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Assessment of Hatchery-Origin Chinook Salmon Occurrence in Coastal Watersheds

Photo credit: Matt Eylash, CDFW

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Abstract

A proportion of hatchery-raised Chinook salmon (*Oncorhynchus tshawytscha*) smolts from California's Central Valley are released at sites along the San Francisco and San Pablo bays and the central California coast to increase juvenile survival and supplement ocean fisheries. However, bay and coastal releases elevate the risk of hatchery-origin Central Valley fall-run (CVF) Chinook salmon straying into nearby coastal watersheds, which may negatively impact native salmonid populations. Using the Regional Mark Information System online database, this study tallied the number of hatchery-raised CVF Chinook salmon from brood years (BY) 2007 to 2019 that were released at bay and coastal locations. Information about the presence of hatchery-raised CVF Chinook salmon in coastal streams was gleaned from existing coastal salmonid population monitoring data. Between 6 and 18 million CVF Chinook salmon from Central Valley hatcheries were released at bay and coastal locations annually, but generally, hatchery-raised fish were rarely found in coastal watersheds. In recent years, very few Chinook salmon with adipose fin clips, indicative of hatchery origin, were observed in spawning ground surveys or at fish counting stations within the California Coastal (CC) Chinook salmon's range. South of this range, observations of either hatchery- or natural-origin Chinook salmon were also sparse, except in Lagunitas Creek. Lagunitas Creek is situated approximately 30 miles south of the CC Chinook salmon's southern range boundary, and the mouth of the creek remains open year-round due to regulated water flows. Migrating salmonids have continuous access to Lagunitas Creek, and genetic evidence suggests that Chinook salmon in the creek have origins in both the Russian River and the Central Valley. A new five-year multi-agency monitoring plan for Chinook salmon in the Lagunitas Creek watershed aims to quantify CVF Chinook salmon straying in this area. Besides the observations in Lagunitas Creek, this study found limited evidence of hatchery-origin CVF Chinook salmon straying into coastal streams. However, continued monitoring is essential for detecting potential changes in the future, and expanded sampling efforts would increase confidence in these findings.

Background

Historically, robust populations of Chinook salmon (*Oncorhynchus tshawytscha*) maintained productive fisheries in California (Yoshiyama et al. 1998). Due to many factors, including overexploitation, mining, irrigation, and power generation, salmon abundances have declined drastically from their historical numbers. Now the state's salmon fisheries are largely supported by hatcheries located in the Central Valley, and many populations are classified as threatened or endangered under the Federal and/or California Endangered Species Acts.

Approximately 32 million Central Valley fall-run (CVF) Chinook salmon are produced annually by the five major fish hatcheries in the Central Valley (California HSRG 2012): Coleman National Fish Hatchery (CFH), Feather River Fish Hatchery (FRH), Nimbus Fish Hatchery (NIM), Mokelumne River Fish Hatchery (MOK), and Merced River Fish Hatchery (MER). Most of the CVF Chinook salmon at these hatcheries are produced under mitigation programs, aimed at replacing the production lost due to water project development and habitat loss above impassible dams (CA Joint Hatchery Review Committee 2001). These salmon are expected to contribute to natural areas and hatchery spawning, as well as ocean and inland fisheries harvest. However, roughly 2 to 3 million salmon are produced at FRH and/or MOK specifically for fisheries enhancement purposes, aimed at increasing ocean salmon landings (Fish and Game Code 7861). The production and release of enhancement salmon is supported by the Commercial Salmon Stamp Fund, created through the passage of AB 2956 in 1978, which required each person commercially fishing for salmon to purchase a Salmon Stamp.

Hatchery-raised CVF Chinook salmon smolts may be released in the Central Valley within their basin of origin, the mainstem river along their migratory route, the San Francisco and San Pablo bays, or along the central California coast. Depending on logistical constraints, salmon may be released directly into the water from a transport truck through a pipe or first acclimated in net pens for a few hours to several days before release. Over the last eight decades, CVF Chinook salmon have been trucked and released at increasing distances from their hatchery of origin through time (Sturrock et al. 2019). While releasing smolts within their basin of origin most closely resembles natural rearing and facilitates imprinting on natal waters, drought and poor freshwater conditions lead to juvenile mortality rates as high as 85% (Michel et al. 2015). One way to improve outmigration survival is to reduce the distance traveled along the migration corridor and release smolts in the bay or along the coast, where conditions are less impacted by drought and low flows. Higher juvenile survival increases opportunities for both harvest and escapement. Salmon produced under enhancement programs are often reared to a larger size at release and released closer to or directly into the Pacific Ocean to maximize ocean harvest opportunities.

One key tradeoff of releasing hatchery-raised juvenile CVF Chinook salmon near the ocean is that downstream releases and greater transport distances from rearing sites is

associated with lower adult homing success and increased straying of returning adult spawners (Solazzi et al. 1991; Keefer et al. 2005; Keefer and Caudill 2014; Lasko et al. 2014; Sturrock 2019). CVF Chinook salmon released at bay and coastal locations often stray at high rates within the Central Valley (Palmer-Zwahlen et al. 2019; Palmer-Zwahlen and Kormos 2020; Letvin et al. 2021). However, the potential for hatchery-origin salmon to stray into nearby coastal streams has not been systematically investigated.

The California Department of Fish and Wildlife (CDFW) has the dual responsibility of supporting fisheries and protecting at-risk salmonid populations. Coastal watersheds neighboring the San Francisco Bay are inhabited by many distinct native salmonid populations, including California Coastal (CC) Chinook salmon (federally threatened), Central California Coast Coho salmon (*Oncorhynchus kisutch*, state and federally endangered), Central California Coast steelhead (*Oncorhynchus mykiss*, federally threatened), and South-Central California Coast steelhead (*Oncorhynchus mykiss*, federally threatened). These sensitive populations may be negatively impacted if they face increased competition for resources (Weber and Fausch 2003) from hatchery-origin strays. There is also the risk of hybridization between CVF and CC Chinook salmon, which could result in reduced population fitness through genetic introgression (Waples 1991).

Negative interactions may be mitigated by asynchronous upstream migration timing between different salmonids. Adult CVF Chinook salmon may enter freshwater as early as June, but most fish migrate upstream from September to December with a peak in October to November (Merz et al. 2013). CC Chinook salmon are also fall-run fish that may start their adult upstream migration around September or October, but seasonal sandbars may form at the mouth of the rivers they inhabit, preventing freshwater entry until breaching by fall/winter storms in November to January (Lacy et al. 2016). Central California Coast Coho salmon return from November to January (Moyle 2002), and as stream flows increase in winter, both Central California Coast and South-Central California Coast steelhead start returning from December to March, with a peak in January and February (Moyle 2002).

In many coastal watersheds, adult and juvenile salmonid population monitoring takes place following the California Monitoring Plan (CMP; Adams et al. 2011). Spawning ground surveys and fixed counting stations (e.g. weir, video) are frequently used to monitor trends in adult and redd abundances (Kiernan et al. 2019; Deibner-Hanson and Henderson 2020; Guczek et al. 2020), while outmigrant traps are commonly used to monitor trends in juvenile salmonid production (Cuthbert et al. 2014; McNeill et al. 2020). These surveys often focus on monitoring Coho salmon and steelhead and may miss earlier migrating Chinook salmon or overlook habitats preferred by Chinook salmon, but they are still the best existing source of information for the prevalence of hatchery-origin salmon in coastal streams.

Hatchery-origin Chinook salmon can be visually identified by the lack of an adipose fin. However, not all hatchery-origin salmon receive an adipose fin clip. Since 2007, salmon

fisheries management in California has been underpinned by the Constant Fractional Marking (CFM) program, which relates the marked fraction of hatchery production to total production (Kormos et al. 2012). At least 25% of CVF Chinook salmon produced at Central Valley hatcheries are both marked with an adipose fin clip and implanted with a coded-wire tag (CWT). Thus, while the observation of an adipose fin-clipped salmon indicates hatchery origin, unmarked salmon may be of either natural or hatchery origin. Recovery and analysis of CWTs from adipose fin-clipped salmon provides additional information, including brood year, hatchery of origin, and release site and strategy. With only the observation of an adipose fin clip, it is not possible to determine where the fish was raised or released. Marked (adipose fin-clipped) and tagged (CWT) Chinook salmon are also produced by the Klamath and Trinity River hatchery programs, and to a limited extent, in the Smith River watershed. Historically, there were also other coastal hatchery programs that raised, tagged, and marked Chinook salmon. However, Central Valley hatcheries produce the largest share of adipose fin-clipped and coded-wire tagged Chinook salmon in California, and due to the regular use of out-of-basin release strategies, these fish have the highest likelihood of straying.

Study Objectives

The purpose of this study is to enumerate the number of juvenile CVF Chinook salmon released at bay and coastal locations and examine the available evidence on straying of these hatchery-origin fish in coastal California streams. We focus on bay and coastal releases of CVF Chinook salmon due to the concern that these release strategies increase straying behavior. All coastal release strategies are exclusively used by fisheries enhancement programs, while bay releases include juveniles produced for both enhancement and mitigation programs. The results of this study will shed light on whether bypassing in-river releases to maximize survival and boost ocean harvest opportunities carries a potential tradeoff with protecting native coastal salmonids. Specifically, we evaluate:

1. The number of hatchery-raised CVF Chinook salmon from BY 2007 to 2019 that were released at bay and coastal locations (Figure 1).
2. The presence of hatchery-origin adipose fin-clipped CVF Chinook salmon in coastal streams within the range for CC Chinook salmon, defined by its evolutionarily significant unit (ESU; Figure 2).
3. The presence of any Chinook salmon in coastal streams south of the range for CC Chinook salmon (Figure 2), which can be presumed to be a stray regardless of natural or hatchery origin.

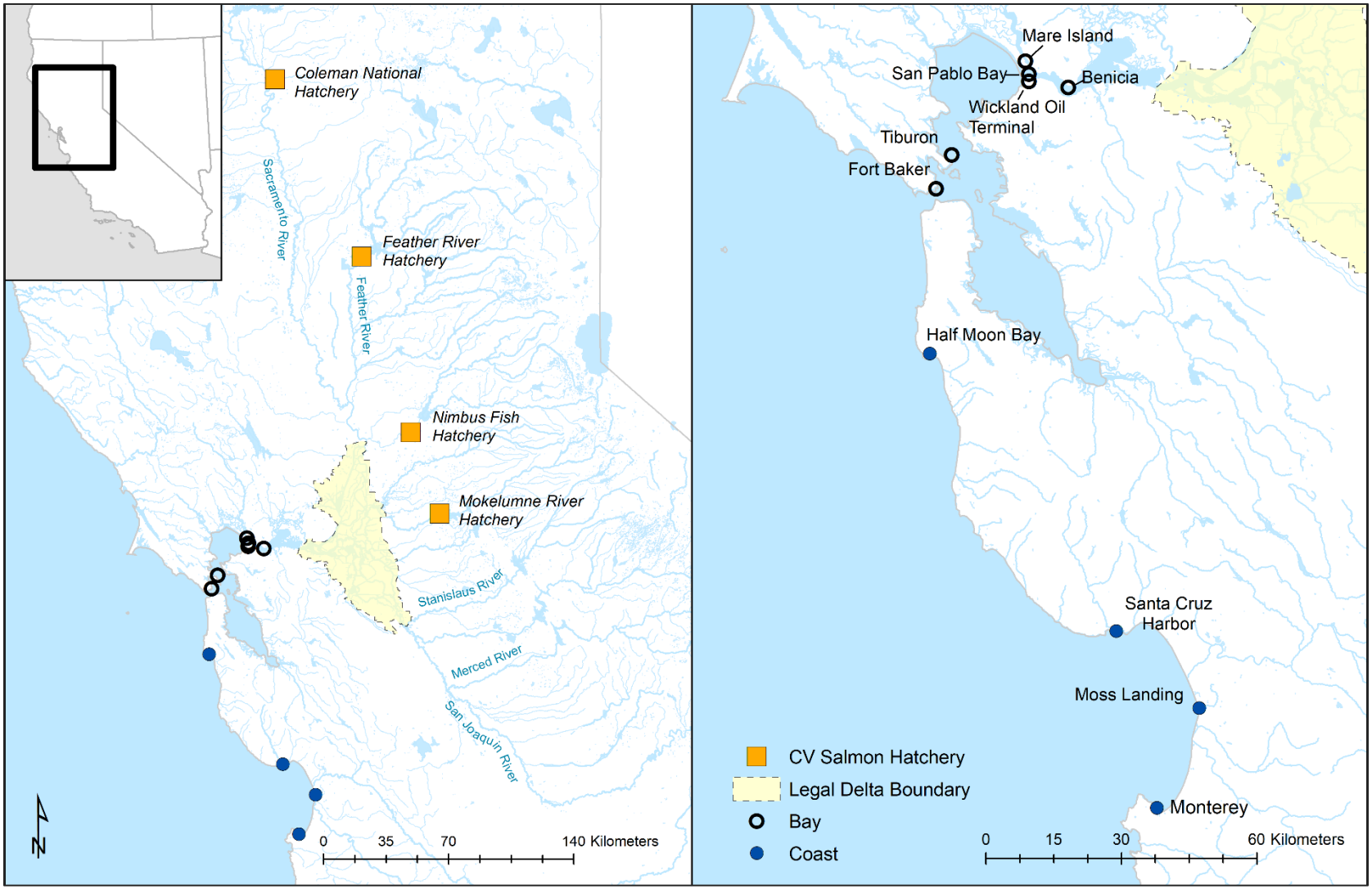

Figure 1. Left panel: Central Valley hatcheries contributing to bay and coastal releases of BY 2007 to 2019 CVF Chinook salmon. Right panel: bay and coastal release locations.

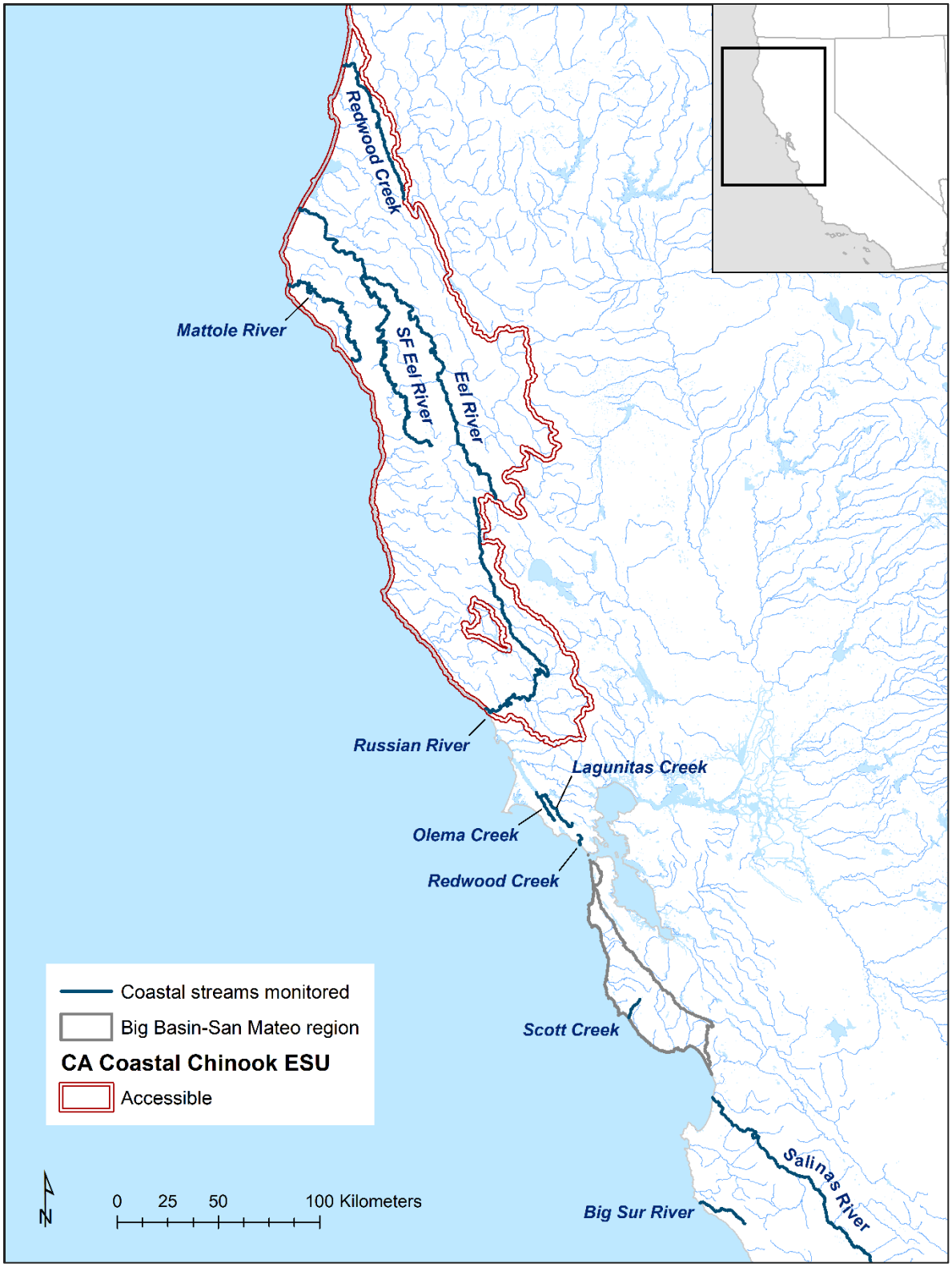

Figure 2. Coastal streams and regions evaluated for the presence of hatchery-origin Chinook salmon. Data synthesis efforts focused on streams that support populations of listed salmonids and maintained population monitoring programs. The range of CC Chinook salmon is outlined with two solid red borders.

Methods

Bay and Coastal Releases

The Regional Mark Information System (RMIS) online database, maintained by the Pacific States Marine Fisheries Commission, is a public database that provides both hatchery release information for all hatchery-raised Chinook salmon on the Pacific Coast of North America and CWT recovery information for Chinook salmon returning to Central Valley rivers and hatcheries. The RMIS online database was queried using the standard reporting interface for bay and coastal releases of BY 2007 to 2019 CVF Chinook salmon. This time frame was selected to align with the beginning of the CFM program (Kormos et al. 2012) and the latest evaluation of hatchery-origin Chinook salmon returns through the 2021/22 monitoring season. Prior to 2007, low numbers of hatchery-origin CVF Chinook salmon were marked and coded-wire tagged primarily for experimental purposes.

The following filters were used for selection in the RMIS online database: species = Chinook salmon; run = fall; hatchery = CFH, FRH, NIM, MOK, MER; BY= 2007–2019; and release stage ≠ yearling. Experimental releases were excluded, i.e., the Feather River barge study, Mokelumne River barge study, and Knaggs Ranch experimental releases. The information was sorted by hatchery and release location. In-river releases were removed from analysis, and only bay and coastal releases were retained. Bay releases are defined as any releases taking place between the Golden Gate Bridge and Chipps Island, which marks the legal boundary of the Sacramento-San Joaquin River Delta (Figure 1). Coastal releases are defined as any releases occurring along the California coast and seaward of the Golden Gate Bridge.

Coastal Stream Monitoring

Since there is little to no production of Chinook salmon at coastal hatcheries, adipose fin-clipped salmon are not monitored within coastal streams as part of established monitoring programs. However, CMP surveys, focused on native coastal salmonid populations, can provide some data about the presence of hatchery-origin salmon in coastal watersheds. CMP data used in this assessment were collected from annual monitoring reports or queried from the CMP database (Burch et al. 2015) when reports were not available (Table R1). Personal communications were used when data were not available from published sources. Data was compiled for years when monitoring took place between 2000 and 2022. Although this time frame predates the onset of the CFM program, data examined south of the range for CC Chinook salmon do not require the identification of an adipose fin-clipped salmon to confirm the presence of a Chinook salmon stray. In addition, data summarized prior to the onset of the CFM program provides a baseline for observations of adipose fin-clipped salmon before a standardized program for marking and tagging hatchery-origin CVF Chinook salmon was established.

Within the range for CC Chinook salmon, data synthesis focused on streams with both substantial populations of Chinook salmon and long-term salmonid monitoring programs. From north to south, these streams included Redwood Creek (Humboldt County), the Eel River, the Mattole River, and the Russian River (Figure 2). We examined the number of adipose fin-clipped Chinook salmon and carcasses observed during spawning ground surveys and at fixed counting stations relative to the total number of Chinook salmon encountered. Unmarked Chinook salmon could be either CC Chinook salmon or CVF Chinook salmon of natural or hatchery origin. However, an adipose fin-clipped Chinook salmon found within any streams in the range for CC Chinook salmon confirms the presence of a hatchery-origin stray produced outside of the region after the year 2007. This is because local artificial propagation activities ceased more than two decades ago within the range for CC Chinook salmon. Production of Chinook salmon at Warm Springs Hatchery on the Russian River was discontinued in 1997 (Chase et al. 2007), and egg collection from Mad River Chinook salmon was discontinued in 2000. The final releases of marked and coded-wire tagged hatchery-origin CC Chinook salmon took place between BY 2000 and 2002 (O'Farrell et al. 2012), so it is unlikely to encounter any of these fish beyond 2007.

In coastal streams south of the range for CC Chinook salmon, data compilation focuses on streams with monitoring programs for listed salmonids. From north to south, these streams included Lagunitas Creek, Olema Creek, Redwood Creek (Marin County), Scott Creek, the Big Basin-San Mateo region, the Salinas River, and the Big Sur River (Figure 2). Since these streams are not recognized as natural spawning grounds for Chinook salmon, the identification of a Chinook salmon, regardless of its fin clip status, indicates the presence of a stray of either natural or hatchery origin. The observation of an adipose fin-clipped Chinook salmon in these streams confirms the presence of a hatchery-origin stray. We tallied the number of Chinook salmon and carcasses, as well as Chinook salmon redds, observed during annual spawning ground surveys, at a count station on the Salinas River, and as part of targeted Chinook salmon stray monitoring in Marin, Santa Cruz, and Monterey counties (Neillands et al. 2015; Nelson 2016; Neillands et al. 2017; Neillands et al. 2018; Michie 2022). The presence of an adipose fin clip was noted if data were available. The number of juvenile Chinook salmon captured annually at juvenile outmigrant traps was also summarized to evaluate successful production.

Coded-Wire Tag Recoveries

CWT recoveries were collected opportunistically from adipose fin-clipped Chinook salmon in some coastal streams during monitoring surveys. Both CDFW Marine Region and National Marine Fisheries Service (NMFS) staff processed CWTs and provided raw recovery data used for this analysis. CWT codes from the recoveries were queried in the RMIS online database to obtain information on BY, hatchery of origin, and release location for each fish.

Seasonal Sandbar Breaches

Seasonal sandbars form at the mouth of many coastal California streams during the dry season, restricting anadromous migrations until fall/winter storms produce sufficient stream flow to breach the sandbars (Osterback et al. 2018). Information on the timing of seasonal sandbar breaches was compiled from available data sources to provide insight on the temporal variability of physical barriers that limit access to spawning habitat in coastal watersheds (Table R1).

Results

Bay and Coastal Releases

The number of juvenile CVF Chinook salmon released annually at bay and coastal locations varied over time (Figure 3). On average, from BY 2007 to 2019, 11 million CVF Chinook salmon were released at bay and coastal locations each year, although the number ranged from approximately 6 to 18 million smolts.

Only bay release sites were used for BY 2007 and 2008, but for BY 2009 to 2019, both bay and coastal release sites were used (Table 1). Bay releases, which included both mitigation and enhancement fish, greatly outnumbered coastal releases (Figure 3). The number of bay releases ranged widely, although between BY 2007 and 2019, bay releases declined overall (Figure 3). Salmon released at bay locations were usually ~25% tagged, but some were ~100% tagged and a few were ~50% tagged (Table 1). When utilized, coastal sites accounted for between 1% (BY 2009 and 2010) and 14% (BY 2016) of the total annual bay and coastal releases. Salmon released along the coast were almost always ~100% tagged, except for one BY 2019 release group that was 25% tagged (Table 1). The number of coastal releases stayed relatively low but increased steadily from BY 2009 to 2019 (Figure 3).

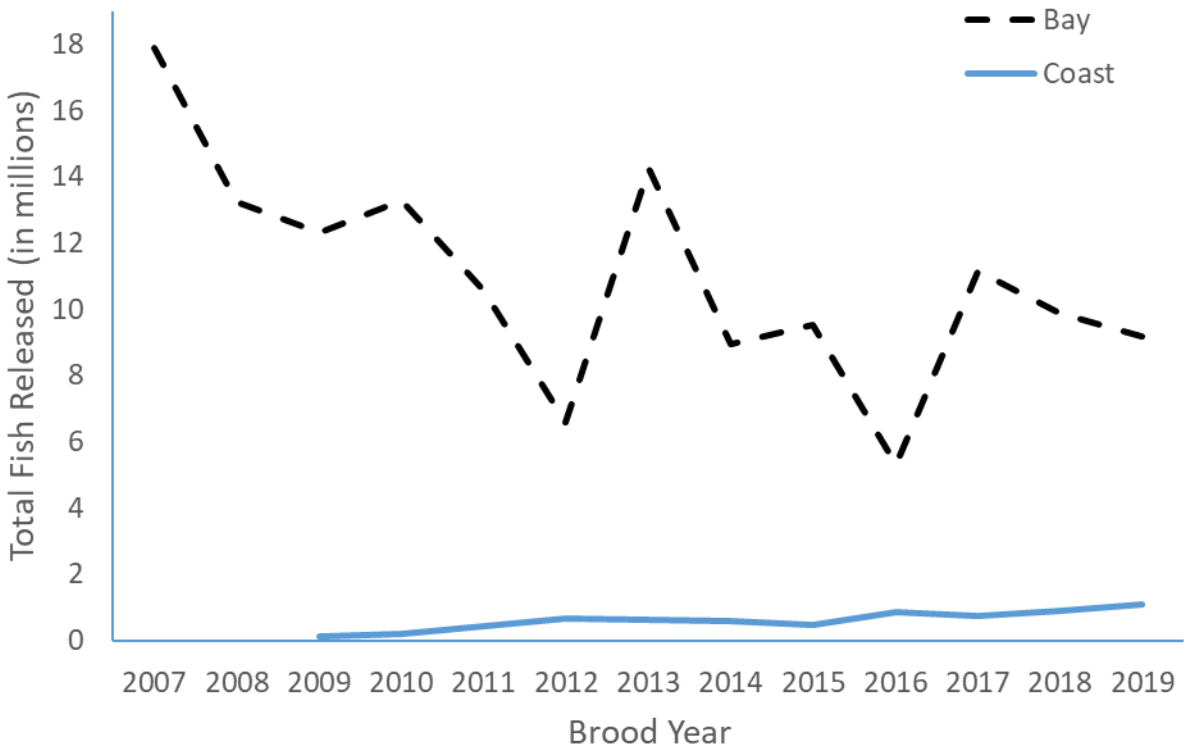

Figure 3. Total number of CVF Chinook salmon in millions of fish released at bay and coastal locations for BY 2007 to 2019.

Table 1. Releases of hatchery-origin CVF Chinook salmon in bay and coastal locations for BY 2007 to 2019 (RMIS online database).

Brood year	Release site	Hatchery	Release type	Net pens used	CWT codes	Number tagged	Total fish released	Percent marked and tagged
2007	San Pablo Bay	CFH	Bay	Yes	3	314,741	1,267,181	24.8%
2007	Benicia	FRH	Bay	No	4	101,712	102,225	99.5%
2007	Mare Island	FRH	Bay	Yes	3	490,658	1,966,070	25.0%
2007	Wickland Oil Terminal	FRH	Bay	Yes	1	260,203	1,041,669	25.0%
2007	San Pablo Bay	FRH	Bay	Yes	5	1,596,535	6,414,782	24.9%
2007	San Pablo Bay	NIM	Bay	Yes	3	1,218,755	4,894,507	24.9%
2007	San Pablo Bay	MOK	Bay	Yes	2	550,668	2,203,488	25.0%
2008	San Pablo Bay	CFH	Bay	Yes	3	371,726	1,491,668	24.9%
2008	Benicia	FRH	Bay	No	3	52,439	56,212	93.3%
2008	Mare Island	FRH	Bay	Yes	5	284,110	568,035	50.0%
2008	Wickland Oil Terminal	FRH	Bay	Yes	1	44,507	180,004	24.7%
2008	San Pablo Bay	FRH	Bay	Yes	5	1,732,594	7,013,128	24.7%
2008	Mare Island	NIM	Bay	Yes	4	976,955	3,924,887	24.9%
2009	San Pablo Bay	CFH	Bay	Yes	3	337,919	1,359,012	24.9%
2009	Santa Cruz Harbor	FRH	Coast	Yes	1	118,879	122,334	97.2%
2009	Wickland Oil Terminal	FRH	Bay	Yes	6	524,254	2,124,375	24.7%
2009	San Pablo Bay	FRH	Bay	Yes	5	1,842,955	7,411,675	24.9%
2009	Tiburon	FRH	Bay	Yes	1	41,238	41,873	98.5%
2009	Mare Island	NIM	Bay	Yes	2	347,527	1,391,632	25.0%
2010	San Pablo Bay	CFH	Bay	Yes	3	334,756	1,339,659	25.0%
2010	Santa Cruz Harbor	FRH	Coast	Yes	2	185,985	187,022	99.4%
2010	Wickland Oil Terminal	FRH	Bay	Yes	3	957,273	3,868,247	24.7%
2010	San Pablo Bay	FRH	Bay	Yes	6	1,596,842	6,440,475	24.8%
2010	Tiburon	FRH	Bay	Yes	1	41,584	41,952	99.1%
2010	Wickland Oil Terminal	NIM	Bay	Yes	3	368,363	1,595,731	23.1%
2011	San Pablo Bay	FRH	Bay	Yes	4	2,293,211	9,265,375	24.8%
2011	Santa Cruz Harbor	FRH	Coast	Yes	1	240,887	241,420	99.8%
2011	Half Moon Bay	FRH	Coast	Yes	2	185,303	185,917	99.7%
2011	Mare Island	NIM	Bay	Yes	2	328,073	1,312,930	25.0%
2012	Santa Cruz Harbor	FRH	Coast	Yes	1	236,800	240,546	98.4%
2012	Half Moon Bay	FRH	Coast	Yes	1	412,360	416,018	99.1%
2012	Wickland Oil Terminal	FRH	Bay	Yes	1	263,432	1,059,194	24.9%
2012	San Pablo Bay	FRH	Bay	Yes	3	1,189,673	4,788,851	24.8%
2012	Mare Island	NIM	Bay	Yes	1	182,413	734,906	24.8%
2013	San Pablo Bay	CFH	Bay	Yes	8	1,182,006	4,755,297	24.9%
2013	Half Moon Bay	FRH	Coast	Yes	1	366,033	368,458	99.3%
2013	Wickland Oil Terminal	FRH	Bay	Yes	5	1,459,468	5,906,741	24.7%
2013	Mare Island	NIM	Bay	Yes	4	896,419	3,587,565	25.0%
2013	Santa Cruz Harbor	MOK	Coast	Yes	1	239,294	240,497	99.5%
2014	San Pablo Bay	CFH	Bay	Yes	2	203,259	821,870	24.7%
2014	Mare Island	FRH	Bay	Yes	4	1,047,852	4,191,625	25.0%
2014	Half Moon Bay	FRH	Coast	Yes	1	321,527	331,177	97.1%
2014	Mare Island	NIM	Bay	Yes	1	163,471	654,346	25.0%
2014	Wickland Oil Terminal	NIM	Bay	Yes	5	816,356	3,278,203	24.9%

Brood year	Release site	Hatchery	Release type	Net pens used	CWT codes	Number tagged	Total fish released	Percent marked and tagged
2014	Moss Landing	MOK	Coast	Yes	1	241,335	243,164	99.2%
2015	Mare Island	FRH	Bay	Yes	7	850,198	3,406,926	25.0%
2015	Wickland Oil Terminal	FRH	Bay	Yes	6	924,941	3,739,553	24.7%
2015	San Pablo Bay	FRH	Bay	Yes	1	244,738	983,524	24.9%
2015	Mare Island	NIM	Bay	Yes	2	349,016	1,397,391	25.0%
2015	Half Moon Bay	MOK	Coast	Yes	1	484,920	486,138	99.7%
2016	Fort Baker	FRH	Bay	No	2	263,611	1,059,692	24.9%
2016	Mare Island	FRH	Bay	Yes	2	478,255	1,879,808	25.4%
2016	San Pablo Bay	FRH	Bay	Yes	4	255,625	1,020,417	25.1%
2016	Mare Island	NIM	Bay	Yes	2	277,532	1,113,203	24.9%
2016	Fort Baker	MOK	Bay	No	1	225,243	225,870	99.7%
2016	Santa Cruz Harbor	MOK	Coast	Yes	1	121,043	122,530	98.8%
2016	Half Moon Bay	MOK	Coast	Yes	1	720,759	729,889	98.7%
2017	Mare Island	FRH	Bay	Yes	2	1,496,598	6,005,638	24.9%
2017	Fort Baker	FRH	Bay	No	8	609,272	2,460,352	24.8%
2017	Mare Island	NIM	Bay	Yes	3	502,349	2,017,318	24.9%
2017	Wickland Oil Terminal	NIM	Bay	Yes	1	162,236	650,108	25.0%
2017	Half Moon Bay	MOK	Coast	Yes	1	727,344	742,256	98.0%
2018	Mare Island	FRH	Bay	Yes	16	1,772,613	7,196,006	24.6%
2018	Mare Island	NIM	Bay	Yes	5	439,333	1,763,232	24.9%
2018	Fort Baker	MOK	Bay	No	2	225,158	901,151	25.0%
2018	Santa Cruz Harbor	MOK	Coast	Yes	1	119,614	120,518	99.2%
2018	Half Moon Bay	MOK	Coast	Yes	1	754,295	758,085	99.5%
2019	Mare Island	FRH	Bay	Yes	12	1,335,074	5,398,892	24.7%
2019	Mare Island	NIM	Bay	Yes	5	453,171	1,823,412	24.9%
2019	Fort Baker	MOK	Bay	No	4	486,615	1,947,732	25.0%
2019	Monterey	MOK	Coast	No	1	156,623	160,230	97.7%
2019	Santa Cruz Harbor	MOK	Coast	No	1	159,905	175,895	90.9%
2019	Half Moon Bay	MOK	Coast	Yes	1	192,201	769,419	25.0%

Coastal Stream Monitoring

Within the range for CC Chinook salmon, very few Chinook salmon carcasses were observed with an adipose fin clip during annual spawning ground surveys (Table 2). Between the 2003/04 and 2021/22 return years, a total of 2,607 Chinook salmon carcasses were found during annual spawning ground surveys in four watersheds within the range of CC Chinook salmon. Only 4 of 2,607 (0.15%) Chinook salmon carcasses recovered were adipose fin-clipped. All four adipose fin-clipped carcasses observed were found in the Mattole River watershed between 2004/05 and 2005/06, prior to CFM program implementation.

Two count stations within the CC Chinook salmon's range recorded few observations of salmon with adipose fin clips over the last decade. At the Van Arsdale Fish Station (VAFS) on the Eel River, counts of fin-clipped Chinook salmon sharply declined after the 2005/06 return year (Table 3). Over the last 13 return years where fin clip status

was recorded (2006/07 to 2018/19), 3 of 12,078 (0.02%) Chinook salmon returning to the VAFS were observed with a fin clip. Nearly all these fin clips were adipose fin clips, but ventral fin clips were observed and tallied in a few rare cases (CDFW unpublished reports). At the Mirabel Fish Ladder on the mainstem Russian River, 30 of 8,838 (0.34%) Chinook salmon were observed with an adipose fin clip in 2013/14 and between 2016/17 and 2020/21 (Table 4).

South of the range for CC Chinook salmon, few live adult Chinook salmon or carcasses were observed at a count station on the Salinas River or during annual CMP spawning ground surveys, except in Lagunitas Creek and in return year 2021/22 (Table 5). Chinook salmon were found in Lagunitas Creek during most return years from 2001/02 to 2021/22. In return year 2021/22, live Chinook salmon and carcasses were also observed in Olema Creek, Redwood Creek (Marin County), and Scott Creek. The only other Chinook salmon observed in this area during CMP spawning ground surveys from 2001/02 to 2021/22 were two carcasses in the San Mateo-Big Basin region, one of which was adipose fin-clipped. However, monitoring in the San Mateo-Big Basin region outside of Scott Creek only occurred for seven years within a 21-year period.

Data on spawning efforts and juvenile production for Chinook salmon are comparable to those on live adults and carcasses south of the range for CC Chinook salmon. Chinook salmon redds and juveniles were rarely observed in most of the streams monitored, except in Lagunitas Creek and in return year 2021/22 (Table 6). Chinook salmon redds and juveniles were observed in Lagunitas Creek most years, and in return year 2021/22, they were also found in Olema Creek and Redwood Creek (Marin County). Besides these occurrences, only one redd in the San Mateo-Big Basin region and two juveniles in Olema Creek were detected from 2001/02 to 2021/22.

Coded-Wire Tag Recoveries

A total of 24 CWTs were recovered from Chinook salmon carcasses found in coastal watersheds between return years 2014/15 and 2021/22 during opportunistic sampling events and some CMP spawning ground surveys (Table 7). All tags were recovered from watersheds south of the range for CC Chinook salmon. Seventeen of these recoveries were CVF Chinook salmon that originated from MOK, six were from FRH, and one was a Sandy Hatchery Chinook salmon from Oregon. Of the 23 California recoveries, seven were Fort Baker releases, five were Half Moon Bay net pen releases, one was a Half Moon Bay direct release, two were Santa Cruz Harbor net pen releases, and eight were Santa Cruz Harbor direct releases.

Seasonal Sandbar Breaches

The timing of the first fall/winter sandbar breaches was variable by year and location (Table 8). Data was not available for all years in all locations. Delayed opening restricts upstream migration at the river mouth for more of the fall migration period. In some coastal streams south of the range for CC Chinook salmon, the first fall/winter sandbar

breaches occurred in December or later, after the peak run time for CVF Chinook salmon (Table 8). However, a few streams generally remain open year-round, including Lagunitas Creek and the Big Sur River. The Russian River also generally remains open year-round, although the river mouth is more frequently closed in the fall from September to November, which coincides with the peak run time for CVF Chinook salmon (Figure 4).

Table 2. Total number of Chinook salmon carcasses observed, and, in parentheses, total number of adipose fin-clipped carcasses observed during annual spawning ground surveys by return year and watershed (south to north). Data sources are listed in Table R1. In years where data are not available, three hyphens are used.

Return Year	Dry Creek (Russian River)	Mattole River	South Fork Eel River	Redwood Creek (Humboldt Co)
2003/04	---	73 (0)	---	---
2004/05	---	35 (2)	---	---
2005/06	---	39 (2)	---	---
2006/07	---	47 (0)	---	---
2007/08	---	17 (0)	---	---
2008/09	---	29 (0)	---	---
2009/10	---	20 (0)	---	23 (0)
2010/11	---	49 (0)	58 (0)	35 (0)
2011/12	---	14 (0)	32 (0)	32 (0)
2012/13	---	208 (0)	77 (0)	254 (0)
2013/14	1 (0)	146 (0)	9 (0)	232 (0)
2014/15	43 (0)	164 (0)	68 (0)	190 (0)
2015/16	4 (0)	38 (0)	14 (0)	125 (0)
2016/17	22 (0)	57 (0)	102 (0)	22 (0)
2017/18	1 (0)	177 (0)	30 (0)	62 (0)
2018/19	4 (0)	---	10 (0)	17 (0)
2019/20	---	---	6 (0)	10 (0)
2020/21	---	---	1 (0)	---
2021/22	---	---	10 (0)	---

Table 3. Total number of Chinook salmon observed by return year at the Van Arsdale Fish Station on the Eel River. Fin clip status was recorded as unmarked (not clipped) vs. marked (clipped) fish. Data sources are listed in Table R1. In years where data are not available, three hyphens are used.

Return Year	Unmarked	Marked	Total
2000/01	223	80	303
2001/02	641	314	955
2002/03	268	61	329
2003/04	999	236	1,235
2004/05	299	82	381
2005/06	620	105	725
2006/07	697	2	699
2007/08	478	0	478
2008/09	496	0	496
2009/10	518	1	519
2010/11	2,314	0	2,314
2011/12	2,436	0	2,436
2012/13	3,471	0	3,471
2013/14	214	0	214
2014/15	588	0	588
2015/16	102	0	102
2016/17	435	0	435
2017/18	232	0	232
2018/19	94	0	94
2019/20	153	---	153
2020/21	65	---	65
2021/22	457	---	457

Table 4. Total number of Chinook salmon observed by return year, including adipose fin clip status, at Mirabel Fish Ladder on the mainstem Russian River (river km 39.7). Observations were made via an underwater video system operated by the Sonoma County Water Agency. Data include the level of certainty expressed by the reviewer regarding species identification when observing a given fish on video. The video system was not operated from return years 2014/15 to 2015/16 due to construction of a new fish ladder. Also, equipment had to be removed during return year 2021/22 due to storms early in the season. Data provided by the Sonoma County Water Agency.

Return Year	Species Certainty	Adipose Fin Clip Not Observed	Adipose Fin Clip Observed	Total
2013/14	High	3,069	0	3,069
	Moderate	65	1	66
	Low	3	0	3
2013/14 Total		**3,137**	**1**	**3,138**
2016/17	High	964	6	970
	Moderate	46	4	50
	Low	0	0	0
2016/17 Total		**1,010**	**10**	**1,020**
2017/18	High	1,895	8	1,903
	Moderate	42	3	45
	Low	1	0	1
2017/18 Total		**1,938**	**11**	**1,949**
2018/19	High	1,160	1	1,161
	Moderate	65	0	65
	Low	2	0	2
2018/19 Total		**1,227**	**1**	**1,228**
2019/20	High	857	1	858
	Moderate	26	0	26
	Low	2	0	2
2019/20 Total		**885**	**1**	**886**
2020/21	High	611	6	617
	Moderate	0	0	0
	Low	0	0	0
2020/21 Total		**611**	**6**	**617**

Table 5. Total number of live adult Chinook salmon (Live CS) and carcasses observed by return year and stream/region (south to north). Carcasses were checked for adipose fin clips opportunistically, and adipose fin-clipped carcasses are noted in parentheses. Data sources are listed in Table R1. Numbers with an asterisk identify pre-season observations. In years where data are not available, three hyphens are used.

Return Year	Live CS (Big Sur River)	Carcass (Big Sur River)	Live CS (Salinas River)	Live CS (Big Basin/San Mateo)	Carcass (Big Basin/San Mateo)	Live CS (Scott Creek)	Carcass (Scott Creek)	Live CS (Redwood Creek, Marin Co)	Carcass (Redwood Creek, Marin Co)	Live CS (Olema Creek)	Carcass (Olema Creek)	Live CS (Lagunitas Creek)	Carcass (Lagunitas Creek)
2001/02	---	---	---	---	---	---	---	0	0	0	0	44	---
2002/03	---	---	---	---	---	0	0	0	0	0	0	31	---
2003/04	---	---	---	---	---	0	0	0	0	0	0	19	---
2004/05	---	---	---	---	---	0	0	0	0	0	0	125	---
2005/06	---	---	---	---	---	0	0	0	0	0	0	10	---
2006/07	---	---	---	---	---	0	0	0	0	0	0	40	---
2007/08	---	---	---	---	---	0	0	0	0	0	0	4	---
2008/09	---	---	---	---	---	0	0	0	0	0	0	1	---
2009/10	---	---	---	---	---	0	0	0	0	0	0	0	1
2010/11	---	---	0	---	---	0	0	0	0	0	0	0	0
2011/12	---	---	0	0	0	0	0	0	0	0	0	0	0
2012/13	---	---	0	0	0	0	0	0	0	0	0	0	0
2013/14	---	---	0	0	1*	0	0	0	0	0	0	11	1
2014/15	0	0	---	0	0	0	0	0	0	0	0	100	7
2015/16	0	0	0	---	---	0	0	0	0	0	0	4	0
2016/17	0	0	0	0	0	0	0	0	0	0	0	82	11
2017/18	0	0	---	0	1 (1)	0	0	0	0	0	0	27	1
2018/19	0	0	---	0	0	0	0	0	0	0	0	65	4
2019/20	0	0	---	---	---	0	0	0	0	0	0	48	4
2020/21	0	0	---	---	---	0	0	0	0	0	0	44	0
2021/22	0	0	---	---	---	1	1	221	33	6	1	51	1

Table 6. Total number of Chinook salmon redds observed and juveniles captured by survey year and stream/region (south to north). Data sources are listed in Table R1. In years where data are not available, three hyphens are used.

Return Year	Redds (Big Sur River)	Juveniles (Salinas River)	Juveniles (Nacimiento River)	Juveniles (Arroyo Seco River)	Redds (Big Basin/San Mateo)	Redds (Scott Creek)	Juveniles (Scott Creek)	Redds (Redwood Creek, Marin Co)	Juveniles (Redwood Creek, Marin Co)	Redds (Olema Creek)	Juveniles (Olema Creek)	Redds (Lagunitas Creek)	Juveniles (Lagunitas Creek)
2001/02	---	---	---	---	---	---	0	0	---	0	---	28	---
2002/03	---	---	---	---	---	0	0	0	---	0	---	20	---
2003/04	---	---	---	---	---	0	0	0	0	0	2	36	---
2004/05	---	---	---	---	---	0	0	0	0	0	0	44	---
2005/06	---	---	---	---	---	0	0	0	0	0	0	8	237
2006/07	---	---	---	---	---	0	0	0	0	0	0	40	775
2007/08	---	---	---	---	---	0	0	0	0	0	0	0	0
2008/09	---	---	---	---	---	0	0	0	0	0	0	1	0
2009/10	---	0	0	0	---	0	0	0	0	0	0	0	0
2010/11	---	0	0	0	---	0	0	0	0	0	0	0	0
2011/12	---	0	0	0	0	0	0	0	0	0	0	0	0
2012/13	---	---	0	---	0	0	0	0	0	0	0	0	0
2013/14	---	---	0	---	1	0	0	0	0	0	0	8	1,229
2014/15	0	---	---	---	0	0	0	0	0	0	0	20	2,005
2015/16	0	---	---	---	---	0	0	0	0	0	0	2	191
2016/17	0	0	0	0	0	0	0	0	0	0	0	32	925
2017/18	0	---	---	---	0	0	0	0	0	0	0	22	1,509
2018/19	0	---	---	---	0	0	0	0	0	0	0	21	792
2019/20	0	---	---	---	---	0	---	0	---	0	---	15	---
2020/21	0	---	---	---	---	0	0	0	0	0	0	19	1,759
2021/22	0	---	---	---	---	0	0	20	33	4	35	13	1,054

Table 7. Information associated with CWTs recovered from Chinook salmon carcasses found in coastal watersheds. Asterisks are used to identify information associated with spring-run Chinook salmon from Oregon. Tags were processed by CDFW Marine Region and NMFS. Hatchery information was queried from the RMIS online database.

Watershed	Recovery Year	Number of Recoveries	Brood Year	Hatchery	Release Site
Arana Gulch	2014/15	1	2012	FRH	Santa Cruz Harbor Net Pen
Arana Gulch	2015/16	1	2013	Sandy Hatchery*	Bull Run River *
Arana Gulch	2015/16	1	2013	MOK	Santa Cruz Harbor Net Pen
Lagunitas Creek	2016/17	3	2013	FRH	Half Moon Bay Net Pen
San Lorenzo River	2017/18	1	2013	FRH	Half Moon Bay Net Pen
Redwood Creek (Marin Co)	2017/18	1	2014	FRH	Half Moon Bay
Lagunitas Creek	2019/20	1	2016	MOK	Half Moon Bay Net Pen
Redwood Creek (Marin Co)	2021/22	5	2019	MOK	Fort Baker
Scott Creek	2021/22	1	2019	MOK	Fort Baker
Pescadero Creek	2021/22	1	2019	MOK	Fort Baker
San Vicente Creek	2021/22	7	2019	MOK	Santa Cruz Harbor
San Lorenzo River	2021/22	1	2019	MOK	Santa Cruz Harbor

Table 8. The dates and/or time frames associated with the first fall/winter sandbar breaches by survey year and coastal stream/region (south to north). Data sources are listed in Table R1. In years where data are not available, three hyphens are used.

Year	Big Sur River	Big Basin/San Mateo Region	Scott Creek	Lagunitas Creek	Mattole River	Redwood Creek (Humboldt Co)
2002/03	---	---	Dec 16	open	---	Nov 6
2003/04	---	---	Dec 14	open	---	Oct 15–21
2004/05	---	---	Dec 8	open	Oct 17	Oct 15–21
2005/06	---	---	Dec 2	open	Oct 15	Nov 3
2006/07	---	---	Nov 14	open	Nov 2	Nov 4
2007/08	---	---	Dec 20	open	Oct 10	Oct 11
2008/09	---	---	Dec 26	open	Oct 5	Nov 3
2009/10	---	---	Oct 15	open	Oct 14	Nov 7
2010/11	---	---	Oct 24	open	Sep 19	Sep 10–16
2011/12	---	---	Oct 4	open	---	Oct 1–7
2012/13	---	Dec	Nov 20	open	---	Oct 15–21
2013/14	---	late Jan	Feb 9	open	---	Sep 10–16
2014/15	Dec 3	Dec	Dec 3	open	---	Sep 10–16
2015/16	Nov 28	---	Dec 21	open	---	Nov 12–18
2016/17	open	mid Oct	Nov 27	open	---	Oct 8–14
2017/18	open	mid Nov	Nov 21	open	---	Oct 20
2018/19	open	late Nov	Jan 6	open	---	Nov 21
2019/20	open	---	Dec 4	open	---	Oct 19
2020/21	open	---	Jan 27	open	---	---
2021/22	open	---	Oct 24	open	---	---

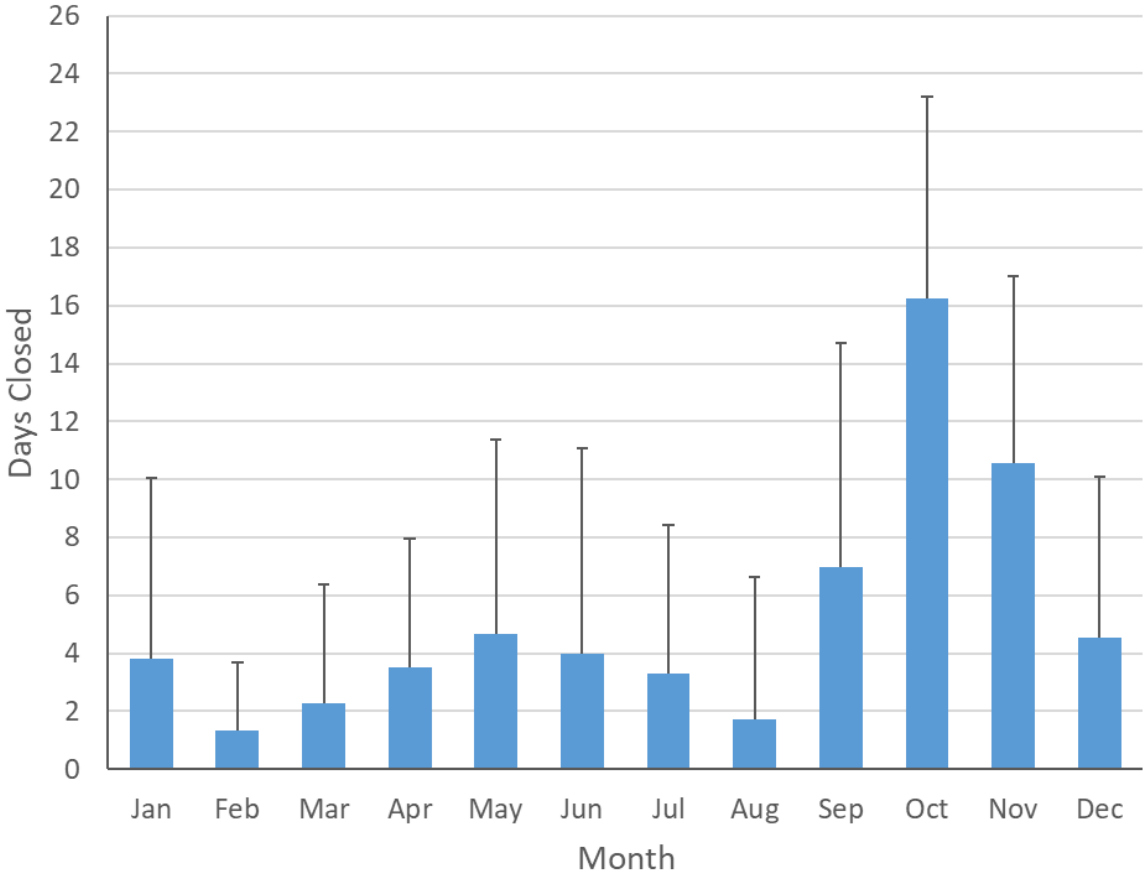

Figure 4. The average number of days per month the mouth of the Russian River was closed from 2000 to 2022. Error bars represent +1 standard deviation. Data provided by the Sonoma County Water Agency.

Discussion

Each year, millions of hatchery-raised CVF Chinook salmon smolts are released into the San Francisco and San Pablo bays, as well as along the central California coast. The annual variation in the number of smolts released at bay and coastal locations (Figure 3) theoretically contributes to variation in the number of hatchery strays, but few Chinook salmon were found to stray in coastal watersheds. Within the range for CC Chinook salmon, the highest number of adipose fin-clipped salmon documented in recent years was found in the Russian River watershed but represented a very small proportion of returning adults. South of the range for CC Chinook salmon, Chinook salmon were found to consistently enter and successfully reproduce in Lagunitas Creek but were rarely detected in other streams. The Russian River and Lagunitas Creek share some features that may highlight key determinants of coastal straying by CVF Chinook salmon: proximity to San Francisco Bay (within 60 miles), managed water flows, and at least partial accessibility during fall spawning migrations.

Most Chinook salmon found in coastal watersheds lay within the CC Chinook salmon ESU boundary, where adipose fin clips were encountered infrequently and many unmarked fish with adipose fins intact can be presumed to be CC Chinook salmon. Earlier observations of adipose fin-clipped fish are likely CC Chinook salmon tagged in past artificial enhancement programs conducted in coastal watersheds. Artificial propagation of CC Chinook salmon occurred in a few coastal watersheds until 2002. The only adipose fin-clipped Chinook salmon noted in CMP spawning ground surveys within the range for CC Chinook salmon were four fish found in the Mattole River between 2004 and 2006 (Table 2), predating the CFM program's mass marking of CVF Chinook salmon. The marked fish in the Mattole River were likely from the Mattole Salmon Group's rescue rearing program (Thompson 2006a; Thompson 2006b), where juvenile Chinook salmon were taken from downstream, marked, and pond-reared over summer before fall release as post-smolts (MSG 2000). The Mad River Fish Hatchery and Warm Springs (Russian River) Fish Hatchery also reared and released marked Chinook salmon during that time, with the final releases of hatchery-origin CC Chinook salmon taking place between BY 2000 and 2002 (O'Farrell et al. 2012). Thus, adipose fin-clipped fish that were commonly observed at the VAFS on the Eel River from 2000 to 2006 (Table 3) were likely CC Chinook salmon. After 2006, adipose fin-clipped salmon were rarely encountered at VAFS, supporting the hypothesis that prior observations were locally reared CC Chinook salmon.

Adipose fin-clipped salmon were also observed infrequently at the Mirabel Fish Ladder on the Russian River, at the southern end of the CC Chinook salmon's range (Table 4). However, the proportion of marked fish in the Russian River was higher than in northern reaches of the CC Chinook salmon's range, likely due to its proximity to San Francisco Bay (Figure 2) and an unimpeded river mouth during some of the fall-run migration period (Figure 4). Still, in the six years with available data, only 0.34% of Chinook salmon were observed with an adipose fin clip

South of the range for CC Chinook salmon, Chinook salmon were consistently observed in Lagunitas Creek and more widely observed in return year 2021/22. Adipose fin clip status was not consistently documented, but between return years 2014/15 and 2021/22, CWT recovery and analysis confirmed the presence of 23 CVF Chinook salmon in several watersheds south of the CC Chinook salmon's range (Table 7). Sixteen of these fish were released from coastal sites, and the remaining seven fish were released from Fort Baker, near the Golden Gate Bridge. While Chinook salmon observed in this region can generally be presumed to be CVF Chinook strays, Lagunitas Creek presented an exception. Preliminary genetic analyses revealed that about 85% of juvenile salmon sampled from Lagunitas Creek in recent years (mostly 2017 and 2021/22) were of CC Chinook salmon lineage, about 10% were CVF Chinook salmon, and a small proportion were Coho salmon (C. Garza [NMFS], personal communication). Of the seven adult genetic samples analyzed from 2016 to 2022 in Lagunitas Creek, none were CVF Chinook salmon. Earlier analyses found that the Chinook salmon in Lagunitas Creek were roughly half CC-origin and half CVF-origin (C. Garza [NMFS], personal communication). CC Chinook salmon found in Lagunitas Creek were closely

related to the Russian River population, which is logical, given the proximity of these two watersheds (Figure 2). These results also bring into question the presence of CC Chinook salmon in Olema Creek, a major tributary of Lagunitas Creek, and nearby Redwood Creek (Marin County), although these creeks have unregulated flow regimes and Chinook salmon were rarely observed outside of the 2021/22 return year (Tables 5 and 6). In contrast, the regulated flow regime in Lagunitas Creek provides more consistent habitat conditions for migrating adult Chinook salmon, as base flows are elevated in the fall to meet mitigation requirements and water quality standards under Section 303(d) of the federal Clean Water Act.

The prevalence of straying varies depending on environmental conditions, e.g. water flow and sandbar breach timing. Fall stream flows and estuary access are important determinants for where Chinook salmon may stray along the coast (Nelson 2016). Stream access, dependent on the timing of the first fall/winter sandbar breaches, is variable by year and location (Table 8). However, a few streams, including the Russian River, Lagunitas Creek, and the Big Sur River, remain open or partially open year-round because of controlled water releases within the watershed or artificial breaching of sandbars. During the 2021/22 monitoring season, unusual early season storms brought large amounts of precipitation to the coast, which provided early access to many coastal streams in late October. As a result, observations of Chinook salmon increased not only in Lagunitas Creek, but also in Olema, Redwood (Marin County), and Scott Creeks (Tables 5 and 6). During water years with large fall rain events, coastal stream discharge may attract CVF Chinook salmon embarking on their spawning migrations (Keefer et al. 2006), as these waters may signal quality habitat (Keefer and Caudill 2014). However, long-term monitoring data indicates that these events are rare.

Overall, hatchery-origin Chinook salmon were infrequently observed in coastal streams. Several explanations for the lack of observed straying include: 1) bay and coastal releases make a large contribution to ocean harvest, 2) CVF Chinook salmon are more likely to return to the Central Valley, 3) access to coastal streams for fall-run Chinook salmon may be limited, 4) Chinook salmon are undercounted because coastal salmonid surveys often focus on monitoring Coho salmon and steelhead, and 5) not all hatchery-origin Chinook salmon are marked. While releasing smolts in bay and coastal locations increases straying, this release strategy helps meet harvest and escapement objectives (Palmer-Zwahlen et al. 2019; Palmer-Zwahlen and Kormos 2020; Letvin et al. 2021). CWT data confirms that using release locations near and along the coast results in higher ocean harvest recovery rates than release locations farther inland. High ocean harvest rates for bay and coastal releases selectively remove fish that have the highest potential to stray into coastal streams. However, when fishery closures are implemented to restrict harvest and improve long-term stock viability, the number of CVF Chinook salmon that stray into coastal streams may increase. Still, CVF Chinook salmon that escape harvest may be genetically predisposed to return to Central Valley waters and have at least partially imprinted on Central Valley sites (Keefer and Caudill 2014). Additionally, water from coastal watersheds may lack the olfactory cues CVF Chinook salmon might use to locate their natal rivers, reducing the attraction to coastal streams.

Furthermore, some coastal streams have bar-built estuaries and sandbars that may form at the mouth of rivers, preventing access to and from the ocean during adult and juvenile migration (Osterback et al. 2018; Chen and Henderson 2021). Adult upstream migration for CVF Chinook salmon peaks from October to November, and sometimes sandbars do not breach until after this period, especially in coastal streams south of the range for CC Chinook salmon (Table 8).

While scarce observations could reflect actual low numbers of hatchery-origin Chinook salmon straying into coastal watersheds, undercounting and data deficiencies also play a factor. There is a lack of standardized monitoring and recovery efforts for hatchery-origin salmon in coastal streams. In some cases, surveys were focused on Coho salmon or steelhead monitoring and did not survey the larger mainstem habitat within coastal watersheds where Chinook salmon tend to spawn or did not encompass the complete time frame that adult Chinook salmon may be present. Additionally, data on adipose fin clip status were not always collected or feasible for collection, and CWTs were only recovered opportunistically. Salmon carcasses are frequently lost to high flow, scavengers, and decomposition, so even at best, information from CWT recoveries in coastal streams is limited. Furthermore, while most coastal releases of CVF Chinook salmon were fully marked and tagged, only 25% of CVF Chinook salmon in bay releases were marked and tagged (Table 1). South of the range for CC Chinook salmon, any Chinook salmon observed was presumed to be a stray. However, within the range for CC Chinook salmon, some Chinook salmon observed without an adipose fin clip may be unmarked CVF Chinook salmon strays that belong to a 25% marked and tagged release group. Given that monitoring for adipose fin-clipped Chinook salmon is opportunistic and CWT recoveries are sparse, it is not possible to expand from sample recoveries to population estimates of hatchery-origin CVF Chinook salmon in coastal watersheds.

While small numbers of CVF Chinook salmon have been documented in coastal watersheds, their effects on local salmonid populations are not well understood. Any level of long-term straying will change the structure of local populations (Grant 1997). However, the effects of straying are unpredictable and depend on the size of the local population, the magnitude of straying, and the reproductive success of strays. Additionally, determining the amount of gene flow between strays and the local population and the resulting change in fitness or diversity requires long-term monitoring and experimentation. The available data suggests low rates of straying into coastal streams, although quantitative estimates of straying are not possible due to the lack of standardized monitoring. In streams where Chinook salmon strays were frequently observed, targeted sampling of CVF Chinook salmon would help to substantiate the findings in this report and may provide watershed specific estimates of straying.

From 2024 to 2029, targeted monitoring surveys for Chinook salmon are planned in Lagunitas Creek as part of a multi-agency collaboration between the National Park Service, Marin Municipal Water District, and CDFW (CDFW 2024). Lagunitas Creek is an ideal location for focused studies on coastal straying of CVF Chinook salmon

because both adult and juvenile Chinook salmon are consistently observed, genetic analyses have confirmed that at least some of these fish are CVF Chinook salmon, and endangered Coho salmon and threatened steelhead populations also inhabit Lagunitas Creek. The monitoring plan for Chinook salmon includes documentation of adipose fin clip status, recovery of CWTs, and tissue sampling for genetic analysis. This work will clarify the degree to which CVF Chinook salmon stray into Lagunitas Creek and improve our understanding of how different Central Valley hatchery release strategies affect populations of coastal salmonids.

References

Adams, P.B., L.B. Boydstun, S.P. Gallagher, M.K. Lacy, T. McDonald, and K.E. Shaffer. 2011. California Coastal Salmonid Population Monitoring: Strategy, Design, and Methods. Fish Bulletin 180. California Department of Fish and Game.

Burch, D., S.P. Gallagher, S. Ricker, and R. Bellmer. 2015. Coastal Salmonid Monitoring Database Management: Status Report and Concept for Success. California State Department of Fish and Wildlife, Redding, CA. 2015 Administrative Report.

California Department of Fish and Wildlife (CDFW). 2024. 2024–2029 Monitoring Plan for Central Valley Fall-run Chinook Salmon in Lagunitas Watershed. California Department of Fish and Wildlife, Fisheries Branch and Bay Delta Region. October 2024.

California Hatchery Scientific Review Group (California HSRG). 2012. California Hatchery Review Statewide Report. Prepared for the US Fish and Wildlife Service and Pacific States Marine Fisheries Commission. April 2012.

California Joint Hatchery Review Committee. 2001. Final Report on Anadromous Salmonid Fish Hatcheries in California. December 2001.

Chase, S.D., D.J. Manning, D.G. Cook, and S.K. White. 2007. Historical accounts, recent abundance, and current distribution of threatened Chinook salmon in the Russian River, California. California Fish and Game 93(3):130–148.

Chen, E., and M. Henderson. 2021. Reduced recruitment of Chinook salmon in a leveed bar-built estuary. Canadian Journal of Fisheries and Aquatic Sciences 78(7):894–904.

Cuthbert, R., P. Cuthbert, A. Fuller, and M. Hellmair. 2014. Salinas Basin Juvenile *O. mykiss* Downstream Migration Monitoring 2014 Annual Report – Final. FishBio. Oakdale, CA.

Deibner-Hanson, J.D., and M. Henderson. 2020. Life Cycle Monitoring of Coho Salmon in Prairie Creek. Humboldt State University. Annual Report prepared for Grant Agreement Number: P1610520.

Grant, W.S. (editor). 1997. Genetic effects of straying of non-native hatchery fish into natural populations: proceedings of the workshop. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-30.

Guczek, J., S. Powers, and M. Larson. 2020. Results of Regional Spawning Ground Surveys and Estimates of Salmonid Redd Abundance in the South Fork Eel River, Humboldt, and Mendocino Counties California, 2019–2020. Annual Report prepared by PSMFC for Grantee Agreement Number: P1510507.

Keefer, M.L., C.A. Peery, and J. Firehammer. 2005. Straying rates of known-origin adult Chinook Salmon and Steelhead within the Columbia River Basin, 2000–2003. U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit. Technical Report 2005-5.

Keefer, M.L., C.C. Caudill, C.A. Peery, and T.C. Bjornn. 2006. Route selection in a large river during the homing migration of Chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 63(8):1752–1762.

Keefer, M.L., and C.C. Caudill. 2014. Homing and straying by anadromous salmonids: A review of mechanisms and rates. Reviews in Fish Biology and Fisheries 24:333–368.

Kiernan, J., A.K. Osterback, C.H. Kern, R.M. Bond, A. Hay, and K.M. KoBayashi. 2019. Summary of Results from the Scott Creek Salmonid Life Cycle Monitoring Station, 2018–2019. University of California Santa Cruz. Annual report prepared for Grantee Agreement No: P1830400-01.

Kormos, B., M. Palmer-Zwahlen, and A. Low. 2012. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2010. California Department of Fish and Wildlife. Fisheries Branch Administrative Report 2012-02.

Lacy, M.K., K. Atkinson, S.P. Gallagher, B. Kormos, E. Larson, G. Neillands, A. Renger, S.J. Ricker, and K.E. Shaffer. 2016. California Department of Fish and Wildlife Plan for Assessment and Management of California Coastal Chinook Salmon. California Department of Fish and Wildlife Administrative Report 2016-02.

Lasko, G.R., R.G. Titus, J.R. Ferreira, and R.M. Coleman. 2014. Straying of late-fall run Chinook salmon from the Coleman National Fish Hatchery into the lower American River, California. California Fish and Game 100:665–682.

Letvin, A., M. Palmer-Zwahlen, B. Kormos, and P. McHugh. 2021. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2019. Joint CDFW-PSMFC Report. September 2021.

Mattole Salmon Group (MSG). 2000. Five-year management plan for salmon stock rescue operations 2000–2001 through 2004–2005 seasons. Mattole Salmon Group, Petrolia, CA. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=32639

McNeill, B., M. Reichmuth, and A. Iwaki. 2020. Long-term Monitoring of Coho Salmon and Steelhead During Freshwater Life Stages in Coastal Marin County, 2018 Annual

Report. Point Reyes National Seashore Association. Annual report prepared for CDFW Contract #P1630402.

Merz, J.E., M. Workman, D. Threloff, and B. Cavallo. 2013. Salmon life cycle considerations to guide stream management: examples from California's Central Valley. San Francisco Estuary and Watershed Science 11(2):1–26.

Michel, C., A. Ammann, S. Lindley, P. Sandstrom, E. Chapman, M. Thomas, G. Singer, A. Klimley, and R. Macfarlane. 2015. Chinook salmon outmigration survival in wet and dry years in California's Sacramento River. Canadian Journal of Fisheries and Aquatic Sciences 72(11):1749–1759

Michie, M. 2022. Monitoring Report: Chinook Salmon Stray Monitoring in Monterey, California Coastal Streams (2019-2021) (Draft Report). California Department of Fish and Wildlife, Region Four. September 2022.

Moyle, P.B. 2002. Inland Fishes of California: Revised and Expanded. University of California Press, Berkeley, CA.

Neillands, G., J. Nelson, and E. Larson. 2015. Chinook salmon Observation Monitoring Central California Coastal Streams (2014). California Department of Fish and Wildlife, Bay Delta Region. April 2015.

Neillands, G., J. Nelson, A. Persau, and E. Larson. 2017. Chinook salmon Observation Monitoring Central California Coastal Streams (2016). California Department of Fish and Wildlife, Bay Delta Region. September 2017.

Neillands, G., J. Nelson, M. Michie, M. Stuhldreher, and E. Larson. 2018. Chinook salmon Observation Monitoring Central California Coastal Streams (2017). California Department of Fish and Wildlife, Bay Delta Region.

Nelson, J. 2016. Chinook salmon Observation Monitoring Central California Coastal Streams (2015). California Department of Fish and Wildlife, Bay Delta Region. March 2016.

O'Farrell, M.R., W.H. Satterthwaite, and B.C. Spence. 2012. California Coastal Chinook Salmon: Status, Data, and Feasibility of Alternative Fishery Management Strategies. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-SWFSC-494.

Osterback, A.K., C.H. Kern, E.A. Kanawi, J.M. Perez, and J.D. Kiernan. 2018. The effects of early sandbar formation on the abundance and ecology of coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*) in a central California coastal lagoon. Canadian Journal of Fisheries and Aquatic Sciences 75(12): 2184–2197.

Palmer-Zwahlen, M., V. Gusman, and B. Kormos. 2019. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2015. Joint PSMFC-CDFW Report. December 2019.

Palmer-Zwahlen, M., and B. Kormos. 2020. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2016. Joint PSMFC-CDFW Report. July 2020.

Regional Mark Information System Database (RMIS) [online database]. Continuously since 1977. Portland (OR): Regional Mark Processing Center, Pacific States Marine Fisheries Commission. URL: <http://www.rmpc.org/>

Solazzi, M.F., T.E. Nickelson, and S.L. Johnson. 1991. Survival, contribution, and return of hatchery coho salmon (*Oncorhynchus kisutch*) released into freshwater, estuarine, and marine environments. Canadian Journal of Fisheries and Aquatic Sciences 48(2):248–253.

Sturrock, A.M., W.H. Satterthwaite, K.M. Yoshida, E.R. Huber, H.W. Sturrock, S. Nussle, and S.M. Carlson. 2019. Eight Decades of Hatchery Salmon Release in the California Central Valley: Factors Influencing Straying and Resilience. Fisheries 44(9):433–444.

Thompson, C. 2006a. Spawning Ground Surveys, 2004–2005 Season, Mattole River Watershed. Mattole Salmon Group. Petrolia, CA. February 2006.

Thompson, C. 2006b. Spawning Ground Surveys, 2005–2006 Season, Mattole River Watershed. Mattole Salmon Group. Petrolia, CA. May 2006.

Waples, R.S. 1991. Genetic interactions between hatchery and wild salmonids: lessons from the Pacific Northwest. Canadian Journal of Fisheries and Aquatic Sciences 48(S1):124–133.

Weber, E.D., and K.D. Fausch. 2003. Interactions between hatchery and wild salmonids in streams: differences in biology and evidence for competition. Canadian Journal of Fisheries and Aquatic Sciences 60(8):1018–1036.

Yoshiyama, R., F. Fisher, and P. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley Region of California. North American Journal of Fisheries Management 18(3):487–521.

Table R1. Data sources used for Tables 2–3, 5–6, and 8. A single asterisk indicates data were collected pre-season from a non-random reach. The 2020/21-2021/22 Mainstem Eel River migrant trap data were taken from the Friends of the Eel River website (https://eelriver.org/) on 10/23/23.

Watershed	Tributaries	Season(s)	Data Type	Source
Big Basin/San Mateo region	Watersheds w/ seasonal lagoon formations	2012/13	Sandbar breach observations	Jankovitz, J. 2013. 2012-2013 escapement estimates for Central California Coast Coho Salmon (*Onchorynchus kisutch*) and Steelhead (*Oncorhynchus mykiss*) south of the Golden Gate. Pacific States Marine Fisheries Commission and California Department of Fish and Wildlife. Annual Report prepared for CDFW Fisheries Grant Restoration Program.
Big Basin/San Mateo region	Watersheds w/ seasonal lagoon formations	2013/14	Sandbar breach observations	Goin, M. 2015. Escapement estimates for Central California Coast Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz Counties for 2013-2014. Annual report prepared for Grant Agreement Number P1230418 00.
Big Basin/San Mateo region	Watersheds w/ seasonal lagoon formations	2014/15	Sandbar breach observations	Goin, M. 2015. 2014-2015 escapement estimates for Central California Coast Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz County streams. Annual report prepared for Grant Agreement Number P1230418 00.
Big Basin/San Mateo region	Watersheds w/ seasonal lagoon formations	2016/17	Sandbar breach observations	Sedoryk, M. 2018. Adult escapement estimates and juvenile spatial structure of Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz Counties for 2016 - 2017. Annual report prepared for Grant Agreement Number P1530409.
Big Basin/San Mateo region	Watersheds w/ seasonal lagoon formations	2017/18	Sandbar breach observations	Sedoryk, M. 2019. Adult spawning distribution and juvenile spatial structure of Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz Counties for 2017 - 2018. Annual report for Grant Agreement Number P1530409.
Big Basin/San Mateo region	Watersheds w/ seasonal lagoon formations	2018/19	Sandbar breach observations	Sedoryk, M. 2019. Adult Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) spawning in Coastal San Mateo and Santa Cruz Counties for 2018-2019. Annual report for Grant Agreement Number P1530409.
Big Basin/San Mateo region	Big Basin/San Mateo region	2011/12	Spawning ground surveys	Jankovitz, J. 2012. 2011-2012 escapement estimates for Central California Coast Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) south of the Golden Gate. Pacific States Marine Fisheries Commission and California Department of Fish and Wildlife. Annual Report prepared for CDFW Fisheries Grant Restoration Program.

Watershed	Tributaries	Season(s)	Data Type	Source
Big Basin/San Mateo region	Big Basin/San Mateo region	2012/13	Spawning ground surveys	Jankovitz, J. 2013. 2012-2013 escapement estimates for Central California Coast Coho Salmon (Onchorynchus kisutch) and Steelhead (Oncorhynchus mykiss) south of the Golden Gate. Pacific States Marine Fisheries Commission and California Department of Fish and Wildlife. Annual Report prepared for CDFW Fisheries Grant Restoration Program.
Big Basin/San Mateo region	Big Basin/San Mateo region	2013/14	Spawning ground surveys	CDFW Aquatic Surveys Program Database, Goin, M. 2015. Escapement estimates for Central California Coast Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz Counties for 2013-2014. Annual report prepared for Grant Agreement Number P1230418 00.
Big Basin/San Mateo region	Big Basin/San Mateo region	2014/15	Spawning ground surveys	CDFW Aquatic Surveys Program Database, Goin, M. 2015. 2014-2015 escapement estimates for Central California Coast Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz County streams. Annual report prepared for Grant Agreement Number P1230418 00.
Big Basin/San Mateo region	Big Basin/San Mateo region	2016/17	Spawning ground surveys	CDFW Aquatic Surveys Program Database, Sedoryk, M. 2018. Adult escapement estimates and juvenile spatial structure of Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz Counties for 2016 - 2017. Annual report prepared for Grant Agreement Number P1530409.
Big Basin/San Mateo region	Big Basin/San Mateo region	2017/18	Spawning ground surveys	CDFW Aquatic Surveys Program Database, Sedoryk, M. 2019. Adult spawning distribution and juvenile spatial structure of Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) in Coastal San Mateo and Santa Cruz Counties for 2017 - 2018. Annual report for Grant Agreement Number P1530409.
Big Basin/San Mateo region	Big Basin/San Mateo region	2018/19	Spawning ground surveys	CDFW Aquatic Surveys Program Database, Sedoryk, M. 2019. Adult Coho Salmon (Oncorhynchus kisutch) and Steelhead (Oncorhynchus mykiss) spawning in Coastal San Mateo and Santa Cruz Counties for 2018-2019. Annual report for Grant Agreement Number P1530409.
Big Sur River	Big Sur River	2014/15	Sandbar breach observations	Neillands, G., J. Nelson, and E. Larson. 2015.Chinook Salmon observation monitoring: Central California coastal streams (2014). California Department of Fish and Wildlife Bay Delta Region.

Watershed	Tributaries	Season(s)	Data Type	Source
Big Sur River	Big Sur River	2015/16	Sandbar breach observations	Nelson, J. 2016. Chinook salmon monitoring in central California streams (2015). California Department of Fish and Wildlife Bay Delta Region.
Big Sur River	Big Sur River	2016/17	Sandbar breach observations	Neillands, G., J. Nelson, A. Persau, and E. Larson. 2017. Chinook Salmon observation monitoring in central California coastal streams (2016). California Department of Fish and Wildlife.
Big Sur River	Big Sur River	2017/18–2019/20	Sandbar breach observations	Michie (CDFW) pers. comm. (3/26/20)
Big Sur River	Big Sur River	2020/21–2021/22	Sandbar breach observations	Michie (CDFW) pers. comm. (11/14/23)
Big Sur River	Big Sur River	2014/15	Spawning ground surveys	Neillands, G., J. Nelson, and E. Larson. 2015.Chinook Salmon observation monitoring: Central California coastal streams (2014). California Department of Fish and Wildlife Bay Delta Region.
Big Sur River	Big Sur River	2015/16	Spawning ground surveys	Nelson, J. 2016. Chinook Salmon monitoring in central California streams (2015). California Department of Fish and Wildlife Bay Delta Region.
Big Sur River	Big Sur River	2016/17	Spawning ground surveys	Neillands, G., J. Nelson, A. Persau, and E. Larson. 2017. Chinook Salmon observation monitoring in central California coastal streams (2016). California Department of Fish and Wildlife.
Big Sur River	Big Sur River	2017/18	Spawning ground surveys	Michie (CDFW) pers. comm. (3/26/20)
Big Sur River	Big Sur River	2019/20 - 2021/22	Spawning ground surveys	Michie, M. 2022. Monitoring Report: Chinook Salmon Stray Monitoring in Monterey, California Coastal Streams (2019-2021) (Draft Report). California Department of Fish and Wildlife, Region Four. September 2022.
Eel River	SF Eel River	2010/11	Spawning ground surveys	Ricker, S., M. Groff, and A. Renger. 2015. Results of regional spawning ground surveys and estimates of salmonid redd construction in South Fork Eel River, Humboldt and Mendocino Counties California, 2010. Annual report prepared for California Department of Fish and Wildlife Fisheries Restoration Grant Program.
Eel River	SF Eel River	2011/12	Spawning ground surveys	Ricker, S., M. Groff, and A. Renger. 2015. Results of regional spawning ground surveys and estimates of salmonid redd construction in South Fork Eel River, Humboldt and Mendocino Counties California, 2011. Annual report prepared for California Department of Fish and Wildlife Fisheries Restoration Grant Program.

Watershed	Tributaries	Season(s)	Data Type	Source
Eel River	SF Eel River	2012/13	Spawning ground surveys	Ricker, S., M. Groff, and A. Renger. 2015. Results of regional spawning ground surveys and estimates of salmonid redd construction in South Fork Eel River, Humboldt and Mendocino Counties California, 2012. Annual report prepared for California Department of Fish and Wildlife Fisheries Restoration Grant Program.
Eel River	SF Eel River	2013/14	Spawning ground surveys	Ricker, S., M. Groff, and A. Renger. 2015. Results of regional spawning ground surveys and estimates of salmonid redd construction in South Fork Eel River, Humboldt and Mendocino Counties California, 2013. Annual report prepared for California Department of Fish and Wildlife Fisheries Restoration Grant Program.
Eel River	SF Eel River	2014/15	Spawning ground surveys	Groff, M. and A. Renger. 2016. Results of regional spawning ground surveys and estimates of total salmonid redd construction in the South Fork Eel River, Humboldt County California, 2014. Annual report prepared for Grant Agreement Number P1310501.
Eel River	SF Eel River	2015/16	Spawning ground surveys	Starks, B. and A. Renger. 2016. Results of regional spawning ground surveys and estimates of total salmonid redd construction in the South Fork Eel River, Humboldt County California, 2015. Annual report prepared for Grant Agreement Number P1310501.
Eel River	SF Eel River	2016/17	Spawning ground surveys	Starks, B. S. Powers, and S. Monday. 2017. Results of regional spawning ground surveys and estimates of total salmonid redd construction in the South Fork Eel River, Humboldt County California, 2015. Annual report prepared for Grant Agreement Number P1310507.
Eel River	SF Eel River	2017/18	Spawning ground surveys	Guczek, J., S. Powers, K. Roberts, and S. Monday. 2018. Results of regional spawning ground surveys and estimates of salmonid redd abundance in the South Fork Eel River, Humboldt County, California, 2017-2018. Annual report prepared for Grant Agreement Number P1510507.
Eel River	SF Eel River	2018/19	Spawning ground surveys	Guczek, J. S. Powers, and M. Larson. 2019. Results of regional spawning ground surveys and estimates of salmonid redd abundance in the South Fork Eel River, Humboldt and Mendocino Counties California, 2018-2019. Annual report prepared for Grantee Agreement Number P1510507.

Watershed	Tributaries	Season(s)	Data Type	Source
Eel River	SF Eel River	2019/20	Spawning ground surveys	Guczek, J. S. Powers, and M. Larson. 2020. Results of regional spawning ground surveys and estimates of salmonid redd abundance in the South Fork Eel River, Humboldt and Mendocino Counties California, 2019-2020. Annual report prepared for Grantee Agreement Number P1510507.
Eel River	SF Eel River	2020/21	Spawning ground surveys	Loomis, C. 2021. Results of regional spawning ground surveys and estimates of total salmonid redd construction in the SFER, Humboldt County, California - 2020-2021. Annual Report prepared for Grantee Agreement Number CMP-18R1001.
Eel River	SF Eel River	2021/22	Spawning ground surveys	David Kajtaniak and Chris Loomis (CDFW) pers. comm. (12/20/22)
Eel River	mainstem Eel River	2001/02–2019/20	Migrant trap, video weir	Scott Harris (CDFW) pers. comm. (4/20/20), CDFW unpublished reports
Eel River	mainstem Eel River	2020/21–2021/22	Video weir	Pacific Gas and Electric pers. comm. (11/2/23)
Lagunitas Creek	Lagunitas Creek	2002/03–2019/20	Sandbar breach observations	Michael Reichmuth (National Parks Service) pers. comm. (8/24/20)
Lagunitas Creek	Lagunitas Creek and others	2001/02–2009/10	Spawning ground surveys	Ettlinger, E., D. Morrell, A. Wolf, and G. Andrew. 2010. Lagunitas Creek salmon spawner survey report 2009-2010. Marin Municipal Water District. Corte Madera, California. October 2010.
Lagunitas Creek	Lagunitas Creek and others	2010/11	Spawning ground surveys	Ettlinger, E. and G. Andrew. 2012.Lagunitas Creek salmon spawner survey report 2010-2011. Marin Municipal Water District. February 2012.
Lagunitas Creek	Lagunitas Creek and others	2011/12	Spawning ground surveys	Ettlinger, E., M. Horwitz, B. Schleifer, and G. Andrew. 2012. Lagunitas Creek salmon spawner survey report 2011-2012. Marin Municipal Water District. Corte Madera, California. November 2012.
Lagunitas Creek	Lagunitas Creek and others	2012/13	Spawning ground surveys	Ettlinger, E. and G. Andrew. 2013. Adult salmonid monitoring in the Lagunitas Creek watershed - 2012-13. Marin Municipal Water District. Corte Madera, California. November 2013.
Lagunitas Creek	Lagunitas Creek and others	2013/14	Spawning ground surveys	Ettlinger, E. and G. Andrew. 2014. Adult salmonid monitoring in the Lagunitas Creek watershed - 2013-14. Marin Municipal Water District. Corte Madera, California. October 2014.
Lagunitas Creek	Lagunitas Creek and others	2014/15	Spawning ground surveys	Ettlinger, E., G. Andrew, P. Doughty, and V. Rogers. 2015. Adult salmonid monitoring in the Lagunitas Creek watershed - 2014-15. Marin Municipal Water District. Corte Madera, California. August 2015.
Lagunitas Creek	Lagunitas Creek and others	2015/16	Spawning ground surveys	Ettlinger, E., G. Andrew, D. Hossfeld, and E. Ruiz. 2016. Adult salmonid monitoring in the Lagunitas Creek watershed - 2015-16. Marin Municipal Water District. Corte Madera, California. September 2016.

Watershed	Tributaries	Season(s)	Data Type	Source
Lagunitas Creek	Lagunitas Creek and others	2016/17	Spawning ground surveys	Andrew, G. and E. Ettlinger. 2018. Adult salmonid monitoring in the Lagunitas Creek watershed - 2016-17. Marin Municipal Water District. Corte Madera, California. March 2018.
Lagunitas Creek	Lagunitas Creek and others	2017/18	Spawning ground surveys	Ettlinger, E. and G. Guaiumi. 2019. Adult salmonid monitoring in the Lagunitas Creek watershed 2017-18. Marin Municipal Water District. Corte Madera, California. January 2019.
Lagunitas Creek	Lagunitas Creek and others	2018/19	Spawning ground surveys	Ettlinger, E. 2019. Adult salmonid monitoring in the Lagunitas Creek watershed 2018-19. Marin Municipal Water District. Corte Madera, California. October 2019.
Lagunitas Creek	Lagunitas Creek and others	2019/20	Spawning ground surveys	Ettlinger, E. and S. Meus. 2020. Adult salmonid monitoring in the Lagunitas Creek Watershed 2019-2020. Marin Municipal Water District. Corte Madera, California. September 2020.
Lagunitas Creek	Lagunitas Creek and others	2020/21	Spawning ground surveys	Ettlinger, E., A. Howe, and J. Sherman. 2021. Adult salmonid monitoring in the Lagunitas Creek watershed 2020-2021. Marin Water. Corte Madera, California. September 2021.
Lagunitas Creek	Lagunitas Creek and others	2021/22	Spawning ground surveys	Ettlinger, E., J. Koehler, K. Joe, and E. Cox. 2022. Adult salmonid monitoring in the Lagunitas Creek watershed 2021-2022. Marin Water. Corte Madera, California. November 2022.
Lagunitas Creek	Lagunitas Creek and others	2006–2019	Rotary screw trap	Ettlinger, E. 2019. Smolt Monitoring in the Lagunitas Creek Watershed – 2019. Marin Municipal Water District. Corte Madera, California. December 2019.
Lagunitas Creek	Lagunitas Creek and others	2020	Rotary screw trap	Ettlinger, E. and J. Koehler. 2021. Smolt Monitoring in the Lagunitas Creek Watershed – 2020. Marin Water. Corte Madera, California. February, 2021.
Lagunitas Creek	Lagunitas Creek and others	2021	Rotary screw trap	Ettlinger, E., J. Sherman, and A. Howe. 2021. Smolt monitoring in the Lagunitas Creek watershed - 2021. Marin Water. Corte Madera, California. September 2021.
Lagunitas Creek	Lagunitas Creek and others	2022	Rotary screw trap	Ettlinger, E., J. Koehler, E. Cox, and K. Joe. 2023. Smolt monitoring in the Lagunitas Creek watershed - 2022. Marin Water. Corte Madera, California. March 2023.
Lagunitas Creek	Olema Creek	2001/02–2019/20	Spawning ground surveys	McNeill, B., M. Reichmuth, and A. Iwaki. 2020. Long-term monitoring of Coho Salmon and Steelhead during freshwater life stages in coastal Marin County: 2018 annual report. Point Reyes National Seashore Association. Report to the California Department of Fish and Wildlife, Grant Number P1630402.

Watershed	Tributaries	Season(s)	Data Type	Source
Lagunitas Creek	Olema Creek	2004–2018	Rotary screw trap	McNeill, B., M. Reichmuth, and A. Iwaki. 2020. Long-term monitoring of Coho Salmon and Steelhead during freshwater life stages in coastal Marin County: 2018 annual report. Point Reyes National Seashore Association. Report to the California Department of Fish and Wildlife, Grant Number P1630402.
Lagunitas Creek	Olema Creek	2019	Rotary screw trap	Ettlinger, E. 2019. Smolt Monitoring in the Lagunitas Creek Watershed – 2019. Marin Municipal Water District. Corte Madera, California. December 2019.
Lagunitas Creek	Olema Creek	2020	Rotary screw trap	Ettlinger, E. and J. Koehler. 2021. Smolt Monitoring in the Lagunitas Creek Watershed – 2020. Marin Water. Corte Madera, California. February, 2021.
Lagunitas Creek	Olema Creek	2021/22	Rotary screw trap	Mike Reichmuth (National Parks Service) pers. comm. (11/9/23)
Mattole River	Mattole River	2004/05	Sandbar breach observations	Thompson, C. 2006. Spawning ground surveys, 2004-2005 season - Mattole River Watershed. Report prepared for Bureau of Land Management Task Order Number 003, Cooperative Agreement Number BAA020030.
Mattole River	Mattole River	2005/06	Sandbar breach observations	Thompson, C. 2006. Spawning ground surveys, 2005-2006 season - Mattole River Watershed. Report prepared for Bureau of Land Management Task Order Number BCF052002, Cooperative Agreement Number BAA020030 and California Coastal Conservancy, Mattole River and Range Partnership Task 4.1, Agreement Number 05-015.
Mattole River	Mattole River	2006/07	Sandbar breach observations	Thompson, C. 2007. Spawning ground surveys, 2006-2007 season - Mattole River Watershed. Report prepared for Bureau of Land Management Task Order Number BCF052002, Cooperative Agreement Number BAA020030 and California Coastal Conservancy, Mattole River and Range Partnership Task 4.1, Agreement Number 05-015.
Mattole River	Mattole River	2007/08	Sandbar breach observations	Thompson, C. 2008. Spawning ground surveys, 2007-2008 season - Mattole River Watershed. Report prepared for State Water Resources Control Board Proposition 40 Integrated Watershed Management Program Agreement Number 06-141-551-0.
Mattole River	Mattole River	2008/09	Sandbar breach observations	Thompson, C. 2009. Spawning ground surveys, 2008-2009 season - Mattole River Watershed. Report prepared for Bureau of Land Management Assistance Agreement Number BCA072012 Amendment Number 002 (R-08010409).

Watershed	Tributaries	Season(s)	Data Type	Source
Mattole River	Mattole River	2009/10	Sandbar breach observations	Thompson, C. 2010. Spawning ground surveys, 2009-2010 season - Mattole River Watershed. Report prepared for Bureau of Land Management Assistance Agreement Number BCA072012 Amendment Number 003 (L08AC14502) and National Conservation System Foundation Mattole 2009 King Range Stewardship Initiative Contract Number OF110509.
Mattole River	Mattole River	2010/11	Sandbar breach observations	Thompson, C. 2011. Spawning ground surveys, 2010-2011 season - Mattole River Watershed. Annual report prepared for Grant Agreement Number P0910506.
Mattole River	Mattole River	2003/04–2013/14, 2015/16	Spawning ground surveys	CDFW Aquatic Surveys Program Database
Mattole River	Mattole River	2014/15	Spawning ground surveys	Queener. N. and M. Dow. 2015. Mattole River watershed 2014-2015 spawning ground surveys and redd population estimate. Mattole Salmon Group. Petrolia, California. March 2015.
Mattole River	Mattole River	2016/17	Spawning ground surveys	Queener, N. 2017. Mattole River 2016-2017 adult salmon and Steelhead abundance monitoring. Mattole Salmon Group. Petrolia, California. March 2017.
Mattole River	Mattole River	2017/18	Spawning ground surveys	Queener, N. 2018. Mattole River 2017-2018 adult salmon and Steelhead abundance monitoring. Mattole Salmon Group. Petrolia, California. April 2018.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2002–2004	Sandbar breach observations	Madej, M.A., A. Torregrosa, and A. Woodward. 2012. Linking physical monitoring to Coho and Chinook Salmon populations in the Redwood Creek watershed, California - Summary of May 3-4, 2012 Workshop: U.S. Geological Survey Open-Rile Report 2012-1245, 24 p.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2004–2016	Sandbar breach observations	Chen, E. 2019. Contribution of juvenile estuarine residency in a bar-built estuary to recruitment of Chinook Salmon (*Oncorhynchus Shawish*). Humboldt State University, Master of Science Thesis. July 2019.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2017–2019	Sandbar breach observations	Dibner-Hanson (HSU) pers. comm. (4/1/20)
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2009/10	Spawning ground surveys	Ricker. S. 2011. Estimation of total observable anadromous salmonid redd construction in Redwood Creek and Humboldt Bay Tributaries, Humboldt County California, 2009-2010. California Department of Fish and Game. Arcata, California. 2011.

Watershed	Tributaries	Season(s)	Data Type	Source
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2010/11	Spawning ground surveys	Ricker, S., K. Lindke, and C. Anderson. 2014. Results of regional spawning ground surveys and estimates of total salmonid redd construction in Redwood Creek, Humboldt County California, 2010. Humboldt State University Sponsored Programs Foundation. Annual report prepared for Grant Agreement Number P0910523.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2011/12	Spawning ground surveys	Ricker, S., K. Lindke, and C. Anderson. 2014. Results of regional spawning ground surveys and estimates of total salmonid redd construction in Redwood Creek, Humboldt County California, 2011. Humboldt State University Sponsored Programs Foundation. Annual report prepared for Grant Agreement Number P0910523.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2012/13	Spawning ground surveys	Ricker, S., K. Lindke, and C. Anderson. 2014. Results of regional spawning ground surveys and estimates of total salmonid redd construction in Redwood Creek, Humboldt County California, 2012. Humboldt State University Sponsored Programs Foundation. Annual report prepared for Grant Agreement Number P0910523.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2013/14	Spawning ground surveys	Ricker, S., K. Lindke, and C. Anderson. 2014. Results of regional spawning ground surveys and estimates of total salmonid redd construction in Redwood Creek, Humboldt County California, 2013. Humboldt State University Sponsored Programs Foundation. Annual report prepared for Grant Agreement Number P1210323.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2014/15	Spawning ground surveys	Anderson, C., and D. Ward. 2015. Results of regional spawning ground surveys and estimates of total salmonid redd construction in Redwood Creek, Humboldt County California, 2014-2015. Humboldt State University. Annual report prepared for Grant Agreement Number P1210323.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2015/16	Spawning ground surveys	Anderson, C., and D. Ward. 2016. Results of regional spawning ground surveys and estimates of total salmonid redd construction in Redwood Creek, Humboldt County California, 2015-2016. Humboldt State University. Annual report prepared for Grant Agreement Number P1210323.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2016/17	Spawning ground surveys	CDFW Aquatic Surveys Program Database
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2017/18	Spawning ground surveys	Dibner-Hanson, J.D., and M. Henderson. 2019. Redwood Creek Chinook Salmon Monitoring. Humboldt State University. 2018 Annual report prepared for Grant Agreement Number P1610535.

Watershed	Tributaries	Season(s)	Data Type	Source
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2018/19	Spawning ground surveys	Dibner-Hanson, J.D., and M. Henderson. 2020. Redwood Creek Chinook Salmon Monitoring. Humboldt State University. 2019 Annual report prepared for Grant Agreement Number P1610535.
Redwood Creek (Humbolt County)	Redwood Creek (Humbolt County)	2020/21	Spawning ground surveys	Dibner-Hanson, J.D., and M. Henderson. 2021. Redwood Creek Chinook Salmon Monitoring 2017-2020. Humboldt State University. Final report prepared for Grant Agreement Number P1610535.
Redwood Creek (Marin County)	Redwood Creek (Marin County)	2001/02–2019/20	Spawning ground surveys	CDFW Aquatic Surveys Program Database, Reichmuth (NPS) pers. comm. (8/24/20)
Redwood Creek (Marin County)	Redwood Creek (Marin County)	2020/21–2021/22	Spawning ground surveys	Reichmuth pers comm. (11/9/23)
Redwood Creek (Marin County)	Redwood Creek (Marin County)	2004–2018	Rotary screw trap	McNeill, B., M. Reichmuth, and A. Iwaki. 2020. Long-term monitoring of Coho Salmon and Steelhead during freshwater life stages in coastal Marin County: 2018 annual report. Point Reyes National Seashore Association. Report to the California Department of Fish and Wildlife, Grant Number P1630402.
Redwood Creek (Marin County)	Redwood Creek (Marin County)	2019	Rotary screw trap	Reichmuth pers comm. (11/9/23)
Redwood Creek (Marin County)	Redwood Creek (Marin County)	2020	Rotary screw trap	Reichmuth pers comm. (11/9/23)
Redwood Creek (Marin County)	Redwood Creek (Marin County)	2021/22	Rotary screw trap	Reichmuth pers comm. (11/9/23)
Russian River	Dry Creek	2013/14	Spawning ground surveys	Sonoma County Water Agency and University of California Cooperative extension/California Sea Grant. 2015. Implementation of California Coastal Salmonid Population Monitoring in the Russian River Watershed. Santa Rosa, Ca.
Russian River	Dry Creek	2014/15	Spawning ground surveys	Sonoma County Water Agency and University of California Cooperative extension/California Sea Grant. 2015. Implementation of California Coastal Salmonid Population Monitoring in the Russian River Watershed. Santa Rosa, Ca.
Russian River	Dry Creek	2015/16	Spawning ground surveys	CDFW Aquatic Surveys Program Database
Russian River	Dry Creek	2016/17	Spawning ground surveys	CDFW Aquatic Surveys Program Database
Russian River	Dry Creek	2017/18	Spawning ground surveys	CDFW Aquatic Surveys Program Database
Russian River	Dry Creek	2018/19	Spawning ground surveys	CDFW Aquatic Surveys Program Database
Russian River	Russian River	2001/02–2019/20	Migrant trap	Gregg Horton & Aaron Johnson (SCWA) pers. comm. (8/27/20)
Russian River	Russian River	2020/21–2021/22	Migrant Trap	Gregg Horton & Aaron Johnson (SCWA) pers. comm. (11/19/23)

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Salinas River	Arroyo Seco River	2009/10	Rotary screw trap	Cuthbert, R., M. Palmer, D. Demko, and S. Ainsley. 2010. Salinas Basin Rotary Screw Trap Monitoring 2010 Final Report. FishBio. Oakdale, CA.
Salinas River	Arroyo Seco River	2010/11	Rotary screw trap	Cuthbert, R., S. Ainsley, and D. Demko. 2011. Salinas Basin Juvenile *O. mykiss* Outmigration Monitoring 2011 Final Report. FishBio. Oakdale, CA.
Salinas River	Arroyo Seco River	2011/12	Rotary screw trap	Cuthbert, R., P. Cuthbert, and M. Peterson. 2013. Salinas Basin Juvenile *O. mykiss* Outmigration Monitoring 2012 Final Report. FishBio. Oakdale, CA.
Salinas River	Arroyo Seco River	2016/17	Rotary screw trap	Cuthbert (ERMC) pers. comm. (3/31/20)
Salinas River	Nacimiento River	2009/10	Rotary screw trap	Cuthbert, R., M. Palmer, D. Demko, and S. Ainsley. 2010. Salinas Basin Rotary Screw Trap Monitoring 2010 Final Report. FishBio. Oakdale, CA.
Salinas River	Nacimiento River	2010/11	Rotary screw trap	Cuthbert, R., S. Ainsley, and D. Demko. 2011. Salinas Basin Juvenile *O. mykiss* Outmigration Monitoring 2011 Final Report. FishBio. Oakdale, CA.
Salinas River	Nacimiento River	2011/12	Rotary screw trap	Cuthbert, R., P. Cuthbert, and M. Peterson. 2013. Salinas Basin Juvenile *O. mykiss* Outmigration Monitoring 2012 Final Report. FishBio. Oakdale, CA.
Salinas River	Nacimiento River	2012/13	Rotary screw trap	Cuthbert, R., P. Cuthbert, and A. Fuller. 2013. Salinas Basin Juvenile *O. mykiss* Outmigration Monitoring 2013 Final Report. FishBio. Oakdale, CA.
Salinas River	Nacimiento River	2013/14	Rotary screw trap	Cuthbert, R., P. Cuthbert, A. Fuller, and M. Hellmair. 2014. Salinas Basin Juvenile *O. mykiss* Outmigration Monitoring 2014 Final Report. FishBio. Oakdale, CA.
Salinas River	Nacimiento River	2016/17	Rotary screw trap	Cuthbert (ERMC) pers. comm. (3/31/20)
Salinas River	Salinas River	2010/11	Resistance board weir and VAKI Riverwatcher fish counting system	Cuthbert, R., S. Ainsley, and D. Demko. 2011. Salinas River Basin Adult Steelhead Escapement Monitoring. 2011 Annual Report prepared by FISHBIO for Monterey County WaterResources Agency, Oakdale, CA.
Salinas River	Salinas River	2011/12	Resistance board weir and VAKI Riverwatcher fish counting system	Cuthbert, R. and M. Hellmair. 2012. Salinas River Basin Adult Steelhead Escapement Monitoring. 2012 Annual Report prepared by FISHBIO for Monterey County WaterResources Agency, Oakdale, CA.
Salinas River	Salinas River	2012/13	Resistance board weir and VAKI Riverwatcher fish counting system	Cuthbert, R., P. Cuthbert, and A. Fuller. 2013. Salinas River Basin Adult Steelhead Escapement Monitoring. 2013 Annual Report prepared by FISHBIO for Monterey County WaterResources Agency, Oakdale, CA.

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Salinas River	Salinas River	2013/14	Resistance board weir and VAKI Riverwatcher fish counting system	Cuthbert, R., P. Cuthbert, A. Fuller, and M. Hellmair. 2014. Salinas River Basin Adult Steelhead Escapement Monitoring. 2014 Annual Report prepared by FISHBIO for Monterey County WaterResources Agency, Oakdale, CA.
Salinas River	Salinas River	2015/16, 2016/17	Resistance board weir and VAKI Riverwatcher fish counting system	Cuthbert (ERMC) pers. comm. (3/31/20)
Salinas River	Salinas River	2010/11	Rotary screw trap	Cuthbert, R., S. Ainsley, and D. Demko. 2011. Salinas Basin Juvenile *O. mykiss* Outmigration Monitoring 2011 Final Report. FishBio. Oakdale, CA.
Salinas River	Salinas River	2011/12	Rotary screw trap	Cuthbert, R. and M. Hellmair. 2012. Salinas River Basin Adult Steelhead Escapement Monitoring. 2012 Annual Report prepared by FISHBIO for Monterey County WaterResources Agency, Oakdale, CA.
Salinas River	Salinas River	2012/13	Rotary screw trap	Cuthbert, R., P. Cuthbert, and A. Fuller. 2013. Salinas River Basin Adult Steelhead Escapement Monitoring. 2013 Annual Report prepared by FISHBIO for Monterey County WaterResources Agency, Oakdale, CA.
Salinas River	Salinas River	2016/17	Rotary screw trap	Cuthbert (ERMC) pers. comm. (3/31/20)
Scott Creek	Scott Creek	2002/03–2013/14	Sandbar breach observations	Nylen, B.D. 2015. Mouth closure and dissolved oxygen levels in a small, bar-built estuary: Scott Creek, California. University of California Davis, Master of Science Thesis. March 2015.
Scott Creek	Scott Creek	2014/15	Sandbar breach observations	Kiernan, J.D., A.K. Osterback, C. Kern, E. Kanawi, and L. Gilbert-Horvath. 2016. Results of Scott Creek life cycle monitoring station, 2014-2016. University of California Santa Cruz and NOAA Fisheries Southwest Fisheries Science Center. Annual report for grant agreement number P1330409.
Scott Creek	Scott Creek	2015/16	Sandbar breach observations	Kiernan, J.D., A.K. Osterback, C. Kern, E. Kanawi, and L. Gilbert-Horvath. 2016. Results of Scott Creek life cycle monitoring station, 2014-2016. University of California Santa Cruz and NOAA Fisheries Southwest Fisheries Science Center. Annual report for grant agreement number P1330409.
Scott Creek	Scott Creek	2016/17	Sandbar breach observations	Kiernan, J.D., A.K. Osterback, C. Kern, R. Bond, A. Hay, and H. Nuetzel. 2018. Results of Scott Creek life cycle monitoring station, 2016-2018. University of California Santa Cruz and NOAA Fisheries Southwest Fisheries Science Center. Annual report for grant agreement number P1630400.

Watershed	Tributaries	Season(s)	Data Type	Source
Scott Creek	Scott Creek	2017/18	Sandbar breach observations	Kiernan, J.D., A.K. Osterback, C. Kern, R. Bond, A. Hay, and H. Nuetzel. 2018. Results of Scott Creek life cycle monitoring station, 2016-2018. University of California Santa Cruz and NOAA Fisheries Southwest Fisheries Science Center. Annual report for grant agreement number P1630400.
Scott Creek	Scott Creek	2018/19	Sandbar breach observations	Kiernan, J.D., A.K. Osterback, C.H. Kern, R.M. Bond, A. Hay, and K.M. Kobayashi. 2019. Summary of Result from the Scott Creek salmonid life cycle monitoring station, 2018-2019. University of California Santa Cruz and NOAA Fisheries Southwest Fisheries Science Center. Annual report for grant agreement number P1830400-01.
Scott Creek	Scott Creek	2019/20	Sandbar breach observations	Searcy, R.T., A.B. Boehm, C, Weinstock, C.M. Preston, S. Jensen, B. Roman, J.M. Birch, C.A. Scholin, K.S. Van Houtan, J.D. Kiernan, and K.M Yamahara. 2022. High-frequency and long-term observations of eDNA from imperiled salmonids in a coastal stream: Temporal dynamics, relationships with environmental factors, and comparisons with conventional observations. Environmental DNA 4(4): 776-789.
Scott Creek	Scott Creek	2020/21	Sandbar breach observations	Kiernan, J.D., R.M. Bond, A.E. Hay, C.H. Kern, and J.M. Meko. 2022. Summary of results from the Scott Creek salmonid life cycle monitoring station: 2021 and 2022. University of California Santa Cruz. Santa Cruz, California.
Scott Creek	Scott Creek	2021/22	Sandbar breach observations	Kiernan, J.D., R.M. Bond, A.E. Hay, C.H. Kern, and J.M. Meko. 2022. Summary of results from the Scott Creek salmonid life cycle monitoring station: 2021 and 2022. University of California Santa Cruz. Santa Cruz, California.
Scott Creek	Scott Creek	2002/03–2018/19	Spawning ground surveys, Weir	Joe Kiernan (NOAA) pers. comm. (4/8/20)
Scott Creek	Scott Creek	2019/20	Spawning ground surveys, Weir	Kiernan, J.D., R.M. Bond, A.E. Hay, C.H. Kern, and J.M. Meko. 2022. Summary of results from the Scott Creek salmonid life cycle monitoring station: 2021 and 2022. University of California Santa Cruz. Santa Cruz, California.
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Scott Creek	Scott Creek	2021/22	Spawning ground surveys, Weir	Kiernan, J.D., R.M. Bond, A.E. Hay, C.H. Kern, and J.M. Meko. 2022. Summary of results from the Scott Creek salmonid life cycle monitoring station: 2021 and 2022. University of California Santa Cruz. Santa Cruz, California.
Scott Creek	Scott Creek	2003–2019	Outmigrant trap	Joe Kiernan (NOAA) pers. comm. (4/8/20)
Scott Creek	Scott Creek	2020	Outmigrant trap	Kiernan, J.D., R.M. Bond, A.E. Hay, C.H. Kern, and J.M. Meko. 2022. Summary of results from the Scott Creek salmonid life cycle monitoring station: 2021 and 2022. University of California Santa Cruz. Santa Cruz, California.
Scott Creek	Scott Creek	2021	Outmigrant trap	Kiernan, J.D., R.M. Bond, A.E. Hay, C.H. Kern, and J.M. Meko. 2022. Summary of results from the Scott Creek salmonid life cycle monitoring station: 2021 and 2022. University of California Santa Cruz. Santa Cruz, California.
Scott Creek	Scott Creek	2022	Outmigrant trap	Kiernan, J.D., R.M. Bond, A.E. Hay, C.H. Kern, and J.M. Meko. 2022. Summary of results from the Scott Creek salmonid life cycle monitoring station: 2021 and 2022. University of California Santa Cruz. Santa Cruz, California.