COASTAL CUTTHROAT TROUT
***Oncorhynchus clarkii clarkii* (Richardson)**

Status: Moderate Concern. Coastal cutthroat trout populations in California are small and face multiple threats, including predicted outcomes of climate change in their range.

Description: Coastal cutthroat trout are similar to coastal rainbow trout (*O. mykiss*) but have heavier spotting, particularly below the lateral line, and heavy spots on paired and anal fins. The spots become nearly invisible when fish become silvery during migrations to and from sea. Mature fish in fresh water have a dark coppery or brassy appearance (Behnke 1992, Moyle 2002). Cutthroat trout tend to be more slender-bodied than rainbow trout and possess characteristic red to orange to yellow slashes under the mandibles, although the slashes are seldom visible until the fish reach over 80 mm total length (TL) (Scott and Crossman 1973, Behnke 1992). Larger fish have long maxillary bones extending past the eye. Well-developed teeth are found on the jaws, vomer, palatines, tongue, and on the basibranchial bones. The dorsal fin has 9-11 rays, the anal fin 8-12 rays, the pelvic fins 9-10 rays, and the pectoral fins 12-15 rays. There are 15-28 gill rakers on each arch and 9-12 branchiostegal rays. The caudal fin is moderately forked and scales are smaller than those of rainbow trout, with 140-200 along the lateral line (Behnke 1992). Parr possess 9-10 widely spaced parr marks (vertical bars) along the lateral line and are difficult to distinguish from rainbow trout parr. Anadromous forms rarely exceed 40 cm fork length (FL) and 2 kg, but individuals reaching 70 cm and 8 kg have been recorded. It is uncommon for individuals from landlocked populations to exceed 30 cm FL.

Taxonomic Relationships: The coastal cutthroat has long been recognized as distinct and it was the first cutthroat trout described by John Richardson in 1836. He used the name "*Salmo clarkii*" so *clarkii* with a 'double-' ending is the correct name, even if not widely used (Trotter 2007). Behnke (1992, 1997) proposed that, approximately one million years ago, cutthroat trout diverged into two major lineages, the coastal cutthroat (*O. c. clarkii*) and all the interior subspecies (with complex evolutionary histories). The coastal cutthroat are characterized by 68 chromosomes and interior cutthroat subspecies are characterized by either 66 or 64 chromosomes. The 64 chromosome fish include Lahontan cutthroat (*O. c. henshawi*) and Paiute cutthroat (*O. c. seleneris*) in California (Trotter 2007). The coastal cutthroat has numerous populations that spend their entire life cycle in fresh water but are genetically connected to sea-run populations (Trotter 2007). Coastal cutthroat have colonized coastal rivers from northern California to Prince William Sound in Alaska; their populations can be divided into a number of Distinct Population Segments (Johnson et al. 1999). California's populations are at the southern end of the coast range lineage and include both sea-run and freshwater populations. The populations in California are considered part of the Southern Oregon-California Coast DPS (Johnson et al. 1999; Trotter 2007).

Life History: Coastal cutthroat trout possess variable life history strategies (DeWitt 1954; Pauley et al. 1989, Moyle 2002). This plasticity is among the most extreme in Pacific salmonids and variations in migratory behavior are found both between and within populations. Trotter (2007) categorizes this diversity into four main groups: (1) amphidromous (sea-run) life history, (2) lacustrine life history, (3) riverine (potadromous) life history, and (4) stream-resident. The amphidromous forms are not considered strictly anadromous because they can move back and forth between fresh and salt water multiple times to feed (often on other salmonids), although they also migrate into fresh water to spawn. Lacustrine coastal cutthroat use large lakes like the ocean (but do not occur in California). Potadromous forms are found in rivers and make seasonal migrations up and down these rivers. Resident populations are typically found above natural barriers, in headwaters. Offspring of resident fish can become amphidromous and vice-versa (Trotter 2007). The Smith and Klamath rivers in California have both amphidromous populations and resident populations isolated in small streams upstream of barriers (e.g., Little Jones and Tectah creeks). Sea-run cutthroat trout generally make their first migrations when two to three years old, although they can enter sea water as late as their fifth year. When multiple forms coexist, temporal and spatial segregation presumably influence genetic structure of the population and may lead to genetic differentiation between sympatric ecotypes within a watershed. Environmental conditions that affect growth rate, such as food availability, water quality, and temperature markedly influence migratory behavior and residency time (Hindar et al. 1991, Northcote 1992, Johnson et al. 1999). Johnson et al. (1999) noted that the large variability in migratory behavior may be due to habitat being most available for cutthroat trout at times when it is not being used by more rigidly anadromous salmonids; this flexibility may release cutthroat trout from competition and predation pressures at certain times of year, while allowing them to track the movements of juvenile salmonids as prey (Trotter 2007).

Coastal cutthroat trout have ecological requirements analogous to those of resident rainbow trout and steelhead. When the two species co-occur, cutthroat trout occupy smaller tributary streams, while the competitively dominant steelhead occupy larger tributaries and rivers. As a consequence, cutthroat trout tend to spawn and rear higher in watersheds than steelhead. While cutthroat and rainbow trout can naturally hybridize, this spatial segregation is likely a key reproductive barrier that functions in many streams where their distribution overlaps. Age at first spawning ranges from 2 to 4 years, depending on migratory strategy and environmental conditions (Trotter 1991). Their life spans are 4-7 years, with non-migratory fish often reaching sexual maturity earlier and at a smaller size than anadromous fish (Trotter 1991, Johnson et al. 1999). Resident fish generally reach sexual maturity between the ages of 2 and 3 years, whereas sea-run fish rarely spawn before age 4 (Johnson et al. 1999). Sexually mature trout can demonstrate precise homing capabilities in their migrations to natal streams. In northern California, coastal cutthroat trout migrate upstream to spawn after the first significant rain, beginning in fall. Peak spawning occurs in December in larger streams and January to February in smaller streams (Johnson et al. 1999). Ripe or nearly ripe females have been caught from September to April in California streams, indicating a prolonged spawning period.

Females dig redds in clean gravels with their tails, predominantly in the tails of pools in low gradient reaches, often with low flows (less than 0.3 m^3/second summer flows) (Johnston 1982, Johnson et al.1999, Trotter 2007). The completed redds average around 35 cm in diameter by 10-12 cm deep. After spawning is completed, the female covers her redd with about 15-20 cm of gravel. Each female may mate with numerous males. Fecundity ranges from 1,100 to 1,700 eggs for females between 20 and 40 cm TL. Coastal cutthroat trout are iteroparous with a higher incidence of repeat spawning than steelhead. They can spawn every year but post-spawning mortality can be quite high. Maximum age recorded for coastal cutthroat is 14 years, from Sand Creek, Oregon (Trotter 2007).

Eggs hatch after 6-7 weeks of incubation, depending on temperature. Alevins emerge as fry between March and June, with peak emergence during mid-April, then spend the summer in backwaters and stream margins (Johnson et al. 1999). Juveniles remain in the upper watershed until approximately 1 year in age, at which point they may move extensively throughout the watershed. Once this age is reached, it is difficult to determine the difference between sea-bound smolts and silvery parr moving back up into the watershed (Johnson et al. 1999). Smolts or adults entering the saltwater environment remain close to the shore and do not normally venture more than about 7 km from the edge of the coast (Johnson et al. 1999). Typically, they stay in or close to the plume of the river in which they were reared (Trotter 2007). Individuals can spend prolonged periods (months) in estuaries, often moving in and out of fresh water, likely taking advantage of different feeding and rearing habitats. Cutthroat trout up to ~350 mm were captured in the Smith River estuary from May- October 1997-2001 (R. Quiñones, unpublished observations). A similar pattern is observed in the Klamath River estuary (M. Wallace, CDFW, pers. comm. 2013).

Adults feed on benthic macroinvertebrates, terrestrial insects in drift and small fish, while juveniles feed primarily on zooplankton, macroinvertebrates, and microcrustaceans (Wilzbach 1985, Romero et al. 2005). White and Harvey (2007) found that cutthroat trout of all sizes in small creeks fed mainly on aquatic insects in low numbers, but that earthworms washed in by winter storms may be bioenergetically most important for overwintering survival. Cutthroat captured in Prairie Creek appeared to feed opportunistically on migrating Chinook salmon fry during peak migration periods (M. Sparkman, CDFW, pers. comm. 2011) and cutthroat captured in the Klamath estuary regurgitated salmon eggs during late summer, when large numbers of adult salmon were being caught and cleaned (M. Wallace, CDFW, pers. comm. 2013). In the marine environment, cutthroat trout feed on various crustaceans and fishes, including Pacific sand lance (*Ammodytes hexapterus*), salmonids, herring and sculpins. Marine predators include Pacific hake (*Merluccius productus*), spiny dogfish (*Squalus acanthias*), harbor seals (*Phoca vitulina*) and adult salmon (Pauley et al. 1989). Freshwater predators include the typical array of herons, mergansers, kingfishers, otters, snakes, and piscivorous fishes.

Habitat Requirements: Coastal cutthroat trout require cool, clean water with ample cover and deep pools for holding in summer. They prefer small, low gradient coastal streams and estuarine habitats, including lagoons. Preferred water velocities for fry are less than 0.30 m/sec, with an optimal velocity of 0.08 m/sec (Pauley et al. 1989). Summer flows in natal streams are typically low, averaging 0.12 m^3/sec in Oregon (Pauley et al. 1989). Adults overwintering in streams, rather than estuaries, prefer pools with fallen logs or undercut banks but will also utilize boulders, depth, and turbulence as alternative forms of cover, if woody debris is not available (Gerstung 1998, Rosenfeld et al. 2000, Rosenfeld and Boss 2001). Juveniles generally rear in smaller streams with dense overhead cover and cool summer temperatures (Rosenfeld et al. 2000, 2002). Fish using large woody debris as cover are less affected by winter high flow events than those without such cover (Harvey et al. 1999). Spawning takes place in small streams with small to moderate sized gravel ranging from 0.16-10.2 cm in diameter. Cutthroat preferentially use riffles and the tails of pools for spawning, with velocities of 0.3-0.9 m/sec, although they have been observed spawning in velocities as low as 0.01-0.03 in small streams in Oregon (Pauley et al. 1989).

Optimal stream temperatures are less than 18°C, with preferred temperatures being around 9-12°C. This may explain why they occur mainly in more northern streams in California, within the coastal fog belt. In Washington streams, most rapid growth occurred at 8-10°C, in early summer, with rates declining as temperatures rose to 12-14°C (Quinn 2005). Spawning has been recorded at temperatures of 6-17° C, with preferred temperatures of 9-12° C (Pauley et al.

1989, Moyle 2002). Coastal cutthroat require high dissolved oxygen levels and will avoid areas with less than 5 mg/L DO in summer months (Pauley et al. 1989). Feeding and movement of adults are impaired at turbidities of greater than 35 ppm. Embryo survival is greatly reduced at turbidities >103 ppm and dissolved oxygen levels <6.9 mg/l.

Distribution: Coastal cutthroat trout are distributed from the Seward River, in Southern Alaska, to tributaries to the Salt River, a tributary to the Eel River estuary in Humboldt County, California. There are anecdotal reports of cutthroat in lower Eel River tributaries, near Fortuna, and, in 1992, coastal cutthroat trout were identified in Barber Creek, a lower Van Duzen River tributary (S. Downie, CDFW, pers. comm. 2012). North of the Eel River, their range coincides closely with that of temperate coastal rain forest (Trotter 2007). The interior range of the subspecies in Washington, Oregon, and California is bounded by rain forests on the western slope of the Cascade Range; their range rarely extends inland more than 160 km and is usually less than 100 km (Johnson et al. 1999). In California, this band is only about 8 km wide at the mouth of the Eel River and 48 km wide at the Oregon border (Moyle 2002). However, a small resident population exists in Elliot Creek in Siskiyou County, about 120 km from the ocean. Elliot Creek is a tributary to Applegate River in Oregon, which drains into the Rogue River. Fish from Elliot Creek have been transplanted successfully to Twin Valley Creek in the Klamath River watershed (Moyle 2002), where they still persist (J. Weaver, CDFW, pers. comm. 2011). Cutthroat from other parts of their range have also been successfully transplanted to Indian Creek, also in the Klamath River watershed (M. McCain, USFS, pers. comm. 2011).

In California, coastal cutthroat trout are at the southern edge of their range and have been observed in 182 named streams (approximately 71% of the 252 named streams within their range in California) and an additional 45 streams may support populations (Gerstung 1997). Self-sustaining populations apparently occur in many coastal basins, including Humboldt Bay tributaries, Little River, and Redwood Creek (Gerstung 1997). The principal large basins where coastal cutthroat trout occur are the Smith, Mad and lower Klamath rivers. Cutthroat trout also rear in approximately 1875 ha of habitat in several coastal lagoons and ponds: Big, Stone, and Espa lagoons, and the Lake Earl-Talawa complex (Gerstung 1997). The largest populations are currently in the Smith River, and to a lesser extent, the lower Klamath River and tributaries (Gale and Randolph 2000). Gerstung (1997) indicated that the lower Mad River is another area of high cutthroat occupancy, but more recent assessments indicate that it contains only a small population (T. Weseloh, pers. comm. 2008). Thus, as Gerstung (1997) noted, almost 46% of California coastal cutthroat trout populations occupy habitats in the Smith and Klamath River drainages.

Historical coastal cutthroat trout distribution may have once extended farther south to the Russian River in Sonoma County. There are anecdotal reports of cutthroat trout in several streams from the Mattole River down to the Garcia River (Gerstung 1997); however, there are currently no known populations south of the Eel River.

Trends in Abundance: There are a limited number of long-term data sets available to evaluate population trends in coastal cutthroat trout, primarily of adults in Oregon and Washington. Data are spotty, scattered, and typically unpublished. Records suggest that coastal cutthroat trout were more abundant historically and, in some locations, supported substantial fisheries (Gerstung 1997). Current coastal cutthroat trout abundance is thought to generally be low in most waters, particularly where juvenile steelhead are present (Johnson et al. 1999, Griswold 2006). Effective population size in California streams is difficult to determine, but Gerstung (1997) estimated that there are likely less than 5,000 spawners each year in all of California.

The largest population apparently exists in the Smith River, where a local watershed group, the Smith River Alliance (SRA) and U.S. Forest Service conduct annual snorkel surveys for salmon and trout. Figure 1 summarizes results for surveys of all cutthroat observed from 2003 to 2011, with the exception of 2004 for which data are unavailable. A dedicated CDFW biologist is now conducting fisheries monitoring in the Smith River watershed (M. Gilroy, CDFW, pers. comm. 2012). Additionally, CDFW's Heritage and Wild Trout Program conducted watershed-wide population and habitat surveys in 2010 and has provided assistance to the annual snorkel survey population counts coordinated by the Smith River Alliance (J. Weaver, CDFW, pers. comm. 2012). Previous population and trend data collections from the Smith River have been intermittent and represent only a small portion of the range with inconsistent locations and methods over the years. The Yurok Tribe has conducted anadromous salmonid surveys on the lower Klamath River and many of its tributaries and found cutthroat widely distributed in medium to high densities in nearly all lower Klamath tributaries downstream of Mettah Creek (Gale and Randolph 2000). Figure 2 summarizes results for the number of adults observed during surveys in Blue Creek, one of the most productive coastal cutthroat streams in the Klamath basin, for most years 1999-2009. Although both populations appear to be increasing in recent years, analysis by Quiñones (2011) was unable to detect significant trends for the Blue Creek data. Longer time series are also difficult to interpret (Figure 3; Johnson et al. 1999).

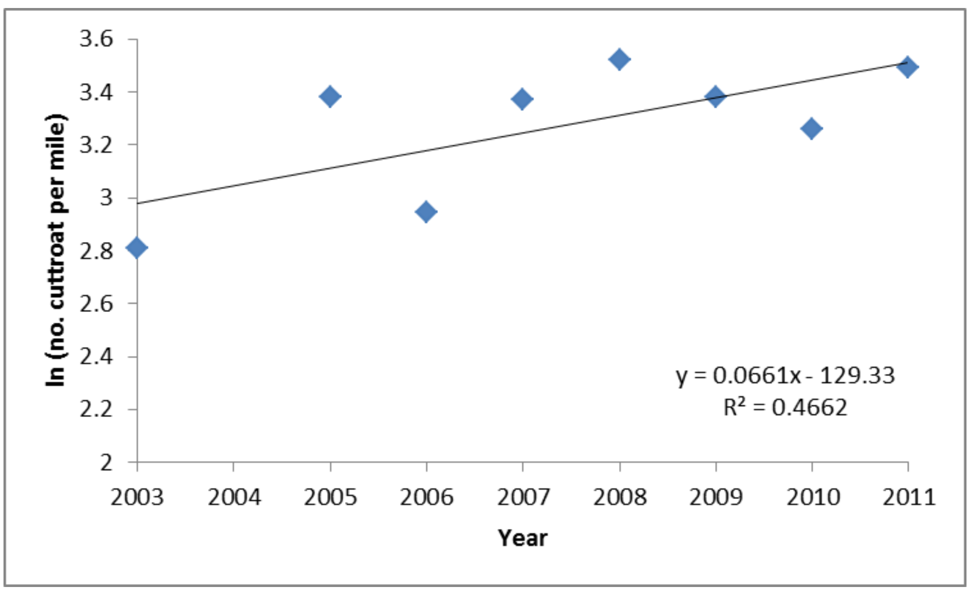

Figure 1. Coastal cutthroat abundance (ln(fish number/mile)) in the Smith River watershed, 2003-2011.

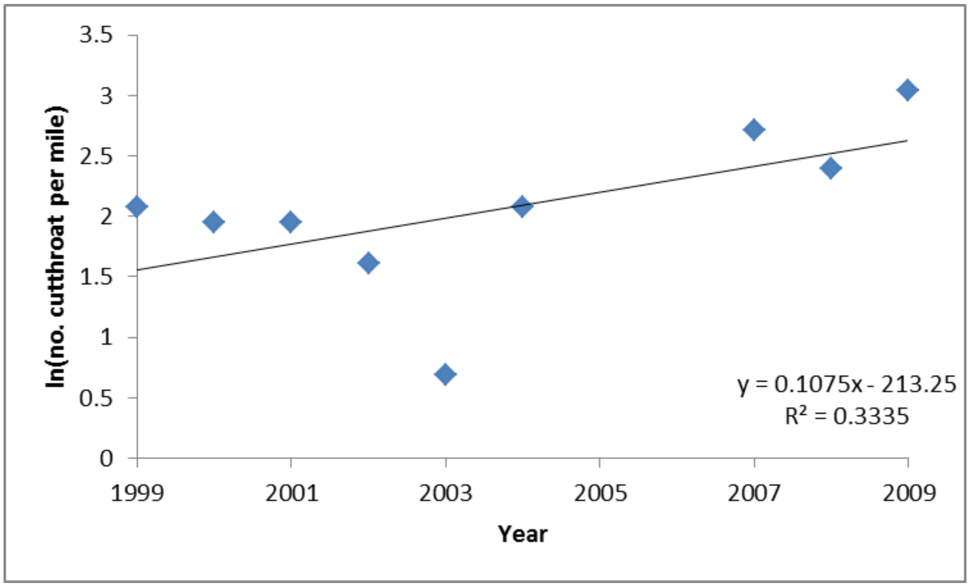

Figure 2. Adult coastal cutthroat abundance (ln(fish number/mile)) in Blue Creek, Klamath basin, 1999-2009.

Because quantitative measures of historical abundance are lacking, it is difficult to determine whether populations are in decline, increasing, or stable (Johnson et al. 1999, Griswold 2006). Declines in coastal cutthroat numbers are likely due to extensive changes made to estuaries, watersheds, and streams throughout their range in California. Fortunately, there is increasing protection in some areas (e.g., Smith River, streams in Del Norte Coast Redwoods State Park), in part to protect listed coho salmon.

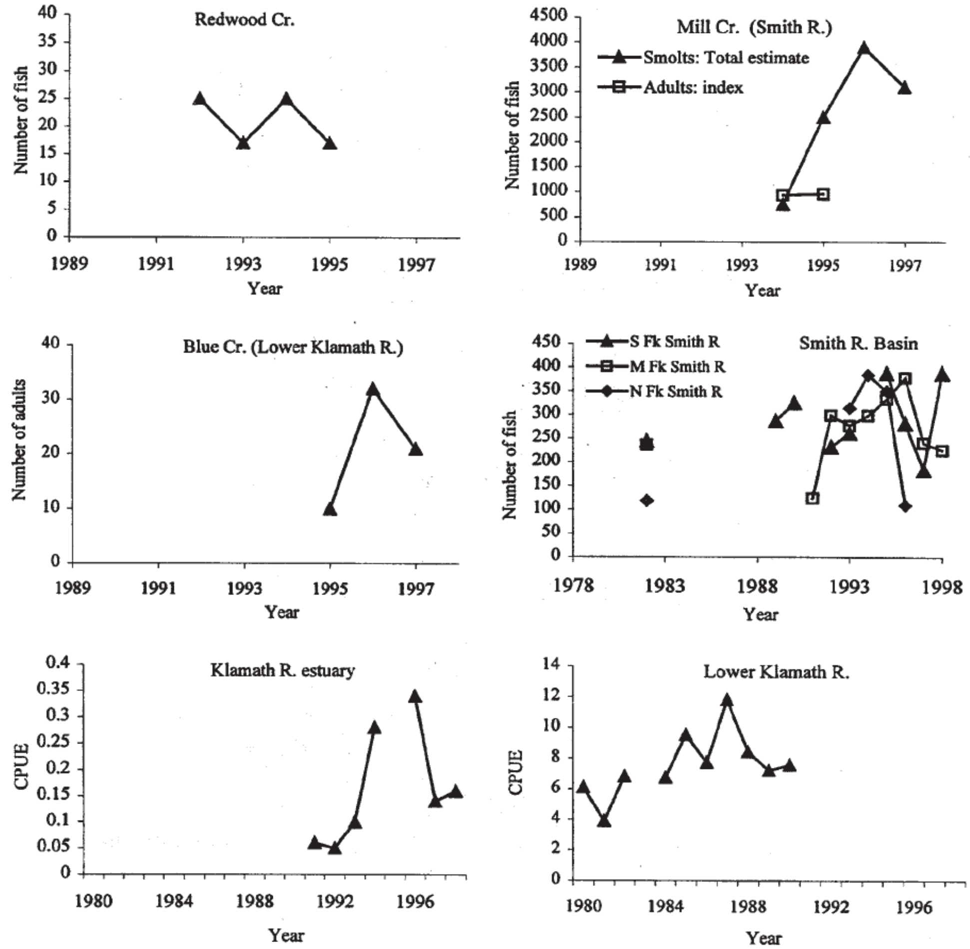

Figure 3. Coastal cutthroat trout abundances from Johnson et al. (1999). Data include both snorkel surveys and electrofishing efforts.

Nature and Degree of Threats: Major factors affecting the status of coastal cutthroat trout are discussed below. Populations are affected differentially by one or more stressors, depending on location (Table 1). According to Gregory and Bisson (1997), degraded habitat is associated with more than 90% of documented extinctions or declines of Pacific salmonid stocks. Coastal cutthroat trout stocks are no exception to the rule. Major anthropogenic land-use activities, including agriculture, forestry, grazing, water diversions, urban and industrial development, road construction and mining, have resulted in the alteration and loss of cutthroat trout habitat and a subsequent loss in production (Johnson et al. 1999). Fish passage issues from loss of over-wintering habitat, changes in geomorphic processes and channel geometry, channelization and simplification of habitat in estuaries, presence of tidal gates, the loss of large wood in channels, and road impacts on small headwater streams are all associated with habitat degradation in the coastal cutthroat trout's range. While treated separately in this account, the various contributing causes of decline are multiple and often interact synergistically. A unique problem relates to the effects of habitat alteration on interactions between steelhead and cutthroat trout. The two species naturally co-occur and hybrids occur naturally, with no obvious impacts on cutthroat trout populations (Neillands 2001). However, habitat disturbance and other factors may increase rates of hybridization, with unknown consequences, but presumably to the detriment of the rarer cutthroat trout.

Dams and diversions. Dams and diversions have altered flows in a number of coastal rivers, most conspicuously the Klamath and Mad rivers, within coastal cutthroat trout range. The impact of these dams on cutthroat trout is not known but altered flow regimes are unlikely to have had a positive effect. Likewise, the effects of small diversions, common in coastal streams, are not known.

	Rating	Explanation
Major dams	Medium	Dams present on some streams
Agriculture	Medium	Conversion of estuarine wetlands to agricultural lands, diversions, influx of fertilizers and other pollutants into estuaries
Grazing	Medium	Some impacts in lowland areas, especially where estuary marshes have been converted to pasture
Rural Residential	Medium	Effects localized, but increasingly an issue in Humboldt Bay tributaries and the Crescent City area
Urbanization	Low	Increasingly an issue in Humboldt Bay tributaries
Instream mining	Low	No known impact but occurs in some streams
Mining	n/a	
Transportation	Medium	Roads are an ongoing source of sediment input, habitat fragmentation, and channel alteration
Logging	Medium	Major activity in many watersheds; dramatic historic impacts in many areas
Fire	Low	Increased stream temperatures and sediment input may be a factor in some inland watersheds
Estuary alteration	Medium	Estuaries are important habitat and have been significantly altered
Recreation	Low	Probably minor but may affect populations in heavily used streams
Harvest	Low	Harvest is generally light but not widely monitored; data mostly limited to CDFW Heritage and Wild Trout Program angler survey boxes at lagoons
Hatcheries	Medium	Possible hybridization or competition with hatchery steelhead
Alien species	Low	Alien species are common throughout range; impacts to coastal cutthroat are unknown but assumed to be minimal at present

Table 1. Major anthropogenic factors limiting, or potentially limiting, viability of coastal cutthroat trout populations in California. Factors were rated on a five-level ordinal scale where a factor rated “critical” could push a species to extinction in 3 generations or 10 years, whichever is less; a factor rated “high” could push the species to extinction in 10 generations or 50 years whichever is less; a factor rated “medium” is unlikely to drive a species to extinction by itself but contributes to increased extinction risk; a factor rated “low” may reduce populations but extinction unlikely as a result; and a factor rated “no” has no known negative impact to the taxon under consideration. Certainty of these judgments is moderate. See methods section for descriptions of the factors and explanation of the rating protocol.

Agriculture. Agricultural practices that most impact cutthroat trout are likely reclamation of estuarine marshes, water diversions and associated dike building, damming, culverts, and runoff. These factors result in degraded water quality, increased temperature, loss of in-stream flows, and loss of estuarine rearing areas (Johnson et al. 1999). Increasingly, marijuana growing (particularly along the north coast region of California) is a threat to aquatic habitats because growers divert water from headwater streams, convert large areas of former timber lands to monocultural crop production, pollute streams with pesticides and other material, and degrade stream habitats. Unfortunately, there are no known studies that document such impacts specifically for coastal cutthroat trout.

Grazing. Grazing occurs in most of the former wetlands surrounding the Smith River estuary, Humboldt Bay, and the Eel River estuary which are present and historic 'hot spots' for coastal cutthroat. Grazing and other agriculture occurs in the lower Mad River, Little River, and Redwood Creek. In all instances, these rivers have been isolated from their surrounding riparian habitat to the detriment of cutthroat trout. In addition, complete blockage of access to estuarine marsh channels by tide gates and dikes to keep pastures from flooding greatly reduce rearing habitat.

Rural residential. Residential areas are scattered throughout the range of coastal cutthroat trout and likely impact fish through habitat alteration, diversion of water, and pollution from septic tanks or surface runoff. These effects are mostly localized but, cumulatively, could pose significant threats during drought periods.

Urbanization. Urbanization plays an important role in reducing cutthroat trout habitat in urban streams in the Humboldt Bay region and around Crescent City (T. Weseloh, pers. comm. 2008). These streams generally have reduced cover, shallower pools, and poorer water quality than less disturbed streams.

Transportation. Roads or railroads line most streams, most dating from past eras of heavy exploitation of natural resources. They continue to be a major source of habitat loss for cutthroat trout through continued bleeding of sediment into streams and poorly constructed or placed culverts that prevent access to headwater areas. In addition, roads, railroads, and other infrastructure associated with transportation and urbanization limit habitat restoration projects because 'hardened' banks are very difficult and expensive to restructure into viable habitat for fish.

Logging. Logging and associated road networks have caused tremendous impacts to coastal cutthroat trout habitats with massive landslides and erosion stemming from excessive tree removal and road construction on steep, unstable soils found in coastal mountains. Small streams (e.g., those favored by cutthroat trout) are inherently more susceptible to such impacts and have, therefore, been disproportionately damaged by land use practices such as timber harvest. Johnson et al. (1999) cite numerous studies showing the importance of riparian vegetation to fish production and note that, in California, approximately 89% of the state's riparian forest has been lost with associated declines in aquatic habitat. Heavy erosion results in stream sedimentation and can elevate turbidity to intolerable levels, as well as bury spawning gravel, alter rearing habitats, and fill pools. Additionally, clear cutting in headwater basins has decreased shading and reduced the absorption capacity of soils. In certain areas, this is likely to have increased stream temperatures and incidence of flash flooding, as well as reduced late summer and early fall base flows. While the (especially legacy) impacts from logging to coastal cutthroat trout may merit a 'high' threat score (Table 1), historic impacts were much greater and, thanks to strict timber harvest regulations and many restoration efforts, current impacts are substantially reduced in many watersheds.

Harvest. Gerstung (1997) indicated that historical runs of coastal cutthroat trout were quite large and that, in some areas, substantial commercial and sport fisheries existed for them. Today, fisheries for coastal cutthroat occur mainly in coastal lagoons, where populations tend to be largest. Fisheries elsewhere are small and largely catch-and-release, although impacts from harvest on coastal cutthroat trout populations are unknown. In general, coastal cutthroat trout receive considerably less attention from anglers than the more popular salmon and steelhead fisheries of the north coast.

Hatcheries. Coastal cutthroat trout are generally competitively subordinate to all other species of salmonids (Johnson et al. 1999) and hatchery steelhead, in particular, are likely to affect their numbers through predation and competition, as well as disease (Johnson et al. 1999).

Estuarine alteration. Estuaries are important for cutthroat trout rearing and passage, yet most in California have been severely altered, usually for agriculture. In general, there is much less habitat available in the larger estuaries (e.g. Eel and Smith rivers, Humboldt Bay) than in the past.

Alien species. Alien species occur throughout the range of coastal cutthroat trout but impacts appear to be small. Aliens with potential impacts include: (1) New Zealand mud snail in lower Klamath, Big and Stone lagoons, Lake Earl, lower Smith River, and Redwood Creek; (2) largemouth bass (*Micropterus salmoides*) in the Big Lagoon watershed; (3) striped bass (*Morone saxatilis*) in several estuaries; and (4) Sacramento pikeminnow (*Ptychocheilus grandis*) in the Eel River (M. Gilroy, CDFW, pers. comm. 2011). The threat from pikeminnow may increase if they spread beyond the Eel River; CDFW has captured small numbers in Martin Slough, a tributary to Elk River, which flows into Humboldt Bay.

Effects of Climate Change. Climate change will further stress coastal cutthroat trout populations in California that have already been depleted over the last 50 years; existing numbers suggest that the overall population in California is low (Johnson et al. 1999). Coastal cutthroat occur primarily in north coast streams close to the ocean, which may seem to be relatively protected from predicted temperature increases, due to the influence of fog, although the effects of climate change on ocean currents and coastal fog is poorly understood (Quinones and Moyle, in press). However, their requirements for exceptionally cool water (<18ºC) may allow even small temperature increases to have a major effect on growth and survival. The suitability of estuarine habitats may also decrease as sea levels rise and more extreme tides and storm surges alter salinity profiles that define food webs. Sea level rise will move estuarine conditions farther upstream, potentially causing more competition and/or hybridization between cutthroat trout and steelhead (M. Wallace, CDFW, pers. comm. 2013). For these reasons, Moyle et al. (2013) regarded coastal cutthroat trout as “critically vulnerable” to extinction in California as the result of the added effects of climate change.

Status Determination Score = 3.0 – Moderate Concern (see Methods section Table 2)**.** Coastal cutthroat trout are apparently in no immediate risk of extinction throughout their range in California, but there is a high degree of uncertainty about their status in the state and most populations can decline rapidly in response to environmental change (Table 2). Coastal cutthroat trout persist in many streams on the northern California coast, although most populations are rarely monitored. They are listed as a Sensitive Species in California by the U.S. Forest Service. Their populations are now entirely dependent on natural reproduction. This makes them unique among the more abundant north coast salmonids, so they are, therefore, a good indicator of condition of streams in their range. Nevertheless, coastal cutthroat trout are a non-commercial, non-listed, widely-distributed, and somewhat cryptic salmonid that support a minor sport fishery. Until there is evidence to the contrary, coastal cutthroat trout should be assumed to be in decline in California; significant habitat alteration throughout their range, coupled with their fairly narrow environmental tolerances, means cutthroat populations can become extirpated one at a time. Monitoring coastal cutthroat populations to document the effects of climate change on north coast rivers is of particular value because of their lack of hatchery influence, dependence upon intact estuarine conditions, low exploitation rates, wide distribution, intolerance of warm temperatures, and preference for smaller streams.

Metric	Score	Justification
Area occupied	5	Found in many watersheds from Eel River north
Estimated adult abundance	3	This would score '5' if assumed all populations are genetically interconnected; most appear to be small and fragmented within California at southern end of range
Intervention dependence	3	Persistence requires improved management of heavily logged watersheds and extensively altered estuaries
Tolerance	2	Prefer water temperatures below 12ºC
Genetic risk	3	Little information on genetics available; hybridization with steelhead may affect populations in some streams
Climate change	2	Most populations are in small streams or depend upon existing estuary conditions; considerable range-wide vulnerability to climate change
Anthropogenic threats	3	See Table 1
Average	3.0	21/7
Certainty (1-4)	3	Information was compiled for recent status review

Table 2. Metrics for determining the status of coastal cutthroat trout in California, where 1 is a major negative factor contributing to status, 5 is a factor with no or positive effects on status, and 2-4 are intermediate values. See methods section for further explanation.

Management Recommendations: The greatest conservation need for coastal cutthroat trout is updated information on their status and distribution so appropriate management measures can be taken. The NMFS team, writing the 1999 status review of coastal cutthroat trout in Washington, Oregon and California, concluded that "there is insufficient evidence to demonstrate that coastal cutthroat trout are at significant risk of extinction," as well as "there is insufficient evidence to demonstrate that coastal cutthroat trout are *not* at significant risk of extinction" (Johnson et al. 1999). A petition for listing coastal cutthroat trout under the ESA was, therefore, denied. In 2005, a symposium on coastal cutthroat trout was held in Port Townsend, Washington, followed by another in 2006, with the goal of "developing a consistent framework to help guide and prioritize conservation, management, research, and restoration of coastal cutthroat trout throughout their native range." This group was formalized in November, 2006, as the Coastal Cutthroat Trout Executive Committee (currently referred to as the Coastal Cutthroat Trout Interagency Committee) (Griswold 2006). Nearly a decade after the 1999 status report, the Executive Committee found the state of coastal cutthroat trout research and monitoring remained virtually unchanged. The committee took up the task of determining the extent of current knowledge and identified data gaps and priorities for monitoring, assessment, and restoration;

their findings for California were that virtually all aspects of coastal cutthroat biology, status, and distribution needed updating. However, as a result of their ongoing efforts, many sources of data have been identified and continue to be compiled in a georeferenced database across the species' range (K. Griswold, pers. comm. 2013). In California, research and monitoring of coastal cutthroat trout is being performed by the California Department of Fish and Wildlife, Humboldt State University, the Yurok Tribe, Green Diamond Resource Company, USFS (Six Rivers National Forest, Redwood Sciences Laboratory), and other agencies and groups. California's Fisheries Monitoring Plan aims to provide consistent methods for monitoring (M. Gilroy, CDFW, pers. comm. 2011). The interagency committee has planned a coastal cutthroat trout rangewide status assessment for 2014-15. The California portion of the range is scheduled first and will be the first comprehensive assessment in California since Gerstung (1997). Developing long-term management strategies for coastal cutthroat trout is heavily dependent on improved monitoring and assessment.

Griswold (2006) noted "it should be recognized that a voluntary effort that tackles difficult scientific and monitoring issues for a non-listed non-commercial subspecies requires considerable leadership and good will from Federal and State agencies." The development of a multi-agency cutthroat trout management team, along with significant resources by state and federal agencies, will hopefully fill much needed data gaps and provide the framework for future coastal cutthroat trout conservation. Such measures are particularly needed in California, where coastal cutthroat trout populations are fragmented at the southern end of their range and, therefore, may be exceptionally vulnerable to climate change or other stressors.

The many measures, both local and regional, taken (or proposed) to protect steelhead and salmon populations should benefit coastal cutthroat trout, although direct benefits remain largely unstudied. Continued management of the Smith River as a free-flowing, wild river that is a refuge for all salmonids, including the seemingly abundant cutthroat trout, is of particular importance. Recent conservation measures have included acquisition and protection of much of the Goose Creek, Mill Creek, Hurdygurdy Creek, Little Jones Creek, and Siskiyou Fork watersheds. Mill Creek has benefited from numerous habitat restoration projects (M. McCain, USFS, pers. comm. 2012). Other targeted restoration efforts include: Lake Earl, Jordan Creek, Stone Lagoon, tributaries to Lake Earl, Big Lagoon, and many creeks in Humboldt and Del Norte counties, including Blue Creek in the Klamath basin (T. Weseloh, pers. comm. 2008, M. Gilroy, CDFW, pers. comm. 2011, R. Quiñones, pers. comm. 2011). Blue Creek has become a Salmon Sanctuary of the Yurok Tribe, to protect its diverse salmonids; the lower reaches are being acquired on behalf of the tribe by the Western Rivers Conservancy (pending successful fund raising, 2013).

Figure 4. Generalized distribution of coastal cutthroat trout, *Oncorhynchus clarkii clarkii,* in California.