ADULT SALMONID MONITORING IN THE LAGUNITAS CREEK WATERSHED 2021-2022

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In collaboration with the National Park Service, Point Reyes National Seashore and the Salmon Protection and Watershed Network (SPAWN)

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MARIN WATER

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Cover photo: Coho Salmon jumping up “The Inkwells” in San Geronimo Creek (Jaclyn Sherman, Marin Water)

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EXECUTIVE SUMMARY

Adult salmonid surveys were conducted by staff and volunteers of Marin Water, the Watershed Stewards Program (WSP), National Park Service (NPS), Salmon Protection and Watershed Network (SPAWN), and the California Department of Fish and Wildlife (CDFW). Surveys were conducted on the main stem of Lagunitas Creek and four tributaries: San Geronimo Creek, Devil's Gulch, Cheda Creek, and Olema Creek. These annual surveys are intended to document the spawning run of Coho Salmon (*Oncorhynchus kisutch*), while also collecting data on steelhead (*O. mykiss*), Chinook or "king" Salmon (*O. tshawytscha*), Chum Salmon (*O. keta*), and Pink Salmon (*O. gorbuscha*). The first survey of the season was conducted by Marin Water on October 27, 2021, and surveys ended on March 31, 2022.

This year, 339 Coho Salmon redds and 816 live Coho Salmon were observed in the Lagunitas Creek Watershed. The official coho escapement estimate was 678, based on a conservative assumption of two spawners per redd. The run was 48% above the average observed since 1997, but a decrease of 8% from the spawning run three years earlier. Coho spawning was distributed as follows: 34% in San Geronimo Creek and its tributaries, 25% in Lagunitas Creek, 21% in Devil's Gulch, and 19% in Olema Creek.

The steelhead run was average with 162 redds and 39 live fish observed. The steelhead escapement was 332 adults, based on an assumption of two spawners per redd. Chinook Salmon were observed throughout the watershed, including in Woodacre and Olema Creeks. Escapement was estimated as 34 Chinook Salmon, based on 17 observed redds. For the third time since 2017 Pink Salmon were observed in Lagunitas Creek. A single live Pink Salmon and three Pink Salmon redds were documented. Finally, two Chum Salmon were seen, but no redds were attributed to them.

INTRODUCTION

Salmonids of the Lagunitas Creek Watershed

Two species of salmonids are found in the Lagunitas Creek Watershed year-round: Coho Salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*). Adult Chinook or "king" Salmon (*O. tshawytscha*) are observed spawning in most years, while Chum Salmon (*O. keta*) are observed in a minority of years. In 2017 Pink Salmon (*O. gorbuscha*) became the fifth salmonid species to be documented in Lagunitas Creek.

Coho Salmon and steelhead populations in the watershed have fluctuated widely since 1970 and are significantly reduced from anecdotal reports of large historic populations. Throughout California, populations of native fish species, including coho and steelhead, have been steadily declining. Human-caused factors for this decline include habitat alterations such as water diversions, road building, timber harvest, urbanization, flood control structures and practices,

and climate change (NMFS 2012). This decline resulted in the listing of Coho Salmon in the Central California Coast Evolutionarily Significant Unit (ESU) as "endangered" under federal and California Endangered Species Acts. Steelhead are listed as federally "threatened."

Coho Salmon and steelhead are anadromous fishes, rearing at least partially in freshwater, migrating to the ocean as smolts, spending their adult life in the ocean, and then migrating back into freshwater streams to spawn. Most Coho Salmon from California streams spend approximately 18 months in freshwater (including incubation) and 18 months in the ocean, returning to spawn in their natal stream in their third year, after which they die (Shapalov and Taft 1954, Moyle 2002). They can be grouped into three-year classes, defined as the current generation of spawners, the parent generation that spawned three years earlier, as well as previous generations. Spawning years with relatively poor reproductive success can result in poor spawning runs three years later. While the majority of coho return as three-year-old fish, some males, called jacks, spend less than a year in the ocean before becoming sexually mature and returning to their natal stream to spawn at two years of age (Sandercock 1991).

Spawning coho begin to arrive near the mouth of Lagunitas Creek in early fall to begin acclimation to freshwater before migrating upstream (Bratovich and Kelley 1988). The spawning period is generally from mid-November to late-January, but adult coho have been observed from late-October to late-February. The life history of steelhead is more flexible than that of Coho Salmon. Steelhead generally spend one to three years in freshwater and one or two years in the ocean before returning to spawn, although the most common life history pattern is to spend two years in fresh water and one year in the ocean (Shapalov and Taft 1954). Unlike coho, steelhead can return to the ocean after spawning and spawn multiple times. This flexibility means that steelhead do not show strong year class patterns in their spawning runs. Steelhead are generally first observed in Lagunitas Creek in late December or early January and continue spawning through April or even into May.

Coho Salmon and steelhead usually spawn at the heads of riffles with gravel substrate (Moyle 2002). Females may excavate small test pits in the gravel substrate before deciding on a site to lay their eggs. Once decided, the female will dig a larger pit (called a "redd") where she deposits her eggs. Often more than one adult male will fertilize the eggs by releasing milt before the female covers the eggs with additional gravel (Moyle 2002). Following spawning, female coho may guard the redd for up to four weeks before dying, while steelhead attempt to return to the ocean.

Location and Organizations

Lagunitas Creek originates on the north slope of Mount Tamalpais and flows in a northwesterly direction for 40 km to Tomales Bay (Figure 1). The lower 19 km is accessible to anadromous

salmonids. San Geronimo Creek, Devil's Gulch, Nicasio Creek, and Olema Creek are the major tributaries to Lagunitas Creek. Devil's Gulch, which flows through National Park and State Park land before entering Lagunitas Creek, is the smallest of these tributaries but provides important spawning and rearing habitat for Coho Salmon and steelhead. Other tributaries to Lagunitas Creek include Cheda Creek, which supports Coho Salmon spawning, and McIsaac Creek, where Coho Salmon have not been seen in many years. The tributaries to San Geronimo Creek that provide spawning habitat include Arroyo, Evans, Larsen, Montezuma, and Woodacre Creeks. Fifty-two percent of the land within the Lagunitas Creek watershed is publicly owned by Marin Water, the National Park Service, California Department of Parks and Recreation, and Marin County Parks.

Marin Water is a public agency that withdraws water from the Lagunitas Creek basin in order to provide water to residents of central and southern Marin County. Marin Water operates four reservoirs on the mainstem of Lagunitas Creek and a fifth reservoir on Nicasio Creek. Water is released from Kent Lake to ensure year-round minimum stream flows in Lagunitas Creek (Table 1). In addition, Marin Water releases periodic "upstream migration flows," which are intended to facilitate passage of anadromous fish through shallow areas in the creek, and are required on November 15, December 1, January 1, and February 1 in the absence of a natural storm event preceding those dates.

Table 1. Flow requirements on Lagunitas Creek at S.P. Taylor State Park.

Time Period	Normal Year Flow (cfs)	Dry Year Flow (cfs)
November 1/15* - December 31	20	20
January 1 - March 15	25	20
March 16 - March 31	20	20
April 1 - April 30	16	14
May 1 - June 15	12	10
June 16 - November 1/15*	8	6

* The minimum flow of 20 cubic feet per second (cfs) in November is to begin following the first storm that produces a "trigger" flow of 25 cfs at the USGS gage at S.P. Taylor State Park. In the absence of a storm causing a "trigger" flow, the 20-cfs requirement becomes effective on November 15 of each year.

Marin Water fisheries staff conduct surveys on Lagunitas Creek, San Geronimo Creek, and Devil's Gulch. Surveys on Olema Creek and Cheda Creek are conducted by NPS staff working for Point Reyes National Seashore and the Inventory and Monitoring Program. AmeriCorps members serving with The Watershed Stewards Program (WSP) assist NPS and Marin Water staff with their survey work. SPAWN staff and volunteers conduct spawner surveys in five

tributaries to San Geronimo Creek, as well as the headwater section of San Geronimo Creek upstream of Woodacre Creek.

METHODS

Marin Water fisheries staff and WSP members walked sections of creek once per week between October 27, 2021 and March 31, 2022. Lagunitas Creek was divided into four sections for weekly surveys (Figure 1): Tocaloma Bridge to Swimming Hole (3.4 km), Swimming Hole to Irving Bridge (3.2 km), Irving Bridge to Shafter Bridge (2.2 km), and Shafter Bridge to Peters Dam (0.8 km). The section of Lagunitas Creek from Tocaloma Bridge downstream to the confluence of Nicasio Creek was surveyed biweekly, as was the section downstream of Nicasio Creek to the upstream limit of tidal influence, when flows allowed. High flows due to an atmospheric river in early December prevented Marin Water staff from conducting spawner surveys in the mainstem of Lagunitas Creek for most of December. In Devil's Gulch, Marin Water biologists surveyed from the mouth to a bedrock cascade approximately three km upstream, which is impassable to coho. We also surveyed a 400 m fork of Devil's Gulch near the upstream end of our survey reach. San Geronimo Creek was walked in two sections: from its confluence with Lagunitas Creek to Meadow Way Bridge (3.8 km) and from Meadow Way Bridge to the confluence of Woodacre Creek (3.4 km). Each stream section was surveyed from the downstream end to the upstream end, apart from the section of Lagunitas Creek downstream of Tocaloma, which was surveyed in a downstream direction.

Surveyors recorded observations of redds, live adult salmonids, salmonid carcasses, and test (i.e., incomplete) redds. Live fish were recorded as male, female, jack, or unknown. Their behavior, condition (color, wear marks, pronounced kype, etc.), and their location in relation to landmarks such as tributaries or bridges were noted. All observed spawning activity was also recorded. Marin Water surveyors collected otoliths from carcasses for subsequent life history analyses and tissue samples for genetic analyses by UC Berkeley and the National Marine Fisheries Service (NMFS), respectively. We attempted to determine if female salmonids had spawned by inspecting for caudal fin wear. Other information recorded during each survey included survey start and stop times, weather conditions, stream flow, and qualitative observations of and water clarity. We intended to collect heads from hatchery origin Chinook salmon, in order to retrieve coded-wire tags, although no carcasses with clipped adipose fins were found.

Redds were classified as having been constructed by one of the salmonid species or recorded as "unknown." Redds were considered to have been conclusively built by one of these species when an identified fish was observed on the redd, or when only one species was present in the creek (e.g., steelhead after January). When fish were not present, redds were classified based

on their dimensions, shape, depth, substrate, location, and relative abundance of salmonid species at the time of the survey. When coho were present in the creek, large redds with wide and shallow pits were classified as coho redds. Smaller redds with deep pits and sharp margins were generally classified as steelhead redds after the first live steelhead were observed. Unoccupied redds observed at a time when multiple salmonid species were in the creek and not displaying clearly diagnostic characteristics were classified as "unknown." Redd classification was evaluated at the end of the season by reviewing field notes for unoccupied redds and by comparing redd dimensions of occupied and unoccupied redds.

Marin Water surveyors assigned a unique number to each redd and marked its location in the field by hanging colored tape (orange this year) on adjacent vegetation. Redds were marked this way so no redd would be double counted during subsequent surveys and so any additional redds near that site could be distinguished. Flagging was labeled with the date, the redd number, redd dimensions, and the position of the redd with respect to the channel (i.e. mid-channel, whole channel, left- or right-bank, etc.). The flag was hung in line with the upstream end of the redd pit, so further enlargement of the redd would be conspicuous during subsequent surveys. If it was determined that a female made a small "test" pit and not a redd, the site was recorded as a "test redd" and flagged with white flagging. We also mapped GPS points for each redd using ArcGIS Field Maps software with a hand held iPad or personal device. We measured the maximum length and width of all redds unless fish were actively constructing the redd or displaying spawning behavior. To avoid disturbing fish we hung white flagging, in addition to the colored flagging, next to occupied redds as a reminder to measure the redd later when no fish were present. We attempted to identify when redds appeared to have been built on or overlapping older redds. High levels of such "superimposition" can indicate a shortage of adequate spawning habitat. Superimposition can kill eggs deposited in the first redd through physical shock, exposure, displacement into less favorable incubation conditions, or predation (Burgner 1991).

Some fish were likely counted multiple times over subsequent surveys while others likely escaped observation entirely. Situations where double-counting was readily apparent include multiple observations of schools of fish in pools and females holding on redds. At the end of the survey season these subsequent observations were subtracted from the fish totals. To avoid overestimating adult abundance we conservatively estimated escapement by assuming that each redd represented a minimum of two spawners. The marine survival rate for Coho Salmon was calculated as the escapement estimate divided by the previous year's coho smolt emigration estimate (e.g., 2021-22 escapement / 2020 smolt emigration).

RESULTS

A total of 339 Coho Salmon redds and 816 live Coho Salmon were observed during spawner surveys in the Lagunitas Creek Watershed (Table 2). The redd count was 48% above the 20-year average, but 9% lower than the count three years ago (Figure 2). The minimum escapement was 678, based on the assumption of two spawners per redd. Approximately 25% of coho spawning this year occurred in mainstem Lagunitas Creek, 34% occurred in San Geronimo Creek, 21% in Devil's Gulch, and 19% in Olema Creek. Two redds were observed in Cheda Creek.

The steelhead run was average, with 166 steelhead redds observed (Figure 3), corresponding to an escapement estimate of 332 steelhead. Only 39 adult steelhead were observed in the watershed (Table 3). Of the steelhead redds observed, 67% were in Lagunitas Creek, 14% in the San Geronimo Creek watershed, 11% in Devil's Gulch, and 7% in Olema Creek.

Surveyors documented 17 Chinook Salmon redds and 57 live Chinook Salmon this season (Table 4). In addition, three Pink Salmon redds and one live Pink Salmon were seen (Table 5), along with two live Chum Salmon (Table 6). Marin Water surveyors could not determine the origin of five redds (1% of Marin Water redds).

DISCUSSION

The 2021-22 Coho Salmon spawning run was well above average, although a small decline in the year class. The apparent marine survival rate was 6.4%, which was also well above average. This survival rate was calculated based on a rough estimate of Coho Salmon smolts leaving Lagunitas Creek in 2020 and should be interpreted with caution. No smolt trapping was conducted that year due to the COVID-19 pandemic.

Redds this year exhibited an average rate of superimposition. Of the 233 Coho Salmon redds observed by Marin Water surveyors, 34 (13%) showed some level of superimposition by later redds. In Lagunitas Creek, however, 29% of coho redds were superimposed. High rates of superimposition tend to occur when stream flows remain stable for extended periods and/or when steelhead abundance is high. While the steelhead run was not particularly large in 2021-22, low stream flows in February and March kept spawning confined to Lagunitas Creek.

Less than half an inch of rain fell between January 5 and March 26 (Figure 4). For coho redds in Lagunitas Creek that were not impacted by superimposition, this exceptional dry period likely resulted in very high egg and fry survival rates. Many redds in tributary streams, however, experienced dewatering during this period. Only a handful of redds were completely desiccated, but 38% of coho redds in Devil's Gulch were exposed to the point that fry were

likely unable to emerge. An additional 25% of coho redds experienced some level of dewatering and little flow.

Counts of steelhead redds were average in 2021-22. When stream flows receded in mid-January spawning activity became largely confined to Lagunitas Creek. Surveys by Marin Water staff were halted on March 31, 2022 and additional steelhead spawning likely occurred in Lagunitas Creek after this date (Figure 5). NPS staff observed few steelhead redds in Olema Creek in April.

The Chinook Salmon run also appeared to be average, with most redds and fish observed between mid-November and early December. An unusually high percentage (41%) of spawning occurred in tributary streams, including Devil's Gulch, Woodacre Creek and Olema Creek.

Pink Salmon spawning declined by 70% from 2019, which itself was a decline of 66% from the relatively large run of 2017. Pink Salmon are likely to disappear or at least difficult to detect in coming years.

No Chum Salmon redds were documented for the third year in a row, although two live fish were observed. Two periods of elevated Chum Salmon spawning have been observed in Lagunitas Creek; first between 2001 and 2004, and again in 2017 and 2018.

Of the 394 redds observed during Marin Water surveys, 269 were never associated with a live fish. One-third of these were observed when steelhead were the only salmonid still spawning, so were classified steelhead. All other unoccupied redds were classified by their dimensions, appearance, and the proportions of salmonid species seen that week. Steelhead redds tend to be narrower than the redds of other species, and 44 redds were classified as being built by steelhead based on being less than two meters wide. Coho Salmon redds tend to have sprawling, shallow pits and are often described as looking "sloppy." Appearance and relative abundance of spawners were used to classify 120 unoccupied redds as being built by Coho Salmon. Chinook Salmon redds are often wide and deep, although smaller individuals build smaller redds. Six redds were classified as being built by Chinook Salmon based on width and qualitative observations of depth. Three tiny redds seen early in the season were classified as Pink Salmon redds. Of the remaining unoccupied redds, five lacked diagnostic features and were left unclassified.

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Table 2. Observations of Coho Salmon in the Lagunitas Creek Watershed, Spawning Season 2021-22

SURVEY DATE	COHO SALMON IN LAGUNITAS CREEK															TOTAL		
	Pt. Reyes-Nicasio			Nicasio-Tocaloma			Tocaloma-Devil's Gulch			Devil's Gulch-Shafter Bridge			Shafter Bridge-Peters Dam					
	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds
27-Oct-21	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
29-Oct-21	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
3-Nov-21	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
4-Nov-21	-	-	-	0	0	0	2	0	0	-	-	-	-	-	-	2	0	0
5-Nov-21	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
8-Nov-21	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0
16-Nov-21	-	-	-	-	-	-	30	0	1	-	-	-	-	-	-	30	0	1
17-Nov-21	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
18-Nov-21	0	0	0	-	-	-	-	-	-	30	0	1	0	0	0	30	0	1
23-Nov-21	-	-	-	-	-	-	25	1	1	-	-	-	-	-	-	25	1	1
24-Nov-21	-	-	-	-	-	-				29	0	0	0	0	0	29	0	0
29-Nov-21	-	-	-	-	-	-	50	0	1	-	-	-	-	-	-	50	0	1
1-Dec-21	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
2-Dec-21	0	0	0	-	-	-	-	-	-	47	0	2	0	0	0	47	0	2
8-Dec-21	-	-	-	-	-	-	74	0	3	-	-	-	-	-	-	74	0	3
9-Dec-21	-	-	-	-	-	-	-	-	-	40	0	1	0	0	0	40	0	1
20-Dec-21	-	-	-	-	-	-	20	0	6	44	0	15	14	0	9	78	0	30
21-Dec-21	-	-	-	7	0	2	-	-	-	-	-	-	5	0	5	12	0	7
19-Jan-22	-	-	-	-	-	-	7	0	9	6	1	12	-	-	-	13	1	21
20-Jan-22	-	-	-	-	-	-	-	-	-	0	0	7	0	0	0	0	0	7
24-Jan-22	-	-	-	0	0	3	-	-	-	-	-	-	-	-	-	0	0	3
26-Jan-22	-	-	-	-	-	-	0	0	1	1	0	3	-	-	-	1	0	4
27-Jan-22	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
28-Jan-22	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1
1-Feb-22	-	-	-	-	-	-	-	-	-	0	0	0	-	-	-	0	0	0
3-Feb-22	-	-	-	-	-	-	1	0	0	0	0	1	0	0	0	1	0	1
8-Feb-22	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
10-Feb-22	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
14-Feb-22	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
15-Feb-22	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
16-Feb-22	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
17-Feb-22	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
23-Feb-22	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
24-Feb-22	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
28-Feb-22	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
Subtotal	**0**	**0**	**1**	**7**	**0**	**5**	**209**	**1**	**22**	**197**	**1**	**42**	**19**	**0**	**14**	**432**	**2**	**84**
Corrected	**0**			**7**			**128**			**143**			**19**			**297**		

SURVEY DATE	COHO SALMON IN SAN GERONIMO CREEK									COHO SALMON IN DEVIL'S GULCH			COHO SALMON IN OLEMA CREEK[2]			TOTAL		
	Mouth-Meadow Way			Meadow Way-Woodacre Cr.			Tributaries[1]											
	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds	Live Coho	Carcasses	Redds
24-Oct-21	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
31-Oct-21	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
8-Nov-21	0	0	0	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
12-Nov-21	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
17-Nov-21	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
21-Nov-21	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
28-Nov-21	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
12-Dec-21	-	-	-	-	-	-	-	-	-	-	-	-	11	0	0	11	0	0
17-Dec-21	17	0	5	17	0	6	-	-	-	84	2	21	-	-	-	118	2	32
19-Dec-21	-	-	-	-	-	-	-	-	-	-	-	-	52	0	18	52	0	18
21-Dec-21	-	-	-	-	-	-	3	0	7	-	-	-	-	-	-	3	0	7
22-Dec-21	-	-	-	-	-	-	6	0	6	-	-	-	-	-	-	6	0	6
26-Dec-21	-	-	-	-	-	-	-	-	-	-	-	-	14	3	0	14	3	0
30-Dec-21	-	-	-	-	-	-	4	0	7	-	-	-	-	-	-	4	0	7
30-Dec-21	-	-	-	-	-	-	11	0	7	18	4	13	-	-	-	29	4	20
2-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	95	19	25	95	19	25
5-Jan-22	-	-	-	-	-	-	15	1	11	46	1	30	-	-	-	61	2	41
6-Jan-22	42	1	28	25	5	15	-	-	-	-	-	-	-	-	-	67	6	43
9-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	34	20	17	34	20	17
11-Jan-22	-	-	-	-	-	-	-	-	-	0	0	8	-	-	-	0	0	8
12-Jan-22	23	6	10	-	-	-	-	-	-	-	-	-	-	-	-	23	6	10
14-Jan-22	-	-	-	4	0	6	-	-	-	-	-	-	-	-	-	4	0	6
16-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	0	7	6	0	7	6
24-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
6-Feb-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
13-Feb-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
20-Feb-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
1-Mar-22	0	0	2				-	-	-	-	-	-	-	-	-	0	0	2
2-Mar-22	-	-	-	0	0	5	-	-	-	-	-	-	-	-	-	0	0	5
Subtotal	**82**	**7**	**45**	**46**	**5**	**32**	**39**	**1**	**38**	**148**	**7**	**72**	**206**	**49**	**66**	**521**	**69**	**253**
Corrected*	**79**			**45**			**39**			**146**			**206**			**515**		

Notes:

(-) Indicates that the spawner survey did not cover the area on that date.

* Corrected coho observations compensate for coho that were presumably double counted.

[1] Data provided by the Salmon Protection and Watershed Network (SPAWN).

[2] Data provided by the National Park Service.

COHO SALMON IN OTHER TRIBUTARIES			
CHEDA CREEK[2]	4	2	2

COHO TOTAL	**816**	**73**	**339**

Table 3. Observations of Steelhead in the Lagunitas Creek Watershed, Spawning Season 2021-22

SURVEY DATE	STEELHEAD IN LAGUNITAS CREEK															TOTAL		
	Pt.Reyes-Nicasio			Nicasio-Tocaloma			Tocaloma-Devil's Gulch			Devil's Gulch-Shafter Bridge			Shafter Bridge-Peters Dam					
	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds
20-Dec-21	-	-	-	-	-	-	0	0	0	1	0	0	0	0	0	1	0	0
19-Jan-22	-	-	-	-	-	-	1	0	4	0	0	7	-	-	-	1	0	11
20-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1	0	0	1
26-Jan-22	-	-	-	-	-	-	-	-	-	4	0	2	-	-	-	4	0	2
28-Jan-22	-	-	-	-	-	-	3	0	0	-	-	-	-	-	-	3	0	0
1-Feb-22	-	-	-	-	-	-	-	-	-	0	0	3	-	-	-	0	0	3
3-Feb-22	-	-	-	-	-	-	0	0	5	0	0	2	-	-	-	0	0	7
8-Feb-22	-	-	-	-	-	-	-	-	-	1	0	3	0	0	0	1	0	3
10-Feb-22	-	-	-	-	-	-	0	0	3	-	-	-	-	-	-	0	0	3
14-Feb-22	-	-	-	0	0	2	-	-	-	-	-	-	-	-	0	0	0	2
15-Feb-22	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
16-Feb-22	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1
17-Feb-22	-	-	-	-	-	-	-	-	-	0	0	4	0	0	0	0	0	4
23-Feb-22	-	-	-	-	-	-	2	0	4	-	-	-	-	-	-	2	0	4
24-Feb-22	-	-	-	-	-	-	-	-	-	2	0	4	0	0	0	2	0	4
28-Feb-22	0	0	4	-	-	-	-	-	-	-	-	-	-	-	-	0	0	4
1-Mar-22	-	-	-	-	-	-	0	0	6	-	-	-	-	-	-	0	0	6
2-Mar-22	-	-	-	-	-	-	-	-	-	0	0	1	0	0	0	0	0	1
4-Mar-22	-	-	-	0	0	8	-	-	-	-	-	-	-	-	-	0	0	8
8-Mar-22	-	-	-	-	-	-	0	0	10	-	-	-	-	-	-	0	0	10
9-Mar-22	-	-	-	-	-	-	-	-	-	0	0	11	-	-	-	0	0	11
15-Mar-22	-	-	-	-	-	-	6	0	8	-	-	-	-	-	-	6	0	8
16-Mar-22	-	-	-	-	-	-	-	-	-	3	0	4	0	0	1	3	0	5
28-Mar-22	0	0	3	1	0	6	-	-	-	-	-	-	-	-	-	1	0	9
31-Mar-22	0	0	5	-	-	-	-	-	-	-	-	-	-	-	-	0	0	5
SUBTOTAL	**0**	**0**	**13**	**1**	**0**	**16**	**12**	**0**	**40**	**11**	**0**	**41**	**0**	**0**	**2**	**24**	**0**	**112**
Corrected*	**0**			**1**			**12**			**11**			**0**			**24**		

SURVEY DATE	STEELHEAD IN SAN GERONIMO CREEK									STEELHEAD IN DEVIL'S GULCH			STEELHEAD IN OLEMA CREEK[2]			TOTAL		
	Mouth-Meadow Way			Meadow Way-Woodacre Cr.			Tributaries[1]											
	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds
30-Dec-21	-	-	-	-	-	-	-	-	-	3	0	2	-	-	-	3	0	2
2-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	3	0	3
5-Jan-22	-	-	-	-	-	-	2	0	1	0	0	6	-	-	-	2	0	7
6-Jan-22	1	0	0	0	0	2	-	-	-	-	-	-	-	-	-	1	0	2
11-Jan-22	-	-	-	-	-	-	-	-	-	0	0	7	-	-	-	0	0	7
12-Jan-22	0	0	3	-	-	-	3	0	5	-	-	-	-	-	-	3	0	8
13-Jan-22	-	-	-	-	-	-	0	0	5	-	-	-	-	-	-	0	0	5
14-Jan-22	-	-	-	0	0	4	-	-	-	-	-	-	-	-	-	0	0	4
16-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	2	0	0	2
24-Jan-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	3	0	0	3
30-Jan-22	-	-	-	-	-	-	0	0	1	-	-	-	-	-	-	0	0	1
6-Feb-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1	0	0	1
24-Feb-22	-	-	-	-	-	-	-	-	-	0	0	4	-	-	-	0	0	4
1-Mar-22	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0
2-Mar-22	-	-	-	1	0	2	-	-	-	-	-	-	-	-	-	1	0	2
6-Mar-22	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1	0	1	1
20-Mar-22	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0	1	0	0
27-Mar-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1	0	0	1
24-Apr-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1	0	0	1
SUBTOTAL	**2**	**0**	**3**	**1**	**0**	**8**	**5**	**0**	**12**	**3**	**0**	**19**	**4**	**1**	**12**	**15**	**1**	**54**
Corrected*	**2**			**1**			**5**			**3**			**4**			**15**		

STEELHEAD IN OTHER TRIBUTARIES			
CHEDA CREEK	0	0	0

STEELHEAD TOTAL	**39**	**1**	**166**

Notes:

(-) Indicates that the Spawning survey did not cover the area on that date.

* Corrected coho observations compensate for coho that were presumably double counted.

[1] Data provided by the Salmon Protection and Watershed Network (SPAWN).

[2] Data provided by the National Park Service.

Table 4. Observations of Chinook Salmon in the Lagunitas Creek Watershed, Spawning Season 2021-22

SURVEY DATE	CHINOOK IN LAGUNITAS CREEK															TOTAL		
	Pt Reyes - Nicasio			Nicasio-Tocaloma			Tocaloma-Devil's Gulch			Devil's Gulch-Shafter Bridge			Shafter Bridge-Peters Dam					
	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds
27-Oct-21	-	-	-	-	-	-	-	-	-	1	0	0	0	0	0	1	0	0
4-Nov-21	-	-	-	0	0	0	0	0	0	-	-	-	-	-	-	0	0	0
8-Nov-21	-	-	-	-	-	-	-	-	-	4	0	1	0	0	0	4	0	1
16-Nov-21	-	-	-	-	-	-	6	0	0	-	-	-	-	-	-	6	0	0
18-Nov-21	0	0	0	-	-	-	-	-	-	11	0	0	0	0	0	11	0	0
23-Nov-21	-	-	-	-	-	-	4	0	0	-	-	-	-	-	-	4	0	0
24-Nov-21	-	-	-	-	-	-	-	-	-	12	0	1	0	0	0	12	0	1
29-Nov-21	-	-	-	-	-	-	4	0	0	-	-	-	-	-	-	4	0	0
2-Dec-21	0	0	0	-	-	-	-	-	-	5	1	1	0	0	0	5	1	1
8-Dec-21	-	-	-	-	-	-	9	0	3	-	-	-	-	-	-	9	0	3
9-Dec-21	-	-	-	-	-	-	-	-	-	4	0	1	0	0	0	4	0	1
20-Dec-21	-	-	-	-	-	-	4	0	1	8	0	2	0	0	0	12	0	3
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**27**	**0**	**4**	**45**	**1**	**6**	**0**	**0**	**0**	**72**	**1**	**10**
Corrected*	**0**			**0**			**19**			**26**			**0**			**45**		

SURVEY DATE	CHINOOK IN SAN GERONIMO CREEK									CHINOOK IN DEVIL'S GULCH			CHINOOK IN OLEMA CREEK			TOTAL		
	Mouth-Meadow Way			Meadow Way-Woodacre Cr.			Tributaries											
	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds	Chinook	Carcasses	Redds
3-Nov-21	-	-	-	-	-	-	4	0	1	-	-	-	-	-	-	4	0	1
7-Nov-21	-	-	-	-	-	-	-	-	-	-	-	-	2	0	0	2	0	0
14-Nov-21	-	-	-	-	-	-	-	-	-	-	-	-	4	0	3	4	0	3
17-Nov-21	-	-	-	0	0	0	0	0	1	-	-	-	-	-	-	0	0	1
21-Nov-21	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1	0	1	1
17-Dec-21	0	0	0	0	0	0	-	-	-	2	0	1	-	-	-	2	0	1
SUBTOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**2**	**2**	**0**	**1**	**6**	**1**	**4**	**12**	**1**	**7**
Corrected*	**0**			**0**			**4**			**2**			**6**			**12**		

CHINOOK TOTAL	**57**	**2**	**17**

Table 5. Observations of Pink Salmon in the Lagunitas Creek Watershed, Spawning Season 2021-22

SURVEY DATE	PINK SALMON IN LAGUNITAS CREEK															TOTAL		
	Pt Reyes - Nicasio			Nicasio-Tocaloma			Tocaloma-Devil's Gulch			Devil's Gulch-Shafter Bridge			Shafter Bridge-Peters Dam					
	Pink	Carcasses	Redds	Pink	Carcasses	Redds	Pink	Carcasses	Redds	Pink	Carcasses	Redds	Pink	Carcasses	Redds	Pink	Carcasses	Redds
29-Oct-21	-	-	-	-	-	-	0	0	1	-	-	-	-	-	-	0	0	1
8-Nov-21	-	-	-	-	-	-	0	0	0	0	0	1	0	0	0	0	0	1
16-Nov-21	-	-	-	-	-	-	1	0	0	-	-	-	-	-	-	1	0	0
18-Nov-21	-	-	-	-	-	-	-	-	-	0	0	1	0	0	0	0	0	1
SUBTOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**3**
Corrected*	**0**			**0**			**1**			**0**			**0**			**1**		

PINK TOTAL	**1**	**0**	**3**

Table 6. Observations of Chum Salmon in the Lagunitas Creek Watershed, Spawning Season 2021-22

SURVEY DATE	CHUM IN LAGUNITAS CREEK															TOTAL		
	Pt Reyes- Nicasio			Nicasio - Tocaloma			Tocaloma - Devil's Gulch			Devil's Gulch - Shafter Bridge			Shafter Bridge-Peters Dam					
	Chum	Carcasses	Redds	Chum	Carcasses	Redds	Chum	Carcasses	Redds	Chum	Carcasses	Redds	Chum	Carcasses	Redds	Chum	Carcasses	Redds
16-Nov-21	-	-	-	-	-	-	1	0	0	-	-	-	-	-	-	1	0	0
9-Dec-21	-	-	-	-	-	-	-	-	-	1	0	0	-	-	-	1	0	0
SUBTOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
Corrected*	**0**			**0**			**1**			**1**			**0**			**2**		

CHUM TOTAL	**2**	**0**	**0**

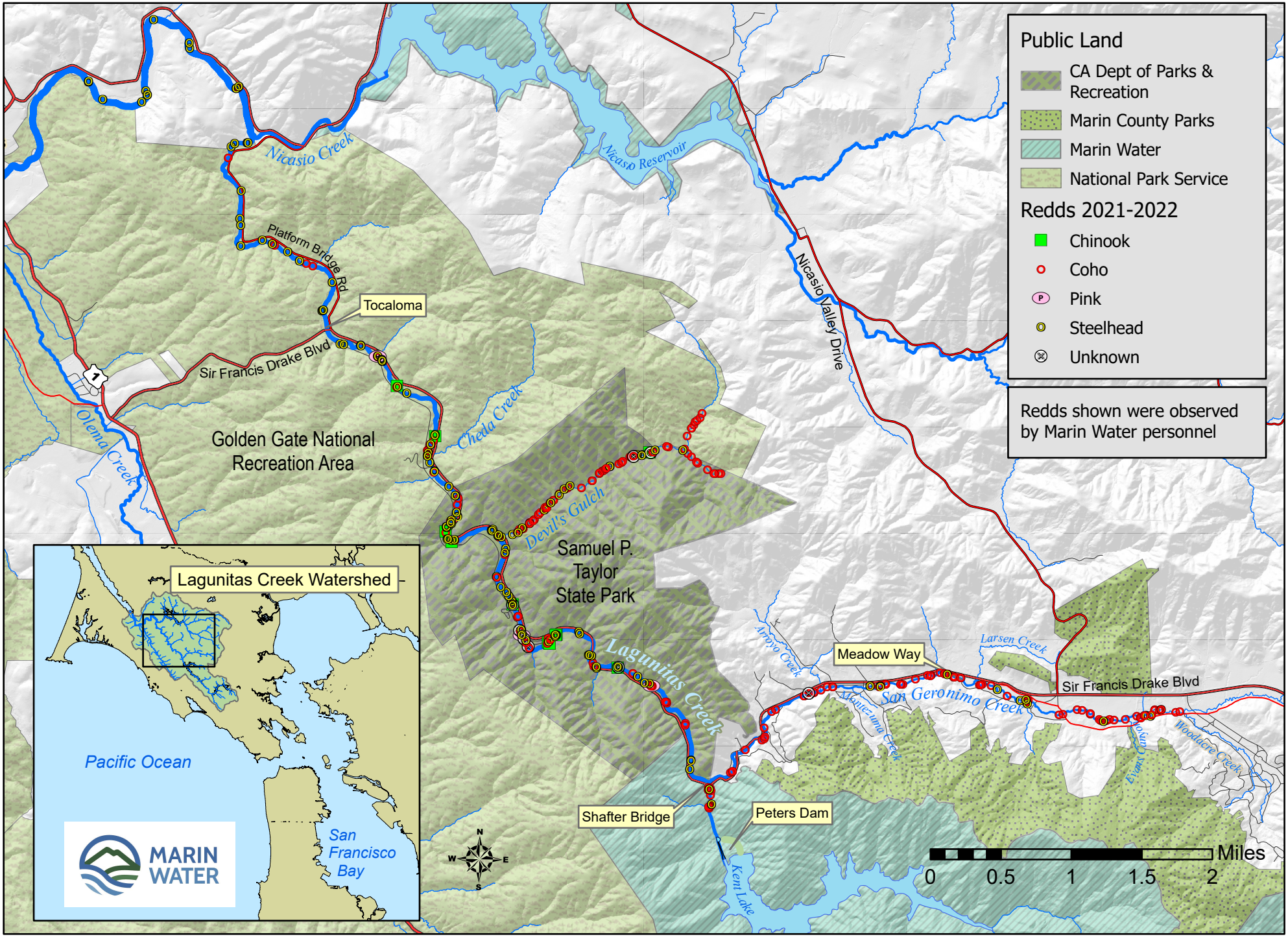

Figure 1. Salmonid redds in the Lagunitas Creek Watershed, 2021-22

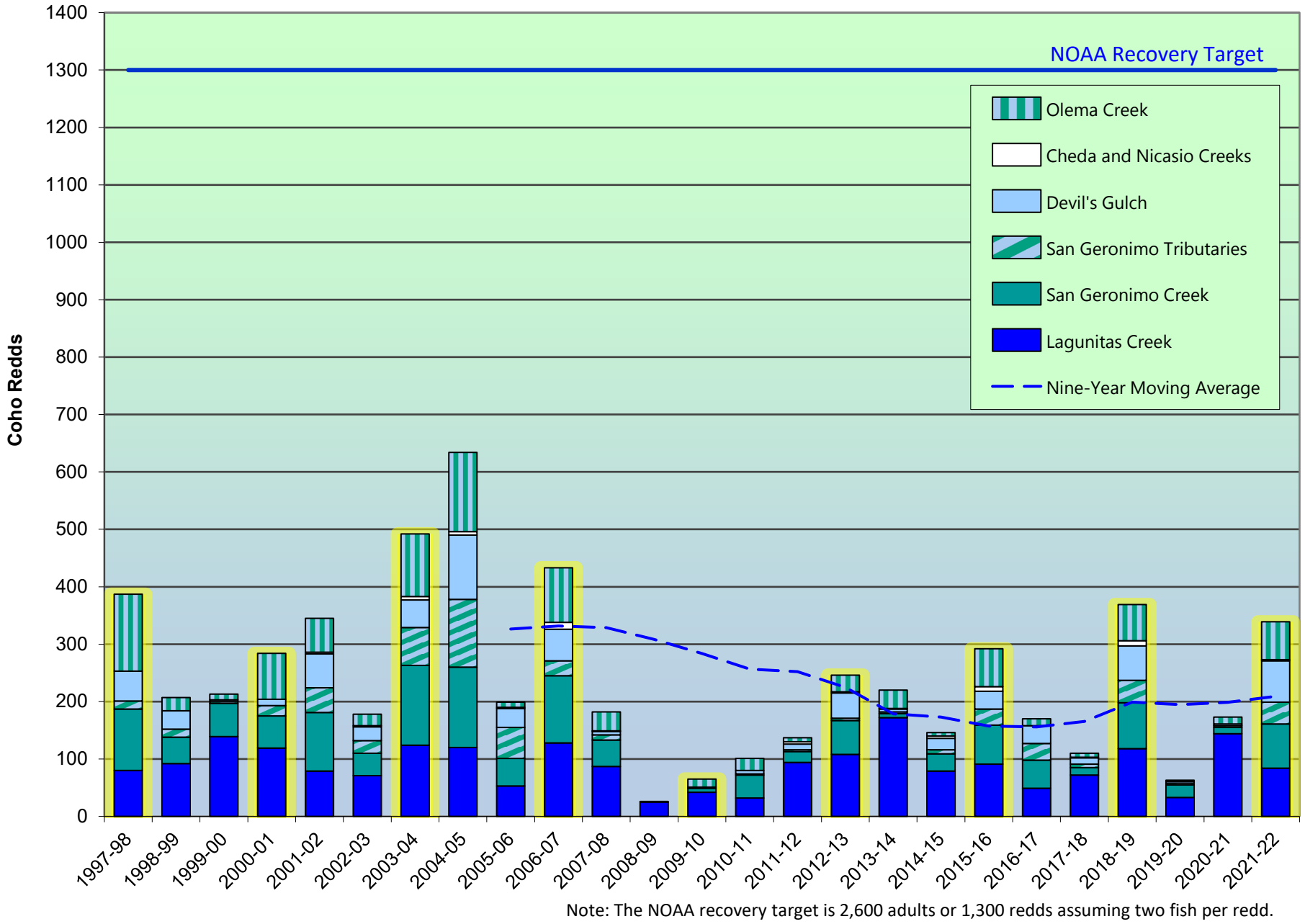

Figure 2. Coho Salmon Redds in the Lagunitas Creek Watershed (the current year class is highlighted).

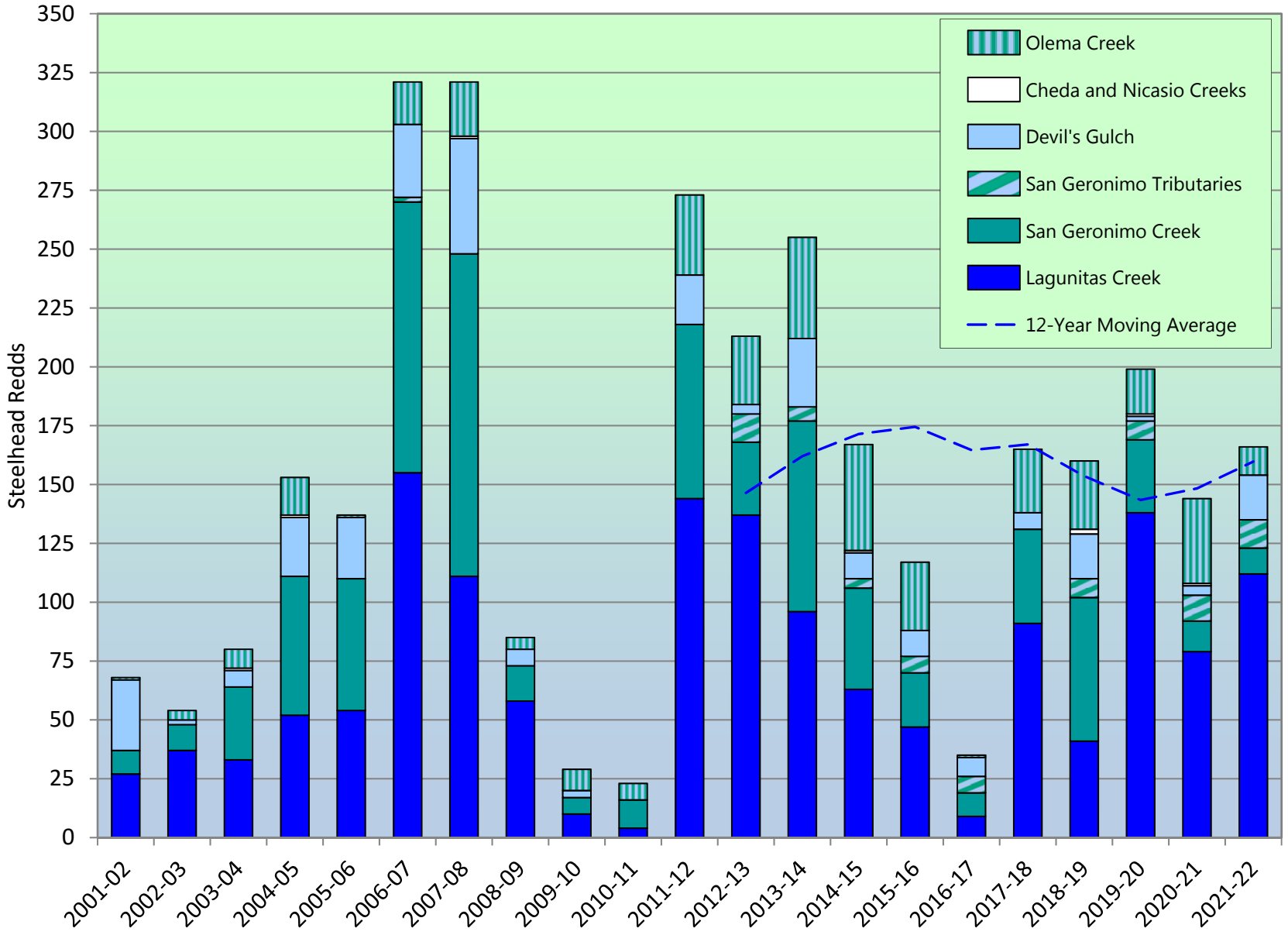

Figure 3. Steelhead Redds in the Lagunitas Creek Watershed.

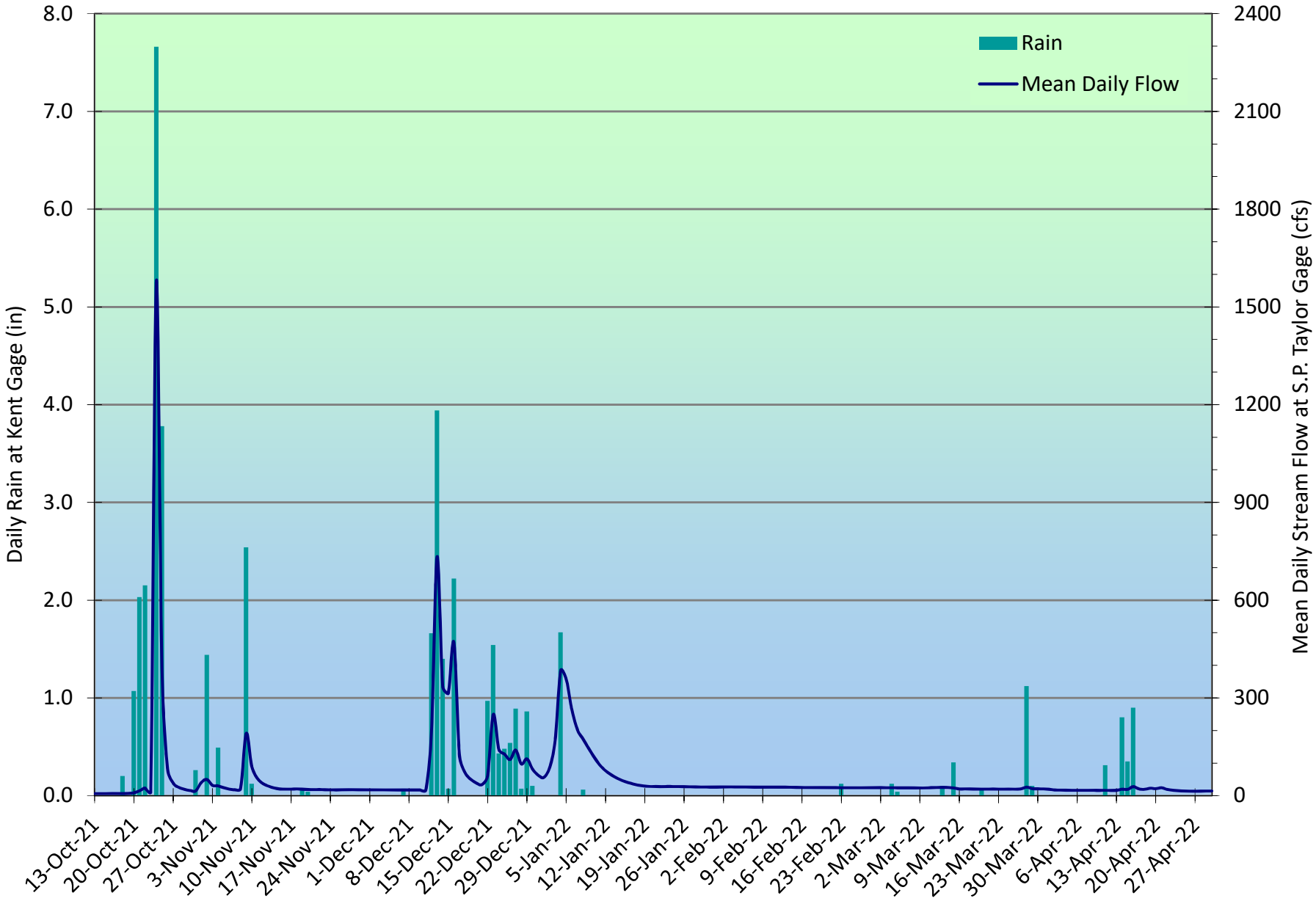

Figure 4. Rain and Lagunitas Creek Stream Flow

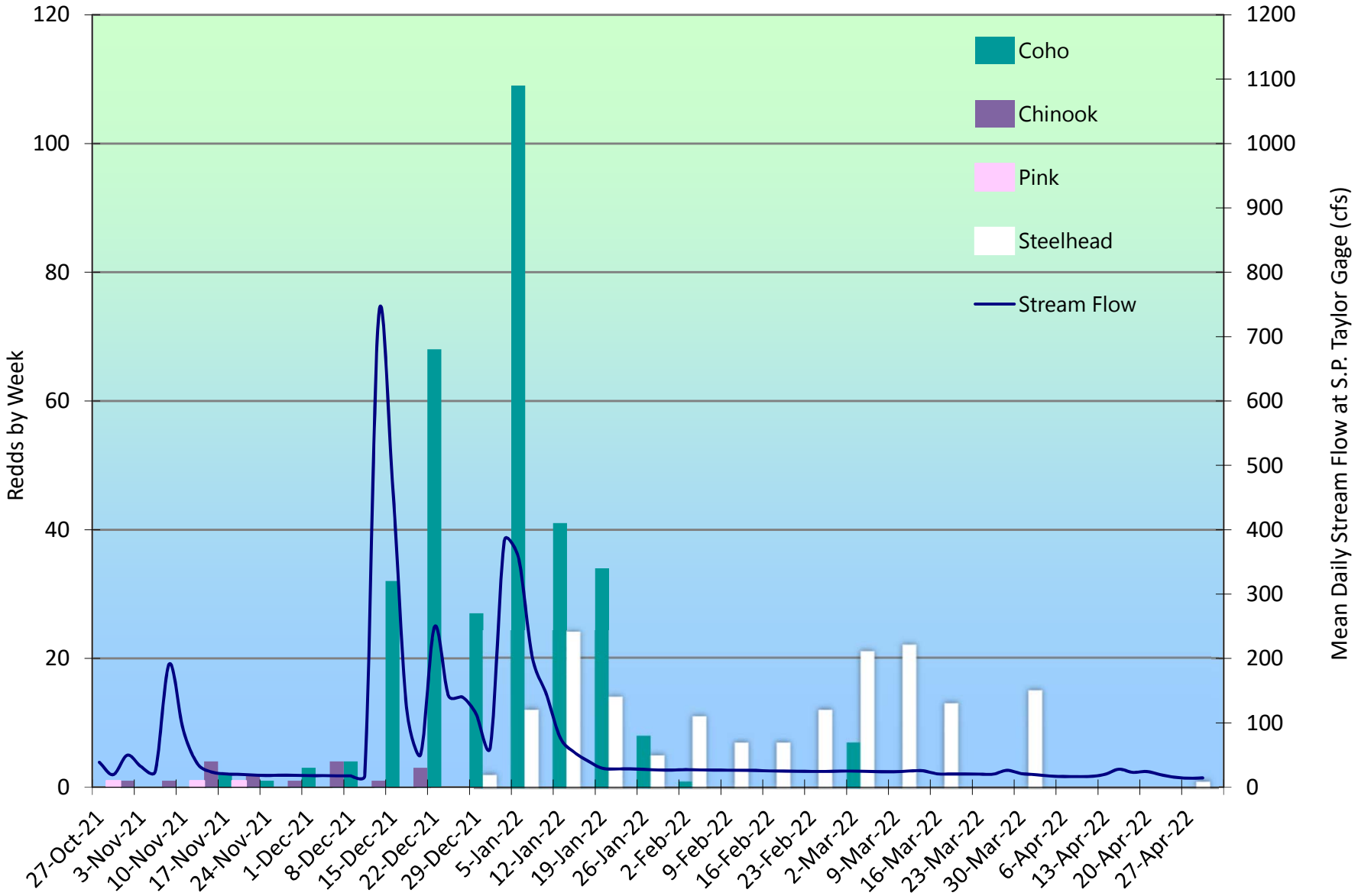

Figure 5. Salmonid Redds and Lagunitas Creek Stream Flow