SALMON CREEK COHO MONITORING 2008-2013
FINAL REPORT

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Table of Contents

Summary 1
Background 1
Methods 2
Spawner/Redd Surveys 2
Summer Juvenile Surveys 4
Results 7
Adult Coho Releases 7
Winter Spawner/Redd and Summer Juvenile Surveys 8
References 22

List of Figures

Figure 1. Salmon Creek Coho Monitoring Program Spawner/Redd Surveys 2011 – 2012 ……24
Figure 2. Salmon Creek Coho Monitoring Program Juvenile Snorkel Surveys 2009 – 2012…...25
Figure 3. Number of juvenile coho observed per mile of creek surveyed during snorkeling surveys conducted 2009-2012……26

List of Tables

Table 1. 2008-2012 Adult Coho Salmon Releases
Table 2. 2008-2009 Spawner/Redd Surveys
Table 3. 2009 Snorkel Surveys
Table 4. 2010 Snorkel Surveys
Table 5. 2011 Snorkel Surveys
Table 6. 2011-2012 Spawner/Redd Surveys
Table 7. 2012 Snorkel Surveys
Table 8. 2012-2013 Spawner/Redd Surveys

Appendices

I. Spawner/Redd Survey Data:

2012-13 Salmon Creek Coho Monitoring Program Spawner Survey, Live Fish & Carcass Datasheet
2012-13 Salmon Creek Coho Monitoring Program Spawner Survey, Redd Datasheet
Spawner/Redd data summary 2011-2012, 2012-2013 -- **not included, available upon request*

II. Summer Juvenile Survey Data:

2012 Salmon Creek Coho Monitoring Program Snorkeling Survey Datasheet
Snorkel survey data summary 2010, 2011, 2012 -- **not included, available upon request*

Summary

Pre-spawning adult Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*) from the Russian River Coho Salmon Captive Broodstock Program (Broodstock Program) have been released every winter since December 2008 in the Salmon Creek estuary or within a few hundred feet upstream of the estuary. Efforts to monitor the effectiveness of the adult releases towards the reestablishment of a coho population in Salmon Creek through spawner/redd surveys in winter and snorkel surveys for juveniles in the summer have been carried out since the first release by local consultants, agency biologists and volunteers. The monitoring effort has been supported by grants to Gold Ridge Resource Conservation District (GRRCD) through the Fisheries Restoration Grant Program (FRGP) from the California Department of Fish and Wildlife (DFW) and a grant from the Pacific States Marine Fisheries Commission. Evidence of coho spawning following the adult releases has been documented in each year in which surveys for spawners or redds were conducted. Snorkel surveys conducted throughout the watershed during summer have documented the distribution and density of juvenile coho and Central California Coast (CCC) steelhead (*O. mykiss*) throughout the watershed. This report summarizes the information collected during winter and summer surveys over the past five years by the Salmon Creek Coho Monitoring (SCCM) team.

Background

The Russian River Coho Salmon Captive Broodstock Program began in 2001 with the capture of wild juvenile CCC coho salmon from Russian River tributaries to serve as the initial broodstock. The program was designed primarily to raise coho from eggs to sexual maturity at the Don Clausen/Warm Springs Hatchery and the Bodega Marine Laboratory, spawn adults at these facilities, and then release juveniles into selected Russian River tributaries in an effort to restore self-sustaining runs of coho salmon in the watershed. Early in the Broodstock Program (ca 2004) a question arose as to what to do with surplus adults that had not been spawned. A decision was made to plant some of the surplus adults, whose mating types represented both Russian River broodstock and broodstock derived from juveniles captured in Olema Creek in Marin County, into Walker Creek in Marin County, a watershed in which historic coho salmon runs had been extirpated. Soon after the adult coho were released, evidence of spawning in Walker Creek was observed, and the presence of juvenile coho in Walker Creek was subsequently documented. Following additional adult releases in Walker Creek in subsequent spawning seasons, Salmon Creek was selected as the next watershed outside of the Russian River Basin for planting adult coho, as the Salmon Creek watershed historically had a strong run, but the run had been extirpated, and a number of salmonid habitat restoration projects and land use improvements had been completed or were underway.

Wild coho were extirpated in the Salmon Creek watershed by the mid-1990's; the last naturally propagated coho was seen in 1996 (B. Cox 2005, *personal communication*). Many habitat restoration and enhancement projects designed to improve instream and riparian habitat conditions, and to minimize effects of roads, agricultural practices, and water withdrawals for the

benefit of salmonids, have been carried out since the mid-1990s. It is hoped that the completed projects and others that are ongoing will have improved freshwater habitat sufficiently that a self-sustaining population of coho can be re-established in the watershed by a program of annually introducing ready-to-breed adults for several years in a row, so that multiple year classes would become established.

Three hundred and ten adult coho from the Broodstock Program were released in the Salmon Creek estuary in December 2008, and Program adults have been released every winter since. Winter surveys for spawners and/or redds and summer snorkel surveys for juvenile coho were conducted following the first release in December 2008, within reaches of the watershed to which access was available from willing landowners. Initially, surveys were conducted by GRRCD staff, DFW and National Marine Fisheries Service (NMFS) staff, Michael Fawcett (Fawcett Environmental Consulting/FEC) and a few other volunteers, as hydrological conditions and volunteers' time allowed. A grant from the Pacific States Marine Fisheries Commission (No. A07-BD6) helped defray costs for the 2010 snorkel surveys, and in late 2010, a two-year FRGP grant from DFW (No. P1030403) was obtained by GRRCD to monitor the effectiveness of the completed habitat restoration projects and the adult releases from summer 2011 through winter 2012-2013. Summary reports on the survey results were submitted to the Salmon Creek Technical Advisory Committee by GRRCD following the 2011 and 2012 summer surveys for juveniles and the 2011-2012 spawner/redd surveys (GRRCD 2011, 2012a, b). This report includes the results of all monitoring activity from late December 2008 through completion of the monitoring program in February 2013 and serves as the final report for FRGP grant No. P1030403. Activities were authorized by DFW Scientific Collecting Permit SC-806 (Michael Fawcett), NMFS Recovery Permit 1045, Modification 1 (Michael Fawcett), and DFW's federal permit authorizing capture and handling of ESA-listed salmonids.

Methods

Surveys followed protocols described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002), Gallagher and Knechtle (2003), and Gallagher et al. (2007). In addition, University of California Cooperative Extension (UCCE) protocols were consulted to ensure consistency with their monitoring efforts in the adjacent Russian River watershed as part of the Russian River Coho Salmon Captive Broodstock Program (UCCE 2011 and 2012).

Spawner/Redd Surveys

<u>2008-2009 spawning season:</u> Surveys consisted of hiking and wading, usually upstream through a reach, watching and listening for fish activity (splashing noises, adult fish sighted on or near a redd, or adult fish holding or swimming), and looking for redds or test redds (excavated pot and tail spills or other indications of substrate disturbance). Observations of habitat, potential spawning areas, fish species present, spawning activity or redds were recorded in a field notebook; tissue samples were collected when partial carcasses were found; and a Garmin GPSmap 60CSx was used to obtain geographic coordinates of starting and end points of surveys and locations of redds, carcasses, and landscape features.

Adult coho carcass showing characteristic mouth and gum colorations.

2009-2010 spawning season: Heavy rain beginning on the day the coho were released (29 December 2009) was followed by an extended period (most of January and February) of high flows and poor water clarity, which, combined with a lack of funding for a coordinated response, limited spawner/redd surveys to a single survey on one reach of Salmon Creek.

2010-2011 spawning season: No spawner/redd surveys were conducted in 2010-2011.

2011-2012 and 2012-2013 spawning seasons: Following a strategy meeting and a training session, teams of two biologists led by Michael Fawcett (Fawcett Environmental Consulting/FEC), Jennifer Michaud (Prunuske Chatham, Inc./PCI), and/or Sierra Cantor (GRRCD) conducted surveys from when the estuary mouth first opened in November until mid-February. The objective was to survey for possible returns of wild fish prior to the release of hatchery adults in December and for wild and/or hatchery-reared spawners or redds after adults were released. Surveys were conducted in each study reach approximately every other week, depending on rainfall, hydrological/safety conditions, and turbidity. Because rain events often trigger migration and spawning activity, attempts were made to get teams out during or soon after rains, depending on hydrological conditions and landowners' willingness to permit access on short notice.

The data sheets used were adapted from methods developed for monitoring adult returns to Northern California streams (Gallagher and Knechtle 2003), amended to be consistent with UCCE monitoring methods and, to meet the needs of this monitoring effort. Redd data were recorded on one data sheet, which included a unique ID code for each redd, species ID when possible, redd measurements including pot width (PW), length (PL), tail spill length (TL) and width measured at 1/3 of the length from the top of the tail spill (TS1) and at 2/3 of the length (TS2), and estimated average size of the dominant substrate in the tail spill; see data sheets in Appendix I. We also noted if live fish were observed on or near a redd, estimated age of the redd, flagged the redd for later re-measurement (where landowner permission for flagging was granted), and recorded coordinates for each redd or test redd.

Measuring length of a coho carcass.

If a live fish or carcass was found, particulars were recorded on a second data sheet. If the fish or carcass was associated with a redd, the redd number was cross-referenced, and the fish number assigned on the redd datasheet was transferred to the live fish/carcass datasheet. All live fish or carcasses also received a unique ID code. Data collected included species, certainty of identification, sex, life stage, and fork length or standard length measured or estimated (if only partial remains were found). Carcasses were tagged (Floy tag) and scanned with a Biomark™ pit tag wand. If a pit tag reading (indicating Broodstock Program release) was not obtained, a tissue sample was taken and preserved dry in an individual envelope following directions from Carlos Garza (NMFS) (G. Garza 2011, *personal communication*), and the head was removed, refrigerated, and later searched for a coded wire tag; otoliths were taken and preserved dry. Tissues and otoliths were transferred to Manfred Kittel, DFW, for analysis. When live fish were observed, efforts were made to avoid disturbing them; binoculars were used to obtain what information was possible from a discreet distance. The location was tagged and nearby coordinates recorded, to aid in subsequent re-surveys of the reach after the fish had spawned, left the site, or died.

In 2012-2013, the adults released into Salmon Creek were tagged with hot pink Floy tag markers prior to their release. This was a helpful tool for both spotting adults and identifying partial carcasses. In some cases, the presence of the Floy tag in the channel was the only indication that an adult coho had been present in that reach.

Summer Juvenile Surveys

2009: No funding was available in 2009, but snorkel surveys were conducted in four tributaries. Surveys followed protocols described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002). A training session for all members of the survey team was conducted by Joe Pecharich (NMFS/NOAA Restoration Center). For small pools, one diver entered at the downstream end of a pool and moved slowly upstream, counting the number of coho salmon and estimating number of juvenile steelhead. The diver would then report the counts and other observations to the second diver, who would record the information on a data sheet. Occasionally, both divers would snorkel a large or complex pool at the same time, then record data. Each pool surveyed was assigned a number, although there was inconsistency among teams as to numbering pools that were too shallow to snorkel or were skipped in order to complete a longer reach by sub-sampling among suitable pools. Efforts focused on observing and counting juvenile coho salmon, but steelhead young-of-the-year (YOY) and parr were recorded as either present or absent. Estimating the number of steelhead per category (High, Medium, or Low) was

preferred, and the presence of other species such as threespine stickleback (*Gasterosteus aculeatus*), California roach (*Lavinia symmetricus*), and prickly sculpin (*Cottus asper*) was noted.

2010: A grant through the Pacific States Marine Fisheries Commission (No. A07-BD6) supported limited juvenile surveys in 2010. Joe Pecharich led a training session at Fay Creek at the beginning of the 2010 season. From 2010 through the 2012-2013 spawning season, trainings and surveys were conducted by Michael Fawcett, GRRCD staff (Sierra Cantor, William Hart, Krista Lindley, Trisha Meisler, Noelle Johnson, Brittany Heck, and Jeremye Schroen) and PCI staff (Jennifer Michaud, Katy Gurin).

2011 and 2012: The current DFW grant (No. P1030403) funded juvenile surveys in both years, as well as spawner/redd surveys for the 2011-2012 and 2012-2013 spawning seasons. The Statement of Work for the grant (p. A-2) stated that the focus of the surveys was on determining only presence and distribution in the watershed, rather than measuring juvenile density. However, juvenile coho were found to be easily identifiable and common in most of the reaches surveyed, so coho were counted in each unit snorkeled, thereby also capturing density data. From 2010 on, the number of juvenile steelhead in each unit was also estimated, as CCC steelhead are federally listed, abundant in the watershed, and are an important element of the habitat for coho salmon.

Each Summer in 2011 and 2012, one training session was conducted for all the biologists expected to participate in the snorkel surveys (FEC, PCI and GRRCD staff). An attempt to correlate proficiency among the snorkel teams consisted each year of having one team conduct a survey of the reach in Fay Creek between the Salmon Creek Road bridge and the Deerhaven (privately owned) bridge, a distance of approximately 0.3 stream miles, then having the second team, without knowing the results of the first team's survey, resurvey the same reach one or two days later. Fay Creek was selected because it had the highest density of coho juveniles in 2009, and it was important that the training and calibration sessions be done in a reach where we were most likely to encounter both coho and steelhead.

Diver surveying pool for juvenile coho.

Additionally, in summer 2011 tissue samples from juvenile coho were collected in tributaries and mainstem Salmon Creek for genetic analysis at Carlos Garza's laboratory in Santa Cruz (NMFS, Southwest Fisheries Science Center), so that their lineage could be determined. Genetic analysis is a relatively straightforward way to

determine if juveniles are progeny of the adult coho released the previous winter, progeny of adults returning from previous adult releases, or strays from some other watershed. Coho were collected for this purpose by seine at upper Salmon Creek near Salmon Creek School, Nolan Creek, and Fay Creek, and some were collected by electrofishing at a restoration site in Tannery Creek. After capture, fish were anesthetized using carbon dioxide (AlkaSeltzer™ method), measured (fork length), and had a small bit of tissue (tip of upper lobe of caudal fin) removed with scissors. The tissue samples were each placed on a strip of filter paper or other plain paper; the strips were folded with the sample inside, and placed in individual envelopes labeled with date, location, species, fork length, and name of collector for storage while drying. The fish were allowed to recover completely from the anesthesia in a bucket of aerated stream water at ambient stream temperature before being released.

Results

Adult Coho Releases

Sexually mature coho from the Broodstock Program were released from mid-December to early January, 2008 to 2012, at one of two locations, depending on weather, access, road conditions, and estuary conditions (Table 1).The preferred release site was a large pool in Salmon Creek near the upper end of the estuary, approximately 1.4 miles from the mouth (river mile 1.4), accessible through a private road on the Chanslor Ranch, which is managed by Chanslor Wildlife, LLC (Figures 1 & 2, located at the end of the document). However, during rainy weather, a steep section of the road that descends to the estuary can become too slippery for hatchery trucks to negotiate, so an alternate location was used, just upstream from the estuary (river mile 2.4), accessible through private property from Bay Hill Road (Figures 1 & 2). This site was also used on one occasion when the salinity at the estuary release site was judged to be too high (22.0 mg/l) to risk exposing the fish, which had been raised entirely in freshwater.

Members of the local community (left) and Manfred Kittell, DFW (right), participating in the 2011 release.

Table 1. 2008-2012 Adult Coho Releases

Date	Location	River Mile	Total No. Released *
12/11-12/2008	Chanslor Ranch	1.4	310
12/29/2009	Freshwater Site	2.4	300
12/15/2010	Freshwater Site	2.4	62
12/19/2011 & 1/5/2012	Chanslor Ranch	1.4	200
12/17/2012	Freshwater Site	2.4	238

* Numbers provided by Ben White, DFW; some numbers differ slightly from numbers reported during or immediately after the release. Mr. White has previously reported details on number of females vs. males, origin (Russian River or Olema Creek or hybrids), and age (brood year) in annual reports to the Broodstock Program committee overseeing progeny release and monitoring.

Winter Spawner/Redd and Summer Juvenile Surveys

Coho eggs observed on the creek bank adjancent to a carcass.

Adult coho holding in a pool following spawning as indicated by the worn flesh.

2008-2009 Spawner/redd surveys

Following the initial release in December 2008, surveys were conducted on 15 days (31 December 2008-27 March 2009) at 20 stream reaches. Michael Fawcett was accompanied by volunteers (most frequently Doug Gore, Dragonfly Stream Enhancement), GRRCD biologists (Diana Hines, Noelle Johnson), DFW biologists (Gail Seymour, Dan Resnik, Bill Cox), UCCE biologists (Mariska Obedzinski), and NMFS/NOAA Restoration Center biologists (Joe Pecharich and Nick Crump) on most of the surveys. However, several surveys were conducted independently by Michael Fawcett, and UCCE and NMFS biologists conducted one survey independently. Live coho were seen in two tributaries after the release (Coleman Valley and Fay Creeks), partial remains of carcasses were found in the Salmon Creek main stem and in Coleman Valley Creek, and partial or completed redds were observed in the Salmon Creek main stem, Coleman Valley Creek, Fay Creek, and Tannery Creek (Table 2). Although at least one of the identified redds was definitely made by steelhead, the sightings of live coho in two of the tributaries suggested that the coho planted in the estuary migrated upstream and into some of the main tributaries to spawn, as was hoped. Data summary is provided in Appendix I. Field notes and data sheets are available upon request from GRRCD.

Table 2. 2008-2009 Spawner/Redd Surveys

Date	Reach/Location	Observations
12/31/2008	Tannery Creek upstream of end of county road	No adult fish or redds
1/2/2009	Salmon Creek from Fay Creek confluence upstream to near Bodega	Scrap of salmonid tissue and bone found near tailout of pool
1/8/09	Salmon Creek near Nolan Creek confluence upstream~1 mile	No adult fish or redds
1/12/09	Upper Tannery Creek to end of anadromy	No adult fish or redds
1/13/09	Upper Finley Creek	No adult fish or redds
1/13/09	Upper Coleman Valley Creek	No adult fish or redds
1/17/09	Tannery Creek from confluence with Salmon Creek to end of County Road	Two probable redds near aluminum house, between confluence and Salmon Creek Road crossing, species undetermined
1/18/09	Salmon Creek estuary release site upstream to end of Chanslor Ranch property	One redd, species undetermined
1/21/09	Fay Creek from second bridge to end of anadromy	No adult fish or redds
1/21/09	Fay Creek From Salmon Creek Road bridge to second bridge	No data reported
1/21/09	Coleman Valley Creek from Salmon Creek Road bridge upstream ~300 ft	Aborted survey, but found piece of coho skin and apparent test redds ~100 ft. upstream from bridge
1/29/09	Coleman Valley Cr. from Salmon Creek Road bridge downstream to Salmon Creek , then up Salmon Creek to Fay Creek confluence	One live coho female hiding under rootwad in Coleman Valley Creek, 3 completed redds in main stem, plus bits of carcasses at two locations
1/31/09	Finley Creek from Salmon Creek confluence upstream 0.7 miles	No adult fish or redds
1/31/09	Coleman Valley Creek from 100ft. downstream from Salmon Creek Road bridge upstream ~0.7 miles	Two adult coho hiding under rootwad where one was seen on 1/29/09; no redds seen.
2/8/2013	Fay Creek from Salmon Creek confluence to first bridge upstream from Salmon Creek Road bridge	Two large steelhead on redd in Salmon Creek at confluence; two small coho males (14-16 in.) near partial redd in Fay Creek
2/12/09	Tannery Creek from 100 ft. below Salmon Creek Road bridge upstream to near round house	No adult fish or redds
3/24/09	Salmon Creek estuary release site upstream to end of Chanslor Ranch property	No new redds or spawners seen

2009 summer juvenile surveys: Snorkel surveys for juvenile coho salmon were conducted during July 2009 by teams of two led by Joe Pecharich, Diana Hines, or Michael Fawcett. Snorkeling teams were assisted by two volunteers, Doug Gore and Amber Villalobos (Americorps). After training by Joe Pecharich, surveys were conducted in Tannery, Fay, Finley, and Coleman Valley Creeks (Figure 2). A total of 294 coho were counted in ~4.5 stream miles surveyed (64.6 coho per mile; Table 3). A copy of the original datasheets is available upon request.

Juvenile steelhead (left) & coho (right) observed during summer snorkel surveys.

Observations made during the snorkel surveys indicated that many of the pools occupied by coho were soon likely to be dry, so an effort was organized by DFW to rescue and relocate some of the juvenile coho, and to keep some at the Warm Springs Hatchery for the Broodstock Program. During August, 306 coho were collected by seine from drying pools in Finley Creek, and 104 from Fay Creek. Of those collected, 201 from Finley Creek were taken immediately to mainstem Salmon Creek and released at two locations; the others were taken to the hatchery, tissue-sampled for genetic typing, and kept separate from other stocks. In November 2009, 123 of the juveniles were returned and released in Fay Creek and Finley Creek; the remaining juveniles were kept at the hatchery as broodstock.

Table 3. 2009 Snorkel Surveys

Stream Reach	**Reach Length (mile)**	**No. of Coho Observed**	**No. Coho Observed/Mile**
Tannery Creek from mouth to second bridge	1.47	5	3.4
Fay Creek from Salmon Creek Road to presumed end of anadromy	1.69	195	115
Finley Creek from Salmon Creek Road upstream	0.64	92	144
Coleman Valley Creek from Salmon Creek upstream	0.75	2	2.7
Total	**4.55**	**294**	**64.6**

2009-2010 spawner/redd surveys: Only one stream reach was surveyed for spawning activity or redds following the December 2009 release: On 9 January 2010, Diana Hines and Michael Fawcett surveyed Salmon Creek from the Highway 12 bridge upstream to the confluence with Nolan Creek (approximately 0.5 stream miles). Two pairs of steelhead were observed making redds, but no other redds and no coho were observed.

2010 summer juvenile surveys: Snorkel surveys conducted in July and August 2010 were supported by PSMFS grant No. A07-BD6. Nearly all of the reaches in Salmon Creek, Fay Creek, and Tannery Creek to which we had landowner access in 2010 were surveyed (Figure 2), a total of 5.30 stream miles (Table 4); a total of 400 coho were counted (68.3 per mile). Coho were observed in 8 of the 11 reaches surveyed, but Fay Creek alone accounted for 93 percent of the coho observed. Finley Creek and Coleman Valley were not accessible in 2010. A table summarizing all the data collected is included in Appendix II.

Table 4. 2010 Snorkel Surveys

Stream Reach	**Reach Length (mile)**	**No. of Coho Observed**	**No. of Coho Observed /Mile**
SAL-01 Lower Salmon Creek	0.362	22	60.8
SAL-02 Middle Salmon Creek upstream of Nolan Creek	1.00	0	0
SAL-03 Middle Salmon Creek	0.508	1	1.97
SAL-04 Upper Salmon Creek upstream of Watson School.	0.197	2	10.15
SAL-05 Upper Salmon Creek	0.553	n.a. (aborted survey)	n.a.
SAL-06	0.268	0	0
FAY-01, 02, 03	2.13	372	175
TAN-01, 02	0.835	3	3.59
Total	**5.853**	**400**	**68.3**

2010-2011 spawner/redd surveys: No spawner/redd surveys were conducted in winter 2010-2011 following the adult release on 15 Dec 2010.

2011 summer juvenile surveys: Calibration of the survey teams was conducted by having one team survey the designated 0.3 mile reach in Fay Creek on 30 June 2011; 18 coho were observed. The second team surveyed the same reach on 5 July 2011 and estimated numbers of juvenile steelhead as well as coho; 17 coho were counted, mixed among an estimated 485 steelhead. The numbers of coho reported by the two teams are obviously close.

From 5 July-12 October 2011 surveys were conducted in Finley, Coleman Valley, Fay, Tannery, Thurston, and Nolan Creeks, and in five reaches in mainstem Salmon Creek (Figure 2). Approximately 8.74 stream miles were surveyed, and 880 coho YOY were counted (101 coho/mile; Table 5). Juvenile coho were seen in all five tributaries surveyed, and in upper Salmon Creek between the town of Freestone and the falls at Salmon Creek School, the presumed limit of coho anadromy.

Two additional reaches were evaluated, but not snorkeled. The downstream-most mainstem Salmon Creek reach (SAL01; Figure 2) was evaluated, but not snorkeled due to poor water clarity, presumably related to high concentrations of phytoplankton and bacteria. Thurston Creek (THU01) was evaluated, but not snorkeled due to low streamflow conditions that made pools throughout the reach too shallow to effectively snorkel.

Table 5. 2011 Snorkel Surveys

Stream Reach	**Reach length (mile)**	No. of Coho **Observed**	No. of **Coho Observed/Mile**
SAL-01 (lower mainstem)		Survey aborted due to poor visibility	n/a
FIN Finley creek	0.664	134	201.9
COL (lower Coleman Valley Creek)	1.104	12	10.9
FAY (Fay Creek from Salmon Creek confluence to limit of anadromy)	2.095	135	64.4
TAN (Tannery Creek from Salmon Creek Road bridge to presumed limit of anadromy)	1.534	272	177.3
NOL (Nolan Creek from Salmon Creek confluence to limit of anadromy)	0.960	160	166.6
SAL-02 (mid-main stem)	0.470	0	0
SAL-03 (mid-main stem)	0.745	0	0
SAL-04: (upper main stem)	0.469	37	79.0
SAL-05 (upper main stem to the presumed limit of anadromy)	0.699	130	186.0
Total	**8.74**	**880**	**100.7**

In 2011, tissue samples for genetic analysis were taken from juvenile coho at four locations: Salmon Creek below Salmon Creek School, Tannery Creek, Nolan Creek and Fay Creek. On 29 September 2011, Manfred Kittel and Michael Fawcett used seines to capture 26 coho from 11 different pools in upper Salmon Creek (SAL05; Figure 2). On 16 November 2011, Manfred Kittle and Michael Fawcett were joined by Dan Logan (NMFS) to collect more tissue samples from coho in two tributaries: Nolan Creek and Fay Creek. All the tissue samples were stored dry on plain paper strips in individual envelopes for delivery to Carlos Garza. In late September or early October 2011, Derek Acomb (DFW) obtained some tissue samples from Tannery Creek coho, while conducting a rescue and relocation operation before dewatering for a stream

enhancement/restoration project. The results of the genetic work are not currently available for review.

2011-2012 spawner/redd surveys: The mouth of Salmon Creek estuary had been closed for several months by a sand berm until rains occurring during the week of Thanksgiving 2011 caused the berm to be breached. The survey teams conducted surveys from 26 November through 8 December 2011 on Fay, Tannery, and Nolan Creeks, and in mainstem Salmon Creek (Figure 1), but saw no adult salmonids or evidence of spawning activity (Table 6). The mouth of Salmon Creek had closed again before 13 December and remained closed until the end of the third week of January 2012. The release of 175 coho occurred on 19 December 2011, followed by another release of 25 adults on 5 January (Table 1). Surveys conducted from 22 December 2011 through 11 January 2012 were concentrated in mainstem Salmon Creek because lack of rainfall and low-flow conditions (riffle depths of 0.1-0.2 m.) in the tributaries and upper Salmon Creek made adult fish movements unlikely. The only indications of spawning activity found during this period were some rotted skin from an unidentified salmonid and one redd in Salmon Creek near the Nolan Creek confluence.

Volunteer measuring large redd on lower Salmon Creek mainstem.

Rains beginning on 19 January 2012 resulted in high flows throughout the watershed for several days and breaching of the berm at the mouth of Salmon Creek. Spawning activity by both coho salmon and steelhead had increased greatly when the surveys were resumed on 24 January 2012 and continued through mid-February (Table 6). Pit tag readings from 4 coho carcasses were taken; each was confirmed by Ben White (DFW) as being among the fish released in December 2011. Tissue for genetic analysis was collected from 7 coho carcasses where no pit tag was detected; some were partial carcasses (e.g., guts had been removed by scavengers, or just a head remained), so pit tags may have been lost. All the tissue samples were given to Manfred Kittel for delivery to Carlos Garza. The results of the genetic work are not currently available for review.

Table 6. 2011-2012 Spawner/Redd Surveys

Date	Reach/Location	Observations
11/26/11	TAN-02 Lower Tannery Creek	No adult fish or redds
11/29/11	FAY-02 Lower Fay Creek	No adult fish or redds
11/30/11	NOL-01, 02 Lower Nolan Creek	No adult fish or redds
11/30/11	SAL-05 Upper Salmon Creek	No adult fish or redds
12/08/11	SAL-01 Lower Salmon Creek from near Coleman Valley Creek to Fay Creek confluence	No adult fish or redds
12/22/11	SAL-04 Salmon Creek just upstream of Freestone	No adult fish or redds
01/06/12	SAL-01 Lower Salmon Creek from near Coleman Valley Creek to Fay Creek confluence	No adult fish or redds
01/10/12	SAL-02 Salmon Creek from Nolan Creek confluence upstream~½ mi.	1 partial carcass, 1 redd
01/11/12	SAL-02 Salmon Creek from endpoint on 1/10/12 upstream ¼ mi.	No adult fish or redds
01/11/12	SAL-03 Salmon Creek from near Watson School to near Valley Ford-Freestone Road	No adult fish or redds
01/11/12	NOL-01 Lower Nolan Creek	No adult fish or redds
01/20/12	FAY-01 Lower Fay Creek	Survey aborted due to high flow and turbidity
01/24/12	TAN-02 Lower Tannery Creek	No adult fish or redds
01/24/12	TAN-03 Upper Tannery Creek	2 adult coho and 3 adult steelhead; no redds
01/25/12	FAY-02 Lower Fay Creek	1 female coho carcass (spawned out), 2 unidentified live salmonids; no redds
01/26/12	NOL-01, 02 Lower Nolan Creek	6 steelhead on or near redds
01/27/12	SAL-04 Salmon Creek just upstream of Freestone	3 steelhead on redds, 2 unidentified salmonids; 2 redds, 2 test redds
01/29/12	TAN-03 Upper Tannery Creek	1 male coho carcass, 1 redd
01/31/12	FAY-02 Lower Fay Creek	2 coho carcasses; 2 live adult steelhead, 1 unidentified salmonid ; no redds
01/31/12	FAY-03 Upper Fay Creek	2 male coho carcasses, 1 nearly dead male coho, 6 live coho, 2 unidentified salmonids; 4 redds (3 of which were under construction during survey)
02/01/12	TAN-02 Lower Tannery Creek	1 male coho; no redds
02/01/12	TAN-03 Upper Tannery Creek	5 coho (2 females, 3 males); 6 redds (2 of which were under construction)

Date	Reach/Location	Observations
02/02/12	SAL-05 Upper Salmon Creek	1 female coho carcass; 4 redds, 1 test redd
02/14/12	NOL-01, 02 Nolan Creek above Thurston Creek confluence	1 female coho carcass; 3 redds (2 steelhead, 1 unknown)
02/14/12	NOL-01 Lower Nolan	1 live steelhead; 1 redd in addition to those above; tissue taken from female coho in row above
02/15/12	SAL-01 Lower Salmon Creek above Coleman Valley Creek confluence	5 redds, 1 test redd
02/15/12	FAY-01 Lower Fay Creek	1 coho male carcass
02/16/12	SAL-03 Salmon Creek above Bodega	3 redds

2012 summer juvenile surveys: Calibration of the snorkel survey teams was conducted in the same reach in lower Fay Creek (FAY-02, ~0.3-mi. reach length) as in 2011 (Figure 2). The first team surveyed the reach on 21 June 2012, counting 219 juvenile coho. The second team surveyed the same reach the following day (22 June), counting 213 juvenile coho. The difference between results (6 out of 200+ fish) is small. Determining whether or not there were statistically significant differences or trends between the teams' counts would require repeated calibration surveys at a number of sites, as well as consistency among the personnel assigned to each team; budget and time constraints did not allow this.

In summer and fall of 2012, 12.3 miles in Salmon Creek and Finley, Coleman Valley, Fay, Nolan, and Thurston Creeks were surveyed (Figure 2) and 2,942 juvenile coho were counted (Table 7).

Table 7. 2012 Snorkel Surveys

Stream Reach	Reach Length (mile)	No. of Coho Observed	No. of Coho Observed /Mile
SAL-01 Lower Salmon Creek	0.859	109	126.9
FIN Mid-Finley Creek*	1.647	381	231.3
COL lower Coleman Valley Creek	Not surveyed	n/a	n/a
FAY Fay Creek from Salmon Creek confluence to limit of anadromy	2.130	1088	510.8
TAN (Tannery Creek from Salmon Creek Road bridge to presumed limit of anadromy)**	2.163	508	234.9
NOL Nolan Creek from Salmon Creek confluence to limit of anadromy	1.511	645	426.9
THU Thurston Creek from Nolan confluence through access reach**	0.802	208	259.4
SAL-02 Upstream of Tannery confluence**	0.189	0	0
SAL-03 Upstream of town of Bodega	1.035	0	0
SAL-04 Upstream of Watson School	0.509	0	0
SAL-05 Upstream of Bohemian Highway bridge at Freestone)**	0.684	0	0
SAL-06 0.4 mi. upstream of Freestone Flat Road bridge to limit of anadromy	0.803	3	0.004
Total	**12.3**	**2,942**	**239**

*Upstream of reach surveyed in 2011
**New reach surveyed in 2012

2012-2013 spawner/redd surveys: Surveys began on 4 December 2012, following breaching of the berm at the mouth of Salmon Creek. Adult coho were released on 17 December (Table 1). Surveys were conducted in Tannery, Fay, Finley, and Nolan Creeks, and in mainstem Salmon Creek (Figure 1). The survey teams were led by either Jennifer Michaud or Sierra Cantor, as Michael Fawcett was temporarily disabled while recovering from knee surgery. Evidence of 12 coho carcasses was found (Table 8), 11 of which were represented by the recovery of Floy tags alone (adult coho released in December 2012 were each tagged with a Floy tag before release; no visible tags or marks were used in prior years). A single pit tag reading was obtained (D46C901). Six live coho were seen, one of which had a visible Floy tag, and 7 unidentified partial carcasses were found. Three redds were observed with coho on them, 1 with steelhead on it, and 48 redds of unidentified species origin were located.

Table 8. 2012-2013 Spawner/Redd Surveys

Date	Reach/Location	Observation
12/04/12	TAN-O2	No adult fish or redds
12/10/12	FAY-02, 03 Salmon Creek Rd. Bridge to 3rd bridge	No adult fish or redds
12/12/12	SAL-01	One redd, sp. unknown
12/12/12	FAY-01	No adult fish or redds
12/31/12	TAN-02, 03, 04	Two live coho, one on redd, one with visible Floy tag
12/31/12	FAY-02, 03	Two live steelhead spawners, 1 unknown sp. adult, 1 piece of skin, sp. unknown (tissue sampled); 6 redds, spp. unknown
01/02/13	NOL-02 (Joy Road bridge upstream 0.864 mi.)	No adult fish or redds
01/03/13	SAL-06	Two live coho on redds, one with visible Floy tag; six redds, including the two with coho on them, and four unattended, species unknown
01/08/13	SAL-04	One coho carcass (parts only), no pit tag, but Floy tag and eggs on bank nearby
01/08/13	FIN-02, 03	One partial coho female carcass, 2 Floy tags in stream bed not associated with redds; 4 redds
01/09/13	TAN-01, 02	No adult fish; 2 redds, one where coho female was working on 12/31/12
01/09/13	SAL-05	One steelhead carcass, 2 live steelhead on a redd, 1 redd, species unknown
01/14/13	SAL-03	Two unidentified carcasses; no redds
01/14/13	FAY-02, 03	One live coho, 1 Floy tag near where skin was found on 12/31; 6 redds, 3 of which were likely re-measures of redds measured on 12/31
01/15/13	FAY-04	No adult fish; 7 redds, spp. Unknown
01/16/13	NOL-02	One coho carcass (Floy tag alone; two redds
01/17/13	SAL-04	No adult fish; one redd, species unknown
01/17/13	SAL-06	Partial carcass, species unknown; 2 Floy tags within 50 ft. downstream; 1 redd
01/21/13	TAN-02, 03, 04	No adult fish; 1 redd
01/23/13	SAL-05	No adult fish; 2 redds
01/23/13	NOL-02	One coho carcass, pit tag D46C901
01/29/13	SAL-01	No adult fish; 13 redds, species unknown
02/05/13	SAL-03	No adult fish; no redds
02/05/13	SAL-03	No adult fish; no redds
02/12/13	SAL-01	One carcass (bit of skin); no redds

Discussion

From January 2009 through February 2013, successful coho spawning and summer juvenile rearing in the Salmon Creek watershed has been documented by a team of local biologists, resource agencies, and volunteers. Evidence of spawning was documented throughout accessible reaches of mainstem Salmon Creek and its five major tributaries. Summer surveys for juveniles documented coho young-of-the-year in every tributary surveyed and in lower numbers in mainstem Salmon Creek (Figure 3). Observations of juveniles within the mainstem, especially in the Bodega Valley reach, were not necessarily indicative of habitat utilization, because of lower visibility relative to the tributaries. In addition to coho salmon, steelhead spawning and rearing was also documented throughout accessible reaches of the watershed.

No attempt has been made to discriminate between coho and steelhead redds on the basis of redd area, as Gallagher and Gallagher (2005) have described for some intensively studied streams in Mendocino County. However, measurements of intact redds have been recorded in accordance with protocols established by Gallagher and Knechtle (2003). There have not been enough observations and measurements of redds made by each species in the Salmon Creek region to confirm that the redd area techniques are appropriate for this region, nor does the survey team have enough experience at identification and aging of redds. Average size of adult coho increases from south to north, as does fecundity (Flosi et al. 2002; NMFS 2012); the same is true for steelhead. Larger individuals make larger redds, so it is unclear whether or not the relationships between redd area and species are the same for coho and steelhead in the Salmon Creek region as for those in the streams further north studied by Gallagher and Gallagher (2005).

Tissue collections from carcasses for which no pit tags or other markers are found are important for determining origin of the carcasses: wild vs. Broodstock Program adult release, second generation-sea run Broodstock Program, or sea run fish straying from another watershed. Skin samples were obtained from 7 carcasses in winter 2011-12, and 2 carcasses in 2012-13. Tissue samples from juveniles captured in rearing areas are easier to obtain, and can provide much of the same information, assuming that the samples are obtained from multiple locations within the watershed and within the reaches sampled. Since additional releases of adult coho in Salmon Creek are planned in the future, possibly through winter 2015-16 (M. Kittel 2013, *personal communication*), continued post-release effectiveness monitoring is essential. However, conducting snorkel surveys in the rearing areas and collecting tissues from juveniles is probably more cost effective than spawner/redd surveys. Once the snorkel surveys have been done within the study reaches, the observed presence/absence and relative abundance of juvenile coho salmon would be the basis for deciding where to go to collect tissue samples.

Because the results from the genetic analysis of tissue samples are not yet available, a determination of whether or not wild coho salmon have been returning to the Salmon Creek watershed cannot be made at this time. The federal Recovery Plan for CCC coho salmon (NMFS 2012) defines the recovery target for downlisting the Salmon Creek coho population from endangered to threatened status as 684 adult spawners returning to Salmon Creek, and the recovery target to downlist from threatened to recovered status as 1,367 returning adult

spawners. Thus far, the combined Broodstock Program-released fish and potential wild returns do not approach either of the recovery targets. It will be necessary to continue monitoring adult returns to better understand if recovery efforts are approaching the outlined goals.

While the numbers of returning adult coho observed in the Salmon Creek watershed are nowhere near the recovery targets, the fact that so much of the watershed is being used for spawning and rearing is important, in that it demonstrates that the spawning, egg incubation-larval emergence, and summer rearing phases of the life cycle can be completed in much of the watershed. Coho salmon have been found to be spawning and rearing in all five named tributaries to Salmon Creek (Finley, Coleman Valley, Fay, Tannery and Nolan/Thurston Creeks) as well as in the upper and lower reaches of mainstem Salmon Creek (SAL01 and SAL06), see Figure 3. The greater the distribution throughout the watershed, the less susceptible the population is to natural or anthropogenic disturbances (Adams et al. 2011).

The NMFS Coho Recovery Plan (NMFS 2012) states several prioritized actions for preventing extinction and improving conditions for coho salmon in the Salmon Creek watershed. These actions include:

Priority 1: Immediate Restoration Actions

- Establish a more natural hydrograph, by-pass flows, seasons of diversion, and off stream storage
- Develop cooperative projects with private landowners to conserve summer flows
- Use surplus broodstock to repopulate remaining extirpated streams within the watershed
- Annually capture or retain (during rescue efforts) - small numbers of surplus fish from drying streams/habitats for purposes of broodstock in Salmon Creek

Priority 2 and 3: Long-Term Restoration Actions

- Implement the Salmon Creek Enhancement Plan by regaining as much of the historical capacity and area of the Salmon Creek Estuary as possible
- Restore estuarine wetlands and sloughs
- Avoid new development within riparian zones and the 100-year flood prone zones
- Investigate the feasibility of beaver re-location and re-introductions to promote channel complexity, improve base flows and provide rearing habitat
- Support the water conservation training conducted by the Occidental Arts and Ecology Center Water Institute, GRRCD, and Salmon Creek Watershed Council."

For an expanded list of watershed management recommendations to benefit coho salmon and aquatic habitat throughout the Salmon Creek Watershed, refer to the "Salmon Creek Integrated Coastal Watershed Management Plan (GRRCD and PCI, 2010) at http://www.goldridgercd.org/watersheds/salmoncreekplan.html.

GRRCD and its partners are working with the Salmon Creek community, including the Bodega Water Company, on water conservation and off-stream water storage projects throughout the Salmon Creek watershed. The Salmon Creek Coho Monitoring team (GRRCD, FEC, PCI staff, and volunteer biologists) has been and will continue to monitor the success of the coho salmon

reintroduction effort through juvenile coho snorkeling and adult spawner surveys as continued access and funding allows.

Future Biological Monitoring Needs

There is a clear need to continue the monitoring of fish populations in the Salmon Creek watershed to determine the success of the coho reintroduction effort. Additionally, because the coho reintroduction strategy employed in Salmon Creek, releasing hatchery raised adults during spawning season, differs significantly from that of the Russian River reintroduction effort, where juvenile coho are released during different times of the year, the Salmon Creek Coho Monitoring program provides vital data to compare and contrast these two strategies for coho salmon reintroduction via hatchery release.

Recommendations for the future biological monitoring needs in Salmon Creek are to:

- Conduct juvenile coho snorkeling surveys twice a year, once in early summer to gauge the success of spawning and a second survey in the late summer/early fall to gauge over-summer survival and rearing success. The late summer/early fall survey will also serve to evaluate how much of the over-summer habitat retains surface water and viable habitat. This information can be used by the landowners and GRRCD to assist with identifying and prioritizing future water conservation and storage projects and other watershed restoration efforts.
- Reduce the adult spawner survey effort to focus on monitoring for wild returns from when the sandbar at the mouth of the Salmon Creek estuary first breaches in the fall, allowing in-migration of spawners, to when the broodstock adults are released into Salmon Creek. Since the recovery metrics are based on the number of wild adult returns to the watershed, spawner surveys are a vital measure of whether Salmon Creek is producing a self-sustaining coho salmon population. Since five years of monitoring have clearly established that releasing adults in the estuary is a successful strategy resulting in up-migration to suitable spawning areas in the main stem and tributaries, focusing the spawner/redd surveys only on wild salmon is appropriate.
- Expand the bioassessment monitoring to include benthic macroinvertebrate (BMI) sampling. Depending on the sampling design, either sample BMIs in the areas with highest quality aquatic habitat value during spring to characterize the refugia available to aquatic organisms or, conversely, sample BMIs in the fall in areas where stream conditions are thought to be a limiting factor to the survival and persistence of sensitive aquatic organisms. Besides being directly related to coho survival as fish food, BMIs are a valuable tool for better understanding the quality of aquatic habitat and can be used to corroborate assumptions about stressors and limiting factors for stream biota.
- Continue to work with and support separate, but related monitoring efforts occurring in the watershed (such as the flow and aquatic habitat study being conducted by UC Berkeley graduate student, Cleo Woelfle-Erskine).

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UCCE. 2012. UCCE Russian River Coho Broodstock Program Spawner Survey Protocol, Winter 2012-2013. University of California Cooperative Extension.

Figure 1. Spawner/Redd Survey Reaches 2011-2013.

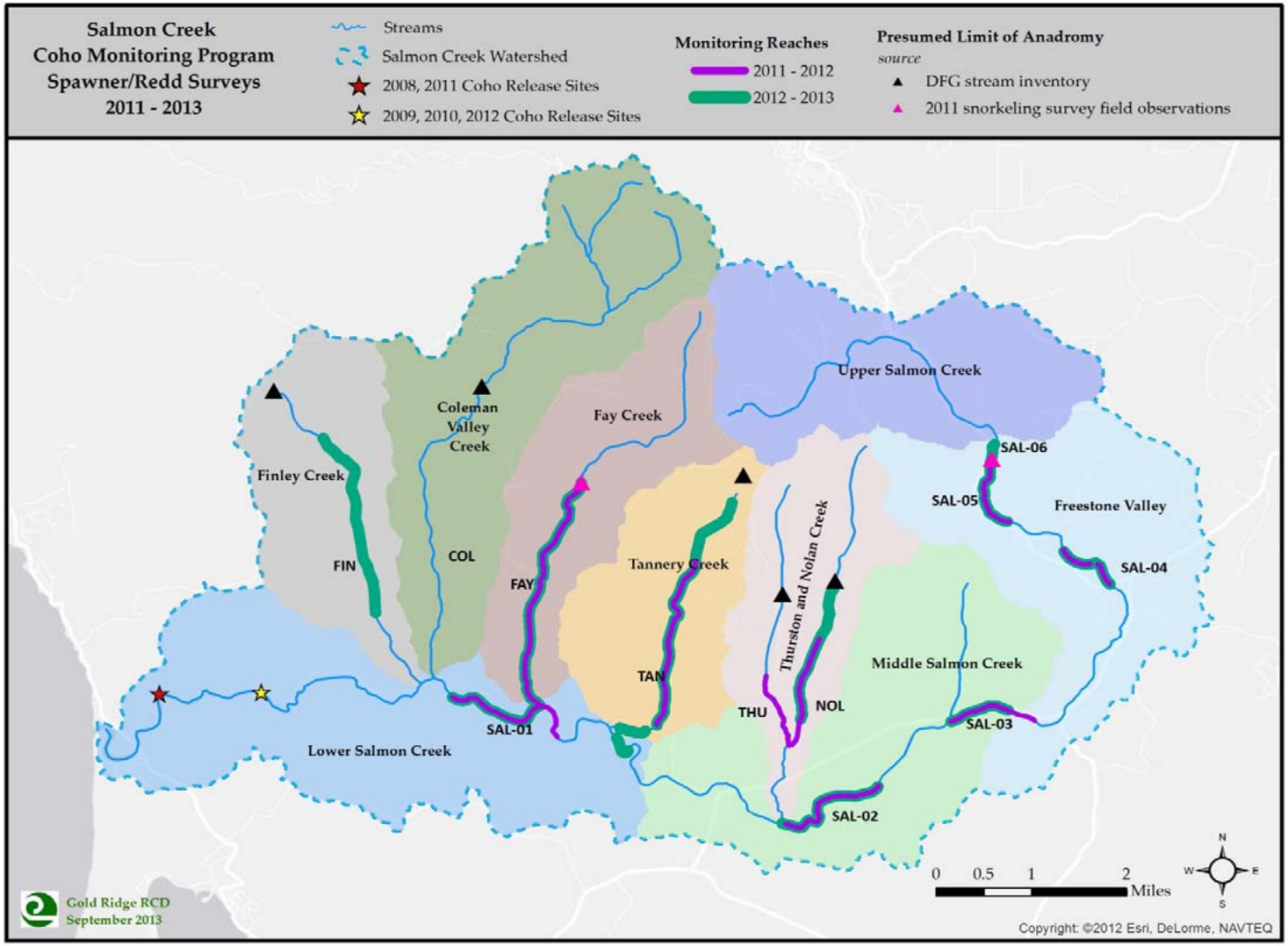


Figure 2. Coho Juvenile Snorkel Survey Reaches 2009 – 2012.

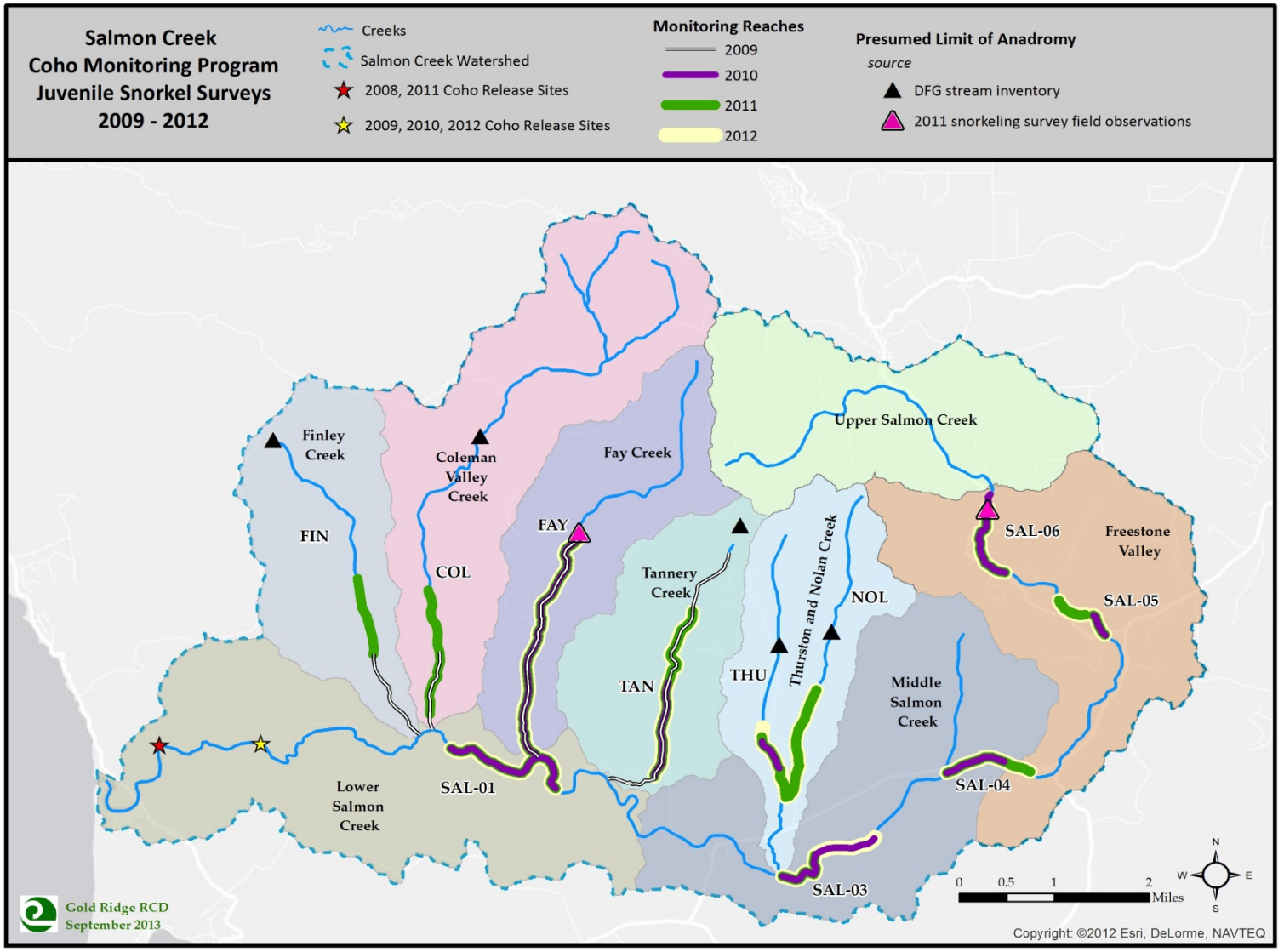
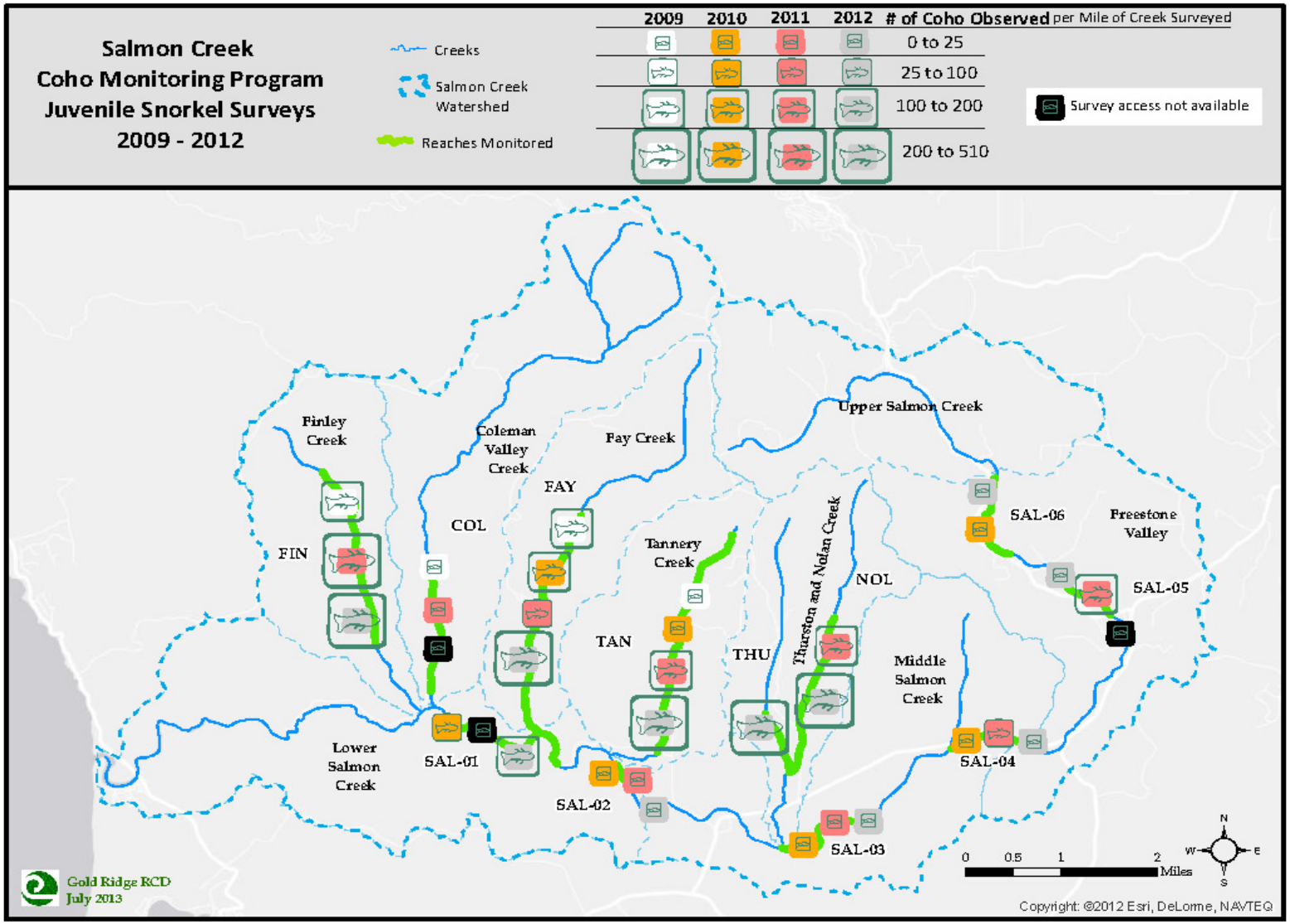


Figure 3. Number of juvenile coho observed per mile of creek surveyed during snorkeling surveys conducted 2009-2012



Appendices

I. Spawner/Redd Survey Data:
2012-13 Salmon Creek Coho Monitoring Program Spawner Survey, Live Fish & Carcass Datasheet
2012-13 Salmon Creek Coho Monitoring Program Spawner Survey, Redd Datasheet
Spawner/Redd data summary 2010-2011, 2011-2012, 2012-2013

II. Summer Juvenile Survey Data
2012 Salmon Creek Coho Monitoring Program Snorkeling Survey Datasheet
Snorkel survey data summary 2010, 2011, 2012

2012-13 Salmon Creek Coho Monitoring Program Spawner Survey Datasheet

LIVE FISH & CARCASS DATASHEET

Stream Name: Start Time: Start Location (Lat/Long decimal degrees WGS 84):

Reach: End Time:

Date: Water Visibility (m): End Location (Lat/Long decimal degrees WGS 84):

Crew: Water Temp. (°C):

Weather: Air Temp. (°C): Stream Flow (cfs):

Notes/Reach descript (include info on habitat quality, i.e. substrate, riparian cover, p/a of algae, visibility, general observations):

	Record #	Use Codes				Life Stage		Fish on Redd? If yes, record redd #		Live or Carcass?	Carcass Info.		Condition of Fish	Adipose Clip?	Genetic Clip?
Obs.#	Stream (STR) Month Day Year 000-999	Species	Certainty of ID (1-3)	Sex	Certainty of ID (1-3)	Adult/Jack/UNK	Fork Length (cm)	(Y/N)	Redd #	(L/C)	Carcass Tag #	Carcass Recapture (Y/N)	(L1-L3) (1-6)	(Y/N/UNK)	(Y/N)
1															
2															
3															
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Fill out form even if no fish or carcasses are observed, use comments section for notes Page ___ of ___

2012-13 Salmon Creek Coho Monitoring Program Spawner Survey Datasheet

REDD DATASHEET

Stream Name:	Start Time:	Start Location (Lat/Long decimal degrees WGS 84):
Reach:	End Time:	
Date:	Water Visibility (m):	End Location (Lat/Long decimal degrees WGS 84):
Crew:	Water Temp. (°C):	
Weather:	Air Temp. (°C):	Stream Flow (cfs):

Comments/Reach descript (include info on habitat quality, i.e. substrate, riparian cover, p/a of algae, visibility, general observations):

Record #	Use Codes	Pot Dimensions (m)				Tail Spill Dimensions (m)				Fish on Redd? If yes, Record Fish #		Redd Age	Remeasured	Test Redd
Stream (STR) Month Day Year 000-999	Species	Length (PL)	Width (PW)	Depth (PD)	Substrate (PS)	Length (TSL)	Width 1 (TSW1)	Width 2 (TSW2)	Substrate (TSS)	(Y/N)	Fish #	(1-5)	(Y/N)	(Y/N)

Fill out form even if no fish or carcasses are observed, use comments section for notes

Page ___ of ___