UC Coho Salmon and Steelhead Monitoring Report: Summer 2018

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1 Background

In 2004, the Russian River Coho Salmon Captive Broodstock Program (Broodstock Program) began releasing juvenile coho salmon 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 (UC) worked with local, state and federal resource managers 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, UC has been closely monitoring smolt abundance, adult returns, survival, and spatial distribution of coho populations in four release streams: Willow, Dutch Bill, Green Valley, and Mill creeks. Data collected from this effort are provided to the Broodstock Program for use in adaptively managing future releases.

Over the last decade, UC has developed many partnerships in salmon and steelhead recovery and our program has expanded to include identification of limiting factors to survival, evaluation of habitat enhancement and streamflow improvement projects, and implementation of a statewide salmon and steelhead monitoring program. In 2010, we began documenting relationships between stream flow and juvenile coho survival as part of the Russian River Coho Water Resources Partnership (Partnership) (http://www.cohopartnership.org), an effort to improve stream flow and water supply reliability to water-users in five flow-impaired Russian River tributaries. In 2013, we partnered with the Sonoma County Water Agency (Sonoma Water) and California Department of Fish and Wildlife (CDFW) to begin implementation of the California Coastal Monitoring Program (CMP), a statewide effort to document status and trends of anadromous salmonid populations using standardized methods and a centralized statewide database. These new projects have led to the expansion of our program, which now includes over 40 Russian River tributaries.

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

In this seasonal monitoring report, we provide preliminary results from our summer and fall Broodstock Program and CMP snorkeling 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 at http://ca-sgep.ucsd.edu/russianrivercoho.

2 Juvenile Presence and Distribution

Summer snorkeling 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 2018. These data were used to determine whether successful spawning occurred the previous winter and to track trends in relative abundance and occupancy over time.

2.1 Methods

2.1.1 Sampling Reaches

For Broodstock Program monitoring, we surveyed juvenile rearing salmonid reaches of Willow, Dutch Bill, Green Valley, and Mill creeks (Figure 1). For CMP monitoring, a spatially-balanced random sample of juvenile coho salmon reaches in 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) (Figure 1). In 2018, we surveyed all juvenile salmonid reaches in the lower Russian River where landowner access could be secured, for a total of 72 reaches representing 40 streams. Of these reaches, 70 of the 72 reaches and 39 of the 40 streams were classified as containing juvenile coho salmon habitat.

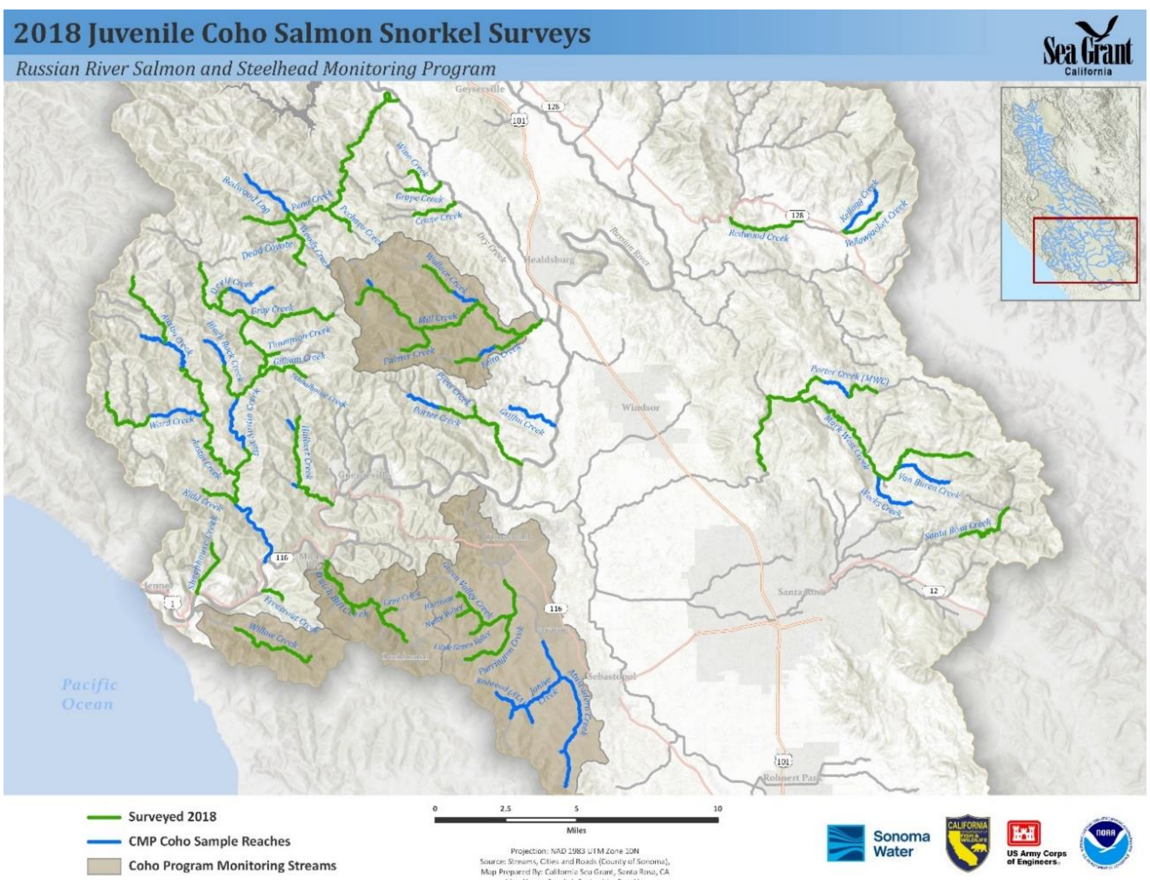

Figure 1. Snorkel survey reaches, 2018.

[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.

2.1.2 Field methods

Sampling was based on modifications of protocols in Garwood and Ricker (2014). In each survey reach, two independent snorkeling passes were completed. On the first pass, fish 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. For use in occupancy models, a second pass was completed the following day in which every other pool that was snorkeled during the first pass was snorkeled a second time. A GPS point was collected at the downstream end of each pool snorkeled on the pass 1 survey.

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 order to minimize disturbance of fish and sediment, snorkelers avoided sudden or loud movements. Double counting was minimized by only counting fish once they were downstream of the observer. 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 (Figure 2), Chinook salmon, steelhead) and age class (young-of-year (yoy) or parr (≥ age-1)), based on size and physical characteristics. Presence of non-salmonid species was documented at the reach scale. Allegro field computers 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 was downloaded, error checked, and stored in an ArcGIS geodatabase for map production.

Figure 2. Coho salmon yoy observed in Willow Creek.

2.1.3 Metrics

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 incorporate variation among pools or detection efficiency; therefore they should only be considered approximate estimates of abundance useful for relative comparisons.

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 (Garwood and Larson 2014; Nichols et al. 2008). Detection probability (*p*) at the pool scale was accounted for using the repeated dive pass data in the occupancy models. The proportion of area occupied (PAO) was then estimated by multiplying the reach and pool scale occupancy parameters (ψ*θ).

2.2 Results

UC and Sonoma Water biologists surveyed a total of 72 reaches representing 205 km (127 mi) of stream and 40 tributaries between May 29 and September 11. All juvenile coho salmon rearing reaches of Willow, Dutch Bill, Green Valley, and Mill creeks were surveyed for Broodstock Program monitoring, and 70 reaches within the Russian River sample frame that were considered juvenile coho habitat (73% of coho reaches) were included in the occupancy estimate for CMP monitoring. The two remaining reaches (on East Austin and Pechaco creeks) were considered steelhead-only habitat and were therefore not included in the coho salmon occupancy estimate.

We observed 4,912 coho salmon yoy during the summer of 2018, with an expanded minimum count of 9,824 (Table 1), and we observed 20,315 steelhead yoy, with an expanded minimum count of 40,630 (Table 2). Because surveys were conducted before spring stocking occurred, all coho salmon yoy were presumed to be of natural origin. Coho salmon yoy were observed in 40 of the 70 juvenile coho salmon reaches surveyed and in 29 of the 39 juvenile coho salmon streams snorkeled (40% and 74%, respectively) (Table 1, Figure 3). Steelhead yoy were observed in 72 of the 72 steelhead reaches and 37 of the 40 steelhead streams surveyed (100% and 93%, respectively) (Table 2). The three streams where steelhead were not observed were small sub-reaches and in each case steelhead yoy were observed in the parent reach. Counts of coho salmon yoy were higher in Willow Creek than any other stream surveyed, with the second highest counts in Green Valley Creek (Table 1).

Based on results of the multiscale occupancy model, we estimate that the probability of coho yoy occupying a given reach within the basinwide Russian River coho stratum (ψ) in 2018 was 0.58 (0.46 - 0.69, 95% CI), and the conditional probability of coho yoy occupying a pool within a reach, given that the reach was occupied (θ), was 0.43 (0.38 – 0.46, 95% CI). The proportion of the coho stratum occupied (PAO) was 0.25.

Juvenile coho salmon were observed in all four Broodstock Program monitoring streams and spatial distribution varied among streams (Table 1, Figure 4 - Figure 7). In Willow Creek, coho salmon yoy were distributed throughout the stream but the highest concentrations were found in the lower portion of the sampled reaches (Figure 4). In Dutch Bill Creek, coho salmon yoy were also observed throughout the stream, as well as in the tributaries Grub and Perenne creeks, with the highest density in the upper reach sampled (Figure 5). In Green Valley Creek, coho salmon yoy were distributed throughout the stream as well as in four tributaries; Purrington, Little Green Valley, Nutty Valley, and Harrison creeks (Figure 6). In the Mill Creek watershed, the highest densities of coho yoy were found in the lower portions of the mainstem of Mill Creek and in lower Felta Creek, just upstream of the confluence with Mill Creek (Figure 7).

Table 1. Number of coho salmon yoy and parr observed in Russian River tributaries and expanded counts, summer 2018.

Tributary	Number of Pools Snorkeled	Yoy	Expanded Yoy[1]	Parr	Expanded Parr[1]
Austin Creek	130	22	44	0	0
Black Rock Creek	25	41	82	0	0
Crane Creek	22	0	0	0	0
Dead Coyote Creek	11	0	0	0	0
Devil Creek	23	0	0	0	0
Dutch Bill Creek	100	190	380	11	22
East Austin Creek	136	1	2	1	2
Felta Creek	58	81	162	2	4
Freezeout Creek	23	295	590	4	8
Gilliam Creek	36	32	64	0	0
Grape Creek	52	315	630	9	18
Gray Creek	96	361	722	8	16
Green Valley Creek	83	883	1,766	16	32
Grub Creek	7	1	2	1	2
Harrison Creek	3	8	16	0	0
Hulbert Creek	63	301	602	0	0
Kidd Creek	37	17	34	0	0
Little Green Valley Creek	17	12	24	0	0
Mark West Creek	171	3	6	0	0
Mill Creek	168	383	766	59	118
Nutty Valley Creek	3	16	32	3	6
Palmer Creek	45	10	20	5	10
Pechaco Creek	23	0	0	0	0
Pena Creek	103	19	38	0	0
Perenne Creek	10	3	6	0	0
Porter Creek	107	475	950	7	14
Porter Creek (MWC)	58	1	2	0	0
Press Creek	8	0	0	0	0
Purrington Creek	76	63	126	0	0
Redwood Creek	39	26	52	0	0
Santa Rosa Creek	54	0	0	0	0
Schoolhouse Creek	9	0	0	0	0
Sheephouse Creek	62	49	98	28	56
Thompson Creek	17	0	0	0	0
Wallace Creek	28	0	0	0	0
Ward Creek	42	0	0	0	0
Willow Creek	99	982	1,964	36	72
Wine Creek	19	10	20	0	0
Woods Creek	59	312	624	0	0
Yellowjacket Creek	32	0	0	0	0
Total	**2,154**	**4,912**	**9,824**	**190**	**380**

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

Table 2. Number of steelhead yoy and parr observed in Russian River tributaries and expanded counts, summer 2018.

Tributary	Number of Pools Snorkeled	Yoy	Expanded Yoy[1]	Parr	Expanded Parr[1]
Austin Creek	130	1,088	2,176	168	336
Black Rock Creek	25	148	296	24	48
Crane Creek	22	94	188	17	34
Dead Coyote Creek	11	0	0	0	0
Devil Creek	23	78	156	21	42
Dutch Bill Creek	100	310	620	113	226
East Austin Creek	136	3,193	6,386	423	846
Felta Creek	58	123	246	58	116
Freezeout Creek	23	29	58	11	22
Gilliam Creek	36	326	652	67	134
Grape Creek	52	62	124	69	138
Gray Creek	96	692	1,384	143	286
Green Valley Creek	83	752	1,504	92	184
Grub Creek	7	0	0	1	2
Harrison Creek	3	0	0	0	0
Hulbert Creek	63	520	1,040	41	82
Kidd Creek	37	18	36	23	46
Little Green Valley Creek	17	13	26	3	6
Mark West Creek	171	1,965	3,930	502	1,004
Mill Creek	168	1,597	3,194	172	344
Nutty Valley Creek	3	2	4	0	0
Palmer Creek	45	332	664	31	62
Pechaco Creek	23	56	112	8	16
Pena Creek	103	3,445	6,890	195	390
Perenne Creek	10	13	26	6	12
Porter Creek	107	1,215	2,430	140	280
Porter Creek (MWC)	58	749	1,498	73	146
Press Creek	8	13	26	9	18
Purrington Creek	76	867	1,734	132	264
Redwood Creek	39	115	230	76	152
Santa Rosa Creek	54	861	1,722	212	424
Schoolhouse Creek	9	32	64	0	0
Sheephouse Creek	62	66	132	10	20
Thompson Creek	17	95	190	4	8
Wallace Creek	28	181	362	6	12
Ward Creek	42	922	1,844	117	234
Willow Creek	99	94	188	45	90
Wine Creek	19	10	20	4	8
Woods Creek	59	203	406	32	64
Yellowjacket Creek	32	36	72	18	36
Total	**2,154**	**20,315**	**40,630**	**3,066**	**6,132**

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

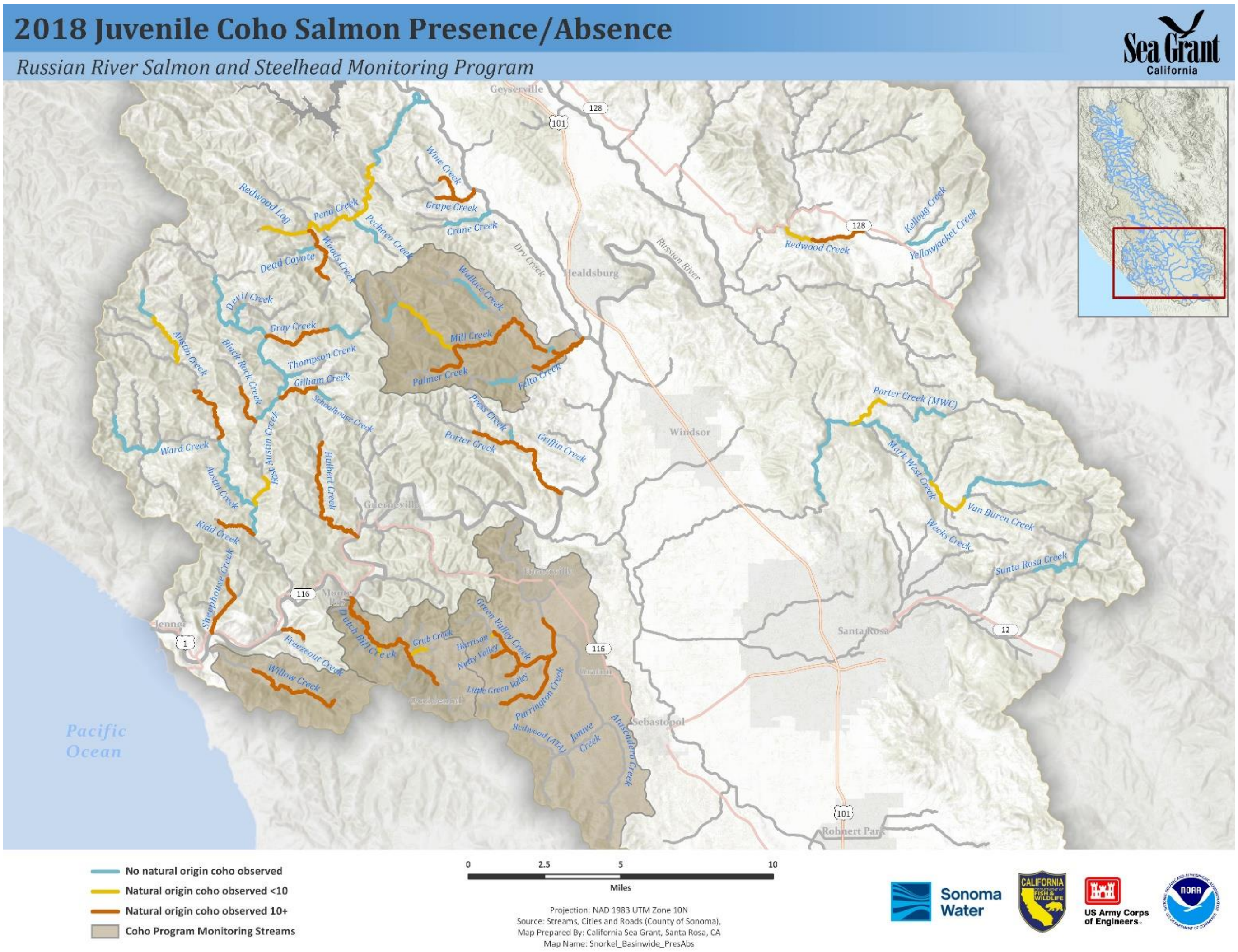

Figure 3. Natural-origin coho salmon presence by reach in surveyed Russian River tributaries, summer 2018.

Figure 4. Density and distribution of juvenile coho salmon yoy observed in Willow Creek, 2018.

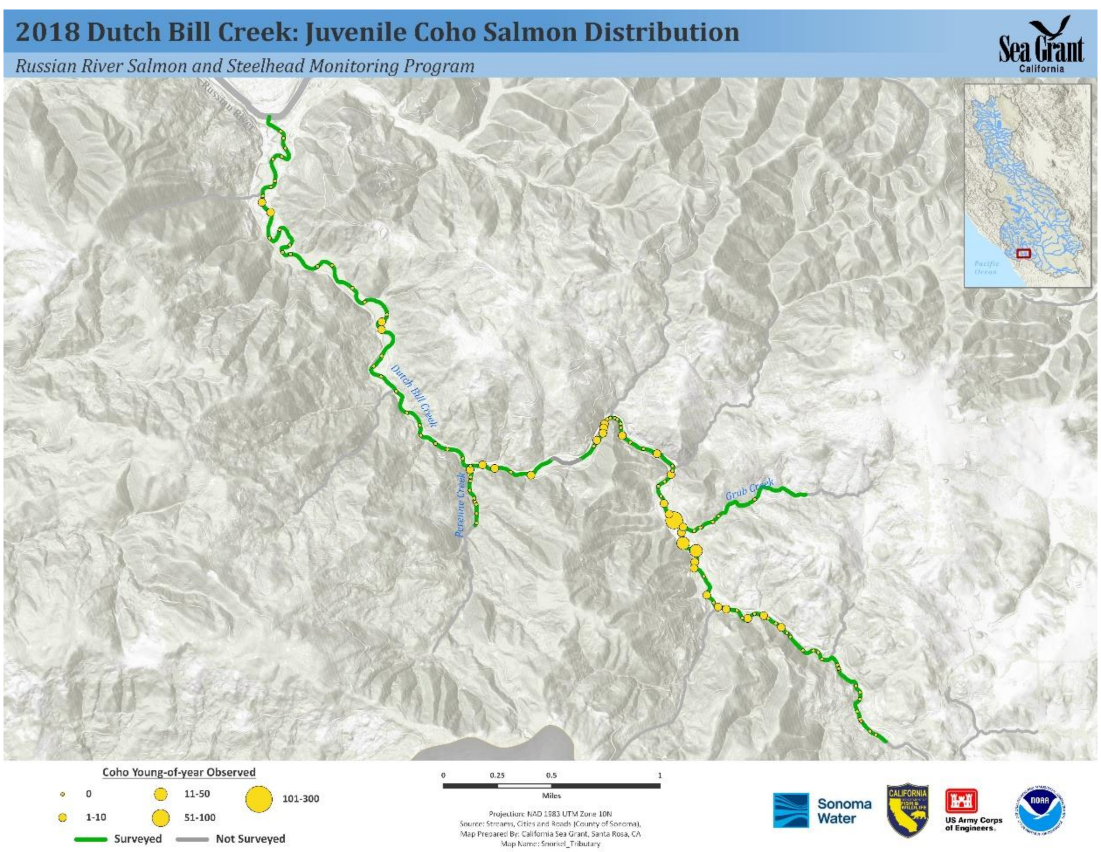

Figure 5. Density and distribution of juvenile coho salmon yoy observed in Dutch Bill Creek, 2018.

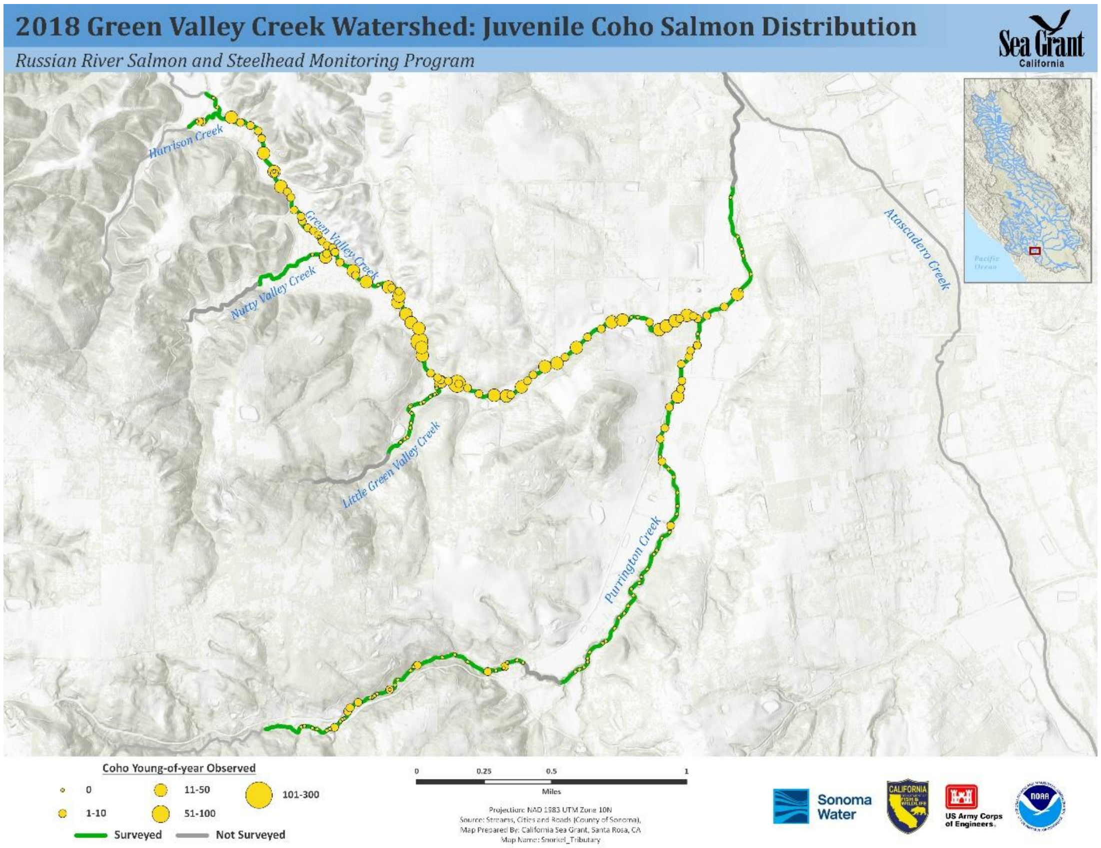

Figure 6. Density and distribution of juvenile coho salmon yoy observed in Green Valley Creek, 2018.

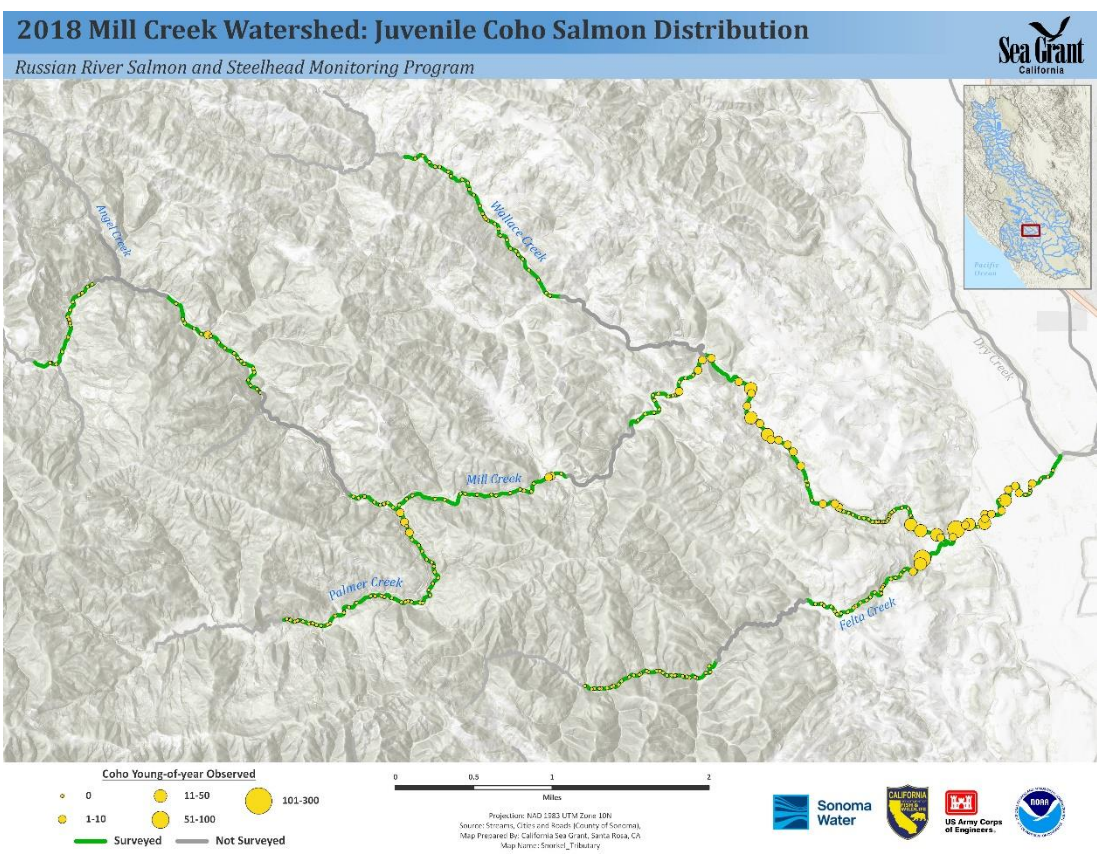

Figure 7. Density and distribution of juvenile coho salmon yoy observed in Mill Creek, 2018.

2.3 Discussion and Recommendations

Natural-origin juvenile coho salmon were present in all four Broodstock Program monitoring streams and in 29 of 39 juvenile coho salmon streams surveyed through the CMP Program in 2018. Ten or more coho salmon yoy were observed in 23 of the 39 coho salmon tributaries. This is a positive indication that successful spawning of adult coho salmon occurred in the Russian River watershed during the winter of 2017/18, and it demonstrates a significant improvement in spatial distribution from the early 2000s when coho salmon were only known to occur in one to two streams per year.

A small number of coho salmon parr (juveniles classified as age-1 based on size and physical characteristics) were observed in several streams throughout the basin (Table 1). Fish classified as parr were likely coho salmon smolts that had not yet emigrated (some surveys occurred during the smolt outmigration window of May and June) or juveniles that residualized, remaining in fresh water for a second year. In previous years, we have documented a small proportion of juvenile coho salmon that remain in fresh water for two years prior to out-migrating to the ocean (Obedzinski et al. 2016b). Potential causes for remaining in the stream for a second year include stranding of smolts when tributary mouths become dry before migration is complete and/or slow freshwater growth.

During the winter of 2017/18, we anticipated that hatchery coho salmon adults would return to spawn in significantly fewer streams than in the previous three spawning seasons due to the lower number of streams in which the 2015 cohort (brood year 2014) of juvenile coho were released. The 2015 cohort was much smaller than average and fish were released in only six tributaries compared to 17-19 tributaries in each of the previous three years. However, despite reduced stocking in 2015/16, coho yoy were observed in a greater percentage of streams surveyed in 2018 (74%) than in the previous three years (Table 3), suggesting that adults returned to spawn in more than the six release streams. Some of the streams where coho yoy were observed were in close proximity to stocked reaches but many, including Kidd, Mark West, Porter, and Redwood creeks, were not.

It is possible that the coho yoy observed in non-release streams are progeny of natural-origin adult returns. However, if this were the case, we would have expected to see significant numbers of natural-origin coho yoy in these creeks during the snorkel surveys conducted in 2015, presuming a three-year life cycle. For some creeks, such as Freezeout and Porter creeks, this was true but for others, such as Mark West and Kidd Creek, few to no coho yoy were observed in 2015 (Obedzinski et al. 2016a).

Another possibility is that adults from the 2015 cohort of hatchery fish strayed into non-release streams. Although small sample size for adult returns limits any firm conclusions we can draw regarding stray rates for adult coho returning to the basin, PIT tag data for the 2015 cohort indicates that more than half of the adults that entered the river as 3-year olds during the winter of 2017/18 did not return to the stream in which they were stocked (4 of 7 adults, 57%). Straying may result from limited acclimation time, which for the smolt release group is often less than two weeks, but it also may be a response to environmental conditions at the time of return. Adult coho salmon frequently enter the Russian River in October and November, when access to many of the spawning tributaries is cut off due to low flows (Bauer et al. 2018). In such cases, it is possible that adult migration upstream is driven more by flow conditions than homing to specific release streams. In exceptionally dry years, we have observed a high proportion of adults migrating up into Dry Creek where flows are higher, rather than back to the tributaries in which they were released (UC, unpublished data).

A third possibility for the unexpectedly high number of streams in which we observed natural-origin juveniles, is that they resulted from age-2 adult returns. The majority of adult returns during the winter of 2017/18 were age-

2 fish from the 2016 cohort (CSG 2018) which was stocked into 19 streams. While age-2 fish are typically males, it is possible that some of these fish were females that successfully spawned. In fact, during the winter of 2017/18 an age-2 female carcass was observed (age presumed based on small size). These three explanations are not mutually exclusive and it is likely that in some creeks spawning took place due to straying of age-3 hatchery origin adults while in others spawning was the result of natural origin and/or age-2 adults returning to their natal or release streams, respectively.

The streams in which coho salmon yoy are observed can provide a good indication of where spawning took place the previous winter; however, to quantify trends in juvenile salmonid spatial distribution over time, occupancy models offer a more rigorous approach. Through the CMP Program, UC and Sonoma Water began conducting basinwide estimates of juvenile coho salmon occupancy in the Russian River watershed in 2015. Juvenile coho salmon occupancy increased in 2018 relative to 2017 but remained low compared to 2015 and 2016, despite the higher number of streams in which coho yoy were observed (Table 4). This indicates that although spawning took place across much of the coho strata within the Russian River sample frame, a large portion of available juvenile coho habitat within reaches remained unused. This is consistent with the low number of age-3 coho estimated to have returned in 2017/2018 and indicates that smaller hatchery release years may still impact important population metrics.

Although we continue to recommend the bet-hedging strategy of stocking multiple streams with a diversity of habitat characteristics, 2018 snorkel survey results indicate that in years where hatchery releases only take place in a small number of tributaries, spawning may still occur in streams throughout the basin. Further investigation to determine whether this is due to straying on the part of hatchery release adults or natural recruitment within these systems is warranted and may have important implications for release strategies. For example, if adult spawning locations are driven more by fall/winter environmental conditions than homing to release streams, it may be less important to dedicate resources towards imprinting fish on specific streams, and more important to stock fish in locations where we expect higher freshwater growth and survival rates. As we build our dataset of PIT-tagged adult returns with additional years of data, we can better examine straying in relation to release groups and environmental conditions.

Table 3. Number of streams stocked in relation to coho salmon yoy observations three years later.

Snorkel Year	Streams stocked	Streams Surveyed	Streams with coho observed	Percentage of streams with coho
2015	17	35	20	57%
2016	18	38	24	63%
2017	19	41	28	68%
2018	6	39	29	74%

Table 4. Percent of area occupied by coho salmon yoy within juvenile coho reaches of the Russian River sample frame, 2015-2018

Year	Reaches Sampled	PAO
2015	58	0.37
2016	72	0.33
2017	73	0.2
2018	70	0.25

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