

2022-2023 Fish Monitoring Summary Report

Scott River Watershed Council

July 24th, 2023



From August 2022 through April 2023, the Scott River Watershed Council (SRWC) conducted six in-hand fish sampling events in habitats on French Creek, Sugar Creek and the mainstem Scott River. The data collected from these efforts is available to be used to determine the efficacy of different kinds of restoration techniques as it pertains to fish populations, as well as to track baseline population conditions over time. Since 2016, SRWC has also continually operated a passive integrated transponder (PIT) array network in the Scott River watershed that allows for tagged fish to be detected as they move throughout the streams in question. Detection data collected at the array stations provides insight into how habitat use varies seasonally, when smolts are outmigrating from their natal streams, etc.

In addition to monitoring juvenile salmonids, SRWC conducted spawning ground surveys during January 2023 in an effort to observe live spawners and redds, and to collect data from spawned-out carcasses. SRWC also maintained and operated a PIT antenna on the California Department of Fish and Wildlife (CDFW) weir at river kilometer (RKM) 29.2 on the Scott River. Adult salmonids returning to spawn in the fall and winter passed through this point and were scanned for tags. These efforts allow SRWC to track factors such as preference for certain spawning habitat and trends in which rearing locations produce returning adults.

2022-2023 Juvenile Coho Salmon Monitoring

Methods

SRWC staff used seines and minnow traps to capture and collect data from fish inhabiting both restored and unrestored habitat units in these streams. All captured salmonids were anaesthetized, weighed and measured. Coho Salmon (*Oncorhynchus kisutch*) greater than 65 mm were eligible to receive a passive integrated transponder (PIT) tag. PIT tagged Coho were identified when recaptured at sampling events, in which case size comparisons were made to determine growth rates. Networks of remote PIT arrays were also operated in these streams, allowing for tagged Coho to be detected as they moved through the watershed.

Findings

Using PIT recapture data and forklength data SRWC staff identified a population of juvenile Coho Salmon that emerged in French Creek in spring 2021 and had not outmigrated by the summer of 2022. Certain analyses presented in this document will attempt to distinguish between these two-summer fish (referred to henceforth as “1+”) and the young of the year (YOY) cohort.

13 distinct habitat units on French Creek and Sugar Creek were repeatedly sampled during the 2022-2023 season (Table 1-2). Among the habitats sampled with consistently suitable catch sizes, average YOY Coho Salmon forklength was almost always highest in the Sugar Creek BDA 1 Pond (Table 3). The Sugar Creek Off-Channel Pond did produce the largest YOY Coho, but no Coho were captured in that habitat in both the first and last sampling events of the season (Figure 1).

French Creek					
	Total Chinook Catch	Total <i>O. mykiss</i> Catch	Total Coho Catch	Total Coho PIT Tags	Total Coho Recaptures
Beaver Dam Pond	-	10	738	250	49
BOR Pretreatment	-	2	27	4	-
Control Pools	-	82	1508	377	142
Engineered Log Jam	-	11	414	109	11
FRGP Side Channel	-	30	583	355	64
Side Channel BDA 1 Pond	-	-	146	46	20
Side Gravel Channel	-	5	35	9	-

Table 1. Total salmonid catch on French Creek in 2022-2023.

Sugar Creek					
	Total Chinook Catch	Total <i>O. mykiss</i> Catch	Total Coho Catch	Total Coho PIT Tags	Total Coho Recaptures
BDA Pond 1	42	278	2115	860	209
BDA Pond 2	-	1	120	14	-
Control Pools	-	11	682	282	120
Off-Channel Pond	1	9	181	126	9
Beaver Dam Pond	1	2	490	155	33
Scott River Above Sugar Confluence	-	61	245	68	17

Table 2. Total salmonid catch on Sugar Creek in 2022-2023.

Location	Sugar Creek BDA 1 Pond						French Creek Beaver Dam Pond						French Creek Side Channel BDA 1 Pond		
	8/1	9/19	10/27	2/1	3/28	4/25	8/2	9/21	11/3	1/30	3/21	4/26	1/31	3/22	4/26
Average (mm)	67	65	74	84	89	92	60	65	73	72	73	79	81	86	91
Stand. Deviation	8.4	7	6.6	6.3	6.4	5.2	7.5	7.6	9.0	8.2	8.0	6.3	5.1	5.8	7.2
Minimum (mm)	49	51	59	65	72	82	47	51	52	56	62	71	69	70	77
Maximum (mm)	92	90	97	103	106	102	80	80	88	89	87	91	89	97	98
Count	310	255	774	105	89	37	89	56	116	34	14	11	29	68	10

Table 3. YOY Coho Salmon forklenght metrics, August 2022 – April 2023.

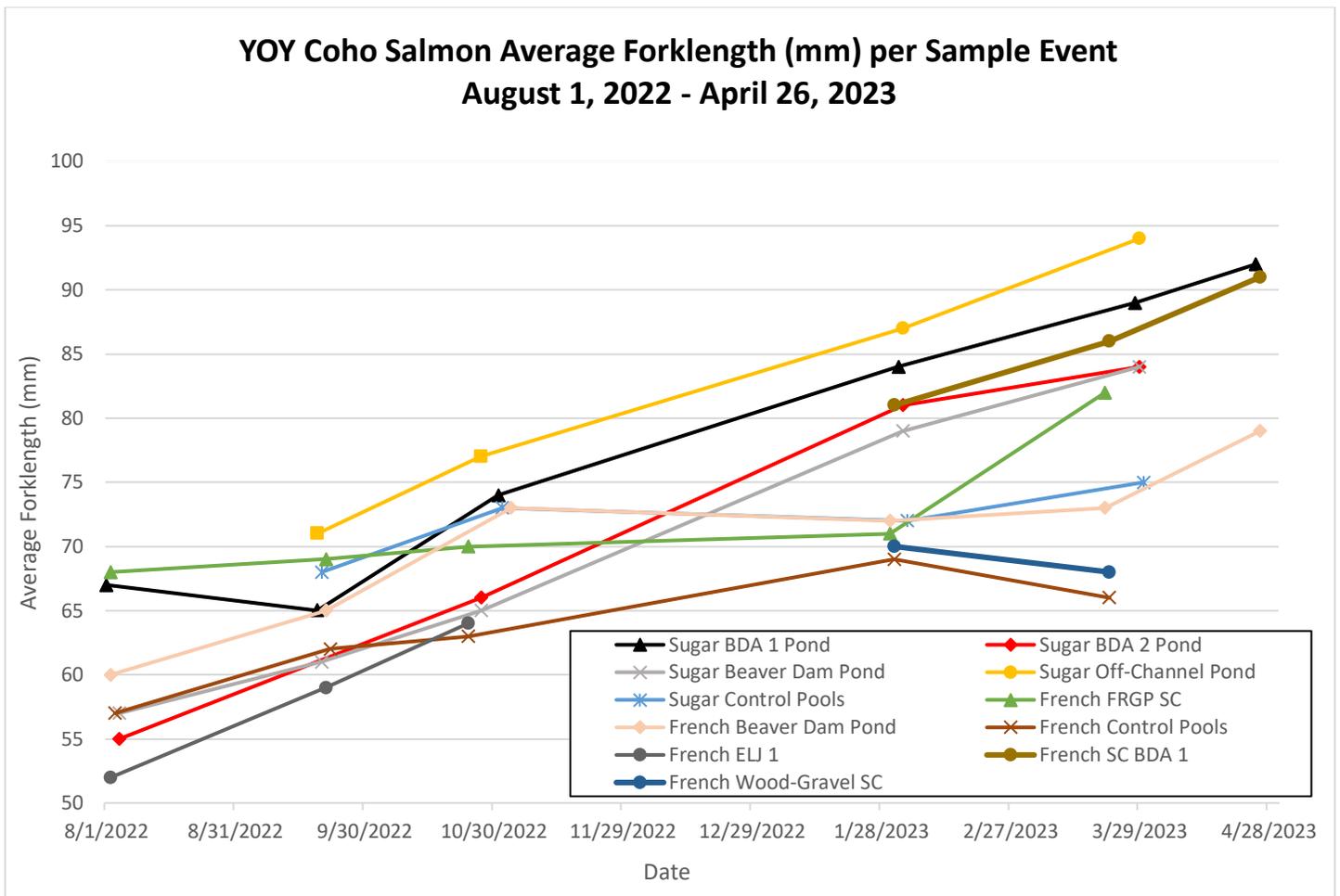


Figure 1. YOY Coho Salmon average forklength per sample event, August 2022 – April 2023.

Calculations of relative growth rates (length gained/forklength of fish/day) were made whenever a suitable sample (n=5) of recaptured PIT-tagged fish were collected at an in-hand sampling event (Table 2). On both French Creek and Sugar Creek, maximum relative growth rates were observed in the February to March period in ponds created by Beaver Dam Analogs (BDAs). In periods in which comparisons of growth rates were able to be made, these rates in habitats on French Creek varied seasonally. In the August to September period the Fisheries Restoration Grant Program Side Channel (FRGP SC) showed better growth rates than the Control Pools. In the August to November period, Coho in the Natural Beaver Dam Pond grew faster than in the Control Pools and the FRGP SC. From September to November, the slow water habitat created by Engineered Log Jams (ELJs) in mainstem French Creek showed the highest growth rates. This analysis confirms the importance of complex stream systems with a diversity of habitat types available to rearing salmonids.

	Aug - Sep	Aug - Nov	Sep - Nov	Feb - Mar
French Beaver Dam Pond		0.099		
French Control Pools	0.029	0.053	0.061	
French ELJ 1			0.095	
French FRGP SC	0.031	0.055	0.095	
French SC BDA 1				0.116
Sugar BDA Pond 1	0.039	0.077	0.126	0.130
Sugar Beaver Dam Pond			0.103	
Sugar Control Pools			0.112	
Sugar Off-Channel Pond				0.080

Table 4. Average forklength relative growth (mm/mm/day) of Coho Salmon. For each time period rates are colored on a gradient with yellow being the lowest value and green being the highest.

Scott River Immigration into Sugar Creek

During the week of October 28th, 2022, 68 Coho Salmon were PIT tagged in the mainstem Scott River just upstream of the confluence of Sugar Creek (Map 1). Over the next few months, 35 of these fish were detected entering Sugar Creek (Figure 2). 26 of these fish entered Sugar Creek between November 2nd and November 10th. Of those 26 fish, 15 (58%) of them also were detected moving downstream out of Sugar Creek during the same period. In contrast, of the seven fish that entered Sugar Creek in early January only one (14%) of them returned to the Scott River in that same period. This indicates that juvenile Coho in the Scott River use Sugar Creek both for brief forays in the low-flow period as well as for longer term respite from high flows in the mainstem during winter storms.



Map 1. Map showing the path from the Scott River pool where tagging occurred to the point of detection on Sugar Creek.

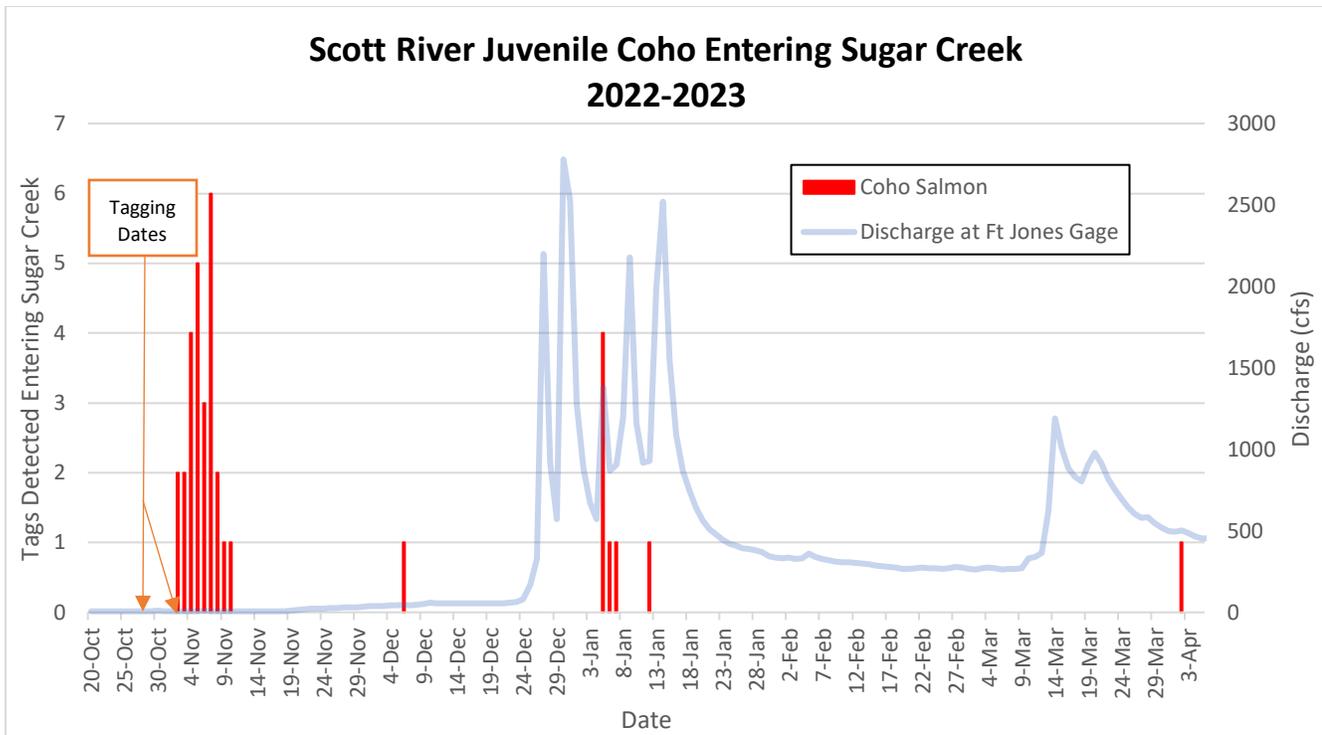


Figure 2. Juvenile Coho Salmon tagged in the Scott River detected entering Sugar Creek.

Survival, Outmigration and Multiyear Comparison

On Sugar Creek, a paired antenna array (named 1A and 1B) below the lowest BDA served as the migration detection station for both the 2021-2022 and 2022-2023 seasons (Map 2). On French Creek, paired antennas 10 and 11 served this purpose in 2021-2022. However, in fall 2021 a beaver dam was constructed directly downstream of these antennas, creating a new rearing habitat for juvenile Coho. In fall 2022, SRWC staff installed a new paired antenna system directly below the beaver dam: F1 and F2 (Map 3).

Sugar Creek - PIT Array Network



Orthoimagery - NAIP 2020



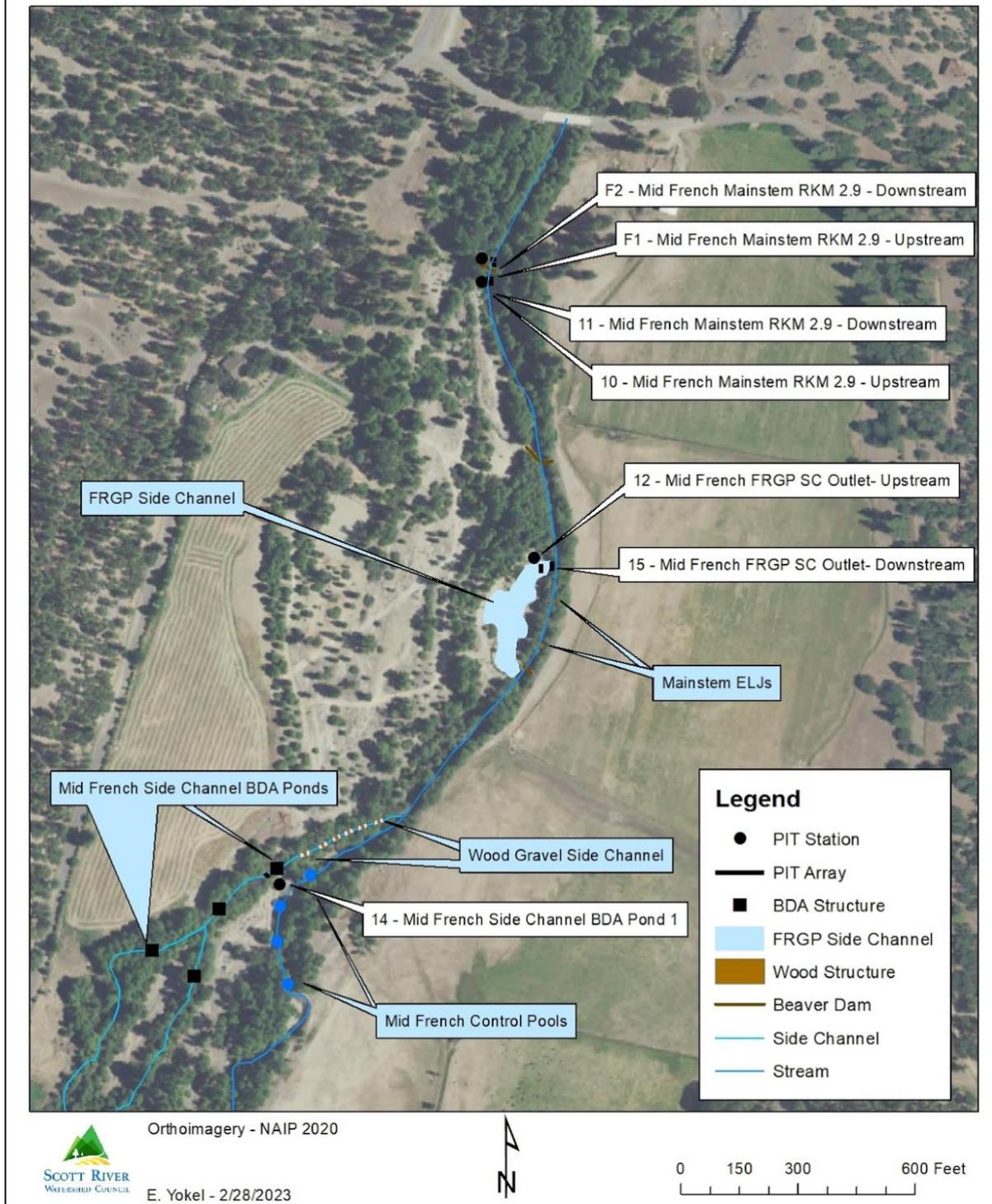
E. Yokel - 2/28/2023



0 100 200 400 Feet

Map 2. Sugar Creek PIT array locations.

Mid French Creek - PIT Array Network



Map 3. French Creek PIT array locations.

Using detection data from the furthest downstream arrays on these tributaries, estimates of the number of juvenile Coho Salmon surviving to outmigration were able to be made. Coho last detected on the downstream PIT arrays between November 1st, 2022, and June 15th, 2023 were determined to be outmigrants. Apparent survival on Sugar Creek dropped from 74% in 2021-2022 to 47% in 2022-2023 (Table 3).

	Sugar Creek Array 1A/1B 2021-2022	Sugar Creek Array 1A/1B 2022-2023
Outmigrants	270	678
Tagged Fish	365	1437
Survival	0.74	0.47

Table 5. Sugar Creek apparent survival to outmigration.

For French Creek, outmigration analysis was conducted on array 10/11 as well as F1/F2 in 2022-2023. This allowed for a more direct comparison to be made to the prior year's estimates as well as to account for antenna F1 being dislodged several times throughout the spring. Regardless of array, apparent survival was higher in the 2021-2022 season when compared to the following year (Table 4). 219 more outmigrants were detected on array 10/11 than array F1/F2 in 2022-2023, which is likely explained by antenna F1 becoming unmoored and resting on top of antenna F2 at some points. Counting the outmigrants that were detected on both antenna F2 and antenna 11, as well as those that were detected on one antenna but not the other, yields an apparent survival of 46%.

	French Creek Array 10/11 2021-2022	French Creek Array F1/F2 2022-2023	French Creek Array 10/11 2022-2023	French Creek Array F2+11 2022-2023
Outmigrants	351	290	509	539
Tagged Fish	588	1161	1161	1161
Survival	0.60	0.25	0.44	0.46

Table 6. French Creek apparent survival to outmigration.

It is possible that the series of significant runoff events during the winter and early spring of 2023 resulted in lower detection efficiency at the outmigrant antennas. (Figure 3). It is also worth noting that the high winter flows in 2023 altered the composition and structure of several rearing habitats in French Creek and Sugar Creek. Apparent survival may be lower in 2022-2023 due to added strain on juvenile Coho surviving through the winter period.

Apparent survival also varied based on the location of the event in which a fish was tagged (Table 7-8). It is worth noting that a fish that was tagged in a certain habitat unit did not necessarily stay in that habitat for the entirety of its freshwater rearing period. Analyses of the survival of Coho tagged in the French Creek Beaver Dam Pond was not conducted due to the location of the outmigration antennas in that pond.

French Creek			
	Outmigrants	Tags	Survival
Beaver Dam Pond	-	-	-
BOR Pretreatment	3	4	0.75
Control Pools	113	377	0.30
Engineered Log Jams	32	119	0.27
FRGP Side Channel	143	355	0.40
Side Channel BDA Pond 1	30	46	0.65
Wood-Gravel Side Channel	8	9	0.89

Table 7. Survival by location of tagging event on French Creek.

Sugar Creek			
	Outmigrants	Tags	Survival
BDA Pond 1	407	821	0.50
BDA Pond 2	29	53	0.55
Control Pools	71	282	0.25
Natural Beaver Dam	63	155	0.41
Off-Channel Pond	62	126	0.49

Table 8. Survival by location of tagging event on Sugar Creek.

Surface water temperatures in French Creek and Sugar Creek were similar in the 2021-2022 and 2022-2023 seasons (Figure 4-5). While this metric is often cited as a limiting factor for salmonids rearing in freshwater environments, it does not appear to explain the differences in apparent survival in these analyses.

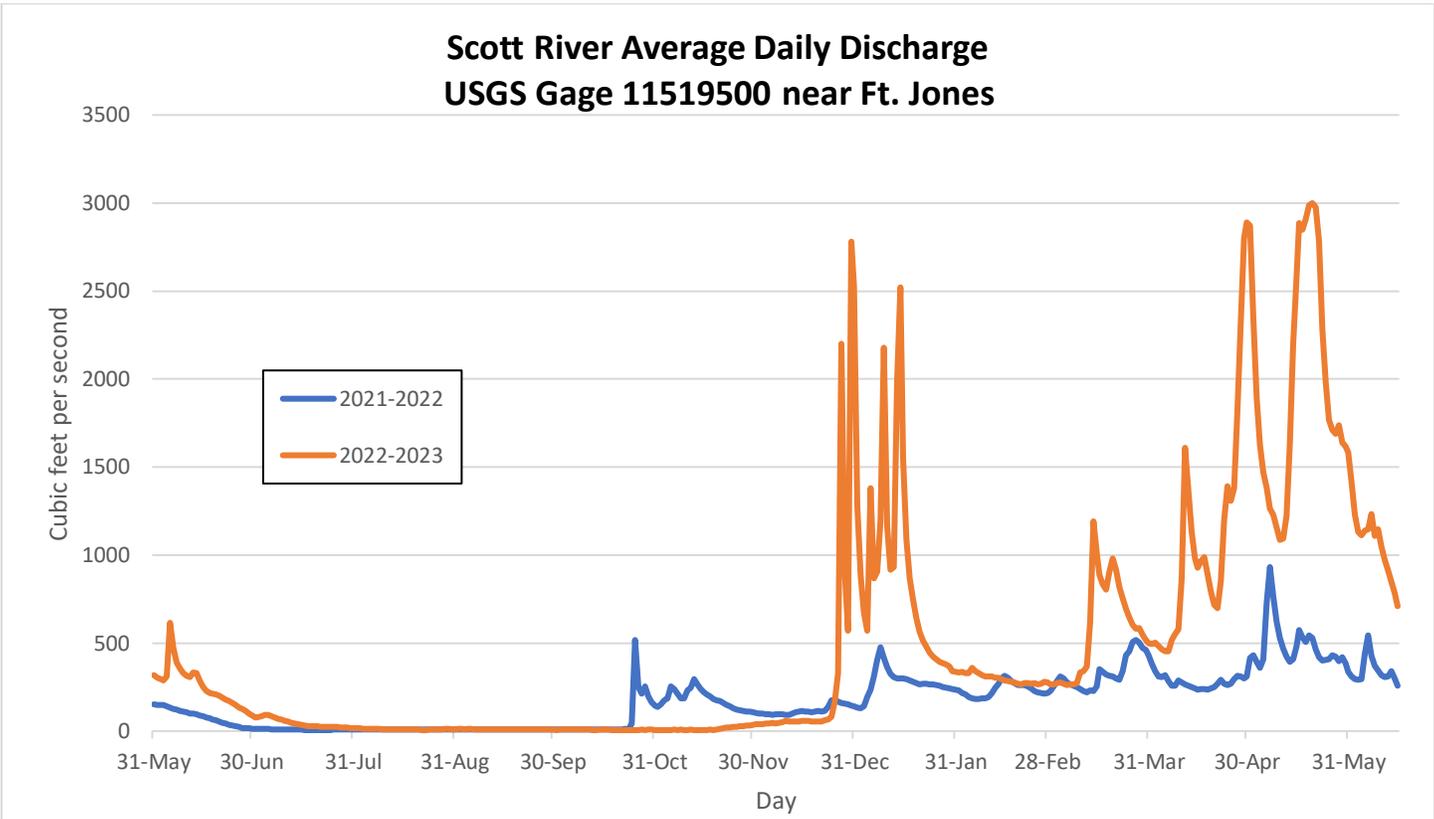


Figure 3. Scott River average daily discharge, 2021-22 vs 2022-23.

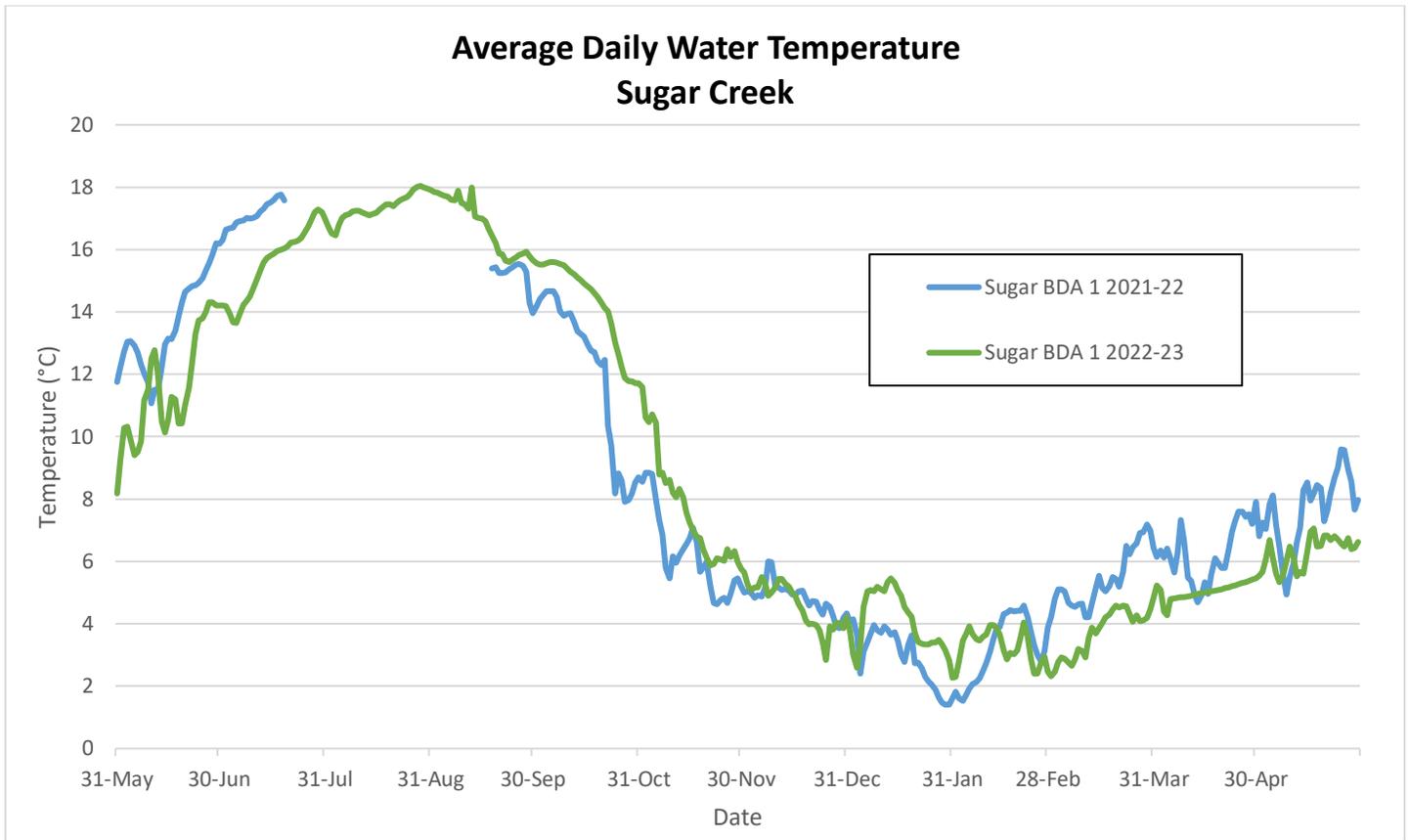


Figure 4. Sugar Creek BDA 1 average daily water temperature, 2021-22 vs 2022-23.

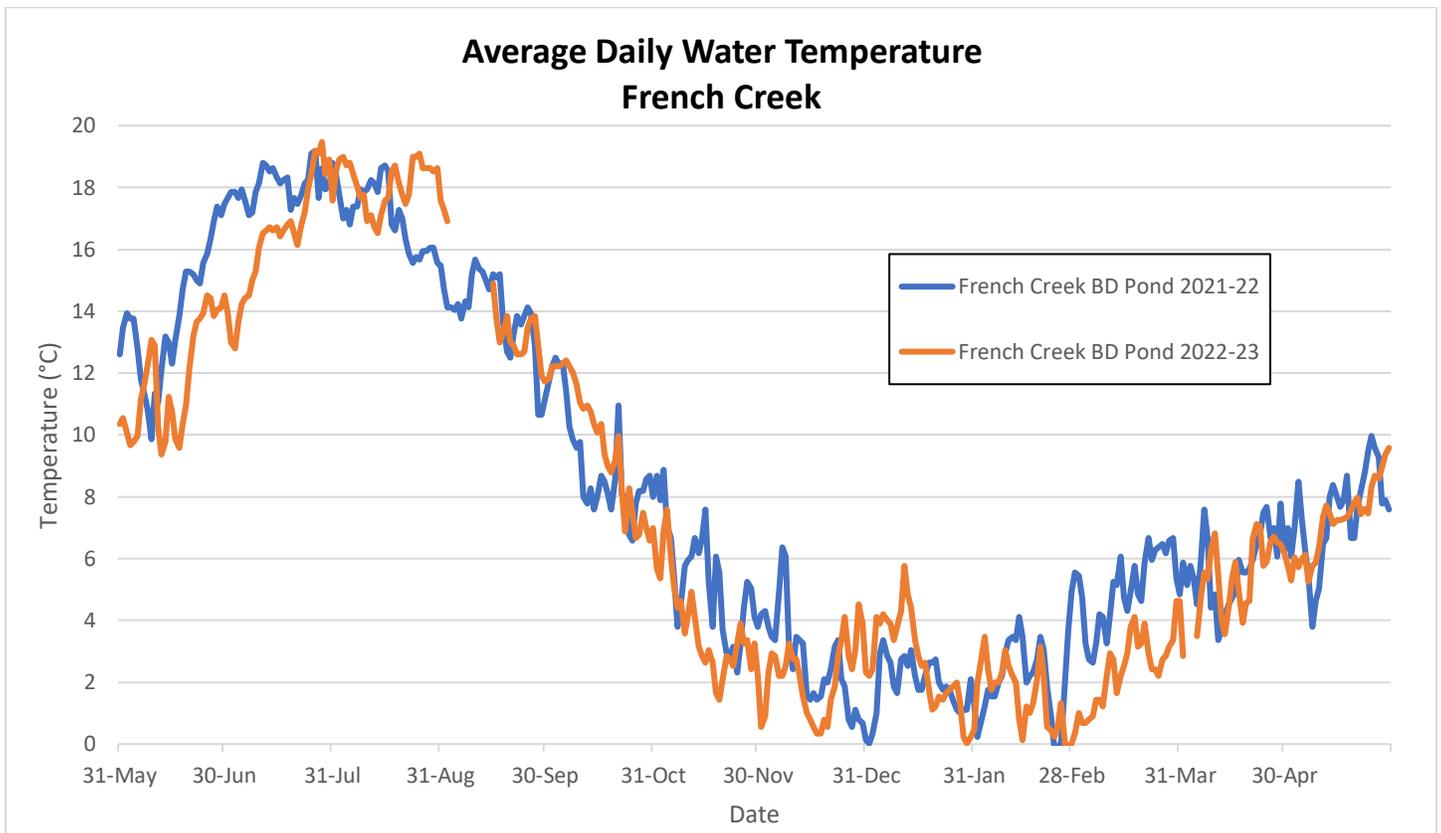


Figure 5. French Creek beaver dam pond average daily water temperature, 2021-22 vs 2022-23.

Detections of outmigrating Coho Salmon on French Creek and Sugar Creek followed a somewhat similar pattern across the two seasons. In both years, outmigration on French Creek peaked significantly earlier than on Sugar Creek (Figure 6-7). The most notable aberration occurred in the winter redistribution period, where in 2022-2023 a much greater proportion of Coho were detected leaving the tributaries than in the prior year. Two possible explanations for this are the differences in discharge and the presence of 1+ (or Brood Year 2020) Coho. On January 23rd, 2023, a total of 20 Coho were detected leaving French Creek despite the lack of a spike in discharge that accompanied all of the other peaks in outmigrants. 50% of the outmigrating fish on this day came from Brood Year 2020, while only 29% of the tagged fish in the 2022-2023 season came from the 2020 Brood Year.

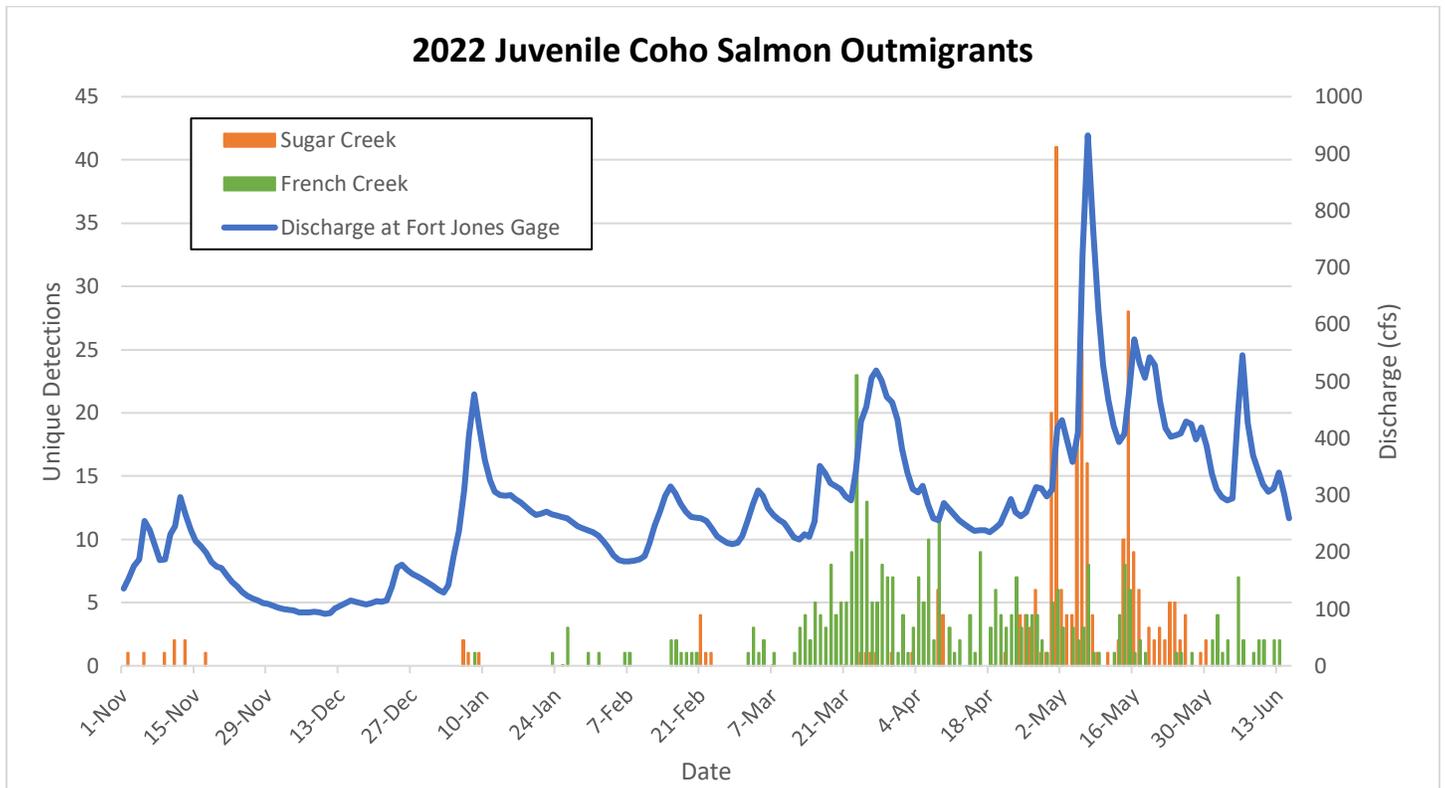


Figure 6. Number of outmigrants from French and Sugar Creek compared to discharge, 2021-2022.

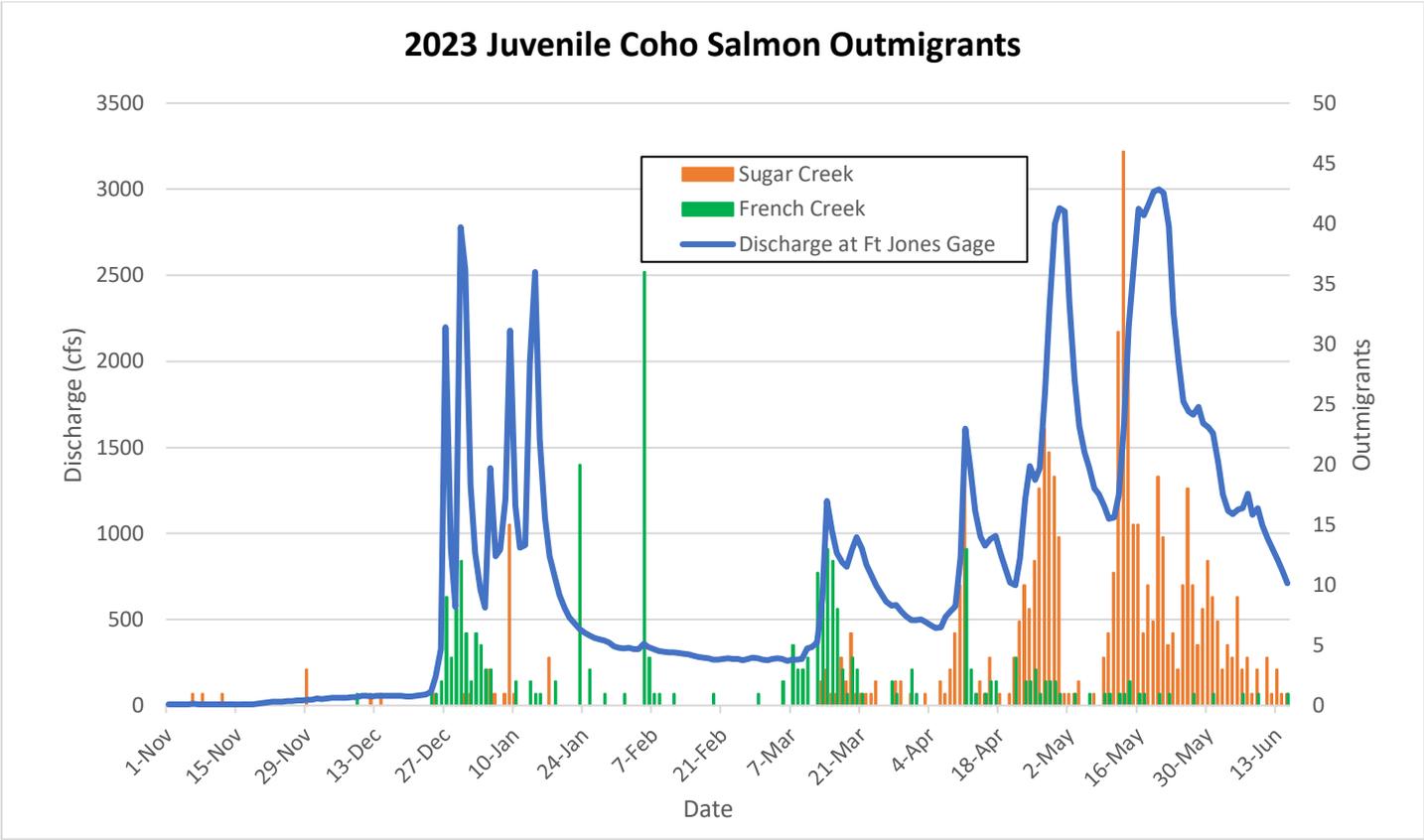


Figure 7. Number of outmigrants from French and Sugar Creek compared to discharge, 2022-2023.

Biometric Comparison

Regarding Sugar Creek, average YOY Coho Salmon forklength in 2021-2022 fish season sampling events was consistently greater than in the 2022-2023 sampling events. On French Creek there was not such a clear trend, with the hierarchy of forklengths varying based on the year and month of the sampling (Table 5, Figure 8).

	Average Forklength (mm)		
	July/August	January	March
Sugar BDA Pond 1 2021-2022	74	97	101
Sugar BDA Pond 1 2022-2023	67	89	89
Sugar BDA Pond 2 2021-2022		95	98
Sugar BDA Pond 2 2022-2023		84	84
French FRGP Side Channel 2021-2022	60	71	73
French FRGP Side Channel 2022-2023	68	71	82
French Side Channel BDA Pond 2021-2022		75	87
French Side Channel BDA Pond 2022-2023		81	86
French Control Pools 2021-2022		76	75
French Control Pools 2022-2023		69	66

Table 9. Comparison of average YOY Coho Salmon forklengths at sampling events, 2022 and 2023 fish years.

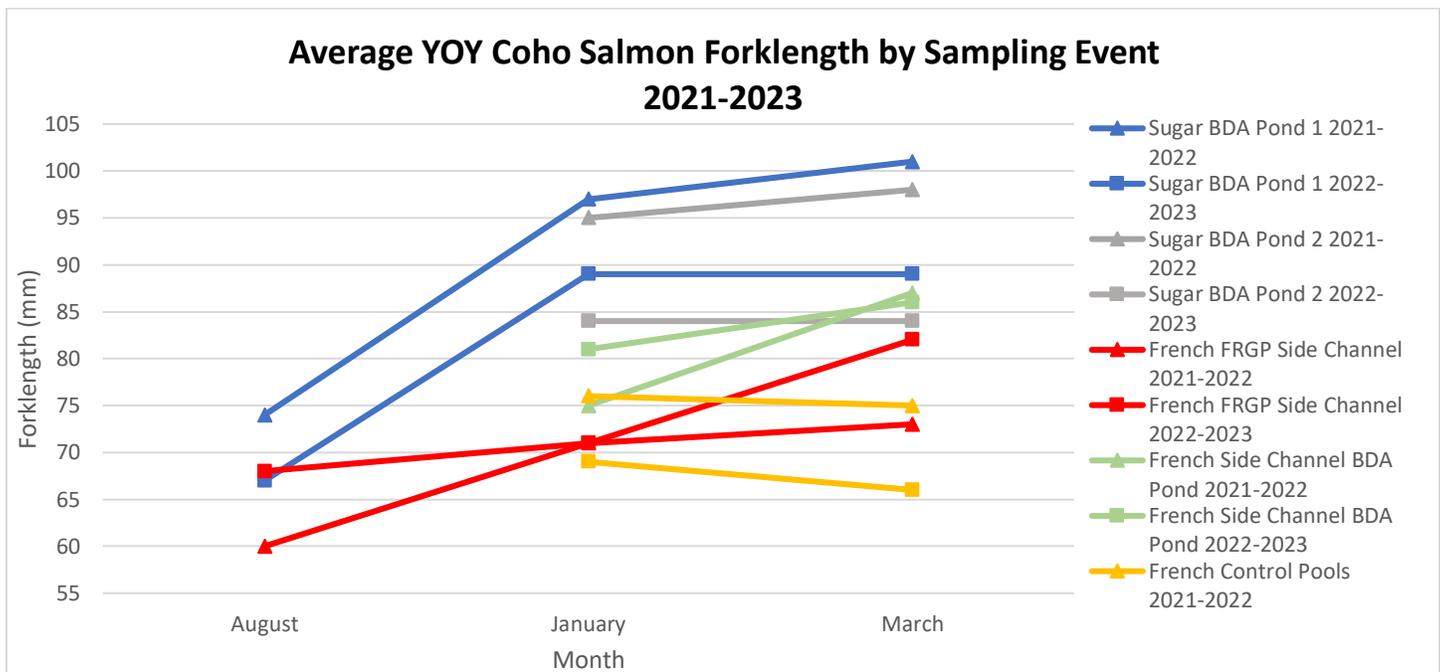


Figure 8. Comparison of average YOY Coho Salmon forklengths at sampling events, 2022 and 2023 fish years.

2022-2023 Adult Coho Salmon Monitoring

Methods

SRWC operated a PIT tag detection antenna on the CDFW weir at RKM 29.2 on the mainstem Scott River during the adult return period until December 26th, when the weir was disassembled. Maintenance checks and data downloads were

performed weekly at this station. Another adult detection antenna was operated on a CDFW weir on the Shasta River at RKM 0.2. This station was checked and downloaded every two weeks.

In addition to remote monitoring, SRWC also conducted spawning ground surveys on sections of French Creek, Miners Creek, Sugar Creek and the mainstem Scott River. Two-person crews walked each of these reaches 3-4 times between January 4th and January 27th, 2023. Observations of live salmonids and redds were noted, and biodata was taken from carcasses.

Findings

In December 2022, three PIT-tagged adult Coho Salmon were detected passing through the CDFW weir, two of which were then detected entering French Creek. All three fish had been tagged in the French Creek watershed in the 2020-2021 fish season. Interestingly, one of the three was last detected leaving French Creek in late November 2020 (Table 6). It is possible that additional PIT tagged adult Coho returned to the Scott watershed after the weir removal, but if so none of these fish were detected entering French Creek or Sugar Creek. The Shasta River PIT station only recorded one detection this season, a Coho that had been tagged by the Karuk Tribe in the Klamath River at the mouth of Independence Creek.

Date	Stream	Location of Detection	Distance (km)	PIT Code	FL (mm)	Weight (g)
2/26/2021	Miners Creek	Miners Below Upper BDA		989001039965887	76	5.1
4/2/2021	French Creek	Mid French Creek RKM 4.5	0.15	989001039965887		
4/2/2021	French Creek	Mid French Mainstem RKM 3.1	1.4	989001039965887		
4/2/2021	French Creek	Mid French Mainstem RKM 2.9 - US	0.2	989001039965887		
4/2/2021	French Creek	Mid French Mainstem RKM 2.9 - DS	0	989001039965887		
12/14/2022	Scott River	Scott Weir RKM 29.2		989001039965887		
12/25/2022	French Creek	Mid French Mainstem RKM 2.9 - US	51.3	989001039965887		
10/7/2020	French Creek	French Control Pool 3		989001038203611	66	2.8
11/25/2020	French Creek	Mid French Mainstem RKM 2.9 - US	1.6	989001038203611		
12/26/2022	Scott River	Scott Weir RKM 29.2		989001038203611		
1/1/2023	French Creek	Mid French Mainstem RKM 2.9 - US	51.3	989001038203611		
12/15/2020	French Creek	FRGP Side Channel		989001038203477	77	4.8
12/16/2020	French Creek	FRGP Side Channel	0	989001038203477		
1/26/2021	French Creek	FRGP Side Channel	0	989001038203477	80	5.1
2/1/2021	French Creek	FRGP Side Channel	0	989001038203477		
2/1/2021	French Creek	FRGP Side Channel	0	989001038203477		
5/28/2021	Scott River	Scott Weir RKM 29.2	51.5	989001038203477		
12/24/2022	Scott River	Scott Weir RKM 29.2		989001038203477		
9/22/2020	Klamath River	Independence Creek Mouth		989001028154351	83	6.3
12/12/2022	Shasta River	Shasta Weir - RKM 0.2	80	989001028154351		

Table 10. PIT-tag detection history of Coho Salmon spawners in 2022-2023

As mentioned earlier in this document, a large spike in discharge occurred in late December/early January. These environmental conditions added difficulty to spawning ground surveys, with increased turbidity and volume potentially

obscuring fish presence. Nonetheless, several live Coho and active redds were observed, as well as three carcasses: two on French Creek and one on Sugar Creek (Table 7).

Stream	French Creek	Miners Creek	Sugar Creek	Scott River
Distance Covered (km)	1.4	0.35	1.2	0.3
Live Coho Observed	3	0	1	2
Redds Observed	3	0	2	0
Coho Carcasses Observed	2	0	1	0

Table 11. Summary of SRWC spawning ground survey effort in 2023.

Other Species

SRWC staff encountered a number of different aquatic species while conducting sampling with seines and minnow traps. After Coho Salmon, the most common fish was rainbow trout/steelhead (*Oncorhynchus mykiss*). The most common non-salmonid was speckled dace (*Rhinichthys osculus*) (Table 8-9).

French Creek		
Species	Count	Months Encountered
Coastal Giant Salamander (<i>Dicamptodon tenebrosus</i>)	1	8
Crayfish (species unknown)	3	8, 9, 11
Marbled Sculpin (<i>Cottus klamathensis</i>)	9	8, 9, 10, 11, 3
Pacific Lamprey (<i>Entosphenus tridentatus</i>)	1	1
Rainbow Trout (<i>Oncorhynchus mykiss</i>)	143	8, 9, 10, 11, 1, 3
Speckled Dace (<i>Rhinichthys osculus</i>)	541	8, 9, 10, 1, 3
Threespine Stickleback (<i>Gasterosteus aculeatus</i>)	4	9, 11

Table 12. Additional species captured in French Creek sampling events.

Sugar Creek		
Species	Count	Months Encountered
Chinook Salmon (<i>Oncorhynchus tshawytscha</i>)	44	8, 9, 10, 2
Coastal Giant Salamander (<i>Dicamptodon tenebrosus</i>)	2	9
Crayfish (species unknown)	2	8
Klamath Smallscale Sucker (<i>Catostomus rimiculus</i>)	3	2
Marbled Sculpin (<i>Cottus klamathensis</i>)	17	9, 10, 2, 3
Rainbow Trout (<i>Oncorhynchus mykiss</i>)	588	8, 9, 10, 2, 3, 4
Speckled Dace (<i>Rhinichthys osculus</i>)	72	8, 9, 10
Threespine Stickleback (<i>Gasterosteus aculeatus</i>)	23	8, 9, 10, 4

Table 13. Additional species captured in Sugar Creek sampling events.