Scott River Coho Salmon Spawning Ground Surveys

2019-2020 Season

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Siskiyou Resource Conservation District

United States Fish and Wildlife Service – Fisheries Program

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ABSTRACT

The Scott River Fish Counting Facility operated by the California Department of Fish and Wildlife located at river mile 18.2 recorded 346 live adult coho migrating upstream into Scott Valley from October 23rd, 2019 to January 4th, 2020 (Knechtle and Giudice, 2020). Below average precipitation through the fall kept the Scott River running through the valley around 50 cfs for most of October and November. It wasn't until the first week of December that sufficient rainfall fully connected the Scott River through the mine tailings and coho salmon gained access to most spawning grounds for the remainder of the run (although a few tributaries experienced intermittent connectivity). Spawning ground surveys were conducted by the Siskiyou Resource Conservation District from December 10th, 2019 to January 24th, 2020 to determine the distribution of coho salmon spawning in the watershed and inform related management decisions over the following year. A total of 23.7 river miles were surveyed (3.9 river miles on the mainstem and 19.8 river miles on tributaries). Surveys were conducted sequentially, 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 79 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, French Creek and its tributary Miners Creek, the and the East Fork of the Scott River. A total of 12 coho carcasses were recovered, sexed, measured and sampled.

ACKNOWLEDGEMENTS

The following entities cooperated in the Scott River survey effort:

California Department of Fish and Wildlife
Scott River Watershed Council
Quartz Valley Indian Tribe
National Marine Fisheries Service

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Siskiyou RCD staff that participated in the 2019-20 field surveys:

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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 as threatened 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 threatened 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 recovery 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 Coho Salmon 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 2019-2020 effort marks the nineteenth consecutive year of data collection (although there was limited data collection during 2017-18 and 2018-19 runs).

Specific project objectives:

1. Conduct cooperative coho salmon spawning ground surveys on the Scott River and tributaries during the 2019-2020 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 local non-governmental organizations and community members of potential locations were juvenile coho may be rearing for the purpose of informed management over the following summer.

Study Location and Run Timing

The 2019-2020 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 Scott River watershed began swelling out of baseflow conditions in the fall of 2019 as the result of periodic light rain events and seasonably cool temperatures. In September, flow on the Scott River increased from about 10 cubic feet per second (cfs) to 50 cfs (as measured by the U.S. Geological Service (USGS) streamflow gaging station at river mile 21 (*Figure 1*) (USGS, 2019)). Discharge remained around 50 cfs for most of October and November due to below average precipitation; weather stations in Callahan and Fort Jones both recorded less than 1 inch of precipitation in the form of rain during those months (Western Regional Climate Center, 2019 and California Department of Water Resources, 2019) (*Figure 1*). Regardless, the mainstem Scott River was fully connected except for a brief section through the historic mine tailings in the upper portion of the watershed (around river mile 55.0). This area usually requires flow greater than 100 cfs for fish passage.

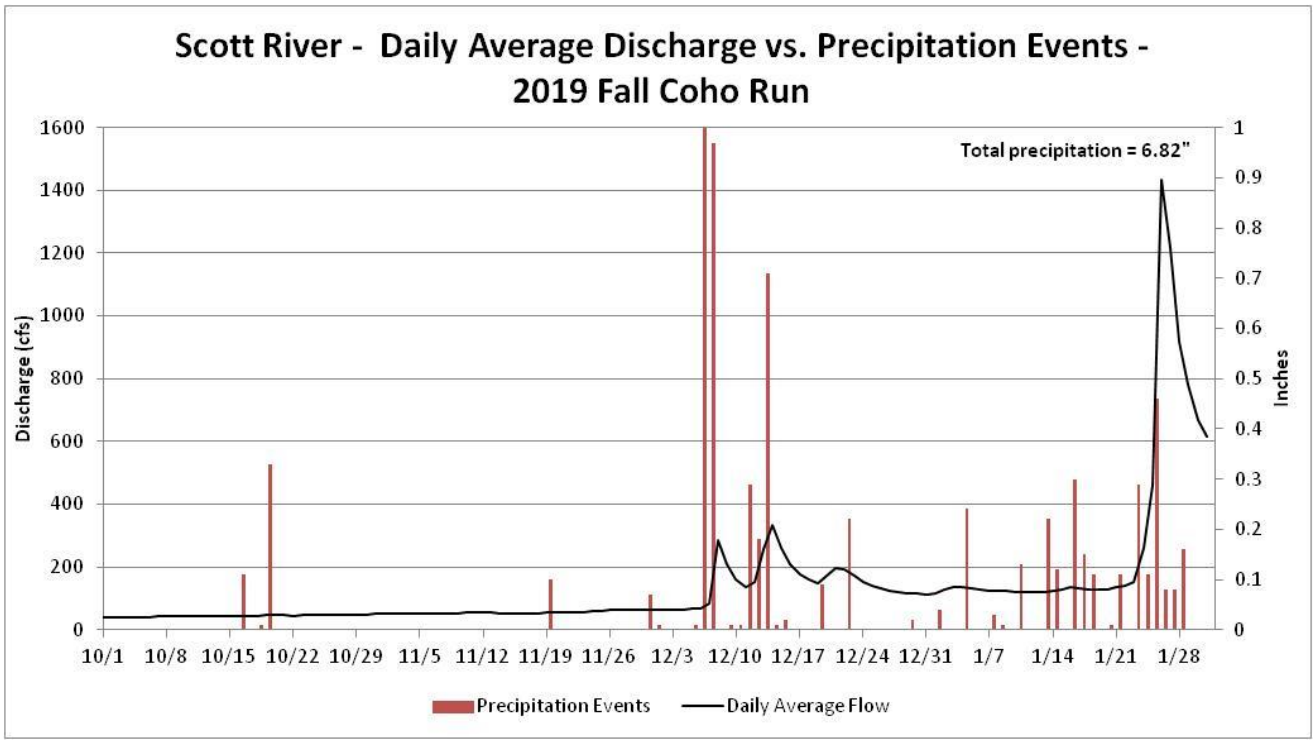


Figure 1: Scott River daily average discharge and.daily accumulated precipitation – USGS Streamflow Gage RM 21 (USGS 2019, provisional data) and Callahan RAWS (Western Regional Climate Center, 2019)

The first notable rain event of the water year accumulated approximately 2 inches of precipitation from December 6-7th, 2019 (Western Regional Climate Center, 2019) (*Figure 1*). According to the USGS gaging station, flow on the Scott River increased from 66 to 152 cfs on December 7th, peaked at over 300 cfs on December 8th and remained over 100 cfs throughout the remainder of the coho spawning season (USGS, 2019) (*Figure 1*). The Siskiyou RCD visually checked connectivity at river-mile 55.0 on December 9th, 2019, and a spawning survey was conducted through Reach 16 on December 11th, 2019, confirming fish passage. Coho salmon gained access to most spawning grounds at this time, although the tailings later experienced intermittent connectivity. The main spawning grounds encompassed by Shackleford Creek, French Creek and their tributaries remained accessible to coho salmon over the reminder of the run (through January). In general, mild weather in December and January provided good conditions for the surveys with no visibility or accessibility limitations due to adverse weather or high flows.

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 ensuring 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, had indicated 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 (by return year) 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 645 adults (*Table 1*, Knechtle and Giudice, 2020). The brood year discussed in this report was made up of the progeny of a return estimated at 226 adult fish in 2016, which were the offspring of the last large cohort that was severely impacted by the 2013-14 drought conditions. Utilizing escapement estimates and average percent yearling survival (from brood years 2004-2008 and 2010-2012), CDFW predicted a return of approximately 698 adults in 2019 (Knechtle, 2020. pers.com.).

Table 1. Scott River Watershed coho salmon redds and total estimated escapement across all Brood Years (Magranet 2017, Knechtle and Giudice, 2020).

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]
2017	ND	382
2018	ND	739
2019	79	346
Average	**142**	**645**

*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 (Maurer, 2002). 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

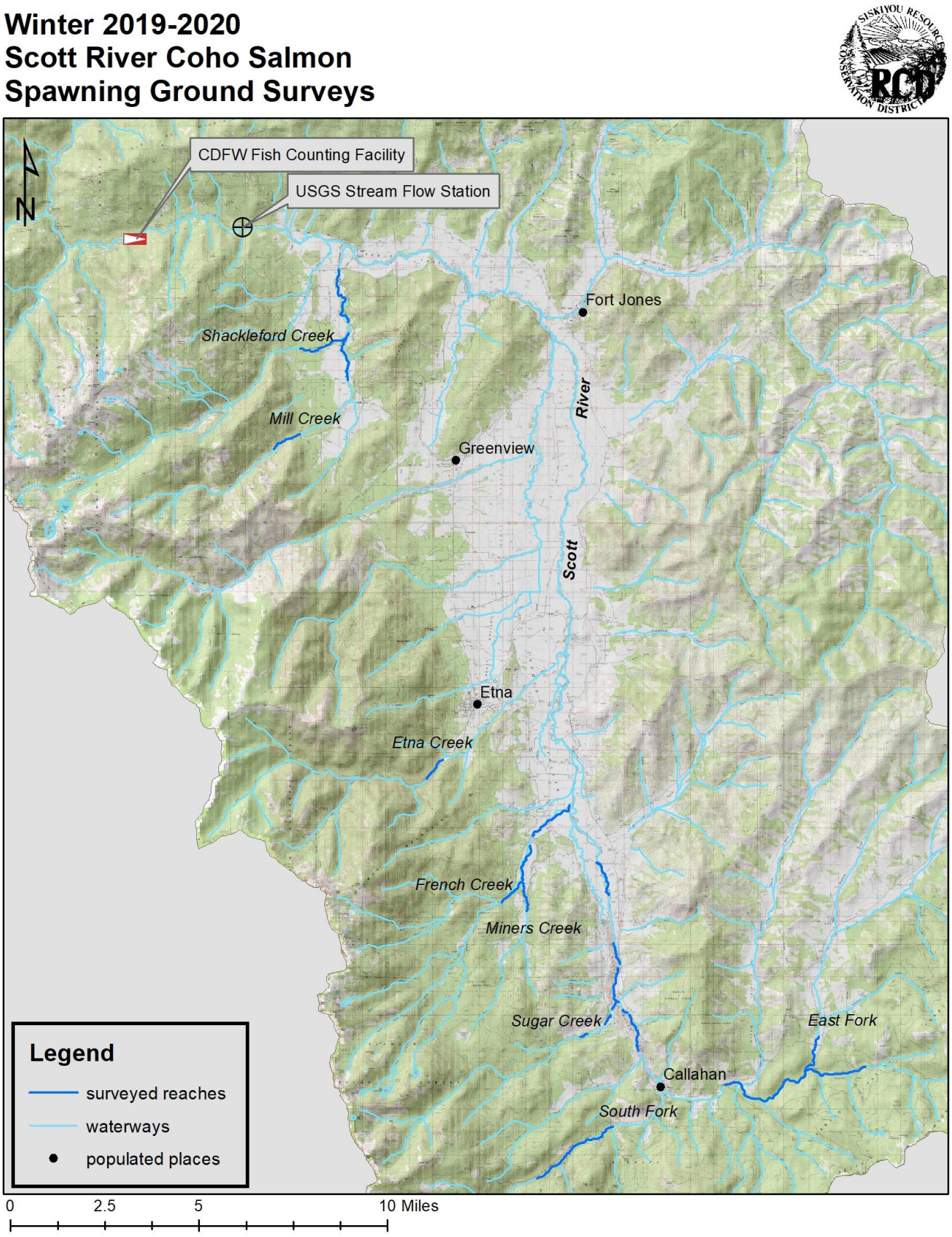
Coho spawning ground surveys were completed on 3.9 miles of the Scott River mainstem and 19.8 miles of tributaries (*Appendix I. Length of Stream Reaches Surveyed*). Tributaries surveyed (from North to South) included: Shackleford & Mill Creek, Etna Creek, French & Miners Creek, Sugar Creek, the East Fork & Grouse Creek and South Fork (*Map 1*).

Crew Training

Crew training was organized by CDFW and the Siskiyou RCD. The Scott River Annual Spawning ground Survey Training was held on December 5th, 2019 at the Siskiyou RCD office in Etna. Training items that were covered included fish species identification, sampling techniques, redd identification, GPS protocol and completing data sheets. All Siskiyou RCD crew members participated in the training offered this year or had been to one in past years. All new field technicians were accompanied by experienced surveyors.

Survey Timing

The Scott River remained fully connected through the fall of 2019 except for a brief section through the historic mine tailings in the upper portion of the watershed (around river mile 55.0). Chinook surveys began on the mainstem on October 16th, 2019 and expanded into the tributaries on November 15th. These surveys are also utilized to scout for early coho in the system. The first observation of adult coho by the SRFCF occurred on October 23rd but the next coho didn't pass through until November 15th. No evidence of coho salmon was found in the valley until after significant precipitation on December 7-8th brought up streamflow and connected most the mainstem to most tributary spawning grounds. The first live coho sighting in the valley reaches of the system was made on December 10th in the middle reach of French Creek. Coho specific surveys were conducted weekly through the remainder of the year. Observations of live fish diminished the over the first couple weeks in 2020, although surveys were carried out for another couple weeks to recover carcasses until concluding the season on January 24th.



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

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 NAD 83 datum and recorded on data sheets in decimal degrees.

Example: SU 112019 L R07 = Sugar Creek, November 20th 2019, Lower Reach, Redd Site #7

Boulder Cr. (South Fork)	BO
Boulder Cr.(Scott)	BS
Canyon Cr.	CA
Clark Cr.	CL
East Fork Scott	EF
Emigrant Creek	EM
Etna Cr.	ET
French Cr.	FR
Grouse Creek	GR
Horse Range Cr.	HR
Indian Creek	IN
Johnson Creek	JO
Kangaroo Cr.	KA
Kelsey Channel	KC
Kelsey Creek	KE
Kidder Creek	KI
McAdams Cr.	MC
Meamber Gulch	ME
Middle Creek	MI
Mill Cr. (Scott Bar)	SB
Mill Creek	ML
Miners Cr.	MI
Moffet Creek	MO
North Fork French	NF
Patterson Creek (Scott)	PS
Patterson Creek(Etna)	PA
Rattlesnake Cr.	RA
Ruffy Gap Trib	RU
Shackleford	SH
Shackleford-Mill	SM
South Fork Scott	SF
Sugar Creek	SU
Thompkins Creek	TO
Wildcat Cr.	WI
Wooliver	WO
Scott River Tailings	TA
Scott River Mainstem Index Reach	S## (Example – S08 = Scott Reach 8)

Sample Collection

A Federal Endangered Species Act Section 4(d) collection permit from the National Marine Fisheries Service (NMFS) 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 between absorptive paper and 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 NMFS, 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, 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: 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 otolith samples were submitted to CDFW – Yreka Fisheries Office for distribution to individuals performing further analysis. This included staff of the NMFS, 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. Several 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 was 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 was installed and began operation on September 19th, 2019. Despite low flow, the Scott River remained connected from the mouth through the valley reaches over the fall of 2019 with the exception of the historic mine tailings within reach 16. This section of the river didn't become connected until December 7th, 2019 allowing spawners access to the upper reaches of the watershed such as the East and South Forks of the Scott River. According to the USGS gage at river mile 21, river discharge increased from 66 cfs to 152 cfs on December 7th, peaked at over 300 cfs on December 8th, and remained over 100 cfs through January (USGS, 2019) (*Figure 2*). This initial pulse provided fish access through the tailings reach and most spawning grounds, although some tributaries experienced intermittent connectivity later in the run.

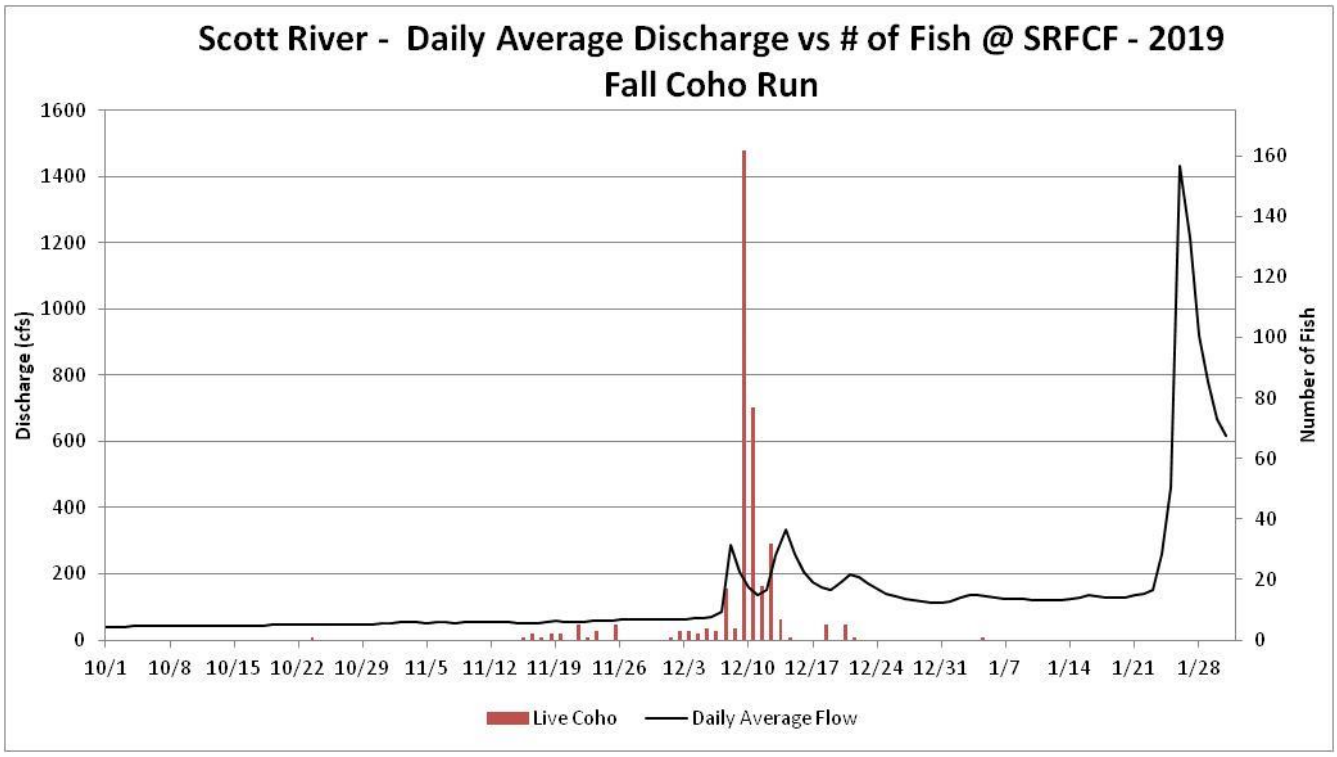


Figure 2. Scott River daily average discharge vs. # of Fish passing though the SRFCF – USGS Gage RM 21 (USGS 2019, provisional data) and preliminary SRFCF data (Knechtle and Giudice, 2020*)*

The early December rain event appears to have prompted the coho run into the valley reaches of the Scott River. The SRFCF recorded upstream movement of adult coho from October 23rd through January 4th, with the majority of fish passing through from December 7th to 15th (Knechtle and Giudice, 2020). Consistent with this timeframe, tributary surveys initiated on December 10th on lower French Creek encountered the first coho salmon documented in the valley (*Appendix II*). It is hypothesized that fish had already entered lower valley tributaries such as Shackleford Creek by this time. From mid-December through late January, streamflow remained relatively stable (*Figure 1*) and coho spawning was regularly documented across the watershed. The bulk of the live coho were seen by surveyors in the valley tributaries between December 17th and December 31st, 2019 (*Appendix II*). Connectivity through the historic mine tailings in Reach 16 was somewhat intermittent through the first week of January. The last live coho that were observed by crews were documented on January 10th, 2020 at the upper end of the

valley on Reach 16 (*Appendix II*). The migrant weir was operated through January 13th, 2020, after which it was dismantled due to a lack of migratory action and in anticipation of high flows. Surveys continued to be completed nearly two more weeks to collect carcasses although minimal observations were made and the last flags were pulled January 24th 2020. A preliminary total of 369 coho had been recorded passing through the SRFCF over the season.

Survey Summary

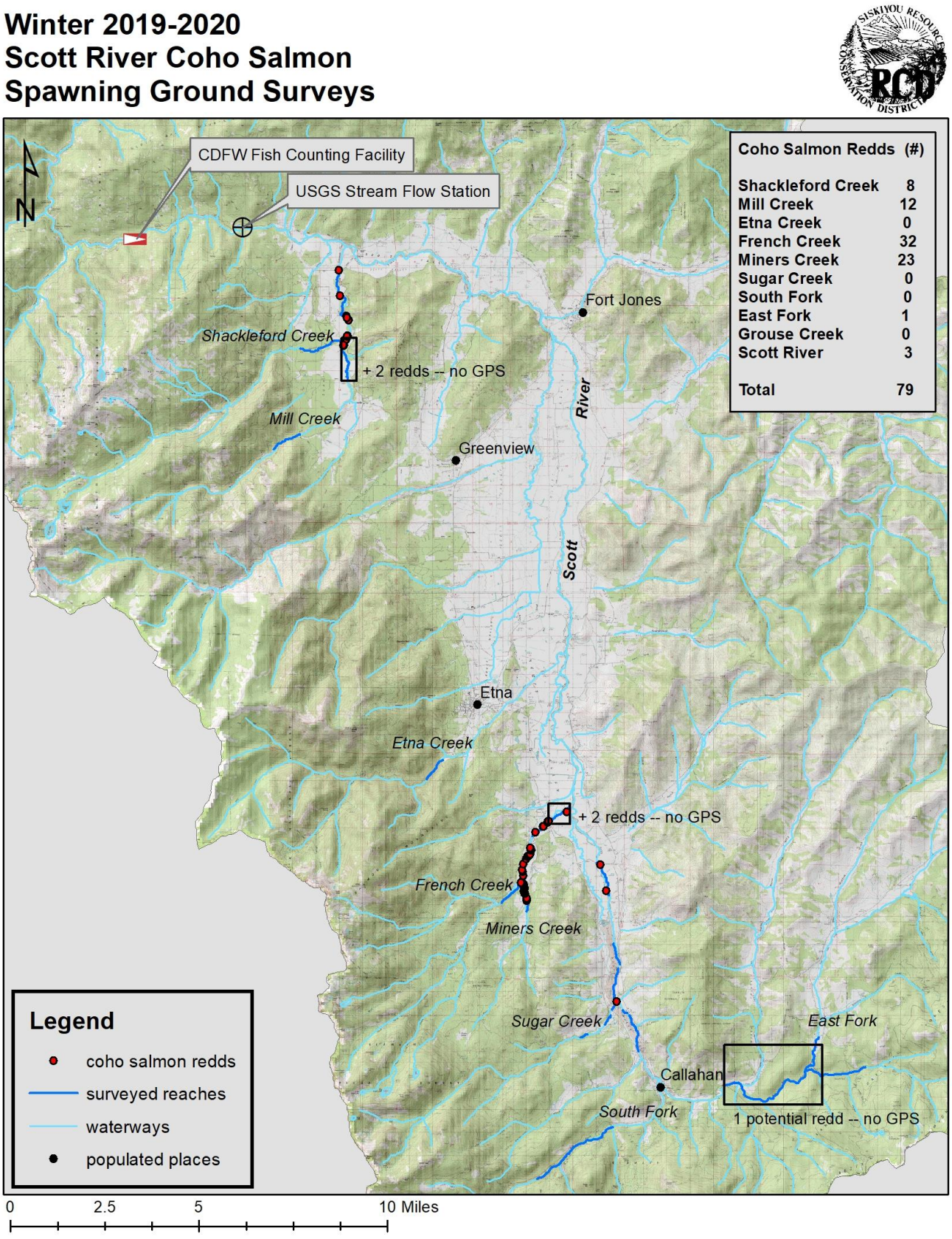
A brief explanation of the coho spawning observations on the mainstem is presented here followed by each of the tributaries ordered from North to South.

Table 2. Summary of Survey Observations by Stream

STREAM	**REDDS**		**CARCASSES**	
Scott River Mainstem	Number	Percentage	Number	Percentage
Reach 16	3	4%	1	8%
Tributaries (North to South)				
Shackleford Creek	8	10%	1	8%
Mill Creek	12	15%	2	17%
Etna Creek	0	0%	0	0%
French Creek	32	41%	5	42%
Miners Creek	23	29%	3	25%
Sugar Creek	0	0%	0	0%
East Fork Scott River	1	1%	0	0%
South Fork Scott River	0	0%	0	0%
Total	**79**	**100%**	**12**	**100%**

Redds

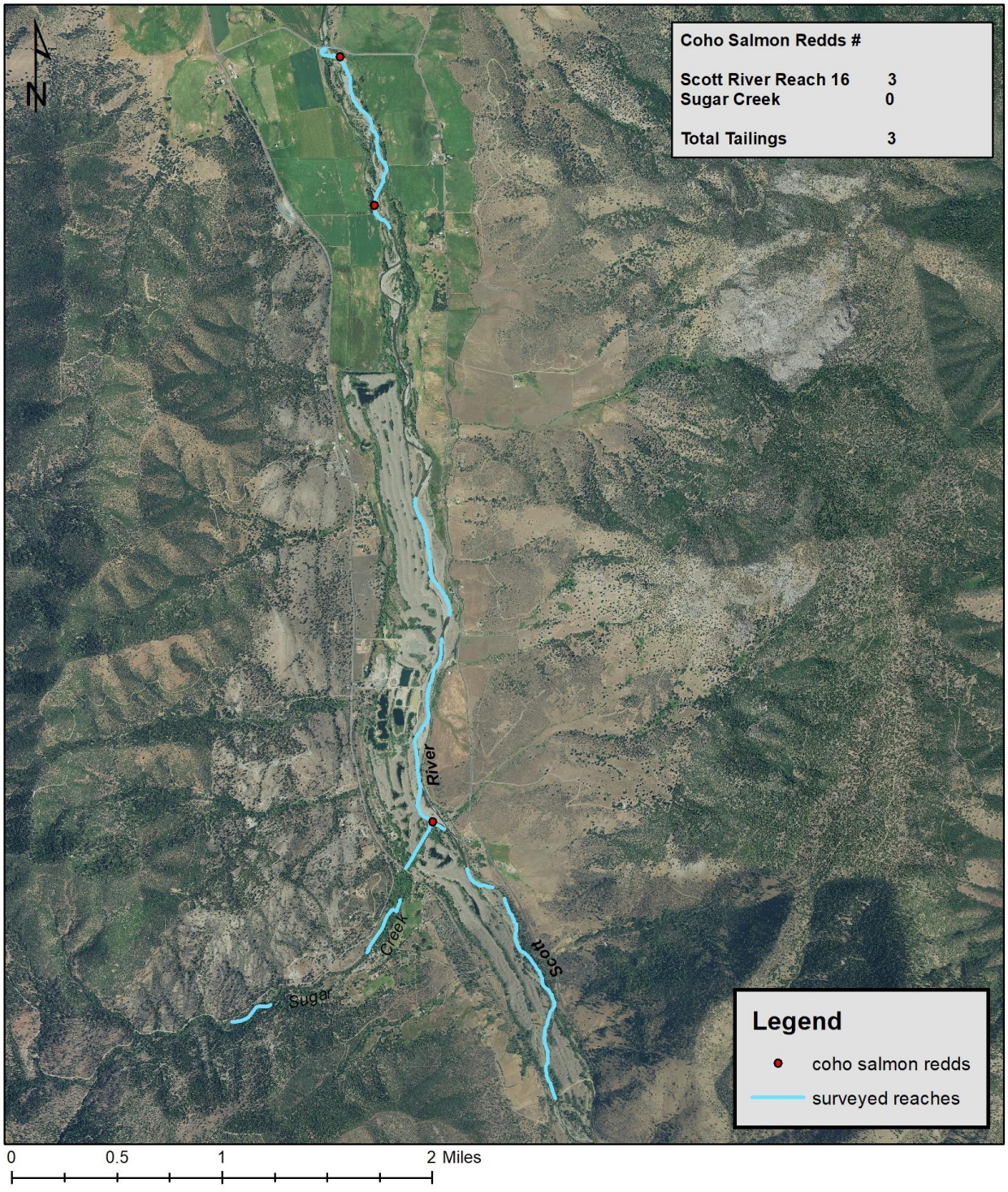
Positional information was gathered for 74 of the 79 coho redds, as presented on *Maps 2-5* and *Figure 3* shows the density of redds observed per mile of stream.



Map 2. Locations of identified coho redds (Siskiyou RCD, 2020).

Mainstem Scott River

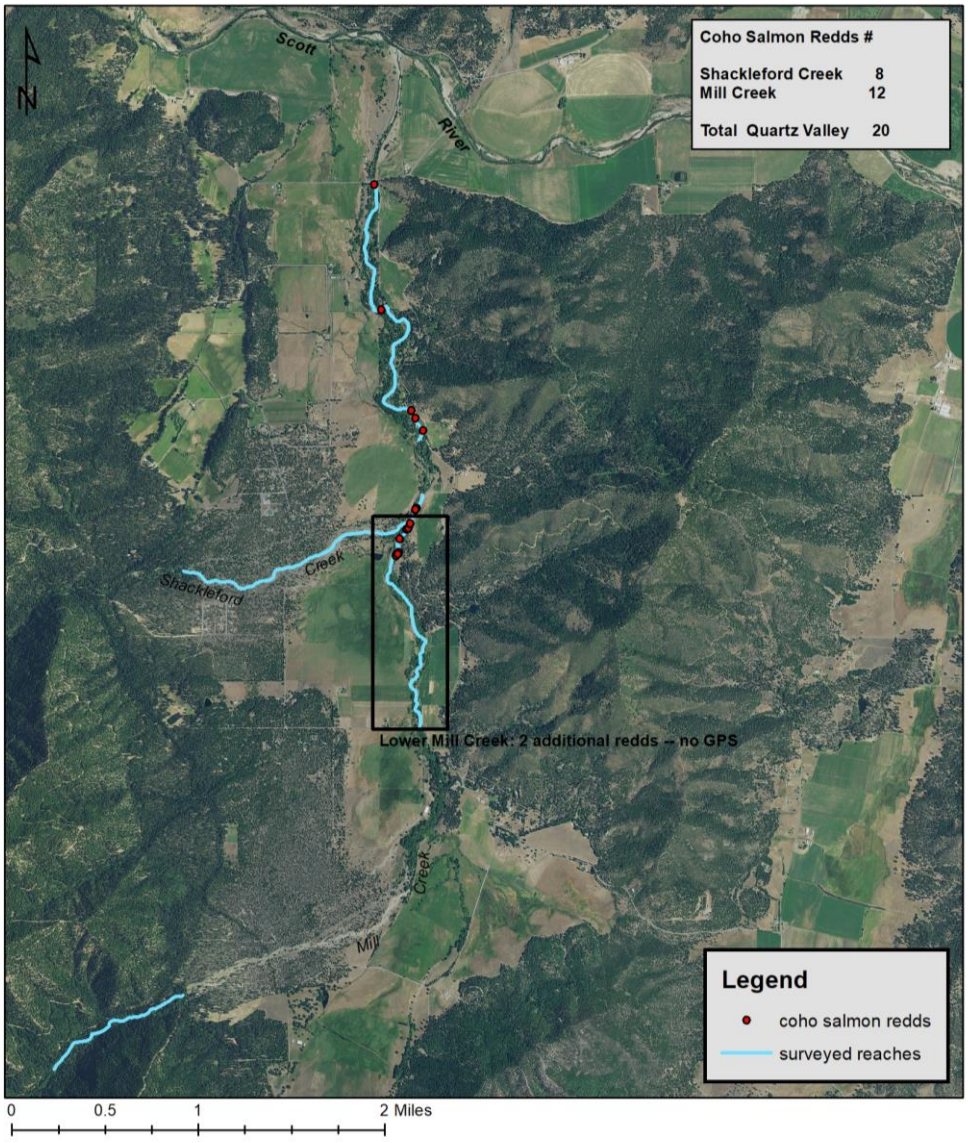
Over the season, coho spawning was observed on the mainstem of the Scott River on reach 16 only -- surrounding Sugar Creek and upstream approximately one river mile from Fay Lane. A total of 3 coho redds were documented in these areas from December 27th through January 10th, 2020 (*Map 2, Map 3 and Table 2*). Coho spawning on the mainstem tended to occur along stream margins or side-channels with smaller substrate. Note that there were no surveys completed on mainstem reaches 9 – 15 beyond November and so it is possible that a limited amount of coho spawning occurred through suitable habitats.



Map 3. Locations of identified coho redds on the Scott River mainstem (Siskiyou RCD, 2020).

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 December 19, 2019, revealed four coho redds on lower Mill Creek. New coho redds were consistently documented on both streams through the second week of January, after which observations of new redds diminished rapidly. Redds were concentrated in certain areas of each creek where there were sufficient suitable sized gravels. On Shackleford Creek, there were no surveys on the lower reach due to a lack of landowner access, however surveys carried out through the middle and upper reaches only found spawning on the middle reach. As such, the upper extent of spawning was determined to be river-mile 3.0 of Shackleford Creek where substrate becomes coarser and fish tend to preferentially move into Mill Creek. On Mill Creek, spawning was observed on the lower reach only; there were no surveys on the middle reach due to a lack of landowner access and surveys through the upper reach found no evidence of coho salmon. Although there were many beaver dams on Mill Creek, the Siskiyou RCD did not see any evidence of coho salmon on Mill Creek above a specific and substantial beaver dam at river-mile 0.2. It is debatable as to whether it was an actual fish passage barrier, as there were shallow side channels around the dam, but fish were not found to have pushed above it. A total of 8 redds were documented on Shackleford Creek and 12 redds on Mill Creek (*Map 2, Map 4* and *Table 2*).



Map 4. Locations of identified coho redds for Shackleford and Mill Creek (Siskiyou RCD, 2020).

Kidder Creek and its tributary Patterson Creek

Surveys on Kidder Creek and its tributary Patterson Creek did not occur over the 2019-2020 season due to a lack of consistent connectivity with the mainstem Scott River during the coho run.

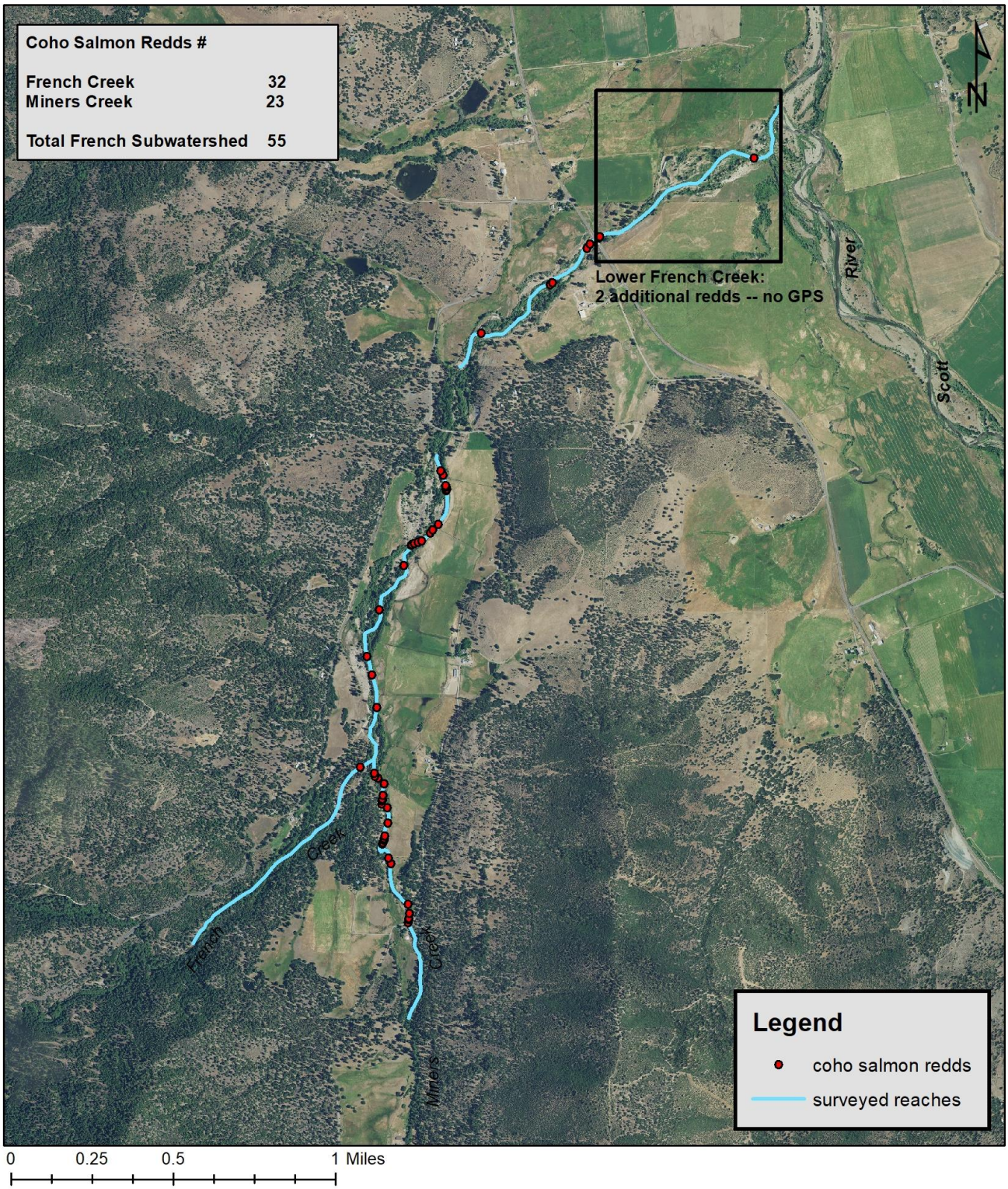
However, Kidder Creek experienced intermittent connectivity and Patterson Creek was never found to have fully hydrated at Eller Lane.

Etna Creek

Surveys on Etna Creek were limited to private timberland within the middle reach below the Etna City Diversion (*Map 2*). 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 once during the season on December 31st, 2019, 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. It is unknown whether Etna Creek maintained full and continuous connectivity to the mainstem Scott River did not occur, although it is possible that spawning could have occurred in areas where the Siskiyou RCD did not have access.

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 November found no observations of chinook activity. However, the first live coho salmon and redd formation were observed by surveyors on the middle reach of French Creek on December 10th, 2019. These were the first live coho and coho redds observed by surveyors within the Scott River basin. New redds were consistently documented during weekly surveys through the second week of January. (It should be noted that this is not apparent on Appendix II because of error in data management). There are several established beaver dams within the first river mile of French Creek; however, none had impacted passage because all of the redds were documented above the lower dam near river mile 0.17, and 26 of the 32 redds on French Creek were above the upper dam near river mile 1.1 (*Map 3*). As such, the upper extent of spawning was determined to be river-mile 3.0 of French Creek, which is consistent with previous observations as the streambed contains more boulders and bedrock. The lowest perennial tributary to French Creek is Miners Creek. The first survey on Miners Creek occurred on December 18th, 2019, and surveys continued weekly through January 13th, 2020. The upper extent of spawning was determined to be river-mile 0.6 of Miners Creek, which is somewhat lower than observed in prior years, but it is known why fish didn't continue further up the tributary. A total of 32 redds were documented on French Creek and 23 redds on Miners Creek (*Map 2, Map 5 and Table 2*).



Map 6. Locations of identified coho redds for French and Miners Creek (Siskiyou RCD, 2020).

Sugar Creek

Although surveys on Sugar Creek were initiated in mid-December and continued weekly into the fourth week of January, evidence of spawning was never found. Previous years' coho spawning ground surveys have documented spawning on the lower and middle reaches, but there was no evidence of spawning

activity in 2019-2020. Although the RCD acquired access to some additional properties in the middle reach this season, it is still possible that spawning could have occurred in areas where the Siskiyou RCD did not have access. It is also possible that a lack of consistent connectivity through the tailings limited fish access and spawning activity.

East Fork of the Scott River and its tributary Grouse Creek

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. Three surveys were conducted on the East Fork on December 20th, 2019, January 3rd and January 24th, 2020. The surveys covered a relatively long length of stream from above the confluence with Grouse Creek to below the confluence with Noyes Valley Creek. One potential unoccupied redd was found on this reach, but nearby gravel disturbances from wildlife could have also produced the characteristic shape of a coho spawning site. Positional information was not collected per landowner request. It is possible that spawning could have occurred in areas of the East Fork where the Siskiyou RCD did not have access. The mouth of Grouse Creek, a 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.

South Fork of the Scott River

Two surveys were completed on the middle reach of the South Fork Scott River on December 18th, 2019, and January 8th, 2020. No evidence of spawning was found and it is unknown whether adult fish utilized the tributary or simply didn't migrate up beyond river-mile 2.3. The number of small private landholdings through Callahan makes access to the downstream portion of this reach infeasible. It is possible that spawning could have occurred in areas where the Siskiyou RCD did not have access.

Carcasses

A total of 12 coho carcasses were recovered from December 17th, 2019, through January 13th, 2020 (*Tables 2&3, Appendix II*). A single coho carcass was observed but was unable to be recovered for sampling on reach 16 of the Scott River near Fay Lane; all the rest were recovered on tributaries *(Table 3*). The majority of carcasses (5) were found on the middle reach of French Creek. The recovered carcasses had fork lengths that measured between 46 and 65 cm (*Table 3)*. Applying the maximum grilse fork length cutoff of 56 cm (Knechtle and Giudice, 2020) three 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 four female carcasses. Scale, tissue and otolith samples were taken from all coho carcasses with the exception of one that could not be recovered for sampling due to its inaccessible location in a deep pool. All coho carcasses were scanned for passive integrated transponder tags, but none were identified. None of the recovered carcasses displayed hatchery markings. Following active spawning and carcass recovery from mid-December through mid-January, no new carcasses were found thereafter. It is unknown why there were so few recovered carcasses, as there were no adverse weather or stream conditions that may have limited carcass recovery, nor was there any observation predation of carcasses by scavengers.

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)
12/17/2019	French Creek	Middle	47	M	N	N/A
12/19/2019	Mill Creek	Lower	46	M	N	N/A
12/24/2019	French Creek	Middle	Unk	M	Unk	Unk
12/24/2019	Miners Creek	N/A	65	M	Unk	Unk
12/26/2019	Shackleford Creek	Middle	64	M	N	N/A
12/27/2019	Scott River	16	Unk	Unk	Unk	Unk
12/31/2019	French Creek	Middle	57	F	N	N
1/7/2020	Miners Creek	N/A	60	F	N	N
1/7/2020	Miners Creek	N/A	56	F	N	N
1/7/2020	French Creek	Middle	Unk	M	Unk	Unk
1/9/2020	Mill Creek	Lower	50	M	N	N
1/13/2020	French Creek	Middle	62	F	N	N

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 strong cohort returning in 2013-2014 had an escapement of 2,752, the largest documented since installation of the Scott River Fish Counting Facility in 2007 and an entire order of magnitude larger than previous cohorts. However, severe drought conditions limited access to tributary spawning grounds and confined the redd distribution to the mainstem Scott River, something that had been previously unseen (Yokel, 2014). In addition, 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.

Weather conditions impacted data collection over the winter of 2016-17, when this generation returned to the Scott River. As a result of these challenges the escapement estimate (226 fish) and redd count (95) wasn't even close to being an order of magnitude larger than the two weaker cohorts as had been observed with the 2013-2014 escapement. Therefore, it seemed likely that the variation in brood year strength for this particular cohort had been leveled by the combination of drought and unfavorable ocean conditions.

Data collection over the winter of 2019-2020 coho spawning ground surveys went smoothly, but again neither the escapement estimate nor the redd count were even close to being an order of magnitude larger than the two weaker cohorts. In fact, with 346 returns, the 2019-20 generation is the smallest of the previous three years (*Table 1*) and about half the historic averages. As a result the 2019-2020 generation can no longer be considered the strong cohort and it is clear that the trend in brood year strength has been reset.

Despite below average returns, the spatial distribution of coho spawning documented across Scott Valley was relatively consistent with previous years. Although there were fewer observations of spawning through the southern portion of the valley, such as on Sugar Creek and the Forks, which could have been related to intermittent connectivity through the mine tailings. 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 Figure 3. French Creek and its tributary Miners Creek had the highest density of redds followed by Mill Creek and Shackleford Creeks *(Table 2 & Figure 3).*

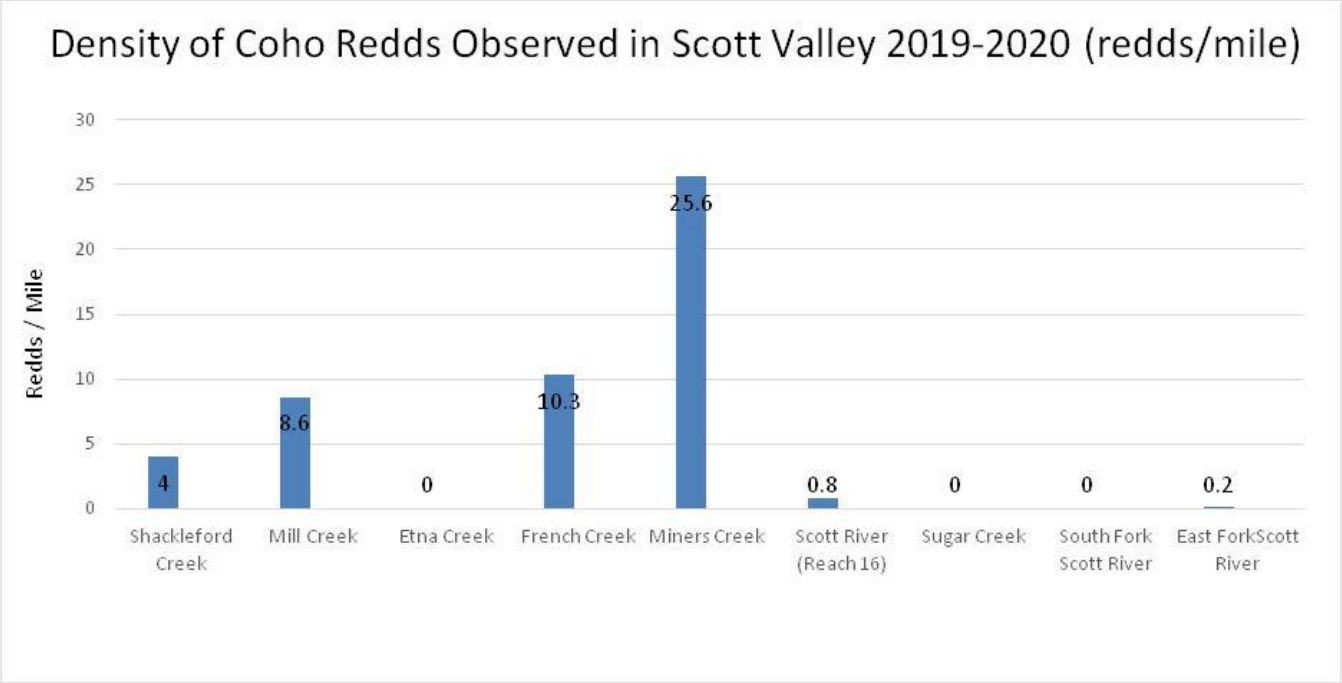


Figure 3: Density of coho redds observed in Scott Valley by tributary (Siskiyou RCD, 2020)

Finally, the Siskiyou RCD found that the upper extent of spawning on several tributaries was slightly lower than in previous years. On Miners Creek it is unknown why fish didn't push beyond the Miner Creek Road bridge, although, on Mill Creek a beaver dam seems to have impacted fish passage to spawning grounds on the lower reach.

Recommendations

The author recommends the following items for future survey seasons: Continue working 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, and middle South Fork.

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) 2019. 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) 2019. 2018-2019 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 Guidice, D. 2020. 2019 Scott River Salmon Studies. Final Report, Klamath River Project. CDFW Yreka Fisheries Office. Yreka, CA.

Knechtle. M. 2020. Personal communication.

Magranet. 2017. Scott River Adult Coho Spawning Ground Surveys 2016-2017 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) 2019. 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). 2019. Stream Discharge Scott River RM 21 Gage # 11519500, provisional data. http://waterdata.usgs.gov/ca/nwis/uv/?site_no=11519500

Western Regional Climate Center 2019 Northern California RAWS Daily Precipitation Callahan station https://raws.dri.edu/cgi-bin/rawMAIN.pl?caCCAL

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

APPENDIX I

Appendix I: Length of Stream Reaches Surveyed

STREAM	REACH	REACH DESCRIPTION	BEGINNING MILE (UPSTREAM)	END MILE (DOWNSTREAM)	TOTAL LENGTH	LENGTH SURVEYED 2019-2020
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	0.2
	Upper	Rail Creek Rd Bridge to Upper Masterson	12	7.2	4.8	NS
Grouse Creek		From mouth to ford	1.7	0	1.8	1.8
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	5.4	2.2	3.2	0.7
	Upper	From Mill Creek to Etna City Diversion	8	5.4	2.6	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	0.8
	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
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	NS
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	NS
	Upper	Upper Youngs Diversion to Highway 3	9.1	7.3	1.8	NS
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	NS
	Reach 13	Horn Lane to Etna Creek	46.5	44.7	1.8	NS
	Reach 14	SVID to Horn Lane	48.6	46.5	2.1	NS
	Reach 15	Fay Lane to SVID	52.2	48.6	3.6	NS
	Reach 16	Fay Lane to Callahan	59.1	52.2	6.9	3.9

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Shackleford Creek	Lower	From North Quartz Valley Rd bridge to mouth	0.8	0	0.8	NS
	Middle	From confluence with Mill Creek to North Quartz Valley Rd.bridge	3.1	0.8	2.3	2.0
	Upper	From the falls to the confluence with Mill Creek	5.2	3.1	2.1	1.4
Mill Creek	Lower	From the South Quartz Valley Rd. bridge to confluence with Shackleford Cr.	1.4	0	1.4	1.3
	Middle	From the South Quartz Valley Rd to Mill Creek Rd crossing	3.8	1.4	2.4	NS
	Upper	Above Mill Creek Rd crossing	4.8	3.8	1	0.9
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	2.6
	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	NS
Wildcat		Mouth up 2 mile	2	0	2	NS
				TOTAL	**109.4**	**23.5**

APPENDIX II

Appendix II: List of Surveys Completed

DATE	STREAM	REACH	LIVES	REDDS	CARCASSES
12/10/2019	French Creek	Middle	1	2	0
12/10/2019	French Creek	Lower	0	0	0
12/10/2019	Scott River	Reach 16 (partial)	0	0	0
12/11/2019	Sugar Creek	Lower	0	0	0
12/11/2019	Scott River	Reach 16 (partial)	0	0	0
12/11/2019	French Creek	Middle	0	0	0
12/16/2019	Sugar Creek	Middle	0	0	0
12/16/2019	Sugar Creek	Lower	0	0	0
12/17/2019	Scott River	Reach 16 (partial)	0	0	0
12/17/2019	French Creek	Middle	2	2	1
12/17/2019	French Creek	Lower	0	0	0
12/17/2019	French Creek	Middle	12	0	0
12/18/2019	South Fork Scott River	Middle	0	0	0
12/18/2019	French Creek	Middle	0	0	0
12/18/2019	Miners Creek	N/A	2	0	0
12/19/2019	Mill Creek	Lower	1	4	1
12/19/2019	Shackleford Creek	Middle	0	0	0
12/20/2019	East Fork Scott River	Middle	0	0	0
12/23/2019	Sugar Creek	Middle	0	0	0
12/23/2019	Sugar Creek	Lower	1	0	0
12/23/2019	Grouse Creek	N/A	0	0	0
12/24/2019	French Creek	Middle	7	0	1
12/24/2019	Miners Creek	N/A	3	0	1
12/26/2019	Mill Creek	Lower	1	4	0
12/26/2019	Shackleford Creek	Middle	1	1	1
12/27/2019	Scott River	Reach 16 (partial)	2	2	1
12/27/2019	French Creek	Upper	0	0	0
12/30/2019	Sugar Creek	Middle	0	0	0
12/30/2019	Sugar Creek	Lower	0	0	0
12/31/2019	French Creek	Middle	4	2	0
12/31/2019	French Creek	Lower	0	5	0
12/31/2019	Miners Creek	N/A	3	0	0
12/31/2019	French Creek	Middle	7	0	1
12/31/2019	Etna Creek	Upper	0	0	0
1/2/2020	Mill Creek	Lower	1	3	0
1/2/2020	Shackleford Creek	Middle	0	1	0
1/3/2020	East Fork Scott River	Middle	0	1	0
1/3/2020	Mill Creek	Upper	0	0	0
1/3/2020	Shackleford Creek	Upper	0	0	0

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1/7/2020	Sugar Creek	Middle	0	0	0
1/7/2020	Sugar Creek	Lower	0	0	0
1/7/2020	Miners Creek	N/A	1	0	2
1/7/2020	French Creek	Middle	1	0	1
1/8/2020	South Fork Scott River	Middle	0	0	0
1/9/2020	Mill Creek	Lower	0	1	1
1/9/2020	Mill Creek	Upper	0	0	0
1/9/2020	Shackleford Creek	Middle	0	3	0
1/9/2020	Shackleford Creek	Upper	0	0	0
1/10/2020	Scott River	Reach 16 (partial)	1	1	0
1/13/2020	Sugar Creek	Middle	0	0	0
1/13/2020	Sugar Creek	Lower	0	0	0
1/13/2020	Miners Creek	N/A	0	23	0
1/13/2020	French Creek	Middle	0	21	1
1/17/2020	Mill Creek	Lower	0	0	0
1/17/2020	Mill Creek	Upper	0	0	0
1/17/2020	Shackleford Creek	Upper	0	0	0
1/17/2020	Shackleford Creek	Middle	0	1	0
1/20/2020	Sugar Creek	Middle	0	0	0
1/20/2020	Sugar Creek	Lower	0	0	0
1/21/2020	Scott River	Reach 16 (partial)	0	0	0
1/21/2019	French Creek	Middle (partial)	0	0	0
1/21/2020	French Creek	Lower	0	0	0
1/23/2020	Mill Creek	Lower	0	0	0
1/23/2020	Shackleford Creek	Middle	0	2	0
1/24/2020	East Fork Scott River	Middle	0	0	0
TOTALS			**51**	**79**	**12**