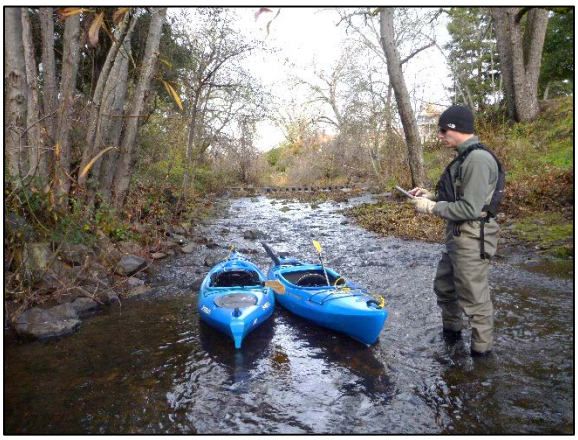
Napa River Steelhead and Salmon Monitoring Program - 2015-16



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The Napa County Resource Conservation District (RCD) would like to thank the group of dedicated volunteers that helped with rotary screw trap monitoring this year, specifically Kevin Bradley, Gary Brandl, Jenna Huddleston, Stephanie Lupien, John Nogue, Steve Orndorf, Michael Polenske, Wayne Ryan, Ron Sheffer, and Pam Smithers.

We would also like to thank our project partners including Napa River Steelhead, Treasury Wine Estates, the Rutherford Dust Society, and the Napa County Flood Control and Water Conservation District for their assistance and ongoing support. The California Department of Fish and Wildlife in cooperation with NOAA's National Marine Fisheries Service issue research permits for this work, and we are thankful for their oversight and contributions over the years.

Finally, we would like to thank Stewart Reid and Damon Goodman (US Fish and Wildlife Service), who remain dedicated to lamprey conservation and have greatly helped us with our understanding of lamprey ecology in the Napa River watershed. We also appreciate their 24-hour staffing of the "lamprey hotline", which has come in handy more than once.

Cover photos:
Left - Napa River rotary screw trap in operation, April 17, 2016
Right - Preparing for a spawner survey in downtown Calistoga, December 28, 2015

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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. The monitoring program is comprised of several integrated methods intended to assess salmonid population trends in the Napa River watershed. In addition, the program also allows us to study salmonid life history details, document the composition of the overall Napa River fish community, and track ecological responses to ongoing habitat restoration. For a more thorough summary 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 2015-16 monitoring season RCD was able to conduct four salmon spawner surveys and one steelhead spawner survey in winter, and juvenile outmigrant trapping throughout most of the spring. 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 installed in the mainstem Napa River on February 24, 2016 to capture juvenile salmonid out-migrants (i.e. smolts) on their downstream migration to the estuary/ocean. The trap has been installed at the same location annually since 2009. The site 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 to 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 covered by Scientific Collecting Permit #003495 issued by the California Department of Fish and Wildlife, and Section 4(d) Research Permit #19725 issued by the National Marine Fisheries Service.

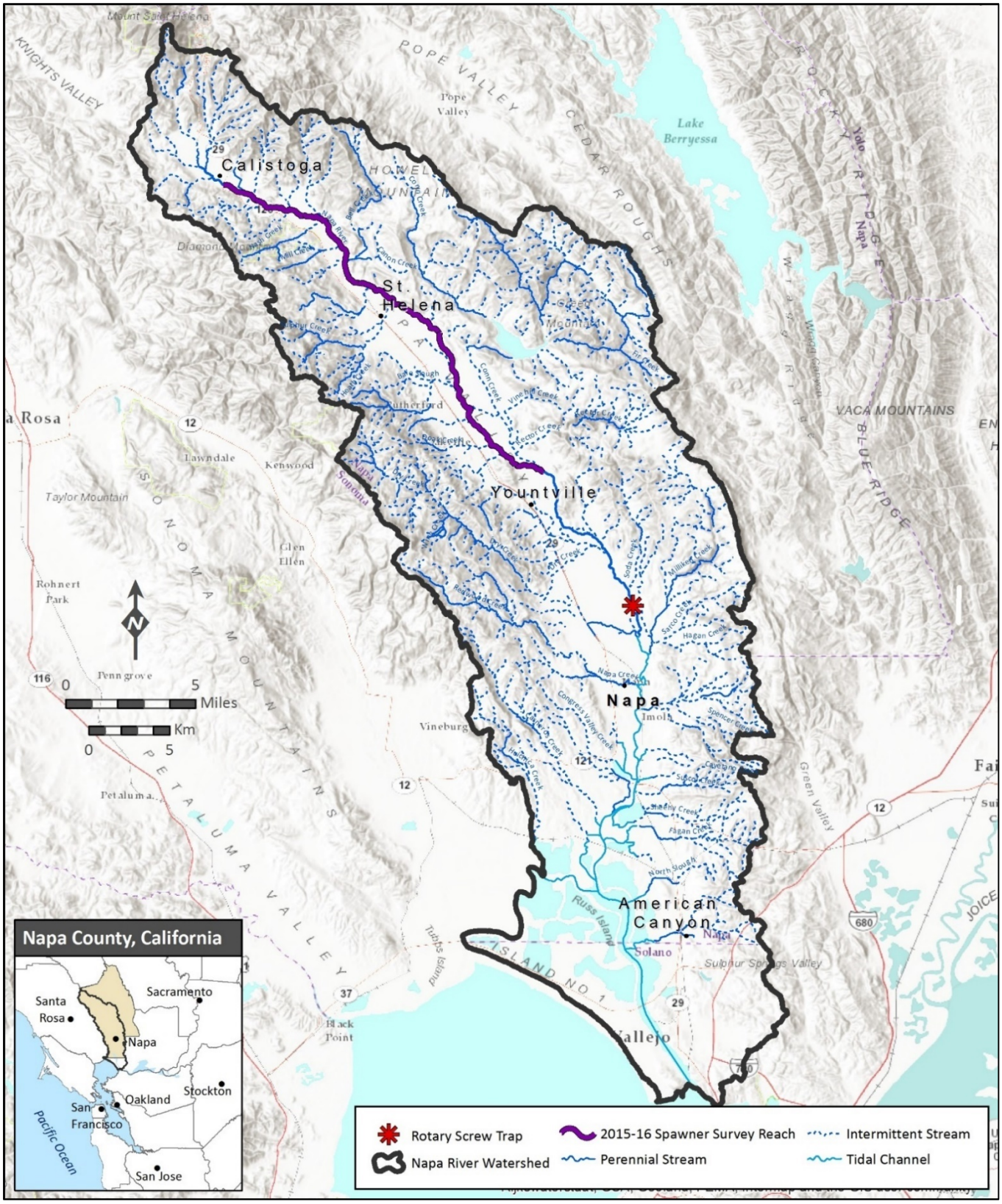

Figure 1. Locations of the Napa River rotary screw trap and 2015-16 spawner surveys.

Out-migrant Sampling Period

The rotary screw trap was operated for a total of 1,474 hours (61.4 days) between March 1 and May 26, 2016 (Figure 2). A large storm in early March produced high flow conditions that prevented sampling for 19 consecutive days. During such periods of high flow (above approximately 500 cubic feet per second [cfs]), the trap's cone was raised out of the water (Figure 3) to halt operation until safe conditions resumed. The trap was disassembled and removed from the river for dry storage on June 9, 2016.

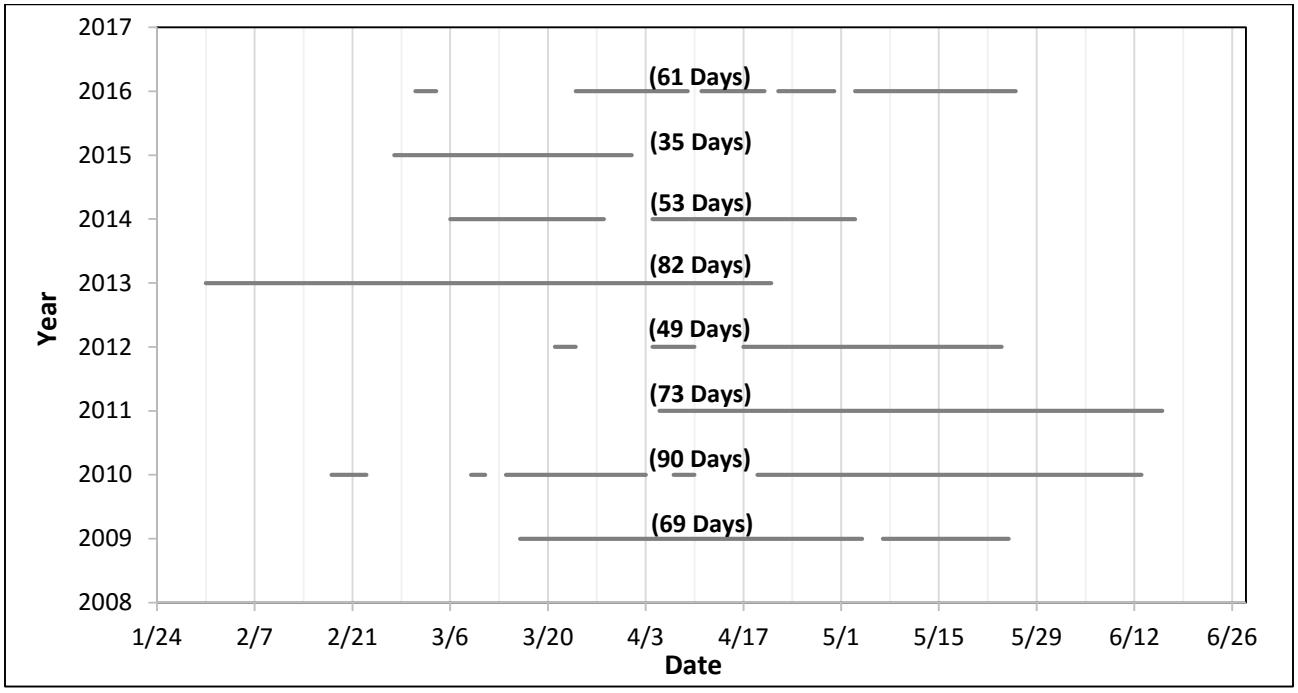

Figure 2. Seasonal periods when the Napa River rotary screw trap was operated in 2009-2016. The total number of sampling days for each year is shown in parentheses. Gaps within each sampling year represent periods when the trap was not operated due to high flows or other factors.

Figure 3. Left: rotary screw trap on March 6, 2016 during a high flow of approximately 6,700 cfs. Right: low flow conditions in early May 2016.

Out-migrant Trapping Results

During the 2016 season, a total of 5,648 fish were captured in the RST (Figure 4). The total catch included 11 native fish species (Table 1), 12 non-native fish species, and 5 non-fish aquatic taxa (Table 2). A total of 658 salmonids were captured, including 78 steelhead and 580 Chinook salmon. Native fishes comprised 95% of the total catch (n=5,357) and non-native fishes accounted for 5% of the total catch (n=291).

Of particular note in 2016, were unusually high numbers of river lamprey and Pacific lamprey. Since both species are anadromous, favorable conditions in either freshwater or the estuary and ocean may have contributed to this upward trend; however local lamprey population dynamics are poorly understood. Pacific lampreys have experienced long-term population declines throughout the west coast, similar to salmonids, and are now the focus of several conservation efforts by the US Fish and Wildlife Service and others. Unfortunately, no historical data exists for Pacific lamprey abundance in the Napa River, which makes it difficult to know how the current population compares with previous eras.

River lampreys are considered rare, and very little is known about their life history details and spawning habits. The fact that the RCD captures so many river lampreys each year suggests that this species is persisting locally, and may even be increasing. Based on a recent inventory of lampreys along the Pacific west coast, it appears that the Napa River may support one of the largest populations of river lampreys in the Bay Area, and perhaps California (Reid, pers. comm.). Therefore, this monitoring program offers a unique opportunity to study this species and promote its long-term survival as well.

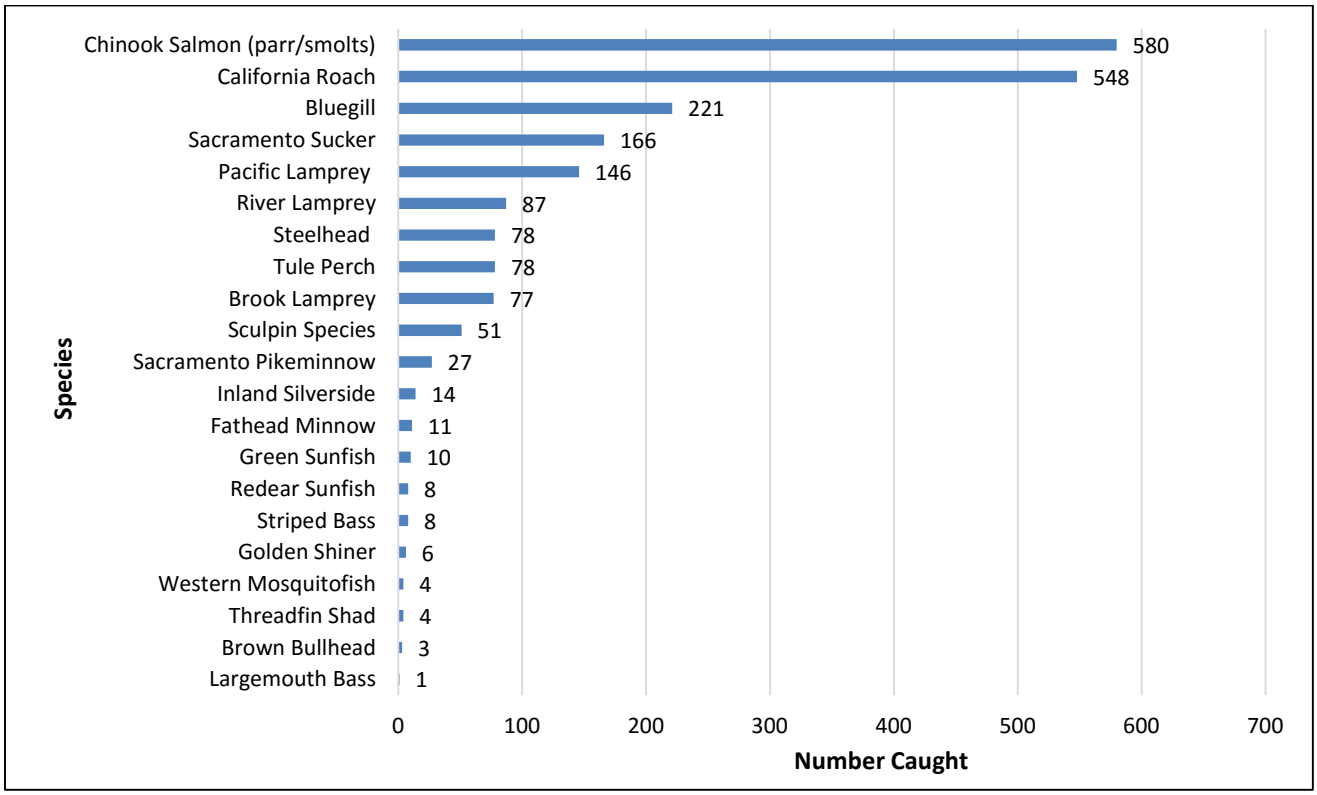

Figure 4. 2016 rotary screw trap total catch. Note: larval counts are not included in this chart due to their extreme abundance. For a complete account of all fish captured from 2009-2016, see Tables 1 and 2.

Table 1. Native fish species collected annually in the Napa River rotary screw trap from 2009 through 2016.

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	Total
Steelhead / Rainbow trout	*Oncorhynchus mykiss*									
Fry / Parr (<130 mm)		941	94	7	152	3,025	303	35	11	**4,568**
Smolt (>130mm)		119	251	175	160	77	31	34	64	**911**
Adult or Resident (>300 mm)		0	3	4	0	3	0	0	3	**13**
Chinook Salmon	*Oncorhynchus tshawytscha*									
Parr / Smolt		1	1,520	7,377	488	19	0	0	580	**9,985**
Kokanee/ Sockeye Salmon	*Oncorhynchus nerka*									
Parr / Smolt		0	342	0	0	0	0	0	0	**342**
Pacific Lamprey	*Entosphenus tridentatus*									
Adult		25	11	38	64	9	14	11	143	**315**
Macrothalmia[1]		-	-	-	-	1	0	0	3	**4**
Ammocete[1]		-	-	-	9	4	7	30	54	**104**
River Lamprey	*Lampetra ayresi*									
Adult[1]		-	2	21	9	3	0	0	86	**121**
Macrothalmia[1]		-	-	-	-	15	0	0	1	**16**
Brook Lamprey (Adult[1]**)**	*Lampetra richardsoni*	-	0	64	7	174	120	87	77	**529**
Lampetra Sp. Ammocete[1]	*Lampetra sp.*	-	-	-	19	108	46	40	136	**349**
Sacramento Splittail	*Mylopharodon conocephalus*	2	6	0	1	26	0	6	0	**41**
Hardhead	*Pogonichthys macrolepidotus*	0	0	1	0	0	1	1	0	**3**
Sacramento Pikeminnow	*Ptychocheilus grandis*	28	87	192	191	33	12	4	27	**543**
California Roach[2]	*Hesperoleucus symmetricus*	4,744	3,571	336	330	498	691	253	548	**10,971**
Sacramento Sucker	*Catostomus occidentalis*	82	419	207	33	78	42	61	166	**861**
Tule Perch	*Hysterocarpus traski*	6	28	30	20	17	8	6	78	**193**
Prickly Sculpin	*Cottus asper*	242	124	62	66	329	184	20	51	**1,078**
Three-spine Stickleback[2]	*Gasterosteus aculeatus*	116	76	273	50	34	37	14	3,329	**3,929**

[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 2016.

Common Name	Scientific Name	2009	2010	2011	2012	2013	2014	2015	2016	Total
Bluegill	*Lepomis macrochirus*	29	100	86	41	11	107	24	221	**619**
Redear Sunfish	*Lepomis microlophus*	0	8	0	0	0	1	9	8	**26**
Pumpkinseed	*Lepomis gibbosus*	0	0	1	0	0	0	0	0	**1**
Green Sunfish	*Lepomis cyanellus*	0	2	5	0	0	19	2	10	**38**
Black Crappie	*Pomoxis nigromaculatus*	1	0	1	1	1	0	1	1	**6**
Largemouth Bass	*Micropterus salmoides*	2	1	4	3	0	0	1	1	**12**
Western Mosquitofish	*Gambusia affinis*	1	0	2	3	1	1	0	4	**12**
Wakasagi	*Hypomesus nipponensis*	0	9	0	0	0	0	0	0	**9**
Threadfin Shad	*Dorosoma petenense*	0	2	3	1	0	0	0	4	**10**
Inland Silverside	*Menidia beryllina*	0	12	1	0	0	0	0	14	**27**
Fathead Minnow	*Pimephales promelas*	2	4	20	0	2	2	12	11	**53**
Common Carp	*Cyprinus carpio*	1	0	0	0	0	0	0	0	**1**
Golden Shiner	*Notemigonus crysoleucas*	1	11	18	1	22	2	14	6	**75**
White Catfish	*Ameiurus catus*	0	1	0	1	0	0	0	0	**2**
Brown Bullhead	*Ameiurus nebulosus*	2	3	3	3	0	2	0	3	**16**
Channel Catfish	*Ictalurus punctatus*	1	0	0	0	0	0	0	0	**1**
Striped Bass	*Morone saxatilis*	3	2	0	1	0	0	0	8	**14**
Non-Fish Taxa										
Bullfrog	*Lithobates catesbeiana*									
Larvae (tadpole)		500	1,401	632	111	54	255	368	560	**3,881**
Adult		1	2	5	2	0	1	9	9	**29**
Pacific Chorus Frog (Larvae)	*Pseudacris regilla*	0	32	0	0	0	0	0	0	**32**
Signal Crayfish	*Pacifastacus leniusculus*	3	103	79	128	123	307	41	64	**848**
Red Swamp Crayfish	*Procambarus clarkii*	40	233	78	46	13	103	25	151	**689**
Red-eared Slider Turtle	*Trachemys scripta elegans*	0	3	1	1	1	0	1	17	**24**
Western Pond Turtle	*Actinemys marmorata*	2	1	1	1	1	1	2	4	**13**

Steelhead and Salmon Smolt Catch Rates

In order to standardize catch rates from year to year, the catch-per-unit-effort (CPUE) was calculated by dividing the total number of smolts captured in a given year by the number of days sampled. Over the past eight years, steelhead catch rates exhibit an increasing trend from 2009 to 2012, followed by a sharp decline in 2013 and continued lower catch rates through 2016 (Figure 5). The cause of this trend is not well understood and is beyond the scope of this monitoring project. However, as illustrated in Figure 5, there appears to be a correlation between steelhead abundance and rainfall, with higher catch rates following relatively wet years and lower catch rates following dry years.

Juvenile steelhead require cool perennial stream flow to survive the dry season; hence it is reasonable to hypothesize that more smolts would be produced in wet years and fewer would be produced in dry years. It is also important to consider that the rotary screw trap is more effective at trapping and holding fish during periods of higher flows and becomes less effective as flows diminish. Therefore, it is difficult to know whether the lower catch rates observed from 2013-2016 were caused by a real population decline related to drier environmental conditions, or if the lower flows during the sampling periods in those years simply reduced the trap's efficiency, yielding a lower catch. Further study is needed to examine these relationships and other possible causes of the declining trend.

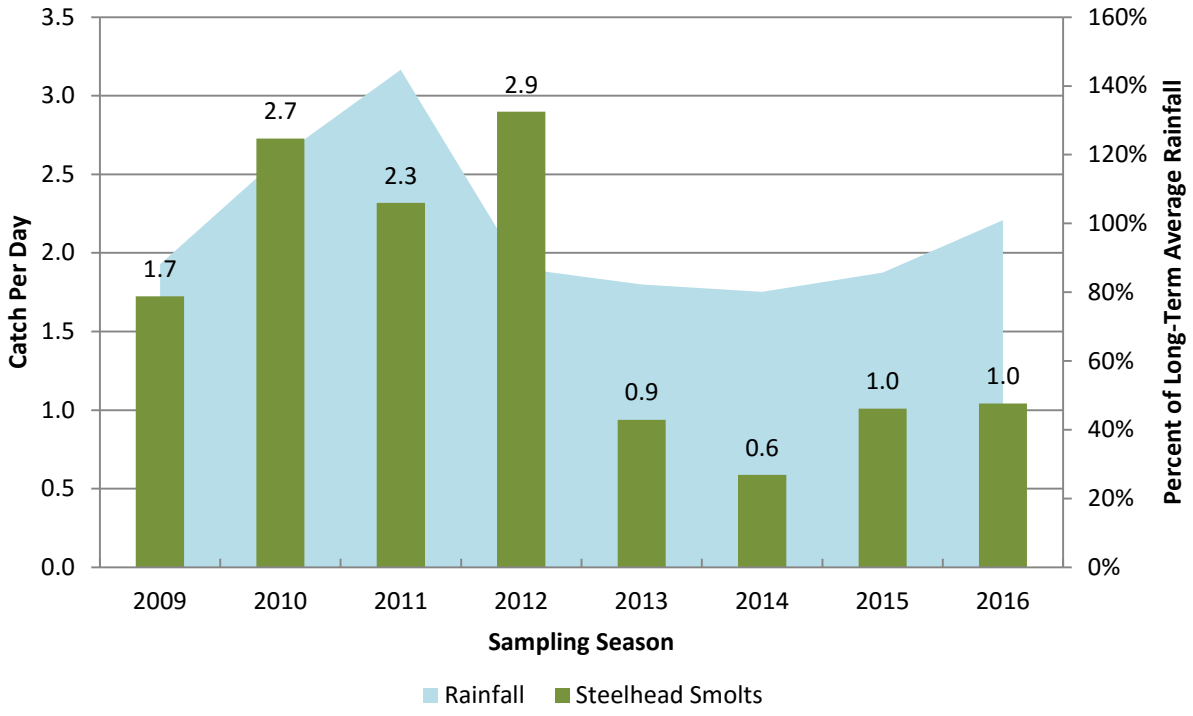

Figure 5. Steelhead smolt catch rates (CPUE) plotted with total annual rainfall for the Napa State Hospital gauging station. The long term average was calculated by dividing the annual total for the water year (October 1 through September 30) by the long-term annual average for the station, which is reported by DWR as 24.18 inches. Data from this station have been shown to be reasonably representative of watershed-wide rainfall patterns: (http://www.napawatersheds.org/files/managed/Document/6838/WaterYear_Methodology.pdf).

Chinook catch rates during the past eight years show significant variability, including several years when no Chinook smolts were captured (Figure 6). The variability in Chinook abundance from year to year suggests that the population is relatively small and may be comprised of a significant percentage of "strays" – fish that were born in 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. However, due to the very small numbers of fish returning during the past several years, we have been unable to collect enough tissue samples from spawned adults to draw meaningful conclusions. Regardless of their origins, Chinook salmon appear to have spawned in the Napa River in greater abundance during the 2015-16 season than the previous four years, suggesting that the opportunity to collect additional samples may be better in the coming years.

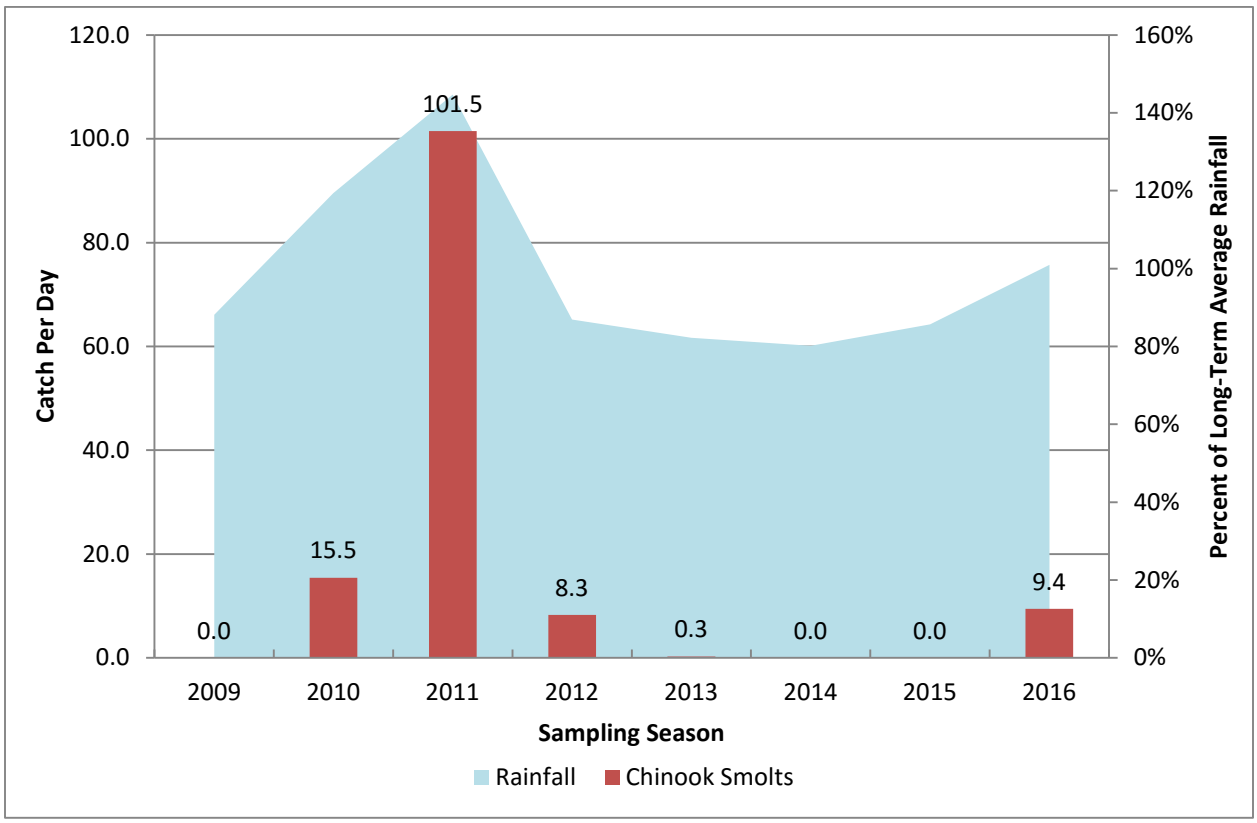

Figure 6. Chinook salmon smolt catch rates (CPUE) plotted with total annual rainfall for the Napa State Hospital gauging station. The long term average was calculated by dividing the annual total for the water year (October 1 through September 30) by the long-term annual average for the station.

Steelhead Smolt Size

The 2016 median steelhead smolt fork length (measured from the tip of the snout to the center of the fork in the tail) was 194 millimeters (7.6 inches), which was slightly higher than the long-term running average of 189 millimeters (7.4 inches) (Figure 7). Several tagging 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. Based on this relationship and the consistently large size of steelhead smolts documented over the past eight years, it appears that insufficient smolt size is not a major limiting factor for the Napa River steelhead population.

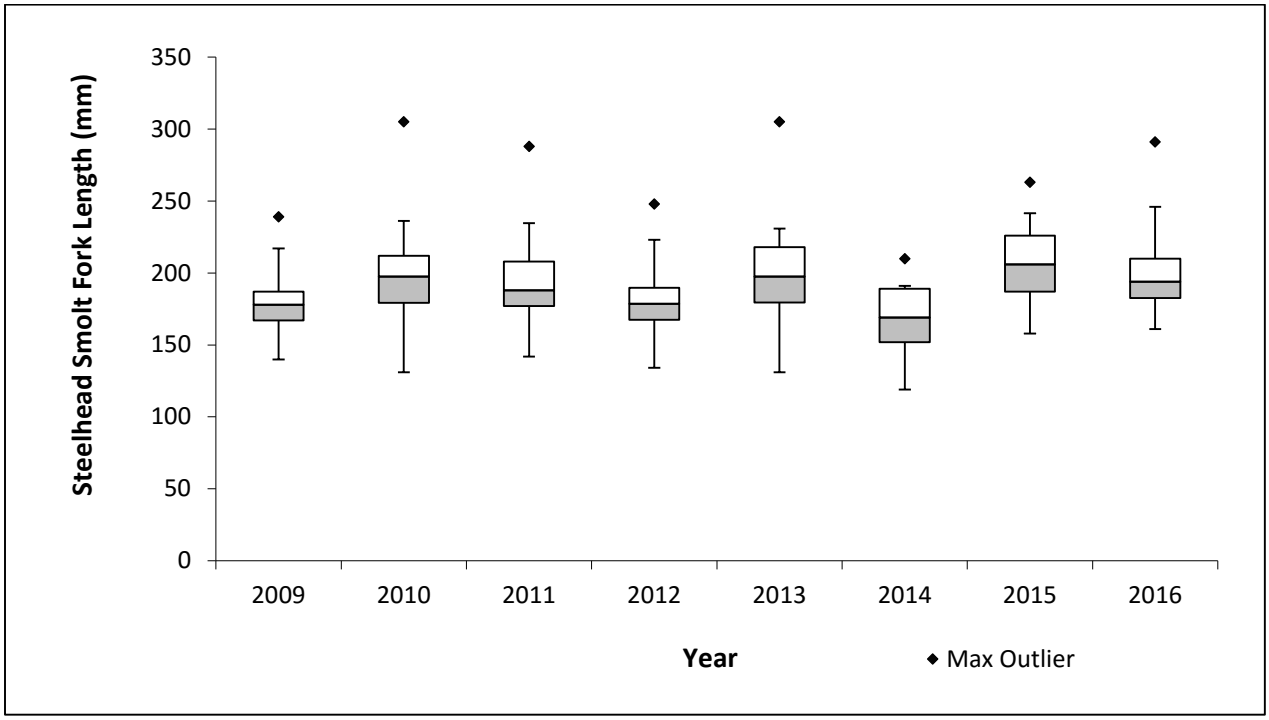

Figure 7. Steelhead smolt fork lengths from the Napa River rotary screw trap 2009-2016. The bottom and top of each box are the 25th and 75th percentiles respectively. The line near the middle of each box is the median, and the vertical lines (whiskers) represent the lowest and highest values within 1.5 times the inter-quartile range. The maximum outlier values represent the largest individual 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 calculated in some weeks due to low or no catch.

During the 2016 season, a total of 43 steelhead smolts and 289 Chinook salmon smolts were marked and released upstream as part of these mark-recapture trials (Table 3). Four of the marked steelhead were recaptured and 110 of the marked Chinook were recaptured, yielding overall trap efficiency estimates of 9% for steelhead and 38% for Chinook (Figure 8). Based on all years of data, the average trapping efficiency for steelhead has been approximately 12% and approximately 24% for Chinook.

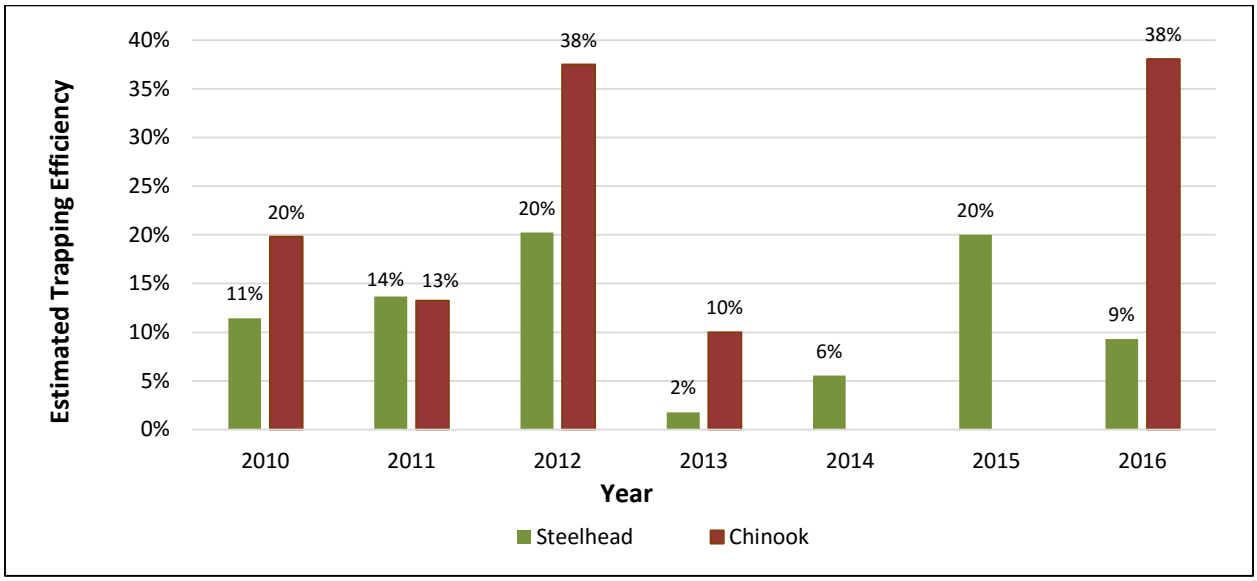

Figure 8. Rotary screw trap efficiency estimates for steelhead and Chinook salmon smolts 2010-2016.

Table 3. Total number of smolts captured, released upstream, and recaptured by the rotary screw trap 2010-2016. 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	25%	0	0	0	-
2016	64	43	4	9%	580	289	110	38.1%

STEELHEAD SMOLT TAGGING

Passive Inductive Transponder (PIT) tags provide a way for researchers to uniquely identify and track individual fish over their entire lifetimes. By PIT tagging steelhead smolts in the Napa River watershed, the RCD is attempting to determine what fraction of these fish return to spawn as adults. Tagging data can also provide insights about ocean survival rates and migration timing and patterns, which are thus far not well understood for the Napa River watershed.

PIT Tagging Methods

PIT tagging is essentially a mark-recapture method, which relies on either recapturing or redetecting previously tagged fish to learn details about their life history. The approach used in the RCD's monitoring program is to tag as many smolts as possible just as they enter the estuary and attempt to recapture or redetect them in subsequent years as returning adults. Since PIT tags do not broadcast their information out into the surrounding environment, they must be re-energized (or interrogated) by a magnetic field generated from a specially designed antenna. These antennae can be hand-held or stationary. Since 2013, the RCD has operated a permanent PIT tag antenna loop that spans the low flow channel of the Napa River approximately 20 meters upstream of the RST (Figure 9). This antenna and its accompanying data-logger operate 24 hours per day on solar/battery power and were in operation continuously during the 2016 spring season. PIT tag implantation procedures are described in detail in Attachment 1.

Figure 9. PIT tag antenna across the Napa River. Note, the lower portion of this "swim-through" loop runs along the bed of the river, and is not visible under the water.

PIT Tagging Results

During the 2016 out-migrant trapping season, 64 steelhead smolts were implanted with PIT tags. This was the fifth consecutive year that the RCD has conducted PIT tagging; however, the tags used during the first year were a different type (full-duplex), which is not compatible with the current tag reading equipment (half-duplex), and is therefore not included in this discussion.

From 2013 to 2016, a total of 215 smolts were implanted with PIT tags (Table 4). The number of fish tagged each year was dictated by catch rates; ideally this number would be as large as possible to improve the odds of re-detection. However, ongoing drought and generally poor trapping conditions during the past four years produced relatively low catch rates and reduced tagging opportunities. During the past several years, the PIT tag antenna has successfully detected a large number of tagged smolts that were released upstream of the antenna as part of the RST efficiency trials. These detections verify that the antenna and tagging approach is an effective monitoring tool, especially during lower-flow conditions (less than about 500 cfs).

As of August 2016, the antenna had not re-detected any returning adult fish. Steelhead typically return to spawn after two to three years at sea, which means that some of the smolts tagged during the spring of 2013 and 2014 would have been expected to re-enter the Napa River system as adults during the 2015/16 water year. However, given the relatively small number of fish tagged each year and the logistical limitations of the PIT tag antenna (e.g. reduced detection rates during storms, missed periods when the antenna was damaged, etc.), it is not too discouraging that these fish have yet to be re-detected. With additional sampling years and larger numbers of fish tagged, the likelihood of re-encountering previously tagged steelhead is expected to increase greatly.

Table 4. PIT tagging results from 2013-2016, including the number of smolts tagged, the number of those tagged fish that were re-detected by the Napa River PIT tag antenna in the same year they were tagged, and the number that were re-detected in subsequent years. Note: Steelhead smolts were collected and tagged in two upstream tributaries, York and Sulphur Creeks, during the 2014 and 2015 seasons.

Year	Location	Smolts tagged	Smolts re-detected during same year	Smolts re-detected during 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

SPAWNER SURVEYS

Spawner surveys are intended to document adult spawning activity, map its distribution, and allow researchers to measure specimens and collect tissue samples from dead carcasses. The RCD's spawner surveys focus on Chinook salmon and steelhead in the mainstem Napa River, with periodic spawner surveys being conducted opportunistically in tributary streams as project-specific funding allows.

Spawner Survey Methods

The 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).

The timing of spawner surveys should correspond to periods when the target species are known or expected to be in the system. Ideally, surveys should be conducted multiple times throughout the winter and spring to bracket the entire spawning period. However, this represents a significant effort and cost – far beyond the funding constraints of the RCD's current monitoring program. Therefore, the results of these surveys are not statistically robust enough to be used for generating population or 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 2015-16 spawning season were generally favorable with storms occurring in late fall and early winter. The resulting flows allowed fish to migrate into the system and spawn during December and early January (Figure 10). Based on the condition of some redds observed in our late December surveys, it appears that Chinook salmon were able to migrate upstream and spawn as early as December 10, 2015.

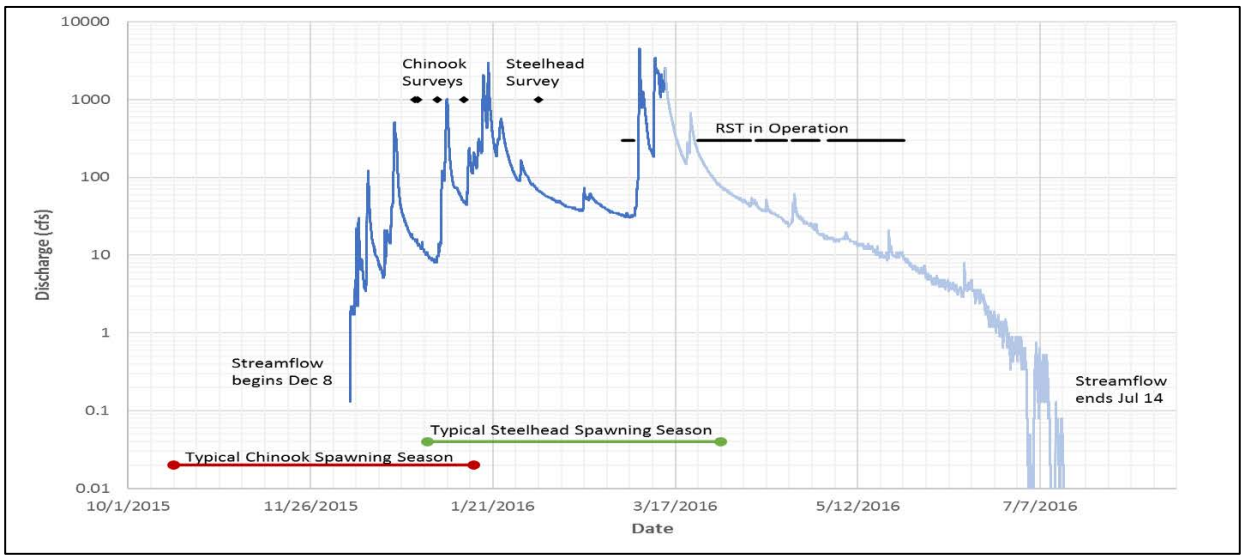

Figure 10. 2015-16 hydrograph for USGS streamgaging station 11456000 Napa River near St Helena, California, showing storm timing and field work. The dark blue portion of the line is quality-controlled and approved data, the light blue section is provisional and subject to change.

RCD conducted a total of four spawner surveys from December 28, 2015 through January 12, 2016 to quantify Chinook salmon spawning in the mainstem Napa River. Additionally, one steelhead spawner survey was conducted on February 4, 2016 along the 7.6 kilometer (4.7 mile) Rutherford Restoration Project Reach of the Napa River. No spawning observations were made during the steelhead survey, and therefore no conclusions can be drawn from this one-time survey.

In total, the spawner surveys encompassed a total of 31.9 kilometers (19.8 miles), which is approximately 67% of the total 48 kilometers (29.8 miles) of viable spawning habitat in the mainstem Napa River. A total of fifteen constructed Chinook redds were observed (Figure 11). Additionally, one live female Chinook salmon was observed near a redd; no carcasses were found. Details of each survey are provided in Table 5.

Based on these four surveys, it appears that Chinook salmon spawned mostly in the lower portion of the Napa River during the 2015/16 season, with the highest concentrations observed in the Rutherford and Oakville reaches (Figure 12). Overall abundance of Chinook spawning appeared to be relatively low, with a total count of just 15 redds throughout the surveyed reaches. Still, this was the highest number of spawning Chinook observed during the past several years, and the capture of juvenile Chinook in the RST confirmed that spawning and rearing was successful enough to produce smolts.

Table 5. Napa River spawner survey details and results.

Date	Distance (km)	Method	Target Species	Redds Observed	Live Fish Observed	Carcasses Observed
Dec 28, 2015	11.6	Kayak	Chinook	1	0	0
Dec 29, 2015	3.9	Wading	Chinook	6	1	0
Jan 4, 2016	8.9	Kayak	Chinook	8	0	0
Jan 12, 2016	7.5	Kayak	Chinook	0	0	0
Feb 4, 2016	7.6	Kayak	Steelhead	0	0	0

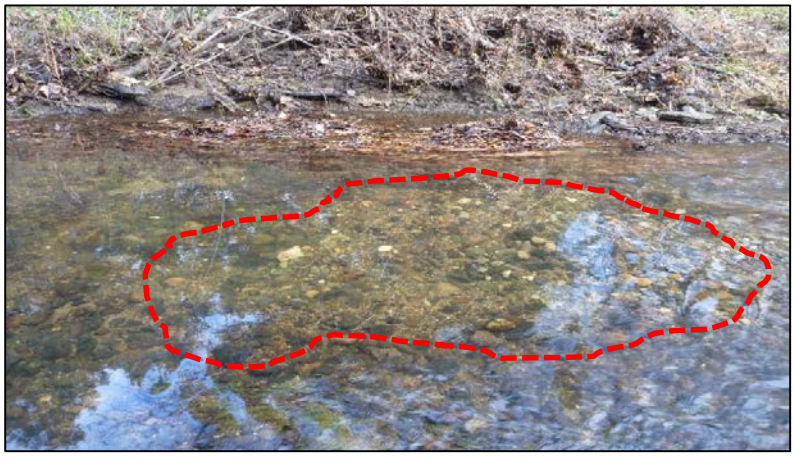

Figure 11. Chinook salmon redd in the mainstem Napa River with approximate boundary outlined.

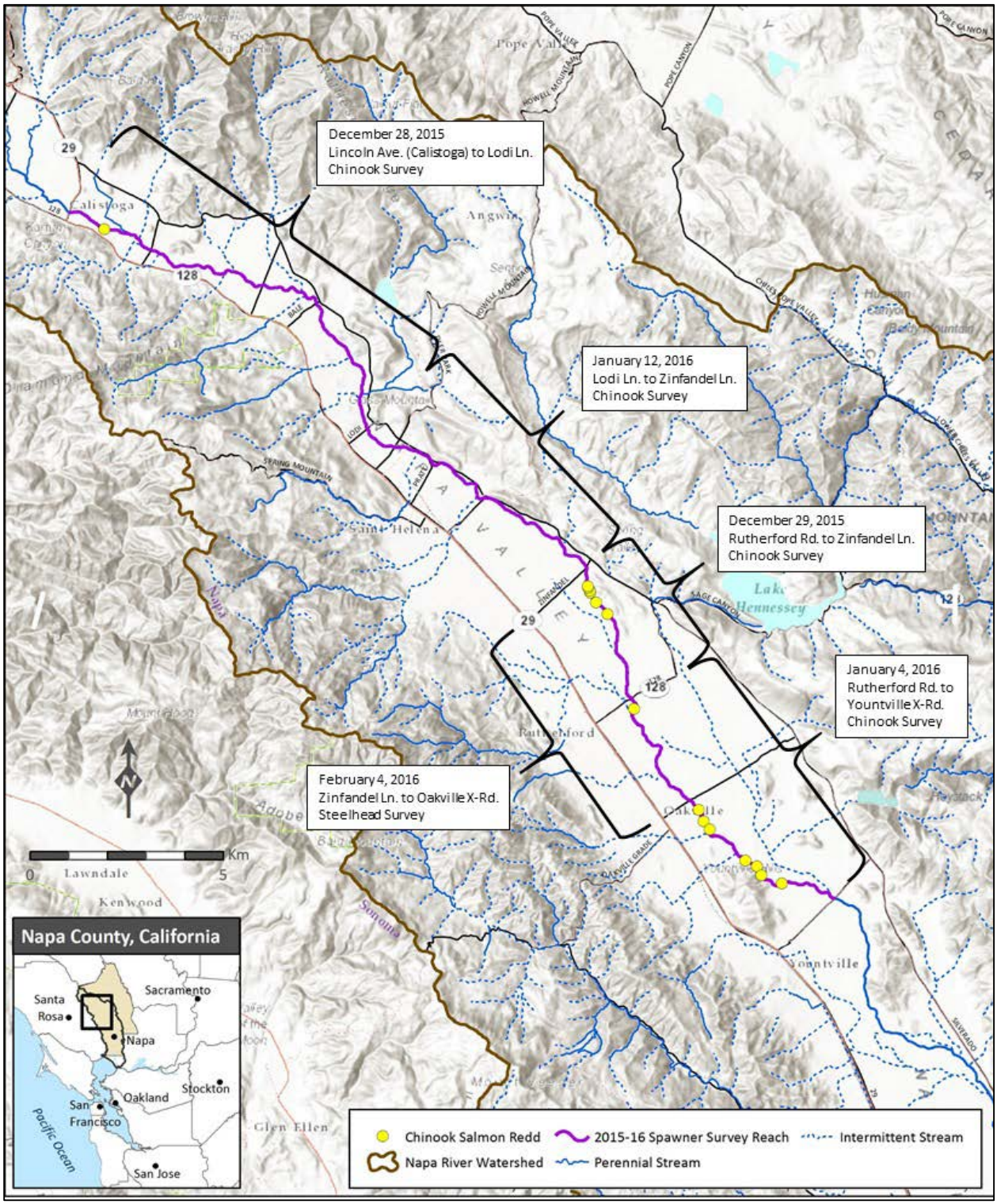

Figure 12. Map showing locations of 2015-16 spawner surveys and observed redds in the Napa River.

FUTURE EFFORTS

The RCD and our partners have secured funding to continue operating the RST in the same location in spring 2017. As a component of the RST monitoring, RCD will continue to tag steelhead smolts and operate the PIT tag antenna throughout the 2016/17 water year. RCD and our partner, Napa County, has received funding from the California Coastal Commission to conduct fish monitoring in the mainstem Napa River related to the ongoing restoration of the Oakville-to-Oak Knoll reach. RCD plans to conduct approximately the same number of spawner surveys in the mainstem Napa River during the 2016/17 water year with focus on the Rutherford and Oakville reaches, as funding dictates.

As part of a separate focused study of the Bale Slough/Bear Creek sub-watersheds, RCD will conduct steelhead spawner surveys during the winter 2016/17 season. Results of these surveys will be published in a separate report to the State Water Resources Control Board.

LITERATURE CITED

Stewart Reid, Consulting biologist to the US Fish and Wildlife Service, 2016. Personal communication with RCD biologist Jonathan Koehler on August 8, 2016.

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

Stream:		Date:	Water temp (°C):	Weather: Clear Partly Cloudy Overcast Drizzle Rain
Trap:	RPM:	Start time:	Air temp (°C):	Comments:
Crew:		End time:	Flow (CFS):	

Steelhead and salmon (other species recorded on back of form)

Fish #	Species	Life stage	Clips obs.	Recap y/n	FL (mm)	WT (g)	Clips applied	Genetics ID	PIT tag #	Tag type	Release us/ds	Mort (y/n)	Notes
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
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26													
27													
28													
29													
30													

Trap Efficiency

Steelhead Smolts	New:	Recaps:	Upstream Releases:
Chinook Smolts	New:	Recaps:	Upstream Releases:

Steelhead Life-stage Classes

Fry: < 40 mm Smolt: 130 - 300mm

Parr: 40 - 130 mm Adult: > 300 mm

Other Species Collected:

Species	Count	Notes
Pacific Lamprey (Adult)		
Pacific Lamprey (Ammocoete)		
River Lamprey (Adult)		
Brook Lamprey (Adult)		
Lampetra Species Ammocoete		
California Roach		
Sacramento Sucker	Adults: Juveniles: Larvae:	
Three-spine Stickleback		
Sculpin species		
Tule Perch	Adults: Juveniles:	
Sacramento Pikeminnow		
Sacramento Splittail		
Hardhead		

Bluegill	Adults: Juveniles:	
Green Sunfish	Adults: Juveniles:	
Redear Sunfish		
Largemouth Bass	Adults: Juveniles: Larvae:	
Western Mosquitofish		
Fathead Minnow		
Golden Shiner		

Bullfrog Tadpole		
Signal Crayfish		
Red Swamp Crayfish		
Red-eared Slider Turtle		
Western Pond Turtle		

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.

(707) 252 - 4188
FAX (707) 252 - 4219

Napa County RCD

SALMON SPAWNING STOCK SURVEY FIELD FORM

Stream: _____ Date: _____ Start time: _____ End time: _____

Starting location: _____ Lat: _____ Long: _____

Ending location: _____ Lat: _____ Long: _____

Surveyed distance: _____ Weather: *clear overcast rain* County: _____

Water clarity: *0-2 ft 2-4 ft >4ft* Air temp: _____ Water temp: _____ Flow (cfs): _____

Flow Data Source: _____ Crew: _____

Number of live fish observed: Chinook: _____

Chinook grilse (<55cm) _____ Steelhead _____ Unknown _____

Number carcasses examined:

Species	Sex	FL (cm)	Fin clip	Carcass ID #	Mark #	Recap. #	Latitude	Longitude	Carcass Condition (1=fresh, 5=skeleton)

Number of skeletons: Chinook_____ Steelhead _____ Unknown _____

Redds: *(Additional sites on back of form)*

Species					
Area (sq m)					
Lat					
Long					
Occupied					
Habitat					

Carcass Condition:
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

Spawning Redds

Species						
Area (sq m)						
Lat						
Long						
Occupied						
Habitat						

Species						
Area (sq m)						
Lat						
Long						
Occupied						
Habitat						

Species						
Area (sq m)						
Lat						
Long						
Occupied						
Habitat						

Species						
Area (sq m)						
Lat						
Long						
Occupied						
Habitat						

Species						
Area (sq m)						
Lat						
Long						
Occupied						
Habitat						

Species						
Area (sq m)						
Lat						
Long						
Occupied						
Habitat						

Coded Wire Tag Labels

Salmon CWT Recovery Tag			
CWT #			
ID #			
Location:			
Lat			
Long			
Species			
Race	Fall	Win	Spr
Sex	M	F	U
Recovery method			
Date			

Salmon CWT Recovery Tag			
CWT #			
ID #			
Location:			
Lat			
Long			
Species			
Race	Fall	Win	Spr
Sex	M	F	U
Recovery method			
Date			

Salmon CWT Recovery Tag			
CWT #			
ID #			
Location:			
Lat			
Long			
Species			
Race	Fall	Win	Spr
Sex	M	F	U
Recovery method			
Date			

Salmon CWT Recovery Tag			
CWT #			
ID #			
Location:			
Lat			
Long			
Species			
Race	Fall	Win	Spr
Sex	M	F	U
Recovery method			
Date			