Napa River Steelhead and Salmon Monitoring Program - 2016-17

NAPA COUNTY RCD
Resource Conservation District

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Cover photo: Adult steelhead captured and released in the Napa River rotary screw trap May 23, 2017

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INTRODUCTION

The Napa County Resource Conservation District (RCD) conducts fisheries monitoring in the Napa River watershed, focusing on steelhead trout (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), and other native fishes. Monitoring provides details on salmonid life history patterns and the composition of the Napa River fish community, and tracks ecological responses to ongoing habitat restoration. For a more detailed summary and history of RCD's fish monitoring program, visit www.naparcd.org/assessment-programs/fisheries-monitoring.

The RCD's monitoring approach is loosely based on the "life-cycle monitoring" methodology used by the California Department of Fish and Wildlife (CDFW) and the National Marine Fisheries Service (NMFS). This approach includes conducting adult spawner surveys, juvenile distribution surveys, out-migrant (smolt) trapping, and mark-recapture using PIT tags and genetic analysis. Limited funding and natural environmental variability (e.g. drought, floods, etc.) pose a significant challenge to fully implementing this monitoring program in any given year. During the 2016-17 monitoring season RCD and our partners were able to conduct six salmon spawner surveys in the mainstem Napa River and four steelhead spawner surveys in the Bale Slough/Bear Creek sub-watershed. Juvenile outmigrant trapping was conducted using a rotary screw trap in spring 2017. This report summarizes the results of these efforts. Reports and data from previous years are available at: www.naparcd.org

SALMONID OUT-MIGRANT TRAPPING

A rotary screw trap (RST) was used to capture juvenile salmonid out-migrants in the Napa River from March 13 through June 4, 2017. The trap was installed at the same location used in all previous sampling years, which is located on private property approximately 3.2 kilometers (2 miles) downstream of the Oak Knoll Avenue Bridge. This site was selected because it had a cooperative landowner, good river access, and was located less than 1 kilometer from the upper extent of tidal influence (i.e. the downstream-most position in the watershed with continuous non-tidal flow). 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 (Figure 1).

Out-migrant Trapping Methods

While in operation, the trap was checked between one and three times per 24-hour period by a permitted RCD staff member and an assistant. Debris was removed from the live box first, followed by non-target species, and finally any steelhead and salmon were removed and processed last. The processing procedure used for salmonids is described in detail in Attachment 1. All activities performed during this period were done according to the provisions listed in Scientific Collecting Permit #003495 issued by the California Department of Fish and Wildlife, and Section 4(d) Research Permit #20879 issued by the National Marine Fisheries Service.

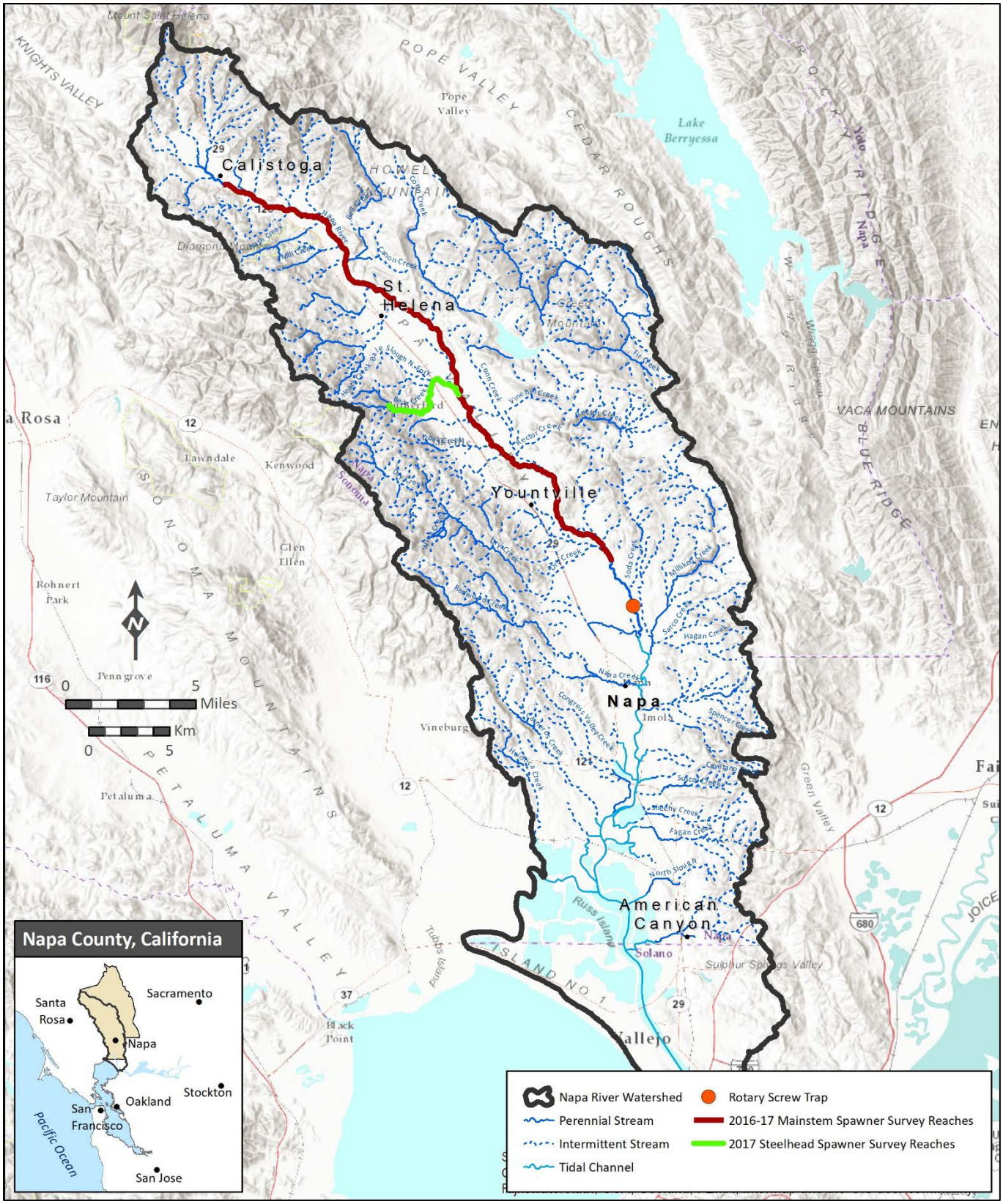

Figure 1. Locations of the Napa River rotary screw trap and 2016-17 spawner survey reaches.

Out-migrant Sampling Period

The rotary screw trap was operated for a total of 1,643 hours (68 days) between March 13 and June 4, 2017 (Figure 2). High flows prevented deployment of the trap on the target start date of March 1. Sampling was halted from March 21-28, April 6-11, and April 13-14 due to high flows. During such periods of high flow (above approximately 500 cubic feet per second [cfs]), the trap's cone was raised out of the water to stop operation until safe conditions resumed. The trap was disassembled and removed from the river for dry storage on June 13.

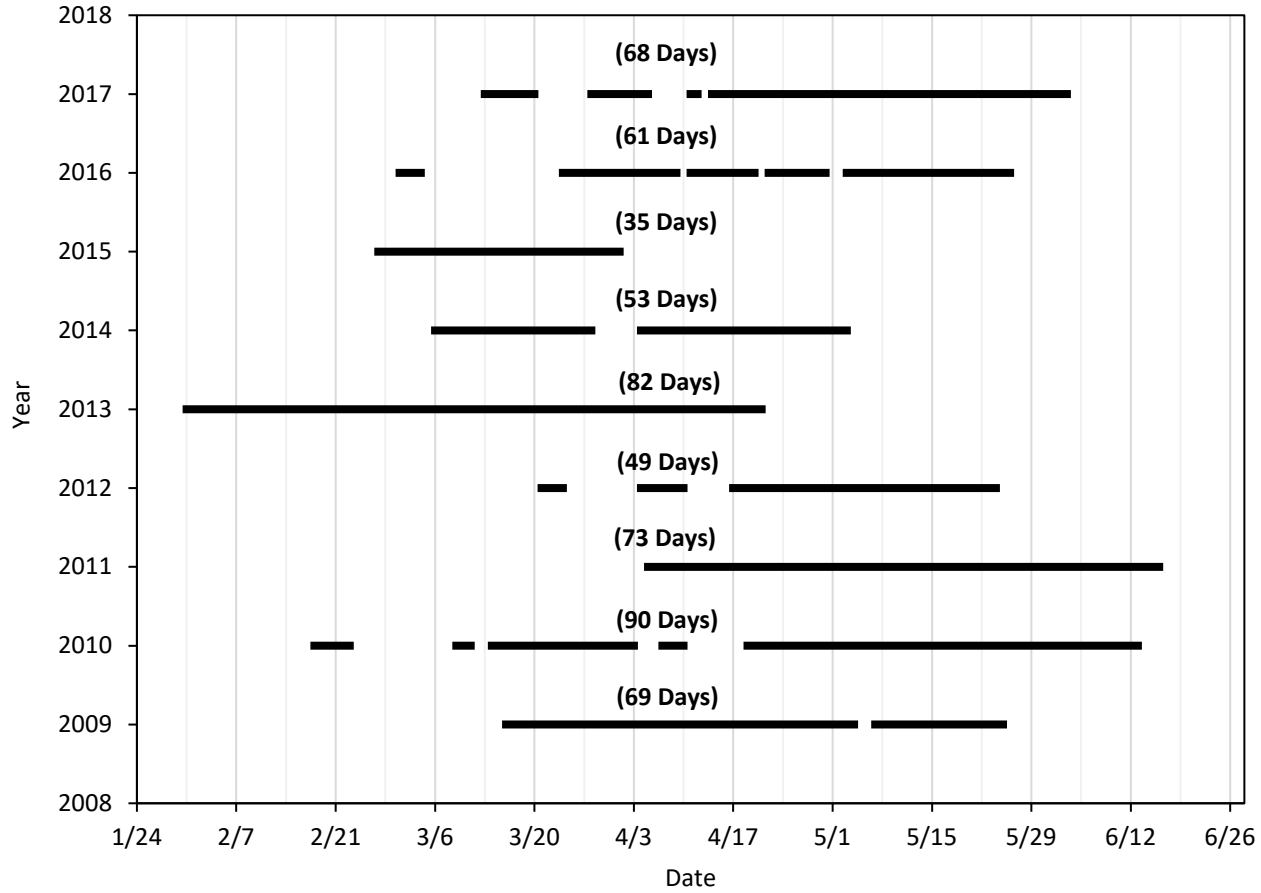

Figure 2. Seasonal periods when the Napa River rotary screw trap was operated in 2009-2017. The total number of sampling days for each year is shown in parentheses. Gaps within each sampling year represent periods when the trap was not operated due to high flows or other factors.

Out-migrant Trapping Results and Discussion

During the 2017 season, a total of 4,217 fish were captured in the RST (Figure 3). The total catch included 12 native fish species (Table 1), 13 non-native fish species, and 5 non-fish aquatic taxa (Table 2). A total of 2,397 salmonids were captured, including 2,315 Chinook salmon and 82 steelhead. Native fishes comprised 93% of the total catch (n=3,935) and non-native fishes accounted for 5% of the total catch (n=282).

For the second year in a row, relatively high numbers of river lamprey and Pacific lamprey were captured. Pacific lampreys have experienced long-term population declines throughout their range and are now the focus of conservation efforts by the US Fish and Wildlife Service and others. River lamprey, a State Species of Special Concern, are also relatively rare throughout their range, and very few details are known about their life history. Given that lampreys have been consistently collected in all sampling years suggests that these species are persisting in the Napa River watershed. However, since there are very few historical lamprey records or population studies available, it is impossible to gauge how the abundance of these species has changed over time.

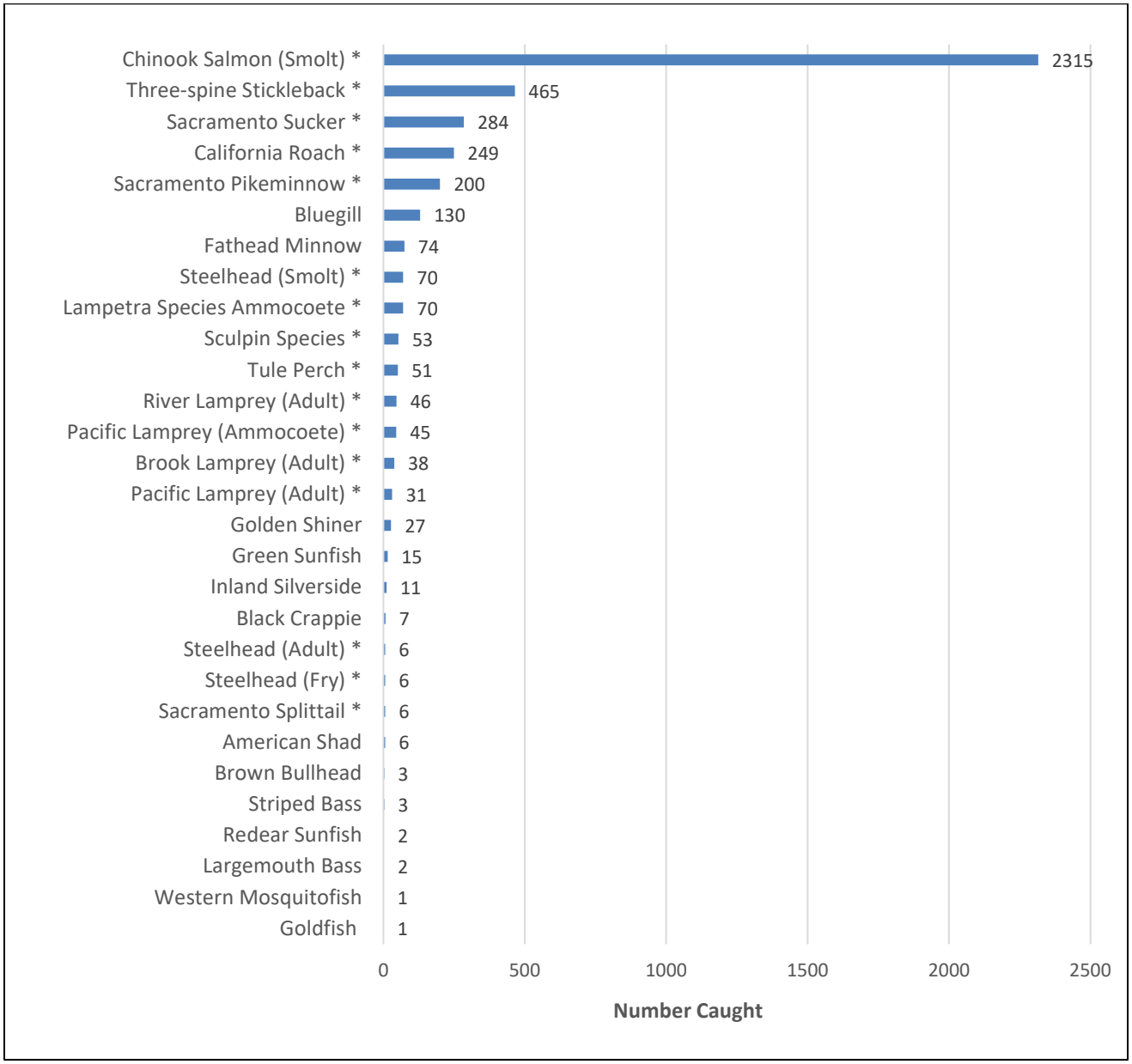

Figure 3. Rotary screw trap fish catch totals in 2017.
*Native species

Table 1. Native fish species collected annually in the Napa River rotary screw trap from 2009 through 2017.

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Steelhead / Rainbow trout	*Oncorhynchus mykiss*										
Fry / Parr (<130 mm)		941	94	7	152	3,025	303	35	11	6	**4,574**
Smolt (>130mm)		119	251	175	160	77	31	34	64	70	**981**
Adult or Resident (>300 mm)		0	3	4	0	3	0	0	3	6	**19**
Chinook Salmon	*Oncorhynchus tshawytscha*										
Parr / Smolt		1	1,520	7,377	488	19	0	0	580	2,315	**12,300**
Kokanee/ Sockeye Salmon	*Oncorhynchus nerka*										
Parr / Smolt		0	342	0	0	0	0	0	0	0	**342**
Pacific Lamprey	*Entosphenus tridentatus*										
Adult		25	11	38	64	9	14	11	143	31	**346**
Macrothalmia[1]		-	-	-	-	1	0	0	3	0	**4**
Ammocete[1]		-	-	-	9	4	7	30	54	45	**149**
River Lamprey	*Lampetra ayresi*										
Adult[1]		-	2	21	9	3	0	0	86	46	**167**
Macrothalmia[1]		-	-	-	-	15	0	0	1	0	**16**
Brook Lamprey (Adult[1]**)**	*Lampetra richardsoni*	-	0	64	7	174	120	87	77	38	**567**
Lampetra Sp. Ammocete[1]	*Lampetra sp.*	-	-	-	19	108	46	40	136	70	**419**
Sacramento Splittail	*Mylopharodon conocephalus*	2	6	0	1	26	0	6	0	6	**47**
Hardhead	*Pogonichthys macrolepidotus*	0	0	1	0	0	1	1	0	0	**3**
Sacramento Pikeminnow	*Ptychocheilus grandis*	28	87	192	191	33	12	4	27	200	**774**
California Roach[2]	*Hesperoleucus symmetricus*	4,744	3,571	336	330	498	691	253	548	249	**11,220**
Sacramento Sucker	*Catostomus occidentalis*	82	419	207	33	78	42	61	166	284	**1,372**
Tule Perch	*Hysterocarpus traski*	6	28	30	20	17	8	6	78	51	**244**
Prickly Sculpin	*Cottus asper*	242	124	62	66	329	184	20	51	53	**1,131**
Three-spine Stickleback[2]	*Gasterosteus aculeatus*	116	76	273	50	34	37	14	3,329	465	**4,394**

[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.

Table 2. Non-native fish species and non-fish taxa collected annually in the Napa River rotary screw trap from 2009 through 2017.

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Bluegill	*Lepomis macrochirus*	29	100	86	41	11	107	24	221	130	**749**
Redear Sunfish	*Lepomis microlophus*	0	8	0	0	0	1	9	8	2	**28**
Pumpkinseed	*Lepomis gibbosus*	0	0	1	0	0	0	0	0	0	**1**
Green Sunfish	*Lepomis cyanellus*	0	2	5	0	0	19	2	10	15	**53**
Black Crappie	*Pomoxis nigromaculatus*	1	0	1	1	1	0	1	1	7	**13**
Largemouth Bass	*Micropterus salmoides*	2	1	4	3	0	0	1	1	2	**14**
Western Mosquitofish	*Gambusia affinis*	1	0	2	3	1	1	0	4	1	**13**
Wakasagi	*Hypomesus nipponensis*	0	9	0	0	0	0	0	0	0	**9**
Threadfin Shad	*Dorosoma petenense*	0	2	3	1	0	0	0	4	0	**10**
American Shad	*Alosa sapidissima*	0	0	0	0	0	0	0	0	6	**6**
Inland Silverside	*Menidia beryllina*	0	12	1	0	0	0	0	14	11	**38**
Fathead Minnow	*Pimephales promelas*	2	4	20	0	2	2	12	11	74	**127**
Common Carp	*Cyprinus carpio*	1	0	0	0	0	0	0	0	0	**1**
Golden Shiner	*Notemigonus crysoleucas*	1	11	18	1	22	2	14	6	27	**102**
White Catfish	*Ameiurus catus*	0	1	0	1	0	0	0	0	0	**2**
Brown Bullhead	*Ameiurus nebulosus*	2	3	3	3	0	2	0	3	3	**19**
Channel Catfish	*Ictalurus punctatus*	1	0	0	0	0	0	0	0	0	**1**
Striped Bass	*Morone saxatilis*	3	2	0	1	0	0	0	8	3	**17**
Non-Fish Taxa											
Bullfrog	*Lithobates catesbeiana*										
Larvae (tadpole)		500	1,401	632	111	54	255	368	560	1,457	**5,338**
Adult		1	2	5	2	0	1	9	9	3	**32**
Pacific Chorus Frog (Larvae)	*Pseudacris regilla*	0	32	0	0	0	0	0	0	0	**32**
Signal Crayfish	*Pacifastacus leniusculus*	3	103	79	128	123	307	41	64	44	**892**
Red Swamp Crayfish	*Procambarus clarkii*	40	233	78	46	13	103	25	151	40	**729**
Red-eared Slider Turtle	*Trachemys scripta elegans*	0	3	1	1	1	0	1	17	1	**25**
Western Pond Turtle	*Actinemys marmorata*	2	1	1	1	1	1	2	4	2	**15**

Steelhead and Salmon Smolt Catch Rates

Standardizing catch rates (catch-per-unit-effort or CPUE) for long-term trend analysis is difficult in wild populations, due primarily to the high degree of natural sampling variation from one year to the next. Nevertheless, even approximate catch rates provide insights into the relative abundance of a given species over time. Steelhead and salmon smolt CPUE was calculated for each year by dividing the total number of smolts captured by the number of days sampled.

From 2009 to 2012, steelhead CPUE appeared to exhibit a stable or slightly increasing trend, followed by a notable decline in 2013 and continued lower catch rates through 2017 (Figure 4). Juvenile steelhead require cool perennial stream habitat to survive the dry season; such habitats were greatly reduced during drought conditions from 2013 - 2016. It is therefore likely that much of the decline in steelhead CPUE may be explained by a reduction in suitable rearing habitat during the same period. It is also important to consider that the rotary screw trap is most efficient during high flows, and 2013 - 2016 were dry years with generally low flows. By contrast, the 2017 season had consistently high flows all spring, and the trap likely operated near peak efficiency. The continued low steelhead CPUE in 2017 is therefore unlikely to have been caused by poor trapping efficiency. This suggests that the recent five-year decline in steelhead smolt CPUE is a real population reduction and not attributed solely to poor trapping efficiency.

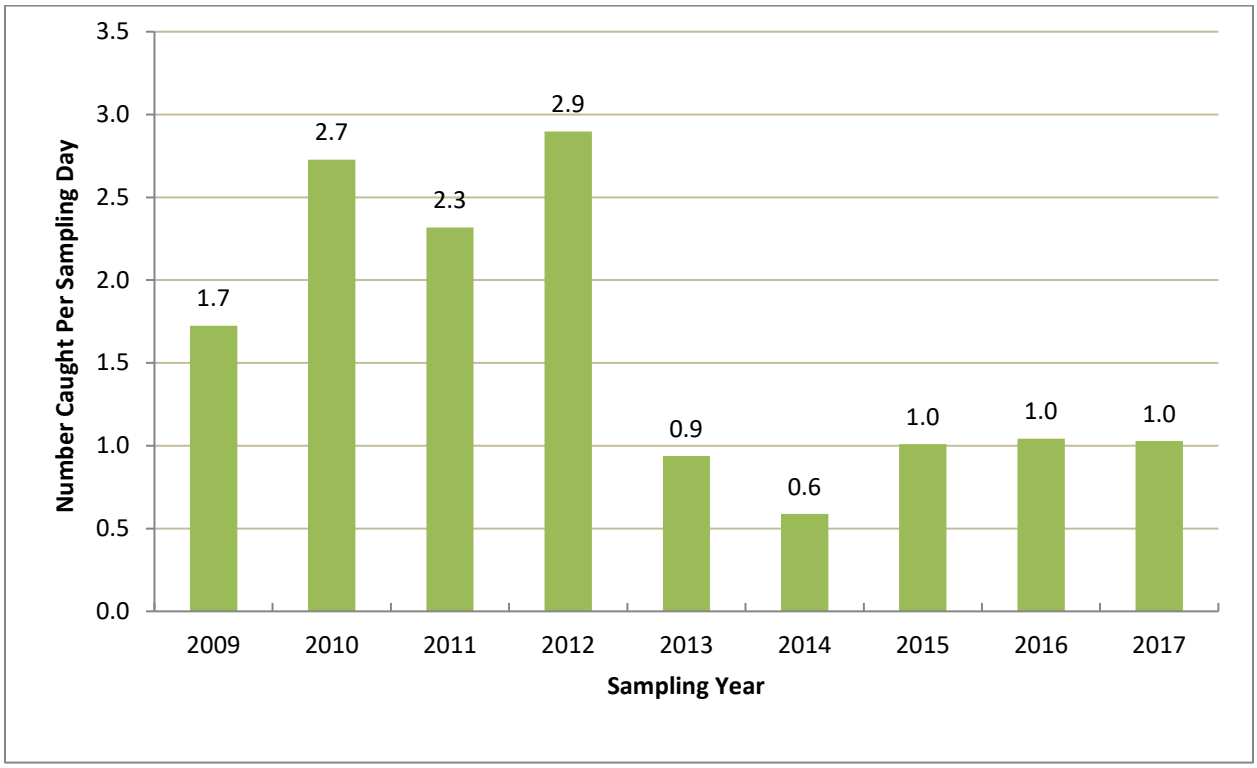

Figure 4. Steelhead smolt catch rates (CPUE) 2009-2017.

Chinook CPUE during the past nine years exhibits a high degree of variability, including several years when no Chinook smolts were captured (Figure 5). This variability suggests that the population is relatively small and unstable. The two most likely sources of this variation are: (1) natural fluctuations in rainfall and runoff timing, and (2) the number of stray salmon (i.e. adult fish that were born in other river systems or hatcheries, but enter the Napa River to spawn) that spawn in the watershed in an any given year. Adult Chinook salmon migrate from the ocean to the Napa River estuary in the fall, typically in September before winter baseflow has been established. In years with little or no early-season rainfall, suitable spawning habitat can be limited or inaccessible, resulting in low spawning success. In years with abundant rainfall during the fall migration period, such as 2016, spawning adults have access to abundant habitat and generally occur in greater numbers with broader distributions.

It is not known to what degree the Napa River Chinook population is dependent on inputs of stray fish from other river systems. The RCD has been involved in ongoing efforts to study the origins of Chinook salmon in the Napa River through otolith micro-chemistry and genetic analysis since this monitoring program began. However, due to limited funding and small sample sizes, we have been unable to draw meaningful conclusions thus far. Regardless of their origins, Chinook salmon have successfully spawned and reared in the Napa River watershed in at least six of the last nine years.

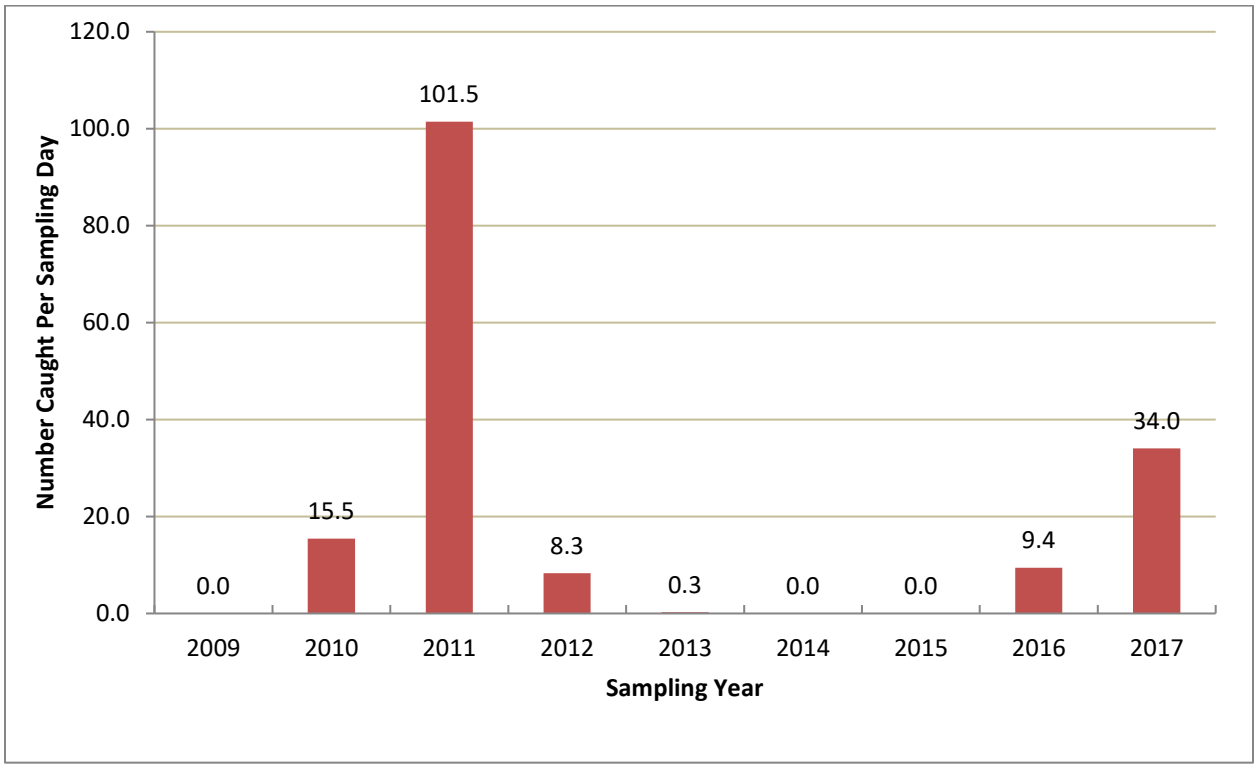

Figure 5. Chinook salmon smolt catch rates (CPUE) 2009-2017.

Steelhead Smolt Size

The 2017 median steelhead smolt fork length (measured from the tip of the snout to the center of the fork in the tail) was 201 millimeters (7.9 inches), which was higher than the long-term running average of 190 millimeters (7.5 inches). Steelhead smolt size has remained relatively constant during the past 9

years, despite considerable variation in environmental conditions (Figure 6). Several studies in other river systems have demonstrated a positive correlation between smolt size and ocean survival, with larger smolts having a higher survival rate and hence higher chances of returning to spawn as adults.

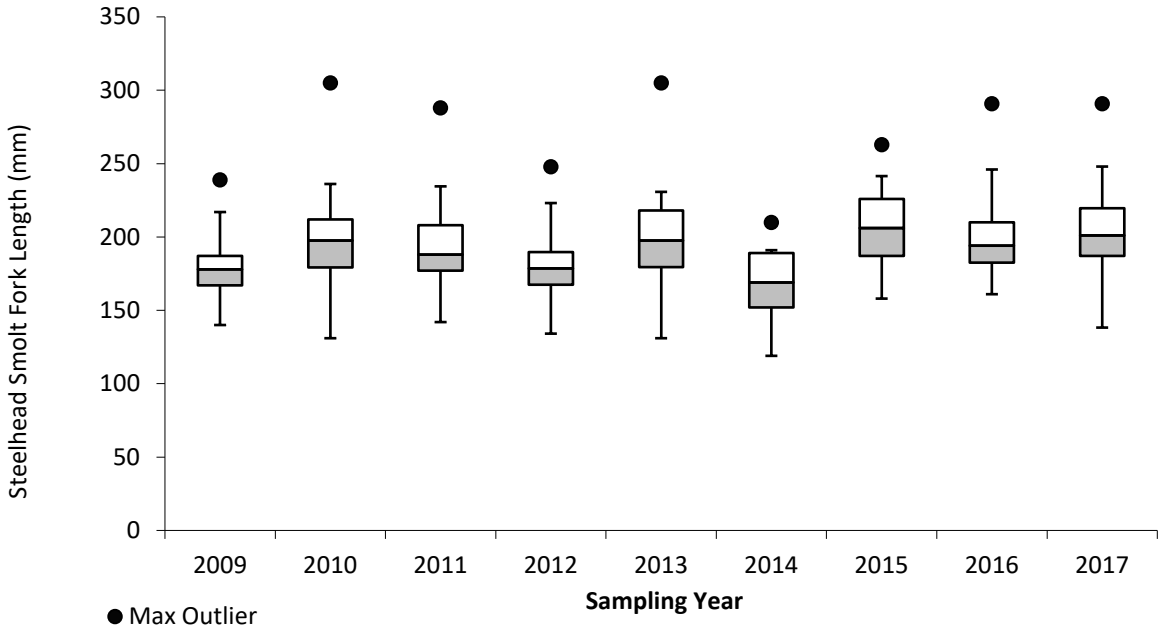

Figure 6. Steelhead smolt fork lengths from the Napa River rotary screw trap 2009-2017. The bottom and top of each box are the 25th and 75th percentiles respectively. The line near the middle of each box is the median, and the vertical lines (whiskers) represent the lowest and highest values within 1.5 times the inter-quartile range. The maximum outlier values represent the largest individual "smolt" measurement for each year.

Rotary Screw Trap Efficiency

In order to estimate the trap's effectiveness (i.e. efficiency) at capturing steelhead and salmon, continuous mark-recapture trials were conducted throughout the sampling period. These trials provide data to calculate weekly trapping efficiency estimates as well as a cumulative estimate for the entire season. The mark-recapture trials used steelhead and Chinook smolts captured in the RST, which were then marked with fin clips, 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 trap efficiency estimate. Upstream releases were conducted Monday through Friday with a break over the weekend to more clearly define the estimate period. Since these trials relied on "wild" caught fish, the number of individuals that were marked and released was variable from week to week, and was dependent upon catch rates. Trap efficiency estimates were not able to be calculated in some weeks due to low or no catch.

During the 2017 season, a total of 53 steelhead smolts and 575 Chinook salmon smolts were marked by clipping a small portion of their fins and released upstream as part of these mark-recapture trials (Table

3). Of these marked fish, 10 steelhead and 113 Chinook were recaptured, yielding overall trap efficiency estimates of 19% for steelhead and 20% for Chinook (Figure 7). From 2009-2017, the average trapping efficiency has been approximately 13% for steelhead and approximately 23% for Chinook.

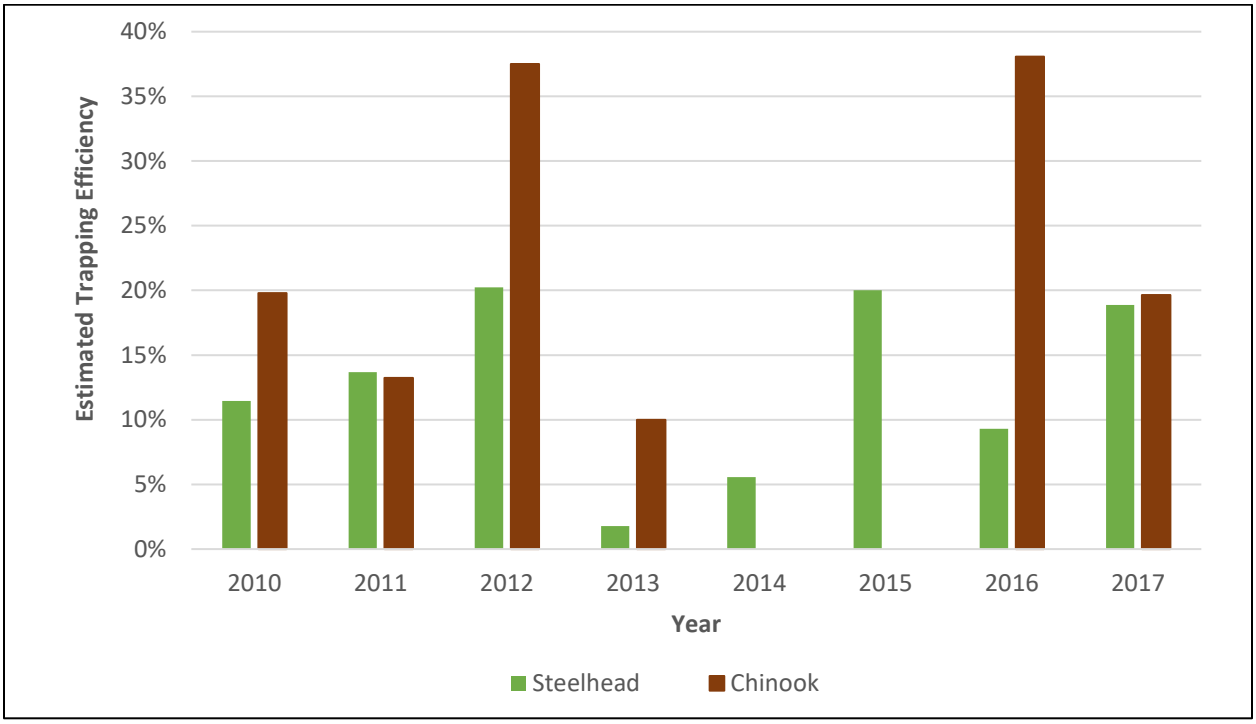

Figure 7. Rotary screw trap efficiency estimates for steelhead and Chinook salmon smolts 2010-2017.

Table 3. Total number of smolts captured, released upstream, and recaptured by the rotary screw trap 2010-2017. Trapping efficiency estimates represent the total number of recaptured fish divided by the total number of fish released upstream in a given year. Note, efficiency releases were not conducted during 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%	2315	575	113	20%

Steelhead Smolt Tagging

Passive Inductive Transponder (PIT) tags are used to uniquely identify and track individual fish throughout their lives. RCD began tagging steelhead smolts with half-duplex (HDX) PIT tags in 2013 to study ocean survival rates and migration timing and patterns, which are thus far not well understood for the Napa River watershed.

During the 2017 out-migrant trapping season, 66 steelhead smolts were implanted with 12mm HDX PIT tags, bringing the total over the past five years to 281 (Table 4). Ideally the number of tagged fish would be much higher to improve the odds of re-detection rates in future years. However, this program relies on wild fish and thus the number of smolts tagged in any given year was dictated primarily by the number of fish captured.

PIT tags are detected by a magnetic field generated from a specially designed antenna. From 2013-2016, the RCD operated a stationary PIT tag antenna loop that spanned the low flow channel of the Napa River approximately 20 meters upstream of the RST (Figure 8). This antenna was destroyed during storm events in early 2017 and was therefore not operational during the 2017 outmigrant trapping season. RCD has acquired a grant from the Napa County Wildlife Conservation Commission to reconstruct the antenna and plans to have it operational by late fall 2017.

Table 4. PIT tagging results from 2013-2017.

Year	Location	Smolts tagged	Smolts re-detected by antenna in same year	Smolts re-detected by antenna in subsequent years	Notes
2013	Napa River	59	0	0	
2014	Napa River	26	12	0	
2014	Sulphur Creek	1	1	0	Tagged in Sulphur Creek 3/10/2014 and detected at Napa River antenna 3/15/2014
2014	York Creek	1	0	0	
2015	Napa River	33	25	0	
2015	Sulphur Creek	19	0	1	Tagged in Sulphur Creek 4/10/2015 and detected at Napa River antenna 4/26/2016
2015	York Creek	12	0	0	
2016	Napa River	64	34	-	Four smolts tagged in late April and early May were continually re-detected at the Napa River antenna through June 2016, suggesting they may have remained resident
2017	Napa River	66	-	-	PIT tag antenna not operational

Figure 8. PIT tag antenna across the Napa River - destroyed during water year 2016-17.

SPAWNER SURVEYS

Spawner surveys are intended to estimate escapement (adult abundance), map spawning distributions, and collect biometric data and tissue samples from dead carcasses. Due to funding and access constraints, the RCD's spawner surveys have historically focused on the mainstem Napa River with periodic spawner surveys being conducted opportunistically in tributary streams as project-specific funding allows.

Spawner Survey Methods

Spawner surveys are carried out by a crew of two or more people either by wading upstream or kayaking downstream (a detailed description of the protocol is provided in Attachment 2). Field surveys are timed to correspond with periods when the target species are known or expected to be in the system. Ideally, surveys should be repeated multiple times throughout the winter and spring to bracket the entire potential spawning period. However, this level of effort is beyond the funding constraints of the RCD's current monitoring program. Therefore, the results of these surveys are inadequate to generate escapement estimates. Rather, these data are indicators of presence/absence and can provide a rough approximation of the spawning distribution within the Napa River watershed in a given year.

Spawner Survey Results

Survey conditions during the 2016-17 Chinook salmon spawning season were favorable with a series of storms establishing baseflow beginning on October 24, 2016 (Figure 9). Adult Chinook salmon were observed in the Napa River in Calistoga and several upper watershed tributaries, including Sulphur and Garnett Creeks, within just a few days of these first storms.

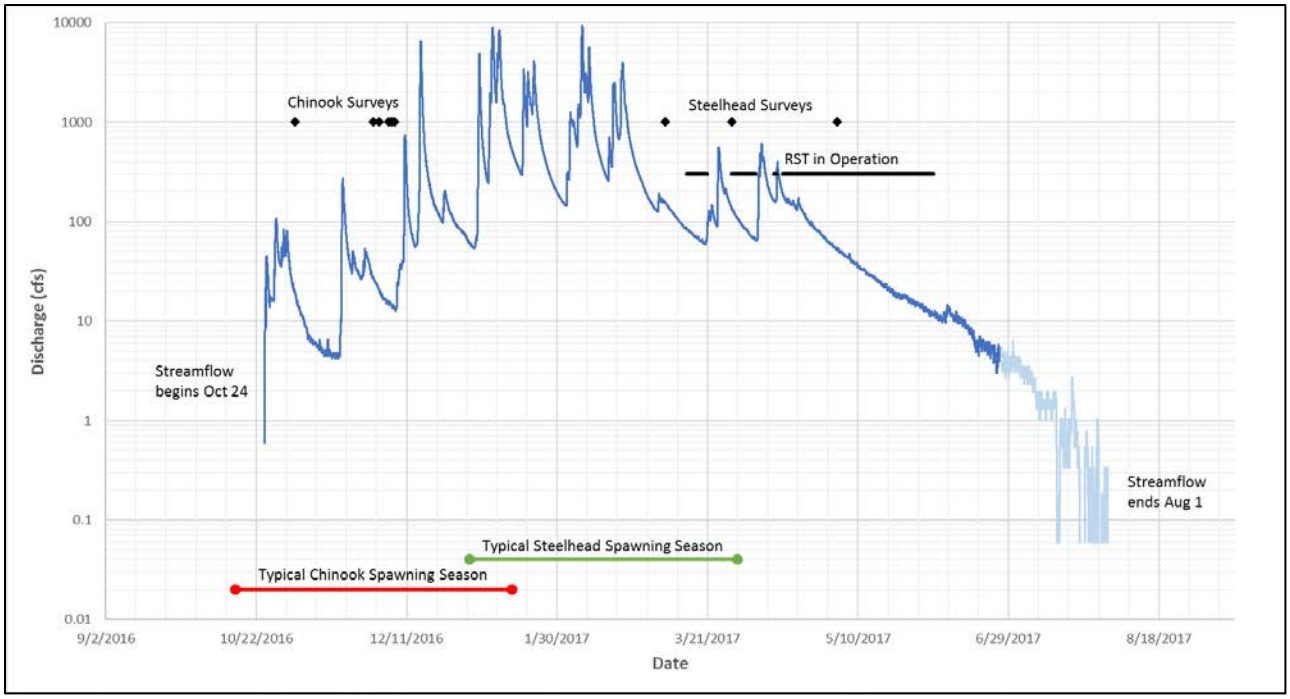

Figure 9. 2016-17 hydrograph for USGS streamgaging station 11456000 Napa River near St Helena, California, showing storm timing and field work. The dark blue portion of the line is quality-controlled and approved data, the light blue section is provisional and subject to change.

RCD conducted a total of six spawner surveys from November 4, 2016 to December 7, 2016 targeting Chinook salmon in the mainstem Napa River. All surveys were conducted by kayak and covered a total of 46.8 kilometers (29.1 miles). A total of 90 redds, 38 live salmon, and 3 carcasses were observed (Table 5). Chinook spawning activity was concentrated in the upper reaches of the Napa River around St. Helena, with lower spawning densities in the lower reaches near Yountville and Napa (Figure 10).

RCD and NOAA conducted three steelhead spawner surveys in Bale Slough and Bear Creek between March 7 and May 3, 2017. No evidence of spawning was observed.

Table 5. Napa River Chinook salmon spawner survey results.

Date	Distance (km)	Flow (cfs)	Redds Observed	Live Fish Observed	Carcasses Observed
Nov. 4, 2016	6.7	15 (1)	0	1	0
Nov. 30, 2016	7.7	9 (1)	23	28	0
Dec. 2, 2016	8.0	16 (1)	18	4	1
Dec. 5, 2016	7.4	15 (1)	30	4	2
Dec. 6, 2016	8.9	15 (1)	9	1	0
Dec. 7, 2016	8.3	26 (2)	10	0	0

[1]Provisional flow data from USGS streamgaging station 11456000 Napa River near St Helena at time of survey

[2]Provisional flow data from USGS streamgaging station 11458000 Napa River near Napa at time of survey

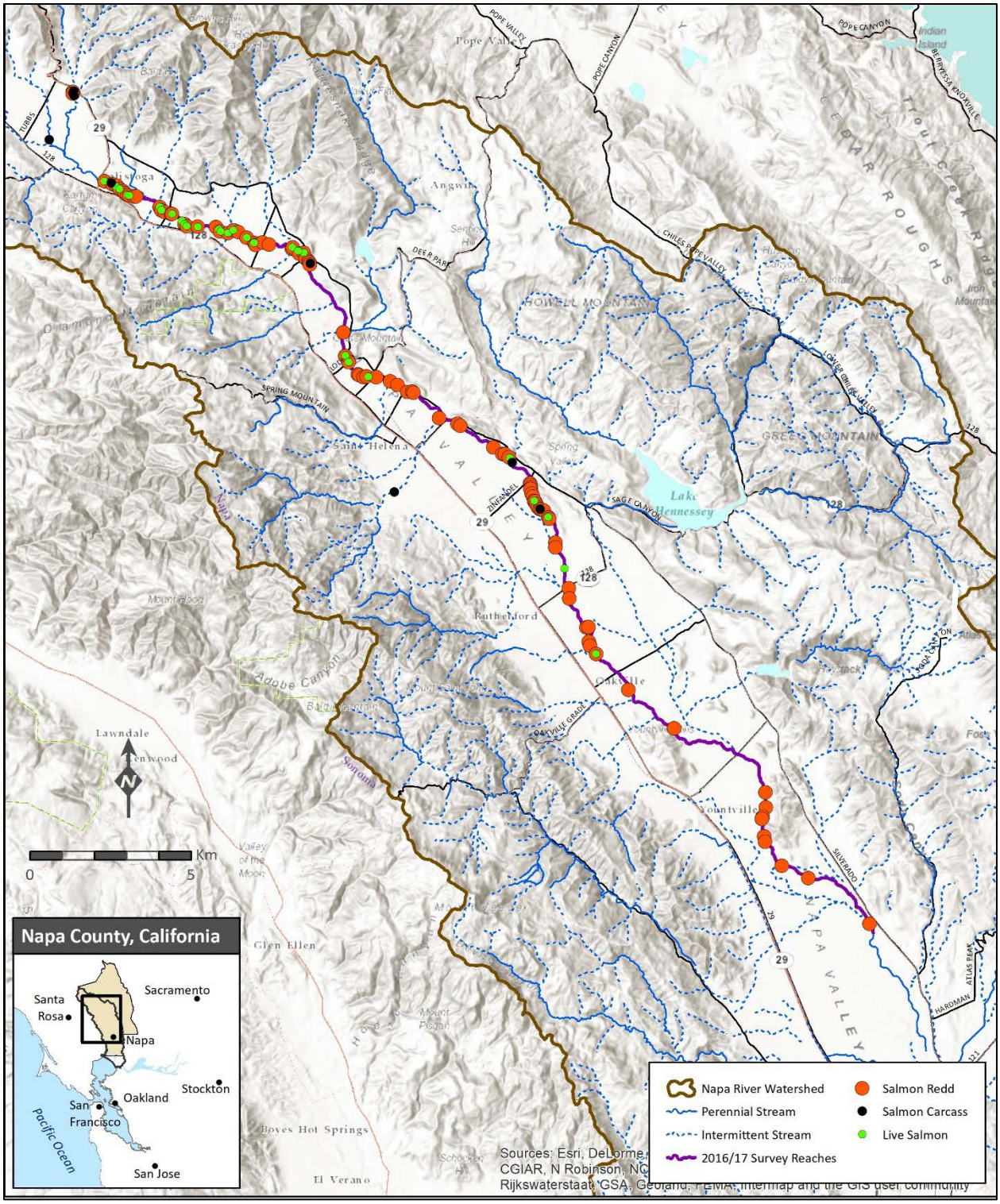

Figure 11. 2016-17 Chinook salmon spawner survey results.

ANTICIPATED MONITORING IN 2017-18

- Funding has been secured to continue RST operations in spring 2018
- Continue PIT tagging up to 300 steelhead smolts per year
- Rebuild and continuously operate the Napa River PIT tag antenna
- Conduct spawner surveys in the mainstem Napa River and other streams as funding allows

ATTACHMENTS

Attachment 1: Napa RCD Out-migrant Trapping Protocol

Attachment 2: Napa RCD Spawner Survey Protocol

ATTACHMENT 1

NAPA RCD OUT-MIGRANT TRAPPING PROTOCOL

Napa County Resource Conservation District
1303 Jefferson St. Suite 500B
Napa, CA 94559

Out-migrant Trapping

Purpose

Steelhead (*Oncorhynchus mykiss)* and Chinook salmon (*Oncorhynchus tshawytscha*) out-migrate from freshwater streams to the ocean as juveniles. This transitional period in their life cycle is known as "smolting", as they undergo physiological changes to cope with changes in water chemistry once in the ocean. Smolts are physically distinguishable from resident fish by their silvery coloration and more streamlined shape.

Smolt trapping in the Napa River watershed is conducted with a rotary screw trap (RST) and fyke nets. The results of annual smolt trapping efforts can be used to calculate abundance estimates, describe details of migration timing, estimate average lengths and weights, and estimate survival rates at various life stages. In addition, smolt trapping data are used to gauge ecological responses to ongoing habitat restoration throughout the watershed.

Trapping Methods

An 8-foot diameter RST is installed in the mainstem Napa River at the same location used in previous years. The trap is installed around March 1 (flows permitting) and operated until flows diminish to a point where the trap no longer spins at least one revolution per minute. Typically, this is around late May or early June. The trap will be operated continuously and checked daily throughout this period. The trap will be disabled when flows are too high to safely fish (>500cfs) or when other circumstances, such as staffing or funding limitations, prevent operation.

The RST will be checked daily beginning around 9:00 AM by at least one permitted RCD staff member, typically with at least one volunteer assistant. Debris will be removed from the trap first, then non-target species, and finally steelhead and salmon for processing. Fish will be removed from the livebox with 3/16" cloth mesh (or finer) dip nets. All fish will be identified to species, counted, and visually inspected for marks or tags. Non-target species will be released off the back of the trap immediately. A sub-sample of the target species (i.e. steelhead and salmon) will be placed and held temporarily in five gallon buckets containing fresh water. Each bucket will be aerated by battery powered air pumps.

The first 30 steelhead and 20 Chinook salmon captured each day will be fully processed, which will include being anesthetized, measured, weighed, and fin clipped. Steelhead smolts will also be PIT tagged if time and budget allows. Full processing will only be done when water temperature (measured in the stream with a hand-held thermometer) is between 5 and 20 degrees C. If water temperature is measured outside of this range, fish will simply be counted and released downstream. If more than 30 steelhead are captured per day, only the first 30 will be fully processed, and any remaining fish will be counted and released immediately downstream. To minimize handling stress, crews will process only a few steelhead smolts at a time.

Anesthetization will be achieved with carbon dioxide from sodium bicarbonate at a rate of approximately 0.4 - 0.6 g/L. Dosage will be adjusted as needed to achieve loss-of-equilibrium in five minutes or less. The anesthetic bath will be made immediately before processing fish by adding bicarbonate (i.e. Alka Seltzer Gold tablets or pre-weighed packets of baking soda powder) to a bucket partially filled with fresh stream water. The bicarbonate material will be allowed to completely dissolve prior to adding fish to the anesthetic bath. Fish will be placed into the solution for several minutes and observed closely until loss of equilibrium is achieved. Anesthetized fish will be removed from the bath and immediately processed.

PIT tags will be inserted ventrally into the body cavity of anesthetized fish approximately 1 cm superior to the origin of the pelvic fins. Depending upon the size of the individual and professional judgement, either 12 mm or 23mm tags will be used. Larger steelhead smolts (> 170mm) may receive a 23mm tag to improve detection, while smaller smolts will receive a 12mm tag to minimize stress. No fish below 130mm will be implanted with a PIT tag. The smaller 12mm tags will be inserted using a sterile syringe injector (manufactured by Biomark Inc.), and the 23mm tags will be inserted using a small incision from a sterilized scalpel.

Fork length to the nearest millimeter will be measured using a wetted, non-abrasive plastic measuring board. Weight to the nearest 0.1 gram will be measured using a digital scale with a wetted tray. Partial fin clips (~10-20 mm2 total area) will be collected using fine-tipped scissors to mark individual fish, and the extracted tissue samples will be stored in labeled vials of 95% ethanol. Fin clips will be made according to the following guidelines: no fin clips on fish <50mm FL, upper caudal clip for all fish 50-130mm FL, pectoral clip for fish 130-300mm FL, upper caudal clip for all fish >300mm FL.

All anesthetized fish will be returned to aerated five-gallon buckets containing fresh stream water and allowed to fully recover before being transported to a release site (either a short distance upstream for mark-recapture studies, or downstream for immediately release). Any incidental mortalities that occur will be recorded, and crews will take the opportunity to collect the specimen's otoliths. Analysis of otolith microchemistry may be done in cooperation with UC Davis and/or UC Berkeley researchers as funding permits to determine life history details about origin, smolt age, etc.

Fyke nets will be used in tributary streams during approximately the same seasonal period as the RST (mid-February through early June). The exact locations for these traps will be determined on an annual basis. The fyke nets will be operated continuously for a minimum of four days per week depending upon streamflow, debris loads, and staffing limitations. Based on previous experience, fyke nets will only be employed when flows are at or below the normal high water mark for each site. Crews will remove the traps from the creeks prior to impending storms and re-install them once the water has cleared and it is safe to wade.

Fyke nets will be constructed with wing walls that can extend from the front of the trap to the stream bank. These wings are constructed of 1/2-inch nylon mesh netting approximately 4-feet in height and serve to direct fish into the main fyke net opening. The wings will be secured to the stream bed and banks using ropes and temporary fence posts as needed. The bottom of the wings will follow the contour of the streambed and will be weighted down with a lead-core rope and cobbles from the stream. A narrow gap (approximately 1-2 feet wide) will be intentionally left between one of the wings and the stream bank to allow for upstream movements of adult salmonids and other stream organisms.

The main fyke net consists of a 4x4 foot square aluminum frame opening leading to a 2-foot diameter round throat entrance. The net is constructed of 3/8-inch nylon mesh and has a series of five stainless steel rings and three net chambers leading to the live box. The downstream-most chamber of each fyke net will be connected to an aluminum-framed live box via a 6-inch diameter PVC pipe several feet in length – this final length of pipe helps prevent captured fish from escaping and it provides cover within the box. The front of the live box is constructed of a solid aluminum panel, which provides shelter from the current for fish trapped in the box. The live box contains a zippered net bag that is constructed of 1/8-inch mesh netting attached to the aluminum frame. The traps will be checked each morning, and catch processing will follow the same procedures described above for the RST. The minimum and maximum temperature criteria for processing steelhead (5-20 degrees C) also apply to fyke net sampling.

Napa County RCD
Smolt Trap Processing Procedure

Species	Lifestage	Recapture	Number to process 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 fin clip and **record unique genetics ID #** 3. Insert PIT tag and record tag # 4. Allow fish to recover in freshwater	Upstream
			31+	Count and release	Downstream
		RECAP	All	1. **Do not anesthetize** 2. Record locations of fin clips or marks observed 3. Scan for PIT tag and record tag # if detected	Downstream
	ADULT ≥ 300mm	-	All	1. **Do not anesthetize** 2. Record locations of fin clips or marks observed 3. Scan for PIT tag and record tag # if detected 4. Record sex, estimated length, and whether fish is likely anadromous 5. Collect small caudal fin clip sample and record genetics ID # 6. Take pictures of fish while holding in water	Downstream
Chinook (or other salmon)	**FRY** ≤ 40mm	-	All	Count and release	Downstream
	PARR / SMOLT ≥ 40 mm	NEW	First 20	1. Anesthetize and record length / weight 2. Apply fin clip and **combine samples** - record pooled genetics ID # 3. Allow fish to recover in freshwater	Upstream
			21+	Count and release	Downstream
		RECAP	All	1. **Do not anesthetize** 2. Record locations of fin clips or marks observed 3. Scan for PIT tag and record tag # if detected	Downstream
All other species	All	-	All	Count and release	Downstream

ATTACHMENT 2

NAPA RCD SPAWNER SURVEY PROTOCOL

Napa County Resource Conservation District
1303 Jefferson St. Suite 500B
Napa, CA 94559

Spawner Survey

Purpose

During fall and winter, adult Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) return to the Napa River to spawn. Spawner surveys are conducted in distinct stream reaches throughout the watershed known to support either or both species. The survey crew is trained to identify and count live fish, carcasses, and redds (spawning nests). Data from these surveys are used to generate spawner abundance estimates for the entire watershed and map the distribution of spawning activity in a given season. Genetic and otolith samples are collected from carcasses to analyze relationships between Napa River fish and other regional populations as well as to determine the origin of individual fish.

Methods

The following protocol is based on methodology described in the California Salmonid Stream Habitat Restoration Manual published by the California Department of Fish and Wildlife (CDFW):

Surveys are conducted either by wading upstream or floating downstream through the channel when conditions are suitable. Suitable conditions include the following elements:

1. Flows are deemed safe to wade or kayak
2. A minimum water visibility of 2 feet
3. Known or expected spawning season for target species

During the survey, the crew continuously scans the stream, focusing on areas likely to be used by spawning salmonids. Polarized sunglasses are used to improve visibility and detection of underwater features.

When live fish are observed, the crew identifies them to species and sex (if possible), and keeps a running tally of how many individual fish are observed. The location of each live fish observation is recorded with a hand-held GPS unit.

When a redd is encountered, its location is recorded with a handheld GPS unit. If the site contains a cluster of redds, the crew counts the redds and categorizes them into the following categories:

Definite redd – clearly defined excavation pit and mound
Possible redd – ambiguous excavation boundary, may be part of other redd

If subsequent surveys are to be made in the same reach, each redd is marked with fluorescent field tape with the date and number of redds written on it. The tape is attached to a nearby tree or overhanging

branch to reduce the chances of double counting the same redd. The crew notes whether the redd is occupied by a spawning fish or is vacant. If the species can be identified, this is also recorded. The redd area is visually estimated and recorded, as well as the specific habitat type (riffle crest, riffle, run, glide, etc.) in which the redd is constructed.

Carcasses found during spawner surveys are removed from the water and measured for length to the nearest centimeter using a gaff hook with one-centimeter graduations along the handle. The species and sex of the carcass are recorded (if known), as well as the presence or absence of an adipose fin. If the carcass is missing its adipose fin, the entire head is removed and placed in a Ziploc bag to be sent to CDFW for coded-wire-tag (CWT) extraction. A label will be placed in the bag listing the collection details for each specimen.

The physical condition of each carcass is assessed and recorded based on the following scale:

1 = Recently died, eyes clear and flesh firm
2 = Eyes cloudy, flesh still firm
3 = Eyes cloudy, flesh soft
4 = Eyes cloudy, flesh very soft, sloughing off
5 = Only head and part of skeleton remain

If the carcass is not too decayed, a tissue sample (operculum or fin clip) is collected and stored on dry blotter paper placed inside a clean wax-paper envelope. If the head is intact, otoliths are removed from each carcass and placed into 1.5mL centrifuge tubes for storage and future analysis.

Each carcass and (all samples taken from it) will be assigned a unique identification code based on the following system:

Stream Code – Species Code – Year Collected – Sample number

Example: NR-CHA-12-3 = Napa River – Chinook Adult – 2012 – sample #3

If mark recapture studies are being conducted to estimate total escapement, each carcass will be marked with a unique numbered aluminum tag wired to a bony part of the skeleton – preferably the lower jaw. The tag number will be recorded in the “Mark#” column on the datasheet. Tagged carcasses encountered during follow up surveys will have their tag numbers recorded in the “Recap#” column of the datasheet.

Once fully processed, carcasses are returned to the approximate location where they were found.