one benefit of prediction models is the ability to compare a baseline scenario to alternate parameterizations to explore how changes in values (or assumptions) affect overall outcomes. Evaluating population dynamics often poses a challenge when empirical data is scarce or limited. In the case of the SCS population, the lack of empirical data has necessitated the use of a simplified model. However, despite these data limitations, we can still gain valuable insights by exploring how population dynamics are affected by individual modeling components and their values.

To that end, we have developed a model baseline scenario that serves as a fundamental starting point for our analysis. This model baseline parameterization not only helps us navigate the complexities of the SCS population dynamics but also serves as a crucial tool for demonstrating key phenomena in a controlled environment. While the model baseline scenario is an abstraction, it allows us to dissect and understand the impact of various factors, such as reproductive rates, mortality, and environmental variables, on population growth and sustainability.

These concepts, while derived from a simplified model, are robust and reveal core features of the model, and SCS adaptations. By focusing on these fundamental principles, we can uncover insights that may guide future data collection efforts or help refine more complex models as data becomes available. Thus, the use of the simplified model not only provides a pragmatic solution to data limitations but also offers a valuable framework for examining critical population dynamics and their sensitivity to different parameters and assumptions.

Impacts of Wet and Dry years

The model baseline assumes an 'regular' water year and has multiple parameters and capacities that are directly tied to 'dry' years to represent deleterious effects on the population. Similarly, 'wet' years offer opportunities for the perched population to 'spill' into connected freshwater habitat. The model's default behavior assumes a sequence of water years that match historic trends, but the model also allows users to generate alternate randomized sequences to explore the impact of longer or shorter sequences of wet and dry years.

To emphasize these effects, consider the following parametrization. By setting the model to only include 'Dry' years, the perched population cannot contribute to the Resident population (and therefore the Anadromous population), and we can generate a downward trend for population, reaching an asymptote of the Perched population total (Figure 9).

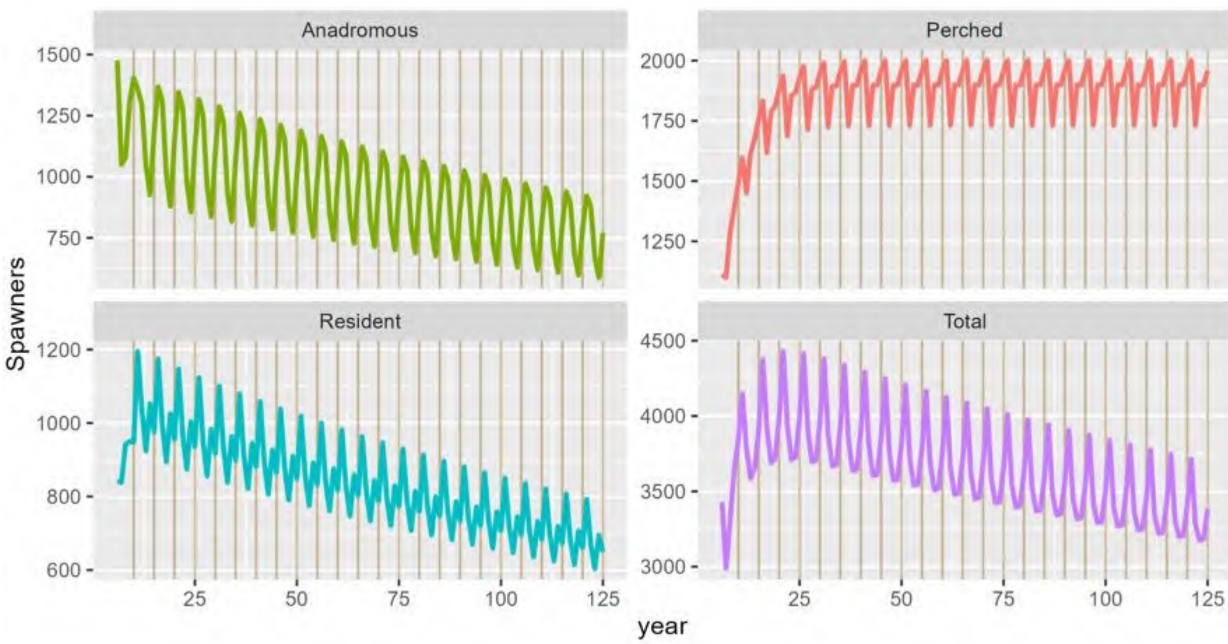

Figure 9. Example of Dry year effects. Plots of Spawners over time for the life history variants modeled in the SCS LCM, along with an aggregated total. Vertical brown lines represent 'dry' years in the run.

Introducing 'wet' years allows the perched population to contribute to the Resident population and can help offset the impacts of the 'dry' years in the run, eventually achieving values approaching MVP (Figure 10).

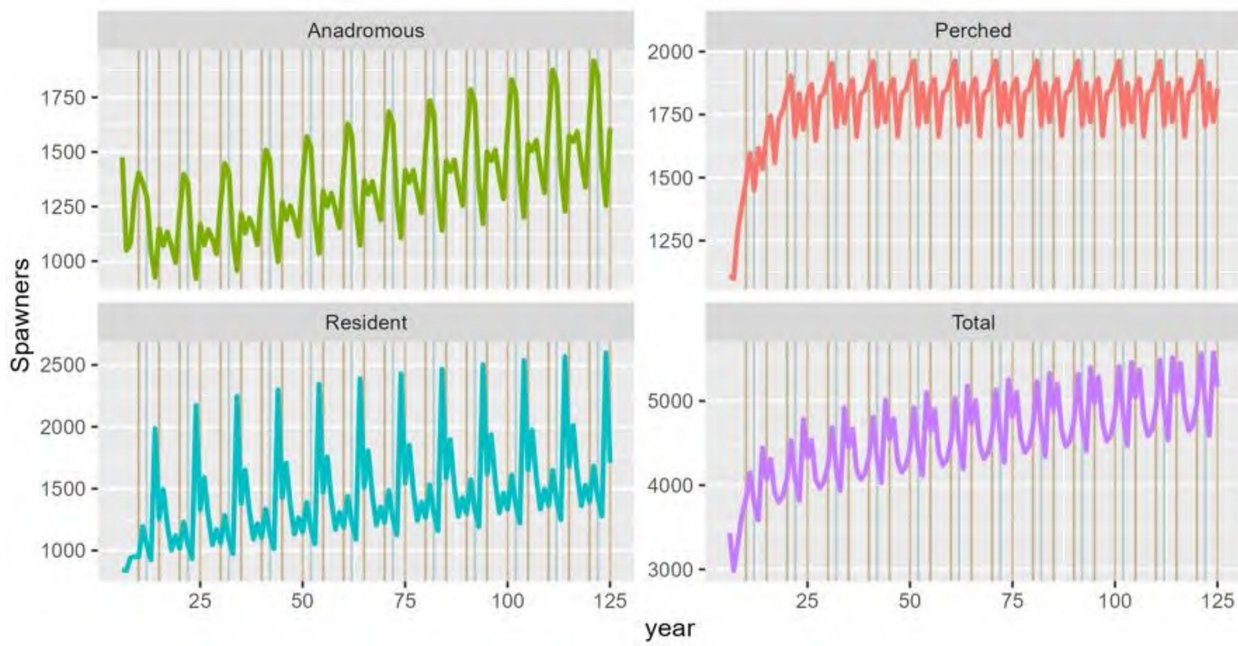

Figure 10. Example of Wet and Dry year effects. Plots of Spawners over time for the life history variants modeled in the SCS LCM, along with an aggregated total. Vertical brown lines represent 'dry' years in the run while blue lines indicate 'wet' years.

Reseeding Populations

Interchange between the resident and anadromous population allows for reseeding an extirpated anadromous population through smolting. Similarly, anadromous adults in the ocean may be able to reseed the freshwater resident population given their lagged return. Finally, the Perched population can reseed the resident population in wet years via ephemeral connections and spillover.

To highlight these dynamics, consider the following parametrization that extirpates the Resident and Anadromous populations after a series of 'dry' years, only to reseed the population from the perched population in a subsequent 'wet' year (Figure 11).

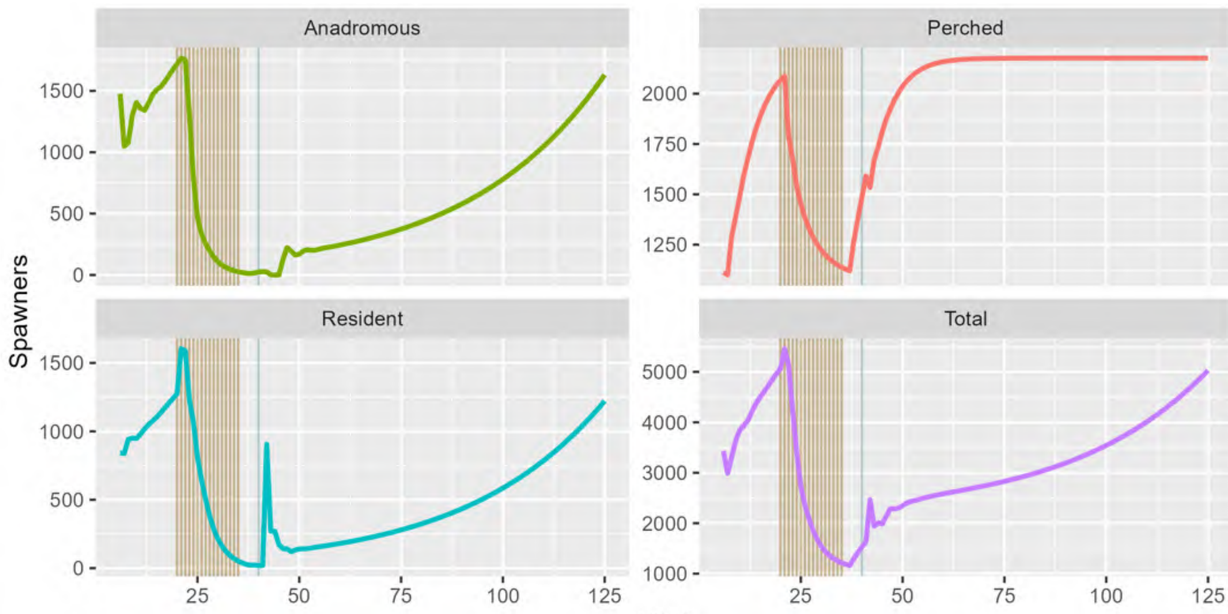

Figure 11. Example reseeding extirpated populations using interchange with a perched population. Plots of Spawners over time for the life history variants modeled in the SCS LCM, along with an aggregated total. Vertical brown lines represent 'dry' years in the run while vertical blue lines represent 'wet' years.

By including both 'wet' and 'dry' years, as well as the potential for interchange between populations, we can begin to produce complex population dynamics (Figure 12).

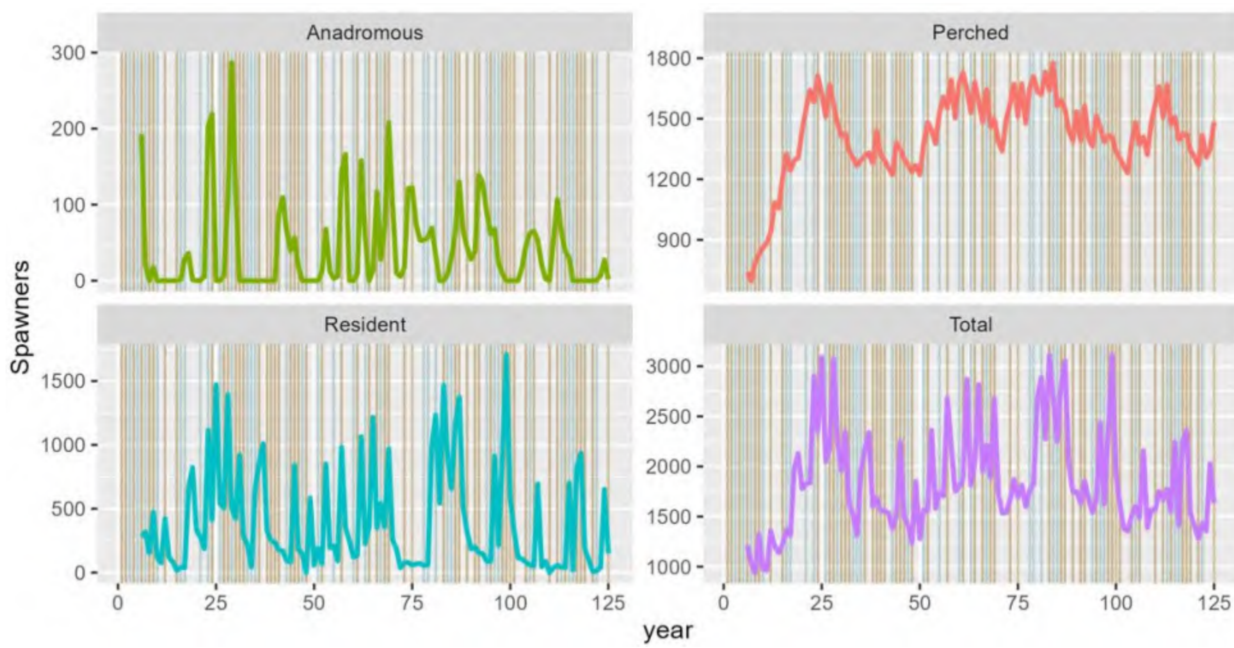

Figure 12. Example of complex populations dynamics by simulating a random sequence of water type years from an empirical distribution. Plots of Spawners over time for the life history variants modeled in the SCS LCM, along with an aggregated total. Vertical brown lines represent 'dry' years in the run while vertical blue lines indicate 'wet' years. Note the anadromous population being reseeded multiple times across the 125-year model run.

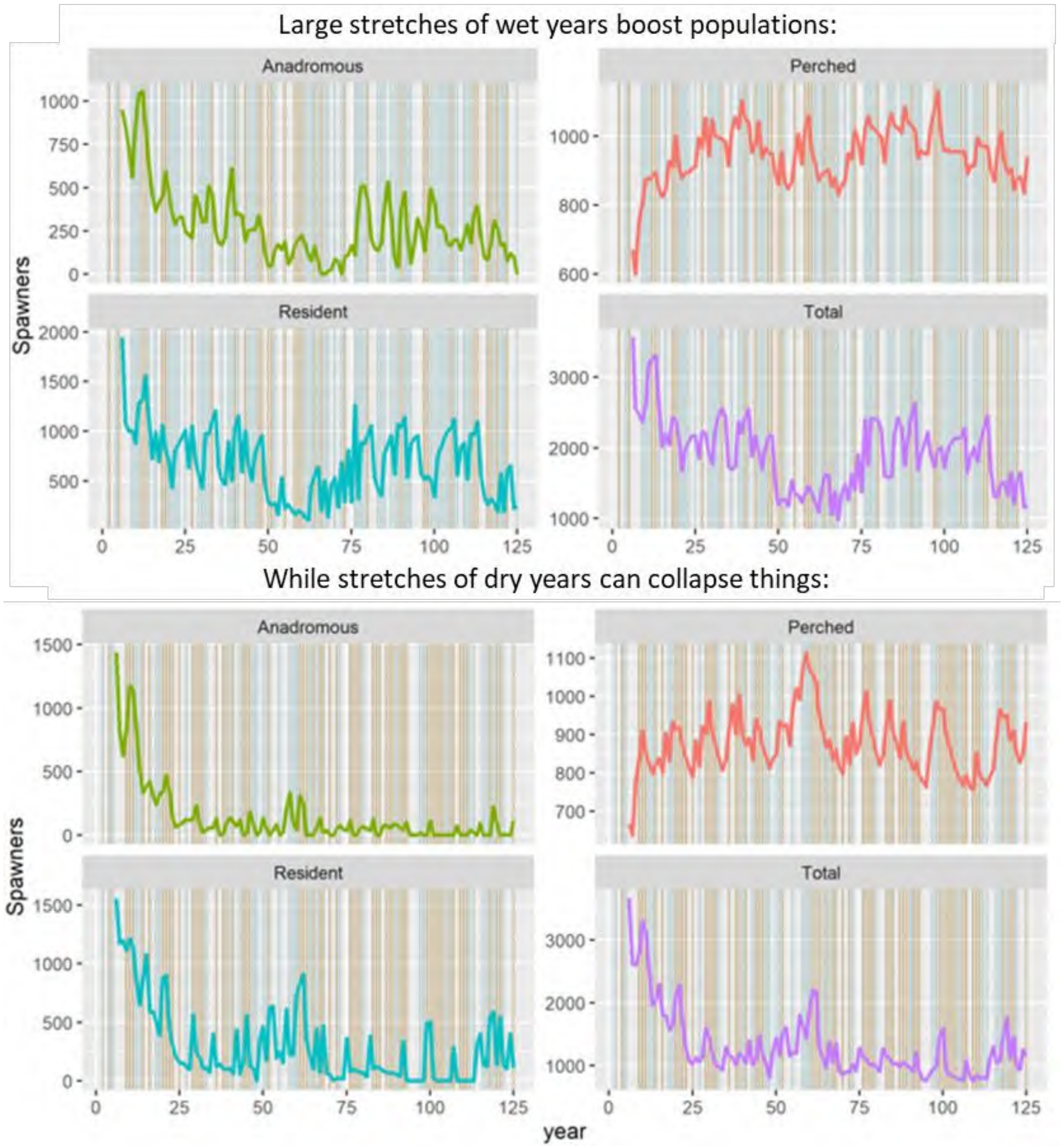

Figure 13. Further examples of complex dynamics demonstrating effects of wet and dry effects. Plots are the same as in Figure 12, but with larger stretches of Wet and dry years highlighting the importance of these environmental factors.

Recolonizing Extirpated Habitats

Beyond local interchange between Resident, Anadromous, and Perched populations, natal straying from the anadromous population can recolonize extirpated habitats. To demonstrate this, we created a diagnostic scenario that forces extirpation in a basin for a set of continuous years to highlight how recolonization can manifest (Figure 14). In the following example, Santa Clara River is recolonized from Natal Straying from nearby systems (Figure 14). Note that the model does not allow the upstream exchange of the Resident population to the Perched population (only the converse), and so the Perched population remains extirpated here:

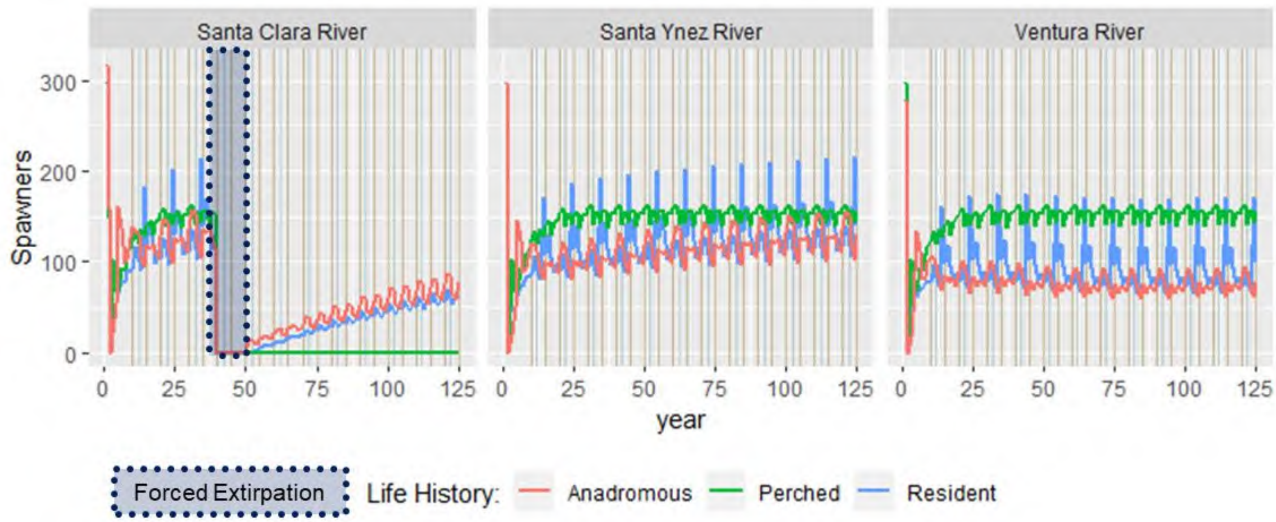

Figure 14. Example of recolonization of extirpated habitat by long-distance natal straying from alternate basins. Plots are of Spawners by year with three basins shown separately, with each Life History Variant distinguished by color. The shaded box represents a forced extirpation lasting 10 years. Vertical brown lines represent 'dry' years in the model while vertical blue lines represent 'wet' years. Note that the water year types match those presented in Figure 10.

Baseline scenario and default Parametrization:

For the model baseline scenario, we set the Anadromous return spawner total to just over the MVP needed to ensure genetic viability (~833 [2500 over 3 years for low extinction risk], Spence et al 2008), while aiming for a total population (including Freshwater and Perched populations) to exceed 4000 fish to achieve an MVP that is more robust to catastrophes and environmental stochasticity (Reed et al 2003 suggests ~5800). Finally, freshwater age structures will be calibrated to closely resemble empirical data from Piru Creek. This parametrization should highlight the overall contributions of the life history variants and connectivity to the long-term persistence of the DPS.

Model Implementation and Dashboard

The SCS LCM model has been implemented in R (R Core Team 2023, version 4.3.1) and only relies on well vetted packages that are available on CRAN with extensive histories of maintenance ("data.table", and "ggplot2"). The model requires little computational resources to operate and should be able to run on most modern computers. Although the code is well commented, it can be intimidating to work with as it is a somewhat complex model relying on nested loops and complex accounting structures. To make the model as user friendly and transparent as possible, we have adapted the code into an R Shiny framework to create a reactive Graphic User Interface (GUI) to run the model (Figure 15). The GUI includes options to rapidly adjust the majority of the model's parameters, and should allow novice users to explore the model, its assumptions, and results.

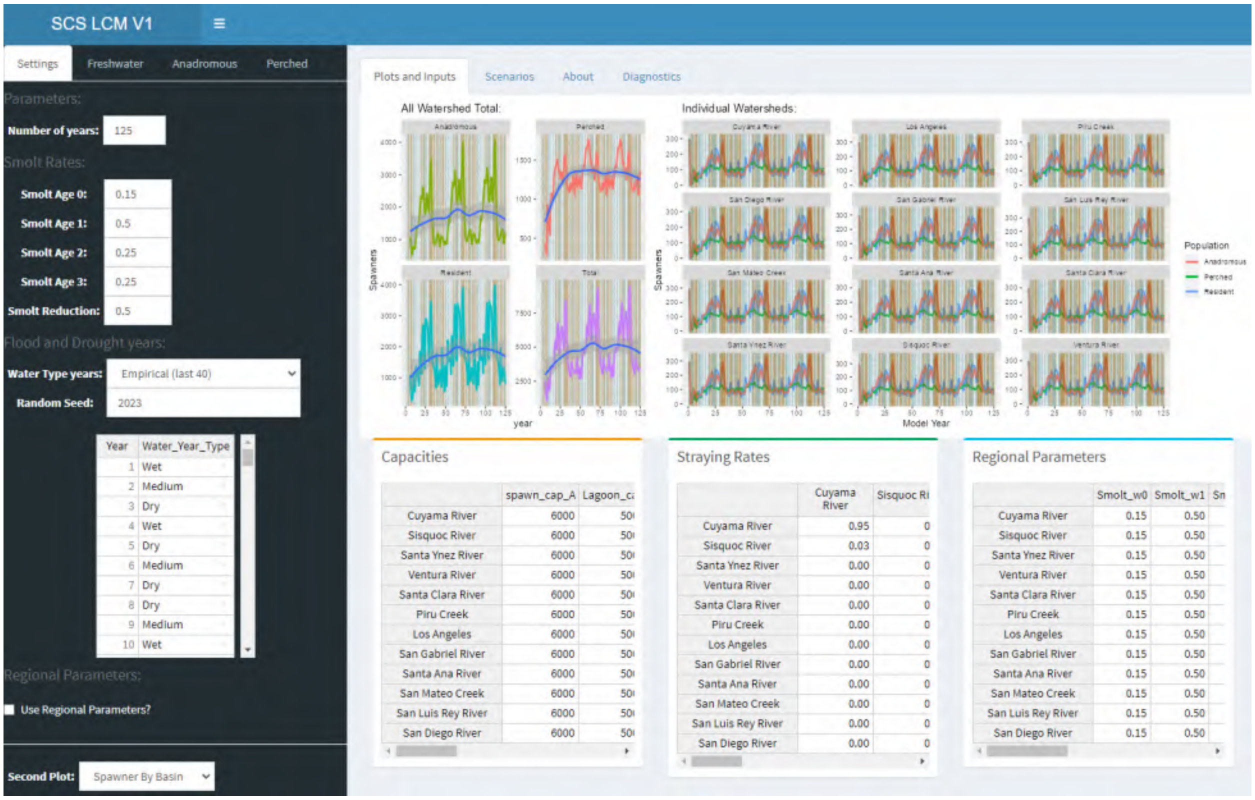

Figure 15. Screen capture of the GUI. A User guide for the model interface is under development and will be included in the 'About' tab.

Additional Scenarios

The model framework is easy to adapt and expand to consider other additional scenarios. As an example of this, we have added a "Reduction Event" scenario to the GUI (under the "Scenarios" tab in the main panel) that allows users to simulate a one-off large scale reduction event. Users have the option to select what year the reduction event starts, its total duration, and how large of a reduction in returning spawners should be applied. This sandbox scenario can help explore the effects of major unforeseen environmental impacts, and to evaluate population resiliency to these events. Moreover, this is meant to demonstrate the type of additional scenarios that can be created and evaluated using this model framework.

Concluding Remarks

- SCS show many adaptations and life history variants, many unique or emphasized for this population (e.g. Freshwater life histories, lagoon Rearing, 'mini-jacks', etc.). Ecological theory suggests that these adaptions are important to the population (hence their development) and should be considered in a population life cycle model to fully understand the dynamics of the population.
- Our model demonstrates how many of these adaptations can impact the long-term population dynamics, generally increasing the longevity and fitness of the population overall.

- Although the model is relatively simple and relies on many assumptions, the core dynamics demonstrate that concepts like connectivity (e.g., straying and perched population spill over) and life history variants (e.g., inclusion of both anadromous and resident spawners) can have relatively large impacts on a population's trajectories and persistence, and that omitting them may not fully capture the population's capabilities.
- By providing the GUI interface, the model can facilitate open discussion on management actions and future condition effects on the persistence of the SCS DPS at both regional and population wide scales.
- The model highlights data gaps and needs and can be updated as more information is available.

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From: Russell Marlow [redacted]>
Sent: Thursday, April 4, 2024 03:09 PM
To: FGC <FGC@fgc.ca.gov>
Subject: Materials for Commissioners Meeting Packet

Good Afternoon,

Attached you will find a public support letter that EnviroVoters collected in favor of fully listing Southern Steelhead under CESA.

Please let me know if there are any needed changes to ensure that these docs are included for the Commissioners' review prior to the meeting.

Thanks, Russell

Thank you,

Russell Marlow
[redacted]

April 4th, 2024

California Fish and Game Commission
P.O. Box 944209
Sacramento, California 94244-2090

RE: California Trout, Inc.'s Petition to list Southern California Steelhead (Oncorhynchus mykiss) as Endangered Office - Administrative Law's Notice ID #Z2021-0702-02 and Z2022-0426-01

President Murray and Commissioners:

As concerned California residents, I write to you today to express my full support for designating the Southern California steelhead as endangered under California's Endangered Species Act.

Southern steelhead are an iconic native species, but without further protections we risk losing them forever. That's not a California I want to live in. Do you? You must act immediately to put in place all precautions to prevent this species from total loss.

Recent research tells us that Southern steelhead populations are in danger of extinction within the next 25 to 50 years if current trends persist. Since their listing as an endangered species in 1997 under the federal Endangered Species Act, Southern steelhead numbers have continued to decline to precariously low levels. In the past 25 years, only 177 adult Southern steelhead were documented in their native range! Allowing this species to disappear is not acceptable, and more protections are essential.

These fish play a key role in our ecosystems, and they can give us crucial information about the greater health of the watersheds they swim in (and that our communities rely upon). We can look to them for clues on how California must work to address bigger problems in our southern rivers and streams, watersheds that provide countless societal and economic benefits for the entire state. I believe that we prosper when rivers and waterways in key locations are thriving, and in many of these places there is work to be done.

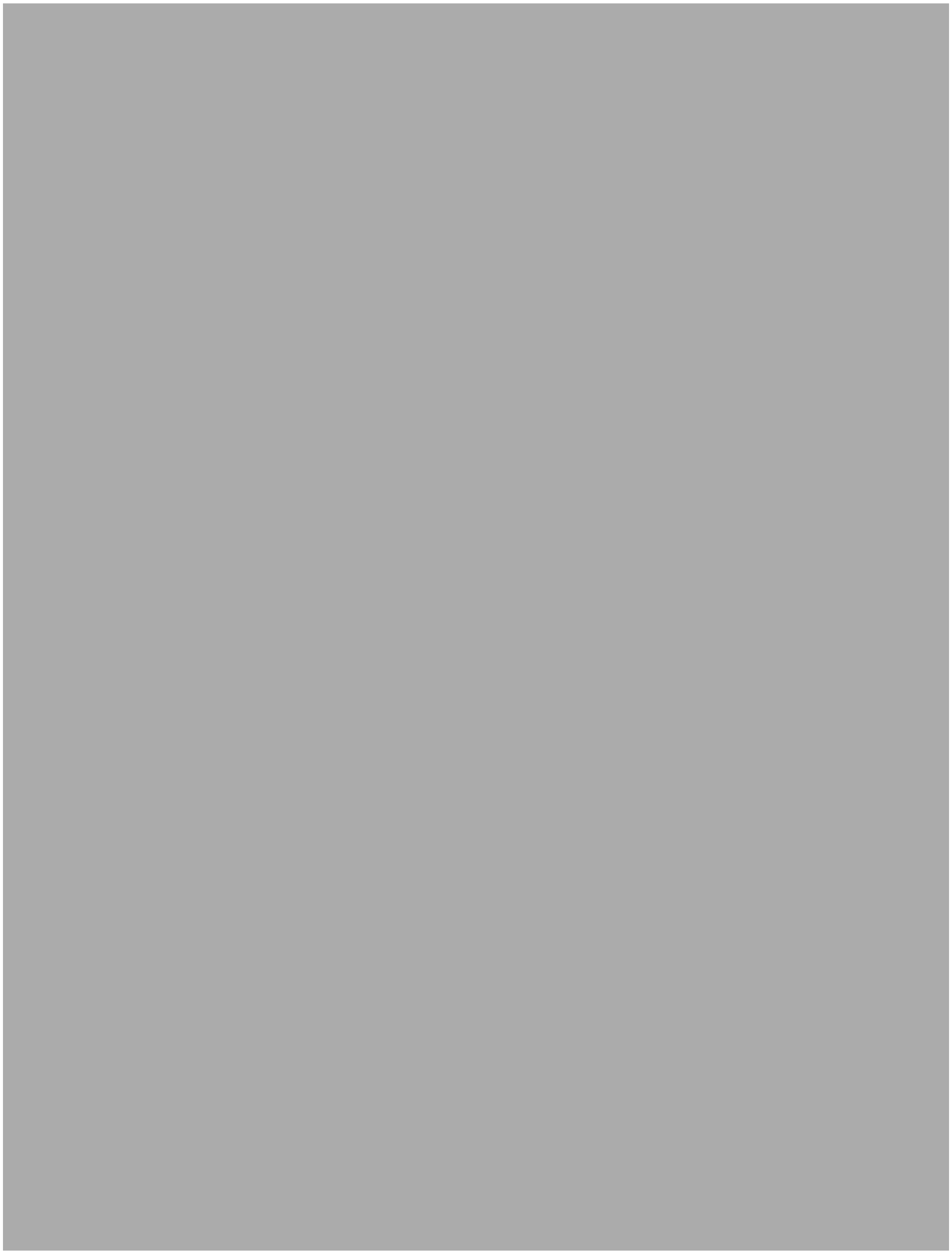
These fish may also play a role in providing resiliency for ecosystems further north along the coast. Southern steelhead are uniquely adapted to Southern California's warmer Mediterranean climate. As climate change continues to increase water temperatures and alter flow regimes along the entire West Coast, Southern steelhead could be critical to the long- term resiliency of their northern relatives.

For all these reasons, I wholeheartedly support California Trout's recommendation that Southern California steelhead be listed as endangered in all waterways within historic range below natural or man-made barriers. CalTrout chose this delineation thoughtfully, so that fishing and continued management for rainbow trout, the freshwater form of this amazing species, would still be possible above these barriers.

It’s not too late to save the Southern California steelhead species from blinking out – but if you don’t act urgently, we may very well miss our chance. Please make protection of these amazing and important fish a conservation priority by listing them as endangered under the state’s Endangered Species Act.

Sincerely,

EnviroVoters Together as Concerned Californians and Individuals All Over



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April 4, 2024

VIA EMAIL fgc@fgc.ca.gov

Ms. Samantha Murray, President & Members
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244

Dear President Murray and Members:

Comments on the Petition to List the Southern California Steelhead Pursuant to the California Endangered Species Act and the Department of Fish and Wildlife's Status Review Report

The Los Angeles County Sanitation Districts (Sanitation Districts) received the Notice of Final Consideration of the subject petition by the California Fish and Game Commission (Commission) for their April 17-18, 2024, meeting, and have reviewed the January 2024 California Department of Fish and Wildlife (CDFW) Status Review Report of Southern California Steelhead (2024 Status Report). The Sanitation Districts previously reviewed the June 7, 2021, Petition to List the Southern California Steelhead under the California Endangered Species Act (CESA) and the November 2021 Petition Evaluation prepared by CDFW and provided comments to the Commission on January 27, 2022 (see Attachment 1). By way of background, the Sanitation Districts are a confederation of 24 special districts serving approximately 5.4 million people in Los Angeles County (County). Our service area covers approximately 850 square miles and encompasses 78 cities and unincorporated territory within the County. The Sanitation Districts construct, operate, and maintain facilities to convey, treat, recycle, and dispose of wastewater, and generate recycled water, bioenergy, and biosolids as byproducts of the treatment process.

General Comments Related to Listing and Identification of the Upper Santa Clara and Lower San Gabriel Rivers

As indicated in our previous comment letter, the Sanitation Districts are not taking a position regarding the listing of Southern California Steelhead (SCS) under CESA. However, we hope that the information provided in that letter has allowed the Commission and CDFW to gain an understanding of our operations and the significant potential consequences of CESA listing to our operations. For the upper Santa Clara River above its confluence with Piru Creek, and the portion of the lower San Gabriel River below its confluence with San Jose Creek, we are unaware of any evidence that SCS currently use these waterbodies due to the presence of physical barriers, lack of streamflow, and/or lack of suitable habitat. Thus, the Sanitation Districts are concerned about the implications of designating these areas as currently supporting SCS, and the impact that this designation may have over time on our ability to carry out the essential public services that we provide. We are concerned about requirements and water quality objectives that may be imposed on the water reclamation plants (WRPs) that we operate by CDFW and/or the Los Angeles Regional Water Quality and State Water Resources Control Boards (collectively the "Waterboards") in order to protect purported SCS habitat. Specifically, we are concerned that, when considering requests for Streambed Alteration Agreements, CDFW may incorrectly assume the presence of SCS to impose stringent prohibitions or conditions on essential activities such as maintaining sewers (which may cross under/over these rivers), maintaining or installing retaining walls, and maintaining discharge outfalls located in the affected water bodies. Further, the Waterboards may update the Los Angeles Region Water Quality Control Plan, as well as subsequently modify National Pollutant Discharge Elimination System (NPDES) permits, to require higher-quality discharges to receiving waters to protect SCS, even if they are not and cannot be present in these locations due to the barriers (i.e., dry gaps, dams, etc.) preventing access. Finally, the Sanitation Districts' wastewater facilities operate under California Water Code Section 1211 approved petitions, which are issued by the Waterboards and govern the discharges, and these allow us to provide recycled water for municipal uses.

One possible consequence of the potential changes to water quality regulatory requirements, or imposition of other new regulatory requirements, could be a need for new types of treatment at our WRP facilities. The cost, energy, and greenhouse gas emission impacts of constructing and operating additional treatment facilities to support SCS habitat would be substantial, and all for a purported SCS distribution that is not known to occur in reaches of the upper Santa Clara River, lower San Gabriel River, and their tributaries to which the Sanitation Districts' WRPs discharge recycled water. Furthermore, the potential listing of SCS could lead to unintended consequences such as less recycled water being available for reuse due to additional discharges to the rivers that could be required, even if this habitat is not accessible or appropriate for SCS. This would affect the water supply and resiliency of this region and potentially create water shortages.

Specific Comment on 2024 CDFW Status Report Figure 7

Moreover, the Sanitation Districts are concerned that Figure 7 of CDFW's 2024 Status Report (page 43) clearly mis-identifies reaches of the Santa Clara River extending far upstream of Piru Creek as current SCS distribution areas. The Sanitation Districts own and operate two WRPs that discharge approximately 18 million gallons per day of recycled water into the upper Santa Clara River, constituting most of the surface flow in portions of that waterbody where surface flow is present. Reaches of the Santa Clara River where discharges occur are separated by a naturally occurring "dry gap" from coastal reaches (see map in Attachment 2). Piru Creek was indicated as the upper limit of potential SCS habitat identified in the National Marine Fisheries Service January 2012 Southern California Steelhead Recovery Plan. Thus, it was the Sanitation Districts' understanding that the Santa Clara River upstream of Piru Creek is not suitable SCS habitat and consequently is not a focus of the potential CESA listing. Prior discussions with CDFW staff in March 2022 had supported this understanding. Furthermore, we are currently working on receiving water temperature studies in the upper Santa Clara River with CDFW and United States Fish and Wildlife Service (USFWS) staff, and SCS have never been identified by the USFWS or any other State or federal resource agencies as a species present in this area of the watershed. Despite these facts, and without any evidentiary basis, the 2024 Status Report shows a blue line signifying actual SCS presence in these reaches.

Research by ESA Consultants (see Attachment 3 for ESA technical memorandum), including several studies conducted over the past several decades in the area, has indicated that there is no record of current SCS occupation in the upper Santa Clara River watershed (east of the Piru Creek confluence) on which to support any determination of species "presence". Despite extensive fish sampling in the area over the last few decades, no SCS have been encountered. Habitat conditions currently do not suggest suitable habitat is present for this species in the area. Furthermore, the 2024 Status Report did not reference any scientific work or publication that would support such a determination. Sanitation Districts staff recently met with CDFW staff involved with development of the 2024 Status Report, and we appreciate the cooperation of CDFW staff in discussing this matter with us. However, during this discussion, CDFW staff did not provide any new evidence or sufficient scientific justification for demarcating the upper Santa Clara River watershed as current SCS habitat. The references discussed in the 2024 Status Report have been thoroughly reviewed by ESA Consultants and incorporated into their attached report. While the Sanitation Districts recognize this is only a status report, we are very concerned about the potential for future misuse of the SCS distribution indicated in the 2024 Status Report to require or suggest unnecessary restrictions and conditions on our facilities in the upper Santa Clara River to protect the species.

Based on the above, the Sanitation Districts respectfully request that the Commission take the following actions:

1) Santa Clara River – Direct CDFW staff to remove the "Current" SCS distribution designation for the Santa Clara River upstream of Piru Creek from Figure 7 of the 2024 Status Report.

2) San Gabriel River – Direct CDFW staff to work with the Sanitation Districts to develop a Section 2084 regulation and Section 2081(d) rule that is protective of the SCS species yet allows the Sanitation Districts to continue activities necessary to support their essential function of providing wastewater treatment and related services, including but not limited to discharge, monitoring and the provision of recycled water, to County residents and businesses. This reiterates the request from our previous correspondence, which is provided again as Attachment 1.

Once again, we thank you for the opportunity to provide these comments and look forward to working with CDFW and the Commission. For any questions, please contact the undersigned at (560) 908-4288, ext. 2701 or rtremblay@lacsd.org.

Very truly yours,

Ray Tremblay

Raymond L. Tremblay
Department Head
Facilities Planning

Attachment 1 – Sanitation Districts previous comment letter dated January 27, 2022
Attachment 2 – Map of the Santa Clara River Watershed relative to Sanitation Districts WRPs
Attachment 3 – ESA Technical Memorandum: Review of Current and Historical *Oncorhychus mykiss* Occurrences in the Upper Santa Clara River Watershed (Los Angeles County)

cc: Melissa Miller-Henson, Executive Director, FGC
Charlton Bonham, Director, CDFW

ATTACHMENT 1

LOS ANGELES COUNTY SANITATION DISTRICTS
Converting Waste Into Resources

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January 27, 2022

VIA EMAIL fgc@fgc.ca.gov

Mr. Peter S. Silva, President & Members
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244

Dear President Silva and Members:

Comments on the Petition to List the Southern California Steelhead Trout Pursuant to the California Endangered Species Act and the Department of Fish and Wildlife's Petition Evaluation

The Los Angeles County Sanitation Districts (Sanitation Districts) have reviewed the June 7, 2021, Petition to List the Southern California Steelhead (Steelhead) under the California Endangered Species Act (CESA) and the November 2021 Petition Evaluation prepared by the California Department of Fish and Wildlife (CDFW). While the Sanitation Districts are not taking a position regarding the application of CESA to Steelhead in Southern California, we wish to provide the California Fish and Game Commission (Commission) and CDFW with information about our operation to help inform the decision making processes of the Commission and CDFW as to the potential consequences of listing as related to our operations. To provide some background, the Sanitation Districts are a confederation of 24 independent special districts serving approximately 5.6 million people in Los Angeles County (County). The Sanitation Districts' service area covers approximately 850 square miles and encompasses 78 cities and unincorporated territory within the County. The Sanitation Districts construct, operate, and maintain facilities to convey, treat, recycle, and dispose of wastewater and industrial wastes and generate recycled water, bioenergy, and biosolids as byproducts of the treatment process. As such, the Sanitation Districts are requesting that if the Steelhead listing proceeds, CDFW and the Commission also develop a Section 2084 regulation and Section 2081(d) rule that is protective of the species, yet allows the Sanitation Districts to continue activities necessary to support their essential function of providing wastewater treatment and related services, including but not limited to discharge, monitoring and the provision of recycled water, to County residents and businesses.

Description of Sanitation Districts Operations Potentially Affected by Steelhead CESA Listing

Facilities

Among other facilities, the Sanitation Districts operate a network of inland water reclamation plants designed to produce high quality recycled water for municipal reuse. Not all the recycled water is currently utilized by our partner water agencies however and the remaining flows must be discharged to inland surface water bodies. A portion of the recycled water that is used is also discharged to inland rivers which are used as conveyance to downstream uses. The Sanitation Districts currently discharge over 30 million gallons per day (MGD) into the San Gabriel River and its tributaries (San Jose Creek and Coyote Creek), from five water reclamation plants (WRPs) under National Pollutant Discharge Elimination System (NPDES) permits issued by the Los Angeles Regional

Water Quality Control Board (Regional Board) (see Figure1). Conditions in the San Gabriel River are unsuitable for promotion of Steelhead under baseline conditions. For example, the portions of the San Gabriel River and tributaries in which these treatment facilities discharge are highly managed, highly modified, mostly concrete lined, and receive little flow from other sources other than stormwater runoff. The only reason there are measurable flows on a seasonal basis is due to the artificial condition of wastewater discharges. There is no affirmative duty under CESA to maintain an artificial condition. Further, the National Marine Fisheries Service January 2012 Southern California Steelhead Recovery Plan (Recovery Plan) found that restoring conditions for Southern California Steelhead in the San Gabriel River would require multiple long-term measures related to water management, recreation, and urban development. It went on to state that a fish passage barrier inventory and assessment for the watershed should be conducted as there are several operating dams that impede fish passage. It is our understanding that any use of the reaches we discharge to for Steelhead recovery would be solely for migration on a seasonal basis.

The Sanitation Districts also own and operate two additional water reclamation plants that discharge approximately 18 MGD into the Upper Santa Clara River, constituting most of the surface flow in portions of that waterbody where surface flow is present. The reaches of the Santa Clara River where discharges occur are separated by a "dry gap" from coastal reaches with surface flow and are far upstream of Piru Creek, the limit of potential Steelhead habitat identified in the Recovery Plan. Thus, it is our understanding that the Santa Clara River upstream of Piru Creek is not a focus of the potential CESA listing and our remaining comments in this letter focus on the San Gabriel River.

Recycled Water and CA Water Code Section 1211 Approved Petitions

Any listing decision should consider the current instream conditions, as well as current and future discharges of recycled water to the San Gabriel River. These discharges vary seasonally and are heavily managed by the Los Angeles County Flood Control District. The Sanitation Districts' goal is to maximize reuse. The Sanitation Districts work with regional and local water agencies to develop these recycled water projects and are actively working on the development of several new projects in the region due to the need to develop additional local climate-resilient water supplies, which can help local and regional municipalities reduce reliance on imported water and ease the pressure on distant watersheds that support habitat for a number of threatened and endangered species. There is significant demand for the Sanitation Districts to supply additional recycled water to local water agencies to the extent to which it is available.

To this end, after numerous years of working with CDFW and the State Water Resources Control Board, the Sanitation Districts obtained approval for several California Water Code Section 1211 Petitions that allow us to reduce our combined discharge to a total of 7 MGD (5 MGD from our San Jose Creek WRP and 2 MGD from our Los Coyotes WRP) to the San Gabriel River. These approved Section 1211 Petitions allow us to provide additional recycled water for reuse to local water agencies without impacting riparian habitat or special status species. The permits require the Sanitation Districts to monitor the surrounding riparian habitat using an adaptive management approach to protect the least Bell's vireo, an endangered avian species. Further, as part of the adaptive management plan, a habitat management committee, which includes participation by CDFW and the United States Fish and Wildlife Service, reviews the collected data collected and provides future recommendations. Because these petitions were only recently approved, the reductions in discharges to the San Gabriel River have not yet occurred. The Sanitation Districts expect to reach these levels of minimum discharge over the next decade as new recycled water projects are implemented.

In addition to minimum discharges to comply with the Section 1211 Petitions, the Sanitation Districts also use the San Gabriel River and its tributaries to convey recycled water from our WRPs to their point of use. Recycled water produced at our WRPs and not used for municipal purposes is discharged for percolation and conveyance downstream. Unlined portions of the San Gabriel River and adjacent engineered spreading basins are used as part of the Montebello Forebay Groundwater Recharge Project to capture recycled water to augment local groundwater supplies. Los Angeles County Flood Control District operates the river and spreading basins to maximize conservation of recycled water and stormwater. During most times of the year, the vast majority of the discharges from the San Jose Creek, Whittier Narrows and Pomona WRPs are captured and conserved.

Excess Recycled Water Discharge

The Sanitation Districts also wish to emphasize that, while we take our responsibility to protect the beneficial uses and habitat of the waterbodies to which we discharge very seriously, we also have a primary responsibility to provide the essential public service of wastewater treatment to approximately 5 million people residing in the Los Angeles Basin; this service must be available on a continuous basis. While supplying recycled water is also an important function, recycled water demand fluctuates diurnally (due to daily usage patterns) and seasonally. Moreover, the amount of wastewater production fluctuates over time, whether it be due to flow reductions attributable to water conservation or peak wet weather flows that occur during and immediately after storms. During winter months and during storm events, demand for recycled water is lower, and more treated wastewater must be discharged to the environment. In short, wastewater treatment and the ability to discharge must always be available, as the volume of water is significant and cannot be directly controlled by the Sanitation Districts. The variability of the flows must also be taken into account when considering the application of discharge standards. While it may be feasible to treat our recycled water to be suitable for Steelhead migration at low flows, it may be infeasible to provide that treatment for all flow after a rain event when recycled water demands are minimal. If discharges were to continue, the Sanitation Districts could be required to construct and maintain very large-scale treatment facilities that only operate a few times of year. There is likely not sufficient space available at our WRPs to provide higher levels of treatment for all the flow.

Treatment Requirements

It is our understanding that if a CESA listing is adopted, the Water Quality Control Plan, Los Angeles Region (Basin Plan) may need to be modified to reflect updated beneficial uses (e.g. for endangered species) and accompanying water quality standards for constituents such as temperature and ammonia toxicity could be adopted by the Regional Board to protect these beneficial uses. The Sanitation Districts are concerned with having to comply with far more stringent effluent limitations to support this beneficial use (potentially at all times of the year) despite the absence of Steelhead in the San Gabriel River under baseline conditions and the presence of Steelhead in the San Gabriel River in the vicinity of our discharges would only occur during migration. The cost, energy, and greenhouse gas emissions for having to construct and operate additional treatment facilities would be substantial. CDFW should consider these costs and other factors when determining if conditions in the San Gabriel River watershed are suitable for Steelhead recovery.

Monitoring Programs

The Sanitation Districts conduct extensive water quality monitoring activities in the San Gabriel River and Santa Clara River. In addition to implementation of an extensive monitoring and reporting program in and around the discharges from the WRPs to the San Gabriel and Santa Clara Rivers, the Sanitation Districts fund and participate in the San Gabriel River Regional Monitoring Program, which is a watershed-wide monitoring program that has been active for over 16 years. All of these monitoring activities are required by the Regional Board and are contained in our NPDES permits.

Request for Pre-Emptive Consultation and Accommodation for Essential Public Services

Notwithstanding our understanding that the reaches of the San Gabriel River to which our facilities discharge are not likely suitable for Steelhead recovery under the CESA listing (and dry reaches upstream of the San Jose Creek and Pomona WRPs make those reaches unsuitable as well), if CDFW decides to accept the petition for consideration, it's our understanding that the Commission can adopt regulations under Section 2084 of the California Fish and Game Code to authorize the taking of a candidate species, subject to terms and conditions it prescribes, based on the best available scientific information. Under Section 2084, CDFW may also recommend to the Commission that it authorize the taking of an endangered, threatened or candidate species. The Sanitation Districts would be glad to work with CDFW and the Commission to develop a Section 2084 regulation that is protective of the species, yet allows the Sanitation Districts to continue activities necessary to support their essential function of providing wastewater treatment services to Los Angeles County residents and businesses.

At this time, the Sanitation Districts recommend that CDFW propose and the Commission adopt a Section 2084 regulation that authorizes the exceptions to the take prohibition described below. These incidental take authorizations would support critical operations, maintenance and capital activities required to provide reliable wastewater services to protect public health, safety, and the environment. In crafting a Section 2084 regulation that accommodates these authorizations, the Sanitation Districts are ready and willing to collaborate with CDFW and the Commission to develop best management practices and other measures to provide for conservation of the species. Furthermore, if the Commission decides to ultimately list the Southern California Steelhead, the Sanitation Districts request CDFW consider adopting a rule pursuant to section 2081(d) that contemplates the same incidental take authorizations.

Incidental Take Authorizations Being Requested

1. Take authorization as it relates to the Sanitation Districts' previously approved Section 1211 permits, and any of their successors.

   As noted above, increasing recycled water supplies is urgently needed to address the State's water crisis. The Sanitation Districts spent over 5 years working with CDFW to develop an adaptive management plan to ensure riparian habitat and special status species will not be impacted by the reduction in discharge to the San Gabriel River from Sanitation Districts' WRPs. The discharge reduction enables more recycled water to be beneficially reused, thereby providing a resilient water supply source. Given the long history of Sanitation Districts' partnership with CDFW in these efforts, the Sanitation Districts believe it is appropriate to exempt actions undertaken pursuant to implementation of conditions contained in approved the 1211 petitions

2. Take authorization to allow required monitoring to be conducted per NDPES permit Monitoring and Reporting Programs and the San Gabriel River Regional Monitoring Program.

   The Sanitation Districts conduct routine monitoring for discharges into the San Gabriel and Santa Clara River watersheds as part of implementation of NPDES permit requirements. The Sanitation Districts also participate in implementation of the San Gabriel River Regional Monitoring Program (www.sgrrmp.org). If best management practices are adhered to, these water quality monitoring activities should be identified as exempt from "incidental take" as they not only help ensure that NPDES permit limits are being met, but also that public health and the environment are protected.

3. Take authorization to allow the Sanitation Districts to discharge more flow (compared to average or dry weather conditions) to the San Gabriel River and its tributaries during wet weather or due to other conditions that may periodically occur, such as maintenance or repair to a recycled water system.

   When there is a reduction in demand for recycled water from one of its WRPs in the San Gabriel River Watershed or during wet weather conditions, the water reclamation plants have historically discharged higher than average flow into the San Gabriel River. For flood control and other public health and safety reasons, the Sanitation Districts need to maintain the flexibility to be able to continue this historic practice.

4. Take authorization to allow the Sanitation Districts to adhere to the temperature compliance schedules in our NPDES permits, including any related studies.

   As mentioned previously, within the San Gabriel River, the Sanitation Districts have five WRPs with NPDES permits issued by the Regional Board. Each of those permits, which were renewed in 2021, contains a ten-year temperature compliance schedule that will allow the Sanitation Districts to identify and implement measures needed to comply with Basin Plan temperature objectives. The Sanitation Districts are also required to conduct studies as part of their compliance. Providing this exception will allow the Sanitation Districts to maintain compliance with their NPDES permits and assure compliance with Los Angeles Region Basin Plan temperature objectives. Similar activities to conduct studies and comply with Los Angeles Region Basin Plan temperature objectives are expected to be included in NPDES permit updates scheduled during 2022 for the two WRPs that discharge to the Upper Santa Clara River, and this exception should be applied there as well.

5. Take authorization to allow continued rotation of discharge from our San Jose Creek and Whittier Narrows WRPs to each of the various NPDES permitted outfall discharge locations.

   Historically, discharge from the San Jose Creek WRP rotates to various NPDES permitted outfall discharge locations. This has been done to maximize recycled water deliveries, maintain habitat, ensure public safety, and allow for system maintenance. Before, during, and after storm events, the Los Angeles County Department of Public Works may switch discharge locations for flood control purposes and to maximize stormwater capture. This flexibility and practice of rotating discharges must be allowed to continue in order to support this diverse range of public-interest goals.

Once again, we thank you for the opportunity to provide these comments and look forward to working with CDFW and the Commission. For any questions, please contact the undersigned at (560) 908-4288, ext. 2701 or rtremblay@lacsd.org.

Very truly yours,

Ray Tremblay

Raymond L. Tremblay
Department Head
Facilities Planning

RLT:JL:pb

Enclosure

cc: Melissa Miller-Henson, Executive Director, FGC
Charles Bonham, Executive Director, CDFW

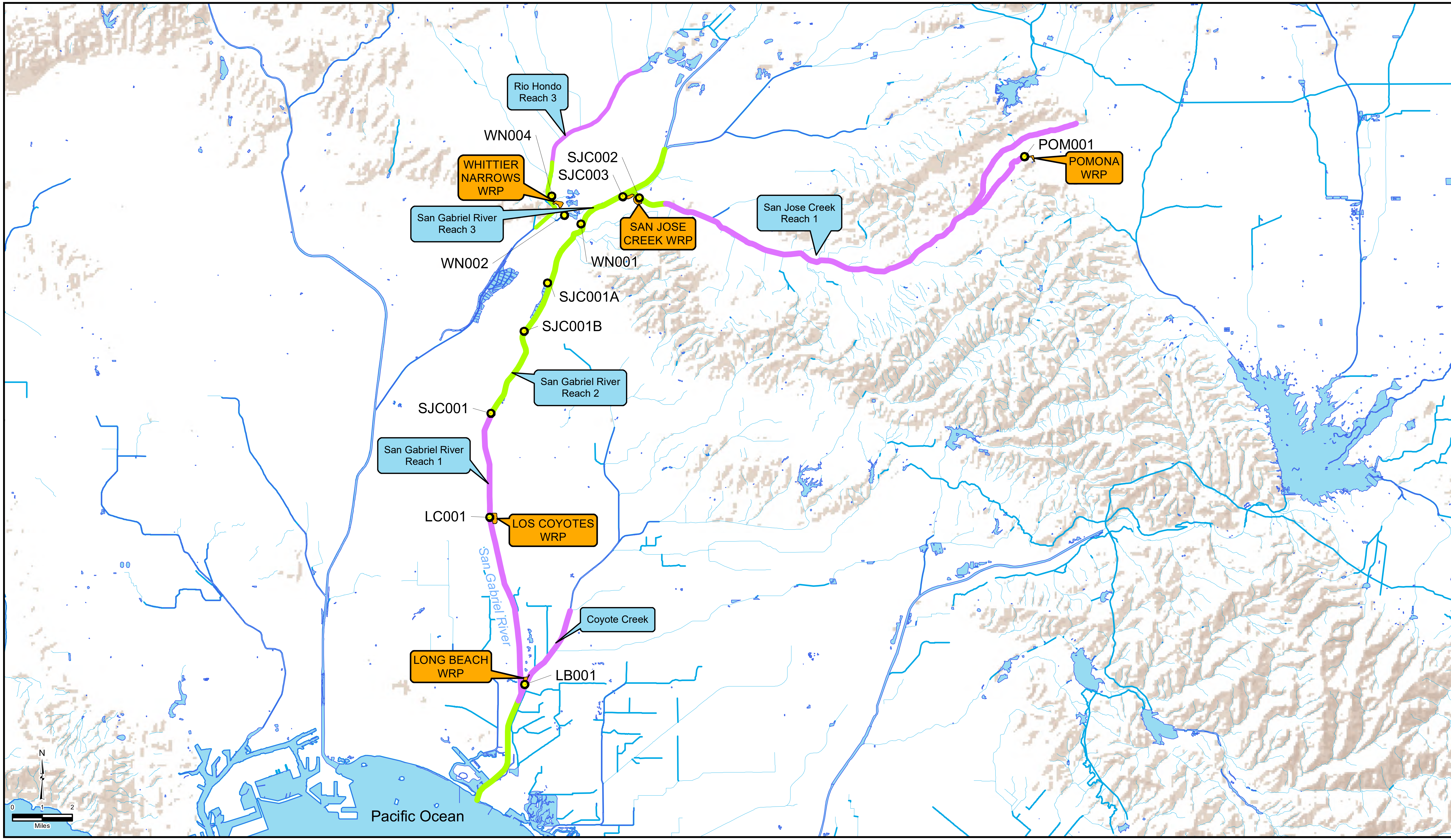

FIGURE 1

WRP Discharge Location (some not used frequently)
WRP
Lined Channel
Unlined Stream Bottom

LACSD Discharges to San Gabriel River System

November 08, 2021

R:\Planning\GIS-Team\Wastewater\projects\SanGabrielRivSysDischargeWRPs.mxd | DOC#: 4445090

ATTACHMENT 2

Path: R:\Planning\GIS-Team\Wastewater\SCV\projects\SantaClaraRiver_Discharges_and_DryGaps\SantaClaraRiver_Discharges_and_DryGaps.aprx DOC#7188413

ATTACHMENT 3

2945 Towngate Road
Suite 200
Thousand Oaks, CA 91361
805.914.1500 phone
esassoc.com

memorandum

date April 2, 2024

to Santa Clarita Valley Water Agency

cc

from Joel Mulder

subject Review of Current and Historical Oncorhychus mykiss Occurrences in the Upper Santa Clara River Watershed (Los Angeles County)

Purpose

ESA has prepared this technical memorandum (memo) for Santa Clarita Valley Water Agency to review and document available information on the current and historical distribution of *Oncorhynchus mykiss (O. mykiss)*, including both the anadromous (southern California steelhead, referred to as steelhead herein) and resident (rainbow trout) life history forms of the species, in the upper Santa Clara River watershed within Los Angeles County (i.e., the watershed upstream of the Piru Dry Gap[1]). Information from a variety of sources is summarized in this memo, including biogeographic datasets, state and federal documents, peer-reviewed publications, historical source compilations, non-governmental organization information, and survey data.

Biogeographic Datasets

A query of California Department of Fish and Wildlife (CDFW) California Natural Diversity Database data (both processed and unprocessed data) found no documented occurrence of steelhead in the Santa Clara River watershed upstream of the Piru Creek confluence.

The CDFW Biogeographic Information and Observation System online mapping tool (BIOS) layers for steelhead range and distribution offer conflicting mapping of southern Steelhead distribution, as described below.

Winter Steelhead Range (ds699).

This dataset, developed by CDFW, contains all CalWater 2.2.1 Planning Watersheds where CDFW has documented winter run steelhead to be present (representing planning watersheds intersecting the known distribution, which is based on where the species has been observed and reported) during or after 1990. This

[1] Beginning about 3.5 river miles downstream of the Los Angeles - Ventura County line, the Santa Clara River surface flow is infiltrated into the underlying eastern Piru groundwater basin. Surface flow reappears approximately 6 miles downstream, past the confluence of Piru Creek. The river is dry through this reach most of the year, with water present only when rainfall events create sufficient stormwater runoff into the river (GSI 2008, LARWQCB 2007). This dry ephemeral reach of the river is informally known as the "Piru dry gap" in the Santa Clara River.

dataset does not show winter steelhead range as occurring in the Santa Clara River watershed upstream of the Piru Creek confluence.

Winter Steelhead Distribution (ds340)

This dataset, developed by CDFW, depicts observation-based stream-level geographic distribution of anadromous winter-run steelhead in California. It was developed for the express purpose of assisting with steelhead recovery planning efforts. The distributions reported in this dataset were derived from a subset of the data contained in the Aquatic Species Observation Database (ASOD), a Microsoft Access multi-species observation data capture application. Data source contributors, as well as CDFW fisheries biologists, have been provided the opportunity to review and suggest edits or additions during a recent review. Data contributors were notified and invited to review and comment on the handling of the information that they provided. The distribution was then posted to an intranet mapping application, and CDFW biologists were provided an opportunity to review and comment on the dataset. During this review, biologists were also encouraged to add new observation data. The dataset does not show steelhead distribution as occurring in the Santa Clara River watershed upstream of the Piru Creek confluence.

Southern California Steelhead Range (ds1290)

This dataset, developed by the University of California at Davis (U.C. Davis), shows a species extant range layer for steelhead by HUC12 watersheds based on datasets and interpreted by PISCES, which is software and data describing the best-known ranges for California's 133 native fish and numerous non-native fish. PISCES “models” presence, with corresponding probabilities if appropriate, based on expert opinion and observation data. PISCES biogeographic modeling outcomes reflect environmental and anthropogenic variables that “predict” where a given species may occur (Santos et al. 2014). The metadata for the layer describes the references for the datasets interpreted by PISCES as Moyle, Quinines and Bell (expert opinion) and NMFS Southern California Steelhead ESU Current Stream Habitat Distribution Table.pdf. It is not clear what the source is for the NMFS current stream habitat distribution table.

There are two primary layers in the PISCES model for steelhead. One is HUC12 watersheds with observations of *O. mykiss*. No HUC12 watersheds upstream of the Piru Creek confluence are shown as having positive observations. The other layer is a “historical expert” layer, which depicts HUC12 watersheds where steelhead occurred historically based on expert opinion. This layer shows steelhead occurring in the HUC12 watersheds containing the mainstem from Piru Creek upstream to about Soledad Canyon, and Castaic Creek, based on expert opinion but not on observational data.

Coastal Steelhead Trout Watersheds (ds962)

This dataset, developed by CDFW, provides a minimal set of watershed fields used to identify coastal steelhead management units. This data set is an extract of the California Watershed (CalWater) dataset. It has been generalized to hydrologic sub-areas for those watersheds that are considered part of the coastal steelhead range. However, the source data for the inclusion of hydrologic units in the “coastal steelhead trout range” is not cited or referenced in the dataset metadata. The dataset depicts hydrologic units in the upper Santa Clara River basin (upstream of the Piru Creek confluence) as coastal steelhead watersheds.

Federal and State Documents

Federal Endangered Species Act designated critical habitat for southern California steelhead in the Santa Clara River watershed extends from the Pacific Ocean, upstream the main Santa Clara River to the confluence with Piru Creek; critical habitat in the Santa Clara River does not extend beyond the confluence with Piru Creek (70 FR 52487).

In the NMFS population characterization for steelhead recovery planning, the discussion of the Santa Clara River states "The available evidence suggests that steelhead have been limited to the western part of the Santa Clara basin (Kelley 2004)" (Boughton et al. 2006). The document uses Boughton and Goslin's (2006) over-summering habitat model (described below) as the basis for its findings.

Boughton and Goslin (2006) developed a model of potential steelhead over-summering habitat using the method of environmental envelopes. Under the envelope method, predicted habitat is the set of stream segments falling within the same range of conditions that encapsulate the known occurrences of the species. In the discussion of results from the Los Angeles Basin, the authors note "The model predicted a distinct patch of potential habitat in the far eastern end of the Santa Clara basin (upper right quadrant, east of Newhall). This did not conform to expectations. Reports from the area suggested that steelhead were confined to the western end of the Santa Clara system. Visits to the eastern area between Newhall and Palmdale indicated that this area is drier than implied by the model, due to a rain-shadow effect from the San Gabriel Mountains (C. Swift, personal communication, Entrix). It probably did not contain potential habitat in reality". In their discussion of the model's environmental envelope outputs, the authors note that the Southern California Coast ESU[2] may have more false positives (warm areas with no potential for thermal refugia), but that these false positives may occur at a finer resolution than addressed by the model. In other words, the model may indicate suitable habitat in some areas of Southern California where in reality temperatures and lack of thermal refugia preclude steelhead occurrence.

In NMFS' 2023 5-Year Review for the species, there is no mention of areas of the Santa Clara River watershed upstream of the Piru Creek confluence (NMFS 2023). In the Southern California Steelhead Recovery Plan (NMFS 2012) discussion of current watershed conditions the only mention of the Santa Clara River watershed upstream of the Piru Creek confluence is that "Fish passage is further impacted by the operation of Castaic Dam on Castaic Creek". Table 2-1 of the Recovery Plan lists the Santa Clara River watershed as historically occupied by steelhead, citing Becker et al. 2009, Boughton et al. 2005, and Titus et al. 2010 (NMFS 2012). A discussion of those sources is provided below, with a focus on historical occurrences in the upper watershed.

Boughton et al. (2005) assessed the current occurrence of anadromous *O. mykiss* in each coastal basin of southern California in which it occurred historically. While the current and historical occurrences in the Santa Clara River are not described specifically in the memorandum, Figure 4 shows the historic distribution of spawning and rearing basins for steelhead in southern California. The figure shows the Santa Clara River basin up to approximately the Ventura-Los Angeles County line as historically occupied. The figure notes that shading of entire basins implies only that steelhead occurred somewhere, not necessarily everywhere, in a basin. The source

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[2] Listed steelhead are now referred to as a ''distinct population segment'' (DPS), which is not recognized in the scientific literature. In 1991, NMFS issued a policy for delineating Pacific salmon DPS (56 FR 58612; November 20, 1991). Under this policy a group of Pacific salmon populations is considered an ''evolutionarily significant unit'' (ESU) if it is substantially reproductively isolated from other conspecific populations, and it represents an important component in the evolutionary legacy of the biological species. Further, an ESU is considered to be a DPS (and thus a ''species'') under the ESA.

for the historical occurrence data for the figure is noted as Titus et al. 2003, Stoecker et al. 2002, and a third source which was omitted from the figure description (text is cut off). Further discussion of Titus et al. is provided below. Stoecker et al. (2002) is a report on steelhead assessment and recovery opportunities in southern Santa Barbara County as is not relevant to the Santa Clara River.

The Titus et al. 2003 in preparation document cited in Boughton et al. 2005 and Titus et al. 2010 in preparation document cited in the species recovery plan (NMFS 2012) is cited as several sources under different publication years as the document has been in draft form with various updates for some time. As of April 2, 2024, the manuscript is still a draft[3]. The report provides stream-specific information on steelhead in central and southern California gathered from three main sources: (1) A literature search of pertinent journal articles, CDFW (known as California Department of Fish and Game until 2013) administrative reports and fish bulletins, and other resource agency, university, and consultant publications; (2) Resource agency files, especially CDFW stream survey files; (3) Interviews conducted with professional biologists, academicians, and representatives of sportfishing organizations and other special interest groups for information from personal files, and anecdotes based on personal observations. The report's description of the Santa Clara River Headwater Tributaries in Los Angeles County states no historical evidence of steelhead runs. San Francisquito Canyon and Soledad Canyon are noted as two streams for which there are CDFW records for rainbow trout presence and/or stocking dating back to circa 1930.

Non-Governmental Organization Resources

Becker et al. (2009) summarizes historical accounts of *O. mykiss* in streams south of San Francisco Bay based on thousands of documents in public and private collections, and interviews with biologists. Only three areas in the upper Santa Clara River watershed are described in the report as having fish observations. It is important to note that these observations are for fish in general, and not specifically steelhead.

Elizabeth Lake Canyon, tributary to Castaic Creek - Field notes from US Forest Service staff from 1947 indicate that "some fish" were caught in Elizabeth Lake Canyon Creek in the previous season (CDFG 1952). The author noted that the creek was unlikely to support fish life throughout the year, presumably due to low flow.

Fish Canyon, tributary to Castaic Creek - A 1956 CDFW stream inventory for Fish Canyon Creek states, "…some native fish reported in upper reaches" (CDFG 1956b). It adds, "This is definitely a marginal water…"

Bouquet Canyon - According to CDFW records, rainbow trout fry from the Shasta hatchery were planted in Bouquet Canyon Creek in 1943 (CDFG 1943). A 1947 stream survey indicates that *O. mykiss* including a "few fingerlings" were observed in the creek but notes, "Fishing maintained only be frequent plantings" (CDFG 1947b).

In a previous document, Becker et al. (2008) appears to acknowledge the unreliable nature of these observations in Figures 24 and 25 of the report, describing the historic and current, respectively, status of *O. mykiss* in coastal streams of southern Ventura County. In the figures, Castaic Creek and its tributaries, as well as San Francisquito and Bouquet Canyon creeks, are shown as "unknown or insufficient data". Paradoxically, the mainstem Santa Clara River upstream of the Piru Creek confluence is shown as "definite run or population" despite no

[3] Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=10194

documentation in the report of any observations currently or historically in that section of river. CalTrout, an organization focused on healthy waters and resilient wild fish, provides on The Southern Steelhead page of their website[4] as well as their publication "SOS II: Fish in Hot Water: Status, threats and solutions for California salmon, steelhead, and trout" a map of current and historical steelhead range. The source of the map is noted as PISCES (2017). See the discussion above under Biogeographic Datasets - Southern California Steelhead Range (ds1290) for PISCES.

The conservation group Trout Unlimited's website[5] provides maps of the historical and current status of *O. mykiss* in coastal streams of southern Ventura County, California. Both maps show the mainstem of the upper Santa Clara River from the Piru Creek confluence up to about the N3 Angeles Forest Highway as historically and currently having a "definite run or population". However, the cited source for these maps is Becker et al. 2009, described above, which does not appear to substantiate the steelhead historical and current distribution depicted on these figures.

Other Sources

Stoecker and Kelley (2005) analyzed the habitat conditions, population status and barriers to migration for steelhead in the lower Santa Clara River watershed from the Piru Creek tributary downstream, including significant drainages. There is no mention of steelhead resources upstream of the Piru Creek confluence.

Bowers (2008) compiled historical steelhead accounts in Ventura County, primarily from newspaper accounts, personal fishing logs, books, pamphlets, and Ventura County Board of Supervisors' Minutes. Because the report looked at Ventura County, little mention is made of the upper Santa Clara River watershed in Los Angeles County except two articles from the Santa Paula Chronicle. The first, in 1925, noted five thousand "trout" were planted in Bouquet Canyon. The second, in 1943, described Bouquet Canyon as being "in good shape with plenty of good-sized fish left over from last year's plant", presumably referring to planted *O. mykiss.*

Bell (1978) described the fishes of the Santa Clara River and made collections at 46 stations from the river mouth upstream as far as water existed. In the upper watershed, this included San Francisquito Creek, Castaic Creek, Arrastre Canyon, and the mainstem river. No *O. mykiss* were encountered. Bell cites Hubbs (1946) as reporting large and consistent runs of *Salmo gairdneri* (the former scientific name for *O. mykiss*) in the Santa Clara River. However, Bell notes that at the time of his survey, *Salmo* were abundant in Sespe Creek, but Piru Creek and the Santa Clara mainstem were much less suitable habitat, and trout were restricted to a few deep holes in Piru Creek and as escapees to the mainstem from Fillmore fish hatchery. No mention is made of trout in the upper watershed.

Numerous fish sampling events have been conducted in the upper Santa Clara River, particularly the mainstem, in more recent years. Table 1 below presents a list of the sources examined. No *O. mykiss* were encountered in any of the surveys.

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[4] Available at: https://caltrout.org/sos/species-accounts/steelhead/southern-steelhead#:~:text=Southern%20Steelhead%20Distribution&text=They%20are%20most%20abundant%20in,Ventura%2C%20and%20Santa%20Clara%20rivers

[5] Available at: https://www.tu.org/california-coastal-steelhead-data/. Figure 24 -– Historical and current status of Oncorhynchus O. mykiss in coastal streams of southern Ventura County, California; Figure 25 - Current status of Oncorhynchus mykiss in coastal streams of southern Ventura County, California.

TABLE 1
SUMMARY OF FISH SPECIES PRESENCE IN UPPER SANTA CLARA RIVER WAERSHED BASED ON LITERATURE REVIEW

Santa Clara River Reach[a] and Location		Unarmored Three spine Stickleback	Santa Ana Sucker	Arroyo Chub	Prickly Sculpin	Common Carp	Mosquitofish	Black Bullhead	Fathead Minnow	Green Sunfish	Largemouth Bass	Goldfish	Sailfin Molly	Convict cichlid	Source
SCR	SCR Watershed	X	X	X			X		X	X	X				Bell 1978, Swift et al. 1993
6	Bouquet Canyon area			X	X		X							X	Compliance Biology 2010
6	SWRP outfall channel													X	Dellith Pers. Comm. 2023
6	Iron Horse Bridge area	X													CDFW 2021
6	Iron Horse Bridge area		X	X											CDFW 2022
6	Iron Horse Bridge to VWRP	X	X	X											Haglund & Baskin 2000
6	McBean Parkway area	X					X								Hovore et al. 2008
5/6	Bouquet Cyn. to Castaic Ck.	X	X	X											Haglund & Baskin 1995
5/6	Bouquet Cyn. to Castaic Ck.	X	X	X											Impact Sciences Inc. 2003c
5/6	Saugus to Castaic Ck.	X		X			X								Haglund 1989
5	I5 to Castaic Ck.	X		X											Aquatic Consulting Services 2002a
5	Old Road to VWRP	X	X												CDFW 2015
5	Old Road to VWRP	X	X	X			X								Pareti Pers. Comm. 2003
5	VWRP to Salt Ck.		X	X		X	X	X			X				Cardno 2015
5	VWRP to Salt Ck.	X	X	X											ENTRIX Inc. 2006a
5	Commerce Center Dr. to Salt Ck.	X	X	X	X	X					X				ENTRIX Inc. 2010
5	Commerce Center Dr. to Salt Ck.	X	X	X											Dudek 2010
5	Castaic Ck. to u.s. 7.2mi	X	X	X	X		X				X	X	X		Impact Sciences Inc. 2003b
5	Commerce Center Dr. to Castaic Ck.	X	X	X											Aquatic Consulting Services 2002b
5	Commerce Center Dr. to Co. Line	X		X			X				X				Aquatic Consulting Services 2002c
5	Castaic Ck. to d.s. 7mi	X	X	X	X		X				X				Impact Sciences Inc. 2003a
5	Castaic Creek to Long Cyn.	X	X	X			X								ENTRIX Inc. 2006b
5	Castaic Ck. to Long Cyn.	X	X	X											Impact Sciences Inc. 2010
5	u.s. of San Martinez Grande Cyn.	X													USFWS 1980
5	u.s. of San Martinez Grande Cyn.	X	X	X			X	X		X					USFWS 1985

NOTES:
Blue shading = Native species, native to Study Area
Green shading = Native to Southern California
No shading = Not native to California (introduced)
a. Reaches delineated according to LARWQCB water body names

Discussion

In review of the available information, no verifiable or concrete observations of native *O. mykiss* in the upper Santa Clara River watershed have been described or recorded historically or currently. Observations that potentially could have been native *O. mykiss* are described in Becker et al. 2009. However, observations of "some fish" or "some native fish" in Elizabeth Canyon and Fish Canyon do not specifically mention *O. mykiss.* The references could be to other native fish in the upper watershed such as threespine stickleback (*Gasterosteus williamsoni*) which were formerly more common in the upper headwater tributaries (Bell 1978). Titus et al. (*In preparation*) also notes San Francisquito Canyon and Soledad Canyon as two streams for which there are CDFW records for rainbow trout presence and/or stocking dating back to circa 1930.

These observations may all well have been planted trout. As described in Titus et al. (*In preparation*) above and in newspaper accounts (Bowers 2008), extensive stocking was occurring in the upper watershed as early as 1925, and it would have been impossible to distinguish native resident trout or steelhead from stocked trout.

Given these unreliable historic accounts and lack of any other verifiable observations, it is of concern that Becker et al. 2008 and Titus et al. (*In preparation*) appear to be the basis for some historic and current distribution maps for southern California steelhead in the upper Santa Clara River (e.g., Boughton et al. 2005, Trout Unlimited), particularly since Becker et al. 2008 itself shows occurrence maps in upper watershed tributaries where there are questionable fish observations as "unknown or insufficient data". It is also not apparent why the upper watershed is considered to have been historically occupied by experts for the U.C. Davis PISCES model, and historically and currently occupied in Figures 24 and 25 of in Becker et al. 2008 despite the absence of observations. Perhaps the underlying assumption is that because the lower Santa Clara River had a well-documented and robust steelhead run (Hubbs 1946, Stoecker and Kelley 2005, Bowers 2008), fish would have inevitably made their way all the way up the river to the upper basin headwaters. However, an examination of habitat conditions in this area suggests that the habitat in the upper basin may have precluded or greatly limited steelhead migration in most years, and that even in particularly wet years when migration was possible, available upstream spawning and over-summering habitat was and is extremely limited or of poor quality.

The Santa Clara River is a perennial stream from Interstate 5 downstream to just west of the Los Angeles - Ventura County line. Beginning about 3.5 river miles downstream of the county line the entire surface flow is infiltrated into the underlying eastern Piru groundwater basin. Surface flow reappears approximately 6 miles downstream, past the confluence of Piru Creek. The river is dry through this reach most of the year, with water present only when rainfall events create sufficient stormwater runoff into the river (GSI 2008, LARWQCB 2007). This dry ephemeral reach of the river is informally known as the "Piru dry gap" in the Santa Clara River. Flood flows in the Upper Santa Clara River increase, peak, and subside rapidly in response to high-intensity rainfall. The "flashy" hydrograph produced by these conditions shows a rapid increase in discharge over a short time period with a quickly developed peak discharge compared to normal baseflow (Kennedy/Jenks 2014). Thus, migration opportunities through the dry gap for upstream migrating steelhead adults and downstream migrating smolts would have historically been limited to typically brief high flow events. The same is true under current conditions, though flows through the dry gap may be artificially altered in duration due to releases from or withholding in upstream reservoirs (e.g., Castaic Lake).

Habitat conditions in the upper watershed tributaries are described in historic accounts as generally poor for *O. mykiss*. For example, field notes from US Forest Service staff from Elizabeth Lake Canyon Creek in 1952 note that the creek was unlikely to support fish throughout the year "presumably due to low flow", and in 1956 regarding Fish Canyon "This is definitely a marginal water…", and in Bouquet Canyon Creek, 1943, "Fishing maintained only by frequent plantings" (Becker et al. 2009). Boughton and Goslin (2006) acknowledge that the watershed between Newhall and Palmdale is subject to a rain-shadow effect from the San Gabriel Mountains and "probably did not contain potential habitat in reality". No current information or surveys reviewed suggest that suitable habitat for *O. mykiss* is extant in the upper basin tributaries. Becker et al. (2010) analyzed information on rearing habitat to identify regionally significant watersheds, which are those offering the greatest potential for producing steelhead smolts, including over-summering opportunities and conditions favoring high growth rates. Within these watersheds the report identifies "essential" streams or reaches that offer the best habitat resources. Within the upper Santa Clara River watershed, portions of the mainstem and several tributaries are identified as “essential” stream, but no waterbodies in the upper watershed are identified as “available” or “suitable” *O. mykiss* habitat (see Figure 14 in the report).

In conclusion, there is no record of current *O. mykiss* occupation in the upper Santa Clara River watershed (east of the Piru Creek confluence) on which to support any determination of species “presence”. Despite extensive fish sampling in the area over the last few decades, no *O. mykiss* have been encountered. Habitat conditions currently do not suggest suitable habitat is present for this species in the area.

There are no verifiable or concrete historical observations of native *O. mykiss* in the upper Santa Clara River watershed, and historical descriptions of habitat conditions do not suggest suitable, perennial habitat was present for *O. mykiss* in the area.

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April 4, 2024

Samantha Murray
President
California Fish and Game Commission
715 P Street, 16th Floor
Sacramento, CA 95814

Electronically Submitted To:
fgc@fgc.ca.gov

Re: California Fish and Game Commission April 17-18, 2024 Meeting Agenda #22 – Southern California steelhead

Dear President Murray:

The California Building Industry Association (CBIA) appreciates the opportunity to comment on the petition to list the Southern California steelhead (steelhead) and the accompanying California Department of Fish and Wildlife (Department) Status Review Report. CBIA is a statewide trade association based in Sacramento representing thousands of member companies including homebuilders, trade contractors, architects, engineers, designers, suppliers and industry professionals in the homebuilding, multi-family and mixed-use development markets.

We have reviewed the petition to list the steelhead, the Department's status review report, and additional information submitted by stakeholders and believe that the petitioned action is not warranted and urge the California Fish and Game Commission (Commission) to deny the petition.

CBIA shares the concerns raised by organizations including the Association of California Water Agencies regarding both the scientific basis for a listing determination, the potential impacts on California's water agencies and their ability to reliably provide water, and the impact certain aspects of the listing will have on the state's homebuilding industry.

CBIA is concerned that part of the rationale leading the Department to recommend to the Commission that the petitioned action is warranted is based on serious deficiencies regarding population information and mapping inaccuracies. The Department's status review points out on page 40 (4.2 Sources of Information) that:

> "Data limitations and uncertainties associated with historical accounts for Southern SH/RT limits our ability to understand their complete historical abundance and distribution in their range. The majority of available historical data are in reports, technical memos, and other documents that have not undergone a formal peer-review process."

The report goes on to state that the data constraints "may limit the power of statistical analyses to assess trends in viability criteria. Therefore, the results of the analyses conducted in subsequent portions of this chapter should be interpreted in the context of these limitations."

CBIA believes that the data limitations has produced flawed analyses and speculation as to what is the current and historical range of the species to the point that several figures contained in the report – for example Figure 7 located on Page 43 and Figure 11 located on Page 58) – could lead a person to believe that Southern California steelhead should be found in certain watersheds where in reality none have been observed.

CBIA believes that if such types of maps are necessary then the Department should utilize the data developed by the U.S. Fish and Wildlife Service in order to provide a level of consistency instead of relying on information and data that is at its core limited and full of uncertainty.

Based on these issues and those raised by organizations including the Association of California Water Agencies, we urge the Commission to find that the petitioned action is not warranted.

Sincerely,

Nick Cammarota
Senior Vice President & General Counsel
California Building Industry Association
ncammarota@cbia.org

State of California
Department of Fish and Wildlife

Original on file, received April 11, 2024

M e m o r a n d u m

Date: April 4, 2024

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director

Subject: Evaluation of Additional References Received for the Status Review of southern California steelhead (Oncorhynchus mykiss)

Summary

The California Department of Fish and Wildlife (Department) has prepared this supplemental information for southern California steelhead (*Oncorhynchus mykiss*) memo for the California Fish and Game Commission (Commission). The Department created the memo in response to references the Department received in February 2024 after the Department transmitted its final status review report on southern California steelhead (Status Review) to the Commission in January 2024. The Department reviewed each reference, assessed its relevance to the Status Review, and compiled the information in this memo. Of the 39 references, we determined that 17 contained information that is directly relevant to the Status Review, 14 contained useful background information but were determined to not be directly relevant to the Status Review, and 8 were already cited in the Status Review. Collectively, the 39 references either support or are consistent with the analysis, conclusions, and recommendations in the Status Review.

If you have any questions or need additional information, please contact Jay Rowan, Branch Chief, Fisheries Branch, at (916) 212-3164 or by email at fisheries@wildlife.ca.gov.

Information directly relevant to the Status Review

1. Allesio, P., M. H. Capelli, S. D. Cooper, B. Keller, E. A. Keller, H. A. Loaiciga, C. McMahon, and J. M. Melack. 2023. Upper Mission and Rattlesnake Creeks: Hydrogeologic and Biologic Investigation, Santa Barbara, California with Special Reference to Mission Tunnel Effects on Creek Flows. Prepared for Urban Creek Council, Santa Barbara.

   This reference reports the key findings and recommendations resulting from a hydrologic, geomorphologic, geologic, and aquatic, and riparian study of the upper, non-urban, watershed of Mission Creek (including its tributary, Rattlesnake Creek). It includes a detailed summary of the history of southern California steelhead populations in the watershed as well as an assessment of suitable habitat. The discussion on abundance and trends in this report is consistent with the Status Review analysis results in Chapter 4, Section 4.4.1.2, Page 63.

2. Boughton, D. A. and M. Goslin. 2006. Potential Steelhead Over-Summering Habitat in the South-Central/Southern California Coast Recovery Domain: Maps Based on the Envelope Method. NOAA Technical Memorandum NMFS-SWFSC-391.

   This report discusses the results of a modeling exercise to map and visualize potential over-summering habitat in the federal South-Central/Southern California Coast recovery domain. The Department evaluated this report during the development of the Status Review. Even though a significant area of over-summering habitat is located above barriers to anadromous migrations, the findings provide useful information about the life-history and habitat of southern California steelhead and is consistent with Chapter 2, Section 2.4, and Chapter 5 of the Status Review.

3. Capelli, M. H. 2023. The role of wildfires in the recovery strategy for the endangered southern California steelhead. In: J. L. Florsheim, A.P. O'Dowd, and A. Chin (eds.). *Biogeomorphic Responses to Wildfire in Fluvial Ecosystems*. Geological Society of America. Special Paper 562

   This research article discusses the role of wildfires in the recovery strategy for the endangered southern California steelhead. It supports and provides additional useful information related to Chapter 6, Section 6.2.7, Pages 101-102 of the Status Review.

4. Cooper, S. D., H. H. Page, S. W. Wiseman, K. Klose, D. Bennett, T. Even, S. Sadro, C. E. Nelson, and T. L. Dudley. 2015. Physicochemical and biological responses of streams to wildfire in riparian zones. *Freshwater Biology* 60(12): 2600–2619.

   This academic journal article documented wildfire impacts on stream food webs resulting from wildfires in the riparian zones of streams in Santa Barbara County. This study was conducted within the range of southern California steelhead and provides post-fire vegetation recovery management implications, and the results support Chapter 6, Section 6.2.7, pages 101-102 of the Status Review.

5. Cooper, S. D., K. Klose, D. B. Herbst, J. White, S. M. Drenner, S.M., and E. J. Eliason. 2021. Wildfire and drying legacies and stream invertebrate assemblages. Freshwater Science 40(4): 659–680 https://doi.org/10.1086/717416.

This academic journal article examines the effects of drought and wildfire on stream invertebrate communities. Stream reaches in Southern California were sampled at sites that have been either burned or unburned during both wet and dry years. The findings highlight the importance of protecting water supplies and riparian vegetation, and support Chapter 6, Section 6.2.7, pages 101-102 of the Status Review.

6. Florsheim, J. L., A. Chin, A. M. Kinshita, and S. Nourbakhshbeidokhti. 2017. Effect of storms during drought on post-wildfire recovery of channel sediment dynamics and habitat in the southern California chaparral, USA. Earth Surface Processes and Landforms 42(10):1482-1492.

   This research article investigated post-wildfire geomorphic responses from storms during a prolonged drought period following a large wildfire in southern California. The study emphasizes the complex, dynamic, and substantial effects of multi-year drought on geomorphic processes following wildfire, with implications for post-fire riparian ecosystem recovery. The study provides useful insight on the complex interactions between storms, wildfires, and drought in southern California streams and supports Chapter 6, Section 6.2.7, pages 101-102 of the Status Review.

7. Douglas, P. L. 1995. Habitat Relationships of Over summering Rainbow Trout (*Oncorhynchus mykiss*) in the Santa Ynez Drainage. M.A. Thesis. University of California Santa Barbara.

   This master’s thesis examined the relationship between trout density and habitat characteristics in streams throughout the Santa Ynez watershed. The results indicate that fry density is associated with instream cover and negatively associated with water temperature. Adult trout were found to be positively correlated with instream cover and negatively associated with stream temperature, aquatic vegetation, and the density of non-salmonid fish species. Although this study was conducted above the major barrier to anadromy in the Santa Ynez watershed, it provides useful information and supports Chapter 5, Sections 5.3 through 5.5 of the Status Review.

8. Hemmert, J. 2018. Coldwater Canyon Creek Rainbow Trout (Oncorhynchus mykiss) Rescue Summary. Fisheries Heritage and Wild Trout Program, Inland Deserts Region. California Department of Fish and Wildlife, Region 6.

   This memo describes rescue actions to relocate rainbow trout from the Coldwater Canyon Creek to the Mojave River hatchery in response to the 2018 Holy Fire. This effort included the capture and transportation of 241 rainbow trout from Coldwater Canyon by the Department. While this rescue effort occurred far upstream of the artificial barrier to anadromy in the Santa Ana River watershed, it provides additional information to support Chapter 6, Section 6.2.7, Page 101 of the Status Review.

9. Jacobson, S. 2021. Southern California Native Rainbow Trout Sub-Population Expansion Plan. Prepared for California Trout, Inc. June 15, 2021.

   This management plan describes a proposal by Cal Trout Inc. and partners to increase the abundance, distribution, and genetic diversity of native rainbow trout through a network of subpopulations in its range through embryonic translocation. This information may contribute in the future to the Influence of Existing Management Efforts (Chapter 7).

10. Pareti, J. 2021. Bobcat Fire Fish Rescue: West Fork San Gabriel River and Bear Creek. Fall 2020. California Department of Fish and Wildlife, Region 5.

    This report details fish rescue efforts on the West Fork San Gabriel River and Bear Creek following the Bobcat fire. A total of 1,374 rainbow trout fish were rescued for this effort. Although this report is not cited in the Status Review, a subsequent report (cited as Pareti 2020 but should be Pareti 2021) is cited that describes how the rescued fish were then translocated to the Arroyo Seco and East Fork San Gabriel Rivers.

11. Stillwater Sciences, R. Dagit, and J. C. Garza. 2010. Lifecycle Monitoring of *O. mykiss* in Topanga Creek, California. Final Report to California Department of Fish and Game Contract No. P0750021. Resources Conservation District of the Santa Monica Mountains.

    This report provides the results of nine years of lifecycle monitoring of steelhead rainbow trout in Topanga Creek. We evaluated this report during the development of the Status Review and opted to instead reference Dagit et al. 2019, which includes a comprehensive summary of lifecycle monitoring efforts in Topanga Creek from 1994 to 2019.

12. Stillwater Sciences. 2020. Conceptual Ecological Model and Limiting Factors Analysis for Steelhead in the Los Angeles River Watershed. Final Technical Memorandum. Prepared by Stillwater Sciences, Los Angeles, California for the Council for Watershed Health, Pasadena, CA. September 2020.

    This technical memorandum describes the ecological basis (i.e., life-history, LA River watershed description, limiting factors analysis, conceptual ecological model) for the steelhead passage and habitat improvements central to the Los Angeles River Fish Passage and Habitat Structures project. This pilot project aims to restore fish passage and habitat within a 4.8-mile section of the concrete-lined Los Angeles River. While this project is still in its pilot phase, it provides additional information that informs the influence of existing management measures described in Chapter 7.3.5 and 7.3.6 of the Status Review.

13. Taylor, J. B., E. D. Stein, M. Beck, K. Flint, and A. Kinoshita. 2019. Vulnerability of Stream Biological Communities in Los Angeles and Ventura Counties to Climate Change Induced Alterations of Flow and Temperature. Southern California Coastal Water Research Project. Southern California Coastal Water Research Project Technical Report 1084.

    The authors of the report used models to relate streamflow and temperature to the probability of six species occurrences (including southern California steelhead) to map out future species distributions. The authors note that the results of their analysis could be used to support a variety of future management and monitoring decisions. The findings specific to southern California steelhead provide additional information and support for the Status Review in Chapter 5, "Habitat That May Be Essential to the Continued Existence of southern California steelhead rainbow trout".

14. Ventura County Fish and Game Commission. 1973. *The Ventura River Recreational Area and Fishery: A Preliminary Report and Proposal*. Prepared for the Ventura County Board of Supervisors. March 1, 1973.

    This draft report describes the Ventura River recreational area and fishery during the early 1970s. The fisheries section of the report characterizes the watershed as an especially productive trout fishery during the pre-1940s. An estimated 4,000-5,000 adult steelhead were observed to have entered the Ventura River to spawn in 1946. The post-1946 fishery was marked by a significant alteration to the watershed, which resulted in the decline of the fishery. However, angling for trout and steelhead was still considered to be productive. This preliminary report provides additional useful background information and support for Chapter 4, Section 4.3.1.3, pages 46-48 in the Status Review.

15. Capelli, M. H. 1997. Ventura River steelhead survey, Ventura County, California. Prepared for California Department of Fish and Game, Region 5. UC Santa Barbara Library: Special Collections, University of California, Santa Barbara, USA.

    This report summarizes the results of a sampling survey conducted on the lower Ventura River below the Robles Diversion. The effort captured a total of 52 rainbow trout across a total of 4.25 stream miles. The fish ranged in size from 7.5 to 16 inches. Five individuals were hatchery fish, while the remaining were determined to be natural residents or anadromous individuals. This survey provides additional relevant information and support for Chapter 4, Section 4.3.1.3, Pages 46-48 of the Status Review.

16. Harrison, L., E. Keller, and M. Sallee. 2005. Santa Monica Mountains Steelhead Habitat Assessment: Watershed hydrologic analysis. University of California, Santa Barbara.

    This watershed analysis aimed to identify which basins in the Santa Monica Mountains are most capable of supporting steelhead trout populations. The study examined the relationship between baseflow and geology and modeled predictions of rainfall-runoff between important watersheds. Larger basins with higher flows were ranked as having the highest potential to support steelhead. These basins include Malibu, Topanga, Arroyo Sequit, Trancas, Zumas, and Las Flores Creek. This study provides an important contribution to our understanding of habitat potential for steelhead trout in the Santa Monica Mountains. However, more recent reports were reviewed during the development of the Status Review, such as the federal Recovery Plan of 2013, which includes updated information on core recovery watersheds in the Santa Monica Mountains and southern California.

17. Nielsen, J., C. Zimmerman, J. Olsen, T. Wiacek, E. Kretschmer, G. Greenwald, J. Wenburg. 2002. Population Genetic Structure of Santa Ynez Rainbow Trout - 2001 Based on Microsatellite and mtDNA Analyses.

    This study examined the genetic diversity of 8 rainbow trout subpopulations in the Santa Ynez River. The relevant findings of the study are that most subpopulations sampled do not appear to be significantly influenced by hatchery fish, despite the considerable amounts of hatchery supplementation that had occurred up until the end of the 1990s. These results provide further support for information provided in Chapter 2, Section 2.5.7, Page 32-33 on the genetic impacts of historical stocking in the Status Review.

Background Information Not Directly Relevant to the Status Review

18. Barabe, R. M. 2021. Population estimates of wild rainbow trout in a remote stream of southern California. *California Fish and Wildlife* 107(1):21-32.

    This reference reports a CDFW-led study on the distribution and abundance of wild Rainbow Trout in Pauma Creek, a tributary to the San Luis River in northern San Diego County. A total of 854 fish were captured during this two-year seasonal survey. Pauma Creek is currently located above multiple barriers to anadromous migration and is therefore not directly relevant to the Status Review.

19. Cooper, S. D., P. Sam, S. Sabater, J. M. Melack, J.M., and J. L. Sabo. 2013. The effects of land-use changes on streams and rivers in Mediterranean climates: Hydrobiologia 719(1): 383–425 https://doi.org/10.1007 /s10750-012-1333-4.

    This academic journal article reviewed literature on the effects of land use changes on Mediterranean river ecosystems, including those in Chile, South Africa, and California. While the information is informative, it is not directly relevant to the Status Review.

20. HDR Engineering, Inc. 2013. Los Padres National Forest Steelhead Monitoring, Tracking and Reporting Program. Final Plan. Prepared for the U.S. Forest Service, Los Padres National Forest. Santa Maria, CA.

    This report provides guidance on monitoring, tracking, and reporting of rainbow trout populations and habitat conditions within the Los Padres National Forest. While informative, watershed specific monitoring programs for streams occurring outside the scope of the Petitioner's listing definition are not directly relevant to the Status Review.

21. Keller, E. A., G. Bean, and D. Best. 2015. Fluvial geomorphology of a boulder-bed, debris-flow- dominated channel in an active-tectonic environment. Geomorphology 243(2015):14-26.

    This scientific research article describes the fluvial geomorphic processes of Rattlesnake Creek in the Santa Ynez Range in Southern California. The authors hypothesize the mechanisms that drive the underlying step-pool morphology of the creek. While the study was conducted within the geographic range of southern California steelhead, its results are not directly relevant to the Status Review.

22. McMahon, C., S. D. Cooper, and S. W. Wiseman, S.W. 2023. Postfire stream responses to spatial fire patterns in riparian and upland zones. In: J. L. Florsheim, A. P. O'Dowd, and A. Chin, A. (eds.). *Biogeomorphic Responses to Wildfire in Fluvial Ecosystems*. Geological Society of America. Special Paper 562.

    This book chapter examined differences in burn patterns in riparian versus upland zones and their implications for stream characteristics. The authors studied fire patterns and postfire vegetation trajectories for the two habitat types across 26 stream sites in coastal southern California over a period of 12-years. There are many interesting and informative findings from this long-term study; however, the findings are not directly relevant to the Status Review.

23. Nielsen, J. L., D. J. Scott, and J. L. Aycrigg. 2001. Endangered species and peripheral populations: cause for conservation. *Endangered Species Update* 18(5):194-197.

    This letter to the editor of the School of Natural Resources and Environment at the University of Michigan advocates for the value of peripheral populations in endangered species conservation. The letter is a rebuttal to a previous article supporting the opposite claim that peripheral populations dilute the effectiveness of species conservation. Southern California steelhead are referenced to support the authors' claim that peripheral populations have intrinsic population value. However, this letter is not directly relevant to the Status Review.

24. Hemmert, J. 2020. 2019 Coldwater Canyon Creek Rainbow Trout (*Oncorhynchus mykiss*) Relocation Summary Report – Mojave River Hatchery to Marion Creek. Fisheries Heritage and Wild Trout Program, Inland Deserts Region. California Department of Fish and Wildlife, Region 6. June 8, 2020.

    This report describes the relocation of Coldwater Creek rainbow trout from the Mojave River hatchery. Of the 241 individuals rescued from Coldwater Creek in response to the Holy Fire, 149 perished at the Mojave River Hatchery, and 92 were translocated to Marion Creek. While these actions serve to inform future management efforts, they are not directly applicable to the Status Review because the watersheds in question are far above natural barriers to anadromy and are thus not directly relevant to the Status Review.

25. White, J., L. Takata, and M. Rieck. 2017. Final Los Padres National Forest 2017 Steelhead Monitoring Report. U.S. Forest Service, Los Padres National Forest. Challenge Cost Agreement between the University of California, Santa Barbara and USFS-LPNF (Agreement No. CS-11050700-007).

    This report assessed the physical, chemical, and biological conditions of streams affected by three major fires that occurred in the Los Padres National Forest. Rainbow trout were observed at 6 of 8 unburned sites but were not observed at sites impacted by fire. This report provides insight on the impact of fire on resident rainbow trout populations and their habitat above major barriers to anadromy. However, the survey sites were all outside the scope of the Petitioner's definition of the species and thus not directly relevant to the Status Review.

26. Bean, G. S. 2007. Geologic controls on channel morphology and low-flow habitat in Rattlesnake Creek, Santa Barbara, California. M.S. Thesis. University of California Santa Barbara.

This master's thesis examined whether geologic and hydrogeologic properties control channel morphology and low-flow habitat for southern California steelhead in Rattlesnake Creek. The study found that rock strength and joint strength of the underlying geology did not significantly affect the channel morphology of the creek. This study is not directly relevant to the Status Review.

27. Capelli, M.H. 1999. Dam Sand Rights: Removing Rindge and Matilija Dams. Proceedings, Sand Rights 1999: Bringing back the beaches, Ventura, CA. September 23-26, 1999.

    This article discusses the many benefits of removing the Rindge and Matilija dams, including the establishment of natural sediment transport, beach restoration, and shoreline armoring. The article advocates for inland sources of beach material, such as sediment trapped behind outdated dams, to be used to restore the beaches of southern California. While this article provides useful background information on the history of Matilija and Rindge dams, it is not directly relevant to the Status Review.

28. Capelli, M.H. 2004. Removing Matilija Dam: Opportunities and challenges for Ventura River restoration. Proceedings U.S. Society on Dams. St. Louis Missouri. March 29-April 2, 2004.

    This article discusses the opportunities, benefits, and challenges of removing Matilija Dam from the Ventura River watershed. Matilija Dam traps 213,000 to 230,000 cubic yards of sediment annually since it was constructed in 1946. The article summarizes the benefits to the southern California steelhead population in the Ventura River if it was removed. Although this article provides detailed background information on the potential for dam removal on the Ventura River, it is not directly relevant to the Status Review.

29. Harrison, Lee & E. Keller. 2007. Modeling forced pool–riffle hydraulics in a boulder-bed stream, southern California. Geomorphology. 83. 232-248. 10.1016/j.geomorph.2006.02.024.

    This scientific research article modeled the interactions among pool-riffle sequences in Rattlesnake Creek in Santa Barbara County. The authors found that pool-riffle sequences in boulder-bed streams are maintained by flows at or near bankfull discharge due to variability in velocity and tractile force. This research article is not directly relevant to the Status Review.

30. Rich, A. & E. Keller. 2013. A hydrologic and geomorphic model of estuary breaching and closure. Geomorphology. 191. 64–74. 10.1016/j.geomorph.2013.03.003.

This scientific research article modeled the hydrology of bar-built estuaries to better understand breaching and closing patterns. The study site used was the Carmel Lagoon in Monterey County. The results demonstrate that the model could accurately predict the breaching and closing of Carmel Lagoon. While the results of the study contribute many interesting findings to estuary hydrology, they are not directly relevant to the Status Review.

31. Cooper, S.D., S.W. Wiseman, B. DiFiore, and K. Klose. 2024. Trout and invertebrate assemblages in stream pools through wildfire and drought. Freshwater Biology (69): 300-320.

    This scientific research article examines how climate change (i.e., drought and fire) influences top predators and their impacts on lower trophic levels. The study examined relationships among the distribution of trout, environmental factors, and stream invertebrate assemblages across sample sites that both contained and did not contain trout. The results indicate that the impact that trout have on invertebrate communities depends on environmental conditions and bottom-up and top-down trophic pressures. While this information contributes to the growing body of science on stream trophic food web impacts due to climate change, the results are not directly relevant to the Status Review.

Information already cited in the Status Review

32. Allen, M. 2014. Steelhead population and habitat assessment in the Ventura River/Matilija Creek Basin 2006 - 2012. Normandeau Associates, Inc., Arcata, CA. (Cited in Chapter 5, Section 5.5, Page 90)

33. Kendall, N. W., J. R. McMillan, M. R. Sloat, T. W. Buehren, T. P. Quinn, G. R. Pess, K. V. Kuzishchin, M. M. McClure, and R. W. Zabel. 2015. Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns. Canadian Journal of Fisheries and Aquatic Sciences 72(3):319-342. (Cited in Chapter 6, Section 6.7, Page 108).

34. Moore, M. R. 1980. Factors Influencing the Survival of Juvenile Steelhead Rainbow Trout (*Salmo gairdeneri gairdneri*) in the Ventura River, California. M.S. Thesis. Humboldt State University. (Cited in Chapter 4, Section 4.3.1.3 and 4.3.1.4., Page 48-50 and Section 4.6, Page 78)

35. Nielsen, J. L., C. Carpanzano, M. C. Frountain, and C. A. Gan. 1997. Mitochondrial DNA and nuclear microsatellite diversity in hatchery and wild *Oncorhynchus mykiss* from freshwater habitats in southern California. *Transactions of the American Fisheries Society* 126(4):397-417. (Cited in Chapter 2, Section 2.5.7, Page 32 and Chapter 4, Section 4.6, Page 79)

36. Nielsen, J. L., 1999. The evolutionary history of steelhead (*Oncorhynchus mykiss*) along the U.S. Pacific Coast: Developing a conservation strategy using genetic diversity. *ICES Journal of Marine Sciences* 56(4):449-458. (Cited in Chapter 2, Section 2.5.6, Page 31 and Chapter 4, Section 4.3.4.1, Page 56)

37. Moore, M. 1980a. An assessment of the impacts of the proposed improvements to the Vern Freeman Diversion on anadromous fishes of the Santa Clara River system, Ventura County, California. Prepared for the Ventura County Environmental Resources Agency under Contract Number 670. (Cited in Chapter 4, Section 4.3.1.4 Page 48, 49, 50)

38. Chubb, S. 1997. Ventura Watershed Analysis - Focused on Steelhead Restoration. Los Padres National Forest, Ojai Ranger District. (Cited in Chapter 5, Section 5.1, Page 85)

39. Moore, M.R. 1980b. Factors influence the survival of juvenile steelhead rainbow trout (*Salmo gairdneri gairdneri*) in the Ventura River, California. M.A. Humboldt State University. (Cited in Chapter 4, Section 4.6 Page 79)

*Note: The Status Review includes two separate Moore (1980) citations, however only one citation is referenced in the literature cited section. The correct in-text should have been Moore 1980a and Moore 1980b.

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