UC Coho Salmon and Steelhead Monitoring Report: Summer 2016

Prepared by:

Mariska Obedzinski, Nick Bauer, Andrew Bartshire, and Andrew McClary
California Sea Grant at University of California
January 2017, 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 2016. 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 stream reaches in the Russian River juvenile coho salmon sample frame (a sample frame of stream reaches identified by the Russian River CMP Technical Advisory Committee[1] as having juvenile coho 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% (32) of 107 reaches within the coho frame (SCWA and UC 2014).

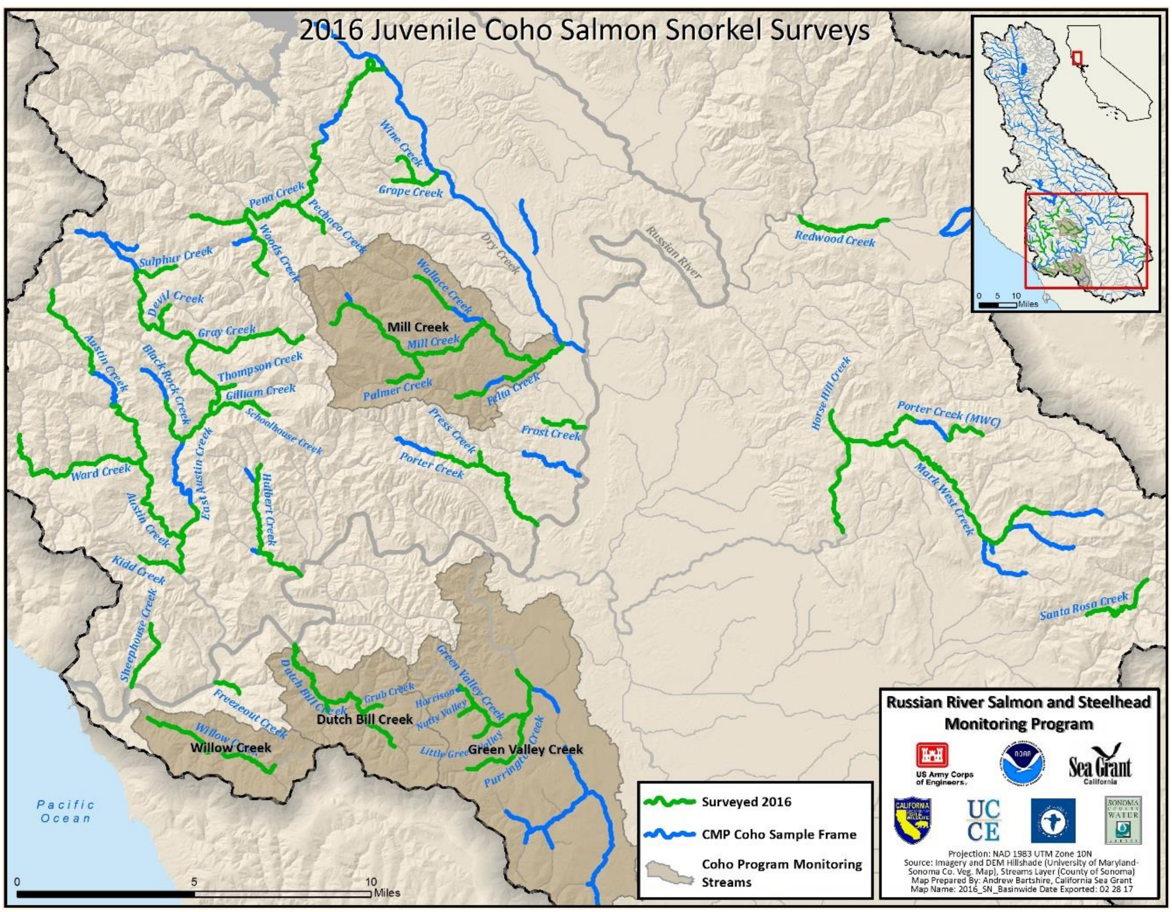

Figure 1. Map of 2016 snorkel survey reaches.

[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). 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), 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 yoy observed in East Austin 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 ($\psi * \theta$).

2.2 Results

UC and Water Agency biologists surveyed a total of 72 reaches representing 193 km (120 mi) of stream between May 23 and August 25. All juvenile coho salmon rearing reaches of Dutch Bill, Green Valley, Mill, and Willow creeks were surveyed for Broodstock Program monitoring, and 70 reaches within the coho sample frame (65% of the coho stratum) were included in the occupancy estimate for CMP monitoring. The two remaining reaches (on Horse Hill and Frost creeks) were removed from the juvenile coho salmon sample frame following surveys due to lack of juvenile habitat and were therefore not included in the occupancy estimate.

We observed 5,198 coho salmon yoy during the summer of 2016, with an expanded minimum count of 10,396 (Table 1), and we observed 26,834 steelhead yoy, with an expanded minimum count of 53,668 (Table 2). Counts of coho salmon yoy were highest in Green Valley Creek, and 10 or more coho yoy were observed in 36 of the 72 reaches and 18 of the 40 creeks snorkeled (49% and 45%, respectively) (Table 1, Figure 3). Steelhead were present in all but three of the 40 streams surveyed (Table 2).

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 2016 was 0.70 (0.58 - 0.80, 95% CI), and the conditional probability of coho yoy occupying a pool within a reach, given that the reach was occupied (θ), was 0.47 (0.43 – 0.51, 95% CI). The proportion of the coho stratum occupied (PAO) was 0.33.

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, where only eight coho salmon yoy were observed, fish were only observed in the downstream half of the survey reach (Figure 4). In Dutch Bill Creek, coho salmon yoy were observed throughout the survey reach with the highest concentrations in the middle and in two 250m reaches that were stocked in June as part of a survival study (Figure 5). In Green Valley Creek, coho salmon yoy were observed in the upper three-fourths of the stream as well as in three tributaries; Purrington, Little Green Valley, and Nutty Valley creeks (Figure 6). In Mill Creek, coho salmon yoy were concentrated in the lower half of the mainstem and in lower Felta Creek, with additional fish observed in the middle reach of the mainstem (immediately downstream of Palmer Creek where fish were released in spring) and in a summer survival study reach (Figure 7).

Table 1. Observations and expanded counts of coho salmon yoy and parr in Russian River tributaries, summer 2016.

Tributary	Number of Pools Snorkeled	Yoy	Expanded Yoy[1]	Parr	Expanded Parr[1]
Austin Creek [2]	147	223	446	5	10
Black Rock Creek	25	0	0	1	2
Devil Creek	21	1	2	0	0
Dutch Bill Creek [3]	100	439	878	0	0
East Austin Creek	113	608	1,216	0	0
Felta Creek	63	16	32	0	0
Freezeout Creek	21	91	182	0	0
Frost Creek	1	0	0	0	0
Gilliam Creek	30	70	140	2	4
Grape Creek	46	99	198	0	0
Gray Creek	95	79	158	1	2
Green Valley Creek [4]	118	1,018	2,036	5	10
Grub Creek	14	0	0	0	0
Harrison Creek	4	0	0	0	0
Horse Hill Creek	1	0	0	0	0
Hulbert Creek	50	0	0	0	0
Kidd Creek [5]	24	9	18	0	0
Little Green Valley Creek	10	8	16	0	0
Mark West Creek	136	8	16	0	0
Mill Creek [6]	171	474	948	4	8
Nutty Valley Creek	2	7	14	6	12
Palmer Creek	52	0	0	0	0
Pechaco Creek	17	0	0	0	0
Pena Creek	73	441	882	0	0
Perenne Creek	10	0	0	0	0
Porter Creek	107	323	646	0	0
Porter Creek (MWC)	34	0	0	0	0
Press Creek	7	0	0	0	0
Purrington Creek	43	115	230	0	0
Redwood Creek	30	14	28	0	0
Santa Rosa Creek	52	0	0	0	0
Schoolhouse Creek	13	0	0	0	0
Sheephouse Creek	62	217	434	0	0
Sulphur Creek	3	0	0	0	0
Thompson Creek	21	0	0	0	0
Wallace Creek	28	0	0	0	0
Ward Creek [7]	67	41	82	0	0
Willow Creek	117	8	16	9	18
Wine Creek	35	520	1,040	5	10
Woods Creek	54	369	738	0	0
Total	**2017**	**5,198**	**10,396**	**38**	**76**

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

[2] *Stream was snorkeled after stocking. Observed count potentially includes natural-origin yoy and hatchery fish released into Gray, Devil, Gilliam, and Thompson creeks.*

[3] *~1,000 coho yoy stocked into study reaches in June. Wild fish presence confirmed prior to stocking, but observed count may include stocked fish.*

[4] *~450 coho yoy stocked into study reach in June. Wild fish presence confirmed prior to stocking, but observed count may include stocked fish.*

[5] *Greater numbers of coho observed by an independent fisheries biologist in May 2016, before extensive drying occurred.*

[6] *~500 coho yoy stocked into study reach in June. Wild fish presence confirmed prior to stocking, but observed count may include stocked fish.*

[7] *All coho yoy were observed within 250 meters of the mouth of Ward Creek, downstream of a high-gradient reach.*

Table 2. Observations and expanded counts of steelhead yoy and parr in Russian River tributaries, summer 2016.

Tributary	Number of Pools Snorkeled	Yoy	Expanded Yoy[1]	Parr	Expanded Parr[1]
Austin Creek	147	1,782	3,564	452	904
Black Rock Creek	25	27	54	20	40
Devil Creek	21	4	8	0	0
Dutch Bill Creek	100	217	434	91	182
East Austin Creek	113	1,015	2,030	339	678
Felta Creek	63	1,086	2,172	52	104
Freezeout Creek	21	24	48	18	36
Frost Creek	1	0	0	0	0
Gilliam Creek	30	304	608	21	42
Grape Creek	46	1,433	2,866	67	134
Gray Creek	95	605	1,210	66	132
Green Valley Creek	118	772	1,544	55	110
Grub Creek	14	0	0	0	0
Harrison Creek	4	0	0	0	0
Horse Hill Creek	1	2	4	0	0
Hulbert Creek	50	1,685	3,370	33	66
Kidd Creek	24	180	360	13	26
Little Green Valley Creek	10	59	118	1	2
Mark West Creek	136	1,317	2,634	235	470
Mill Creek	171	2,334	4,668	490	980
Nutty Valley Creek	2	0	0	1	2
Palmer Creek	52	200	400	47	94
Pechaco Creek	17	954	1,908	37	74
Pena Creek	73	5,014	10,028	454	908
Perenne Creek	10	1	2	0	0
Porter Creek	107	2,833	5,666	166	332
Porter Creek (MWC)	34	164	328	27	54
Press Creek	7	1	2	2	4
Purrington Creek	43	257	514	34	68
Redwood Creek	30	623	1,246	47	94
Santa Rosa Creek	52	483	966	50	100
Schoolhouse Creek	13	128	256	8	16
Sheephouse Creek	62	69	138	4	8
Sulphur Creek	3	1	2	0	0
Thompson Creek	21	5	10	8	16
Wallace Creek	28	24	48	3	6
Ward Creek	67	967	1,934	84	168
Willow Creek	117	185	370	18	36
Wine Creek	35	1,243	2,486	49	98
Woods Creek	54	792	1,584	26	52
Total	**2,017**	**26,790**	**53,580**	**3,018**	**6,036**

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

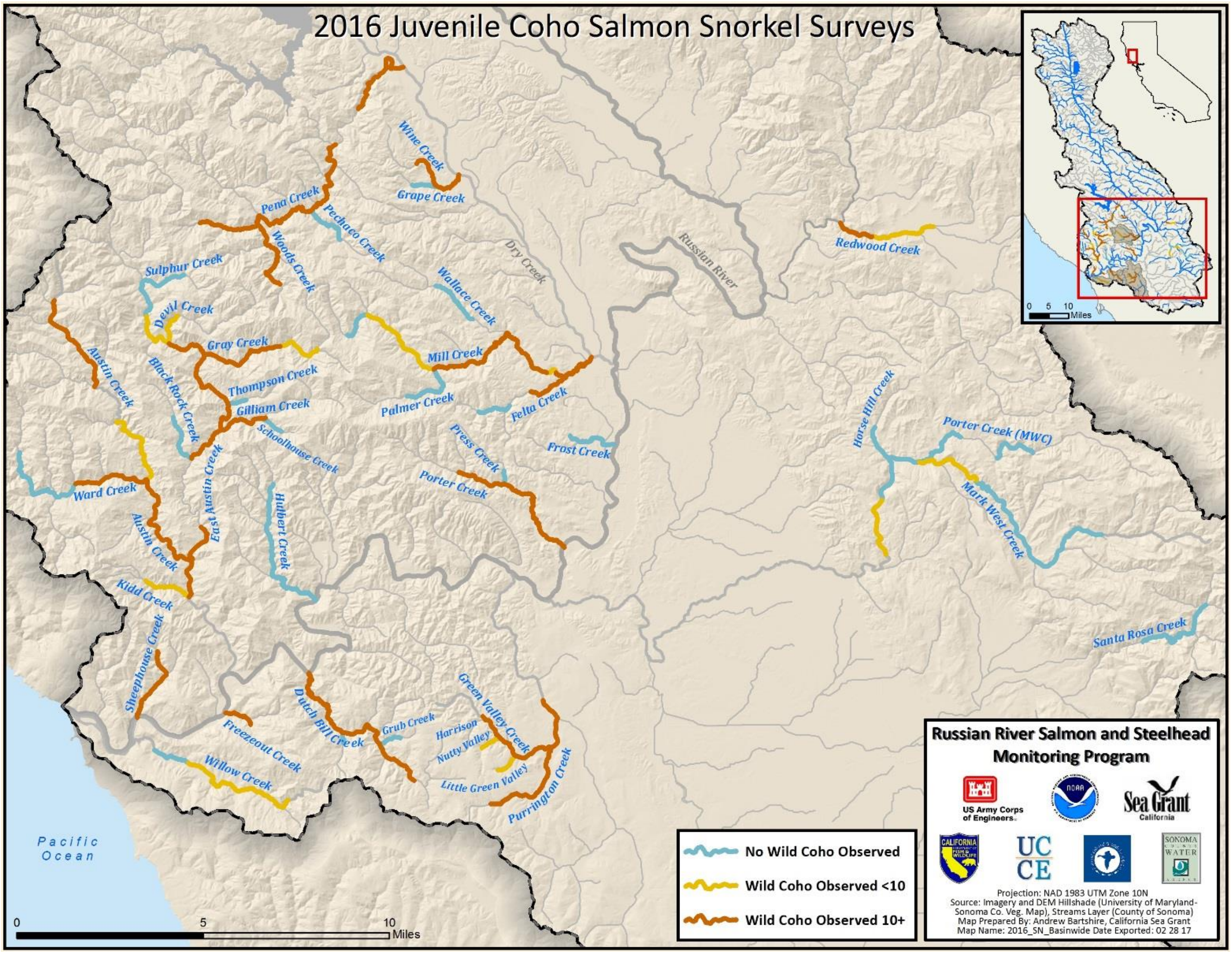

Figure 3. Map showing natural-origin coho salmon presence in surveyed Russian River tributaries, summer 2016.

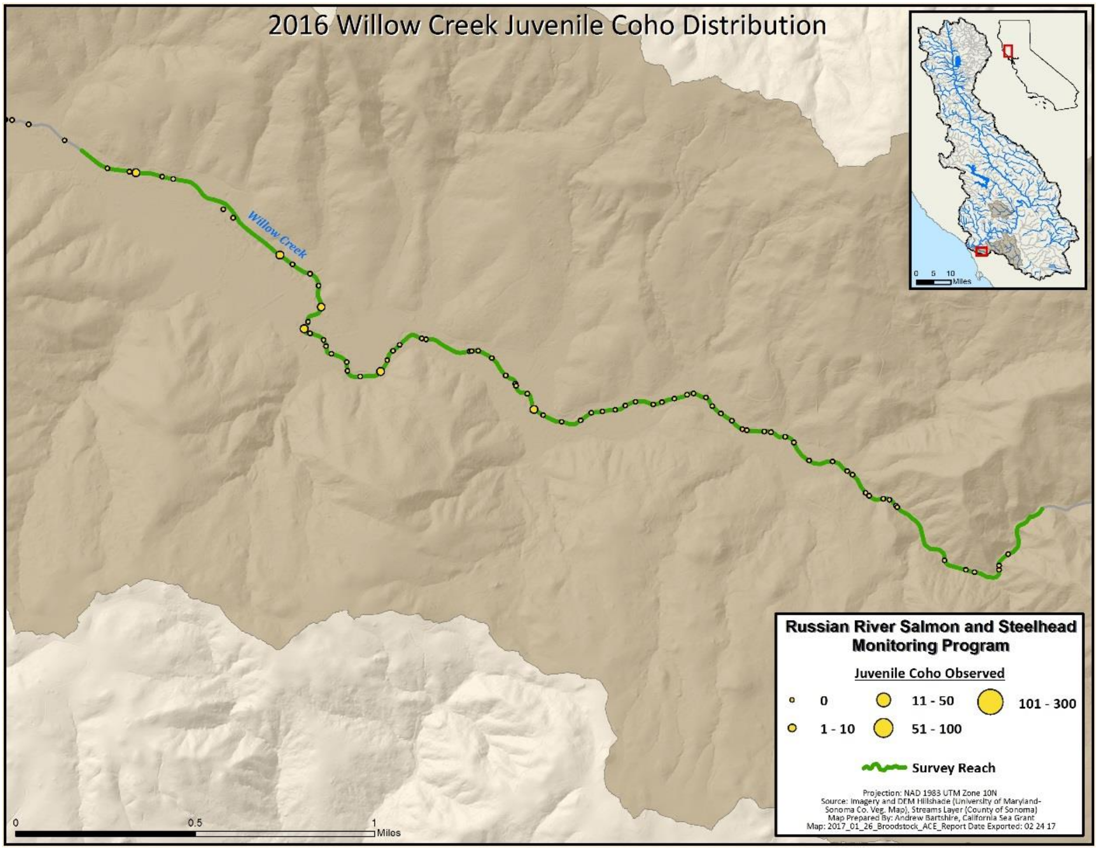

Figure 4. Density and distribution of juvenile coho salmon yoy observed in Willow Creek, 2016.

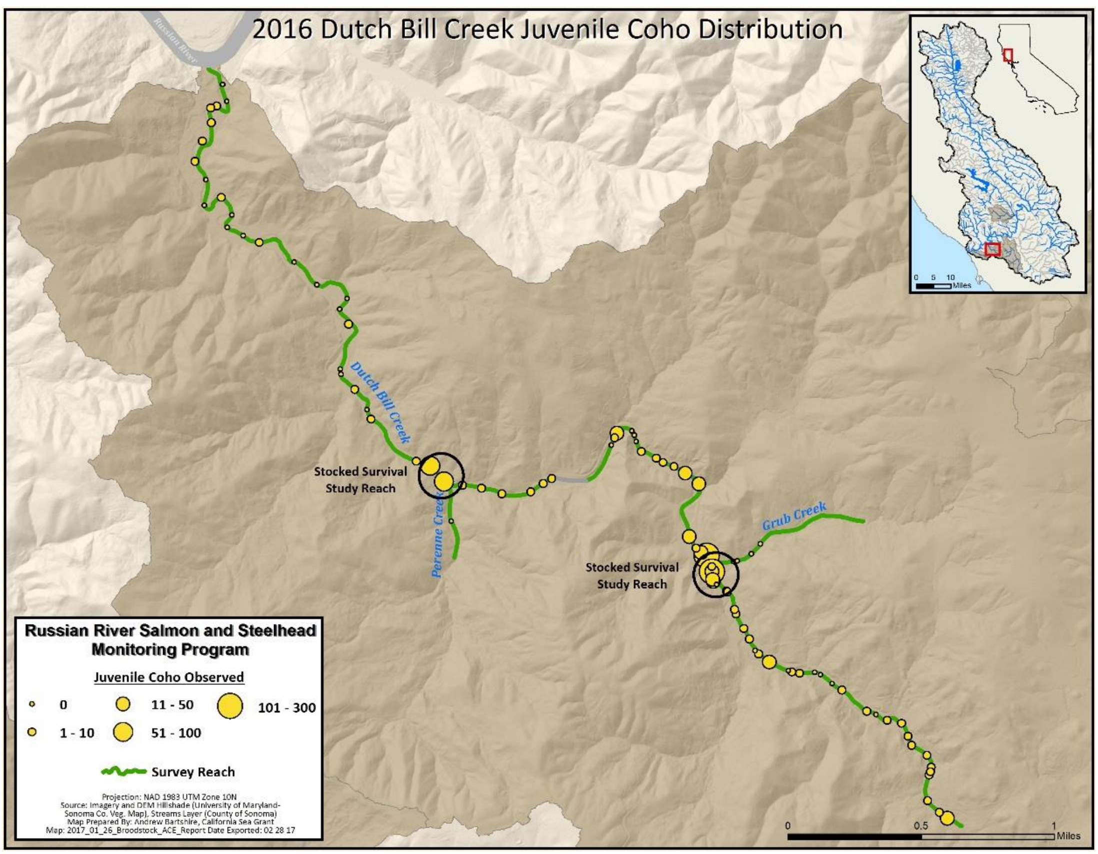

Figure 5. Density and distribution of juvenile coho salmon yoy observed in Dutch Bill Creek, 2016.

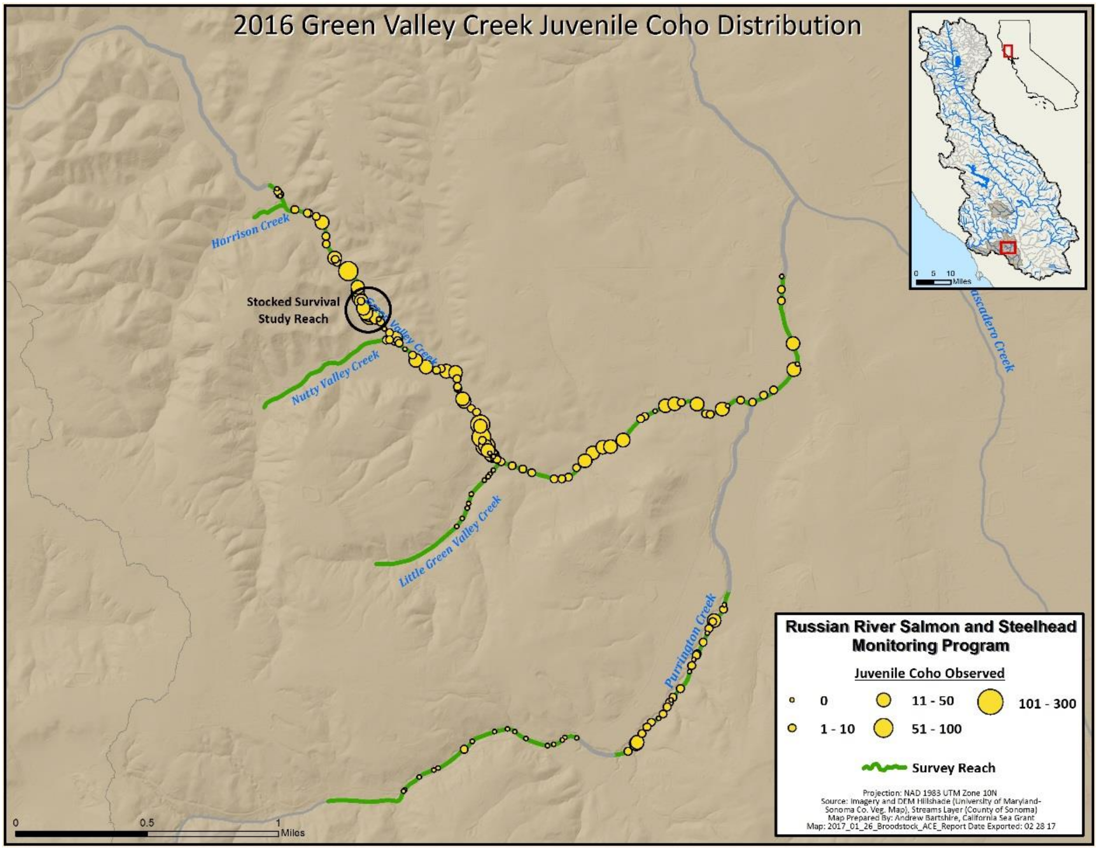

Figure 6. Density and distribution of juvenile coho salmon yoy observed in Green Valley Creek, 2016.

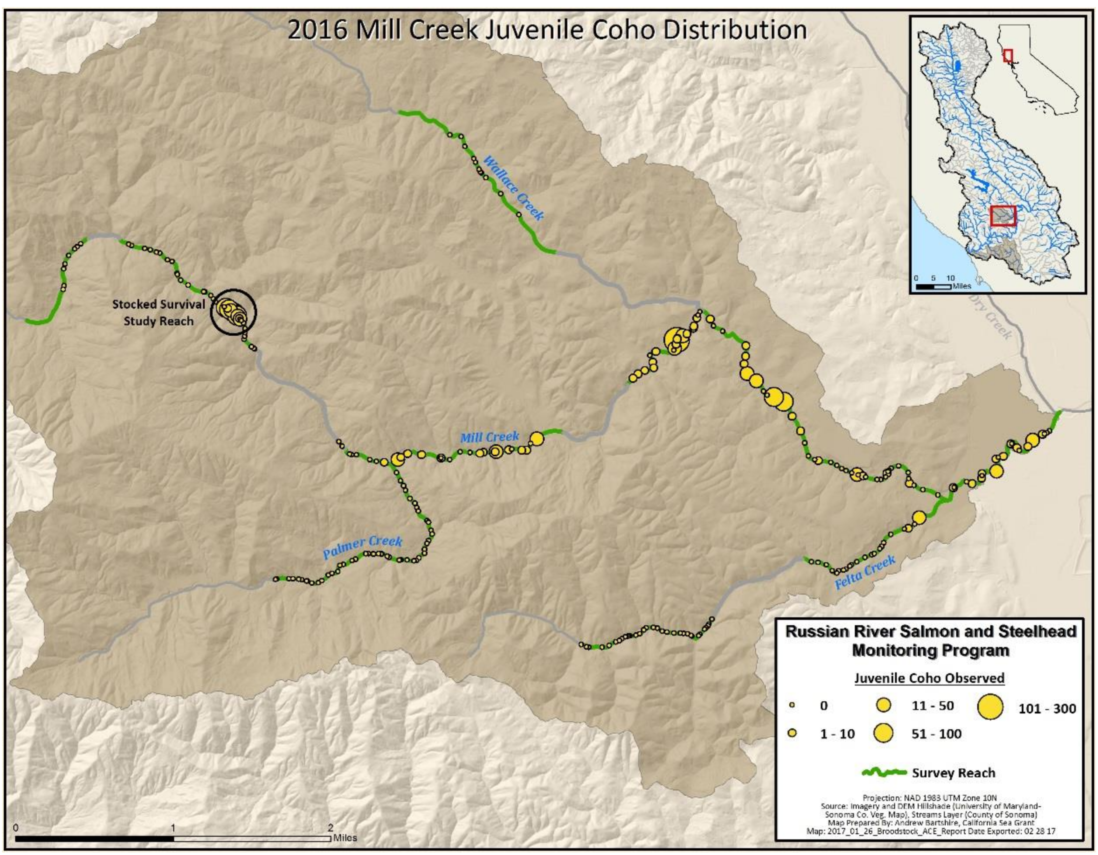

Figure 7. Density and distribution of juvenile coho salmon yoy observed in Mill Creek, 2016.

2.3 Discussion and Recommendations

Natural-origin juvenile coho salmon were present in all four Broodstock Program monitoring streams and in 24 of 40 streams surveyed through the CMP Program in 2016. More than 10 coho salmon yoy were observed in 18 of the 40 surveyed tributaries. This is a positive indication that successful spawning of adult coho salmon occurred in the Russian River watershed during the winter of 2015/16, 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 2015/16, we anticipated the return of hatchery coho salmon adults to 18 tributaries (excluding Dry Creek) based on release streams for the 2013 year-class, and, in turn, the presence of natural-origin juveniles during the summer of 2016. Of the 18 streams where natural-origin juveniles were expected, they were found in 15; Palmer, Thompson, and Black Rock creeks were the only three streams where natural-origin coho salmon were not found.

In Palmer Creek, we attribute the lack of juvenile coho salmon to a partial barrier in lower Mill Creek that likely limited access of returning adults during the winter of 2015/16. This barrier was addressed in 2016 and we anticipate adults will have the ability to return during future winters. A possible explanation for the lack of juveniles in Thompson and Black Rock creeks is that those streams were stocked in the spring of 2013 (rather than in the fall of 2013 or with smolts in 2014). 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 2015/16 and subsequent lower natural production in these streams. 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 consider releasing fish during the fall season into the East Austin tributaries rather than continuing to stock in the spring.

Natural-origin juvenile coho salmon were also found in nine tributaries where we did not anticipate adult returns in 2015/16 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 and Redwood Creek in the Maacama watershed were the exceptions (Figure 3).

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 the coho sample frame occupied in 2016 (0.33) was similar but slightly lower than in 2015 (0.37). As coho salmon populate new reaches and become more abundant within each reach, we anticipate observing an increase in PAO, with the ultimate goal of PAO=1 within the Russian River coho sample frame. We recommend using this metric indefinitely as a way to track trends in distribution over time.

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.

In streams where hatchery juveniles are released in spring, it is difficult to clearly document relative abundance of natural-origin juvenile coho salmon. In years prior to 2013, all hatchery-released coho salmon were adipose clipped, which served as a visual means of distinguishing hatchery from natural-origin fish during snorkeling surveys. To address this lack of a visual mark, we attempt to conduct snorkeling surveys in spring-release streams prior to hatchery release. Unfortunately, we do not always have the resources to survey every spring-release stream prior to stocking, which makes it impossible to accurately distinguish hatchery-origin coho yoy from natural-origin coho yoy in those streams. We are aware of these issues and continue to work to refine our scheduling in order to get the most accurate counts possible.

Following a year of extreme drought where drying reaches caused significant mortality to juvenile coho salmon rearing in Russian River tributaries (Obedzinski et al. 2016), in 2016 we first conducted surveys in streams that historically go dry early in the summer, in order to document fish presence before drying occurred. This prioritization enabled us to inform California Department of Fish and Wildlife personnel about which streams contained wild coho yoy so that rescue operations could occur in a timely manner. We intend to continue this process into the future.

3 References

Adams, P. 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.

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

Garwood, J. M. 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.

Nichols, J. D., L. Bailey, L., A. F. O'Connell Jr., N. W. Talancy, E. H. Campbell 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 45:1321-1329.

Obedzinski, M., N. Bauer, A. Bartshire, S. Nossaman, and P. Olin. 2016. UC Coho Salmon and Steelhead Monitoring Report: Summer-fall 2015. University of California Cooperative Extension and California Sea Grant, Santa Rosa, CA.

Sonoma County Water Agency and University of California Cooperative Extension/California Sea Grant. 2014. Implementation of the California Coastal Salmonid Monitoring Plan in the Russian River. Santa Rosa, CA.