Napa River Steelhead and Salmon Monitoring Program
2021-2023 Report

NAPA RCD

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Prepared by

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Executive Summary

This update covers Napa County Resource Conservation District's fish monitoring efforts for the 2021, 2022, and the 2023 sampling seasons.

The program utilizes a rotary screw trap to sample fish on the Napa River mainstem, which ideally is operated between March 1 and May 31 for a total of 92 potential sampling days. In general, the 2021 – 2023 sampling seasons posed many challenges that limited our ability operate the rotary screw trap, and thus effectively monitor salmonid populations in the watershed. No trapping occurred in 2021 due to exceptionally low flows. Again, due to exceptionally lowflow conditions throughout spring, the trap was only in operation for 12 days in the 2022 season. Conversely, the 2023 season was delayed due to high flows but was operated for 29 days. All in all, few steelhead smolts were sampled, with 2 being captured in 2022 and 5 in 2023. We sampled 281 steelhead parr in 2022, which is unusual given the proximity of the trap to tidal areas. This may reflect the relatively low flow conditions, and thus limited spawning opportunities for adult steelhead. Steelhead smolt size exhibited variation between 2022 and 2023 but has generally remained stable over the program's history, despite considerable variation in environmental conditions within that same period.

A total of 388 and 354 Chinook parr/smolts were captured in spring 2022 and 2023, respectively. In general, Chinook catch rates have exhibited a high degree of variability over the past 12 years, ranging from 0 - 101.5 smolts captured per sampling day. Chinook abundance in any given year appears to be primarily dependent upon natural variability in the amount and timing of rainfall, and inputs of stray salmon from other river systems.

As in previous years, both the 2022 and 2023 sampling seasons were dominated by native fish species, with counts of native fish exceeding >95% of the catch.

A total of 6 steelhead smolts were PIT tagged in 2022 and 2023. Our program has tagged a total of 570 steelhead smolts, with six having been re-detected in subsequent years by the Napa River PIT tag antenna. These tagging data represent the first known confirmation of steelhead returning to the Napa River.

We conducted a total of 5 spawner surveys over the three monitoring seasons with very limited observations of spawning activity in the 2021 and 2022 seasons. Moderate Chinook spawning activity was observed in 2023.

Introduction

In 2009, the Napa County Resource Conservation District (RCD) began the Napa River Watershed Steelhead and Salmon Monitoring Program with the goal of better understanding steelhead trout and Chinook salmon populations in the Napa River watershed. Since the program's inception, the RCD has consistently monitored smolt abundance and adult returns. Additionally, the RCD has opportunistically gathered data on salmonid genetics and juvenile distribution.

This monitoring program is intended to provide science-based information to all stakeholders involved in steelhead and salmon management and recovery. In addition to generating data on steelhead and salmon, the monitoring program also provides information about other native fishes and tracks ecological responses to ongoing habitat restoration.

In this update, we provide results from our spring downstream migrant trapping (smolt trapping), fall and winter spawner surveys, and operation of our Passive Integrated Transponder (PIT) tag detection system located in the Napa River for the years 2021, 2022, and 2023. Additional information and previous years' reports can be found at our website: https://naparcd.org/resources/category/watershed-assessments.

Smolt Trapping

Methods

An 8-foot diameter rotary screw trap (RST) was used to capture fish in the Napa River during the spring seasons of 2022 and 2023 (**Figure 1**). The full RST protocol is provided in **Appendix A**. Exceptionally low flow conditions precluded operating the RST during the spring of 2021. Year 2023 represented the 14th year the RCD has operated the RST at the same location, approximately 3.2 kilometers (2 miles) downstream of the Oak Knoll Avenue Bridge (**Figure 2**). The RST site was selected based on accessibility, landowner cooperation, and its location just upstream of tidal influence. Approximately 67% (~188 stream kilometers) of the total anadromous salmonid spawning and rearing habitat in the Napa River watershed is located upstream of this site.

Hydrographs for each of 2021, 2022, and 2023 water years, which also indicate the timing of monitoring activities and salmonid spawning seasons, are provided in **Figure 3**. Generally, the target RST operating period begins on March 1 and extends through early June, or until catch and/or flows diminish.

Figure 1. Napa River rotary screw trap

The 2021-2023 water years posed many monitoring challenges. Due to exceptionally low flow conditions in spring 2021, there was insufficient water velocity to spin the trap during the entire season. Similarly, spring 2022 offered few opportunities to operate the RST due to relatively low flows. In contrast, the spring 2023 RST season was delayed due to high flow conditions. The RST was in operation for 0 days in 2021, 12 days in 2022, and 29 days in 2023 (**Figure 4**). As a result, the entire 2021 season was not sampled, and 80 potential sampling days for 2022 and 63 potential sampling days for 2023 within the target period from March 1 to June 1 were missed due to either low or high flow conditions.

While in operation, crews checked the trap at least once per day to process the catch and remove debris. The trap was only operated Monday through Friday for the spring 2023 season. Fish captured in the trap were processed according to the procedures described in **Appendix A**.

A sub-sample of steelhead and Chinook smolts captured each week were marked with a small fin clip, and a PIT tag in the case of steelhead, then transported in buckets upstream approximately 1 kilometer (0.6 miles) for release. Typically, the number of these marked fish that are subsequently recaptured is used to generate weekly and season-long trap efficiency estimates. However, trap efficiency estimates were not calculated for the 2021 – 2023 seasons due to low or no catch.

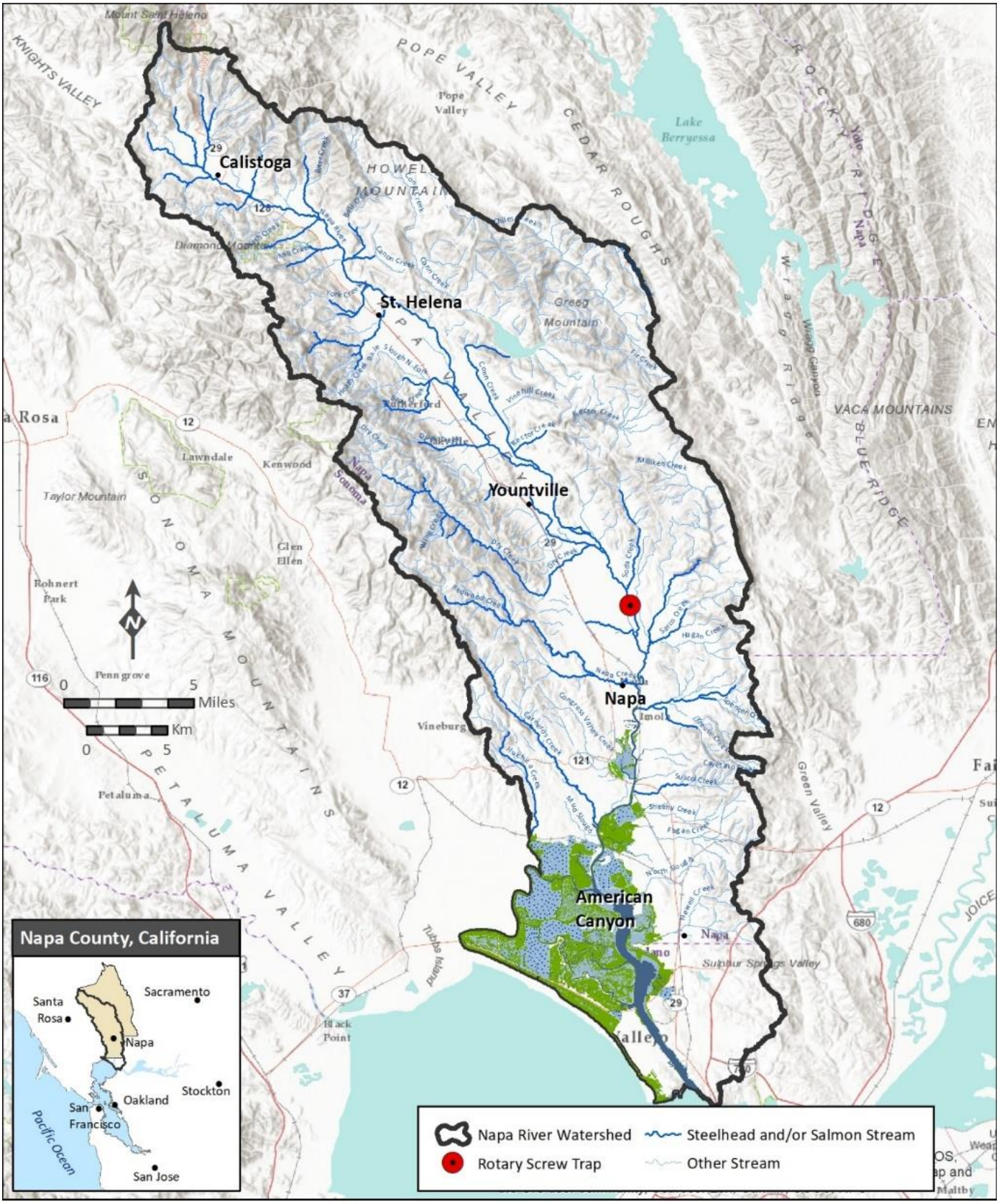

Figure 2. Napa River rotary screw trap location.

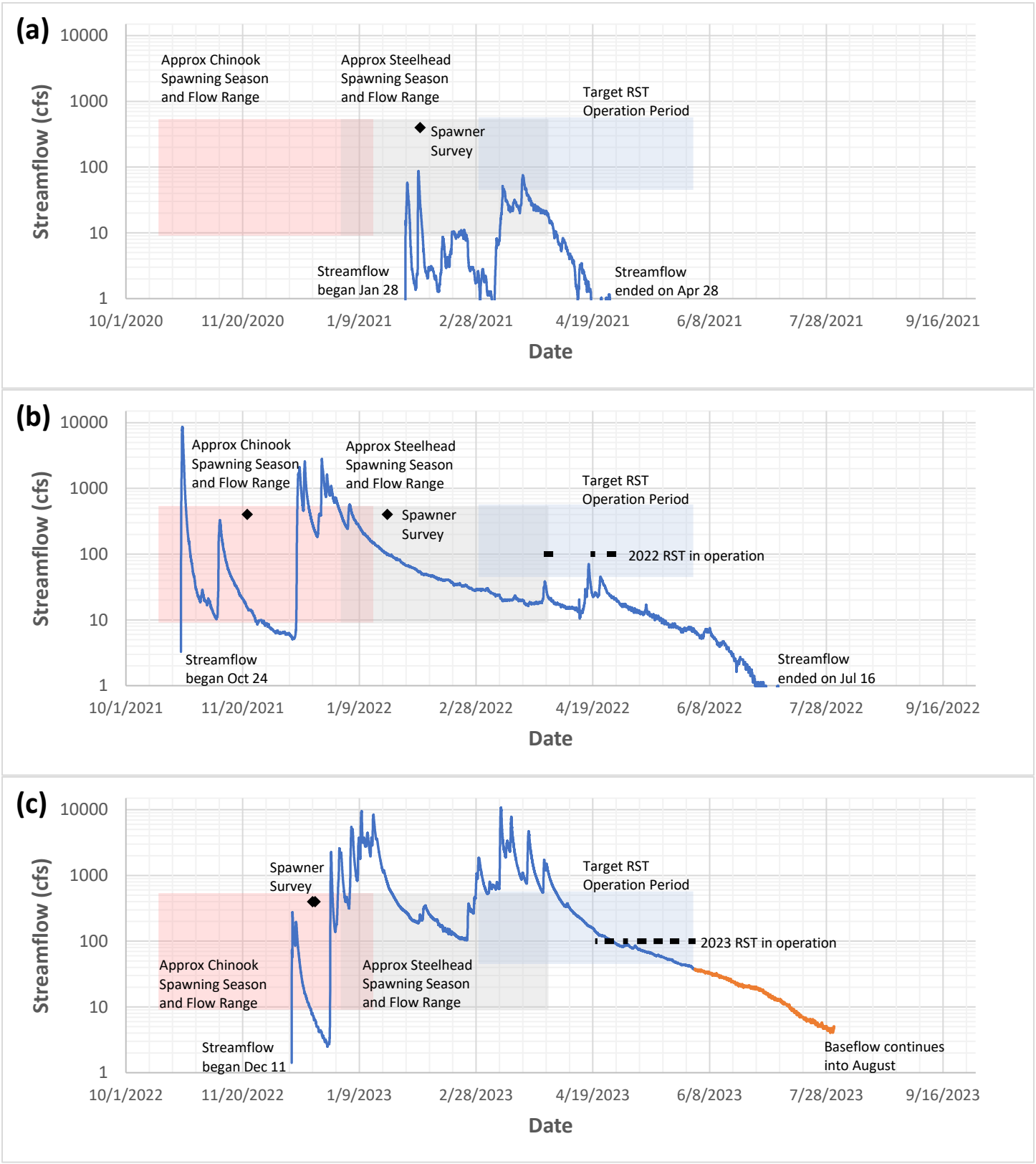

Figure 3. (a) Water Year (WY) 2020-21, (b) WY 2021-22, and (c) WY 2022-23 hydrographs for USGS streamgaging station 11458000 Napa River near Napa, California, showing storm timing and fieldwork. Black diamonds indicate when spawner surveys were conducted, and black lines indicate when the RST was operated. The blue line represents "approved" discharge data and the orange line represents "provisional" discharge data at the time of reporting.

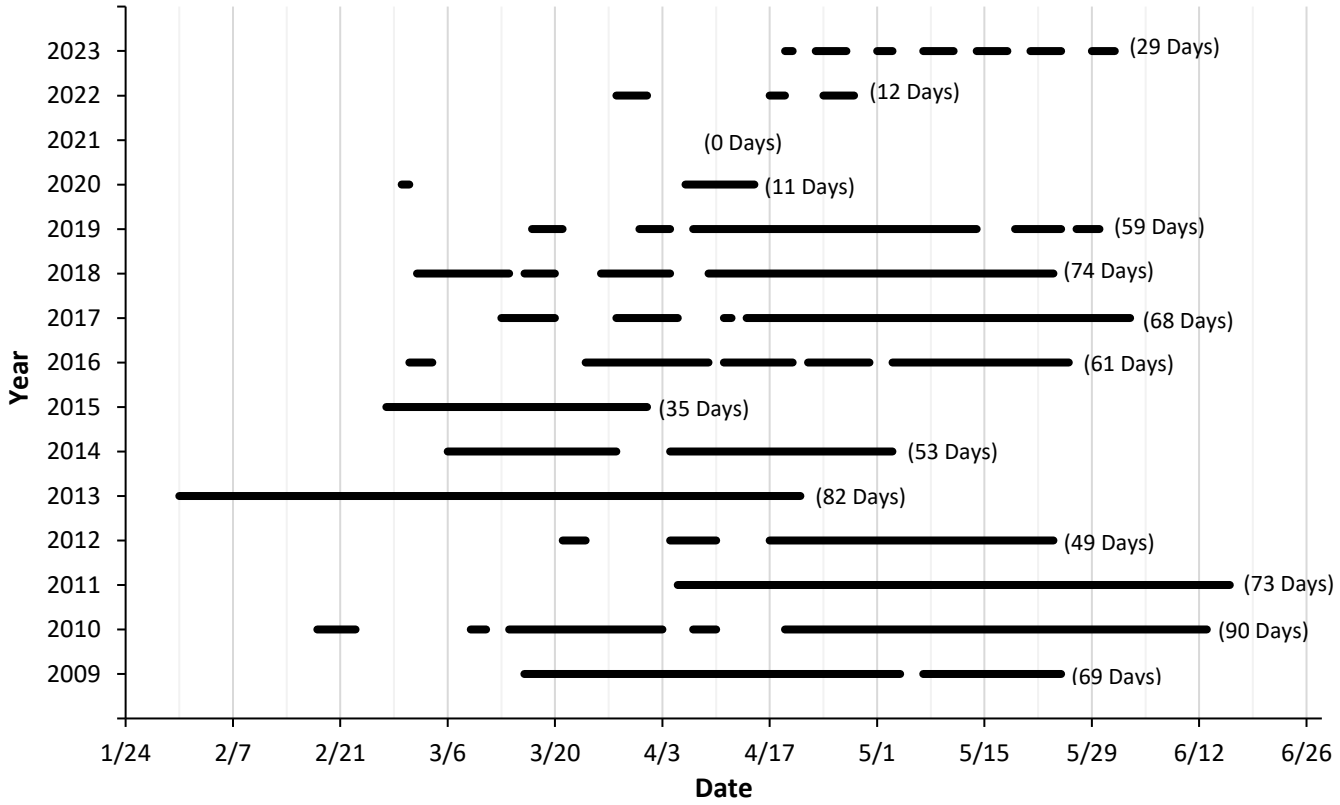

Figure 4. Dates of operation for the Napa River rotary screw trap from 2009-2023. Note: the total number of sampling days per year is shown in parentheses. Gaps within each sampling year represent periods when the trap was not operated due to high flows, low flows, or other factors.

Results and Discussion

In spring 2022 and 2023, we captured a total of 1,999 and 750 fish, respectively. In 2022, we sampled 12 native and 7 non-native species, while in 2023, we sampled 11 native and 9 non-native species (**Figure 5**). As with previous years, native species made up over 95% of the total catch. Note that this count excludes the larval stages of some species, such as the Sacramento sucker, three-spine stickleback, and California roach, which were often too numerous to be accurately counted, as has been the case in previous years.

Appendix B provides count totals for each fish species as well as incidentally captured non-fish taxa from 2009-2023.

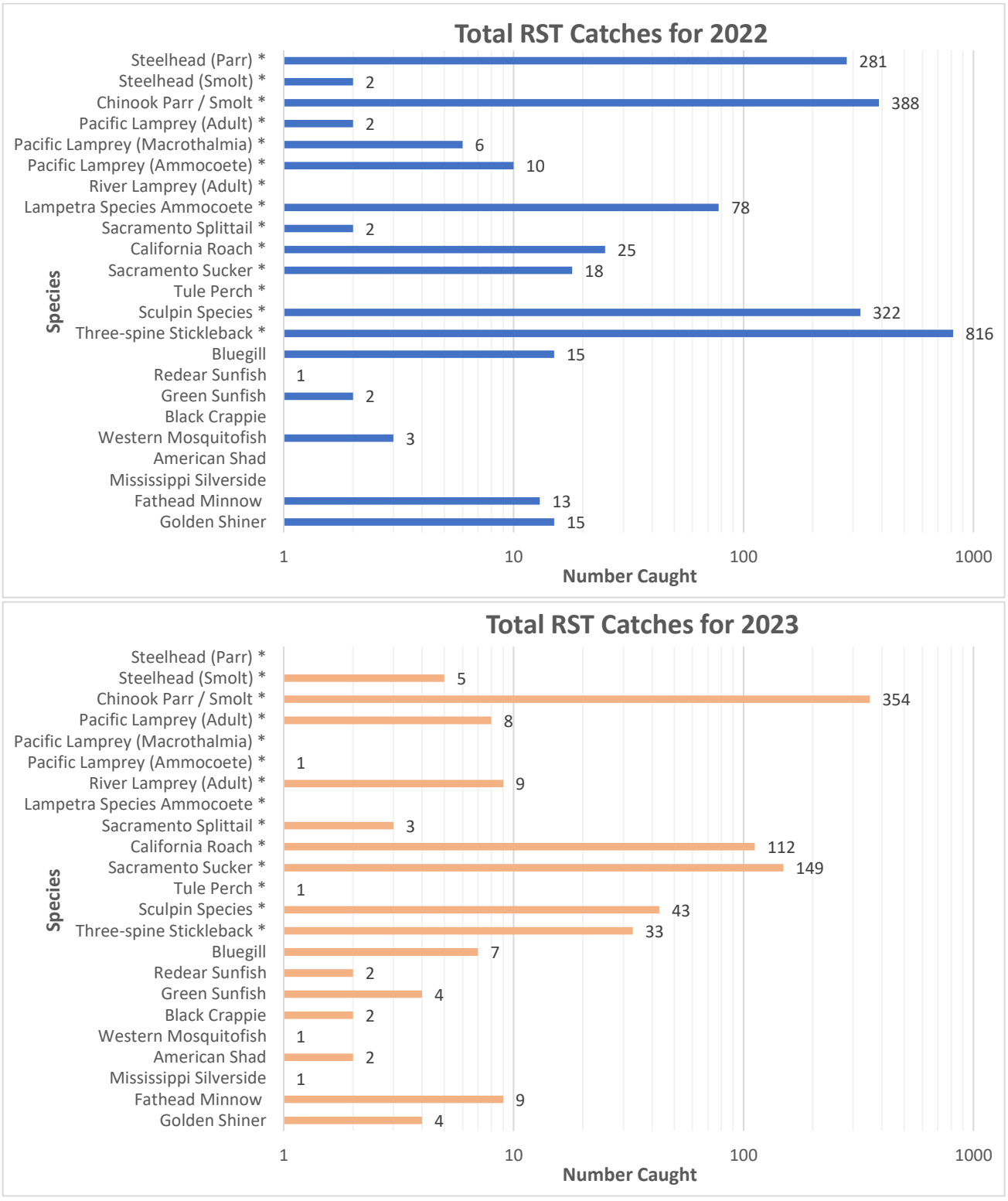

Figure 5. 2022 (top) and 2023 RST season catch totals, excluding larval specimens.
*Native species

Steelhead and Salmon Smolt Catch

In the 2022 RST sampling season, a total of 2 steelhead smolts and 388 Chinook salmon smolts were captured, while in the 2023 season, 5 steelhead smolts and 354 Chinook salmon smolts were captured. Additionally, during the 2022 season, 281 steelhead parr were captured, which is unusual because our sampling location is near where the river becomes tidally influenced and parr are usually found in the tributaries or farther upstream. The high number of parr, their limited early post-emergence movement, and the relatively low flow conditions adult steelhead experienced during their migration suggest that there may have been more steelhead spawning activity in the mainstem than is usual. In spring 2023, the high river flow, as well as RST repairs, delayed operating the RST until April 20th, with the typical peak steelhead smolt outmigration occurring around April 1st in any given year. This could partially explain the relatively low catches for the 2023 season. Chinook smolt catch-per-unit-effort (CPUE) from our rotary screw trap efforts was 24 smolts/day in 2022 and 12.2 smolts/day in 2023, which is relatively close to our program's long-term average of 16.8 smolts/day.

The sampling seasons for these years were exceptionally brief, and the sample sizes were limited, which precluded the calculation of steelhead CPUE for comparison with previous years. Nevertheless, it is important to highlight that despite the challenges posed by low and high flow conditions during the 2022 and 2023 seasons, our data confirm that both steelhead and Chinook were able to complete their life cycles and successfully migrate to the ocean.

Steelhead Smolt Size

In 2022, the median fork length of steelhead smolts was 202 millimeters (8.0 inches), which is larger than the program’s previous 12-year average of 188 (7.4 inches). The median size in 2023 was 178 millimeters (7.0 inches). Median steelhead smolt size has remained relatively stable during the monitoring program’s history with a range of 170 - 206 millimeters (6.7 - 8.1 inches), despite considerable variation in environmental conditions within the monitoring period (**Figure 6**).

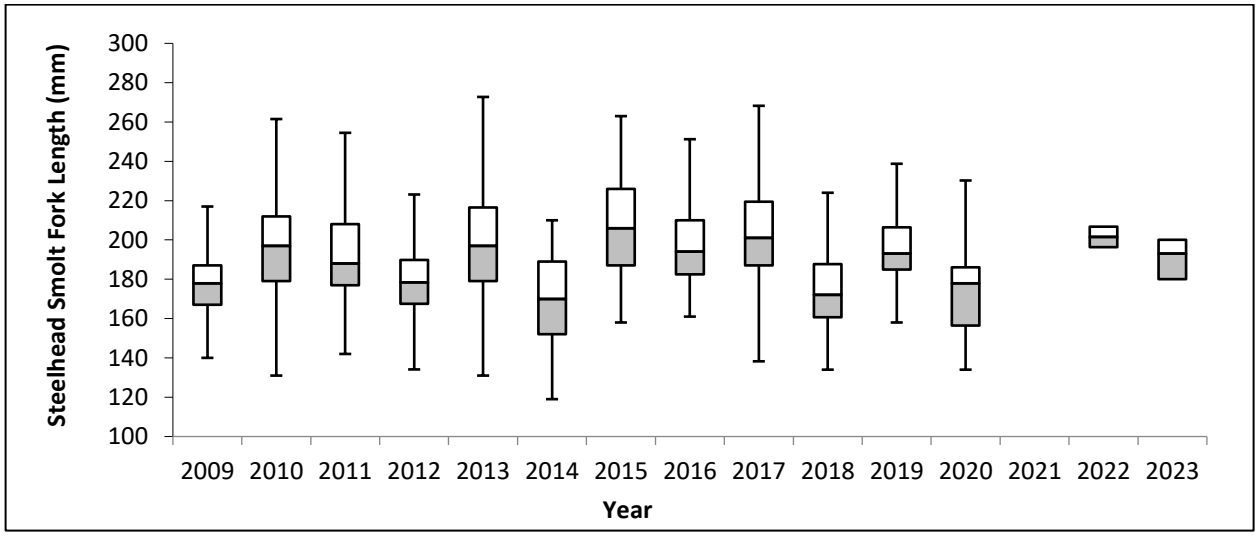

Figure 6. Steelhead smolt fork lengths from the Napa River rotary screw trap 2009-2023. The bottom and top of each box are the 25th and 75th percentiles respectively. The line near the middle of each box is the median, and the vertical lines (whiskers) represent the lowest and highest values within 1.5 times the inter-quartile range. Note: No fish were sampled in 2021, and sample sizes were relatively small in the year 2022 and 2023.

Trapping Efficiency

Trapping efficiency was not calculated for the 2022 or 2023 smolt trapping season, due to the extremely limited sampling period and low overall catch. The trapping efficiency for the first 11-year period of this monitoring program has been approximately 13% for steelhead and approximately 25% for Chinook. For further details and discussion on this topic, see reports from previous years.

PIT Tagging

Methods

Passive Integrated Transponder (PIT) tags were used to uniquely identify and track individual steelhead in the Napa River. Steelhead smolts larger than 130 mm fork length were anesthetized and implanted with 12 mm half-duplex (HDX) tags using a Biomark injection gun. Tagged fish were then scanned with a handheld tag reader and the unique tag code was recorded in the RCD's database.

A pair of stationary PIT tag antenna loops located in the Napa River approximately 20 meters upstream of the RST was operated continuously throughout the 2021-2022 seasons but sustained damage and was out of operation during the 2023 water year (**Figure 7**).

Figure 7. Paired PIT tag antenna loops in the Napa River.

Results and Discussion

During the 2022 and 2023 out-migrant trapping seasons, a total of 6 steelhead smolts received PIT tags. From 2013 – 2023, RCD has tagged a total of 570 steelhead smolts (**Figure 8**). Of that total, six individual steelhead have been re-detected in subsequent years by the Napa River PIT tag antenna (**Table 1**). These tagging data confirm steelhead reproduction and return spawning within the Napa River watershed. No returning fish have been detected since 2018, likely reflecting a combination of adverse dry conditions and scarce tagging opportunities.

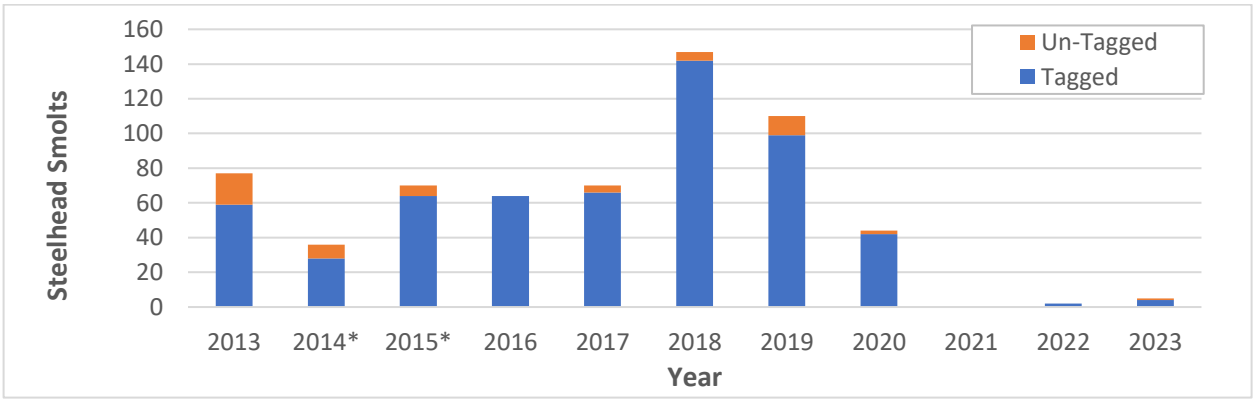

Figure 8. Number of PIT tagged steelhead smolts relative to the total catch 2013-2023. *Note: 2014 and 2015 included steelhead captured in fyke nets in Sulphur and York Creeks in addition to the RST.

Table 1. PIT tagged steelhead re-detected by the Napa River PIT tag antenna in subsequent years.

Date Tagged	Tagging Location	Length (mm)	Weight (g)	Re-Detection Date	Days between tagging and re-detection
4/1/2016	Napa River RST	192	65.1	3/1/2018	699
4/2/2016	Napa River RST	201	85.1	3/1/2018	698
5/12/2017	Napa River RST	193	68.4	2/17/2019	646
3/18/2018	Napa River RST	190	63.5	3/11/2020	724
4/17/2018	Napa River RST	185	68.1	2/17/2020	671
4/23/2018	Napa River RST	185	65.1	3/19/2019	330

Spawner Surveys

Methods

Spawner surveys were conducted according to the RCD Spawner Survey Protocol, which is based on the methodology described in the California Salmonid Stream Habitat Restoration Manual published by the California Department of Fish and Wildlife (CDFW 1998). Kayak surveys were conducted on the Napa River mainstem once sufficient rainfall had occurred and continuous base flow had been established. During each survey, the crew continuously scanned areas likely to be used by spawning salmonids. Polarized sunglasses were used to improve visibility and detection of underwater features. The following data, along with the geographic coordinates of each observation, were recorded:

- Salmon (live) - total count, species, sex
- Salmon (carcass) - count, species, sex, length, presence/absence of adipose fin, condition
- Redd - total count, species, area, habitat type, occupied/not occupied

Results and Discussion

No fish or redds were observed during the single 2021 spawner survey (**Table 2**). Streamflow began in late January 2021, which is outside the optimal Chinook salmon spawning season, thereby potentially restricting the available spawning opportunities for the season (**Figure 3a**). A single fish and zero redds were observed during the two 2022 water year spawner surveys. The results of our surveys contrast with anecdotes of fish sightings from the community and our capturing of Chinook smolts in the rotary screw trap in 2022. This in combination with the anecdotal evidence suggests

there were spawning opportunities in the 2022 water year for Chinook salmon. Two spawner surveys were conducted in the 2023 water year, covering approximately 8.2 mi (13.2 km) of the mainstem Napa River (**Figure 9**). During these surveys, 20 redds, 25 live salmon, and six carcasses were observed (**Table 2**). The results of the 2023 water year spawner surveys suggest there were spawning opportunities.

Table 2. 2021-2023 Chinook salmon kayak spawner survey details and results.

Date	2/4/2021	11/22/2021	1/21/2022	12/20/2022	12/21/2022
Water Year	2021	2022	2022	2023	2023
Stream	Napa River	Napa River	Napa River	Napa River	Napa River
Flow (cfs)	25	8	6	7	7
Flow source	Oak Knoll Ave USGS gage	Oak Knoll Ave USGS gage	Dunaweal Lane ALERT gage	Pope Street USGS gage	Pope Street USGS gage
Survey Extent	Oakville Cross Road to bottom of OVOK Group C	Bottom of OVOK Group C to Oak Knoll Ave	Lincoln Ave Calistoga to Bale Lane	Bale Lane to Pope Street	Oakville Cross Road to Yountville Cross Road
Survey Length (mi)	4.05	4.55	4.77	4.95	3.27
Survey Length (km)	6.52	7.32	7.68	7.97	5.26
Live Chinook	0	1	0	25	0
Chinook carcasses	0	0	0	4	2
Redds	0	0	0	15	5

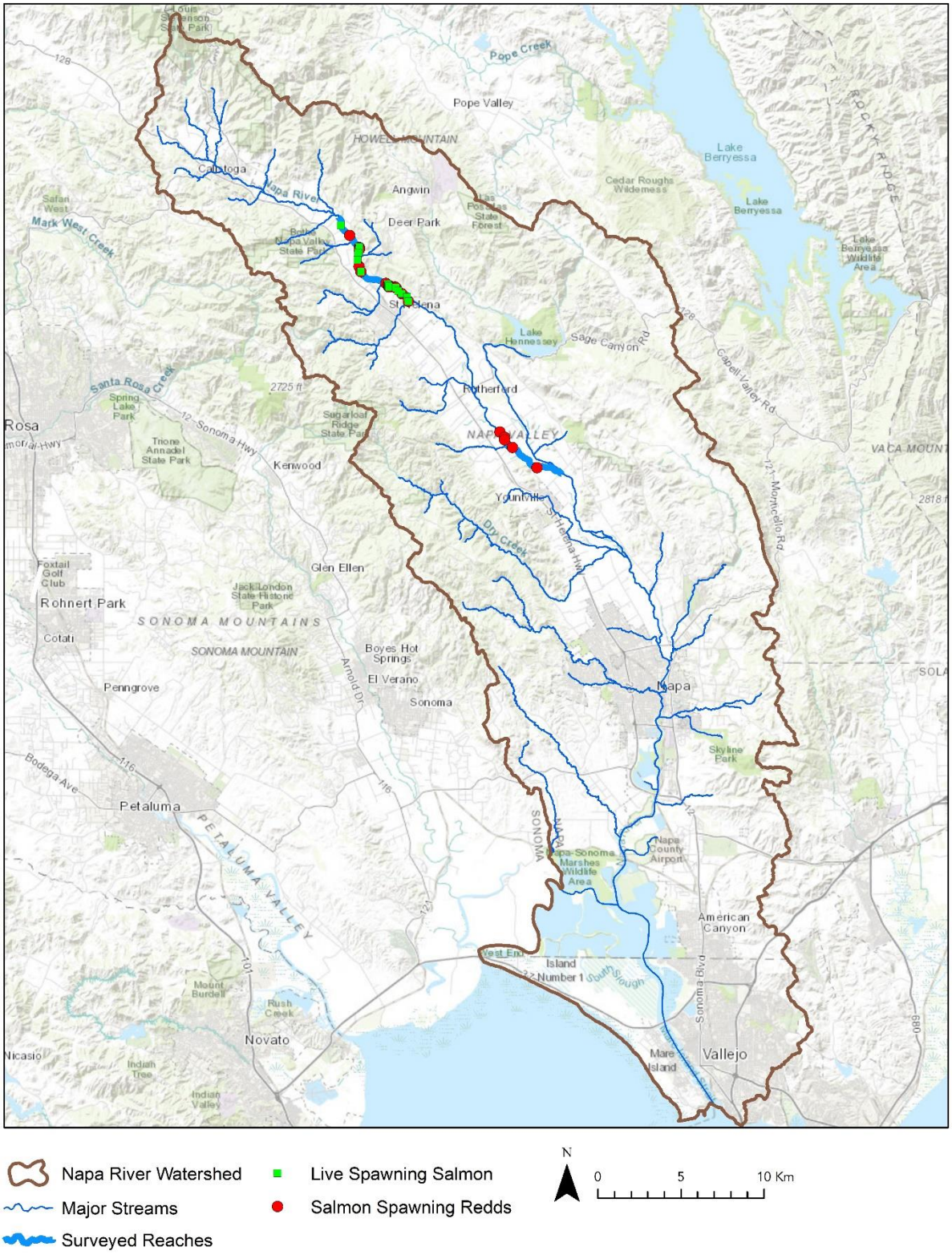

Figure 9. WY 2023 spawner survey results. Note: Spawner surveys conducted during WY 2021 and WY 2022 are not shown due to low observations of fish and redds (see Table 2).

Anticipated Monitoring in 2023 and 2024

At the time of reporting, the RCD has funding from the California State Coastal Conservancy and local partners to continue Napa River rotary screw trap monitoring and spawner surveys through 2024. The PIT tag antenna sustained unrepairable damage during WY 2023 high flow events and is scheduled to be rebuilt during the 2024 low flow period.

References

California Department of Fish and Wildlife (CDFW). 1998. California Salmonid Stream Habitat Restoration Manual. http://www.dfg.ca.gov/fish/Resources/HabitatManual.asp.

List of Appendices

Appendix A: Smolt Trap Processing Procedure

Appendix B: Rotary Screw Trap Season Totals 2009-2023

Appendix A: Smolt Trap Processing Procedure

Species	Life Stage	Mark/ Recapture	Number per day	Processing Procedure	Release location
Steelhead	**FRY** ≤ 40mm	-	All	Count and release	Downstream
	PARR 40 - 130 mm	-	All	Count and release	Downstream
	SMOLT ≥ 130 mm	NEW	First 30	1. Anesthetize and record length / weight 2. Apply pelvic fin clip and record **unique genetics ID #** 3. Insert PIT tag and record tag #	Upstream (Mon-Fri) Downstream (Sat, Sun)
			31+	Count and release	Downstream
		RECAP	All	1. **Do not anesthetize** 2. Scan for PIT tag and record tag # if detected 3. Record fin clip location, life stage, and notes on condition	Downstream
	ADULT ≥ 300mm	-	All	1. **Do not anesthetize** 2. Scan for PIT tag and record tag # if detected 3. Record sex, estimated length, and any fin clips observed 4. Collect caudal fin clip and record **unique genetics ID #** 5. Take pictures of fish while holding in water	Downstream
Chinook	**FRY** ≤ 40mm	-	All	Count and release	Downstream
	PARR / SMOLT ≥ 40 mm	NEW	First 20	1. Anesthetize and record length / weight 2. Apply upper caudal fin clip and record **pooled genetics ID #**	Upstream (Mon-Fri) Downstream (Sat, Sun)
			21+	Count and release	Downstream
		RECAP	All	Count and release	Downstream
River Lamprey	Adult	-	All	1. Anesthetize and record total length, sex, and maturity 2. Take photo on measuring tray	Downstream
Pacific Lamprey	Adult	-	All	Record maturity, sex, and notes on condition	Downstream
All other species	All	-	All	Count and release	Downstream

Appendix B: Rotary Screw Trap Season Totals 2009-2023

Native Fishes

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Steelhead / Rainbow trout	*Oncorhynchus mykiss*																
Fry / Parr (<130 mm)		941	94	7	152	3,025	303	35	11	6	32	1	6	-	281	0	**4,894**
Smolt (>130mm)		119	251	175	160	77	31	34	64	70	147	110	44	-	2	5	**1,289**
Adult or Resident (>300 mm)		0	3	4	0	3	0	0	3	6	3	2	0	-	0	0	**24**
Chinook Salmon	*Oncorhynchus tshawytscha*																
Parr / Smolt		1	1,520	7,377	488	19	0	0	580	2,315	1,922	89	33	-	388	354	**15,086**
Kokanee/ Sockeye Salmon	*Oncorhynchus nerka*																
Parr / Smolt		0	342	0	0	0	0	0	0	0	0	0	0	-	0	0	**342**
Pacific Lamprey	*Entosphenus tridentatus*																
Adult		25	11	38	64	9	14	11	143	31	26	12	0	-	2	8	**394**
Macrothalmia[1,2]		-	-	-	-	1	0	0	3	0	7,203	0	964	-	6	0	**8,177**
Ammocete[1]		-	-	-	9	4	7	30	54	45	314	121	2	-	10	1	**597**
River Lamprey	*Lampetra ayresi*																
Adult[1]		-	2	21	9	3	0	0	86	46	1	21	0	-	0	9	**198**
Macrothalmia[1]		-	-	-	-	15	0	0	1	0	5	1	1	-	0	0	**23**
Brook Lamprey (Adult[1])	*Lampetra richardsoni*	-	0	64	7	174	120	87	77	38	63	20	20	-	0	0	**670**
Lampetra Sp. Ammocete[1]	*Lampetra sp.*	-	-	-	19	108	46	40	136	70	74	148	8	-	78	0	**727**
Sacramento Splittail	*Pogonichthys macrolepidotus*	2	6	0	1	26	0	6	0	6	39	0	0	-	2	3	**91**
Hardhead	*Mylopharodon conocephalus*	0	0	1	0	0	1	1	0	0	0	0	0	-	0	0	**3**
Sacramento Pikeminnow	*Ptychocheilus grandis*	28	87	192	191	33	12	4	27	200	512	63	53	-	0	0	**1,402**
California Roach[2]	*Hesperoleucus symmetricus*	4,744	3,571	336	330	498	691	253	548	249	260	347	112	-	25	112	**12,076**
Sacramento Sucker	*Catostomus occidentalis*	82	419	207	33	78	42	61	166	284	1,060	148	188	-	18	149	**2,935**
Tule Perch	*Hysterocarpus traski*	6	28	30	20	17	8	6	78	51	27	7	1	-	0	1	**280**
Sculpin sp.	*Cottus sp.*	242	124	62	66	329	184	20	51	53	84	215	14	-	322	43	**1,809**
Three-spine Stickleback	*Gasterosteus aculeatus*	116	76	273	50	34	37	14	3,329	465	78	89	3	-	816	33	**5,413**

[1] Juvenile and larval lamprey as well as adult river and brook lampreys were only differentiated consistently beginning with the 2012 season.

[2] Includes estimated numbers during periods of high abundance.

Non-Native Fishes

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Bluegill	*Lepomis macrochirus*	29	100	86	41	11	107	24	221	130	52	21	0	-	15	7	**844**
Redear Sunfish	*Lepomis microlophus*	0	8	0	0	0	1	9	8	2	1	0	0	-	1	2	**32**
Pumpkinseed	*Lepomis gibbosus*	0	0	1	0	0	0	0	0	0	0	0	0	-	0	0	**1**
Green Sunfish	*Lepomis cyanellus*	0	2	5	0	0	19	2	10	15	9	4	1	-	2	4	**73**
Black Crappie	*Pomoxis nigromaculatus*	1	0	1	1	1	0	1	1	7	1	21	0	-	0	2	**37**
Largemouth Bass	*Micropterus salmoides*	2	1	4	3	0	0	1	1	2	47	3	0	-	0	0	**64**
Western Mosquitofish	*Gambusia affinis*	1	0	2	3	1	1	0	4	1	2	3	1	-	3	1	**23**
Wakasagi	*Hypomesus nipponensis*	0	9	0	0	0	0	0	0	0	1	0	0	-	0	0	**10**
Threadfin Shad	*Dorosoma petenense*	0	2	3	1	0	0	0	4	0	0	0	0	-	0	0	**10**
American Shad	*Alosa sapidissima*	0	0	0	0	0	0	0	0	6	6	1	0	-	0	2	**15**
Mississippi Silverside	*Menidia beryllina*	0	12	1	0	0	0	0	14	11	0	8	0	-	0	1	**47**
Fathead Minnow	*Pimephales promelas*	2	4	20	0	2	2	12	11	74	189	43	6	-	13	9	**387**
Common Carp	*Cyprinus carpio*	1	0	0	0	0	0	0	0	0	0	0	0	-	0	0	**1**
Golden Shiner	*Notemigonus crysoleucas*	1	11	18	1	22	2	14	6	27	58	28	0	-	15	4	**207**
White Catfish	*Ameiurus catus*	0	1	0	1	0	0	0	0	0	0	0	0	-	0	0	**2**
Brown Bullhead	*Ameiurus nebulosus*	2	3	3	3	0	2	0	3	3	0	0	0	-	0	0	**19**
Channel Catfish	*Ictalurus punctatus*	1	0	0	0	0	0	0	0	0	0	0	0	-	0	0	**1**
Striped Bass	*Morone saxatilis*	3	2	0	1	0	0	0	8	3	2	1	0	-	0	0	**20**

Non-Fish Taxa

Bullfrog	*Lithobates catesbeiana*																
Larvae		500	1,401	632	111	54	255	368	560	1,457	832	61	12	-	3	159	**6405**
Adult		1	2	5	2	0	1	9	9	3	7	1	0	-	0	0	**40**
Pacific Chorus Frog (Larvae)	*Pseudacris regilla*	0	32	0	0	0	0	0	0	0	0	0	0	-	0	0	**32**
California Toad (Adult)	*Anaxyrus boreas*	0	0	0	0	0	0	0	6	11	21	3	0	-	2	3	**46**
Signal Crayfish	*Pacifastacus leniusculus*	3	103	79	128	123	307	41	64	44	129	47	3	-	0	0	**1071**
Red Swamp Crayfish	*Procambarus clarkii*	40	233	78	46	13	103	25	151	40	283	9	4	-	57	3	**1085**
Red-eared Slider Turtle	*Trachemys scripta elegans*	0	3	1	1	1	0	1	17	1	6	6	0	-	1	4	**42**
Western Pond Turtle	*Actinemys marmorata*	2	1	1	1	1	1	2	4	2	3	4	0	-	1	0	**23**