Napa River Steelhead and Salmon Monitoring Program
2017-18 Report

NAPA COUNTY RCD
Resource Conservation District

November 2018

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BACKGROUND

In 2009, the Napa County Resource Conservation District (RCD) began the Napa River Watershed Steelhead and Salmon Monitoring Program (Fish Monitoring Program) with the goal of better understanding steelhead trout and Chinook salmon populations in the Napa River watershed. Since the program was initiated, the RCD has annually monitored smolt abundance, adult returns, juvenile distribution, and genetic diversity, as funding and environmental conditions allowed.

The purpose of our monitoring and research is to provide science-based information to all stakeholders involved in steelhead and salmon management and recovery. In addition to salmonids, the Fish Monitoring Program also generates information on other native fishes and tracks ecological responses to ongoing habitat restoration.

In this annual 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. Additional information and previous reports can be found on our website at www.naparcd.org/assessment-programs/fisheries-monitoring.

SMOLT TRAPPING

Methods

An 8-foot diameter rotary screw trap (RST) was used to capture steelhead and Chinook smolts in the Napa River in spring 2018 (Figure 1). This was the tenth consecutive 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 above the extent 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.

The target sampling window for the RST is from March 1 through early June, depending on flow conditions. In spring 2018, the RST was in operation from March 2 through May 25 for a total of 1,767 hours (73.6 days). Sampling was halted on May 25, 2018 due to low flows and diminished catch (Figure 3). While in operation, crews checked the trap at least once per day to process the catch and remove debris. Fish captured in the trap were processed according to the procedures outlined in Appendix B. During high-flow conditions, the trap was checked multiple times per day to reduce the risk of injury or mortality to captured fish. If flows became too high to safely access the site, the trap was disabled. During the spring 2018 season, 10 potential sampling days were missed due to high flow conditions (Figure 4).

Figure 1. Napa River rotary screw trap

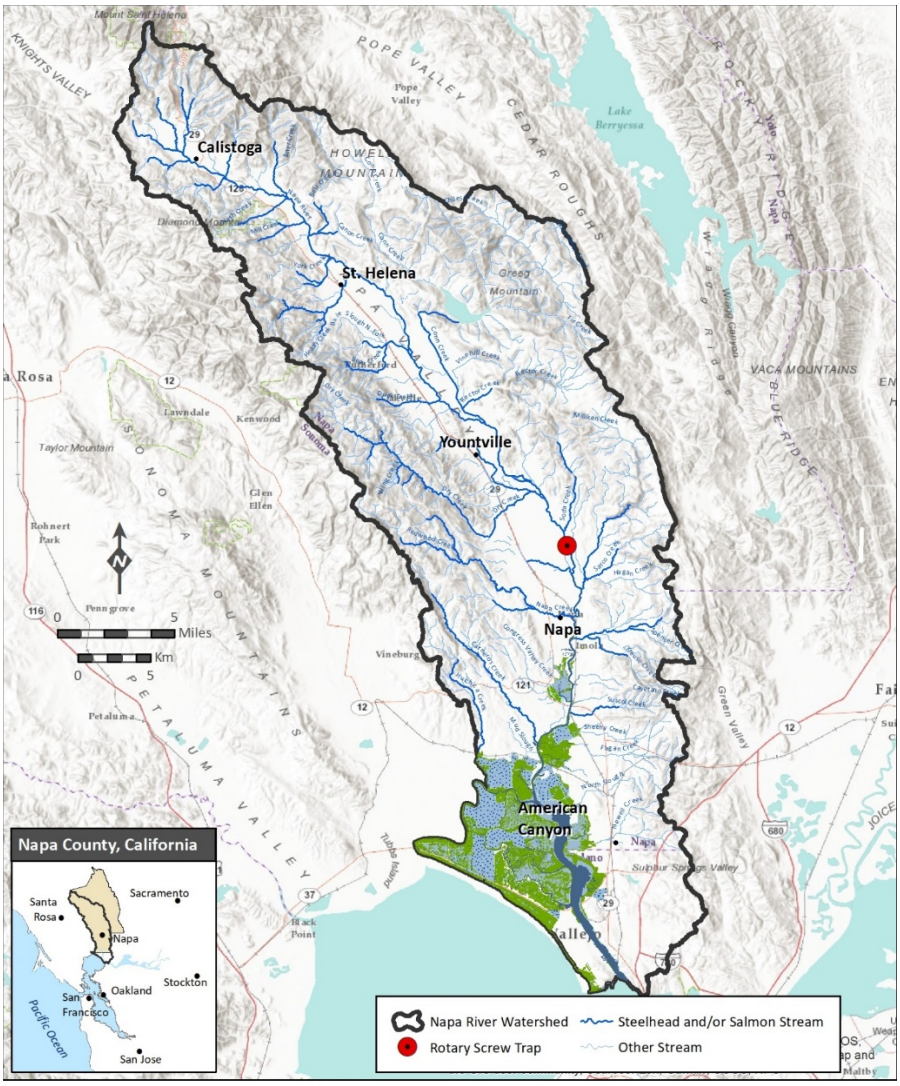

Figure 2. Napa River rotary screw trap location.

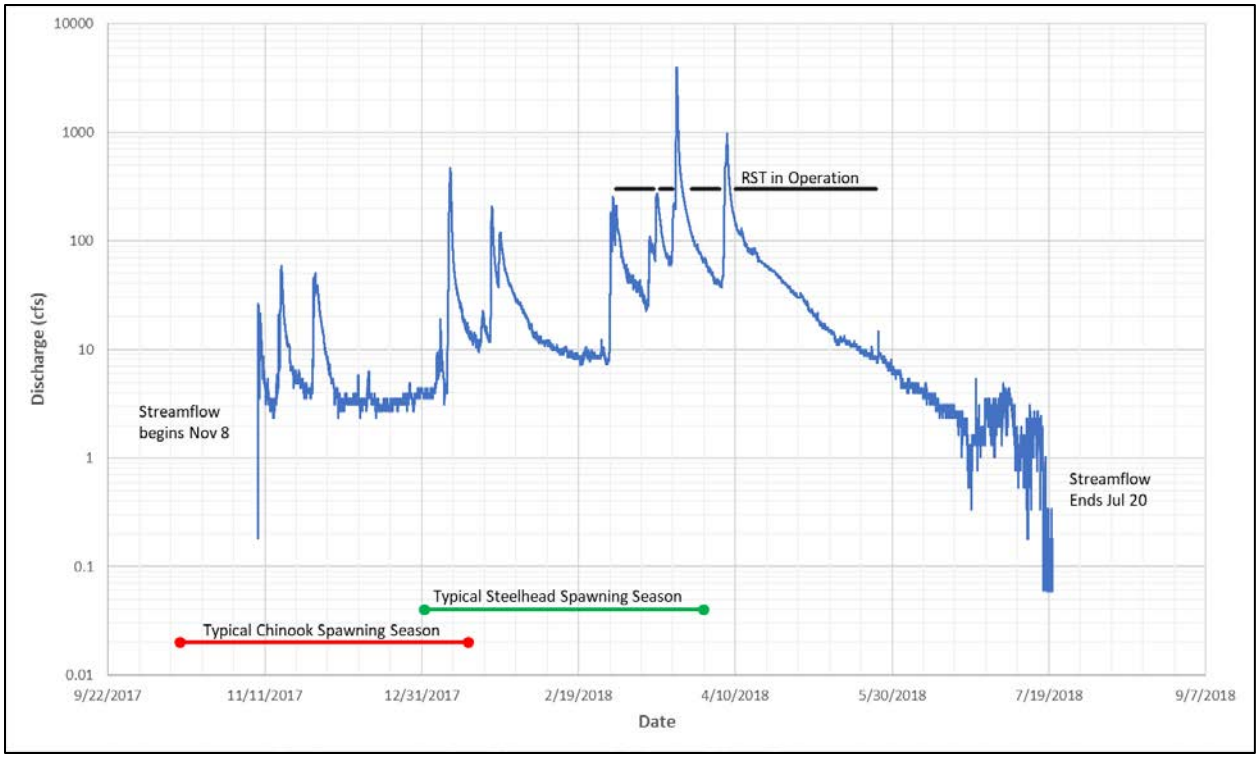

Figure 3. 2017-18 hydrograph for USGS streamgaging station 11456000 Napa River near St Helena, California, showing storm timing and field work.

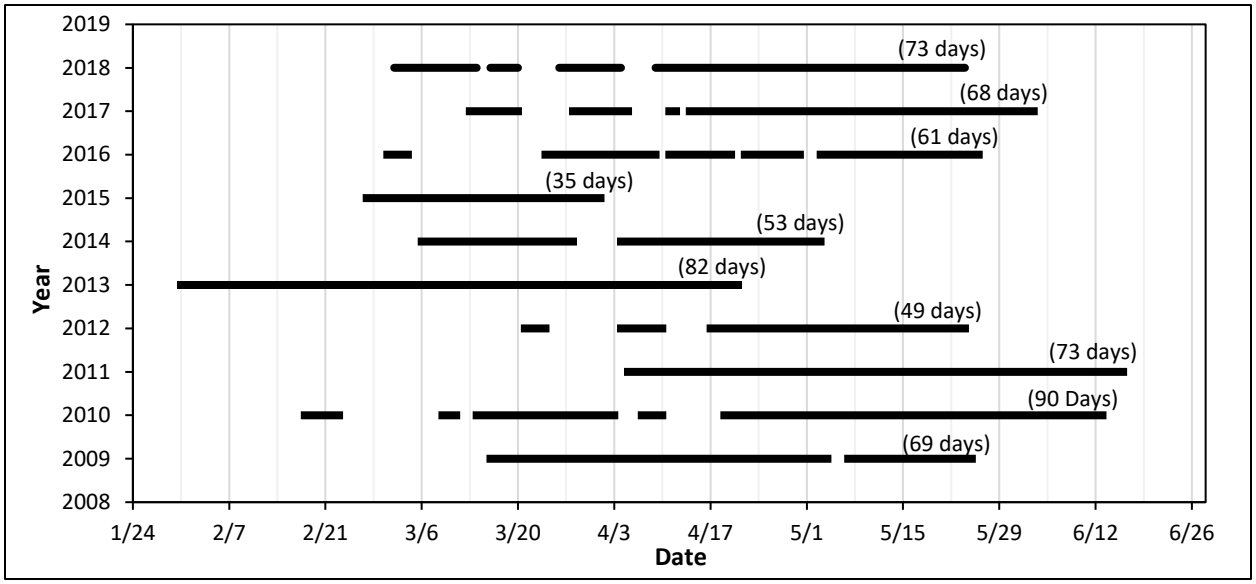

Figure 4. Rotary screw trap periods of operation 2009-2018. Note: the total number of sampling days per year is shown in parentheses. Gaps within each sampling year represent periods when the trap was not operated due to high flows or other factors.

Trapping efficiency was estimated based on weekly mark-recapture trials conducted throughout the season. A fraction of the steelhead and Chinook smolts captured in the RST each week were fin clipped, transported in buckets upstream approximately 1 kilometer (0.6 miles), and released back into the river. The number of these marked fish that were subsequently recaptured was then divided by the total number of upstream releases to generate a season-long trap efficiency estimate. Upstream releases were conducted on weekdays only with a two-day break on weekends. The number of fish that were marked and released each week was variable based on catch rates. Trap efficiency estimates were not able to be calculated during weeks with low or no catch.

Results

During the spring 2018 season, 23 fish species were captured in the RST, including 12 natives and 11 non-natives (Figure 5). Pacific lamprey macrothalmia were by far the most abundant fish captured (Figure 6); however, due to their extreme abundance and challenging physical characteristics (i.e. difficult to hold and identify), an accurate count was not possible. During the first week of operation, an estimated 5,000 Pacific lamprey macrothalmia were captured, and a second pulse of approximately 2,500 were captured two weeks later. Since these counts represent very rough estimates, abundances for this species/life stage were not included in any of the quantitative data analysis for this year. Excluding Pacific lamprey macrothalmia, native fishes comprised 93% of the remaining total catch (n=4,974) and non-native fishes accounted for 7% of the total catch (n=370).

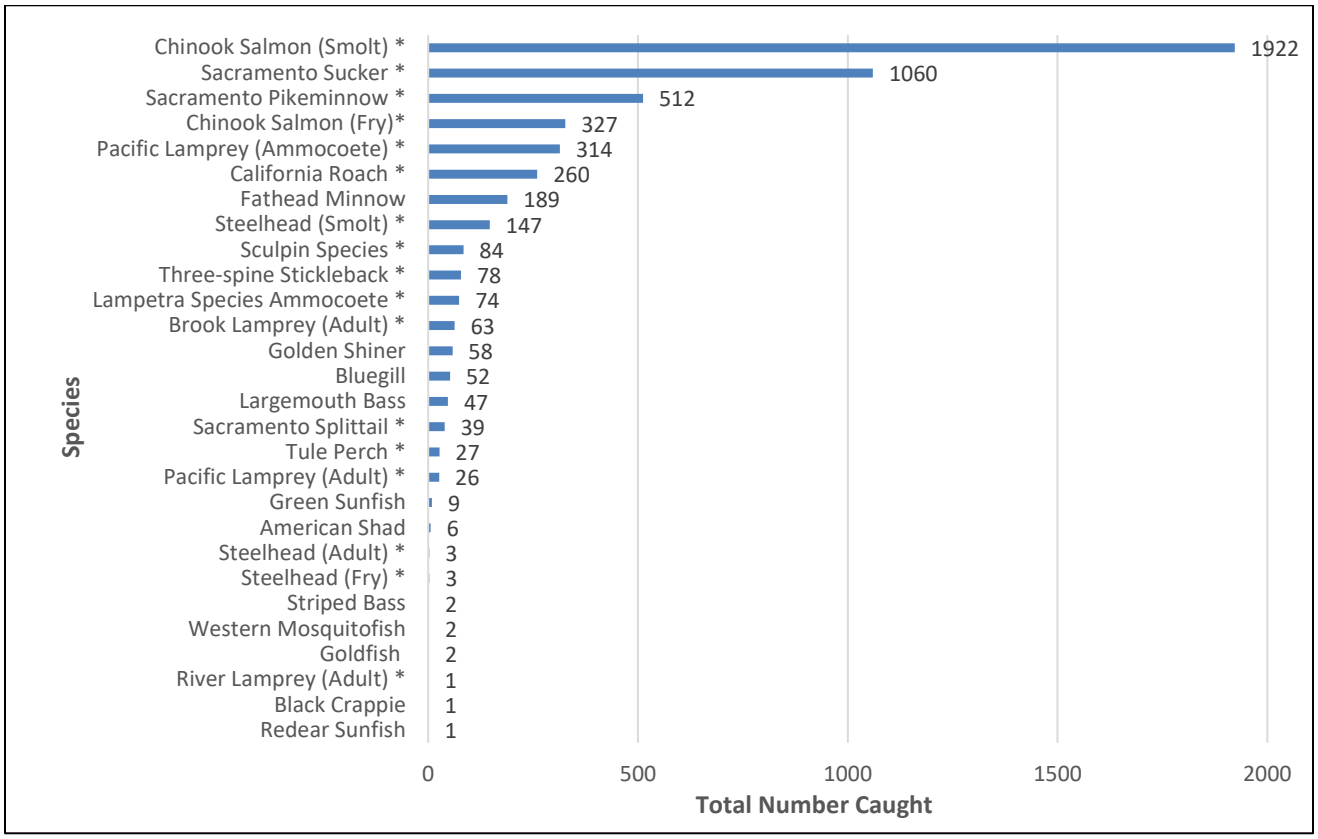

Figure 5. 2018 RST season catch totals excluding lamprey macrothalmia, which were too abundant to count. *Native species

Figure 6. Pacific lamprey macrothalmia

Steelhead and Salmon Smolt Catch Rates

Steelhead smolt catch-per-unit-effort (CPUE) showed an increasing trend in 2018 and was the fourth highest value in the program's 10-year record (Figure 7). CPUE from 2009 to 2012 exhibited a stable or slightly increasing trend, followed by notably lower catch rates from 2013-2017. Drought conditions persisted in the region from 2013-2016, so the increased catch in 2018 may represent a recovery (albeit relatively slight) from those low rainfall years.

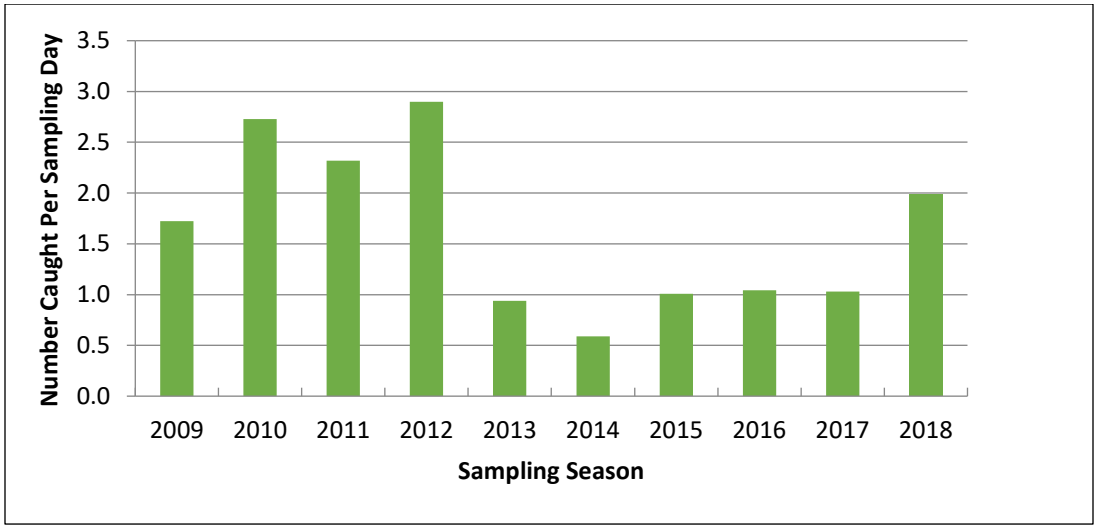

Figure 7. Steelhead smolt catch rates (CPUE) 2009-2018.

The 2018 CPUE for Chinook smolts declined from 2017, but it was still the third highest value in the program's 10-year record (Figure 8). The year-to-year variability in Chinook abundance suggests that the Napa River population is relatively small and especially affected by (1) natural fluctuations in rainfall and runoff quantity and timing, and (2) inputs of stray salmon (i.e. adult fish from other river systems or hatcheries that enter the Napa River) that spawn in the watershed in an any given year.

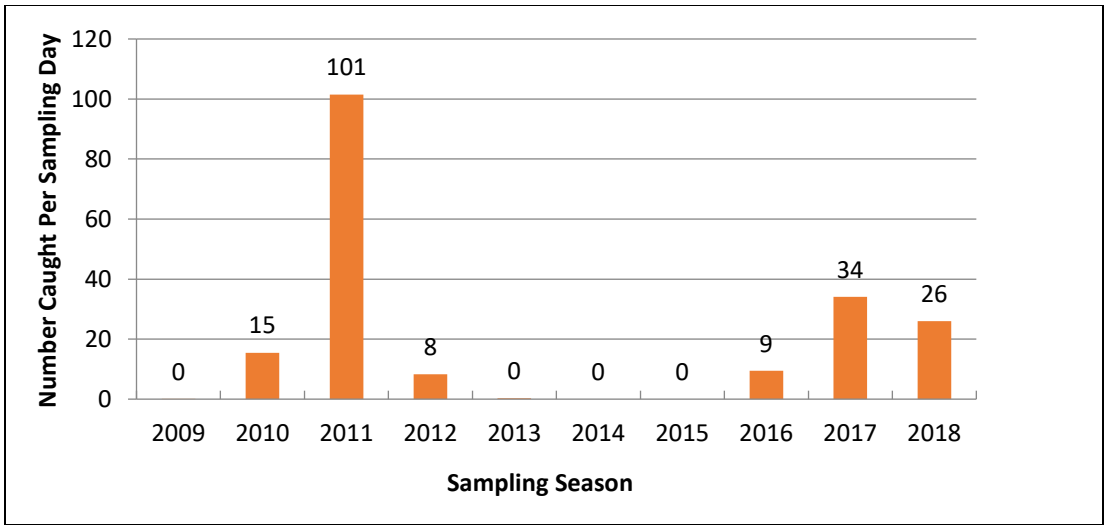

Figure 8. Chinook salmon smolt catch rates (CPUE) 2009-2018.

Steelhead Smolt Size

The 2018 median steelhead smolt fork length was 172 millimeters (6.8 inches), which was less than the previous 9-year average of 190 millimeters (7.5 inches). Median steelhead smolt size has remained relatively stable during the monitoring program's 10-year history, despite considerable variation in environmental conditions (Figure 9).

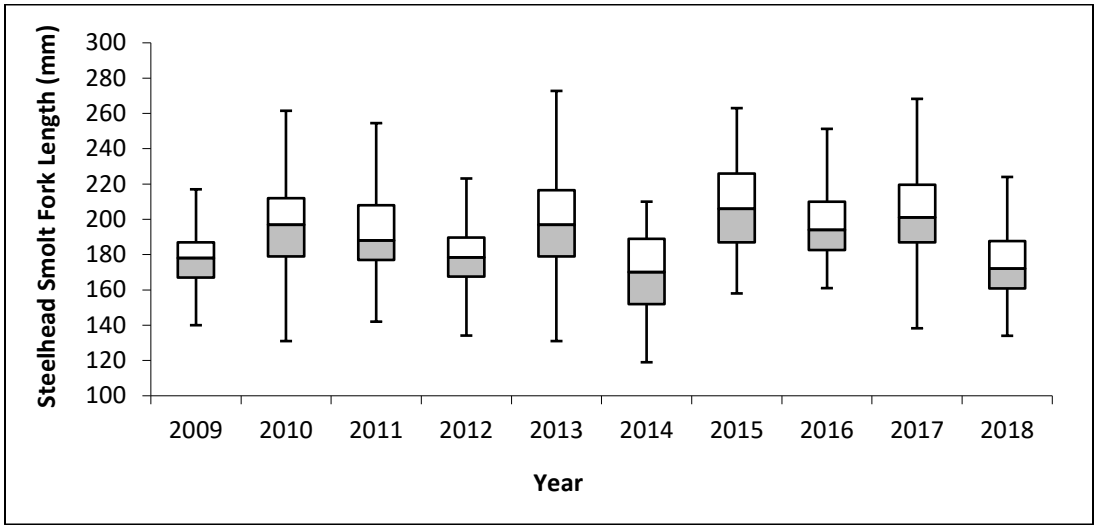

Figure 9. Steelhead smolt fork lengths from the Napa River rotary screw trap 2009-2018. The bottom and top of each box are the 25th and 75th percentiles respectively. The line near the middle of each box is the median, and the vertical lines (whiskers) represent the lowest and highest values within 1.5 times the inter-quartile range.

Trapping Efficiency

During the 2018 season, a total of 111 steelhead smolts and 635 Chinook salmon smolts were marked and released upstream to generate weekly and season-long trapping efficiency estimates (Table 1). Of these marked fish, 13 steelhead and 216 Chinook were recaptured, yielding season-long trap efficiency

estimates of 13% for steelhead and 35% for Chinook (Figure 10). The average trapping efficiency during the previous 8-year period was 13% for steelhead and approximately 23% for Chinook.

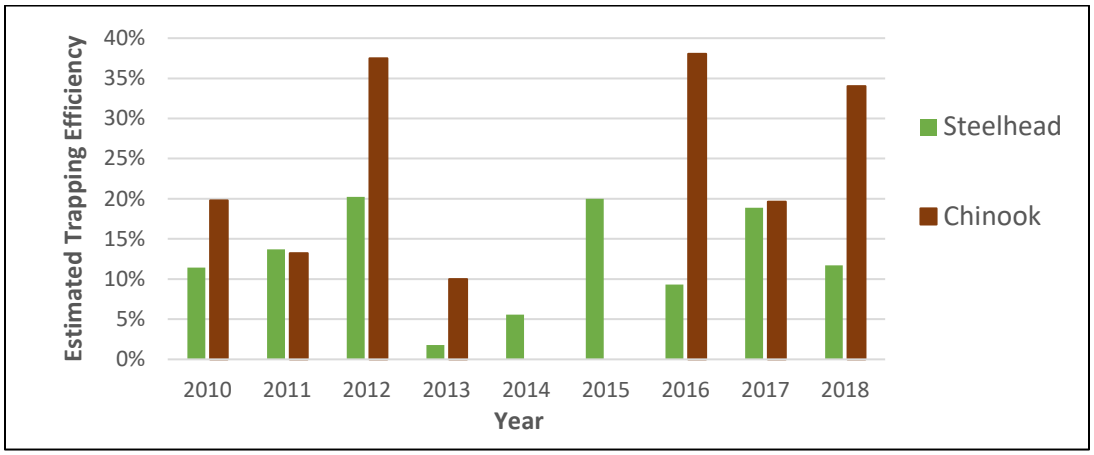

Figure 10. Rotary screw trap season-long trapping efficiency estimates for steelhead and Chinook salmon smolts 2010-2018.

Table 1. Total number of smolts captured, released upstream, and recaptured by the rotary screw trap 2010-2018. Note: efficiency releases were not conducted for the 2009 season.

Year	Steelhead				Chinook			
	Total smolts captured	Marked smolts released upstream	Smolts recaptured	Trapping efficiency estimate	Total smolts captured	Marked smolts released upstream	Smolts recaptured	Trapping efficiency estimate
2010	242	201	23	11%	1,371	702	139	20%
2011	166	95	13	14%	7,265	914	121	13%
2012	142	84	17	20%	406	272	102	38%
2013	77	56	1	2%	19	10	1	10%
2014	31	18	1	6%	0	0	0	-
2015	34	25	5	20%	0	0	0	-
2016	64	43	4	9%	580	289	110	38%
2017	70	53	10	19%	2,315	575	113	20%
2018	147	111	13	13%	1,922	216	635	35%

PIT TAGGING

Methods

Passive Inductive Transponder (PIT) tags were used to uniquely identify and track individual steelhead through time. 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 code was recorded in the RCD's database.

In fall 2017, RCD constructed a new pair of stationary PIT tag antenna loops in the Napa River approximately 20 meters upstream of the RST (Figure 11). The new antennas were installed to replace the RCD's old single loop antenna that had been in use since 2013 at the same location but was destroyed by high flows in early 2017. The new paired antennas were powered by solar-charged batteries and remained in good operating condition continuously throughout the 2018 smolt trapping/tagging season.

Figure 11. Paired PIT tag antenna loops in the Napa River.

Results

During the 2018 out-migrant trapping season, 142 steelhead smolts were implanted with PIT tags, bringing the total over the past five years to 423 (Table 2). On March 1, 2018, the Napa River PIT tag antennas detected two adult steelhead that had originally been tagged and released as smolts on April 1, 2016 and April 2, 2016. These PIT tag detections represent the first confirmed evidence of return-spawning by steelhead in the Napa River that we are aware of. One of the adult steelhead was determined to be traveling upstream based on the sequence of records for each antenna (i.e. detected at the downstream loop first followed by detection at the upstream loop). The other fish was detected by only one of the two antennas, and therefore direction-of-travel could not be determined.

Table 2. Steelhead PIT tagging results from 2013-2018.

Year	Tagging Location	Smolts tagged	PIT Tag Antenna Detections	Detection Notes
2013	Napa River	59	0	
2014	Napa River	26	0	
2014	Sulphur Creek	1	1	Tagged in Sulphur Creek 3/10/2014 and detected at Napa River antenna 3/15/2014
2014	York Creek	1	0	
2015	Napa River	33	0	
2015	Sulphur Creek	19	1	Tagged in Sulphur Creek 4/10/2015 and detected at Napa River antenna 4/26/2016
2015	York Creek	12	0	
2016	Napa River	64	2	Two steelhead tagged as smolts in 2016 were detected swimming upstream in April 2018.
2017	Napa River	66	-	PIT tag antenna not operational
2018	Napa River	142	-	New paired antennas operational all season

SPAWNER SURVEYS

Methods

Spawner surveys for Chinook salmon are conducted November - January and focus on the mainstem Napa River and valley-floor reaches of larger tributary streams. Steelhead spawner surveys are typically conducted January - April and extend from the valley floor to the headwaters of tributary streams. In low-flow and/or low-abundance years, RCD conducts reconnaissance surveys of known spawning and aggregation areas to determine if full protocol-level spawner surveys are warranted. Protocol-level spawner surveys involve walking or boating the channel and recording geographic coordinates and other details for all spawning redds, live fish, and carcasses encountered. Tissue samples, otoliths, and heads (for coded-wire-tag recovery) are collected from carcasses whenever possible.

Results

Flow conditions in the Napa River were very low throughout the 2017-18 Chinook salmon spawning season with only a few small storms occurring from October through early January (Figure 4). RCD conducted a total of 8 reconnaissance surveys throughout the Napa River watershed (Figure 12) in November and December 2017 following each of these small storm events. Chinook salmon were not observed during any of the reconnaissance surveys, and therefore full protocol-level spawner surveys were not deemed necessary.

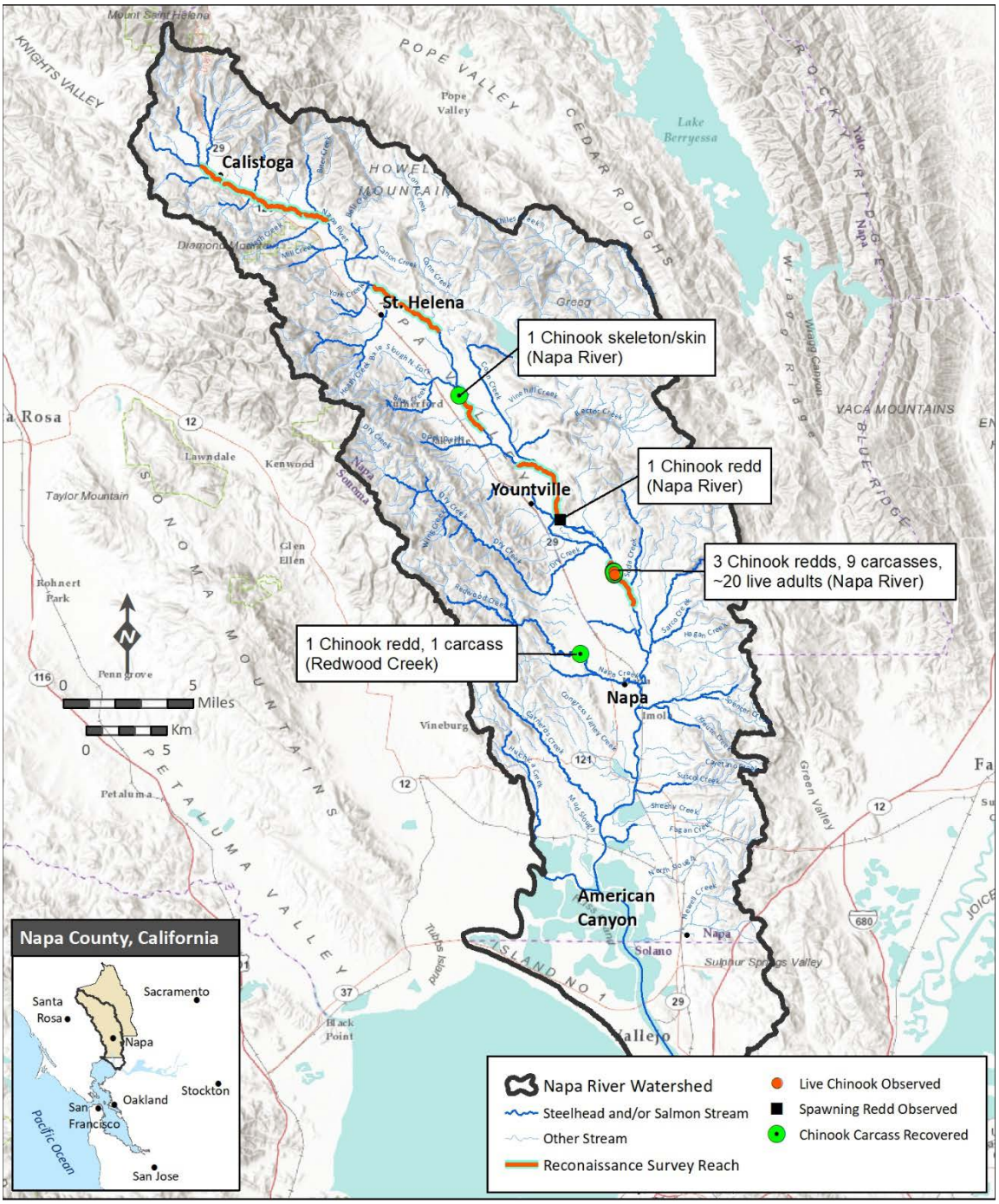

Figure 12. 2017-18 Reconnaissance survey locations and results.

RCD conducted two steelhead spawner surveys in Bale Slough and Bear Creek in spring 2018 as part of a watershed planning project for that sub-watershed. No evidence of steelhead spawning was observed during either survey. No other steelhead spawner surveys were conducted during the 2017-18 season.

A private landowner contacted the RCD in mid-November to report a small group of salmon (approximately 20) spawning in the Napa River about 1 mile south of the Oak Knoll Avenue Bridge. We

were able to collect 9 carcasses and partial skeletons from this location and document 3 redds within several hundred linear feet. Several of the fish were missing adipose fins, indicating likely hatchery origin. Tissue samples were collected from all carcasses and skeletons. Otoliths were collected from those carcasses with intact heads, and the remaining portion of the head/snout was removed and retained for coded-wire-tag analysis.

RCD was contacted by another private landowner in early December within the Napa city limits who observed salmon spawning in Redwood Creek. We documented one fully constructed redd at the site and recovered a Chinook carcass nearby. The carcass was missing its adipose fin, indicating hatchery origin. A tissue sample and otoliths were collected, and the head was removed and retained for coded-wire-tag analysis.

The other two observations of salmon spawning activity occurred while doing unrelated fieldwork in the Napa River on January 17, 2018. We observed a single Chinook redd within the Oakville-to-Oak Knoll restoration project reach, and a partial Chinook skeleton (skin and fins) within the Rutherford restoration project reach.

A total of 6 Chinook salmon heads were recovered from carcasses and partial skeletons and sent to the CDFW laboratory in Healdsburg, California for coded-wire-tag recovery. Coded wire tags were found in 3 of the heads, providing information on the hatchery origin of these fish (Table 3).

Table 3. Chinook salmon heads analyzed for coded-wire-tags

Date Collected	Species	Stream	ID Code	Adipose Fin	CWT	Brood Year	Hatchery of Origin	Release Site
12/3/17	Chinook	Napa R.	NR-CHA-17-4	Missing	060661	2014	Mokelumne R.	Moss Landing
12/4/17	Chinook	Napa R.	NR-CHA-17-6	Unknown	none found	-	-	-
12/4/17	Chinook	Napa R.	NR-CHA-17-7	Unknown	060764	2015	Mokelumne R.	Golden Gate Bridge
12/4/17	Chinook	Napa R.	NR-CHA-17-8	Unknown	none found	-	-	-
12/4/17	Chinook	Napa R.	NR-CHA-17-9	Unknown	none found	-	-	-
12/7/17	Chinook	Redwood Cr.	RE-CHA-17-1	Missing	060662	2014	Feather R.	Half Moon Bay

ANTICIPATED MONITORING IN 2018-19

RCD and our project partners have secured funding to conduct the following fish monitoring activities in 2018-19:

1. Continue daily operation of the RST at the same location using the same protocols beginning on March 1, 2019 and extending through approximately early June
2. PIT tag up to 300 steelhead smolts captured in the RST
3. Continue operation and routine maintenance of the Napa River PIT tag antennas
4. Conduct spawner surveys in the mainstem Napa River as flow conditions allow

LIST OF APPENDICES

Appendix A: Rotary Screw Trap Season Totals 2009-2018

Appendix B: Smolt Trap Processing Procedure

Appendix A: Rotary Screw Trap Season Totals 2009-2018

Native Fishes

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Steelhead / Rainbow trout	*Oncorhynchus mykiss*											
Fry / Parr (<130 mm)		941	94	7	152	3,025	303	35	11	6	32	**4,606**
Smolt (>130mm)		119	251	175	160	77	31	34	64	70	147	**1,128**
Adult or Resident (>300 mm)		0	3	4	0	3	0	0	3	6	3	**22**
Chinook Salmon	*Oncorhynchus tshawytscha*											
Parr / Smolt		1	1,520	7,377	488	19	0	0	580	2,315	1,922	**14,222**
Kokanee/ Sockeye Salmon	*Oncorhynchus nerka*											
Parr / Smolt		0	342	0	0	0	0	0	0	0	0	**342**
Pacific Lamprey	*Entosphenus tridentatus*											
Adult		25	11	38	64	9	14	11	143	31	26	**372**
Macrothalmia[1,2]		-	-	-	-	1	0	0	3	0	7,203	**7,207**
Ammocete[1]		-	-	-	9	4	7	30	54	45	314	**463**
River Lamprey	*Lampetra ayresi*											
Adult[1]		-	2	21	9	3	0	0	86	46	1	**168**
Macrothalmia[1]		-	-	-	-	15	0	0	1	0	5	**21**
Brook Lamprey (Adult[1]**)**	*Lampetra richardsoni*	-	0	64	7	174	120	87	77	38	63	**630**
Lampetra Sp. Ammocete[1]	*Lampetra sp.*	-	-	-	19	108	46	40	136	70	74	**493**
Sacramento Splittail	*Pogonichthys macrolepidotus*	2	6	0	1	26	0	6	0	6	39	**86**
Hardhead	*Mylopharodon conocephalus*	0	0	1	0	0	1	1	0	0	0	**3**
Sacramento Pikeminnow	*Ptychocheilus grandis*	28	87	192	191	33	12	4	27	200	512	**1,286**
California Roach[2]	*Hesperoleucus symmetricus*	4,744	3,571	336	330	498	691	253	548	249	260	**11,480**
Sacramento Sucker	*Catostomus occidentalis*	82	419	207	33	78	42	61	166	284	1,060	**2,432**
Tule Perch	*Hysterocarpus traski*	6	28	30	20	17	8	6	78	51	27	**271**
Sculpin sp.	*Cottus sp.*	242	124	62	66	329	184	20	51	53	84	**1,215**
Three-spine Stickleback	*Gasterosteus aculeatus*	116	76	273	50	34	37	14	3,329	465	78	**4,472**

[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 and Non-Fish Taxa

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Bluegill	*Lepomis macrochirus*	29	100	86	41	11	107	24	221	130	52	**801**
Redear Sunfish	*Lepomis microlophus*	0	8	0	0	0	1	9	8	2	1	**29**
Pumpkinseed	*Lepomis gibbosus*	0	0	1	0	0	0	0	0	0	0	**1**
Green Sunfish	*Lepomis cyanellus*	0	2	5	0	0	19	2	10	15	9	**62**
Black Crappie	*Pomoxis nigromaculatus*	1	0	1	1	1	0	1	1	7	1	**14**
Largemouth Bass	*Micropterus salmoides*	2	1	4	3	0	0	1	1	2	47	**61**
Western Mosquitofish	*Gambusia affinis*	1	0	2	3	1	1	0	4	1	2	**15**
Wakasagi	*Hypomesus nipponensis*	0	9	0	0	0	0	0	0	0	1	**10**
Threadfin Shad	*Dorosoma petenense*	0	2	3	1	0	0	0	4	0	0	**10**
American Shad	*Alosa sapidissima*	0	0	0	0	0	0	0	0	6	6	**12**
Mississippi Silverside	*Menidia beryllina*	0	12	1	0	0	0	0	14	11	0	**38**
Fathead Minnow	*Pimephales promelas*	2	4	20	0	2	2	12	11	74	189	**316**
Common Carp	*Cyprinus carpio*	1	0	0	0	0	0	0	0	0	0	**1**
Golden Shiner	*Notemigonus crysoleucas*	1	11	18	1	22	2	14	6	27	58	**160**
White Catfish	*Ameiurus catus*	0	1	0	1	0	0	0	0	0	0	**2**
Brown Bullhead	*Ameiurus nebulosus*	2	3	3	3	0	2	0	3	3	0	**19**
Channel Catfish	*Ictalurus punctatus*	1	0	0	0	0	0	0	0	0	0	**1**
Striped Bass	*Morone saxatilis*	3	2	0	1	0	0	0	8	3	2	**19**

Non-Fish Taxa

Bullfrog	*Lithobates catesbeiana*											
Larvae		500	1,401	632	111	54	255	368	560	1,457	832	**6170**
Adult		1	2	5	2	0	1	9	9	3	7	**39**
Pacific Chorus Frog (Larvae)	*Pseudacris regilla*	0	32	0	0	0	0	0	0	0	0	**32**
California Toad (Adult)	*Anaxyrus boreas*	0	0	0	0	0	0	0	6	11	21	**38**
Signal Crayfish	*Pacifastacus leniusculus*	3	103	79	128	123	307	41	64	44	129	**1021**
Red Swamp Crayfish	*Procambarus clarkii*	40	233	78	46	13	103	25	151	40	283	**1012**
Red-eared Slider Turtle	*Trachemys scripta elegans*	0	3	1	1	1	0	1	17	1	6	**31**
Western Pond Turtle	*Actinemys marmorata*	2	1	1	1	1	1	2	4	2	3	**18**

Appendix B: Smolt Trap Processing Procedure

Species	Life Stage	Mark/ Recapture	Number per day	Processing Procedure	Release location	Data Entry
Steelhead*	**FRY** ≤ 40mm	-	All	Count and release	Downstream	QTally
	PARR 40 - 130 mm	-	All	Count and release	Downstream	QTally
	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)	QTally Excel (steelhead)
			31+	Count and release	Downstream	QTally
		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	Excel (steelhead) Excel (trap efficiency)
	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	QTally Excel (steelhead)
Chinook (or other salmon)	**FRY** ≤ 40mm	-	All	Count and release	Downstream	QTally
	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)	QTally Excel (chinook)
			21+	Count and release	Downstream	QTally
		RECAP	All	Count and release	Downstream	QTally Excel (trap efficiency)
River Lamprey	Adult	-	All	1. Anesthetize and record total length, sex, and maturity 2. Take photo on measuring tray	Downstream	QTally Excel (lamprey)
Pacific Lamprey	Adult	-	All	Record maturity, sex, and notes on condition	Downstream	QTally Excel (lamprey)
All other species	All	-	All	Count and release	Downstream	QTally Excel (0+ abundance)