Scott River Adult Coho Spawning Ground Surveys
2016-2017 Season

Report Prepared by Lindsay Magranet and Erich Yokel
Siskiyou Resource Conservation District

United States Fish and Wildlife Service – Fisheries Program
Agreement # F16AP00694

June 2017

Siskiyou Resource Conservation District – P.O. Box 268 Etna, CA 96027
(530) 467-3975
sisqrcd@sisqtel.net

ABSTRACT

The Scott River Fish Counting Facility operated by the California Department of Fish and Wildlife located at river mile 18.2 recorded 226 live adult coho migrating upstream into the Scott Valley from October 22nd to December 7th 2016. Pulse flows that occurred in mid-October had connected the Scott River and allowed salmon to access valley spawning grounds. Spawning ground surveys were conducted by the Siskiyou Resource Conservation District from November 1st 2016 to January 3rd 2017 to determine the distribution of coho salmon spawning in the watershed and inform related management decisions over the following year. A total of 33.6 river miles were surveyed (10.8 river miles on the mainstem and 22.8 river miles on western tributaries). Surveys were conducted continuously as conditions allowed through the active period of the run and consisted of trained two-person field crews hiking established reaches either in-stream or along the bank in waders. Field technicians counted the number of live fish by species, documented the location and dimensions of redds, and collected biological samples (scale, tissue, and otolith) from recovered carcasses. A total of 95 coho redds were recorded by surveyors on the Scott River mainstem and the following tributaries (from north to south): Shackleford Creek and its tributary Mill Creek, Patterson Creek, French Creek and its tributary Miners Creek, Sugar Creek and the East Fork Scott River. A total of 22 coho carcasses were recovered, sexed, measured and sampled.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The following entities cooperated in the Scott River survey effort:

California Dept. of Fish and Wildlife
United States Fish and Wildlife Service
United States Forest Service

The Siskiyou Resource Conservation District was funded by the United States Fish and Wildlife Service, Fisheries Program.

Siskiyou RCD Field Technicians:
Erich Yokel
Lindsay Magranet
Wade DeDobbeleer

The Siskiyou RCD would like to extend a specific acknowledgement to all the participating Scott Valley landowners that gave permission for field technicians to conduct surveys on their property. This work would not have been completed without their cooperation.

INTRODUCTION

Coho salmon (*Oncorhynchus kisutch*) are endemic to the Scott River system and belong to the Southern Oregon Northern California Coast (SONCC) Evolutionarily Significant Unit, which was listed as threatened under the Federal Endangered Species Act (by the National Marine Fisheries Service) in 1997. In 2001, the State of California began considering listing coho salmon and, with the expectation of an abundant run on the Scott River, the Klamath National Forest spearheaded the first spawning ground survey effort (Maurer 2002). The spawning ground surveys began as a cooperative effort among local landowners, agencies and concerned volunteers. At that time it was recognized that baseline population and distribution data was needed in order to implement and assess effective restoration plans and efforts. In 2004, the California Fish and Game Commission acted to add coho salmon to the state endangered and threatened species list and the listing became effective March 5th 2005. The collection of coho spawning distribution data has continued annually on the Scott River since the initiation of the surveys in 2001.

In addition to the spawning ground surveys, coho population data (run size and timing) has been gathered since 2007 at the Scott River Fish Counting Facility (SRFCF) run by the California Department of Fish and Wildlife (CDFW). The counting station is operated during the Chinook and coho salmon migration period and consists of a temporary weir constructed at river mile 18.2 that directs fish through a video flume where they are counted by species. This video weir data is coupled with downstream mark and recapture population estimates completed during the spawning ground surveys to make an escapement determination for the Scott River.

The monitoring of coho spawning parameters (abundance, range, distribution, and timing) through annual surveys and operation of the SRFCF is valuable on both an annual basis and for long-term trend analysis. By locating known coho spawning sites, stream reaches can be identified where juvenile coho salmon may be rearing the following summer when low-flow conditions may impact growth and survival. The Scott River Water Trust, a nonprofit that seeks to voluntarily improve stream flow in critical stream reaches, relies on this information each year to prioritize water leases. Over the long-term, this distribution data has allowed for the development of strategic management plans as well as the design, implementation and assessment of informed restoration projects across the Scott River watershed.

Project Purpose and Objectives

The purpose of the annual *Scott River Adult Coho Spawning Ground Surveys* is to gather data on run parameters including the abundance, timing, duration, age composition, hatchery contribution and redd distribution of coho salmon in the Scott River and tributaries. The 2016-2017 effort marks the sixteenth consecutive year of data collection. Specific project objectives:

1. Conduct cooperative adult coho spawning ground surveys on the Scott River and tributaries during the 2016-2017 survey season to document the distribution of coho salmon spawning within the historic range.
2. Attempt to document the upper extent of spawning in each tributary where coho are found.
3. Collect biological samples from carcasses to build upon our understanding of the life history of the evolutionarily significant SONCC coho salmon and for comparison of the genetic relationship between Scott River fish and other stocks.
4. Inform the Scott River Water Trust of potential locations were juvenile coho may be rearing for the prioritization of water leases over the following summer.

Study Location and Run Timing

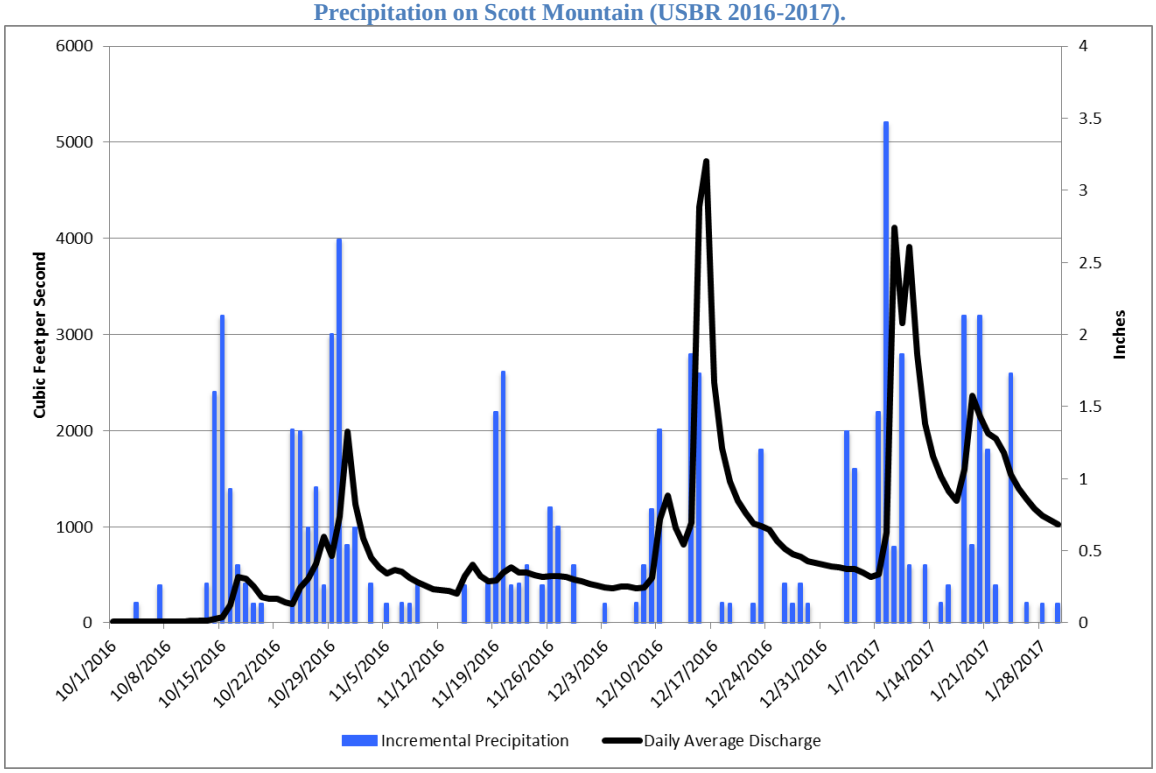
The 2016-2017 survey effort took place in the Scott River Watershed, a sub-basin of the Klamath River Basin. The Scott River is a major tributary and enters the Klamath River at river mile 143 in Siskiyou County, California. Coho salmon (*O. kisutch*) generally return to the Scott River to spawn from mid-October to early January with Chinook salmon (*O. tshawytscha*) (mid-September through late December) and Steelhead trout (*O. mykiss*) (November through April) runs overlapping.

Water Year Conditions

Streams throughout the watershed began swelling out of base-flow conditions in early October, such that the Scott River was confirmed to be connected through Oro Fino on October 12th 2016. The first notable rain event of the Water Year accumulated approximately 4.5 inches of precipitation from October 13th to 18th 2016 (CAL FIRE 2016, Figure 1). The Scott River at the USGS streamflow gage (river mile 21) exceeded 500 cfs on October 17th and became fully connected throughout the valley to the confluence with the Klamath River (USGS 2017, preliminary data). Ocean run salmon gained access to the valley portion of the watershed at this time. Subsequent precipitation events and pulses of flow ensured connectivity of all major tributaries to the Scott River throughout the remainder of the spawning season.

Weather conditions in the valley were relatively wet over the survey season with precipitation events occurring at frequent intervals (Figure 1). Significant runoff events increased flows on the mainstem to the extent that several surveys had to be postponed due to poor water visibility and the inability for survey crews to make safe stream crossings. These pulse flow events further impacted data collection by disturbing spawning evidence (e.g., pushing carcasses downstream and flattening redds).

Figure 1. Scott River Daily Average Discharge – USGS Gage RM 21 (USGS 2017, preliminary data) and Precipitation on Scott Mountain (USBR 2016-2017).



Coho Population Trends in the Scott River Watershed

Annual monitoring of the quantity and distribution of Scott River coho salmon spawning began in 2001 and since then has enumerated between 6 and 960 redds per year (Table 1). It is important to note that surveys do not cover all potential spawning habitats and it is understood that these figures do not represent a total count of coho redds in the watershed. The survey effort has attempted to maintain coverage of consistent index reaches over the years thus insuring that the relative number of redds observed each year is comparable. This data in combination with the yearling juvenile smolt emigration abundance collected since 2000 indicates a significant variation in brood year strength, with one of the three brood years being notably stronger (Jetter et al. 2016). Adult coho spawner escapement has been estimated since 2007 and is predominantly derived from the SRFCF recordings with adjustments made to account for spawning below the migrant weir. This data shows that adult returns to the Scott River have ranged from 63 to 2,752 fish, with an average of 692 adults (Table 1). The brood year discussed in this report belongs to the larger cohort and was made up of the progeny of a return estimated at 2,752 adult fish in 2013. Utilizing escapement estimates and average percent yearling survival (from brood years 2004-2008 and 2010-2012), CDFW predicted a return of approximately 405 adults in 2016 (Knechtle and Chesney 2017).

Table 1. Coho redds and abundance in the Scott River across all Brood Years (Magranet 2015, Knechtle and Chesney 2017).

Year	Total Redds Documented	Estimated Coho Spawner Escapement
2001*	211	ND
2002*	17	ND
2003	6	ND
2004	960	ND
2005	30	ND
2006	9	ND
2007	259	1,622
2008	24	63
2009	6	81
2010	162	927
2011	26	355
2012	24	201[a]
2013	354[b]	2,752
2014	103	485
2015	60	212[a]
2016	95	226[a]

*Survey reaches expanded in 2003, therefore data collected in 2001 and 2002 are not directly comparable

[a]abundance underestimated, high flows prematurely ended survey season

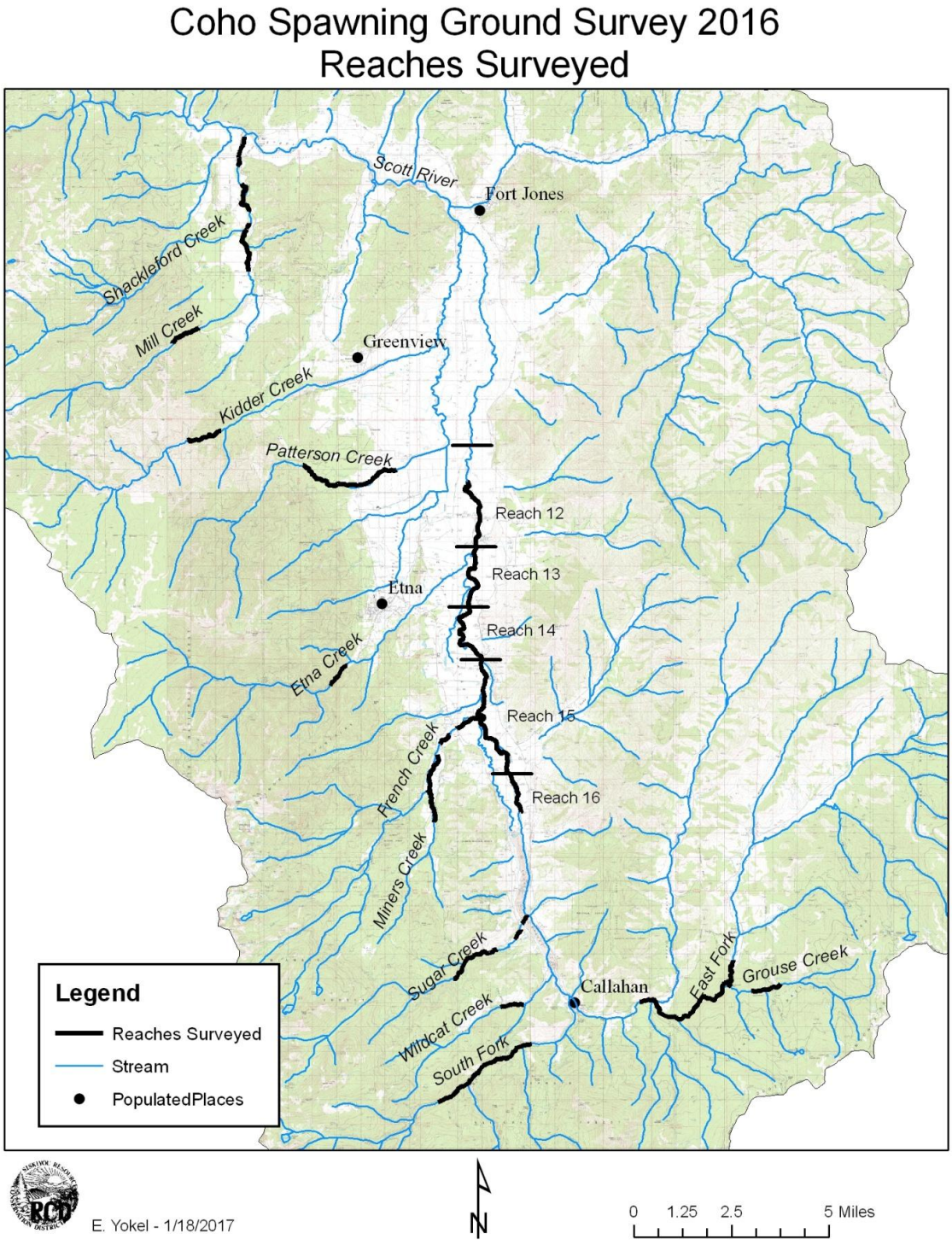
[b]superimposition of coho redds observed in all locations including with Chinook redds

METHODS

The Siskiyou RCD follows the protocol employed since 1992 to assess Chinook populations in the Klamath River Basin. This protocol has been used in the Scott River watershed for adult coho spawning ground surveys since they were initiated in 2001. Stream reaches were surveyed by hiking the stream channel during the coho spawning season (mid-November through January). Surveyors worked in teams of two (sometimes accompanied by the landowner), traversing the stream in neoprene waders and felt soled boots, walking in a downstream direction. The number of live fish, redds and carcasses observed were counted by species, recorded on data sheets and mapped for each stream surveyed. Redd dimensions and substrate composition information was collected from redds only if it did not disturb spawning fish. Flagging was hung adjacent to all new redds on each survey to prevent double counting. GPS points were collected at redd sites, carcass sites, and sites of unusual fish observation (i.e. beyond previously documented extent of rearing). Tissue, scale, and otolith samples were taken from each recovered coho carcass for age and DNA analysis. All carcasses that had been sampled were chopped in half with a machete to signify that they had been handled and were promptly returned to the stream.

Reaches Surveyed

Adult coho spawning ground surveys were completed on 10.8 miles of the Scott River mainstem and 22.8 miles of tributaries (Appendix I. Length of Stream Reaches Surveyed). Tributaries surveyed (from North to South) included: Shackleford & Mill Creek, Kidder Creek, Patterson Creek, Etna Creek, French & Miners Creek, Sugar Creek, Wildcat Creek and the East Fork and South Fork of the Scott River (Map 1).



Map 1. Scott River Index Reach Boundaries and tributary reaches surveyed (Siskiyou RCD).

Crew Training

The Siskiyou RCD and CDFW did not hold the Scott River Annual Coho Spawning Ground Survey Training in 2016 because there were not any new crew members working this season. All Siskiyou RCD field technicians had participated in the training during past years. A review of sampling protocols was performed in the field during the initial survey to insure quality of the collected survey data.

Survey Timing

Rainfall had connected the full length of the Scott River by mid-October allowing adult salmon access to the valley spawning grounds. Chinook surveys began on the mainstem on October 12th 2016 and were utilized to scout for early coho in the system. Surveys expanded into the tributaries on November 1st to look for Chinook spawners that may have dispersed more widely and coho spawners that may have migrated through the mainstem unnoticed. The first observation of adult coho in the valley reaches of the system occurred on November 10th, with the identification of a spawning pair on the Scott River near the confluence with French Creek. Surveys continued through the first week of January until funding constraints were realized.

GPS Data Collection

Hand-held Global Positioning System (GPS) units were used to record the location of each redd observed and carcass recovered. Each documented redd and carcass was assigned a unique identifier code based on the stream and reach, date and sequential number. The unique identifier code was used to label GPS coordinates in the hand-held unit so that this information could be tied back to the data sheet. GPS coordinates were taken in WGS 84 datum and recorded on data sheets in degrees with decimal minutes.

Example: SU 112014 L R07 = Sugar Creek, November 20th 2014, Lower Reach, Redd Site #7

Boulder Cr. (South Fork)	BO	Meamber Gulch	ME
Boulder Cr.(Scott)	BS	Middle Creek	MI
Canyon Cr.	CA	Mill Cr. (Scott Bar)	SB
Clark Cr.	CL	Mill Creek	ML
East Fork Scott	EF	Miners Cr.	MI
Emigrant Creek	EM	Moffet Creek	MO
Etna Cr.	ET	North Fork French	NF
French Cr.	FR	Patterson Creek (Scott)	PS
Grouse Creek	GR	Patterson Creek(Etna)	PA
Horse Range Cr.	HR	Rattlesnake Cr.	RA
Indian Creek	IN	Ruffy Gap Trib	RU
Johnson Creek	JO	Shackleford	SH
Kangaroo Cr.	KA	Shackleford-Mill	SM
Kelsey Channel	KC	South Fork Scott	SF
Kelsey Creek	KE	Sugar Creek	SU
Kidder Creek	KI	Thompkins Creek	TO
McAdams Cr.	MC	Wildcat Cr.	WI

Wooliver	WO	Scott River Mainstem Index Reach S##
Scott River Tailings	TA	(Example – S08 = Scott Reach 8)

Sample Collection

A Federal Endangered Species Act Section 4(d) collection permit from the NOAA Fisheries Service was held by the Siskiyou RCD for biological sample collection from salvaged coho carcasses. The Siskiyou RCD also maintained a current California Endangered Species Act Memorandum of Understanding with CDFW for this effort.

Three sets of scale samples were taken from each carcass. The preferred location for scale collection is above the lateral line between the posterior insertion of the dorsal fin and the anterior insertion of the anal fin. Scales were collected after cleaning the area with a knife. Each set of scales was placed into a separate sample envelope and labeled with the unique identifier code that matches the GPS coordinates of its recovery. Sample envelopes and data sheets also record specific information about the carcass including: species identification, fork length measurement (cm), sex determination, and a check for hatchery markings.

Tissue sampling protocol for coho salmon carcasses followed the direction provided by the NOAA Fisheries Service, Southwest Fisheries Science Center, Santa Cruz Laboratory. A pair of tissue samples was taken from each carcass by clipping, with a hole-puncher, two disks from the operculum tissue (gill plate). The tissue samples were placed between absorptive paper and placed in one of the sample envelopes, which also contained scales. The envelope was labeled with information about the carcass, as described above, as well as the sample contents: Tissue + Scales.

At least one otolith was collected from each coho carcass with an intact head. A sharp knife was used to section the cranium by making a transverse cut from the dorsal side of the head to roughly above the posterior edge of the preopercular margin revealing the otic capsule. Otoliths were carefully withdrawn using forceps and placed in one of the sample envelopes, which also contained scales. The envelope was labeled with information about the carcass, as described above, as well as the sample contents: Otolith + Scales.

Therefore, there were three sample envelopes assembled for each carcass: one with only scales, a second with tissue and scale samples, and a third with otolith and scale samples. All tissue, scale and otholith samples were submitted to CDFW – Yreka Fisheries Office for distribution to individuals performing further analysis. This included staff of the NOAA Fisheries Service, Southwest Fisheries Science Center, Santa Cruz Laboratory. All coho carcasses were scanned for passive integrated transponder tags before being returned to the stream.

Species, Gender and Origin Identification

Positive identification of coho salmon is a crucial step in the collection of reliable data from the spawning ground surveys. All field technicians who participated in the surveys

this season were experienced at distinguishing between anadromous salmonid species. A number of characteristics were used to identify salmonid species in the field including size, body morphology, markings, coloration, behavior, run timing and geographic location. Suspected coho redds encountered in the absence of spawning fish were distinguished from other species' redds by a combination of the dimensions, gravel size and habitat characteristics.

The sex of carcasses were verified by squeezing the anal opening to check for the release of milt (male) or eggs (female) or by slitting the abdomen to examine the reproductive organs. Prespawn mortality in females was determined by the visual presence of approximately 100 or more eggs.

Hatchery markings are distinct for both species of salmon present in the Klamath River system. Hatchery Chinook lack an adipose fin while hatchery coho have a maxillary clip (Right maxillary clip = Trinity River Hatchery, Left maxillary clip = Iron Gate Hatchery). Any hatchery marked carcasses encountered have the snout removed and submitted to the CDFW - Yreka Fisheries Office for recovery of the coded-wire tag.

RESULTS

Run Abundance and Timing, Flow Conditions and Access

The Scott River Fish Counting Facility (SRFCF) was installed and began operation on September 22nd 2016, however, the valley portion of the Scott River did not connect with the canyon until rains brought up the water level in mid-October. The Scott River at the river mile 21 gage climbed from less than 25 cfs on October 12th to just over 500 cfs on October 17th (USGS 2017, preliminary data). This pulse ensured connectivity through the tailings reach and fish access to valley spawning grounds through the remainder of the run. The main push of Chinook salmon passed through the counting station around this time accompanied by a single coho salmon recorded on October 22nd (Knechtle and Chesney, 2017).

The first notable peak in streamflow occurred on October 31st and reached a maximum of 2,360 cfs (USGS 2017, preliminary data, Figure 1). This event appears to have prompted the coho run into the valley reaches of the Scott River. The SRFCF regularly recorded upstream movement of adult coho from November 2nd through December 7th (Knechtle and Chesney, 2017). Consistent with this timeframe, tributary surveys initiated November 1st (lower French Creek and lower Sugar Creek) did not encounter any coho salmon (Appendix II). The first coho salmon observed by surveyors in the valley reaches occurred on November 10th within Reach 15 of Scott River. It is hypothesized that fish had already entered lower valley tributaries such as Shackleford Creek by this time. From mid-November through early December, streamflow remained relatively stable (Figure 1) and coho spawning was regularly documented from Shackleford Creek to the Scott River tailings.

The migrant weir was dismantled on December 13th in anticipation of high flows. A total of 226 coho had been recorded passing through the SRFCF up until this point (Knechtle and Chesney, 2017). There was relatively little spawning observed after discharge recorded at the river mile 21 gage peaked on December 15th-16th at 6,930 cfs (USGS 2016-2017, preliminary data, Figure 1). Although carcasses continued to be recovered on the tributaries, few new redds were constructed and established redds appeared washed over (flattened pile, siltation between gravels, irregular shape). The last live coho adults that were observed by crews were documented on December 28th; one on French Creek and four on its tributary, Miners Creek (Appendix II).Surveys continued to be completed into the beginning of January until funding constraints were realized but nothing new was found.

Table 2. Summary of Survey Observations by Stream.

STREAM	**REDDS**		**CARCASSES**	
Scott River Mainstem	Number	Percentage	Number	Percentage
Reach 12	0	0%	0	0%
Reach 13	0	0%	0	0%
Reach 14	0	0%	0	0%
Reach 15	8	8%	1	5%
Reach 16	6	6%	0	0%
Tributaries (North to South)				
Shackleford Creek	10	11%	6	27%
Mill Creek	27	28%	3	14%
Kidder Creek	0	0%	0	0%
Patterson Creek	1	1%	0	0%
Etna Creek	0	0%	0	0%
French Creek	21	22%	4	18%
Miners Creek	14	15%	7	32%
Sugar Creek	7	7%	1	5%
Wildcat Creek	0	0%	0	0%
East Fork Scott River	1	1%	0	0%
South Fork Scott River	0	0%	0	0%
Total	**95**	**100%**	**22**	**100%**

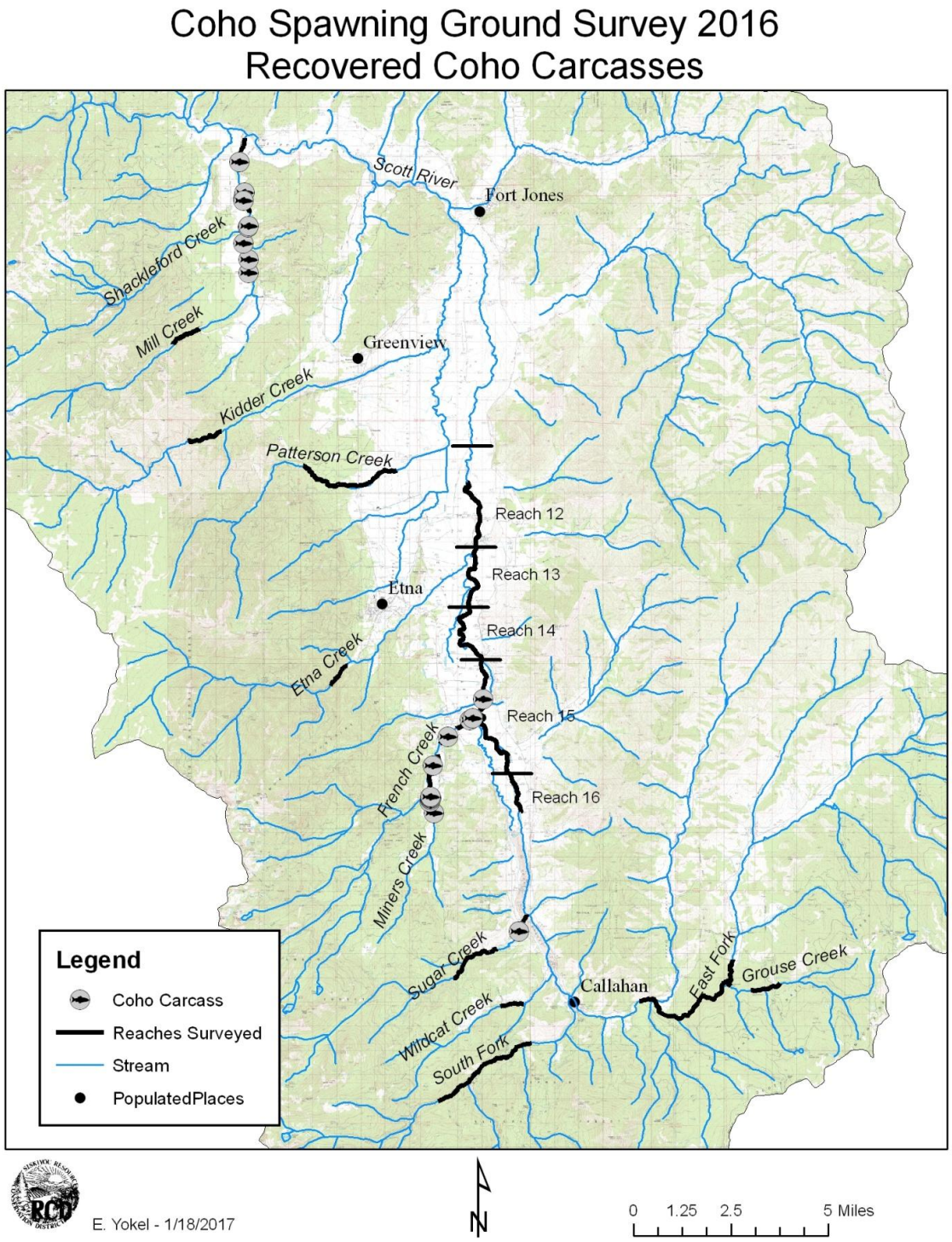
Carcasses

A total of 22 coho carcasses were recovered from November 30th through December 28th 2016 (Table 3 and Appendix II). A single coho carcass was recovered on the Scott River mainstem below the confluence of French Creek; all the rest were recovered on tributaries (Table 3 and Map 2). All of the recovered carcasses had fork lengths that measured between 60 and 69 cm (Table 3), therefore, none of the carcasses were considered to be grilse (single sea winter salmon as opposed to multi sea winter salmon). No evidence of prespawn mortality was identified in any of the seventeen female

carcasses. Scale, tissue and otolith samples were taken from all coho carcasses with the exception of one in which the head had been damaged from predation. All coho carcasses were scanned for passive integrated transponder tags, but none were identified. Following active spawning from mid-November through early December, high flows swept carcasses out of the system resulting in the inability to recover a considerable portion of the fish.

Table 3. Inventory of all recorded coho carcasses.

Date	Stream	Reach	Fork Length (cm)	Sex (M,F,Unk)	Hatchery Clip (Yes/No)	Prespawn Mortality (Yes/No)
11/30/2016	Miners Creek	Lower	61	F	N	N
12/1/2016	Shackleford Creek	Middle	65	F	N	N
12/1/2016	Shackleford Creek	Middle	67	F	N	N
12/1/2016	Shackleford Creek	Middle	69	F	N	N
12/6/2016	Scott River	Reach 15	64	F	N	N
12/7/2016	Miners Creek	Lower	61	F	N	N
12/7/2016	Miners Creek	Lower	63	F	N	N
12/7/2016	Miners Creek	Lower	60	F	N	N
12/7/2016	French Creek	Middle	62	M	N	-
12/8/2016	Mill Creek	Lower	69	F	N	N
12/8/2016	Mill Creek	Lower	65	F	N	N
12/8/2016	Mill Creek	Lower	68	M	N	-
12/8/2016	Shackleford Creek	Middle	68	F	N	N
12/8/2016	Shackleford Creek	Middle	67	F	N	N
12/19/2016	Shackleford Creek	Middle	66	F	N	Unk
12/21/2016	Miners Creek	Lower	67	M	N	-
12/21/2016	French Creek	Middle	68	F	N	N
12/21/2016	French Creek	Lower	61	F	N	N
12/21/2016	French Creek	Lower	63	F	N	N
12/27/2016	Sugar Creek	Middle	Unk	F	N	Unk
12/28/2016	Miners Creek	Lower	65	M	N	-
12/28/2016	Miners Creek	Lower	63	M	N	-

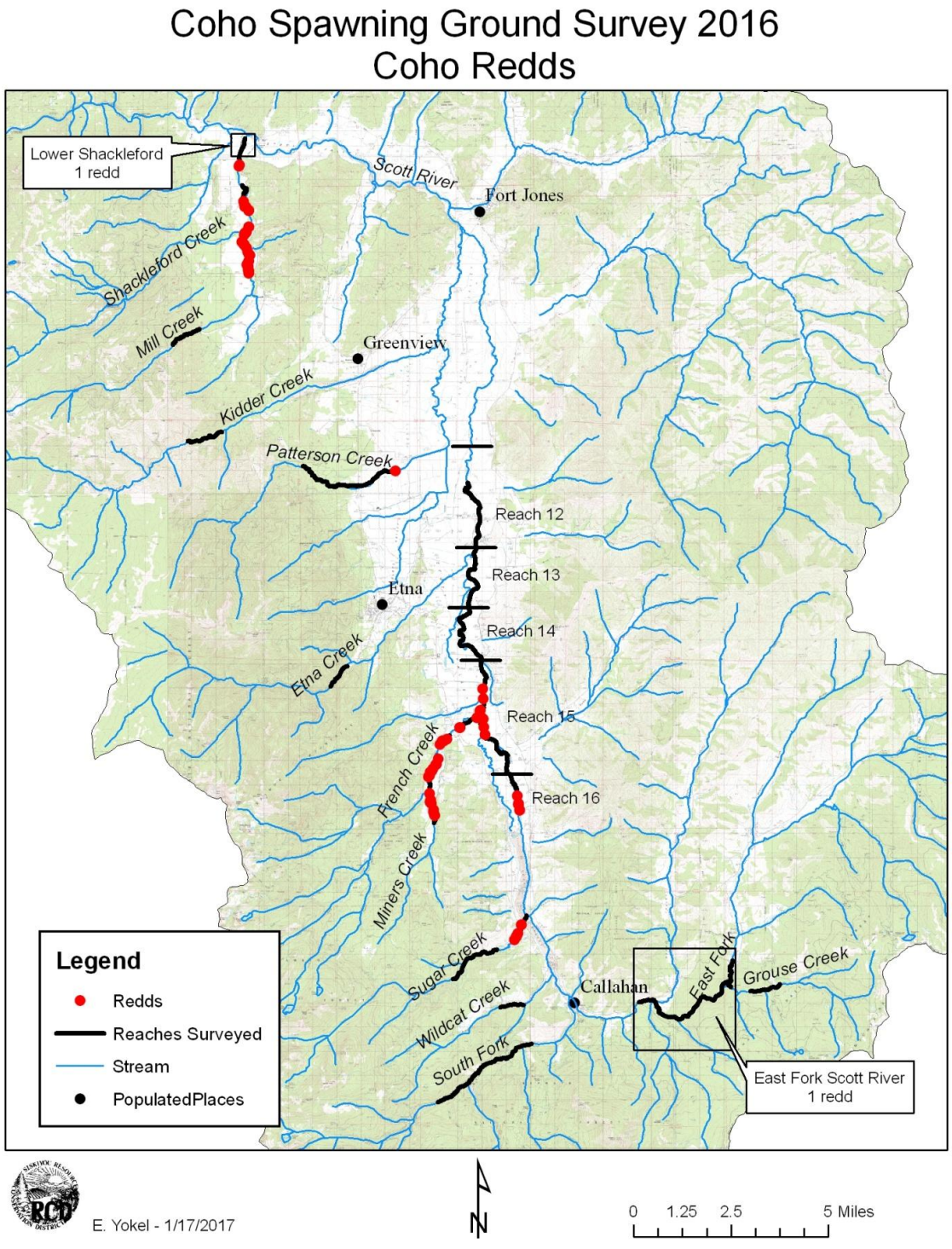


Map 2. Locations of recovered coho carcasses (Siskiyou RCD).

Redds

The first redd verified to be constructed by coho salmon in Scott Valley was documented on November 10th 2016 during routine surveys of the mainstem Scott River (Appendix

II). A brief explanation of the coho spawning observations on the mainstem is presented here followed by each of the tributaries ordered from North to South. Positional information was gathered for 93 of the 95 coho redds, as presented on Map 3.



Map 3. Locations of identified coho redds (Siskiyou RCD).

Mainstem

Over the season, coho spawning was observed on the mainstem of the Scott River surrounding French Creek and from Fay Lane upstream approximately one river mile (Map 3). A total of 14 coho redds were documented in these areas from November 10th through December 6th 2016, after which the river was no longer wadeable. Coho spawning on the mainstem tended to occur along stream margins or side-channels with smaller substrate. Note that Reach 12, 13 and 14 were only surveyed through November 21st and there were not any surveys completed through the historic mining tailings (Reach 16, river mile 53.5 through 59.1) .

Shackleford Creek and its tributary Mill Creek

Shackleford Creek and its main tributary Mill Creek are known to be well utilized by anadromous salmon. Initial surveys conducted on November 18th revealed mixed spawning by both Chinook and coho salmon. Based on the timing of spawning on other tributaries it is likely that adult coho had entered Shackleford Creek a week or two before the first survey was performed. New coho redds were consistently documented on both streams through the first week of December, after which observations diminished. It is unknown if the reduction in observed new redd formation was due to a period of high flows that reduced the survey efficiency. A total of 10 redds were documented on Shackleford Creek and 27 redds on Mill Creek (Table 2). Redds were well dispersed across the available habitat and there were not any identified passage barriers. Although there is substantial beaver activity in Quartz Valley there were no dams encountered on either Shackleford Creek or Mill Creek this season. Redds were observed on Mill Creek at the upstream access boundary of the middle reach (RM 1.3) but no evidence of spawning was found in the upper reach (RM 3.8 – 4.7) (Map 3). No surveys were completed on Shackleford Creek above the confluence with Mill Creek so it is unknown whether adult coho utilized Shackleford Creek above the Mill Creek confluence.

Kidder Creek

Access to Kidder Creek was limited to the upper reach where the stream has a steeper gradient and is confined to a deep bedrock ravine (Map 3). This area of Kidder Creek is characterized by pool and riffle morphology that provides some spawning gravels predominantly located in pool tail-out habitats. Despite scheduling efforts, only a single survey was completed in this reach and there was no evidence of spawning. Outreach in recent years to acquire landowner permission for surveys just downstream where the stream transitions into a wider low-gradient channel with a cobble streambed has not resulted in sequential access.

Patterson Creek

With the exception of a 1.5 mile section in lower Patterson Creek near Eller Lane, surveys covered the majority of available spawning habitat on Patterson Creek (Map 3). Crews monitored an area of disturbed gravel identified on November 29th at the lower boundary of the surveyed reach which developed over the season to the extent that it was eventually documented as a coho redd (Map 3). There were no adult fish or carcasses encountered on the tributary to corroborate this finding. It is possible that coho utilized habitat within the unsurveyed section and the redd at river mile 1.5 was the upper extent

of spawning on the tributary. Summer juvenile surveys could be used to confirm utilization by the species.

Etna Creek

Surveys on Etna Creek were limited to private timberland within the middle reach below the Etna City Diversion (Map 3). This section of stream has a moderate gradient and is characterized by long riffle habitats with boulders and large cobble substrate. With limited pockets of suitable-sized gravel observed in the stream margin, there was not a substantial effort made to survey this section of Etna Creek. The reach was surveyed twice during the season with no observed evidence of spawning. The number of private landholdings of Etna Creek through the City of Etna makes access to the downstream portion of this reach infeasible.

French Creek and its tributary Miners Creek

The earliest tributary surveys of the season were conducted on French Creek because of the potential for Chinook salmon to be there as well. Surveys through the lower reaches of the stream in early November found few observations of Chinook activity. However, immediately after the first pair of coho salmon were identified on the adjacent section of the Scott River, redd formation was observed through French Creek and its lowest perennial tributary, Miners Creek. New redds were consistently documented on weekly surveys through the first week of December, after which high flows diminished observations. There was no longer spawning observed on French Creek after this period of high flow but activity continued on Miners Creek through the end of December. A total of 21 redds were documented on French Creek and 14 redds on Miners Creek (Table 2). There are several established beaver dams within the first river mile of French Creek, however none appeared to have impacted passage because all of the redds were documented above the lower dam and 18 of the 21 redds on French Creek were above the upper dam (Map 3). Likewise, a debris jam on Miners Creek did not prevent fish from accessing upstream habitats. Unfortunately, due to funding constraints surveys were not conducted on French Creek above the confluence with Miners Creek so it is unknown whether adult coho utilized French Creek to the North Fork and beyond. Live coho salmon were found near the upstream boundary of the Miners Creek survey reach so the extent of spawning could not be defined there either.

Sugar Creek

Although surveys on Sugar Creek were initiated in early November, evidence of spawning was not found until December 2nd when a redd was identified upstream of the massive debris jam associated with a beaver dam and pond at river mile 0.5. The documentation of spawning past this potential barrier suppressed fish passage concerns. Subsequent surveys recorded the construction of additional redds through the end of December. A total of 7 redds were documented on Sugar Creek during the run and they were found directly above the BDA ponds in lower Sugar Creek and above the debris jam beaver dam complex (Table 2, Map 3). Several surveys were conducted through the upper reach (above the CDWR stream gaging station) but there was no evidence that

spawners had migrated up that far. It seems likely that additional spawning occurred in the unsurveyed sections of the low-gradient middle reach.

Wildcat Creek
A landowner on Wildcat Creek offered to investigate the stream for potential spawning habitat through their property. They reported that a walk through on December 9th did not identify any suitable spawning gravels or evidence of salmon in the tributary.

South Fork of the Scott River
A single survey was completed on the South Fork of the Scott River before access had to be withdrawn due to a transfer in property ownership. By December 8th there had been no evidence of coho salmon having entered the middle reach (above river mile 2.3) and it is unknown whether adults migrated that far during the season. Based on the observed timing of spawning on Sugar Creek, it is possible that access was lost before coho reached this end of the watershed. The number of small private landholdings through Callahan makes access to the downstream portion of this reach infeasible.

East Fork of the Scott River
The East Fork is one of the largest drainages that enters the Scott River and is known to have high volume flow events; therefore, it is important to carefully time winter surveys in order to catch the stream under wadeable conditions with good visibility. The first survey that was organized on the East Fork occurred on December 13th and covered a relatively long length of stream from above the confluence with Grouse Creek to below the confluence of Noyes Valley Creek. A single unoccupied coho redd was found in this reach but positional information was not collected per landowner request. The mouth of Grouse Creek, tributary to the East Fork, was verified to be passable so it was also surveyed but appropriately sized spawning gravel was limited and there was no sign of utilization. A second follow-up survey was scheduled for early January, however, funding constraints concluded the field season before it could be completed. It is possible that additional spawning on the East Fork went undocumented through the latter part of the run.

DISCUSSION AND CONCLUSIONS

Since the coho spawning ground surveys were initiated in the Scott River watershed over the winter of 2001-02, the documented population trends have indicated varying strength of the three cohorts of coho salmon in the Scott River. Between the three cohort cycles, there existed one stronger and two weaker generations. The stronger cohort was roughly an order of magnitude larger than the two smaller cohorts (Table 1). The 2016-17 generation discussed in this report belongs to this stronger cohort which had an estimated escapement of 2,752 fish during the winter of 2013-14. However, severe drought created flow conditions during the 2013 escapement that limited access to tributary spawning grounds and confined the redd distribution to the mainstem Scott River, which had been previously unseen (Yokel 2014). Persistent drought conditions prompted a large-scale rescue and relocation of juvenile coho salmon into tributary habitats over the summer of

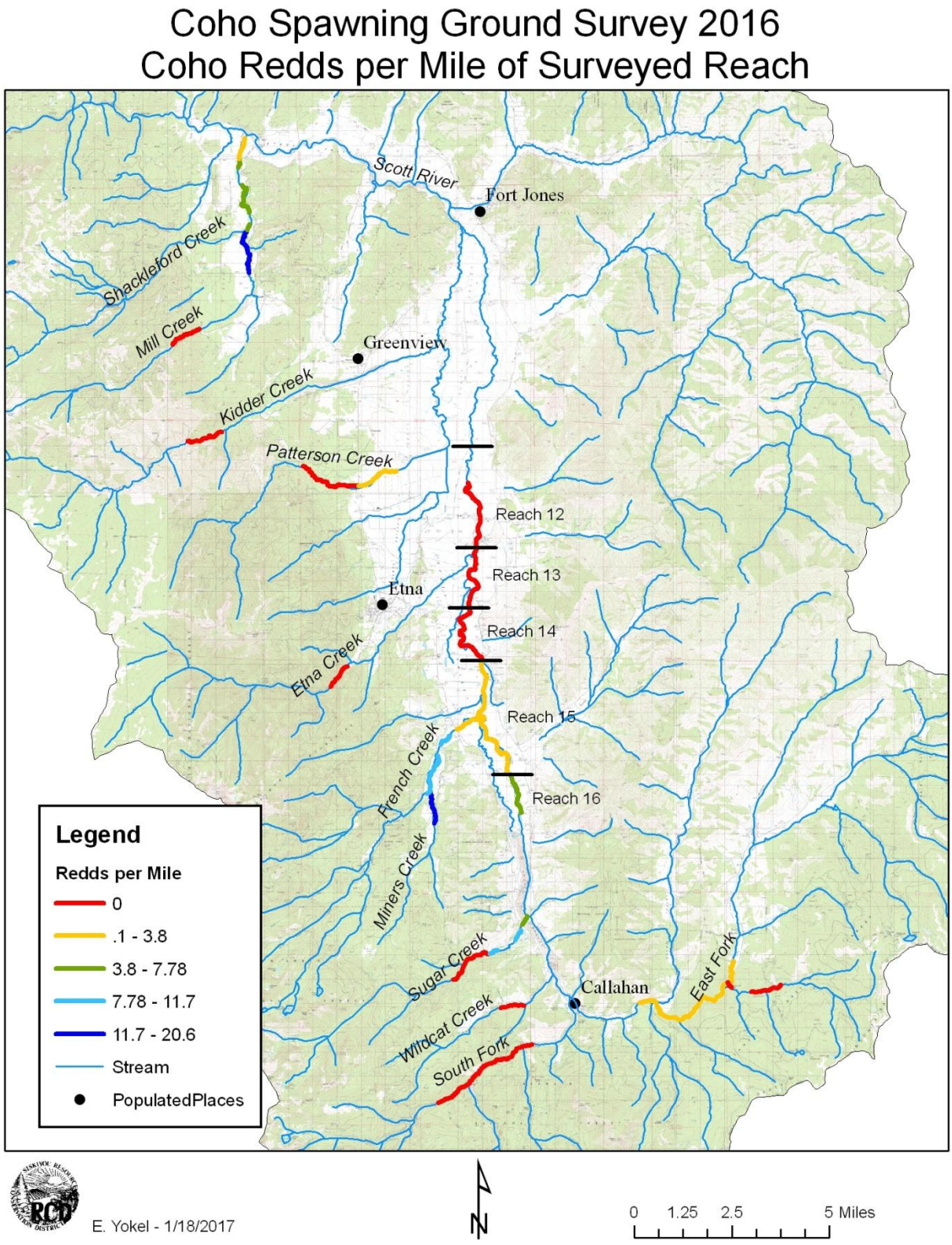
2014 (CDFW et. al. 2015). As such, there has been widespread interest in the survival and spawning distribution of this generation.

Unfortunately data collection on returning adults during the winter of 2016-17 was met with substantial challenges. The SRFCF video flume had to be periodically replaced with sonar equipment until December 13th when the weir was removed altogether. Furthermore, spawning ground surveys had to be postponed on several occasions due to unwadeable conditions. As a result the totals presented in Table 1 should be understood as minimum values. However, despite these limitations, neither the adult escapement or the redd count were even close to being an order of magnitude larger than the two weaker cohorts. It seems that the variation in brood year strength may have been leveled by the combination of drought and unfavorable ocean conditions.

The spatial spawning distribution documented in the Scott River Valley was relatively consistent with previous years. Because the observation of redds is affected by a number of factors (e.g. permission for access to private property, the survey effort staffing/scheduling, and environmental conditions) relative redd densities are calculated in order to make the data more comparable. Redd densities (redds per mile surveyed) were classified for presentation as shown in Map 4. Comparison of the 2016-17 run with the two previous runs indicate that maximum redd densities are similar between the brood years and reiterates that the most utilized tributaries are the Shackleford-Mill and French-Miners systems (Table 4).

Field technicians noticed an interesting temporal spawning distribution during the 2016-17 run. There appeared to be an upstream progression in spawning through the watershed. This was really only discernible between tributaries that were surveyed on consistent weekly intervals. For instance, spawning within the Shackleford-Mill system began sometime over the first two weeks of November and concluded by the first week of December. Redd formation was not observed on Sugar Creek until the beginning of December. Unfortunately, due to funding constraints the Siskiyou RCD had to conclude the field season prematurely; additional surveys planned for reaches in the southern portion of the watershed would potentially better define this presumed succession in spawning.

Finally, as previously mentioned, the upper extent of coho spawning was difficult to pinpoint during the 2016-17 run because of fragmented survey access from landowners. On all tributaries where spawning was documented evidence of coho salmon was found within a quarter of a mile of the access boundary but no evidence of spawning was found at the next point of access (if there was one). It is likely that somewhere within the unsurveyed section there was spawning but without permission the upper extent cannot be explicitly defined. Coho were not found upstream of historical spawning grounds over the season.



Map 4 – Coho redds per surveyed mile by reach – 2016-2017

Stream	Reach	2014-15 redds per mile	2015-16 redds per mile	2016-17 redds per mile
Shackleford Creek	Lower	6.7	0.0	1.8
Shackleford Creek	Middle	21.3	5.4	6.3
Mill Creek	Lower	22.9	31.4	20.6
Mill Creek	Upper	0.0	NS	0.0
Kidder Creek	Upper	0.0	0.0	0.0
Patterson Creek	Middle	0.0	0.0	0.9
Patterson Creek	Upper	0.0	0.0	0.0
Patterson Creek	Lower	0.0	NS	NS
Etna Creek	Middle	0.0	0.0	0.0
French Creek	Lower	5.0	0.0	3.8
French Creek	Middle	8.0	2.7	11.7
French Creek	Upper	0.0	0.0	NS
Miners Creek	Lower	NS	2.2	15.8
Sugar Creek	Lower	0.0	10.0	7.8
Sugar Creek	Middle	1.7	0.0	9.4
Sugar Creek	Upper	0.0	0.0	0.0
Wildcat Creek	Middle	NS	NS	0.0
South Fork Scott River	Middle	0.0	0.0	0.0
East Fork Scott River	Middle	0.0	NS	0.3
East Fork Scott River	Upper	0.0	NS	NS
Scott River Mainstem	Index Reach 12	0.0	NS	0.0
Scott River Mainstem	Index Reach 13	0.0	0.0	0.0
Scott River Mainstem	Index Reach 14	1.9	NS	0.0
Scott River Mainstem	Index Reach 15	1.9	NS	2.2
Scott River Mainstem	Index Reach 16	1.9	NS	4.8

Table 4 - Redd density (redds per mile) in surveyed reaches over the last 3 runs

Recommendations

The author recommends the following items for future survey seasons:

- Initiate surveys of Shackleford and Mill Creek earlier in the season because spawners likely enter this system before tributaries in the central and southern portion of the valley. This is especially valuable in years where there is overlapping runs because it allows for redds to be more easily differentiated by species.
- Determine whether identifying the upper extent of spawning is a realistic objective. Efforts to define this boundary have been inconclusive the last couple of years due to fragmented survey access.
- Work to maintain positive relationships with landowners and expand access for surveys. Areas of interest might include middle Kidder Creek, middle Patterson

Creek, lower Etna Creek, middle Sugar Creek, middle South Fork and above the confluence of Grouse Creek in the East Fork Scott River.

REFERENCES

California Department of Fish and Wildlife (CDFW) et al. 2015. Cooperative Report of the Scott River Coho Salmon Rescue and Relocation Effort: 2014 Drought Emergency. Siskiyou RCD, Etna CA. https://www.siskiyourcd.com/resources

California Department of Forestry and Fire Protection (CAL FIRE) 2016. Incremental Precipitation Quartz Hill Station (QTZ). California Data Exchange Center. http://cdec.water.ca.gov/cgi-progs/stationInfo?station_id=QTZ

California Department of Water Resources (CDWR) 2015. 2014-2015 Water Year Monthly Precipitation, Fort Jones RS (FJN) and Callahan (CAL) stations. California Data Exchange Center. http://cdec.water.ca.gov/cgi-progs/reports/PRECIPOUT

Jetter , C and Chesney, B. 2016. Shasta and Scott River Juvenile Salmonid Outmigrant Study, 2016. Final Report. California Department of Fish and Wildlife - Yreka, CA.

Knechtle, M. and Chesney, D. 2017. 2016 Scott River Salmon Studies. Final Report, Klamath River Project. CDFW Yreka Fisheries Office. Yreka, CA.

Knechtle. M. 2016. Scott River Fish Counting Facility (River Mile 18): 2016 Operations. Unpublished Excel data. Klamath River Project. CDFW Yreka Fisheries Office. Yreka, CA.

Magranet. 2015. Scott River Adult Coho Spawning Ground Surveys 2014-2015 Season. Final Report. Siskiyou RCD - Etna, CA.

Maurer, S. 2002. Scott River Watershed Adult Coho Salmon Spawning Survey: December 2001 - January 2002. Prepared for the Klamath National Forest, Fort Jones, CA.

United States Bureau of Reclamation (USBR) 2016-2017. Incremental Precipitation Scott Mountain Station (SCT). California Data Exchange Center. http://cdec.water.ca.gov/cgi-progs/stationInfo?station_id=SCT

United States Geological Survey (USGS). 2017. Stream Discharge Scott River RM 21 Gage # 11519500, provisional data. http://waterdata.usgs.gov/ca/nwis/uv/?site_no=11519500

Yokel, D. 2014. Scott River Adult Coho Spawning Ground Surveys 2013-2014 Season. Final Report. Siskiyou RCD Etna, CA.

APPENDIX I. Length of Stream Reaches Surveyed

STREAM	REACH	REACH DESCRIPTION	BEGINNING MILE (UPSTREAM)	END MILE (DOWNSTREAM)	TOTAL LENGTH	LENGTH SURVEYED 2016-2017
East Fork Scott River	Lower	East Highway 3 Bridge to mouth	2.3	0	2.3	NS
	Middle	China Cove to East Highway 3 Bridge	4.6	2.3	2.3	2.3
	Middle	Lower Masterson to China Cove	6.2	4.6	1.6	1.6
	Middle	Upper Masterson to Lower Masterson	7.2	6.2	1	NS
	Upper	Rail Creek Rd Bridge to Upper Masterson	12	7.2	4.8	NS
Grouse Creek		From mouth to ford	1.7	0	1.7	1
Kangaroo Creek	Lower	From mouth to KNF	1.4	0	1.4	NS
	Upper	KNF	2.2	1.4	0.8	NS
Etna Creek	Lower	Highway 3 to mouth	2.2	0	2.2	NS
	Middle	Etna City Diversion to Grease Flats	5.5	4.8	0.7	0.7
	Upper	From Mill Creek to Alder Creek	8	6	2	NS
French Creek	Lower	HWY 3 to mouth	0.8	0	0.8	0.8
	Middle	Confluence w/Miners to HWY 3	2.8	0.8	2	1.5
	North Fork Area	North Fork to Miners Creek	3.9	2.8	1.1	NS
	Paynes Creek Area	Above and below mouth of Paynes Creek	6	5.5	0.5	NS
	Duck Lake Area	Above and below mouth of Duck Lake	7.3	6.8	0.5	NS
Miners Creek		From mouth upstream	2	0	2	0.9
Paynes Creek		From mouth upstream	0.2	0	0.2	NS
North Fork French Creek		From mouth upstream	0.7	0	0.7	NS

APPENDIX I. Length of Stream Reaches Surveyed

Kidder Creek	Lower	Below Hwy 3 bridge	6	0	6	NS
	Middle	Above Hwy 3 bridge	10.3	6	4.3	NS
	Upper	Timbervest Property	11.7	10.3	1.4	1
Patterson Creek	Lower	Johnson Creek to mouth	4.6	0	4.6	NS
	Middle	Highway 3 to Johnson Creek	7.3	4.6	2.7	1.2
	Upper	Upper Youngs Diversion to Highway 3	9.1	7.3	1.8	1.8
Scott River Mainstem	Reach 9	Dunlop to Meamber Bridge	29.5	24.4	5.1	NS
	Reach 10	Highway 3 to Dunlop	35.6	29.5	6.1	NS
	Reach 11	Eller Lane to Highway 3	41.1	35.6	5.5	NS
Scott River Mainstem	Reach 12	Etna Creek to Eller Lane	44.7	41.1	3.6	2.1
	Reach 13	Horn Lane to Etna Creek	46.5	44.7	1.8	1.8
	Reach 14	SVID to Horn Lane	48.6	46.5	2.1	2.1
	Reach 15	Fay Lane to SVID	52.2	48.6	3.6	3.6
	Reach 16	Fay Lane to Callahan	59.1	52.2	6.9	1.2
Shackleford Creek	Lower	From North Quartz Valley Rd bridge to mouth	0.8	0	0.8	0.6
	Middle	From confluence with Mill Creek to North Quartz Valley Rd.bridge	3.1	0.8	2.3	1.4
	Upper	From the falls to the confluence with Mill Creek	5.2	3.1	2.1	NS
Mill Creek	Lower	From the South Quartz Valley Rd. bridge to confluence with Shackleford Cr.	1.4	0	1.4	1.4
	Middle	From the South Quartz Valley Rd to ditch crossing	3.3	1.4	1.9	NS
	Upper	0.5 mile above and below Mill Creek Rd crossing	4.3	3.3	1	0.9

APPENDIX I. Length of Stream Reaches Surveyed

South Fork Scott River	Lower	mouth to Boulder Creek	2.3	0	2.3	NS
	Middle	40N21Y Bridge to Boulder Creek	5	2.3	2.7	3
	Upper	Camp Gulch to 40N21Y Bridge	6.1	5	1.1	NS
Boulder Creek		From mouth upstream	0.2	0	0.2	NS
Fox Creek		From mouth upstream	0.1	0	0.1	NS
Sugar Creek	Lower	From Hwy 3 to Mouth	0.3	0	0.3	0.3
	Middle	From cattle guard to HWY 3	1.6	0.3	1.3	0.5
	Upper	From road crossing on Rd # 40N23 to cattle guard	3.7	1.6	2.1	1.3
Wildcat		Mouth up 2 mile	2	0	2	0.6
				TOTAL	**105.7**	**33.6**

APPENDIX II. List of Coho Surveys Completed

Date	Stream	Reach	Lives	Redds	Carcasses
11/1/2016	French Creek	Middle	0	0	0
11/1/2016	French Creek	Lower	0	0	0
11/1/2016	Sugar Creek	Lower	0	0	0
11/10/2016	Scott River	Index Reach 15	2	1	0
11/11/2016	French Creek	Middle	2	1	0
11/11/2016	French Creek	Lower	1	0	0
11/11/2016	Sugar Creek	Middle	0	0	0
11/11/2016	Sugar Creek	Lower	0	0	0
11/16/2016	Miners Creek	Lower	1	0	0
11/16/2016	French Creek	Middle	2	2	0
11/16/2016	French Creek	Lower	3	1	0
11/17/2016	Sugar Creek	Middle	0	0	0
11/18/2016	Mill Creek	Lower	0	3	0
11/18/2016	Shackleford Creek	Middle	0	4	0
11/18/2016	Shackleford Creek	Lower	0	1	0
11/21/2016	Scott River	Index Reach 12	0	0	0
11/21/2016	Scott River	Index Reach 13	0	0	0
11/21/2016	Scott River	Index Reach 14	0	0	0
11/21/2016	Scott River	Index Reach 15	0	0	0
11/22/2016	Scott River	Index Reach 16 (rkm 80-82)	0	3	0
11/22/2016	Sugar Creek	Lower	0	0	0
11/22/2016	Sugar Creek	Middle	0	0	0
11/23/2016	Miners Creek	Lower	4	4	0
11/23/2016	French Creek	Middle	0	3	0
11/23/2016	French Creek	Lower	1	0	0
11/29/2016	Patterson Creek	Upper	0	0	0
11/29/2016	Patterson Creek	Middle	0	0	0
11/30/2016	Miners Creek	Lower	3	4	1
11/30/2016	French Creek	Middle	4	6	0
11/30/2016	French Creek	Lower	2	1	0
12/1/2016	Mill Creek	Lower	6	17	0
12/1/2016	Shackleford Creek	Middle	3	5	3
12/1/2016	Shackleford Creek	Lower	0	0	0
12/2/2016	Patterson Creek	Middle	0	0	0
12/2/2016	Etna Creek	Middle	0	0	0
12/2/2016	Sugar Creek	Middle	0	1	0
12/5/2016	Scott River	Index Reach 16 (rkm 80-82)	0	3	0
12/5/2016	Scott River	Index Reach 15	3	5	0
12/6/2016	Scott River	Index Reach 15	0	2	1
12/6/2016	Mill Creek	Upper	0	0	0
12/6/2016	Sugar Creek	Upper	0	0	0
12/6/2016	Sugar Creek	Middle	0	0	0
12/6/2016	Sugar Creek	Lower	0	0	0
12/7/2016	Miners Creek	Lower	4	3	3
12/7/2016	French Creek	Middle	0	6	1
12/7/2016	French Creek	Lower	0	1	0

APPENDIX II. List of Coho Surveys Completed

12/8/2016	South Fork Scott River	Middle	0	0	0
12/8/2016	Mill Creek	Lower	1	7	3
12/8/2016	Shackleford Creek	Middle	1	0	2
12/9/2016	Patterson Creek	Upper	0	0	0
12/9/2016	Patterson Creek	Middle	0	0	0
12/9/2016	Wildcat Creek	Middle	0	0	0
12/12/2016	Shackleford Creek	Lower	0	0	0
12/12/2016	Kidder Creek	Upper	0	0	0
12/13/2016	Sugar Creek	Upper	0	0	0
12/13/2016	Sugar Creek	Middle	0	2	0
12/13/2016	Sugar Creek	Lower	10	2	0
12/13/2016	East Fork Scott River	Middle	0	1	0
12/13/2016	Grouse Creek	Middle	0	0	0
12/13/2016	Grouse Creek	Lower	0	0	0
12/14/2016	Miners Creek	Lower	1	0	0
12/19/2016	Mill Creek	Lower	0	0	0
12/19/2016	Shackleford Creek	Middle	0	0	1
12/19/2016	Shackleford Creek	Lower	0	0	0
12/20/2016	Sugar Creek	Middle	0	1	0
12/20/2016	Sugar Creek	Lower	7	0	0
12/20/2016	Patterson Creek	Middle	0	0	0
12/21/2016	Miners Creek	Lower	9	2	1
12/21/2016	French Creek	Middle	0	0	1
12/21/2016	French Creek	Lower	1	0	2
12/22/2016	Mill Creek	Upper	0	0	0
12/22/2016	Sugar Creek	Upper	0	0	0
12/26/2016	Mill Creek	Lower	1	0	0
12/26/2016	Shackleford Creek	Middle	0	0	0
12/26/2016	Shackleford Creek	Lower	0	0	0
12/27/2016	Patterson Creek	Upper	0	0	0
12/27/2016	Patterson Creek	Middle	0	0	0
12/27/2016	Sugar Creek	Middle	0	1	1
12/27/2016	Sugar Creek	Lower	0	0	0
12/27/2016	Etna Creek	Middle	0	0	0
12/28/2016	Miners Creek	Lower	4	1	2
12/28/2016	French Creek	Middle	1	0	0
12/28/2016	French Creek	Lower	0	0	0
1/3/2017	Sugar Creek	Middle	0	0	0
1/3/2017	Sugar Creek	Lower	0	0	0
1/3/2017	Patterson Creek	Middle	0	1	0
		Total	**77**	**95**	**22**