Coho Salmon and Steelhead Monitoring Report

Summer 2024

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1. Background

In 2004, the Russian River Coho Salmon Captive Broodstock Program (Broodstock Program) began releasing juvenile coho salmon raised at the US Army Corps of Engineer's (USACE) Don Clausen Fish Hatchery into tributaries of the Russian River with the goal of reestablishing populations that were on the brink of extirpation from the watershed. California Sea Grant at University of California (CSG) worked with local, state, and federal biologists to design and implement a coho salmon monitoring program to track the survival and abundance of hatchery-released fish. Since the first Broodstock Program releases, CSG has been closely monitoring smolt abundance, adult returns, survival, and spatial distribution of coho salmon populations in four life cycle monitoring (LCM) watersheds: Willow, Dutch Bill, Green Valley, and Mill creeks. Data collected from this effort are provided to the Broodstock Program for use in evaluating the success of hatchery releases and adaptively managing future releases.

In 2013, CSG began partnering with Sonoma Water (SW) and California Department of Fish and Wildlife (CDFW) to implement the California Monitoring Plan (CMP) in the Russian River watershed. The CMP is a statewide effort to document status and trends of anadromous salmonid populations to inform recovery, conservation, and management activities. This work complements the Broodstock Program monitoring by incorporating a basinwide component that includes surveys in over 40 streams and expanding the species monitored to include steelhead and Chinook salmon.

In 2023, CSG began transitioning away from field data collection and subcontracted with SW to conduct field activities associated with Broodstock Program monitoring. Beginning in the summer of 2023, all field data has been collected by SW.

The intention of our monitoring is to provide science-based information to stakeholders involved in salmon and steelhead recovery. Our work would not be possible without the support of our partners, including public resource agencies and non-profit organizations, along with hundreds of private landowners who have granted us access to the streams that flow through their properties.

In this seasonal monitoring report, we provide results from our summer Broodstock Program and CMP snorkel surveys, including relative abundance and spatial distribution of juvenile salmonids in Russian River tributaries. Additional information and previous reports can be found on our website.

2. Juvenile Presence and Distribution

2.1. Goals and objectives

Summer snorkel surveys were conducted in Russian River tributaries to document the relative abundance and spatial distribution of juvenile coho salmon and steelhead during the summer of 2024. These data were used to determine whether successful spawning occurred the previous winter and to track spatiotemporal trends in relative abundance and occupancy.

2.2. Methods

2.2.1. Sampling reaches

For Broodstock Program monitoring, we surveyed juvenile salmonid reaches of Willow, Dutch Bill, Green Valley, and Mill creeks (Figure 1) during the summer season. For CDFW's California Monitoring Plan for Salmon and Steelhead (CMP), a spatially-balanced random sample of reaches from the Russian River sample frame (a sample frame of stream reaches identified by the Russian River CMP Technical Advisory Committee[1] as having coho salmon, steelhead, and/or Chinook salmon habitat) was selected using a generalized random tessellation stratified (GRTS) approach as outlined in Fish Bulletin 180 (Adams et al. 2011). The reaches surveyed (using a GRTS draw) were selected only from reaches that contained juvenile coho habitat. Counts from these reaches were used to estimate basinwide juvenile coho salmon occupancy. Counts from all surveyed reaches (i.e., census surveys in the life cycle monitoring reaches and coho ocupancy reaches) were used to document relative abundance of juvenile coho and steelhead. Sample frame reaches identified as steelhead-only (primarily tributaries to the upper basin) were not surveyed.

2.2.2. Field methods

Sampling was based on modifications of protocols described in Garwood and Ricker (2014). On each snorkel survey, salmonids were counted in every other pool within the reach, with the first pool (one or two) determined randomly. Pools were defined as habitat units with a depth of greater than one foot in an area at least as long as the maximum wetted width, and a surface area of greater than three square meters. A GPS point was collected at the downstream end of each pool snorkeled. For reaches that were included in the occupancy estimate, a second snorkeling pass was completed the following day. During the second pass, every other pool that was snorkeled during the first pass was snorkeled a second time in order to account for snorkel count efficiency in the occupancy model.

During each survey, snorkeler(s) moved from the downstream end of each pool (pool tail crest) to the upstream end, surveying as much of the pool as water depth allowed. Dive lights were used to inspect shaded and covered areas. In larger pools requiring two snorkelers, two lanes were agreed upon and each snorkeler moved upstream through the lane at the same rate. Final counts for the pool were the sum of both lane counts. All observed salmonids were identified to species (coho salmon, Chinook salmon, steelhead, or unknown salmonid species) and age class (young-of-year (yoy)

[1] A body of fisheries experts, including members of the Statewide CMP Technical Team, tasked with providing guidance and technical advice related to CMP implementation in the Russian River.

or parr (≥ age-1)), based on size and morphological characteristics. Presence of non-salmonid species was documented at the reach scale. Electronic devices were used for data entry and, upon returning from the field, data files were downloaded, error checked, and transferred into a SQL database. Spatial data were downloaded, error checked, and stored in an ArcGIS geodatabase for map production.

We assumed that all coho juveniles observed were correctly assigned to age class (age-0 v. age-1) and that all yoy observed were natural-origin (NOR). Because no hatchery-origin (HOR) fish were released during spring, 2024, the NOR assumption for yoy is valid. However, because there is no visual mark we can use to distinguish age classes (age-0 v. age-1), we approximated fish length visually during surveys using a size cut-off of 100 mm. For several reasons (e.g., observer error, differences in growth opportunity among streams and/or years, variability in emergence time, etc.), it is possible that age class assignment for some individuals was incorrect (i.e., fish assigned as yoy were in fact small age-1 fish and/or large age-0 fish were incorrectly assigned as age-1). However, we do not think violation of the size/age class assumption resulted in significant bias because the frequency of age-2 "holdovers" emigrating from the four LCMs as smolts is rare (1%, based on PIT-tagged smolts captured in downstream migrant traps from 2013 – 2023). Nevertheless, it is possible that age class assignment errors could result in incorrect documentation of coho yoy presence if all individuals in a given reach were incorrectly assigned. Because this is only problematic in reaches where very few coho are observed, on our presence absence maps we color code reaches with less than 10 coho yoy observations with different coloring.

2.2.3. Metrics

2.2.3.1. Relative abundance

First-pass counts were used to document the minimum number of coho salmon and steelhead yoy and parr observed in each reach. Because only half of the pools were snorkeled, minimum counts were doubled for an expanded minimum count. Expanded minimum counts did not account for detection efficiency; therefore, they should only be considered approximate estimates of abundance for relative comparisons. It should also be noted that only reaches thought to contain both coho and steelhead habitat were surveyed (see Section 2.2.1).

2.2.3.2. Spatial distribution

Multiscale occupancy models were used to estimate the probability of juvenile coho salmon occupancy at the sample reach scale (ψ) and conditional occupancy at the sample pool scale (θ), given presence in the reach (Nichols et al. 2008; Garwood and Larson 2014). Detection probability (p) at the pool scale was accounted for using the repeated dive pass data in the occupancy model. The proportion of area occupied (PAO) was then estimated by multiplying the reach- and pool-scale occupancy parameters (ψ*θ).

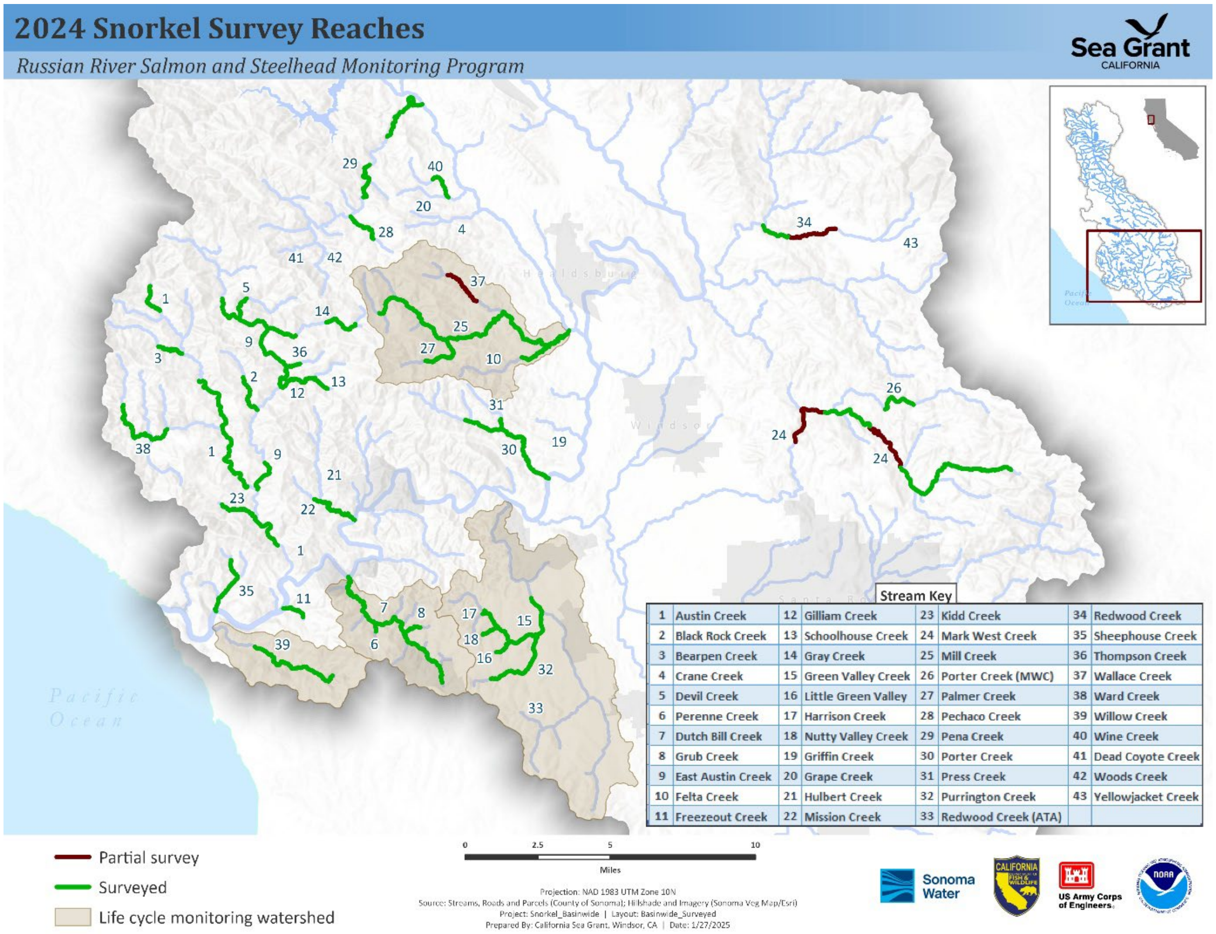

Figure 1. Reaches snorkeled during 2024 summer juvenile surveys. Note that in four of the reaches, surveys were incomplete.

2.3. Results

Between June 10 and September 19, 2024, SW biologists snorkeled 54 reaches representing 154 km of stream length in 35 tributaries. With the exception of a portion of Mill Creek where we do not have landowner access, all juvenile coho salmon rearing reaches of Willow, Dutch Bill, and Green Valley creeks were surveyed for Broodstock Program monitoring, and 51 reaches within the Russian River sample frame that were considered to contain juvenile coho salmon habitat (49% of coho salmon reaches) were included in the basinwide occupancy estimate. Three reaches (one on Wallace Creek, one on Redwood Creek, and one on Mark West Creek) were not included in the occupancy estimate because visibility was so poor on the first pass that the second pass was abandoned.

During the summer of 2024, we observed a total of 1,287 coho salmon yoy, with an expanded minimum coho count of 2,574 (Table 1), and we observed 15,045 steelhead yoy, with an expanded minimum steelhead count of 30,090 (Table 2). The mean density of 17 coho yoy per km was well below the previous nine-year average of 64, while the 195 steelhead yoy per reach was above the previous nine-year average of 171 (Figure 2). Coho salmon yoy were observed in 18 of the 54 juvenile coho salmon reaches surveyed and in 16 of the 35 juvenile coho salmon streams snorkeled (33% and 46%, respectively) (Figure 3). Steelhead yoy were observed in 51 of the 54 steelhead reaches and 32 of the 35 steelhead streams surveyed (94% and 91%, respectively). In 6 of the 16 streams where coho yoy were found, fewer than 10 coho were observed. Coho yoy counts were highest in Green Valley, Dutch Bill and Kidd creeks, though even in those streams numbers were low. Counts of steelhead yoy were highest in the Pena and Mill subwatersheds, and relatively high numbers were also observed in Porter Creek.

Based on results of the multiscale occupancy model, we estimate that the probability of coho salmon yoy occupying a given reach within the basinwide Russian River coho salmon stratum (ψ) in 2024 was 0.34 (0.22 - 0.48, 95% CI), and the conditional probability of coho salmon yoy occupying a pool within a reach, given that the reach was occupied (θ), was 0.40 (0.35 - 0.46, 95% CI). The proportion of the coho salmon stratum occupied (PAO) was 0.14, which was the second lowest observed since we began occupancy surveys in 2015 and approximately 55% of the 10-year average of 0.25 (Table 3).

Juvenile coho salmon were observed in all four Broodstock Program monitoring watersheds, though counts were low, especially in Willow and Mill creeks (Table 1). In Willow Creek, coho were found in the lower half of the surveyed stream length (Figure 4). In Dutch Bill Creek, the highest coho densities were in the upper half of the surveyed stream length with smaller numbers upstream of the confluence with the Russian River and in Perenne Creek (Figure 5). In Green Valley Creek watershed, the highest densities of coho were upper reaches of Green Valley from just downstream of the confluence with Little Green Valley Creek upstream to the confluence with Harrison Creek (Figure 6). Coho were found in lower densities in the lower survey reaches of Green Valley Creek and in Purrington Creek. In the Mill Creek watershed, coho were nearly absent, observed in extremely low numbers only in lower Felta Creek, Mill Creek near the confluence with Felta Creek, and in Palmer Creek (Figure 7). Spatial patterns from previous years can be viewed on our snorkel dashboard. Note that counts reported on our dashboard may differ slightly from totals in this report since all incidental snorkeling events were included on the dashboard (i.e., more than every other pool in some instances or additional streams/reaches).

Table 1. Number of coho salmon yoy and parr observed in Russian River tributaries and expanded minimum counts, summer 2024.

Tributary	Pools snorkeled	Stream length snorkeled (km)	Coho yoy	Expanded coho yoy [1]	Coho parr	Expanded coho parr [1]
Austin Creek	92	13.6	12	24	0	0
Bearpen Creek	17	1.9	0	0	0	0
Black Rock Creek	22	2.5	0	0	0	0
Devil Creek	15	1.5	0	0	0	0
Dutch Bill Creek	123	11.4	305	610	3	6
East Austin Creek	83	11	0	0	0	0
Felta Creek	25	2	13	26	0	0
Freezeout Creek	22	1.5	77	154	5	10
Gilliam Creek	39	2.6	0	0	0	0
Gray Creek	57	4.1	0	0	0	0
Green Valley Creek	75	7	460	920	2	4
Grub Creek	6	1.1	0	0	0	0
Harrison Creek	3	0.2	0	0	0	0
Hulbert Creek	30	3.2	0	0	0	0
Kidd Creek	25	2.5	112	224	1	2
Little Green Valley Creek	11	1.2	0	0	0	0
Mark West Creek [2]	122	15.7	2	4	0	0
Mill Creek	136	16.6	1	2	0	0
Nutty Valley Creek	4	1.2	7	14	0	0
Palmer Creek	49	2.9	12	24	0	0
Pechaco Creek	31	2.3	26	52	0	0
Pena Creek	45	6.9	37	74	0	0
Perenne Creek	10	0.5	7	14	0	0
Porter Creek	80	7.4	0	0	0	0
Porter Creek (MWC)	19	2.4	0	0	0	0
Press Creek	8	0.6	0	0	0	0
Purrington Creek	88	4.8	9	18	0	0
Redwood Creek [2]	30	4.8	0	0	0	0
Schoolhouse Creek	9	1.1	0	0	0	0
Sheephouse Creek	41	3.7	9	18	1	2
Thompson Creek	15	0.9	0	0	0	0
Wallace Creek [2]	20	2.5	0	0	0	0
Ward Creek	70	5	0	0	0	0
Willow Creek	107	6	198	396	7	14
Wine Creek	24	1.8	0	0	0	0
Total	**1,553**	**154**	**1,287**	**2,574**	**19**	**38**

[1] *Expanded count is the observed count multiplied by a factor of 2.*

[2] *Surveys were abbreviated in one reach due to poor visibility.*

Table 2. Number of steelhead yoy and parr observed in Russian River tributaries and expanded counts, summer 2024.

Tributary	Pools snorkeled	Stream length snorkeled (km)	Steelhead yoy	Expanded steelhead yoy [1]	Steelhead parr	Expanded steelhead parr [1]
Austin Creek	92	13.6	146	292	255	510
Bearpen Creek	17	1.9	334	668	17	34
Black Rock Creek	22	2.5	43	86	7	14
Devil Creek	15	1.5	88	176	31	62
Dutch Bill Creek	123	11.4	419	838	27	54
East Austin Creek	83	11	296	592	256	512
Felta Creek	25	2	753	1,506	40	80
Freezeout Creek	22	1.5	5	10	8	16
Gilliam Creek	39	2.6	422	844	166	332
Gray Creek	57	4.1	630	1,260	142	284
Green Valley Creek	75	7	428	856	106	212
Grub Creek	6	1.1	2	4	0	0
Harrison Creek	3	0.2	0	0	0	0
Hulbert Creek	30	3.2	0	0	8	16
Kidd Creek	25	2.5	80	160	22	44
Little Green Valley Creek	11	1.2	0	0	0	0
Mark West Creek [2]	122	15.7	620	1,240	196	392
Mill Creek	136	16.6	2,106	4,212	436	872
Nutty Valley Creek	4	1.2	2	4	0	0
Palmer Creek	49	2.9	622	1,244	103	206
Pechaco Creek	31	2.3	232	464	75	150
Pena Creek	45	6.9	3,655	7,310	123	246
Perenne Creek	10	0.5	2	4	0	0
Porter Creek	80	7.4	1,614	3,228	139	278
Porter Creek (MWC)	19	2.4	893	1,786	63	126
Press Creek	8	0.6	90	180	6	12
Purrington Creek	88	4.8	359	718	102	204
Redwood Creek [2]	30	4.8	16	32	39	78
Schoolhouse Creek	9	1.1	65	130	5	10
Sheephouse Creek	41	3.7	27	54	19	38
Thompson Creek	15	0.9	38	76	4	8
Wallace Creek [2]	20	2.5	142	284	58	116
Ward Creek	70	5	657	1,314	172	344
Willow Creek	107	6	156	312	43	86
Wine Creek	24	1.8	103	206	23	46
Total	**1,553**	**154**	**15,045**	**30,090**	**2,691**	**5,382**

[1] *Expanded count is the observed count multiplied by a factor of 2.*

[2] *Surveys were abbreviated in one reach due to poor visibility.*

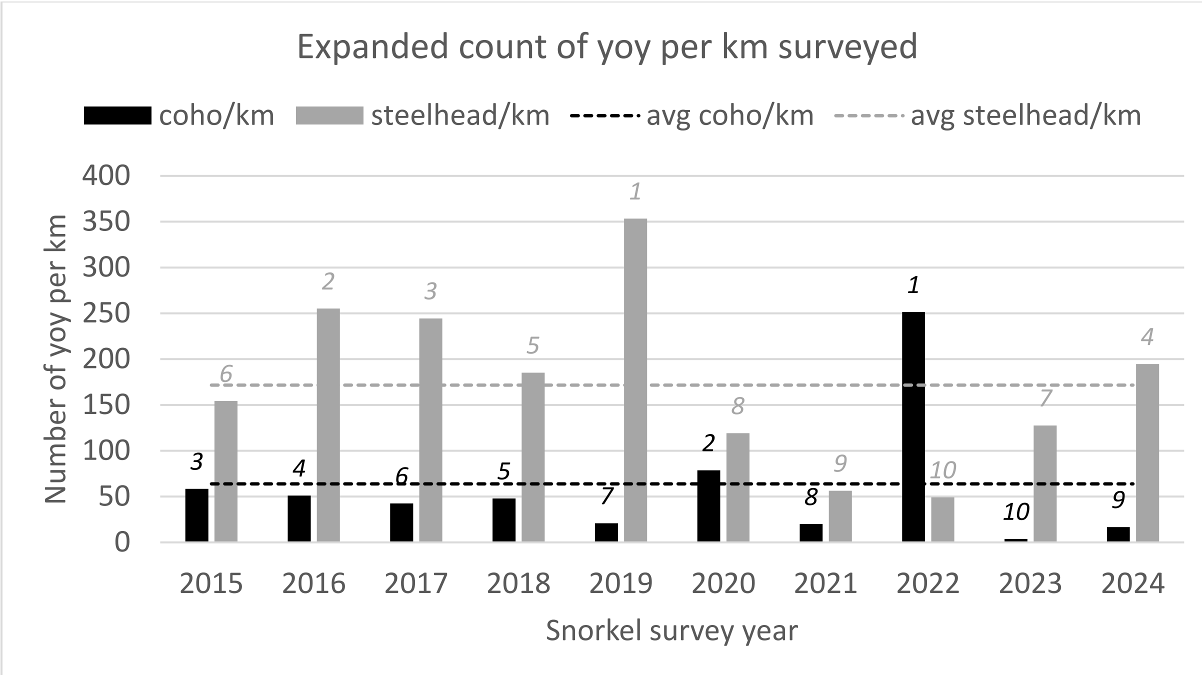

Figure 2. Estimated density of natural-origin coho salmon and steelhead yoy per km of stream surveyed. Numbers above bars represent ranked densities for each species.

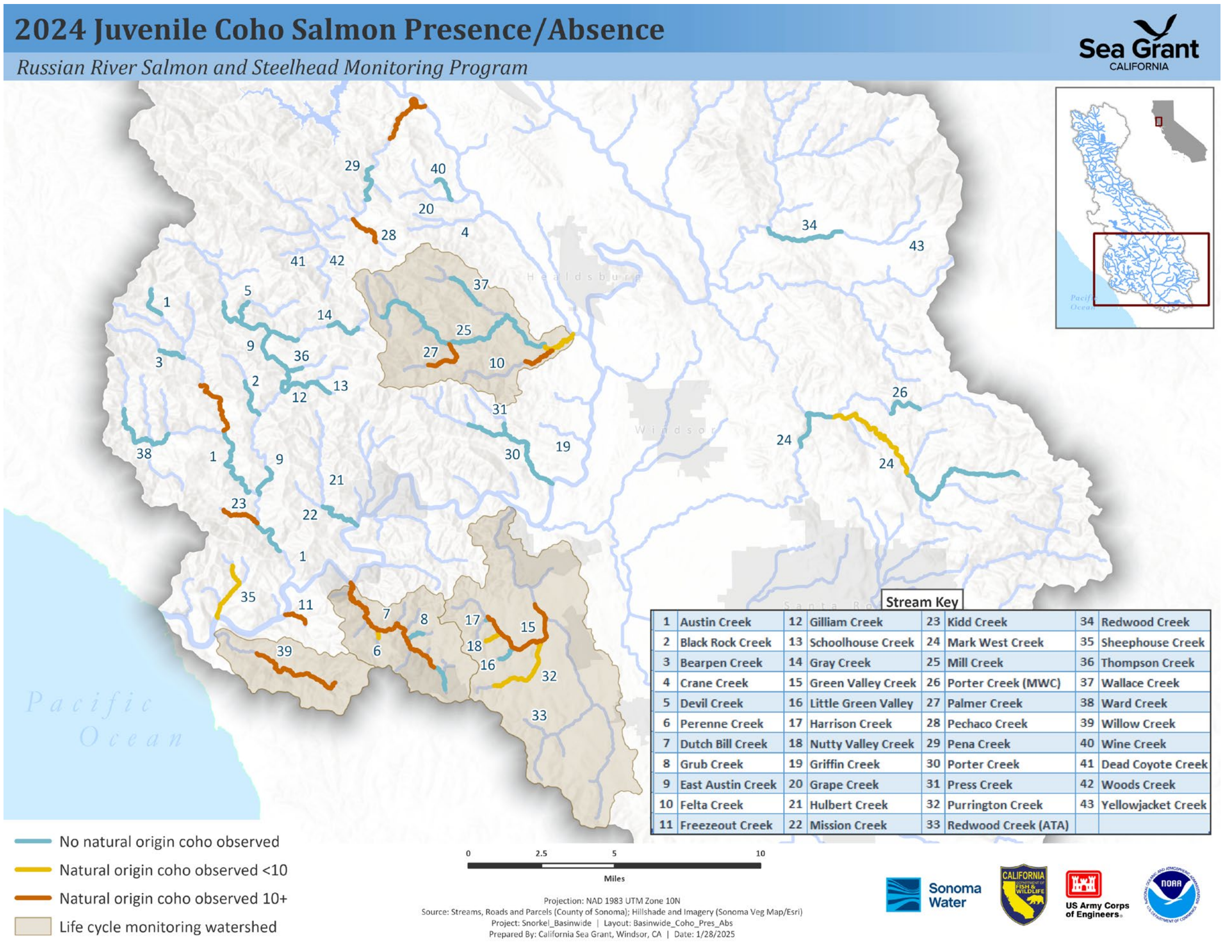

Figure 3. Natural-origin coho salmon presence by reach in surveyed Russian River tributaries, summer 2024.

Table 3. Proportion of area occupied by coho salmon yoy within juvenile coho salmon reaches of the Russian River sample frame, 2015-2024.

Year	Reaches Sampled	Stream length surveyed (km)	PAO
2015	58	167	0.37
2016	72	206	0.33
2017	73	214	0.21
2018	69	205	0.25
2019	70	211	0.15
2020	51	139	0.37
2021	63	178	0.16
2022	69	199	0.45
2023	67	195	0.08
2024	51	145	0.14

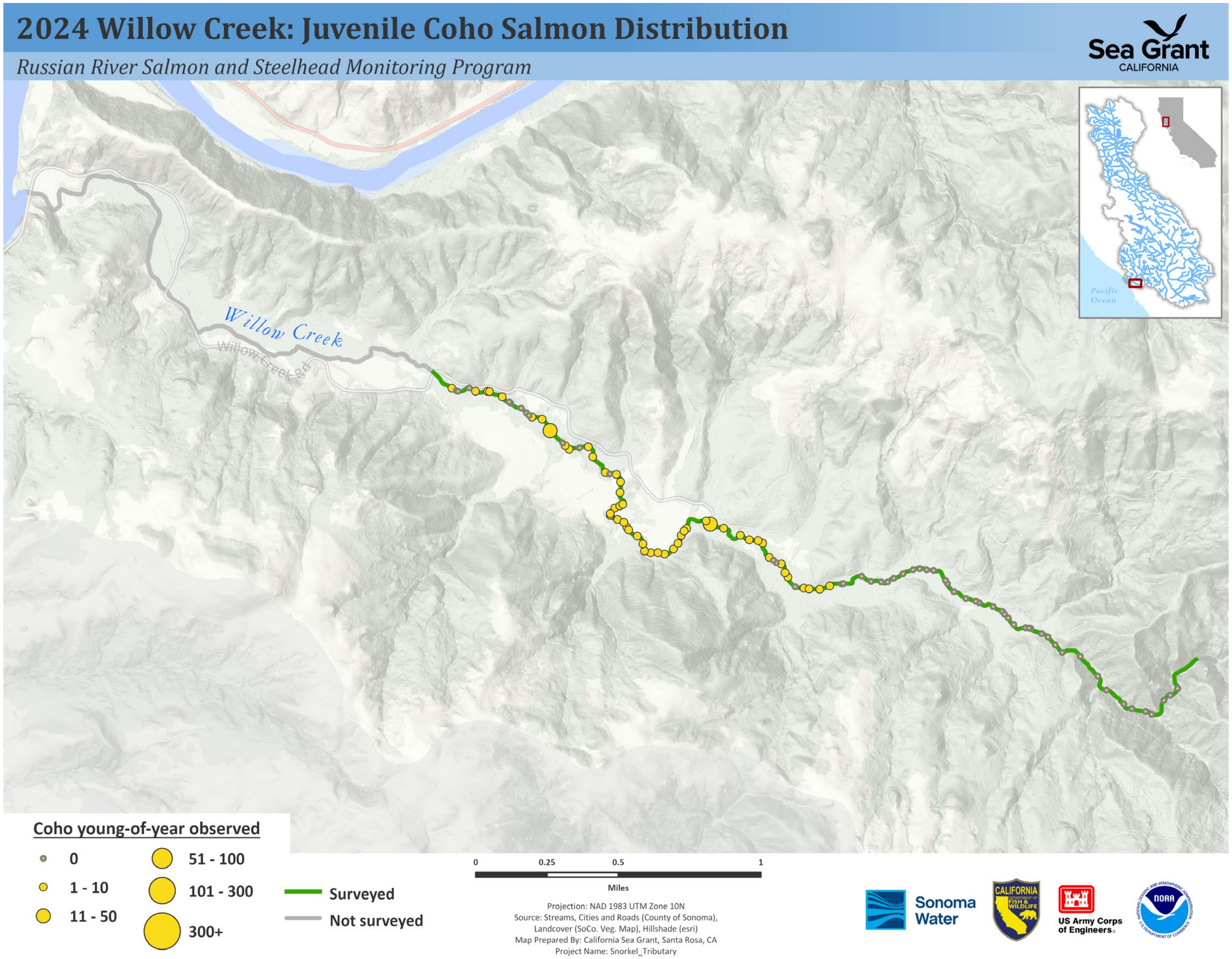

Figure 4. Density and distribution of juvenile coho salmon yoy observed in Willow Creek, 2024. Note that the smallest circle indicates no coho salmon observations in the associated pool.

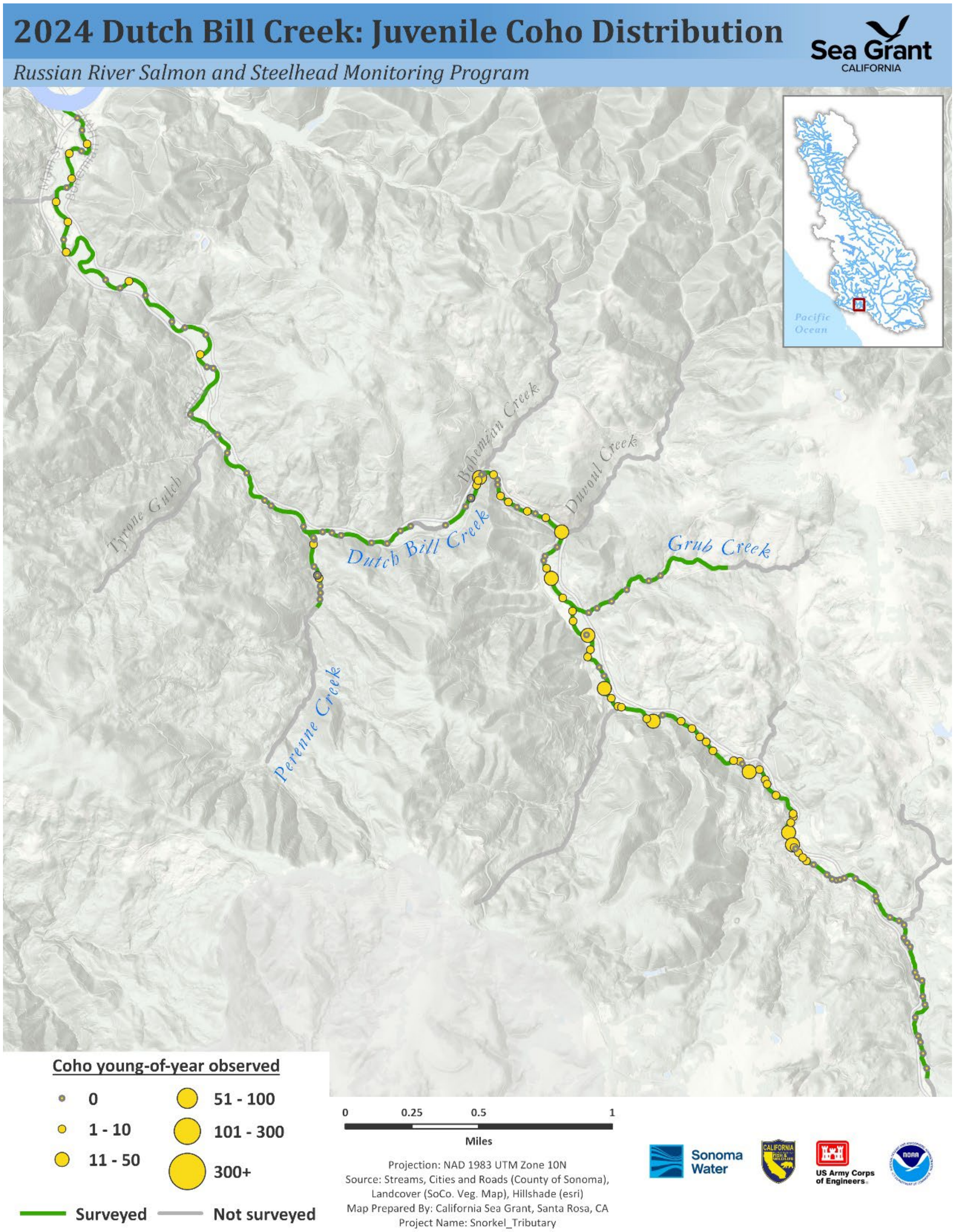

Figure 5. Density and distribution of juvenile coho salmon yoy observed in Dutch Bill Creek, 2024. Note that the smallest circle indicates no coho salmon observations in the associated pool.

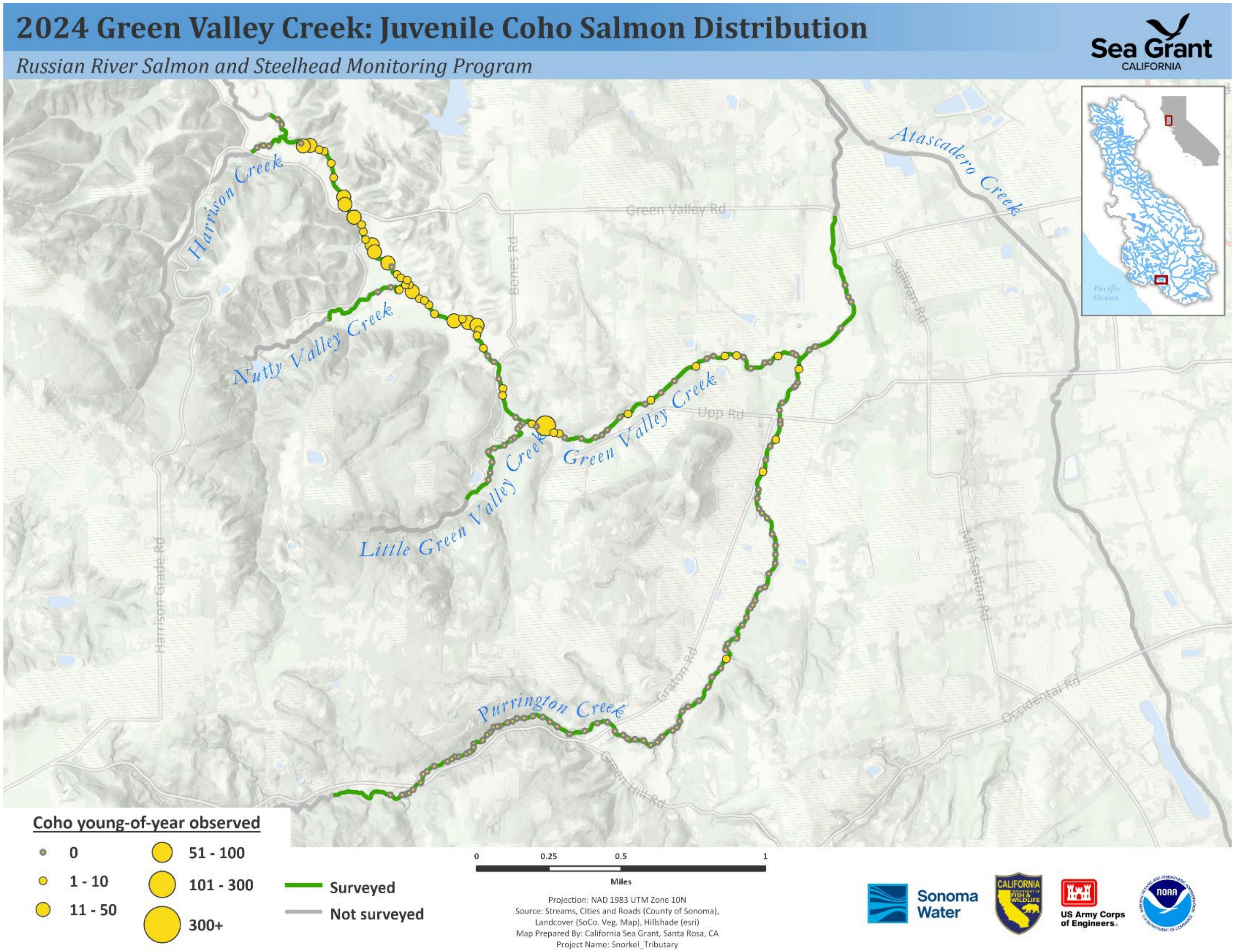

Figure 6. Density and distribution of juvenile coho salmon yoy observed in Green Valley Creek, 2024. Note that the smallest circle indicates no coho salmon observations in the associated pool.

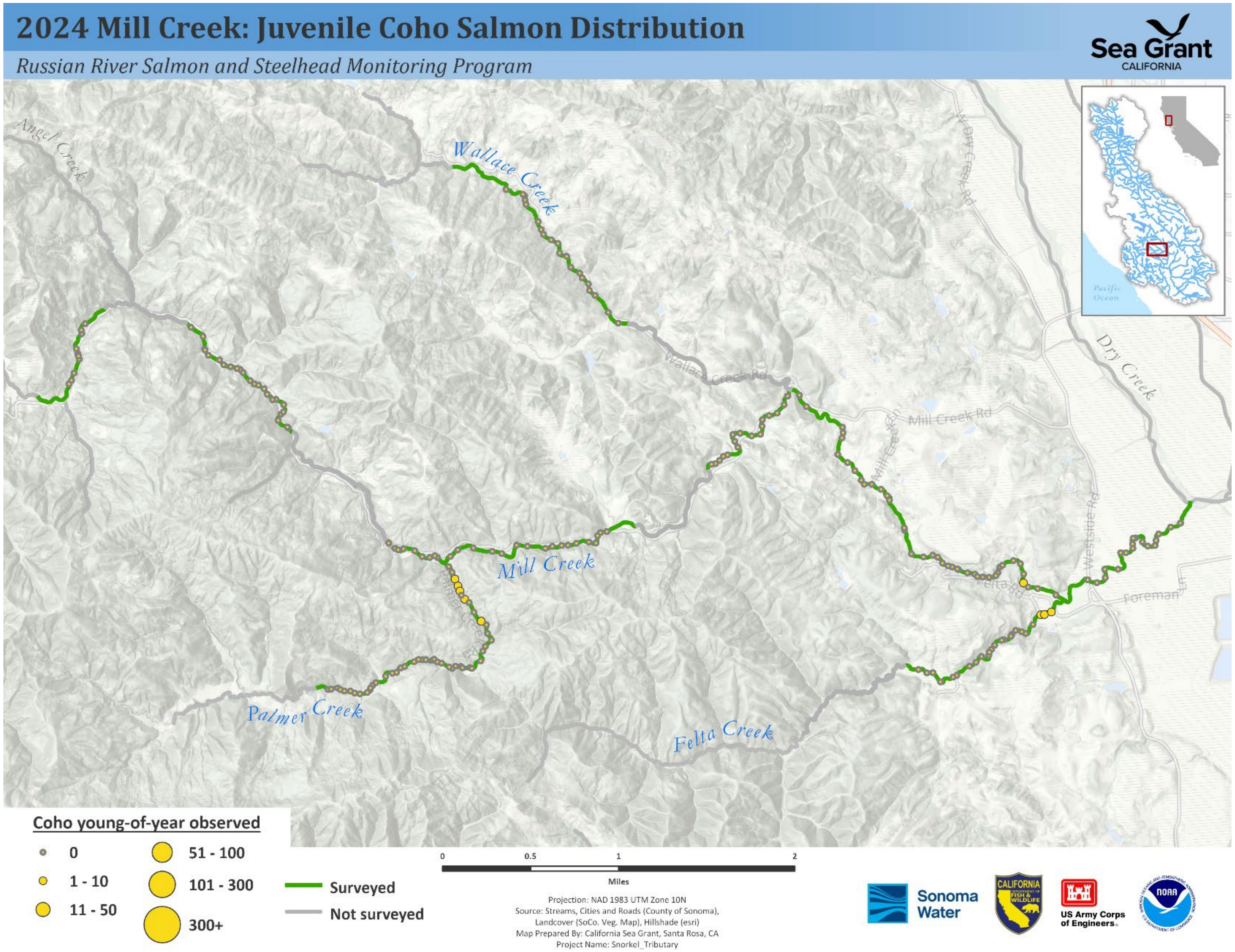

Figure 7. Density and distribution of juvenile coho salmon yoy observed in Mill Creek, 2024. Note that the smallest circle indicates no coho salmon observations in the associated pool.

3. Discussion and recommendations

In 2024, coho yoy density was once again low while steelhead density was the second highest since standardized snorkel surveys began in 2015 (Figure 2). The low number of coho was likely related to low numbers of adult returns in winter of 2023/24 (the parental generation). We detected relatively few age-3 fish on our PIT antenna arrays in winter 2023/24 and the basinwide coho redd estimate was 67, the lowest in the last 10 years (California Sea Grant and Sonoma Water 2024). We suspect that the low number of coho yoy in 2024 was partly a carry-over effect from the previous generation of fish that experienced severe drought as juveniles in 2021 – 2022. Coho that hatched in 2021 were subject to high temperatures in the hatchery prior to release, low flow and poor water quality conditions in the stream environment as yoy, and low flows during their smolt emigration in spring of 2022. With lower than average smolt abundance in three of the four life cycle streams estimated in 2022 (California Sea Grant 2022), the low adult returns in winter 2023/24 and subsequent low numbers of coho yoy in 2024 were not unexpected.

Occupancy of coho yoy was also low in 2024 and although yoy density and PAO track one another ($R = 0.79$, $p < 0.05$), neither yoy distribution or density are explained by redd abundance (Figure 8). For example, in Mill Creek we observed the greatest number of coho redds in 2023/24 and the fewest coho yoy in 2024 and the reverse was true in Willow Creek. While sampling error might explain some of the discrepancy, another possible explanation is low egg and fry survival that may occur between egg deposition and summer snorkel surveys, more so in some streams than others. We suspect that the timing and magnitude of winter flows may play a role in early life stage success. In years when there are large winter storms that scour redds or result in physical conditions that challenge fry survival, the number of yoy the following summer may be severely reduced even when the number of redds is high. Extreme drought conditions in winter may also result in low summer abundance if redds are located in reaches that dry prior to fry emergence. We recommend analysis and research that examines the relationship between flow patterns and yoy to redd ratios in different subwatersheds.

To generate an approximation of the expected number of coho yoy produced from the estimated 67 redds in 2023/24, we multiplied 67 by an estimated mean number of eggs/female of 2,360 (Broodstock Program unpublished data) and a nine-year mean egg to juvenile survival rate estimated in nearby Olema Creek of 0.10 (Woodward et al. 2010). Using these values, the predicted number of juveniles in Russian River tributaries during the summer of 2024 is 15,812. While this method of prediction is very coarse, the fact that that is orders of magnitude higher than the numbers observed suggests a high level of early life stage mortality and/or emigration and we recommend analysis and research that focuses on identifying drivers of early life stage mortality (e.g., flow, sediment, substrate mobility) and fry emigration, as well as restoration actions that improve early life stage survival. Because early life stage apparent survival appears to vary across streams, and we are unable to predict which stream will have greater success in a given year, we recommend continuing to release fish into multiple subwatersheds with different characteristics as a means of bet-hedging.

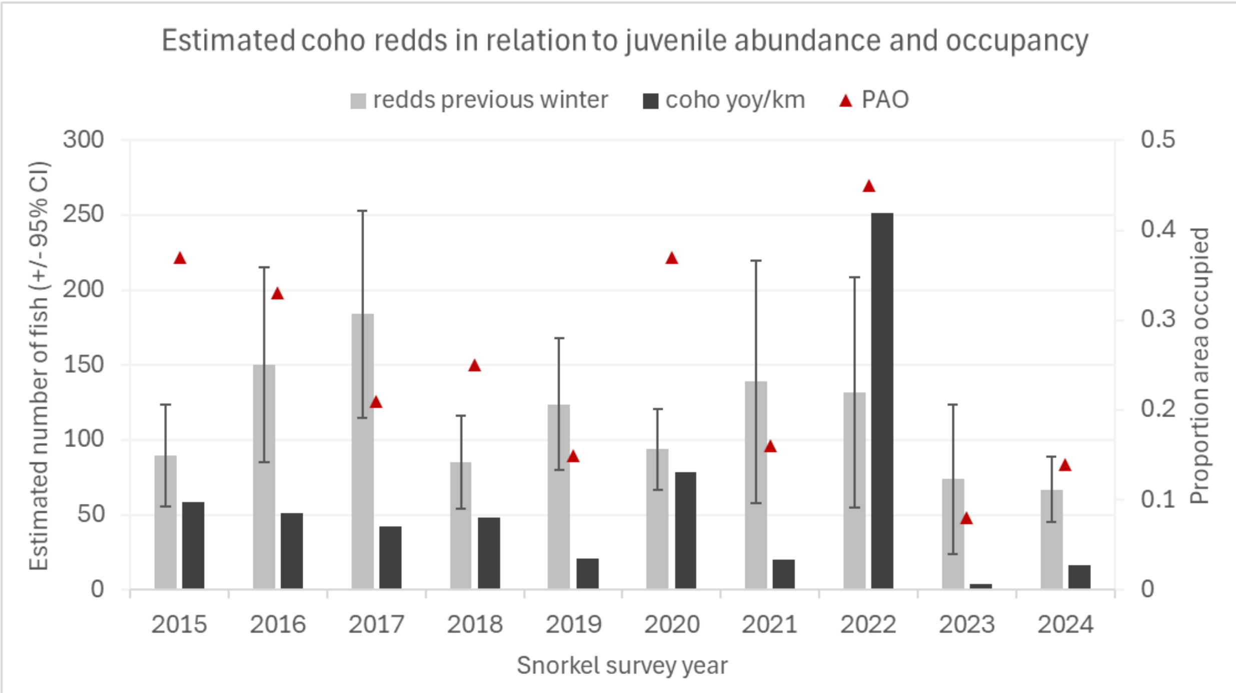

Figure 8. Estimated coho salmon redd abundance in relation to natural production (coho salmon yoy density and percent area occupied (PAO) the following summer) in the Russian River watershed.

4. References

Adams, A. 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. California Department of Fish and Game, California.

California Sea Grant. 2022. Coho salmon and steelhead monitoring report: Spring 2022. Page 32. University of California, Windsor, CA.

California Sea Grant, and Sonoma Water. 2024. Coho salmon and steelhead monitoring report: Winter 2023/24. Page 46. University of California.

Garwood, J., and M. D. Larson. 2014. Reconnaissance of salmonid redd abundance and juvenile spatial structure in the Smith River with emphasis on coho salmon (Oncorhynchus kisutch). California Department of Fish and Wildlife, Arcata, California.

Garwood, J., and S. Ricker. 2014. 2014 Juvenile coho spatial structure monitoring protocol: Summer survey methods. California Department of Fish and Wildlife, Arcata, California.

Nichols, J. D., L. L. Bailey, A. F. O'Connell, N. W. Talancy, E. H. C. Grant, A. T. Gilbert, E. M. Annand, T. P. Husband, and J. E. Hines. 2008. Multi-scale occupancy estimation and modelling using multiple detection methods. Journal of Applied Ecology 45(5):1321–1329.

Woodward, A., A. Torregrosa, M. Madej, M. Reichmuth, and D. Fong. 2010. Users' guide to system dynamics model describing coho salmon survival in Olema Creek, Point Reyes National Seashore, Marin County, California. Page 58. US Geological Survey, Open-File Report 2014–1131.