ADULT SALMONID MONITORING IN THE LAGUNITAS CREEK WATERSHED 2022-2023

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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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Cover photo: Coho and Chinook Salmon in Lagunitas Creek (Credit: George Osner)

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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 November 2, 2022, and surveys ended on March 3, 2023.

This year, 106 Coho Salmon redds and 257 live Coho Salmon were observed in the Lagunitas Creek Watershed. The official coho escapement estimate was 212, based on a conservative assumption of two spawners per redd. The run was less than half of average but increased by 68% from the spawning run three years earlier.

The steelhead run was one of the smallest on record, with 43 redds and 12 live fish observed. Based on an assumption of two spawners per redd, the steelhead escapement was 86 adults. The 49 Chinook Salmon redds and 134 live Chinook observed were both record highs. The conservative Chinook Salmon ecapement estimate was 98 spawners. No Pink Salmon were observed, but two Chum Salmon and one Chum redd were seen.

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 in most years, as are a handful of Chum Salmon (*O. keta*). Pink Salmon (*O. gorbuscha*) have been observed occasionally since 2017.

Coho Salmon and steelhead populations in the watershed have fluctuated widely since 1970 and are significantly reduced from historic populations. 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 two years 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 female 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.

METHODS

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. 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.

Marin Water fisheries staff and WSP members walked sections of creek once per week between November 2, 2022 and March 3, 2023. Lagunitas Creek was divided into three sections for weekly surveys (Figure 1): Tocaloma Bridge to Devil's Gulch (4.0 km), Devil's Gulch to

Shafter Bridge (4.8 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 twice. 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 (pink 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., 2022-23 escapement / 2021 smolt emigration).

RESULTS

A total of 106 Coho Salmon redds and 257 live Coho Salmon were observed during spawner surveys in the Lagunitas Creek Watershed (Table 2). The redd count was less than half of the 20-year average, but 68% higher than the count three years ago (Figure 2). The minimum escapement was 212, based on the assumption of two spawners per redd. A record 58% of spawning occurred in the San Geronimo Creek watershed. The remaining spawning included 33% in mainstem Lagunitas Creek, 8% in Devil's Gulch, and 1% in Olema Creek.

The steelhead run was among the smallest on record, with only 43 steelhead redds observed (Figure 3), corresponding to an escapement estimate of 86 steelhead. Only 12 adult steelhead were observed in the watershed (Table 3). Of the steelhead redds observed, 39% were in the San Geronimo Creek watershed, 29% in Olema Creek, 24% in Lagunitas Creek, and 7% in Devil's Gulch.

By contrast, the Chinook Salmon run was the largest on record. Surveyors documented 49 Chinook Salmon redds and 134 live Chinook Salmon this season (Table 4). In addition, two live Chum Salmon and one Chum Salmon redd were seen (Table 5). Marin Water surveyors could not determine the origin of 14 redds (8% of Marin Water redds).

DISCUSSION

The 2022-23 Coho Salmon spawning run was below average, but an improvement in the year class. The apparent marine survival rate was a below average 2.5%. A succession of atmospheric rivers between late-December and mid-January (Figure 4) prevented surveys for four weeks during what is ordinarily the latter part of the Coho Salmon run. While some spawning may have been missed during that time, observations of live fish and redds were already declining sharply from their early-December peaks (Figure 5). The below average redd count was almost certainly due to a small Coho Salmon run and not a truncated survey effort.

The extended pause in surveys may have had a greater impact on steelhead observations, but here too the available evidence points to an unusually small run. Steelhead spawning typically peaks in February, but the six redds observed in February were the fewest on record, despite favorable survey conditions. There's also no evidence that spawning would have increased in March after surveys ended.

The large Chinook Salmon run was somewhat surprising given the apparently poor marine survival rates for coho and steelhead. Chinook smolt numbers have not been unusually large in recent years. One possibility is that many of the spawners were hatchery strays, but we have little evidence of that. Few fish were observed to have missing adipose fins - the telltale mark of a hatchery fish. However, many hatchery Chinook Salmon are not given an external mark, so the contribution of stray hatchery fish to this year's large run remains a mystery.

Only five percent of Coho Salmon redds were superimposed by later redds, which makes sense given the small number of steelhead redds observed. Of nine superimposed redds, eight were superimposed by other coho, and only one was superimposed by a steelhead. High stream flows likely had a larger impact on incubating salmonid eggs. In January and March, flows reached magnitudes that have been associated with streambed movement and poor fry production. In 2017 and 2019, stream flows exceeded 4,000 cubic feet per second (similar to this year) and Coho Salmon egg-to-fry survival was only three percent, or about half of average.

Of the 165 redds observed during Marin Water surveys, 75 (45%) were never associated with a live fish. Six of these were observed when steelhead were the only salmonid still spawning, so were classified as steelhead. All other unoccupied redds were classified by their dimensions, appearance, and the proportions of salmonid species seen that week. Nearly half of these redds were classified as Coho Salmon based on the abundance of coho that week and their sprawling,

sandy pits. Steelhead redds tend to be narrower than the redds of other species, and 13 redds were classified as being built by steelhead based on being less than two meters wide. Eight redds were classified as Chinook Salmon based on their large size and/or early date. A single redd built in deep, slow-moving water was classified as Chum Salmon, after a single Chum Salmon was seen in that reach. Evidence was mixed for the remaining 12 unoccupied redds and these remained unclassified.

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Table 2. Observations of Coho Salmon in the Lagunitas Creek Watershed, Spawning Season 2022-23

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
2-Nov-22	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
10-Nov-22	-	-	-	-	-	-	-	-	-	0	0	0	-	-	-	0	0	0
16-Nov-22	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
17-Nov-22	-	-	-	-	-	-	-	-	-	1	0	0	1	0	0	2	0	0
22-Nov-22	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	2	1	1
23-Nov-22	-	-	-	-	-	-	-	-	-	1	0	0	0	0	0	1	0	0
29-Nov-22	-	-	-	-	-	-	6	0	0	-	-	-	-	-	-	6	0	0
2-Dec-22	-	-	-	-	-	-	-	-	-	19	0	2	0	0	0	19	0	2
6-Dec-22	-	-	-	-	-	-	27	0	11	-	-	-	-	-	-	27	0	11
9-Dec-22	-	-	-	-	-	-	-	-	-	19	0	8	4	0	2	23	0	10
13-Dec-22	-	-	-	-	-	-	6	0	0	-	-	-	-	-	-	6	0	0
15-Dec-22	-	-	-	-	-	-	-	-	-	24	1	4	2	0	1	26	1	5
19-Dec-22	-	-	-	-	-	-	8	3	2	-	-	-	-	-	-	8	3	2
20-Dec-22	-	-	-	-	-	-	-	-	-	15	4	4	2	0	0	17	4	4
26-Jan-23	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
27-Jan-23	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
31-Jan-23	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
2-Feb-23	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
15-Feb-23	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
17-Feb-23	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
21-Feb-23	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
23-Feb-23	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	0	0	0
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**49**	**4**	**14**	**79**	**5**	**18**	**9**	**0**	**3**	**137**	**9**	**35**
Corrected	**0**			**0**			**46**			**78**			**8**			**132**		

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
9-Nov-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
21-Nov-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
6-Dec-22	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
7-Dec-22	9	0	6	-	-	-	-	-	-	-	-	-	-	-	-	9	0	6
14-Dec-22	-	-	-	34	0	15	3	0	5	-	-	-	0	0	1	37	0	21
15-Dec-22	32	0	18	-	-	-	-	-	-	-	-	-	-	-	-	32	0	18
16-Dec-22	-	-	-	-	-	-	-	-	-	3	0	7	-	-	-	3	0	7
21-Dec-22	32	0	4	-	-	-	-	-	-	-	-	-	0	1	0	32	1	4
22-Dec-22	-	-	-	-	-	-	0	0	1	-	-	-	-	-	-	0	0	1
3-Jan-24	-	-	-	-	-	-	18	0	12	-	-	-	-	-	-	18	0	12
4-Jan-23	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
11-Jan-23	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
18-Jan-23	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
23-Jan-23	1	0	1	-	-	-	-	-	-	-	-	-	0	0	0	1	0	1
24-Jan-23	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
25-Jan-23	-	-	-	-	-	-	-	-	-	0	2	0	-	-	-	0	2	0
1-Feb-23	-	-	-	-	-	-	-	-	-	-	-	-	0	1	0	0	1	0
7-Feb-23	-	-	-	-	-	-	-	-	-	0	0	1	0	0	0	0	0	1
8-Feb-23	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
9-Feb-23	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
19-Feb-23	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0
2-Mar-23	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	0	0	0
3-Mar-23	-	-	-	-	-	-	-	-	-	0	0	0	-	-	-	0	0	0
Subtotal	**74**	**0**	**29**	**34**	**0**	**15**	**21**	**0**	**18**	**3**	**2**	**8**	**0**	**2**	**1**	**132**	**4**	**71**
Corrected*	**67**			**34**			**21**			**3**			**0**			**125**		

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]	0	0	0

COHO TOTAL	**257**	**13**	**106**

Table 3. Observations of Steelhead in the Lagunitas Creek Watershed, Spawning Season 2022-23

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
26-Jan-23	-	-	-	-	-	-	-	-	-	2	0	4	-	-	-	2	0	4
27-Jan-23	-	-	-	-	-	-	0	1	1	-	-	-	-	-	-	0	1	1
31-Jan-23	-	-	-	0	0	2	-	-	-	-	-	-	-	-	-	0	0	2
15-Feb-23	-	-	-	-	-	-	-	-	-	0	0	1	0	0	0	0	0	1
17-Feb-23	-	-	-	-	-	-	0	0	1	-	-	-	-	-	-	0	0	1
21-Feb-23	-	-	-	-	-	-	-	-	-	0	0	1	0	0	0	0	0	1
SUBTOTAL	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**1**	**2**	**2**	**0**	**6**	**0**	**0**	**0**	**2**	**1**	**10**
Corrected*	**0**			**0**			**0**			**2**			**0**			**2**		

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
14-Dec-22	-	-	-	0	0	4	-	-	-	-	-	-	-	-	-	0	0	4
15-Jan-23	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	1	0	1
22-Jan-23	-	-	-	-	-	-	-	-	-	-	-	-	5	1	3	5	1	3
23-Jan-23	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1
24-Jan-23	-	-	-	0	0	3	-	-	-	-	-	-	-	-	-	0	0	3
25-Jan-23	-	-	-	-	-	-	-	-	-	0	0	2	-	-	-	0	0	2
29-Jan-23	-	-	-	-	-	-	-	-	-	-	-	-	2	0	5	2	0	5
5-Feb-23	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1	0	0	1
7-Feb-23	-	-	-	-	-	-	-	-	-	0	0	3	-	-	-	0	0	3
19-Feb-23	-	-	-	-	-	-	-	-	-	-	-	-	0	0	2	0	0	2
2-Mar-23	2	0	2	0	0	0	0	0	6	-	-	-	-	-	-	2	0	8
SUBTOTAL	**2**	**0**	**3**	**0**	**0**	**7**	**0**	**0**	**6**	**0**	**0**	**5**	**8**	**1**	**12**	**10**	**1**	**33**
Corrected*	**2**			**0**			**0**			**0**			**8**			**10**		

Notes:

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

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

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

[2] Data provided by the National Park Service.

STEELHEAD IN OTHER TRIBUTARIES			
CHEDA CREEK	0	0	0

STEELHEAD TOTAL	**12**	**2**	**43**

Table 4. Observations of Chinook Salmon in the Lagunitas Creek Watershed, Spawning Season 2022-23

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
10-Nov-22	-	-	-	-	-	-	-	-	-	2	0	1	-	-	-	2	0	1
16-Nov-22	-	-	-	0	0	1	-	-	-	-	-	-	-	-	-	0	0	1
17-Nov-22	-	-	-	-	-	-	-	-	-	16	1	10	2	-	2	18	1	12
22-Nov-22	-	-	-	-	-	-	12	0	4	-	-	-	-	-	-	12	0	4
23-Nov-22	-	-	-	-	-	-	-	-	-	24	1	8	5	0	1	29	1	9
29-Nov-22	-	-	-	-	-	-	1	0	0	-	-	-	-	-	-	1	0	0
2-Dec-22	-	-	-	-	-	-	-	-	-	15	0	5	5	0	1	20	0	6
6-Dec-22	-	-	-	-	-	-	8	0	2	-	-	-	-	-	-	8	0	2
9-Dec-22	-	-	-	-	-	-	-	-	-	30	2	8	1	0	0	31	2	8
13-Dec-22	-	-	-	-	-	-	2	0	2	-	-	-	-	-	-	2	0	2
15-Dec-22	-	-	-	-	-	-	-	-	-	14	0	1	9	-	1	23	0	2
19-Dec-22	-	-	-	-	-	-	0	1	0	-	-	-	-	-	-	0	1	0
20-Dec-22	-	-	-	-	-	-	-	-	-	4	0	0	2	0	2	6	0	2
Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**23**	**1**	**8**	**105**	**4**	**33**	**24**	**0**	**7**	**152**	**5**	**49**
Corrected*	**0**			**0**			**22**			**89**			**23**			**134**		

CHINOOK TOTAL	**134**	**5**	**49**

Table 5. Observations of Chum Salmon in the Lagunitas Creek Watershed, Spawning Season 2022-23

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
22-Nov-22	-	-	-	-	-	-	1	0	0	-	-	-	-	-	-	1	0	0
15-Dec-22	-	-	-	-	-	-	-	-	-	1	0	0	-	-	-	1	0	0
20-Dec-22	-	-	-	-	-	-	-	-	-	0	0	1	-	-	-	0	0	1
SUBTOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**1**
Corrected*	**0**			**0**			**1**			**1**			**0**			**2**		

CHUM TOTAL	**2**	**0**	**1**

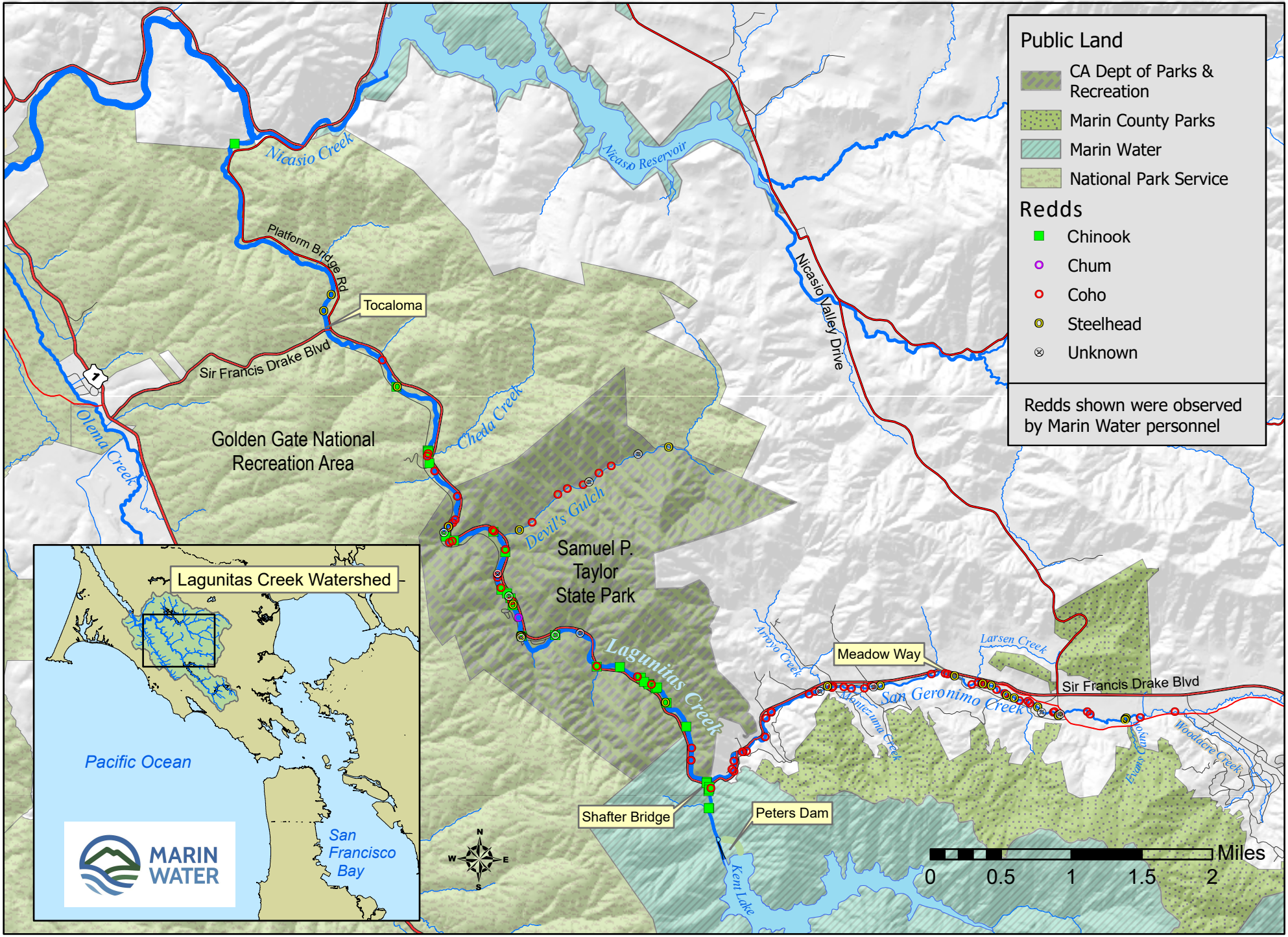

Figure 1. Salmonid redds in the Lagunitas Creek Watershed, 2021-22

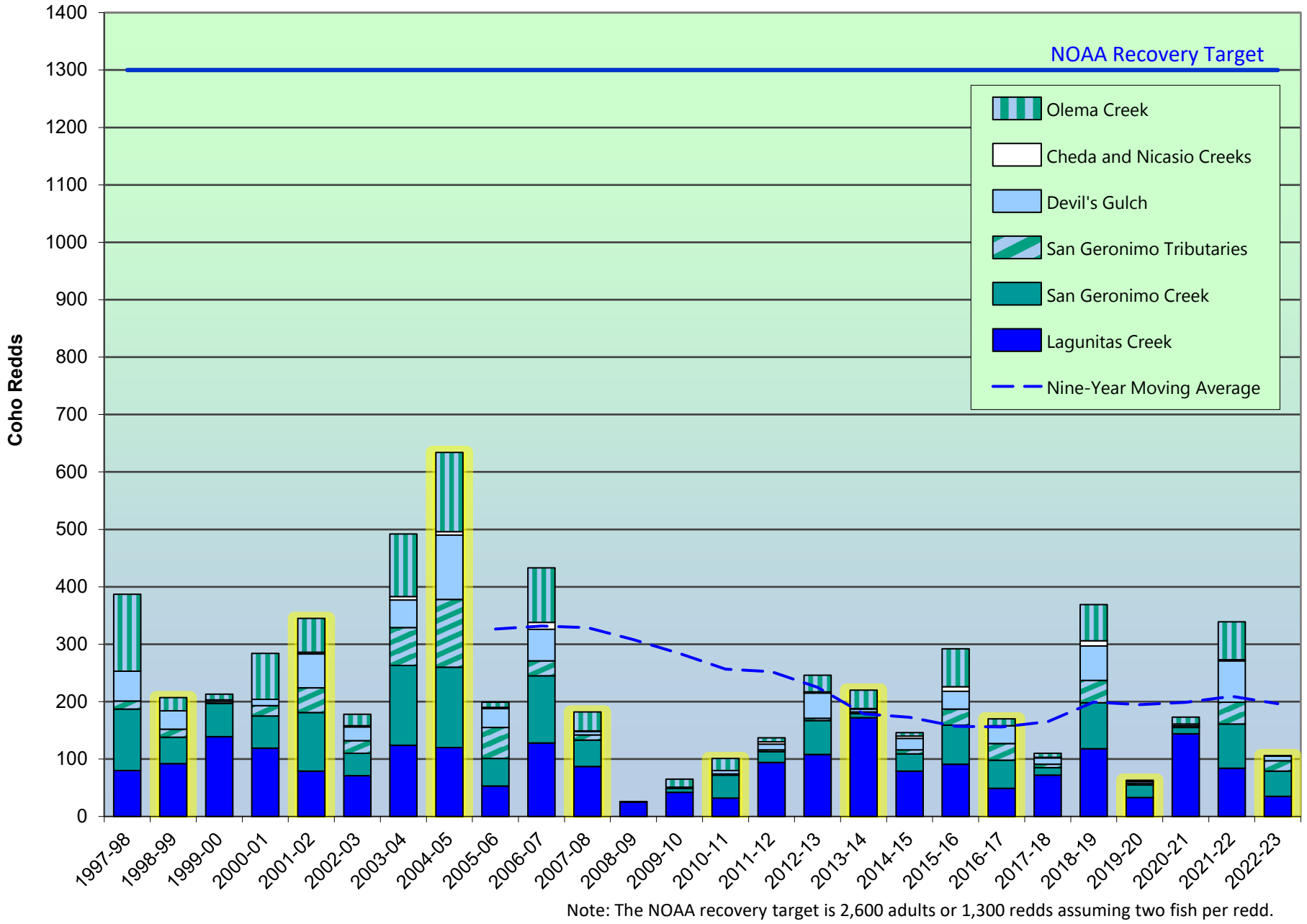

Figure 2. Coho Salmon Redds in the Lagunitas Creek Watershed (the current year class is highlighted).

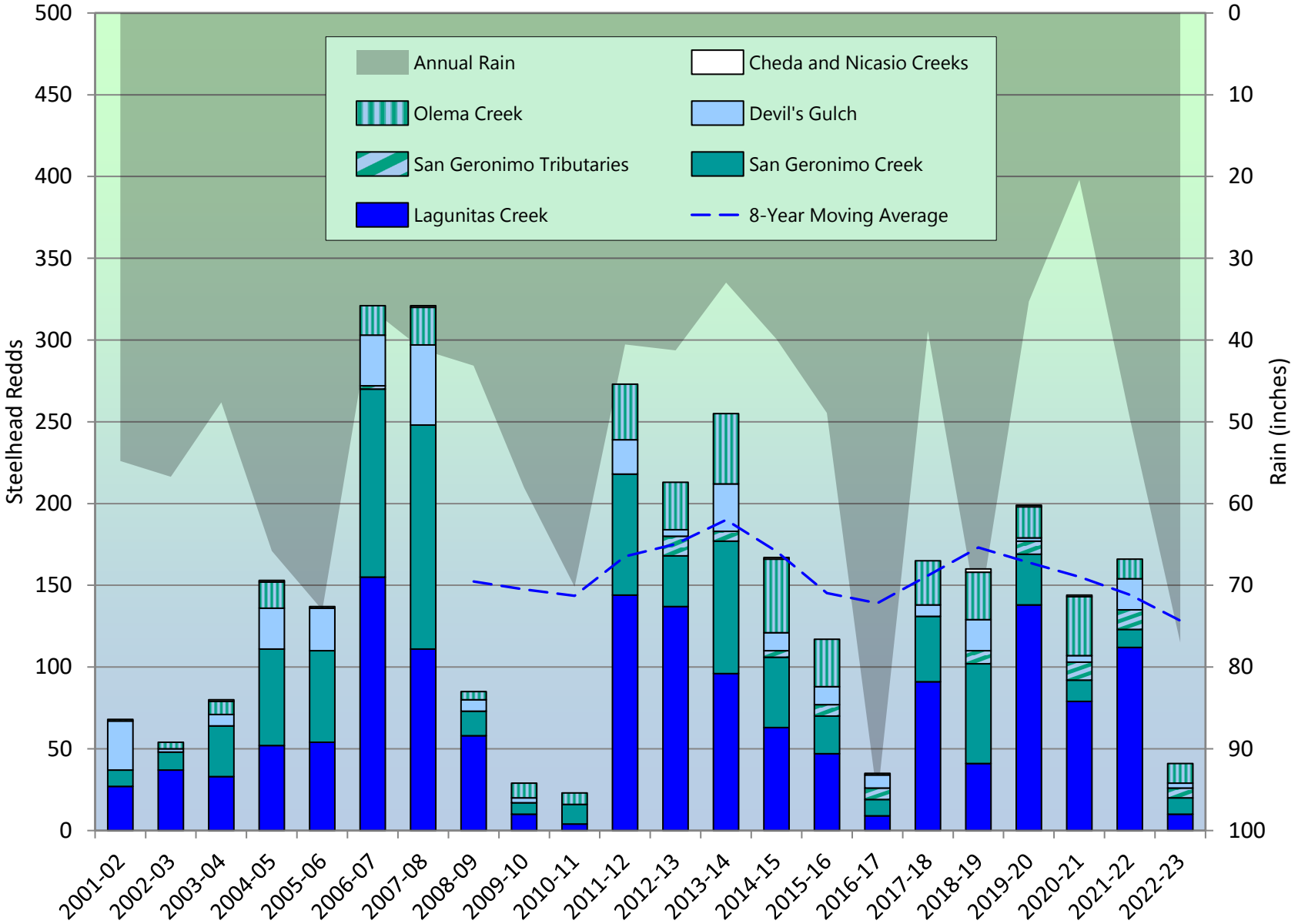

Figure 3. Steelhead Redds in the Lagunitas Creek Watershed. Note: Wet years typically result in fewer surveys.

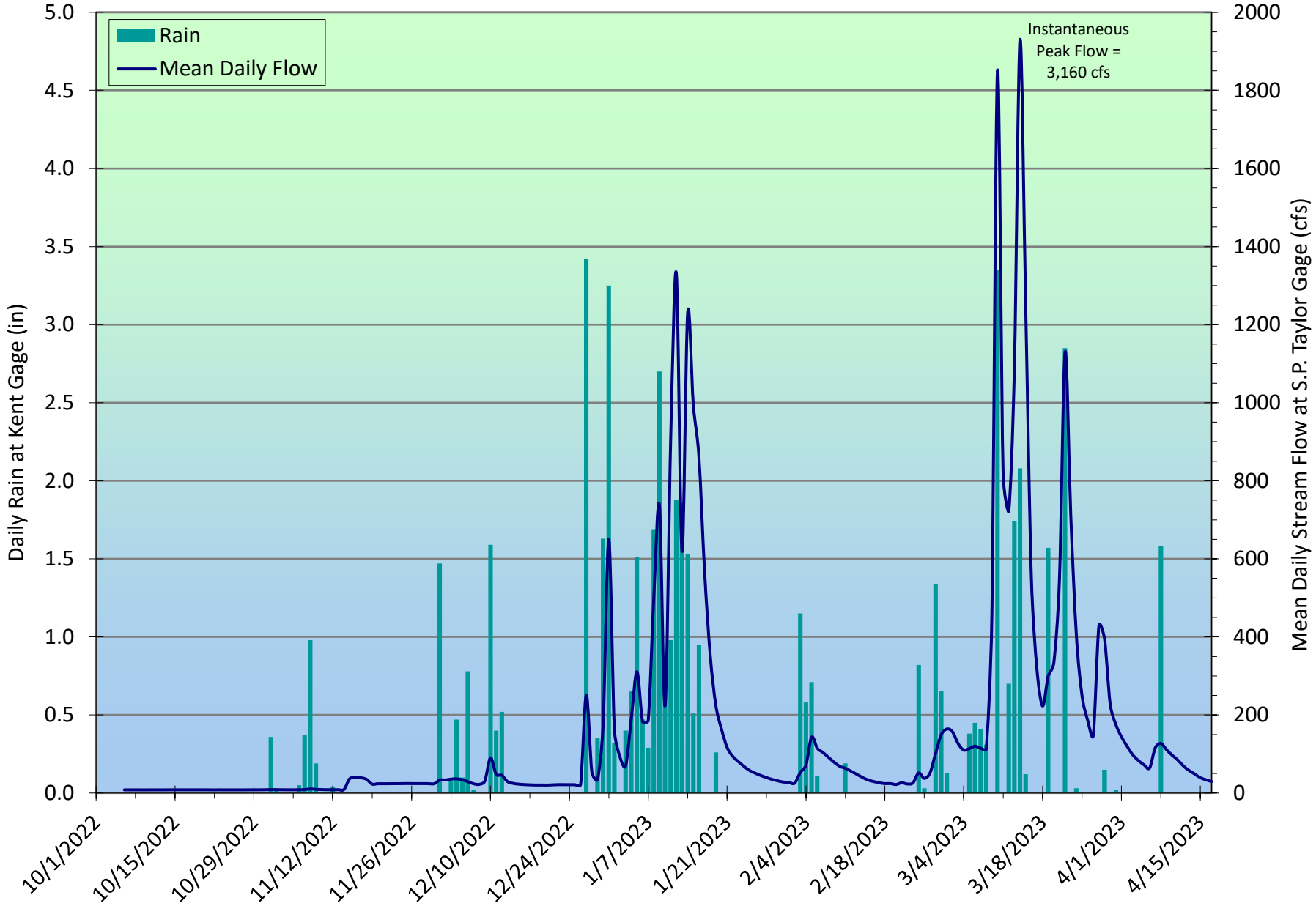

Figure 4. Rain and Lagunitas Creek Stream Flow

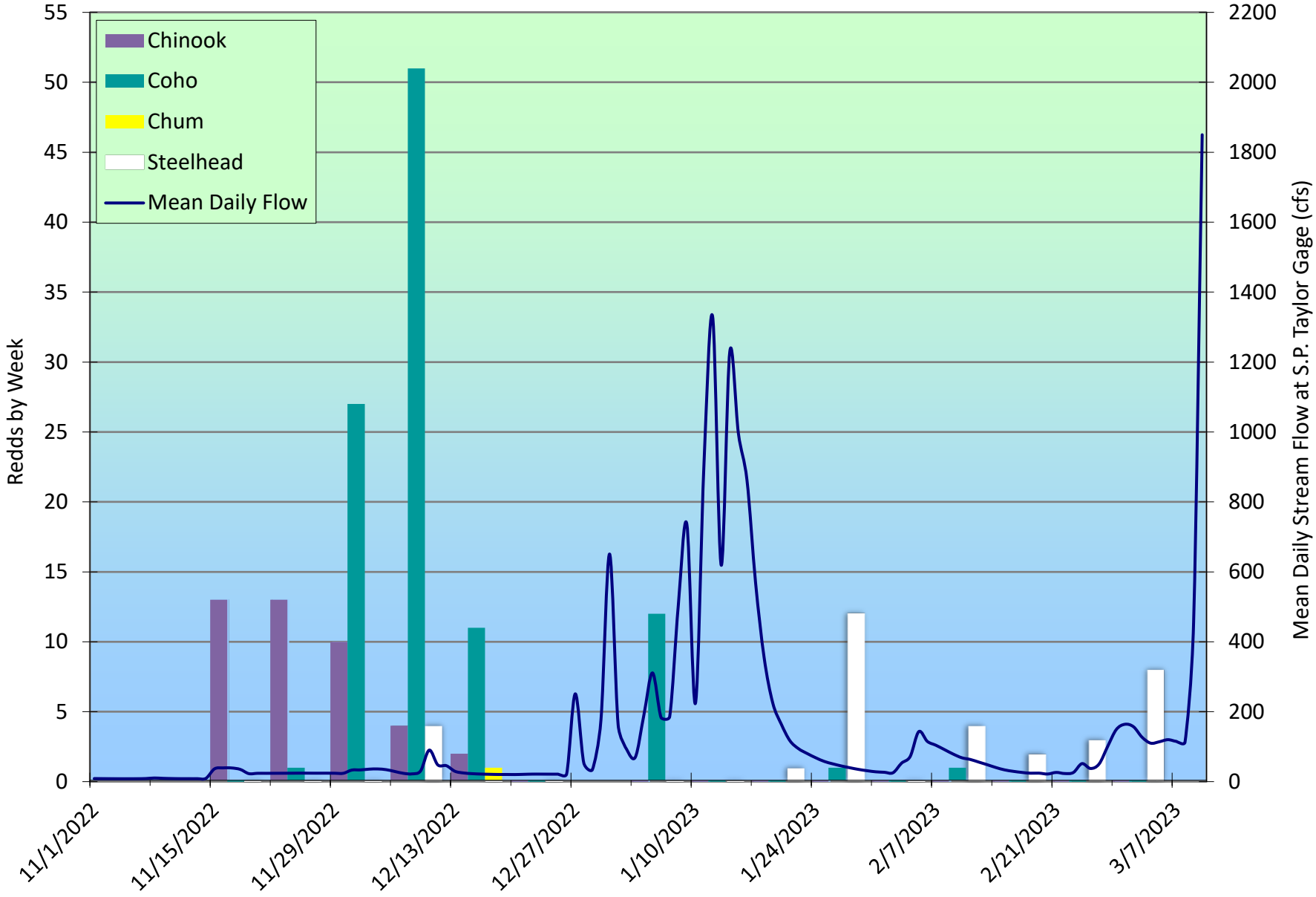

Figure 5. Salmonid Redds and Lagunitas Creek Stream Flows