Mattole Watershed Juvenile Coho Salmon Distribution Monitoring 2015

Coho salmon in Ancestor Creek, Mattole River watershed, June, 2015.

Technical Report prepared by the Mattole Salmon Group in partial fulfillment of California Department of Fish and Wildlife Fisheries Restoration Grant Program, Contract# P1410538

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Abstract

To assess coho salmon (*Onchorynchus kisutch)* population spatial structure in the Mattole River watershed, we used multi-pass snorkel surveys to gather information on the presence of coho and other aquatic vertebrates, and a suite of habitat parameters, during the summer baseflow period in 2015. Possible survey reaches were pre-defined to include all likely coho rearing habitat in the watershed, based on GIS-calculated reach gradient, valley width, and mean annual discharge. We surveyed a total of 52 reaches. In 2015 coho were detected in 7 of 51 reaches. Multi-scale occupancy models were used to calculate the proportion of area occupied (PAO) and the probability of species occurrence at both the reach and sample unit scale. PAO in 2015 was 0.08, less than the PAO of 0.13 in both 2013 and 2014. Unit-level occupancy (within occupied reaches) was 0.57, while reach-level occupancy was 0.14. Chinook Salmon PAO was 0.09. Juvenile *O. mykiss* were widely distributed, present in 50 of 51 reaches and nearly every sample unit.

Patterns of coho spatial distribution appeared similar to all years in the last three decades for which data exists, with 90-95% of the coho observed concentrated in the mainstem Mattole and a few tributaries in the extreme southernmost portion of the watershed. Reaches and habitat units with coho presence had higher cover ratings, cover area values, and intrinsic potential scores than those where coho were not detected, and at the unit-scale pool depth, cover area, and LWD count were also greater in pools with coho.

The differences in habitat quality, especially differences in cover, between the reaches and units with coho present and absent suggest that effective habitat restoration actions focused on enhancing habitat complexity and cover should help improve the availability of suitable coho rearing habitat. Streams and reaches with coho presence but low abundance adjacent to the core area of occupancy may be the most logical focus for continued restoration efforts. A better understanding of coho seasonal movement and winter habitat use and availability in the watershed would also help direct restoration efforts.

Introduction

Spatial structure, along with abundance, diversity, and productivity, is one of the key population characteristics that need to be assessed in order to evaluate trends in salmon population viability (Adams et al. 2011, McElhany et al. 2000). To assess coho salmon (*Onchorynchus kisutch*) population spatial structure in the Mattole River watershed, we used multi-pass snorkel surveys to gather information on the presence of coho and other aquatic vertebrates, and a suite of habitat parameters, during the summer baseflow period in 2015. Surveys were also conducted in 2013 and 2014 using the same protocol.

Study Area

The project took place in the 304 mi^2 Mattole River watershed, in coastal Humboldt and Mendocino counties.

Objectives

The primary project objectives were to:

- Determine distribution (spatial structure) of juvenile coho salmon in Mattole River watershed.
- Estimate abundance of juvenile coho salmon in the Mattole River watershed.

Additional objectives were to

- Assess relationship between coho occupancy and habitat variables
- Compare coho juvenile distribution to prior years

Methods

Field methods followed Garwood and Ricker (2015), and those described in detail in that document are reviewed only briefly here. Prior to the survey season, surveyors attended the protocol training conducted by CDFW in early June. Following this training, multiple days of additional training were conducted surveying a reach not among the GRTS-drawn reaches, focused particularly on species identification.

Reach Selection

Survey reaches were all potential coho salmon spawning reaches in the sample frame that was developed for Mattole River adult salmonid spawner surveys by CDFW with input from the MSG (Garwood and Ricker 2008) (Figure 1). Reaches attributed as potential coho habitat in this sample frame have a maximum stream gradient of five percent or less, and a minimum estimated mean annual discharge of greater than 0.05 cubic meters per second. A handful of reaches that fall outside of these parameters were included based on past documentation of coho presence (Garwood and Ricker 2008). One reach in the mainstem Mattole River, which is impossible to safely access during the winter spawner survey

season was added to the juvenile coho frame in 2015.

Reaches were surveyed in order from a spatially-balanced random draw made using the generalized random tessellation stratified (GRTS) algorithm. We did not use a rotational visitation scheme with a fixed panel as recommended in the Coastal Monitoring Plan (Adams et al. 2011), due to the lack of multi-year funding for this survey effort. A fixed panel survey scheme could be instituted at a future time.

Landowners were contacted for access permission by both mail and phone (when phone numbers were obtainable). Any segment of a reach where access permission was obtained was surveyed, unless the segment required additional travel time of greater than one hour to access (was not adjacent to another surveyed reach) and was so short that it may not have contained any qualifying units.

Field work and data handling

Every other pool within a reach was sampled that met specific depth, width, area, and temperature criteria, in addition to descriptive morphologic criteria, as described in Garwood and Ricker (2015). In "large river" reaches, defined as mean annual discharge of >10 m^3 s^{-1} (which in the Mattole sample frame is mainstem river reaches with reach ID #'s 273-299), qualifying units were defined by the presence of cover in addition to the above criteria. Every fourth pool in a reach meeting these criteria was snorkeled using an independent double-pass, with divers identifying and tallying all fish species present, as well as other relevant aquatic or amphibious species. Every pool meeting the criteria was sampled in "large river" reaches, due to the infrequent occurrence of qualifying units.

The following physical parameters were recorded for each sampled unit: pool type, length, average width, maximum depth, cover rating, instream shelter, and woody debris. In reaches where coho were observed, surveyors were instructed to obtain photographic documentation of coho presence.

Data from paper field data sheets was entered into the *Microsoft Access* database provided by CDFW. QA/QC checks were completed based on procedures provided by CDFW staff, and the completed database was transferred to Justin Garwood of CDFW.

Data analysis – occupancy and spatial structure

Population spatial structure was assessed by using detection probabilities from the independent double-pass dives to calculate the probability of species occupancy at the sample unit and sample reach scale. The single-season multi-method approach in program PRESENCE (USGS 2013) was used to calculate estimates of occupancy (ψ), estimates of conditional occupancy (θ), and detection probability (p) for each species and age class category. P was assumed to remain constant in pools between the two snorkel passes. The proportion of area occupied (PAO) was calculated by multiplying the estimate of occupancy (ψ) and the estimates of conditional occupancy (θ) (Garwood and Larson 2014). These calculations were completed by Justin Garwood of CDFW.

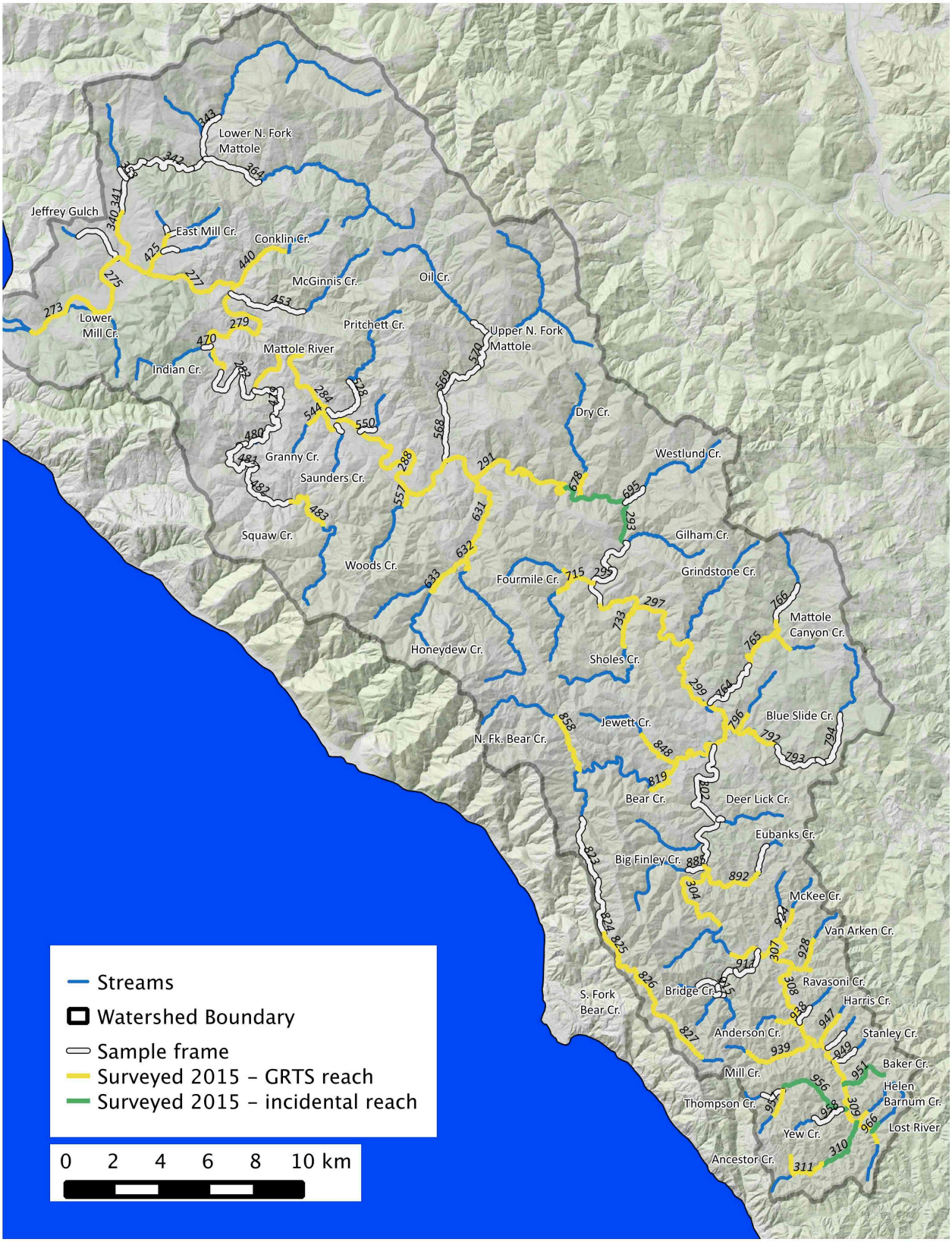

Figure 1. Mattole Coho summer spatial structure sample frame with reach ID #'s.

Estimate of coho abundance

The use of data collected under this protocol to make watershed-level juvenile coho abundance estimates incorporating detection probabilities and within- and between-reach variance has not yet been completed, but is under development (J. Garwood, pers com. January 2016).

With the highly skewed dataset and a majority of reaches with no coho presence, accounting for between-reach variance and developing a confidence interval would require the use of a bootstrapping technique, which is beyond the scope of this report. To develop an idea of how many juvenile coho were in the watershed in 2015, we calculated a simple watershed-wide "abundance" estimate that does not incorporate detection probability nor provide a confidence interval.

$$\textit{Estimated abundance} = \textit{Sum of coho observed (single dive pass)} * 2 * \frac{100}{\textit{Percentage of total frame length surveyed}}$$

The total number of coho observed was multiplied by two since only every other qualifying unit was sampled.

This number should not be construed as a population estimate, but does allow for a relative comparison of year-to-year abundance, and provides context for interpreting spatial structure and distribution results.

Data analysis – coho presence and habitat values

We performed some cursory analysis of habitat data to examine the following questions:

- Are there differences in habitat characteristics between reaches with and without coho presence?
- In reaches with coho, are there differences in habitat between pools with and without coho occupancy?

Data from the "large river" reaches (Reach ID's 273-299) was not used due to the differences in criteria for a qualifying unit, particularly the requirement that the unit must contain cover.

We calculated reach median values of unit depth, cover rating, cover area, LWD count, pool area, the proportion of pool area with cover, and reach mean temperature. Basin area at the downstream end of the reach, as well as reach-averaged intrinsic potential (Agrawal et al. 2005) were also included. Most habitat data was non-normally distributed, commonly with a preponderance of small values (positively skewed). We log or cube-root transformed data

when necessary to approximate normality, and used a t-test to test the hypothesis that there was no difference between habitat values in reaches with and without coho presence

In comparing habitat between units with and without coho detections, within reaches with coho presence at the reach-level, we excluded data from the one reach with only single coho found in two units near the stream mouth, 939. For comparison of habitat metrics in units with and without coho, we used the Wilcoxon rank-sum test (also known as the Mann-Whitney test), the non-parametric equivalent of the t-test.

In order to account for the compounding probability of Type I error with the use of multiple tests, we applied Bonferroni's adjustment to the p-value that would be considered significant at the 95% confidence level. Bonferroni's adjustment is α/p, where p is the number of variables, so for the comparison between reaches 0.05/9=0.006, and for the comparison between unit values 0.05/6=0.008.

Results

Reaches surveyed

Sixty-seven landowners were contacted for stream access permission. Forty gave permission, while 27 did not respond, or we were unable to find a valid address or phone number to reach them. One landowner replied and denied access permission.

Out of a total of 99 reaches in the Mattole sample frame, 52 reaches were surveyed in GRTS draw order, 51% of all possible reaches (Table 1). An additional five reaches were surveyed incidentally with additional funding. Of these 52 reaches, 39 were main reaches and 13 sub-reaches (surveyed by implication with the main reach). Field time to complete each reach averaged 24.8 hours, including travel time.

Table 1. Summary to number of reaches and units surveyed by year, including 2013 and 2014.

Year	# of reaches surveyed	Length surveyed (km)	# of units surveyed	% of reaches in frame surveyed	% of frame surveyed by length
2013	27	83.8	588	29%	33%
2014	37	98.7	716	39%	39%
2015	52	141.2	915	51%	51%

Coho salmon occupancy and distribution

In 2015, coho were observed in a smaller proportion of reaches (7 of 51) and units (121 of 915) surveyed than in 2013 and 2014, but in greater abundance in reaches where they were observed. The calculated percent area occupied (PAO), the product of reach and pool-level occupancy probabilities, was 0.08 in 2015, less than the value of 0.13 in 2013 and 2014. The probability of reach-level occupancy, **Ψ,** was also less in 2015 than in 2013 and

2014, 0.14 compared to 0.31 and 0.35. In contrast, Θ, the probability of coho detection in a given pool in a reach where coho were present, was higher in 2015, 0.57, than in the previous two years (Table 2). Detection probability, p, was 0.98 in 2015, a very high value.

The high detection probability was in large part a result of the pattern of distribution - unlike in the past few years, we had no reaches with a single coho, and very few reaches occupied by non-natal fish (Table 3, Figure 2). Where coho were present, they were more abundant and more densely distributed than in 2013 and 2014 (Figure 3, and see data in Appendix A and B).

Coho observations in 2015 occurred entirely in the Southern subbasin of the watershed, upstream of Thorn Junction (Table 3, Figure 2). Among the seven reaches where coho were observed, more than half of the coho counted by surveyors were in reach 309 in the mainstem Mattole. Mainstem reaches 308, 309, 310 (not in the reach draw but surveyed incidentally), and 311 also contained numbers of juveniles that seemed to indicate spawning throughout this portion of the mainstem Mattole. The only tributary stream where juvenile abundance and distribution suggested spawning activity was Lost River. For the second year in a row, there appeared to have been no coho spawning and reproduction in Thompson Creek. Prior to these past two years this stream had been considered, along with the mainstem Mattole River upstream of Thompson Creek, to be the most productive coho stream in the watershed.

Chinook occupancy

Chinook were detected in sixteen stream reaches in 2015, with a PAO of 0.09, similar to in 2013, and higher than in 2014 when spawning distribution was limited by low flows (Table 2). Most detections were of a single fish in a pool, with a median count of one, and most Chinook were seen in the mainstem Mattole. The reaches with the greatest number of Chinook observed were at the downstream and upstream ends of the mainstem – mainstem reach 273 just upstream of the Mattole estuary, and 309 and 310 upstream of the village of Whitethorn, as well as Thompson Creek reach 956, which was not in this year's sample draw but was surveyed as a training reach (Figure 4).

Steelhead occupancy

Young-of-the-year (YOY) *O. mykiss* (either rainbow trout of steelhead) were present in 50 out of 51 reaches surveyed (Table 2, Figure 5). Only a single pool was surveyed in the one reach (Crooked Prairie Creek, #796) where none were seen. Mean and median counts per pool were 34.6 and 12, respectively. *O. mykiss* judged to be from older age classes, lumped together as 1+ fish, were slightly less widespread and abundant, but still present in 47 out of 51 reaches. These results are similar to 2013 and 2014, and juvenile steelhead seem to be present in nearly every Mattole stream reach that spawning adults can access, and that contains at least some water throughout the summer.

Table 2. Occupancy estimates by salmonid species, Mattole River basin, 2013-2015. Calculations completed by J. Garwood.

Species and Year	Psi	SE	95% CI	Theta	SE	95% CI	*p*	SE	95% CI	PAO	# of Reaches present	Mean pool count	Median pool count
Coho salmon 2013	0.31	0.10	0.15 - 0.52	0.43	0.03	0.36 - 0.50	0.86	0.03	0.80 - 0.91	0.13	7 of 24	5.7	4
Coho salmon 2014	0.35	0.08	0.21 - 0.53	0.37	0.05	0.28 - 0.46	0.68	0.07	0.53 - 0.80	0.13	12 of 37	10.3	4
Coho salmon 2015	0.14	0.05	0.07 - 0.27	0.57	0.04	0.50 - 0.60	0.98	0.02	0.90 – 1.00	0.08	7 of 51	13.3	6
Chinook Salmon 2013	0.47	0.11	0.27 - 0.68	0.22	0.03	0.17 - 0.28	0.71	0.06	0.58 - 0.81	0.10	10 of 25	3.4	1
Chinook Salmon 2014	0.15	0.06	0.06 - 0.30	0.29	0.08	0.15 - 0.47	0.79	0.11	0.50 - 0.94	0.04	5 of 37	2.1	2
Chinook Salmon 2015	0.39	0.08	0.25 - 0.55	0.22	0.03	0.16 - 0.29	0.69	0.08	0.52 - 0.81	0.09	16 of 51	4.8	1
YOY *O. mykiss* 2013	1.00	–	–	0.95	0.01	0.93 - 0.97	0.98	<0.01	0.97- 0.99	0.95	25 of 25	27.2	15
YOY *O. mykiss* 2014	1.00	–	–	0.82	0.02	0.78 - 0.85	0.97	<0.01	0.95 - 0.98	0.82	37 of 37	44.8	23
YOY *O. mykiss* 2015	1.00	–	–	0.89	0.01	0.87 - 0.91	0.96	<0.01	0.94 - 0.97	0.89	50 of 51	34.6	12
1+ *O. mykiss* 2013	1.00	–	–	0.94	0.01	0.91-0.95	0.93	0.01	0.91 - 0.95	0.93	25 of 25	10.7	6

Species and Year	Psi	SE	95% CI	Theta	SE	95% CI	*p*	SE	95% CI	PAO	# of Reaches present	Mean pool count	Median pool count
1+ *O. mykiss* 2014	0.92	0.04	0.78 - 0.98	0.76	0.03	0.70 - 0.81	0.79	0.03	0.73 - 0.84	0.73	34 of 37	4.8	3
1+ *O. mykiss* 2015	0.95	0.03	0.83 - 0.98	0.75	0.02	0.66 - 0.75	0.82	0.02	0.77 - 0.86	0.67	47 of 51	5.4	3

Psi Ψ- The probability a species is detected in a given reach for the survey year.

Theta-**Θ** Conditional occupancy - the probability a species is detected in a given sample pool conditional to the species being present in the reach for the survey year.

p-Individual species detection probability if present in a given sample pool.

PAO-Proportion of area occupied. (PSI * Theta) Overall occupancy value; incorporates reach-level- and pool-level occupancy for the entire sample frame in a given year

Table 3. Drainage area, length surveyed, # of units surveyed, and coho occupancy and Chinook presence by reach, 2015

Reach ID	Stream Name	Drainage area km^2	Length surveyed (m)	# of units in reach	# of units occupied by coho	Total # coho observed**	Mean coho count per pool	Suspected coho rearing type	Chinook presence
273	Mattole River	762.5	3990	25	0				X
275	Mattole River	748	5237	8	0				x
277	Mattole River	633.8	4699	10	0				x
279	Mattole River	616.6	8288	9	0				
284	Mattole River	522.4	11580	10	0				
288	Mattole River	490.4	11251	13	0				x
291	Mattole River	357.11	6883	0	0				
297	Mattole River	277.7	6384	2	0				
299	Mattole River	254.9	7290	4	0				x
304	Mattole River	126.1	2504	20	0				x
307	Mattole River	79.4	5091	24	4	6	1.5	non-natal	x
308	Mattole River	52.3	6731	42	25	175	7.0	natal	x
309	Mattole River	30.3	3513	32	29	925	31.9	natal	x
311	Mattole River	5.8	1594	44	37	367	9.9	natal	x
328	Lower Mill Creek	5.4	912	22	0				
340	Lower N. Fork Mattole	97.6	1900	5	0				
425	East Mill Creek	7.4	456	4	0				
440	Conklin Creek	14.4	757	3	0				
483	Squaw Creek	18.9	2618	20	0				
544	Granny Creek	2.4	889	2	0				x
557	Woods Creek	5.1	180	1	0				
631	Honeydew Creek	44.3	946	6	0				
632	Honeydew Creek	33.8	2540	8	0				
633	Honeydew Creek	17.9	1465	8	0				
641	Honeydew Creek, Lower E. Fork	13.5	579	6	0				
646	West Fork Honeydew Creek	5.9	115	2	0				
678	Dry Creek	14.8	1385	12	0				
715	Fourmile Creek	14.1	2072	17	0				
718	Fourmile Creek, N. Fork	4.6	560	7	0				
733	Sholes Creek	10.5	2268	26	0				x
765	Mattole Canyon Creek	24.2	3218	22	0				
770	Panther Creek	6.7	996	7	0				
792	Blue Slide Creek	25.8	1934	15	0				
796	Crooked Prairie (Bick's) Creek	2.4	245	1	0				
818	Bear Creek	55.4	3114	16	0				x
819	Bear Creek	45.3	2177	11	0				

Reach ID	Stream Name	Drainage area km^2	Length surveyed (m)	# of units in reach	# of units occupied by coho	Total # coho observed**	Mean coho count per pool	Suspected coho rearing type	Chinook presence
825	Bear Creek, S. Fork	9.1	1981	17	0				
826	Bear Creek, S. Fork	6.7	2911	40	0				
827	S. Fork Bear Creek	4	3477	90	0				
848	Jewett Creek	6.1	2177	20	0				x
858	N. Fork Bear Creek	13.4	3040	23	0				
892	Eubanks Creek	8.9	1500	18	0				
924	McKee Creek	5.4	1405	28	0				
928	Van Arken Creek	5.2	1967	41	0				
930	South Fork Van Arken Creek	1.5	289	6	0				
937	Anderson Creek	1.8	755	12	0				
939	Upper Mill Creek	6	731	15	2	2	1.0	non-natal	
947	Harris Creek	2.5	667	20	0				
957	Thompson Creek	2.3	1159	49	0				
963	Lost River	5.1	1367	34	12	93	7.8	natal	x
964	Helen Barnum Creek	1.6	583	16	0				
972	Ancestor Creek	2.6	778	22	12	37	3.1	natal	x
Totals				915	121	1605			
			Incidental Surveys – non-GRTS Reaches						
293	Mattole River	345.2	5619	1	0				x
310	Mattole River	9.3	2721	43	16	72	4.5	natal	x
951	Baker Creek	4.0	1200	25	9	30	3.3	non-natal	x
956	Thompson Creek	9.5	2845	35	1	5	5.0	non-natal	x
966	Lost River, N. Fork	1.6	580	16	0				

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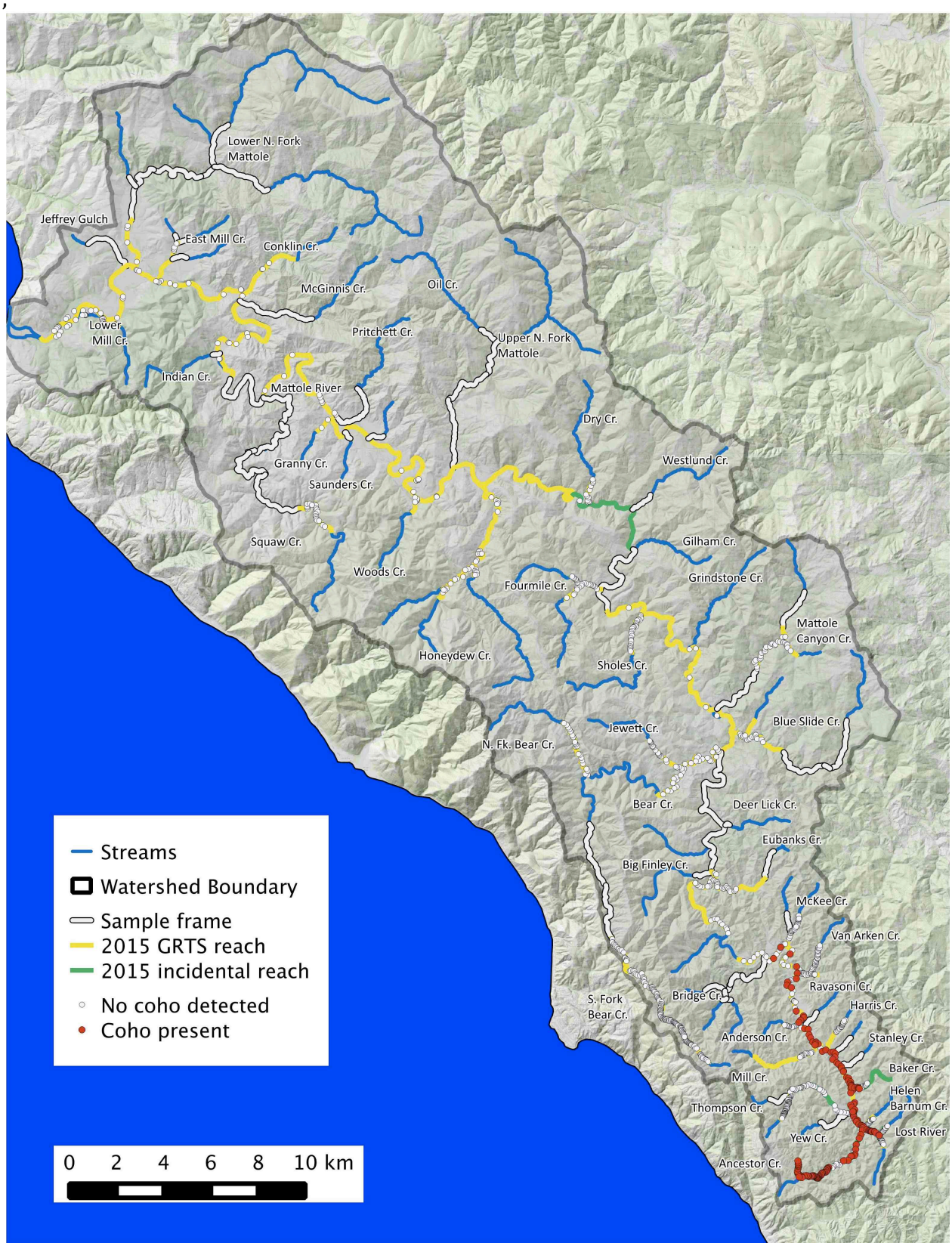

Figure 2. All pools surveyed and coho detections, 2015.

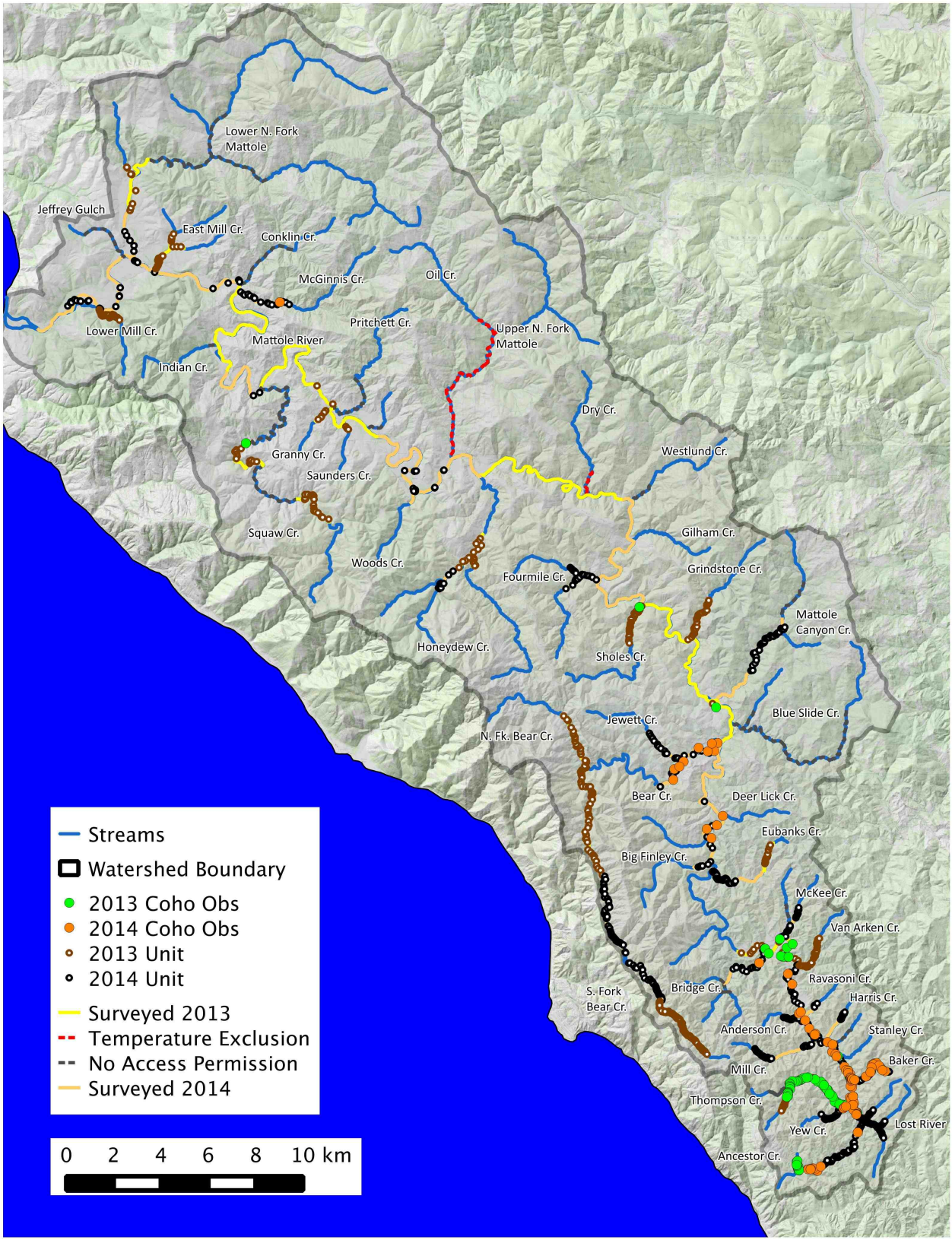

Figure 3. All pools surveyed and coho detections, 2013-2014.

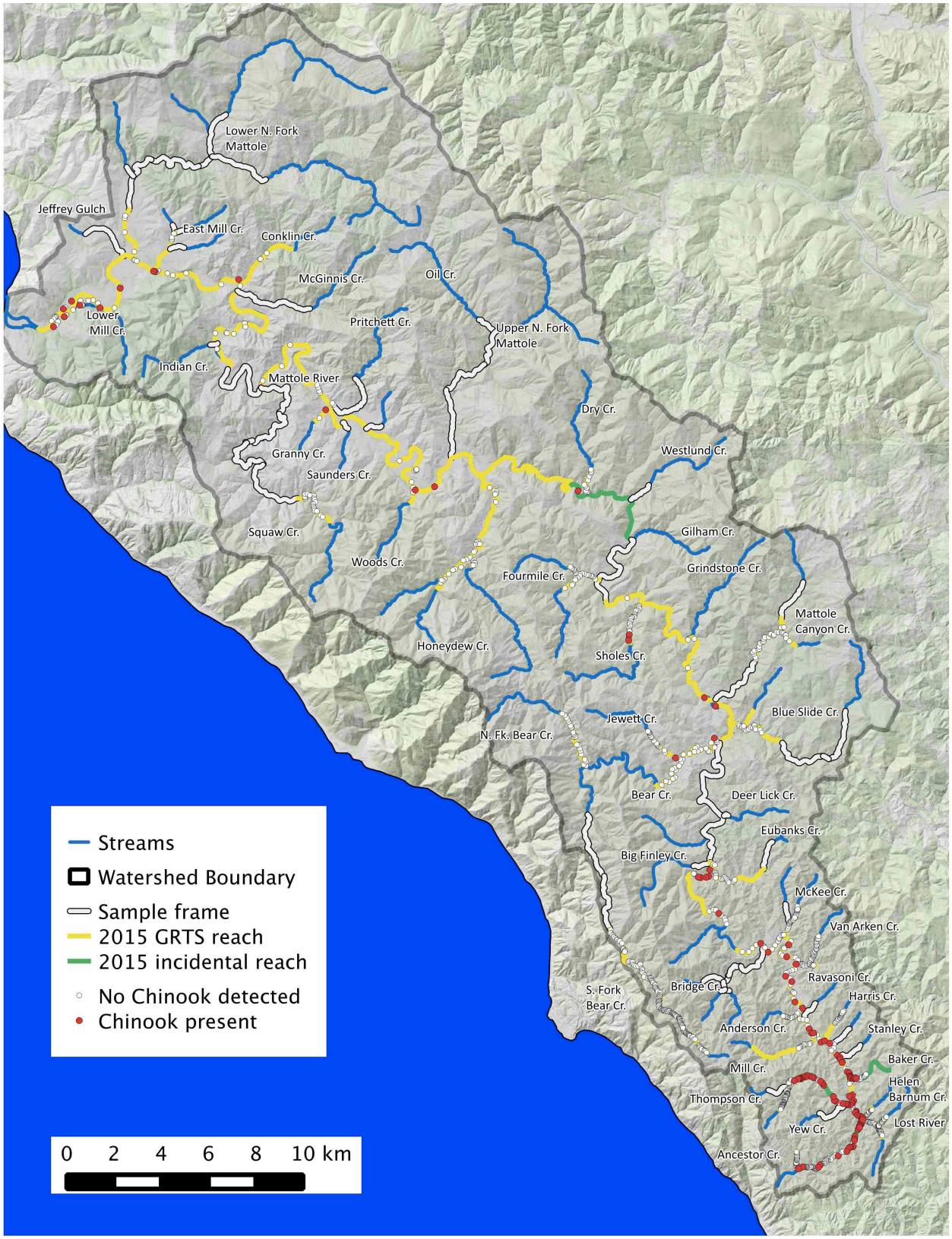

Figure 4. All pools surveyed and Chinook detections 2015.

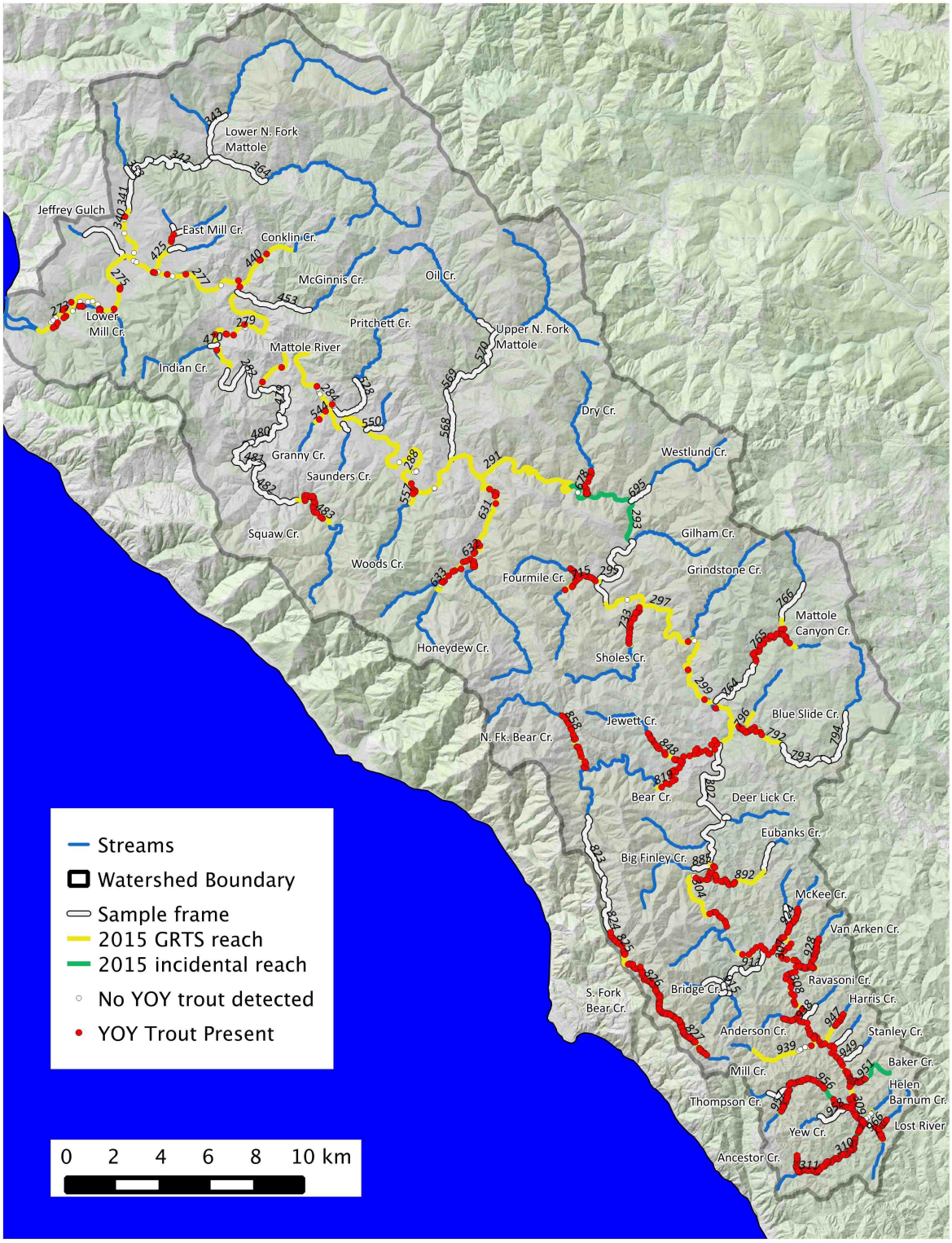

Figure 5. All pools surveyed and YOY trout detections, 2015.

Other biological observations of note

Pacific lamprey redds were observed in all mainstem Mattole River reaches from #279 upstream to #309. Due to the low spring flows in 2015 redds likely remained visible for longer than is typical, and surveyors tallied 415 lamprey redds in these mainstem reaches, with particularly high counts from reaches 291 and 307 (179 and 149, respectively). Single lamprey redds were also noted in reaches Blue Slide Creek 792, Bear Creek 818, South Fork of Bear Creek 825, and South Fork of Van Arken Creek 930.

Three non-native green sunfish were observed in reach 293, and bullfrog tadpoles were seen in mainstem reaches 284 and 299.

Estimate of coho abundance

In 2015 the sum of all coho observed was 1615 (Table 3) with 51% of the total reach length in the sample frame surveyed, yielding a basin wide abundance estimate of 6,294 coho parr, compared to estimates of 2,851 and 3,072 in 2014 and 2013.

Coho distribution in the Mattole watershed 2013-2015

From 2013-2015, 65 unique reaches were surveyed under this protocol (Table 4). Coho were detected at least once in 21 out of these 65 reaches. Only a single fish in a single year was detected in five of the reaches with coho detections. Coho were seen in 9 reaches multiple years and also every year those reaches were surveyed, out of 49 reaches surveyed at least two years.

Reaches with coho detections in multiple years were all in the southern third of the watershed, and included mainstem reaches 307 through 311, and tributary reaches in Upper Mill (939), Baker (951), Thompson (956), and Ancestor (972) creeks.

Table 4. Comparison of total coho counts by reach and year, 2013-2015.

Reach ID	Stream Name	2013	2014	2015
273	Mattole River		0	0
275	Mattole River		1*	0
277	Mattole River		0	0
282	Mattole River		0	
284	Mattole River	0		0
288	Mattole River		0	0
291	Mattole River	0	0	0
293	Mattole River		0	0
295	Mattole River		0	
297	Mattole River	0		0
299	Mattole River	1		0
302	Mattole River	3**	24	
307	Mattole RIver	10	2**	6
308	Mattole River	86**	32	175
309	Mattole River	150**	290	925
310	Mattole River		1	72
311	Mattole River		14	367
328	Lower Mill Creek	0	0	0
340	Lower N. Fork Mattole		0	0
341	Lower N. Fork Mattole	0		
353	Grizzly Creek	0		
425	East Mill Creek	0		0
428	South Branch, East Mill Creek	0		
453	McGinnis Creek		1	
481	Squaw Creek	3		
483	Squaw Creek	0		0
544	Granny Creek	0		0
548	Saunders Creek	0		
557	Woods Creek		0	0
632	Honeydew Creek	0		0

Reach ID	Stream Name	2013	2014	2015
633	Honeydew Creek		0	0
641	Honeydew Creek, East Fork	0		0
646	Honeydew Creek, West Fork			0
715	Fourmile Creek		0	0
718	Fourmile Creek, N. Fork		0	0
733	Sholes Creek	1		0
764	Mattole Canyon Creek		0	
765	Mattole Canyon Creek		0	0
792	Blue Slide Creek			0
796	Crooked Prairie Creek			0
818	Bear Creek		46	0
819	Bear Creek		7	0
824	Bear Creek, S. Fork		0	
825	Bear Creek, S. Fork		0	0
826	Bear Creek, S. Fork		0	0
827	Bear Creek, S. Fork	0		0
848	Jewett Creek		0	0
858	Bear Creek, N. Fork	0		0
885	Big Finley Creek		0	
892	Eubanks Creek		0	0
893	Eubanks Creek	0		
911	Bridge Creek		1	
924	McKee Creek		0	0
928	Van Arken Creek	0		0
937	Anderson Creek		0	0
938	Ravishoni Creek		0	
939	Upper Mill Creek		1	2
947	Harris Creek		0	0
951	Baker Creek	717	228	30
956	Thompson Creek	249	20	5
957	Thompson Creek	10		0
958	Yew Creek		10	

Reach ID	Stream Name	2013	2014	2015
963	Lost River		0	93
964	Helen Barnum Creek		0	0
972	Ancestor Creek	213	9	37

*Coho seen outside of sample unit

**Reach not surveyed using spatial structure protocol, total shown from MSG Summer Steelhead Dive

Habitat measurements and coho presence

Median values of unit depth, cover rating, cover area, LWD counts, pool area, and intrinsic potential were all higher in reaches where coho were detected (Table 5). The differences in cover rating, cover area, and intrinsic potential were significant at 95% confidence (p=***0.0020, 0.0038, and 0.0024*****).** Among reaches with coho present, the minimum reach median pool depth, cover rating, cover area, and intrinsic potential were greater than the median reach-median values in reaches without coho present (Figure 6). A similar, although less clear-cut pattern is seen with pool area and LWD occurrence, with no coho detected in the reaches with very low values of both these habitat metrics (Figure 6).

There appeared to be little difference in basin area and cover area as a proportion of pool area between coho and no coho reaches. The range in temperature was greater in reaches without coho present, with no coho detected in either the coldest or warmest reaches (Figure 6).

Table 5. Medians of reach median habitat values, grouped by reaches with and without coho detections, and p-values from Student's t-test.

	Unit Depth (cm)	Cover Rating	Cover Area (m^2)	LWD Count (pieces/ pool)	Pool Area (m^2)	Cover area as proportion of pool area	Basin Area (km^2)	Intrinsic Potential	Mean °C
Coho present *(n=7)*	72	2.26	4.63	1.17	54.0	0.030	6.0	0.80	14.0
Coho not detected *(n=35)*	50.25	2.06	1.25	0.42	29.4	0.037	7.4	0.56	15.5
p-value	*0.1915*	***0.0020***	***0.0038***	*0.0344*	*0.0941*	*0.6992*	*0.4095*	***0.0024***	*0.717*

(bold p-values significant at 0.95 confidence with Bonferroni adjustment)

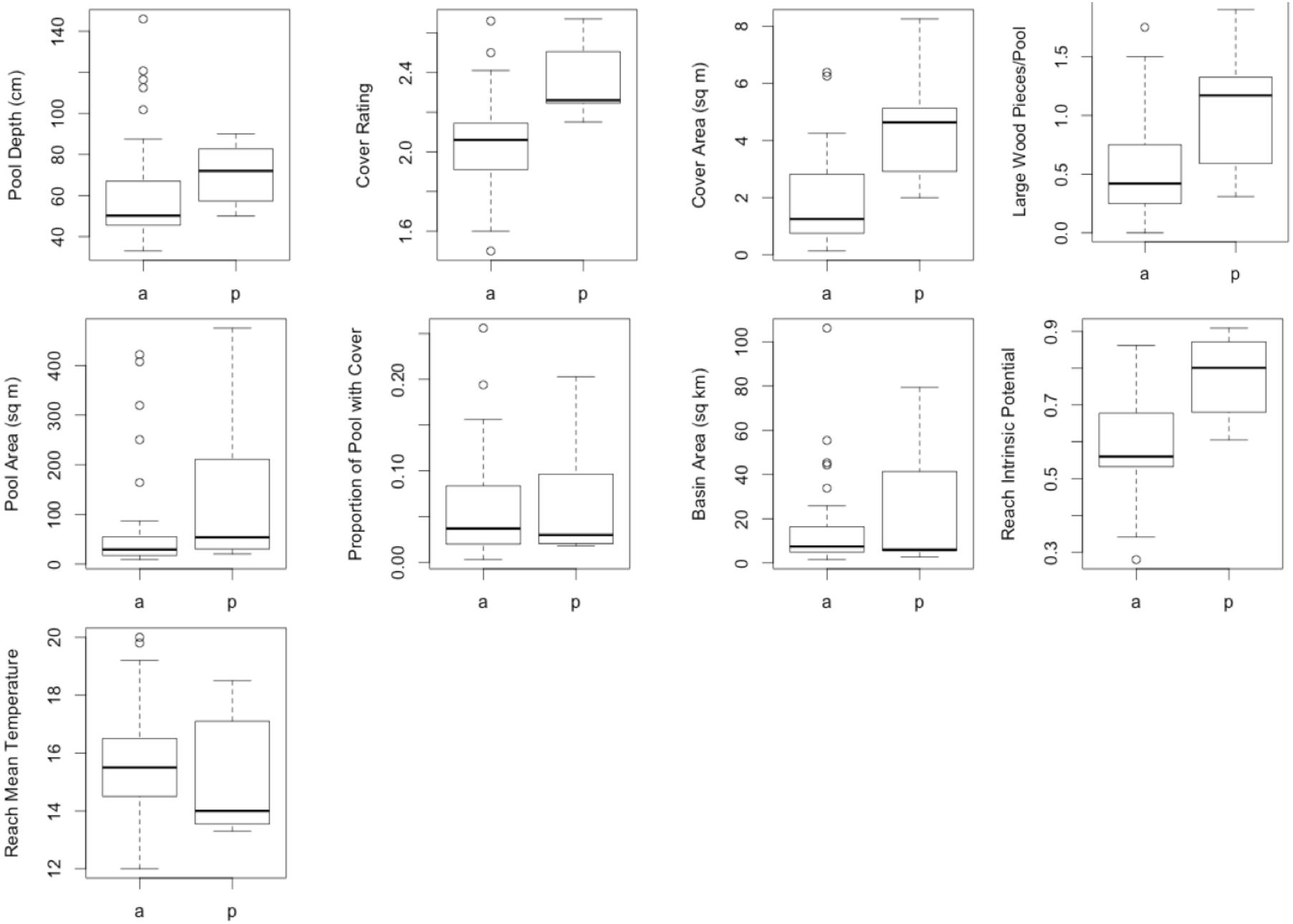

Figure 6. Boxplots comparing habitat values from the 7 stream reaches where coho were observed (p) and 35 reaches where no coho were detected (a)

In reaches with coho present, the fish appeared to show a preference for deeper pools with cover. Comparing units with and without coho, median values of unit depth, cover rating and area, LWD counts, pool area, and cover area as proportion of pool area were all higher in the pools with coho (Table 6, Figure 7). However differences were significant at 95% confidence only in unit depth, cover area, and LWD count (**all *p-values <0.001*).**

Table 6. Median habitat values from units with and without coho detections, within reaches where coho were present, and p-values from Wilcoxon rank-sum test.

	Unit Depth (cm)	Cover Rating	Cover Area (m^2)	LWD Count (pieces/ pool)	Pool Area (m^2)	Cover area as proportion of pool area
Coho present *(n=119)*	72	2.44	5.45	1.64	68.1	0.06
Coho not detected *(n=78)*	56	2.26	2.58	0.45	53.0	0.03
p-value	***<0.001***	*0.085*	***<0.001***	***<0.001***	*0.191*	*0.013*

(bold p-values significant at 0.95 confidence with Bonferroni adjustment)

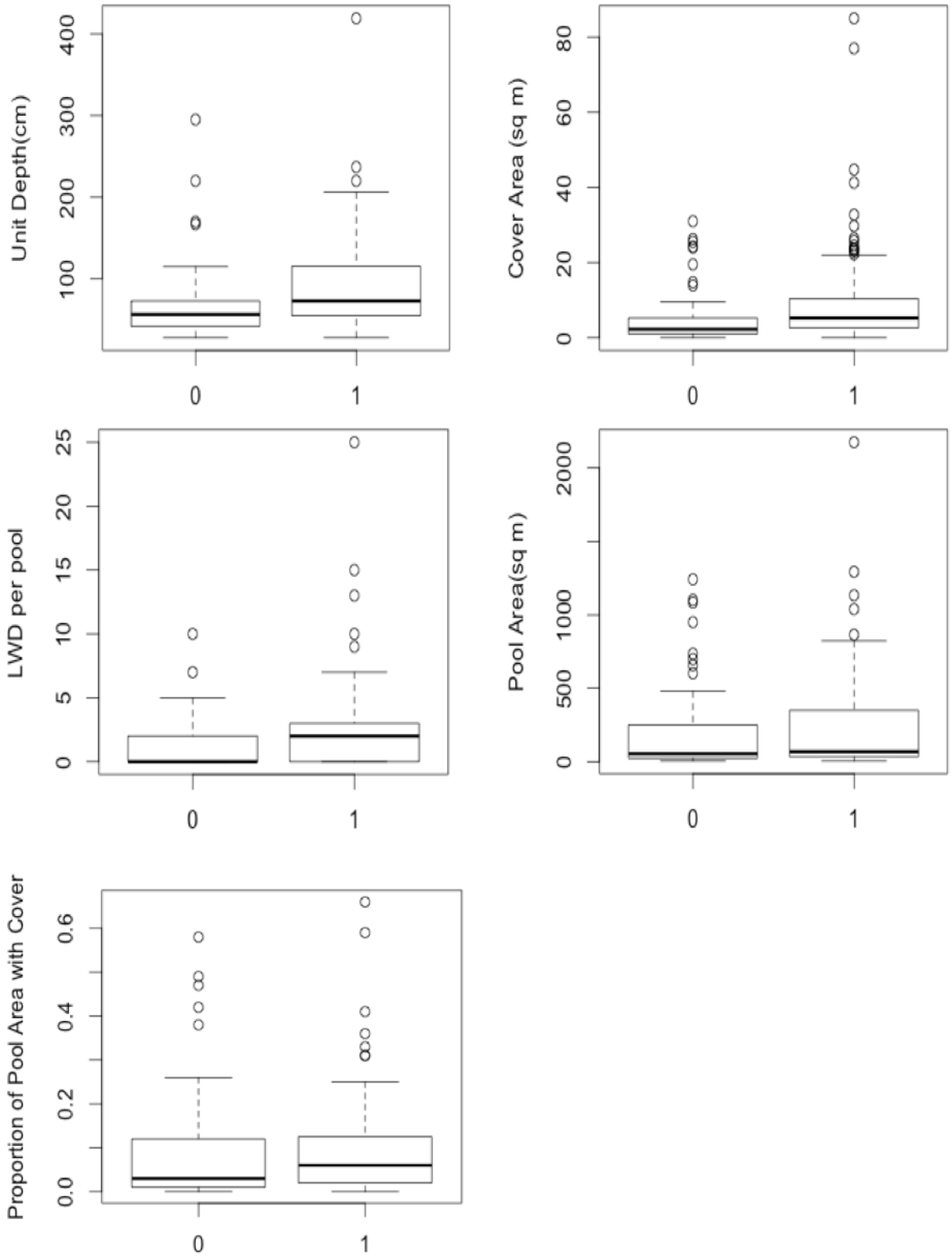

Figure 7. Boxplots comparing habitat values from the units where coho were present (1) (*n=119)* or not detected (0)*(n=78)* from within the six reaches where more than two coho was observed.

Discussion

Patterns in coho distribution and habitat condition, 2013-2015

Coho salmon are not abundant in the Mattole watershed, with a percent area occupied (PAO) in theoretically suitable habitat of just 0.08 in 2015, and a PAO of 0.13 in both 2013 and 2014. In all three years in which surveys have been conducted using this protocol, coho juvenile distribution has been broadly similar to that documented over the past two decades, with rearing (and apparent spawning) concentrated in the Mattole mainstem and tributaries near the town of Whitethorn in the southern portion of the watershed, and only isolated detections of juveniles elsewhere (Figure 2, Figure 3, Appendix D) (Garwood 2012a, Garwood 2012b, Mattole River and Range Partnership 2011).

We did find differences in the habitat parameters we measured between both reaches with and without coho presence, and units with and without coho in reaches where coho were present. Differences in cover area were particularly pronounced between both reaches and units with coho presence and those without. There were also differences in unit depth and LWD count at the unit-level, and cover rating at the reach level.

The presence of overhead cover has been found to correlate with juvenile coho presence and density in other studies, in both winter (Tschaplinski and Hartman 1983) and summer (Fransen et al. 1993, Kiffney et al. 2011). Others have come to the opposite conclusion, and documented a lack of affinity for cover (Spalding et al. 1995). Differing conclusions about the relationship of coho habitat use and cover presence probably have to do with cover affinity being mediated by other factors such as prey availability, and the scale at which the relationship was investigated (Giannico 2000). Cover area as we measured it may in part be an indicator of the availability of suitable winter rearing habitat (velocity refuge) in a reach.

Our comparison of habitat variables and coho presence had several shortcomings, including spatial auto-correlation, not quantifying the interaction between reach and unit variables, and a focus on fish presence and habitat quality during only the summer base-flow period. These are common issues with analyses of fish-habitat relationships (Sharma and Hilborn 2001). Nonetheless, it seems clear that coho juveniles are choosing habitat with specific attributes for summer rearing. The differences in habitat between the reaches and units with coho present and absent suggest that effective restoration actions that increase instream cover should provide more suitable coho rearing habitat.

Recovery planning for Mattole coho has concluded that a lack of summer and winter rearing habitat are primary impediments to the population's survival, with a history of timber harvest and stream cleaning resulting in a lack of instream cover and winter flow refuge (Mattole River and Range Partnership 2011, National Marine Fisheries Service 2014). Considerable restoration work has been done to address these issues. While measuring habitat variables in reaches where LWD had been placed as part of restoration projects we quantified the number of pieces in the reach that had been placed, and the number of natural pieces racked on placed wood.

In multiple reaches over half of the wood in dive units was placed wood, or associated with placed wood (Table 7). In at least some reaches where projects adding wood have been implemented, enough wood has been introduced to greatly increase the amount in the reach.

Table 7. Count of restoration project placed wood pieces, pieces racked on placed wood, and the total number of pieces by reach.

Reach ID	Stream	Placed Wood	Natural wood racked on placed wood	Total wood pieces	% placed wood	% placed+ racked
273	Mattole River	12	0	22	55%	55%
308	Mattole River	21	12	96	22%	34%
309	Mattole River	33	9	77	43%	55%
818	Bear Creek	3	3	21	14%	29%
826	Bear Creek, South Fork	11	15	89	12%	29%
939	Upper Mill Creek	4	2	20	20%	30%
956	Thompson Creek (2014 data)	56	23	224	25%	35%

The concentration of coho juveniles in just a few reaches was particularly pronounced in 2015, with over half of the coho observed in mainstem reach 309, and no detections downstream of reach 307. This was in sharp contrast to 2013-2014 (Figure 3, Appendix B & C), when non-natal fish, while few in number, were observed in tributaries throughout the watershed. Streamflows in the spring of 2015 were much lower than in the springs of 2013 and 2014, and it seems possible that the lack of storm flows during early rearing may have led to the seeming lack of dispersal observed in 2015.

Stream reaches proximal to the portion of the watershed with higher counts of coho seem like an important area of focus for continued restoration work. The mainstem Mattole downstream of Stanley Creek through the Whitethorn valley (reaches 307 and 308) may be particularly important. Distribution in 2013, 2014, and 2015, with very low coho densities, but fish spread throughout this ~10 km reach, seems to be consistent with prior years (Mattole Salmon Group unpublished data). Better understanding distribution in this reach relative to juvenile density and distribution in upstream reaches, and spring/summer streamflows would improve our understanding of the factors limiting coho salmon and productivity in the watershed. A lack of cover and LWD in reach 310 (2014 data) relative to adjacent reaches also highlights the need for wood placement in this reach.

However, the availability of suitable non-natal habitat in seasons other than summer baseflow may be an important factor inhibiting population recovery. A lack of understanding of coho juvenile winter habitat use or the distribution of suitable winter

rearing habitat inhibit our ability to identify the areas of the watershed or life-stages which are currently limiting coho survival.

Summary of restoration and monitoring recommendations

- Continue to implement habitat restoration work that increases instream cover and complexity
- Prioritize this work in areas proximal to reaches with the highest coho densities and consistent coho presence
- Inventory winter rearing habitat availability and distribution, and seek to understand seasonal movements and habitat use of coho juveniles
- Further investigate annual patterns in coho juvenile distribution in the Mattole mainstem in the Whitethorn valley.
- Seek to better understand importance of genetic vs. habitat suitability bottlenecks to population recovery

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Appendix A – Summary of Chinook and *O. mykiss* counts and habitat metrics by reach

Reach ID	Stream	# of pools surveyed	Total # Chinook observed	Mean # of Chinook per pool	Total # YOY Trout Observed	Mean # of Yoy Trout per pool	Total # 1+Trout Observed	Mean # of 1+ Trout per pool
273	Mattole River	25	140	23.3	940	67.1	140	17.5
275	Mattole River	8	7	7.0	380	76.0	32	16.0
277	Mattole River	10	25	8.3	245	49.0	13	3.3
279	Mattole River	9			204	29.1	9	2.3
284	Mattole River	10			39	7.8	2	2.0
288	Mattole River	13	2	1.0	370	61.7	7	7.0
293	Mattole River	1	5	5.0	0	0.0	0.0	0.0
297	Mattole River	2			59	59.0	0.0	0.0
299	Mattole River	4	6	3.0	26	8.7	10	3.3
304	Mattole River	20	7	1.2	1087	60.4	96	6.0
307	Mattole River	24	11	2.8	3223	134.3	177	8.0
308	Mattole River	42	21	1.8	3919	95.6	375	9.6
309	Mattole River	32	59	3.7	1954	63.0	178	7.7
310	Mattole River	43	139	6.6	506	11.8	142	4.6
311	Mattole River	44	9	3.0	387	8.8	82	2.5
328	Lower Mill Creek	22			215	9.8	31	1.9
340	Lower N. Fork Mattole	5			40	40.0	3	3.0
425	East Mill Creek	4			39	9.8	2	2.0
440	Conklin Creek	3			63	21.0	2	1.0
483	Squaw Creek	20			963	48.2	92	4.8
544	Granny Creek	2	1	1.0	20	10.0	13	13.0
557	Woods Creek	1			45	45.0	1	1.0
631	Honeydew Creek	6			254	42.3	26	4.3
632	Honeydew Creek	8			506	63.3	68	8.5
633	Honeydew Creek	8			152	21.7	12	3.0

Appendix A – Summary of Chinook and *O. mykiss* counts and habitat metrics by reach

Reach ID	Stream	# of pools surveyed	Total # Chinook observed	Mean # of Chinook per pool	Total # YOY Trout Observed	Mean # of Yoy Trout per pool	Total # 1+Trout Observed	Mean # of 1+ Trout per pool
641	Honeydew Creek, Lower E. Fork	6			137	22.8	9	4.5
646	West Fork Honeydew Creek	2			20	10.0	4	2.0
678	Dry Creek	12			363	30.3	31	2.8
715	Fourmile Creek	17			584	34.4	60	5.0
718	Fourmile Creek, N. Fork	7			177	25.3	9	1.5
733	Sholes Creek	26	2	1.0	702	27.0	57	3.4
765	Mattole Canyon Creek	22			477	21.7	105	5.5
770	Panther Creek	7			107	15.3	14	2.3
792	Blue Slide Creek	15			893	59.5	26	2.9
796	Crooked Prairie (Bick's) Creek	1				-		-
818	Bear Creek	16	1		4186	261.6	210	15.0
819	Bear Creek	11			1317	119.7	55	6.1
825	Bear Creek, S. Fork	17			111	6.5	138	8.1
826	Bear Creek, S. Fork	40			448	11.8	161	4.6
827	S. Fork Bear Creek	90			427	5.1	83	2.5
848	Jewett Creek	20	1	1.0	210	10.5	39	2.6
858	N. Fork Bear Creek	23			425	18.5	100	5.3
892	Eubanks Creek	18			154	8.6	137	8.6
924	McKee Creek	28			627	22.4	31.0	2.2
928	Van Arken Creek	41			278	7.1	28.0	1.6
930	South Fork Van Arken Creek	6			54	9.0		-
937	Anderson Creek	12			42	3.8	22	3.1
939	Upper Mill Creek	15			63	12.6	19	2.4
947	Harris Creek	20			20	1.8	3	1.0
951	Baker Creek	25	52	5.8	524	23.8	18	2.0
956	Thompson Creek	35	168	7.0	589	16.8	160	4.8
957	Thompson Creek	49			177	4.7	68	2.1

Appendix A – Summary of Chinook and *O. mykiss* counts and habitat metrics by reach

Reach ID	Stream	# of pools surveyed	Total # Chinook observed	Mean # of Chinook per pool	Total # YOY Trout Observed	Mean # of Yoy Trout per pool	Total # 1+Trout Observed	Mean # of 1+ Trout per pool
963	Lost River	34	1	1.0	181	9.1	24	3.4
964	Helen Barnum Creek	16			1	1.0		
966	Lost River, N. Fork	16			47	3.9	7.0	1.4
972	Ancestor Creek	22	2	2.0	48	3.0	16.0	2.7

Appendix A – Summary of Chinook and *O. mykiss* counts and habitat metrics by reach

Reach ID	Stream Name	Drainage area km2	Mean Temperature (°C)	Median Pool Depth (cm)	Median Cover Rating	Median Cover Area (m^2)	Median LWD Count (pieces/pool)	Median Pool Area (m^2)
273	Mattole River	762.5	16.5	62	2.79	12.75	0.21	55.7
275	Mattole River	748	18.5	59	2.25	5.50	0.07	122.8
277	Mattole River	633.8	16.7	56	2.20	12.50	0.00	30.3
279	Mattole River	616.6	17.8	58	2.25	4.25	0.07	37.45
284	Mattole River	522.4	19.4	79	2.13	2.50	0.33	56.3
288	Mattole River	490.4	18.5	51	1.91	1.50	0.04	28.6
293	Mattole River	345.2	20.0	46	1.00	0.00	0.00	4.4
297	Mattole River	277.7	20.0	169	1.50	0.13	0.00	108.45
299	Mattole River	254.9	19.8	52	2.17	4.38	0.50	88.3
304	Mattole River	126.1	18.3	102	2.09	6.25	0.27	319.5
307	Mattole River	79.4	18.5	83	2.55	8.25	0.58	475.2
308	Mattole River	52.3	17.8	83	2.24	5.25	1.17	275.65
309	Mattole River	30.3	16.4	90	2.26	5.00	1.33	146.1
310	Mattole River	9.3	N/A	N/A	N/A	N/A	N/A	N/A
311	Mattole River	5.8	14.0	62	2.46	4.63	1.32	34.5
328	Lower Mill Creek	5.4	12.0	43	2.15	1.30	0.25	17.2
340	Lower N. Fork Mattole	97.6	18.4	48	2.33	6.50	0.33	17
425	East Mill Creek	7.4	16.0	36	2.00	1.13	1.50	10.25
440	Conklin Creek	14.4	16.0	33	1.75	1.00	0.25	15.6
483	Squaw Creek	18.9	16.0	62	2.06	1.50	0.50	62.05
544	Granny Creek	2.4	15.0	88	1.50	0.13	0.00	27.3
557	Woods Creek	5.1	16.0	49	2.00	1.00	0.00	42.2
631	Honeydew Creek	44.3	16.0	117	2.25	6.38	0.50	164.2
632	Honeydew Creek	33.8	14.0	146	2.07	4.00	0.50	250.55
633	Honeydew Creek	17.9	N/A	66	1.93	1.25	0.17	57.05
641	Honeydew Creek, Lower E. Fork	13.5	15.0	46	1.90	0.88	0.25	43.4

Appendix A – Summary of Chinook and *O. mykiss* counts and habitat metrics by reach

Reach ID	Stream Name	Drainage area km2	Mean Temperature (°C)	Median Pool Depth (cm)	Median Cover Rating	Median Cover Area (m^2)	Median LWD Count (pieces/pool)	Median Pool Area (m^2)
646	West Fork Honeydew Creek	5.9	16.0	56	2.00	0.63	0.50	42
678	Dry Creek	14.8	20.0	52	1.94	0.75	0.83	17.05
715	Fourmile Creek	14.1	17.0	74	2.31	3.75	0.75	51.7
718	Fourmile Creek, N. Fork	4.6	18.0	48	2.08	1.50	0.75	29.4
733	Sholes Creek	10.5	15.0	48	1.77	0.55	0.15	33.35
765	Mattole Canyon Creek	24.2	17.3	56	1.81	0.92	0.15	45.5
770	Panther Creek	6.7	18.0	51	1.63	0.50	0.38	19.1
792	Blue Slide Creek	25.8	19.2	62	1.60	0.75	0.33	87
796	Crooked Prairie (Bick's) Creek	2.4	15.0	53	2.00	0.50	1.00	10.4
818	Bear Creek	55.4	19.8	113	2.14	3.80	0.75	407.5
819	Bear Creek	45.3	17.0	121	2.11	4.25	0.29	422.1
825	Bear Creek, S. Fork	9.1	14.7	68	2.13	1.75	0.63	33.45
826	Bear Creek, S. Fork	6.7	13.8	45	2.33	3.50	1.75	52.55
827	S. Fork Bear Creek	4	14.0	46	2.66	3.40	1.00	25.15
848	Jewett Creek	6.1	15.5	42	1.79	0.63	0.21	18.85
858	N. Fork Bear Creek	13.4	14.5	68	2.08	1.83	0.32	68.7
892	Eubanks Creek	8.9	14.5	49	1.70	0.13	0.19	17.35
924	McKee Creek	5.4	15.0	46	2.03	1.00	0.40	29
928	Van Arken Creek	5.2	12.6	50	2.21	2.25	1.08	21.05
930	South Fork Van Arken Creek	1.5	12.0	38	2.25	2.00	1.50	15.4
937	Anderson Creek	1.8	15.8	42	2.10	0.88	0.25	9.1
939	Upper Mill Creek	6	13.7	72	2.15	2.00	0.60	54
947	Harris Creek	2.5	14.0	41	2.41	1.88	1.00	11.4
951	Baker Creek	4	N/A		N/A	N/A	N/A	
956	Thompson Creek	9.5	14.3	50	2.79	6.25	2.08	45.6
957	Thompson Creek	2.3	14.5	46	2.50	3.38	0.42	17.45
963	Lost River	5.1	13.4	50	2.25	2.33	0.31	26.5
964	Helen Barnum Creek	1.6	13.0	33	1.92	0.75	0.50	10.35

Appendix A – Summary of Chinook and *O. mykiss* counts and habitat metrics by reach

Reach ID	Stream Name	Drainage area km2	Mean Temperature (°C)	Median Pool Depth (cm)	Median Cover Rating	Median Cover Area (m^2)	Median LWD Count (pieces/pool)	Median Pool Area (m^2)
966	Lost River, N. Fork	1.3	N/A		N/A	N/A	N/A	
972	Ancestor Creek	2.6	13.3	53	2.67	3.50	1.90	20.3

Appendix B – Drainage area, length surveyed, # of units surveyed, and coho occupancy and Chinook presence by reach, 2013

Reach ID	Stream Name	Drainage area km^2	Length surveyed (m)	# of units in reach	# of units occupied by coho	Total # coho observed **	Mean coho count per pool	Suspected coho rearing type	Chinook presence
279	Mattole River	616.6	8084	0	---	---	---		
284	Mattole River	522.4	10821	2	0	0	---		yes
292	Mattole River	357.1	9421	0	---	---	---		
299	Mattole River	261.9	10733	2	1	1	1	non-natal	
307	Mattole River	79.4	4867	24	8	10	1.3	non-natal	yes
341	Lower N. Fork Mattole	94.9	2152	4	0	0	---		
353	Grizzly Creek	5.4	520	4	0	0	---		
425	East Mill Creek	7.4	1238	23	0	0	---		
428	East Mill Creek, S. Branch	2.1	794	3	0	0	---		
481	Squaw Creek	37.0	2130	14	1	3	3	natal	yes
483	Squaw Creek	18.9	2417	21	0	0	---		
544	Granny Creek	2.4	914	5	0	0	---		yes
548	Saunders Creek	2.2	311	5	0	0	---		yes
632	Honeydew Creek	33.8	2539	11	0	0	---		yes
641	Honeydew Creek, Lower E. Fork	13.5	583	7	0	0	---		
733	Sholes Creek	10.5	2270	31	1	1	1	non-natal	yes
749	Grindstone Creek	9.9	2370	26	0	0	---		
822	S. Fork Bear Creek	22	2758	26	0	0	---		yes
823	S. Fork Bear Creek	15.3	2986	22	0	0	---		yes
827	S. Fork Bear Creek	4.0	3522	102	7	20	2.9	non-natal*	
858	N. Fork Bear Creek	13.4	2990	21	0	0	---		
893	Eubanks Creek	3.8	1178	14	0	0	---		
928	Van Arken Creek	5.2	1926	35	0	0	---		
956	Thompson Creek	9.5	3565	79	53	249	4.7	natal	yes
957	Thompson Creek	2.3	1120	46	8	10	1.3	natal	yes
972	Ancestor Creek	2.6	449	18	18	213	11.8	natal	
Totals				545	97	507			

**Coho observed in reach #827 were relocated there from Baker Creek due to de-watering associated with a restoration project.*
***In double-dive pass units, the maximum count was used.*

Appendix C – Drainage area, length surveyed, # of units surveyed, and coho occupancy and Chinook presence by reach, 2014

Reach ID	Stream Name	Drainage area km^2	Length surveyed (m)	# of units in reach	# of units occupied by coho	Total # coho observed**	Mean coho count per pool	Suspected coho rearing type	Chinook presence
273	Mattole River	762.5	3990	11	0	0			yes
275	Mattole River	748.0	4701	10	0	0			yes
277	Mattole River	633.8	4609	5	0	0			yes
282	Mattole River	572.4	4192	2	0	0			yes
288	Mattole River	490.4	10534	13	0	0			
302	Mattole River	126.1	8549	10	4	24	6.0	natal?	yes
308	Mattole River	52.3	6351	41	12	32	2.7	non-natal	
309	Mattole River	30.3	3828	34	26	290	11.2	natal	
310	Mattole River	9.3	2430	43	1	1	1.0	*natal	
311	Mattole River	5.8	2013	27	9	14	1.6	*natal	
328	Lower Mill Creek	5.4	1152	36	0	0			
340	Lower N. Fork Mattole	97.6	1900	5	0	0			
453	McGinnis Creek	15.6	2516	18	1	1	1.0	non-natal	
557	Woods Creek	5.1	180	1	0	0			
633	Honeydew Creek	17.9	1528	12	0	0			
715	Fourmile Creek	14.1	2067	13	0	0			
718	Fourmile Creek, N. Fork	4.6	614	8	0	0			
764	Mattole Canyon Creek	26.8	490	4	0	0			
765	Mattole Canyon Creek	24.2	2868	31	0	0			
818	Bear Creek	55.4	3392	10	5	46	9.2	natal	
819	Bear Creek	45.3	2154	9	4	7	1.8	natal	yes
824	Bear Creek, S. Fork	11.9	2795	27	0	0			
825	Bear Creek, S. Fork	9.1	1323	17	0	0			
826	Bear Creek, S. Fork	6.7	2717	32	0	0			
848	Jewett Creek	6.1	2135	17	0	0			
885	Big Finley Creek	8.2	638	5	0	0			
892	Eubanks Creek	8.9	1500	30	0	0			
911	Bridge Creek	11.1	2400	18	1	1	1.0	non-natal	
924	McKee Creek	5.4	970	15	0	0			
925	McKee Creek	2.4	217	8	0	0			
937	Anderson Creek	1.8	732	20	0	0			
938	Ravishoni (E. Anderson)	1.8	290	4	0	0			
939	Upper Mill Creek	6	1598	30	1	1	1.0	non-natal	
947	Harris Creek	2.5	480	13	0	0			
951	Baker Creek	4	2359	73	27	228	8.4	natal	
958	Yew Creek	2.4	1565	35	4	10	2.5	natal	
963	Lost River	5.1	1300	28	0	0			
964	Helen Barnum Creek	1.6	557	17	0	0			
965	Lost River, S. Fork	1.8	502	17	0	0			
Totals				749	95	655			

**Coho observed in reach #'s 310 and 311 were exclusively 1+ fish, as were 84 of the coho observed in reach #951.*

***In double-dive pass units, the maximum count was used.*

Appendix D. Presence of coho salmon juveniles by survey reach, 1980-2015. Data from 1980-2011 from Garwood (2012a and 2012b). Data encompasses multiple survey techniques and varying levels of survey effort.

0=coho not detected, 1=coho present, unclear if natal or non-natal; 2=present, suspected natal; 3=present, suspected non-natal

Reach ID #	Stream	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
273*	Mattole River																																			0	0
275*	Mattole River																									1			2	2						3	0
277*	Mattole River																																			0	0
279*	Mattole River																																				0
282*	Mattole River																																			0	
284*	Mattole River																									1									0		0
288*	Mattole River																																			0	0
291*	Mattole River																																			0	0
293*	Mattole River																																			0	0
295*	Mattole River																																				
297*	Mattole River																																		0		0
299*	Mattole River																																		3		0
302	Mattole River																								1		1		0	0	0	1			3	1	
304	Mattole River																																				0
307	Mattole River																				0	1	1	1	1		3	0	1	1	0	0	0	1	3		3
308	Mattole River																					2	1		2	1	2	1	1	1	1	3	3	1	2	3	2
309	Mattole River																				1	1	1	2	2	2	2	2	1	1	1	3	1	1	2	2	2
310	Mattole River																				1	1	2	2	2	2	2	2	1	2	2	1	1	1	2	1	2
311	Mattole																				1	2	1	2		1				1	0	1	2	2		1	2

Appendix D. Presence of coho salmon juveniles by survey reach, 1980-2015. Data from 1980-2011 from Garwood (2012a and 2012b). Data encompasses multiple survey techniques and varying levels of survey effort.

Reach ID #	Stream	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	River																																				
328	Lower Mill Creek					1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1			3	3	3	0		0		0	0	0
337	Jeffry Gulch																																				
340	North Fork Mattole											0	0	0	0	0	0	0	0	0	0		0	0	0			0	0	0	0					0	0
341	North Fork Mattole																																		0		
342	North Fork Mattole																																				
343	North Fork Mattole																																				
353	Grizzly Creek																																		0		
364	East Branch North Fork Mattole River																			0																	
425	East Mill Creek			0												0				0		0	1	0	1	3		3	0	0	0		0		0		0
428	South Branch, East Mill Creek																																		0		
440	Conklin Creek						0							0				0	0		0	0		0	0			0	0								0
453	McGinnis Creek																						0	0	0			0	0	0						3	
470	Indian Creek		0	1																			0	0													
479	Squaw Creek		1	1			0					0	0	0	0	0	0	0	0	0	0	0	0	0	1			2	0	0	0	0	0		0		
480	Squaw Creek																																				
481	Squaw Creek																																		2		
482	Squaw Creek																																				
483	Squaw Creek																															0			0		0
528	Pritchard Creek																							0	0												
544	Granny Creek																						0	0	0										0		0
548	Saunders Creek																						0	0	0			0							0		

Appendix D. Presence of coho salmon juveniles by survey reach, 1980-2015. Data from 1980-2011 from Garwood (2012a and 2012b). Data encompasses multiple survey techniques and varying levels of survey effort.

Reach ID #	Stream	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
550	Lindley Creek																																				
557	Woods Creek																				0		1	0	0			3	0	1	0	0				0	0
568	Upper North Fork Mattole River												0	0	0	0		0	0	0	0	0															
569	Upper North Fork Mattole River																											0	0	0	0		0				
570	Upper North Fork Mattole River																																				
593	Oil Creek												0	0	0	0	0			0			0	0	0				0								
631	Honeydew Creek																																				0
632	Honeydew Creek		0	0													0	0	0	0	0	0	1	0	0			0	0	0	0				0		0
633	Honeydew Creek																																			0	0
641	East Fork Honeydew Creek		0																	0	0								0	0	0				0		0
646	W. Fork Honeydew																																				0
678	Dry Creek																					0	0	0													0
695	Westlund Creek																			0	1	0	0	0	0												
715	Fourmile Creek																			0			1	0	0				1	0	0	0				0	0
718	N. Fork Fourmile																			0																0	0
733	Sholes Creek																						1	0	0				0	0	0				3		0
749	Grindstone Creek			0																0		0	1	0	0				0		0				0		
764	Mattole Canyon			0											0			0	0	0	0		0	0	0											0	
765	Mattole Canyon																													0	0					0	0

Appendix D. Presence of coho salmon juveniles by survey reach, 1980-2015. Data from 1980-2011 from Garwood (2012a and 2012b). Data encompasses multiple survey techniques and varying levels of survey effort.

Reach ID #	Stream	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
766	Mattole Canyon																																				
770	Panther Creek																																				0
792	Blue Slide Creek																	0	0	0	0	0	0	1	1				0								0
793	Blue Slide Creek																																				
794	Blue Slide Creek																																				
796	Crooked Prairie																																				0
818	Bear Creek			0								0					0	1	1	1	0	1	0	1	0				0	0	0	0				2	0
819	Bear Creek																																			2	0
822	South Fork Bear Creek																																		0		
823	South Fork Bear Creek																												0	0	0				0		
824	South Fork Bear Creek																																			0	
825	South Fork Bear Creek																																			0	0
826	South Fork Bear Creek																																			0	0
827	South Fork Bear Creek								0	1	1	0	1	0	0		0	0	1	1	1	1	0	0	1							0			0		0
848	Jewett Creek		0															0											0						0	0
858	North Fork Bear Creek									1	1	1						0	0		0	0								0	0				0		0
877	Deer Lick																												0								
885	Big Finley Creek			0												1	1			1	1			0	0				1	0	0	0	1			0	
892	Eubank Creek			1												1	1	0	0	0	1	0		1	0				0	0	0	0				0	0
893	Eubank Creek																																		0		
911	Bridge Creek	0	0	0							0	0	0		0			1	0	1	1	0	1	2	2	1			0	1	0	0	1			3	
912	W. Fork Bridge Creek																		0		0	0	1	2	2							0	1				

Appendix D. Presence of coho salmon juveniles by survey reach, 1980-2015. Data from 1980-2011 from Garwood (2012a and 2012b). Data encompasses multiple survey techniques and varying levels of survey effort.

Reach ID #	Stream	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
915	Bridge Creek																							2	2	1						0	2				
916	Bridge Creek																																				
924	McKee Creek		1	1													0	0			0	1	0	1	1				1	0	0	0				0	0
926	Painter Creek		0																																		
928	Van Arken Creek			0						1	0					0	0	0	0	0	0	3	0	1	1				1	0	0	0	0		0		0
930	S. Fork Van Arken Creek																																				0
937	Anderson Creek															0		1						0	0					0						0	0
938	E. Anderson																						1	1												0	
939	Mill Creek			1											0			0			0	0	1	2	2	2			0	1	1	0	0			3	3
947	Harris Creek		0	0																																0	0
948	Gibson Creek																						0														
	Stanley Creek			1																	0																
951	Baker Creek			1					1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	2	2	2			2	2	2	0	0		2	2	3
956	Thompson Creek		1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	2			2	2	2	2	2	2	2	1	3
957	Thompson Creek																							2	2	2						2	2		3		0
958	Yew Creek			0				1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	2			2	2	2	0	0		0	2	
960	Danny's Creek																		0	1	0	1	0	2	2	2						1	2				
963	Lost River														0				1	1	1			2	2	2			1	1	0		0			0	2
964	Helen Barnum							0							0			0						1	1	1			0				0			0	0
966	N Fork Lost																																			0	0
972	Ancestor Creek						1	1								0	0		0					2	2	2			2	2	2	2	1		2	1	2
	# Reaches Surveyed	1	10	17	0	1	4	4	5	7	8	10	10	10	14	14	15	22	21	26	31	28	36	45	43	16	5	14	36	33	32	26	23	6	32	40	52
	# Reaches Coho Present	0	3	7	0	1	2	3	4	7	6	5	5	4	4	6	6	7	7	10	13	12	18	23	24	16	5	7	14	14	8	9	12	6	12	15	10

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Reach ID #	Stream	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Proportion reach occupancy	0.00	0.30	0.41		1.00	0.50	0.75	0.80	1.00	0.75	0.50	0.50	0.40	0.29	0.43	0.40	0.32	0.33	0.38	0.42	0.43	0.50	0.51	0.56	1.00	1.00	0.50	0.39	0.42	0.25	0.35	0.52	1.00	0.38	0.38	0.19

0=coho not detected, 1=coho present, unclear if natal or non-natal; 2=present, suspected natal; 3=present, suspected non-natal

*Did not display non-detections prior to 2013, due to differing methodology. Most pre-2013 surveys of these large mainstem reaches have targeted other species, such as summer steelhead, and divers were not necessarily seeking out likely coho habitat.