UC Coho Salmon and Steelhead Monitoring Report: Summer 2017

Prepared by:

Andrew McClary, Nick Bauer, Andrew Bartshire, and Mariska Obedzinski

California Sea Grant at University of California
February 2018, Santa Rosa, CA.

Contents

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 (Water Agency) 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 2017. 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 reaches of Dutch Bill, Green Valley, Mill, and Willow creeks (Figure 1). For CMP monitoring, a spatially-balanced random sample of juvenile coho salmon reaches in the Russian River juvenile 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). Our target sampling effort was a minimum of 30% (31) of 104 juvenile coho salmon reaches (SCWA and UC 2014).

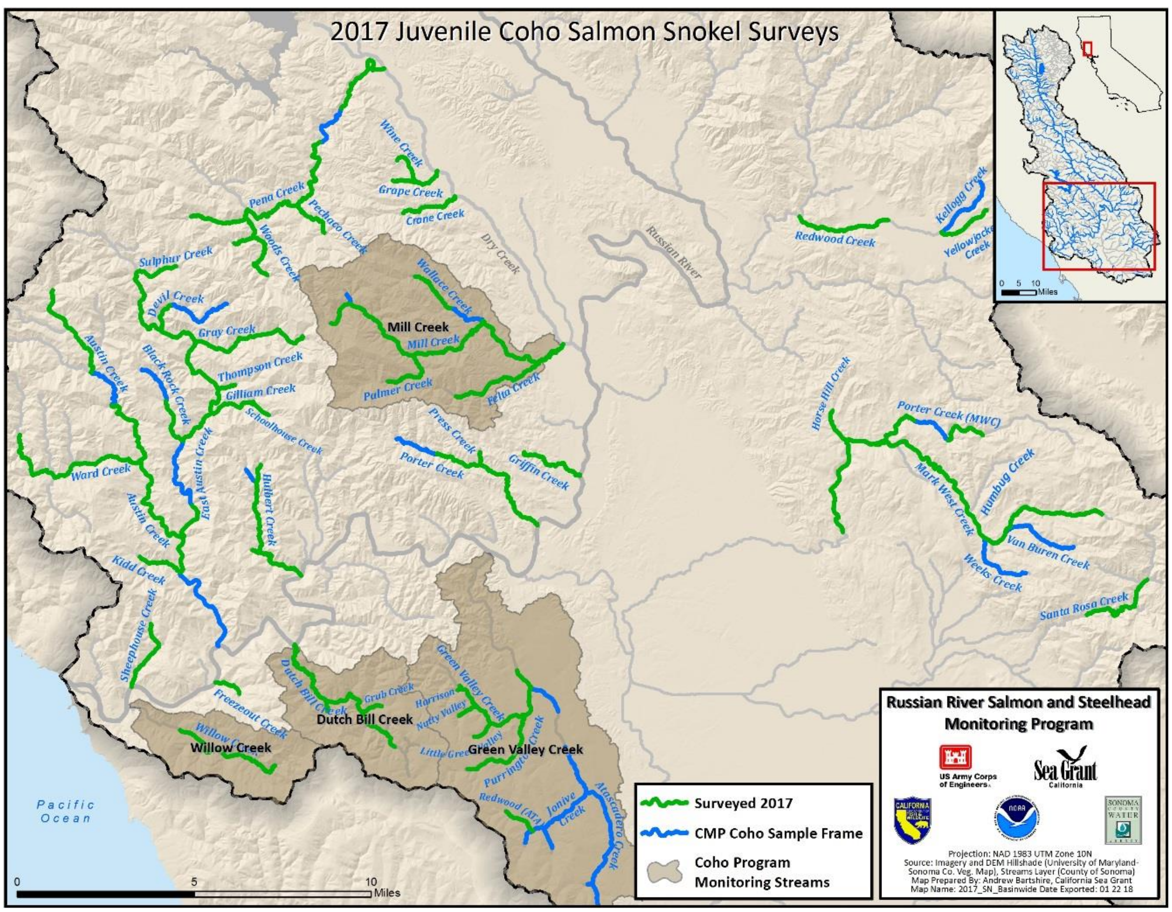

Figure 1. Map of 2017 snorkel survey reaches.

[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. A coho salmon juvenile observed in Mill 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 Water Agency biologists surveyed a total of 77 reaches representing 193 km (120 mi) of stream between May 22 and October 31. All juvenile coho salmon rearing reaches of Dutch Bill, Green Valley, Mill, and Willow creeks were surveyed for Broodstock Program monitoring, and 73 reaches that were considered juvenile coho habitat (70% of coho reaches) were included in the occupancy estimate for CMP monitoring. The four remaining reaches (on Horse Hill, Sulphur, East Austin, and Pechaco creeks) were considered steelhead-only habitat and were therefore not included in the coho salmon occupancy estimate.

We observed 4,620 coho salmon yoy during the summer of 2017, with an expanded minimum count of 9,240 (Table 1), and we observed 28,536 steelhead yoy, with an expanded minimum count of 57,072 (Table 2). Because surveys were conducted before spring stocking took place, all coho salmon yoy were assumed to be of natural origin. Coho salmon yoy were observed in 40 of the 73 juvenile coho salmon reaches surveyed and in 28 of the 41 juvenile coho salmon streams snorkeled (55% and 68%, respectively) (Table 1, Figure 3). Steelhead yoy were observed in 76 of the 77 steelhead reaches and 44 of the 45 steelhead streams surveyed (99% and 98%, respectively) (Table 2). Counts of coho salmon yoy were higher in Green Valley Creek than any other stream surveyed (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 2017 was 0.50 (0.38 - 0.61, 95% CI), and the conditional probability of coho yoy occupying a pool within a reach, given that the reach was occupied (θ), was 0.42 (0.38 – 0.46, 95% CI). The proportion of the coho stratum occupied (PAO) was 0.21.

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 reach with slightly higher densities in the lower half (Figure 4). In Dutch Bill Creek, the highest concentrations of coho salmon yoy were observed in the upper half of the stream (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, coho salmon were evenly distributed throughout most of the mainstem of Mill Creek and in Palmer Creek with a relatively high concentration in lower Felta Creek, just upstream of the confluence with Mill Creek (Figure 7).

Table 1. Observations and expanded counts of coho salmon yoy and parr in Russian River tributaries, summer 2017.

Tributary	Number of Pools Snorkeled	Yoy	Expanded Yoy[1]	Parr	Expanded Parr[1]
Austin Creek	133	8	16	0	0
Black Rock Creek	26	2	4	0	0
Crane Creek	29	0	0	0	0
Dead Coyote Creek	13	11	22	0	0
Devil Creek	24	0	0	0	0
Dutch Bill Creek	96	61	122	1	2
East Austin Creek	120	24	48	0	0
Felta Creek	102	172	344	0	0
Freezeout Creek	34	18	36	0	0
Gilliam Creek	48	47	94	0	0
Grape Creek	53	506	1,012	1	2
Gray Creek	106	44	88	0	0
Green Valley Creek	92	1,876	3,752	31	62
Griffin Creek	6	1	2	0	0
Grub Creek	9	0	0	0	0
Harrison Creek	3	9	18	0	0
Horse Hill Creek	2	0	0	0	0
Hulbert Creek	104	5	10	0	0
Kidd Creek	36	5	10	0	0
Little Green Valley Creek	13	51	102	0	0
Mark West Creek	228	282	564	0	0
Mill Creek	145	48	96	159[2]	318
MISSION CREEK	5	0	0	0	0
Nutty Valley Creek	8	104	208	3	6
Palmer Creek	65	7	14	0	0
Pechaco Creek	30	0	0	0	0
Pena Creek	88	41	82	0	0
Perenne Creek	10	0	0	0	0
Porter Creek	120	98	196	1	2
Porter Creek (MWC)	48	0	0	0	0
Press Creek	10	0	0	0	0
Purrington Creek	88	172	344	1	2
Redwood Creek	46	0	0	0	0
Redwood Creek (Atascadero)	10	0	0	0	0
Santa Rosa Creek	70	0	0	0	0
Schoolhouse Creek	7	0	0	0	0
Sheephouse Creek	78	17	34	0	0
Sulphur Creek	6	0	0	0	0
Thompson Creek	18	0	0	0	0
Wallace Creek	28	0	0	0	0
Ward Creek[3]	108	4	8	0	0
Willow Creek	122	575	1,150	54	108
Wine Creek	32	113	226	0	0
Woods Creek	63	319	638	0	0
Yellowjacket Creek	47	0	0	0	0
Total	**2,529**	**4,658**	**9,316**	**251**	**502**

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

[2] *Mill Creek parr counts likely include fish from a hatchery smolt release that took place two days prior to snorkel counts.*

[3] *Coho were only observed in lowest 300 m of the stream.*

Table 2. Observations and expanded counts of steelhead yoy and parr in Russian River tributaries, summer 2017.

Tributary	Number of Pools Snorkeled	Yoy	Expanded Yoy[1]	Parr	Expanded Parr[1]
Austin Creek	133	1,662	3,324	308	616
Black Rock Creek	26	53	106	23	46
Crane Creek	29	541	1,082	6	12
Dead Coyote Creek	13	84	168	12	24
Devil Creek	24	112	224	14	28
Dutch Bill Creek	96	239	478	38	76
East Austin Creek	120	699	1,398	350	700
Felta Creek	102	981	1,962	90	180
Freezeout Creek	34	39	78	13	26
Gilliam Creek	48	785	1,570	93	186
Grape Creek	53	1,190	2,380	95	190
Gray Creek	106	1,155	2,310	334	668
Green Valley Creek	92	723	1,446	97	194
Griffin Creek	6	9	18	0	0
Grub Creek	9	5	10	0	0
Harrison Creek	3	0	0	0	0
Horse Hill Creek	2	2	4	0	0
Hulbert Creek	104	1,764	3,528	93	186
Kidd Creek	36	168	336	26	52
Little Green Valley Creek	13	45	90	0	0
Mark West Creek	228	1,592	3,184	534	1,068
Mill Creek	145	776	1,552	146	292
MISSION CREEK	5	57	114	0	0
Nutty Valley Creek	8	1	2	1	2
Palmer Creek	65	178	356	46	92
Pechaco Creek	30	1,417	2,834	14	28
Pena Creek	88	4,918	9,836	82	164
Perenne Creek	10	15	30	0	0
Porter Creek	120	3,024	6,048	158	316
Porter Creek (MWC)	48	679	1,358	129	258
Press Creek	10	80	160	9	18
Purrington Creek	88	482	964	96	192
Redwood Creek	46	206	412	53	106
Redwood Creek (Atascadero)	10	23	46	19	38
Santa Rosa Creek	70	1,695	3,390	125	250
Schoolhouse Creek	7	72	144	3	6
Sheephouse Creek	78	71	142	17	34
Sulphur Creek	6	24	48	0	0
Thompson Creek	18	32	64	1	2
Wallace Creek	28	232	464	7	14
Ward Creek	108	821	1,642	287	574
Willow Creek	122	249	498	26	52
Wine Creek	32	948	1,896	44	88
Woods Creek	63	640	1,280	58	116
Yellowjacket Creek	47	48	96	58	116
Total	**2,529**	**28,536**	**57,072**	**3,505**	**7,010**

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

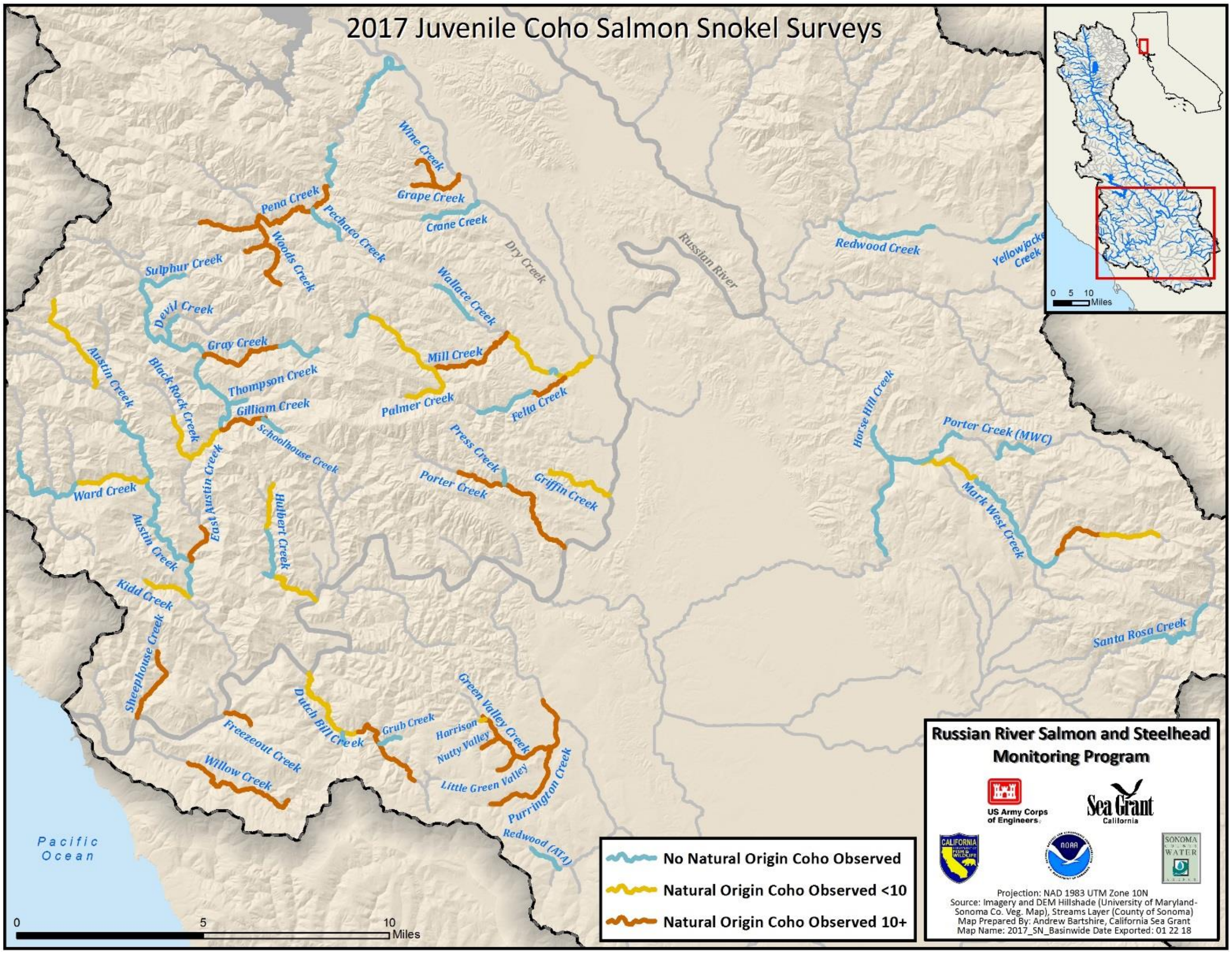

Figure 3. Map showing natural-origin coho salmon presence in surveyed Russian River tributaries, summer 2017.

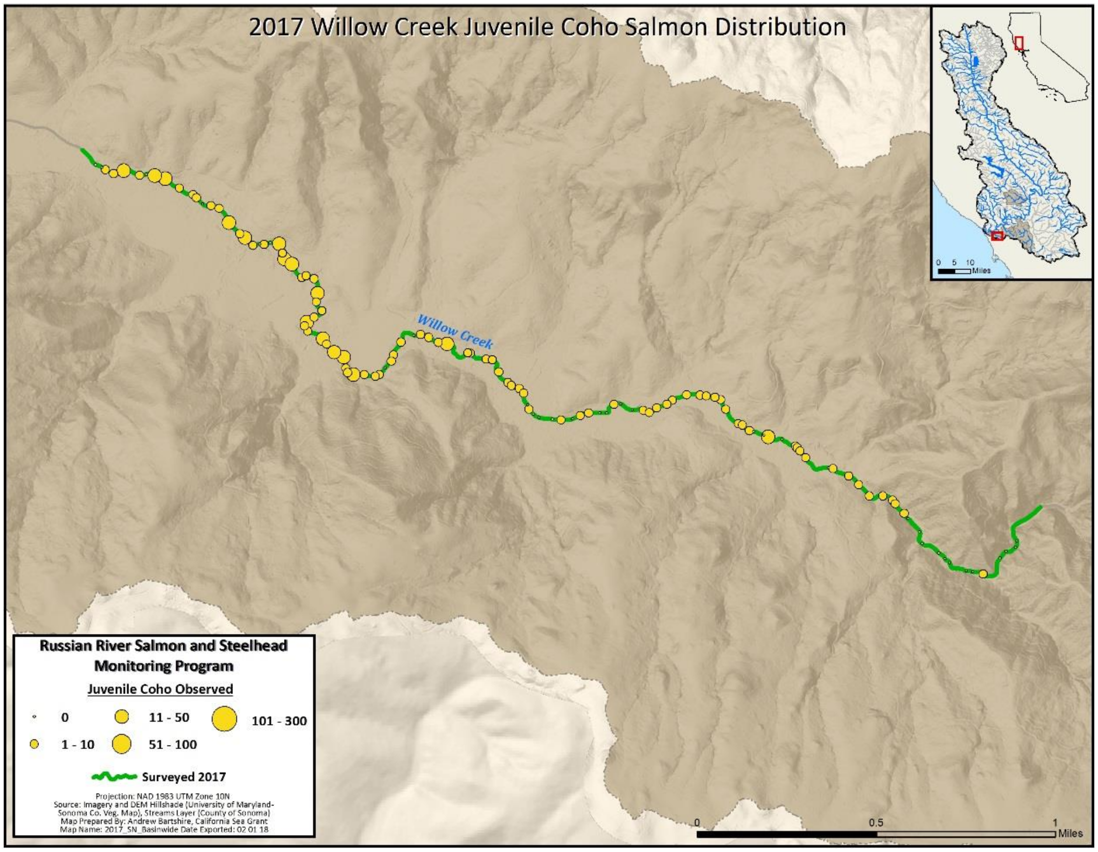

Figure 4. Density and distribution of juvenile coho salmon yoy observed in Willow Creek, 2017.

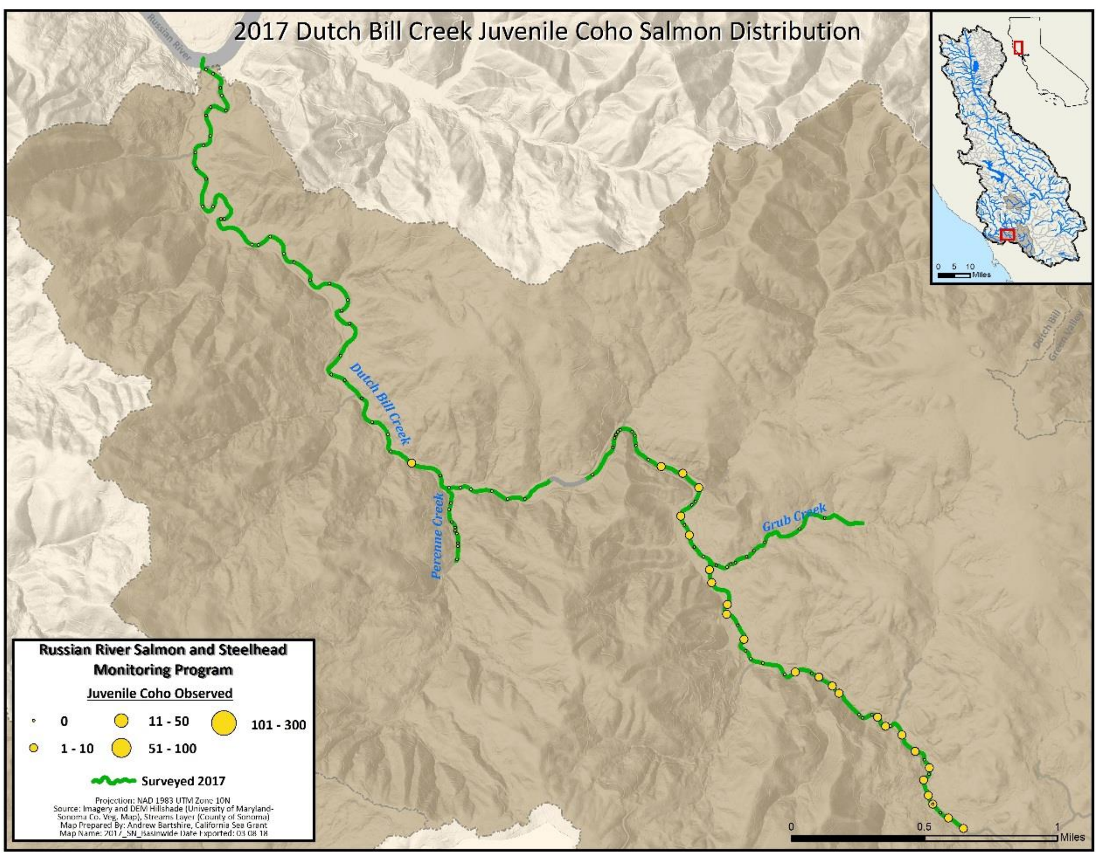

Figure 5. Density and distribution of juvenile coho salmon yoy observed in Dutch Bill Creek, 2017.

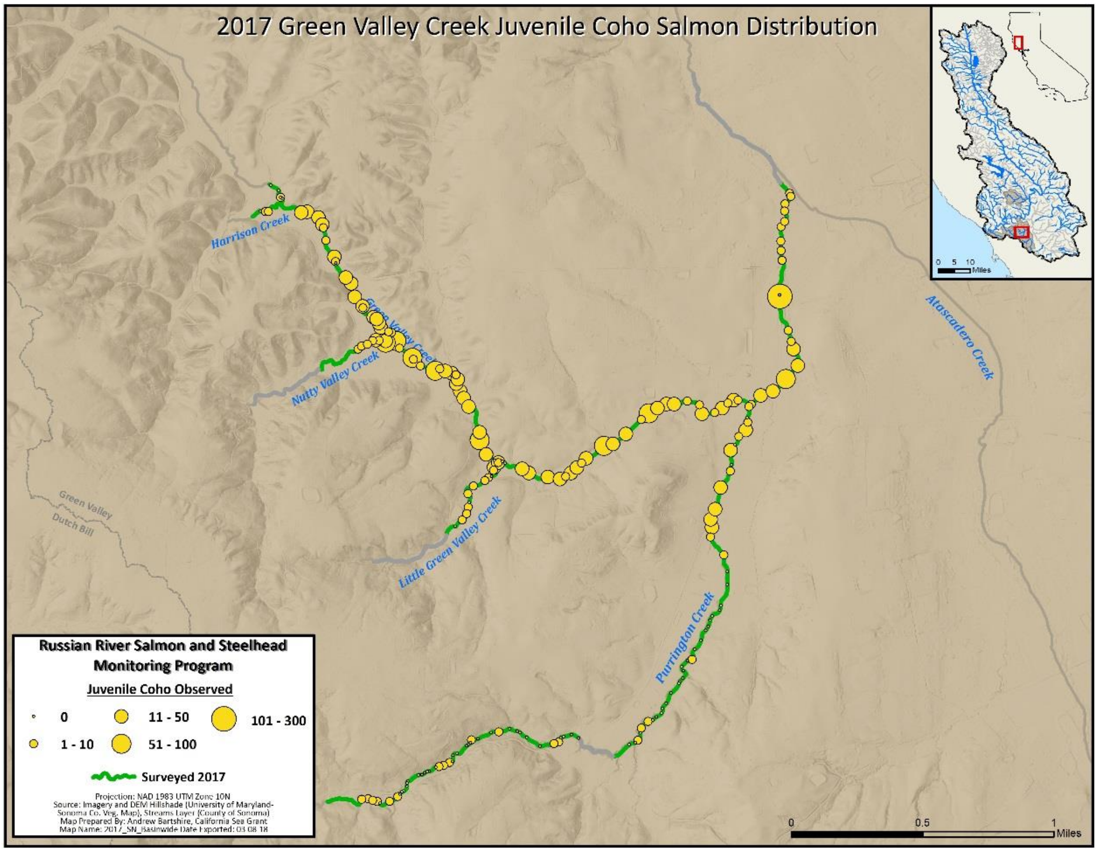

Figure 6. Density and distribution of juvenile coho salmon yoy observed in Green Valley Creek, 2017.

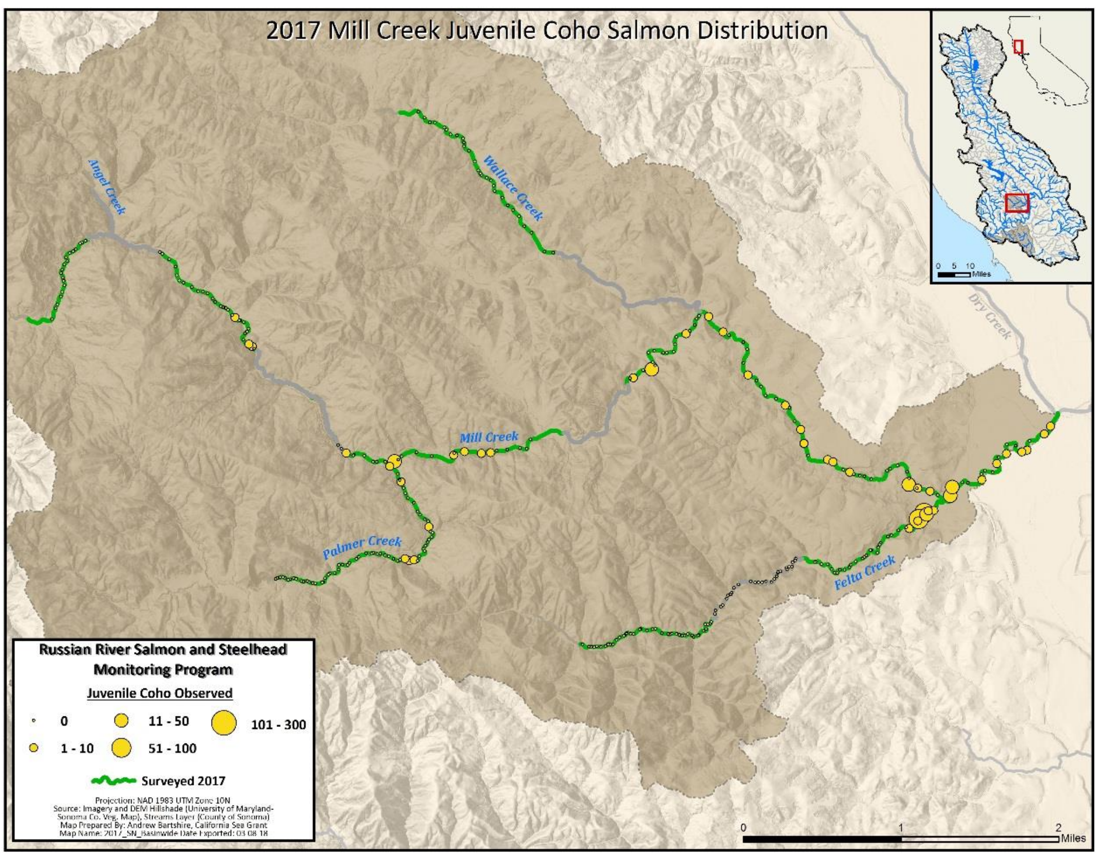

Figure 7. Density and distribution of juvenile coho salmon yoy observed in Mill Creek, 2017.

2.3 Discussion and Recommendations

Natural-origin juvenile coho salmon were present in all four Broodstock Program monitoring streams and in 28 of 41 coho streams surveyed through the CMP Program in 2017. Ten or more coho salmon yoy were observed in 20 of the 41 surveyed 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 2016/17, 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.

During the winter of 2016/17, we anticipated the return of hatchery coho salmon adults to 19 tributaries (excluding Dry Creek) based on release streams for the 2014 year-class, and, in turn, the presence of natural-origin juveniles during the summer of 2017. Of the 19 streams where natural-origin juveniles were expected, they were found in 17; Thompson, and Devil creeks were the only two release streams where natural-origin coho salmon were not observed.

A possible explanation for the lack of juveniles in Thompson and Devil creeks is that those streams were stocked in the spring of 2014 (rather than in the fall of 2014 or with smolts in 2015). The fact that spring-release fish spend a longer amount of time in the stream environment where they experience higher mortality than in the hatchery, may explain the possible lack of returning adults in 2016/17 and subsequent lower natural production in these streams. Thompson and Devil creeks also have relatively higher gradient and less spawning gravel than other release streams, which may also play a role. The other East Austin Creek tributaries that were also only stocked in spring had low relative abundance as compared to many of the other streams (Table 1). We recommend that the Broodstock Program release fish during the fall season into the East Austin tributaries rather than stocking in the spring.

Natural-origin juvenile coho salmon were also found in eleven tributaries where we did not anticipate adult returns in 2016/17 as a result of hatchery releases. Almost all of these streams were in close proximity to streams that were stocked. Kidd Creek in the Austin Creek watershed, Redwood Creek in the Maacama watershed, and Griffin Creek were the exceptions (Figure 3). Juvenile coho salmon were also observed in the Kidd and Redwood Creek reaches in the summer of 2016.

Presence absence maps (e.g. Figure 3) are useful in displaying specific reaches where coho salmon are present in a given year; however, to quantify trends in juvenile salmonid spatial distribution over time, occupancy models offer a unique approach. Through the CMP Program, UC and the Water Agency began conducting basinwide estimates of juvenile coho salmon occupancy in the Russian River watershed beginning in 2015, and we are currently funded to continue data collection through 2018. The proportion of juvenile coho salmon reaches occupied in 2017 (0.21) was lower than in 2016 (0.33) or 2015 (0.37). This reduction in juvenile occupancy took place despite an increase in the number of coho redds observed in the 2016-2017 spawner season. We suspect that this trend was driven by a high flow event that occurred shortly after the majority of coho spawning took place. These high flows may have led to low early life-stage survival due to scouring and sedimentation. This appeared to have a greater effect in streams with higher gradient; the redd to yoy ratios observed in higher gradient Broodstock Program monitoring streams (Dutch Bill and Mill creeks) were lower than those observed in the lower gradient Broodstock Program monitoring streams (Green Valley and Willow creeks) (Figure 8). Because of this type of variation among streams and the unpredictable nature of streamflow conditions each year, we recommend the continuation of the bet-hedging strategy of stocking multiple streams with a diversity of habitat characteristics.

In some streams, fewer than 10 juvenile coho salmon were observed during snorkeling surveys. This could be explained by low spawning activity the previous winter and/or high early life stage mortality. Other possible explanations include juvenile straying from neighboring streams or misclassification of the age of the fish. On occasion, juveniles have been documented spending an additional year in freshwater and because fish do not always fall into the size/age classes we assign, it is possible to classify "holdover" parr as yoy. Future examination of redd abundance and distribution in comparison to juvenile abundance and distribution may help inform why juveniles were observed in such low numbers in certain streams.

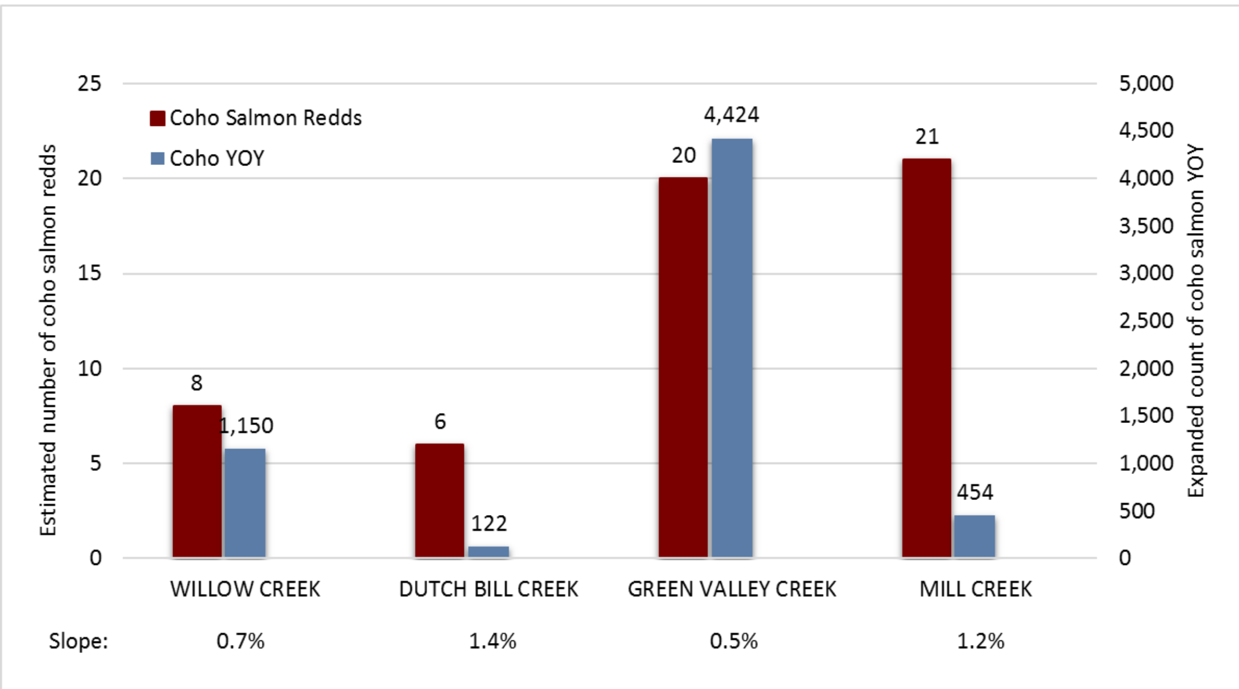

Figure 8. Coho Salmon redds observed in 2016-2017 spawner season along with Coho YOY counts from 2017 snorkel surveys

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