NAPA RIVER STEELHEAD AND SALMON SMOLT MONITORING PROGRAM

ANNUAL REPORT – YEAR 2

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NAPA COUNTY RESOURCE CONSERVATION DISTRICT

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ABSTRACT

The Napa County Resource Conservation District (RCD) initiated a salmonid outmigrant monitoring program in 2009 using a rotary screw trap. This report covers the second operating season for this trap, which began on February 17, 2010 and extended through June 14, 2010. A group of over 20 volunteers assisted RCD staff with installation, daily processing, and maintenance of the trap, which was located in the mainstem Napa River north of Trancas Avenue (~400 meters upstream of the extent of tidal influence). The trap was in place for 118 days and was in operation for a total of 90 days. The trap was tilted out of the water for a total of 28 days (not consecutively) when it was deemed unsafe to operate during periods of high flow.

A total of 25 fish species were captured (13 native, 12 exotic). The total catch was 33,550 fish, which was comprised of 32,426 natives and 1,124 exotics. Larval fish (< 25mm in length) were a large component of the total catch, including approximately 25,644 Sacramento sucker larvae and approximately 969 largemouth bass larvae. The total catch of non-larval fish was 6,937. Native species dominated the total non-larval catch as well (n=6,782), accounting for 97.7% of all non-larval specimens. Five species were collected for the first time in 2010: wakasagi (*Hypomesus nipponensi*s), inland silverside (*Menidia beryllina*), and white catfish (*Ameiurus catus*), which had all been previously documented in the estuary portion of the river, as well as redear sunfish (*Lepomis microlophus*) and sockeye/kokanee salmon (*Oncorhynchus nerka*), which had never been documented in the Napa River.

A total of 314 steelhead (*Oncorhynchus mykiss*) were captured, including 223 smolts, 88 parr, and 3 adults (>300mm in length). The median steelhead smolt length was 198mm, compared to 178 mm in 2009. A total of 1,371 Chinook salmon (*O. tshawytscha*) parr and smolts were captured, compared to a single Chinook caught in 2009. A total of 317 salmonid specimens were captured that could not be readily identified based on morphology. The RCD distributed photos of these fish to fisheries experts throughout California and Washington, who initially concluded they were a mix of pink (*O. gorbuscha*) and/or chum salmon (*O. keta*). However, at the end of the season, three of the unidentified salmon were determined to be sockeye/kokanee (*O. nerka*) through genetic marker analysis by the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries). An additional 151 tissue samples collected from these fish are anticipated to be analyzed by NOAA Fisheries in late 2010 to determine whether all of the unidentifiable specimens were sockeye/kokanee salmon. Fry were first captured on March 10 and parr and smolt lifestages were captured up until May 17.

In total, fin clips were collected from 307 steelhead, 680 Chinook, and 154 of the unidentified salmonid specimens for genetic analysis by NOAA Fisheries). Throughout the sampling period, a total of 198 steelhead smolts and 702 Chinook smolts were marked and released upstream of our trap to determine trap efficiency. A total of 22 steelhead smolts and 139 Chinook smolts were recaptured, yielding trap efficiencies of 11.1% for steelhead and 19.8% for Chinook.

The Napa RCD and its partners plan to continue operating the trap annually to develop salmonid population estimates and track ecological responses to ongoing habitat restoration.

BACKGROUND

The Napa River is known to have historically supported three salmonid species: steelhead (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), and coho salmon (*Oncorhynchus kisutch*). There has been a significant decline in the distribution and abundance of steelhead and coho salmon in the Napa River and its tributaries since the late 1940s (USFWS 1968; Anderson 1969; Leidy et al. 2005). The U.S. Fish and Wildlife Service (1968) estimates that the Napa River watershed once supported runs of 6,000–8,000 steelhead, and 2,000–4,000 coho salmon, and that by the late 1960s, coho salmon were extinct in the watershed, and the steelhead run had reduced to about 1,000 adults. Napa River steelhead belong to the Central California Coast Steelhead Distinct Population Segment (DPS), which was listed as a threatened species under the Federal Endangered Species Act in August 1997.

Little is known about the historical abundance or distribution of Chinook salmon in tributaries to the San Francisco Estuary (Leidy et al. 2005). However, based on analysis of natural channel form, hydrology, and ecology, it is believed that the Napa River likely supported a large, sustainable population of Chinook salmon under historical conditions (Stillwater Sciences, 2002).

The Napa County Resource Conservation District (RCD) began an adult salmon monitoring program in 2003 to track Chinook spawning abundance and distribution within a five-mile reach of the Napa River near Rutherford (Koehler 2006, 2007, 2008). When feasible, the RCD also conducts spring snorkel surveys to document juvenile salmonid abundance and distribution. Consistent observations of juvenile salmon have been made from 2004-2010, indicating that successful spawning occurs in most years. The genetics of both adults and juveniles has been sampled for multiple years and is being analyzed by NOAA Fisheries Southwest Science Center located in Santa Cruz, California (Koehler 2009).

Despite long-term habitat degradation and loss, the Napa River watershed still contains extensive areas of relatively high-quality steelhead and salmon habitat. In fact, it has been identified as one of the most important anchor watersheds within the San Francisco Estuary for the protection and recovery of regional steelhead populations (Becker et al. 2007). The RCD initiated the smolt monitoring program in 2009; prior to this, smolt trapping had never been conducted for the Napa River watershed.

The objective of this monitoring program is to answer the following questions:

- What is the annual index of steelhead and salmon smolt outmigration from the Napa River?
- What is the average length and weight of steelhead and salmon smolts from the Napa River?
- What is the genetic relationship between Napa River steelhead and salmon and other known stocks?
- When does steelhead and salmon smolt outmigration occur in the Napa River watershed?

Figure 1. Rotary screw trap monitoring site located on the mainstem Napa River approximately two miles downstream of the Oak Knoll Avenue Bridge.

METHODS

A rotary screw trap (RST) with an 8-foot diameter cone was installed in the mainstem Napa River approximately 2 miles downstream of the Oak Knoll Avenue Bridge on private property (Figure 1). The site is located approximately 1,500 feet (400 meters) upstream of the upper extent of tidal influence at the lowest point in the mainstem where a rotary screw trap can be deployed and still maintain continuous downstream flow.

The trap was assembled onsite with the assistance of a group of volunteers and positioned in a deep pool approximately 300 feet in length. The trap was in operation continuously (24 hours per day, 7 days per week) from February 17 to June 14, 2010. The trap was not operated for a total of 28 days throughout the season when flows were too high or debris jammed the cone (Table 1). A hydrograph of the entire sampling period is shown in Appendix A.

Date range	**Total number of days not operated**	**Reason for stoppage**
Feb 24 – Mar 9	14	High Flow
Mar 13 –Mar 14	2	High Flow
Apr 5 – Apr 7	3	High Flow
Apr 12 – Apr 19	8	High Flow
Apr 25	1	Jammed by log

Table 1. Dates and durations of trap stoppages during the 2010 sampling season.

The trap was visually inspected daily for proper operation, and debris was removed as needed. The number of revolutions per minute (RPM) was recorded daily. Streamflow was recorded daily from the USGS streamgage (# 11458000) at Oak Knoll Ave Bridge two miles upstream of our sampling site. Field data were recorded on waterproof data sheets and transferred to a Microsoft Excel database at the RCD office.

Fish were removed from the live box with dip nets every morning around 9:00 AM and placed in five gallon buckets with battery operated pumps providing aeration. Fish were identified to species, counted, visually inspected for marks or tags and released off the back of the trap. The first twenty individuals of any salmonid species were placed into a bucket containing an anesthetic solution of MS-222 (Tricaine-S) at a concentration of 50 mg/L. These fish were allowed to become mildly sedated for several minutes before being measured and weighed. They were allowed to completely recover in freshwater before being transported in 5 gallon buckets to a release site. Steelhead that were simply counted remained in an aerated bucket of water and were not anesthetized. Fork length (mm) and weight to 0.1g was recorded for a subsample of randomly selected fish of each species on each trapping day. If catch rates were low, all fish were fully measured.

The degree of smoltification was determined by visual examination and fork length. Juvenile salmon were classified as parr if parr marks were distinct and smolts if parr marks were not visible and the fish exhibited a silvery appearance. All steelhead greater than 130 mm FL were classified as smolts. Steelhead larger than 300 mm were classified as adults or resident rainbow trout.

A fin clip (usually pelvic and/or caudal) was collected from a minimum of the first twenty individuals of any salmonid species. Fin clips were used as marks for trap efficiency trials as well as providing tissue samples for genetic analysis. Scales were also collected from a range of smolt sizes to determine age class structure. Scale analysis was beyond the scope of this year's monitoring effort, but all samples have been archived at the RCD office for future study.

Marked steelhead and salmon smolts were transported approximately 1 km upstream (two riffle-pool sequences) and released to determine trap efficiency. These mark-recapture studies were conducted continuously throughout the 2010 sampling season. A total of 198 steelhead and 702 Chinook smolts were marked with fin clips and released upstream.

Migration over the discreet period, N_i, was estimated using the Peterson mark-recapture equation;

$$\hat{N}_i = \left[\frac{(M_i + 1)(C_i + 1)}{(R_i + 1)}\right] - 1$$

Where

M_i	=	Number of fish marked and released during discreet period *i*,
C_i	=	Number of unmarked fish captured during discreet period *i*, and
R_i	=	Number of marked fish recaptured during discreet period *i*.

The variance, $V(N_i)$, of the Peterson estimate was calculated using;

$$V(\hat{N}_i) = \hat{N}_i^2 \frac{(C_i - R_i)}{[(C_i + 1)(R_i + 2)]}$$

Total steelhead and Chinook smolt production was calculated by determining cumulative migration estimates and variance, and assigning 95% confidence intervals of ± 1.96 times the standard deviation.

For comparison purposes, we also calculated smolt production estimates using methods described in Carlson et al (1988). This method is considered statistically superior to the Peterson method because it incorporates weekly trapping efficiency estimates. However, weekly efficiency studies were not conducted in 2009 due to budgetary constraints; therefore this comparison is only possible with our 2010 data.

RESULTS

During 90 days of operation in 2010, a total of 25 fish species were captured including 13 natives and 12 exotics (Tables 2 and 3). The total catch was 33,550 fish, which was comprised of 32,426 natives and 1,124 exotics. Larval fish (< 25mm in length) were a large component of the total catch, including an estimated 25,644 Sacramento sucker larvae and 969 largemouth bass larvae. Exact counts of larval specimens were not made. The total catch of non-larval fish was 6,937. Native species dominated the total catch (n=6,782), accounting for 97.7% of all non-larval specimens. Appendix B contains photographs of most of the species captured in 2010.

Five species were collected for the first time in 2010: wakasagi (*Hypomesus nipponensis*), inland silverside (*Menidia beryllina*), and white catfish (*Ameiurus catus*), which had all been previously documented in the estuary portion of the river, as well as redear sunfish (*Lepomis microlophus*) and sockeye/kokanee salmon (*Oncorhynchus nerka*), which had never been documented in the Napa River. Redear sunfish is a species that has been extensively stocked in ponds and reservoirs throughout California, including those in the Napa River watershed.

Common Name	**Scientific Name**	**2010 Total**
Steelhead Smolt (silvery)	*Oncorhynchus mykiss*	224
Steelhead Fry/Parr (<130 mm)	*Oncorhynchus mykiss*	88
Steelhead/Rainbow adult (>300 mm)	*Oncorhynchus mykiss*	3
Chinook Parr (with parr marks)	*Oncorhynchus tshawytscha*	2
Chinook Smolt (silvery)	*Oncorhynchus tshawytscha*	1,371
Salmonid sp. fry/parr	*Oncorhynchus (nerka?)*	63
Salmonid sp. smolt	*Oncorhynchus (nerka?)*	105
Mixed Salmon Sp. fry	*Oncorhynchus (nerka?)*	150
River Lamprey adult	*Lampetra ayresi*	2
Western Brook Lamprey	*Lampetra richardsoni*	93
Pacific Lamprey adult	*Lampetra tridentata*	11
Lamprey Sp. (Ammocete)	*Lampetra sp.*	155
Sacramento Splittail	*Pogonichthys macrolepidotus*	6
Sacramento Pikeminnow	*Ptychocheilus grandis*	87
California Roach	*Hesperoleucus symmetricus*	3,571
Sacramento Sucker adult	*Catostomus occidentalis*	419
Sacramento Sucker Larvae/Juveniles	*Catostomus occidentalis*	25,644*
Tule Perch	*Hysterocarpus traski*	28
Prickly Sculpin	*Cottus asper*	124
Three-spine Stickleback	*Gasterosteus aculeatus*	76

**Counts of larval specimens were estimated*

Table 2. Native fishes captured during the 2010 sampling season.

Common Name	Scientific Name	2010 Total
Bluegill	*Lepomis macrochirus*	100
Redear Sunfish	*Lepomis microlophus*	8
Green Sunfish	*Lepomis cyanellus*	2
Largemouth Bass adult	*Micropterus salmoides*	1
Largemouth Bass Larvae (<25mm)	*Micropterus salmoides*	969*
Western Mosquitofish	*Gambusia affinis*	9
Wakasagi	*Hypomesus nipponensis*	2
Inland Silverside	*Menidia beryllina*	12
Fathead Minnow	*Pimephales promelas*	4
Golden Shiner	*Notemigonus crysoleucas*	11
White Catfish	*Ameiurus catus*	1
Brown Bullhead	*Ameiurus nebulosus*	3
Striped Bass	*Morone saxatilis*	2

**Counts of larval specimens were estimated*

Table 3. Exotic fishes captured during the 2010 sampling season

Common Name	Scientific Name	2010 Total
Bullfrog Tadpole	*Rana catesbeiana*	1401
Bullfrog Adult	*Rana catesbeiana*	2
Pacific Chorus Frog Tadpole	*Pseudacris regilla*	32
Signal Crayfish	*Pacifastacus leniusculus*	103
Louisiana Crayfish	*Procambarus clarkii*	233
Crayfish sp. (not identified)	-	11
Red-eared Slider Turtle	*Trachemys scripta elegans*	3
Western Pond Turtle	*Actinemys marmorata*	1

Table 4. Non-fish taxa captured during the 2010 sampling season

A total of 317 salmonid specimens were captured in 2010 that could not be readily identified based on morphology. Fry were first captured on March 10 and parr and smolt lifestages were captured up until May 17. Photographs of these fish were distributed to fisheries experts in California and Washington. Several biologists familiar with early lifestages of northern salmonids tentatively concluded that some of the smallest specimens were potentially pink (*O. gorbuscha*) or chum salmon (*O. keta*). However, when genetically analyzed by NOAA Fisheries in July 2010, three of the unidentified salmon specimens were determined to be sockeye/kokanee (*O. nerka*). An additional 151 tissue samples collected from these fish are anticipated to be analyzed by NOAA Fisheries in late 2010 to determine whether all of the unidentified fish were in fact sockeye/kokanee salmon. A photographic comparison between the unidentified salmonid and Chinook salmon is shown in Appendix C.

Fin clips were collected from 307 steelhead, 680 Chinook, and 154 unidentified salmonid specimens for genetic analysis by NOAA Fisheries.

A total of 314 steelhead were captured, including 224 smolts, 88 parr, and 3 adults (possible resident rainbow trout). Steelhead smolts ranged from 131 – 270 mm with a median length of 197 mm (Figure 2). Steelhead smolt weights ranged from 25.3– 249.5 g with a median weight of 81.3 g (Table 5).

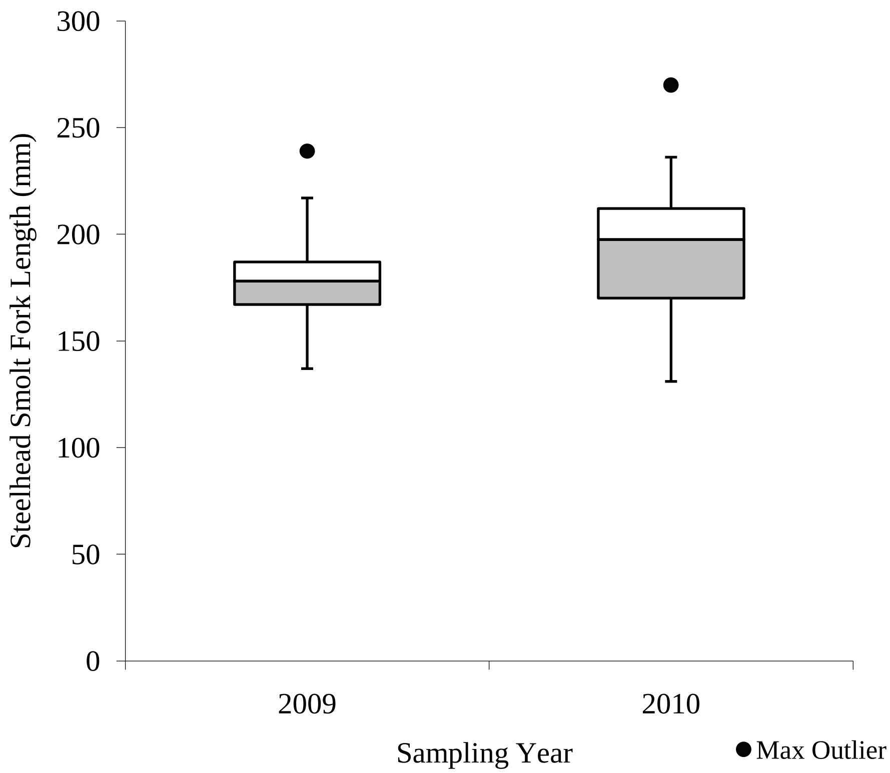
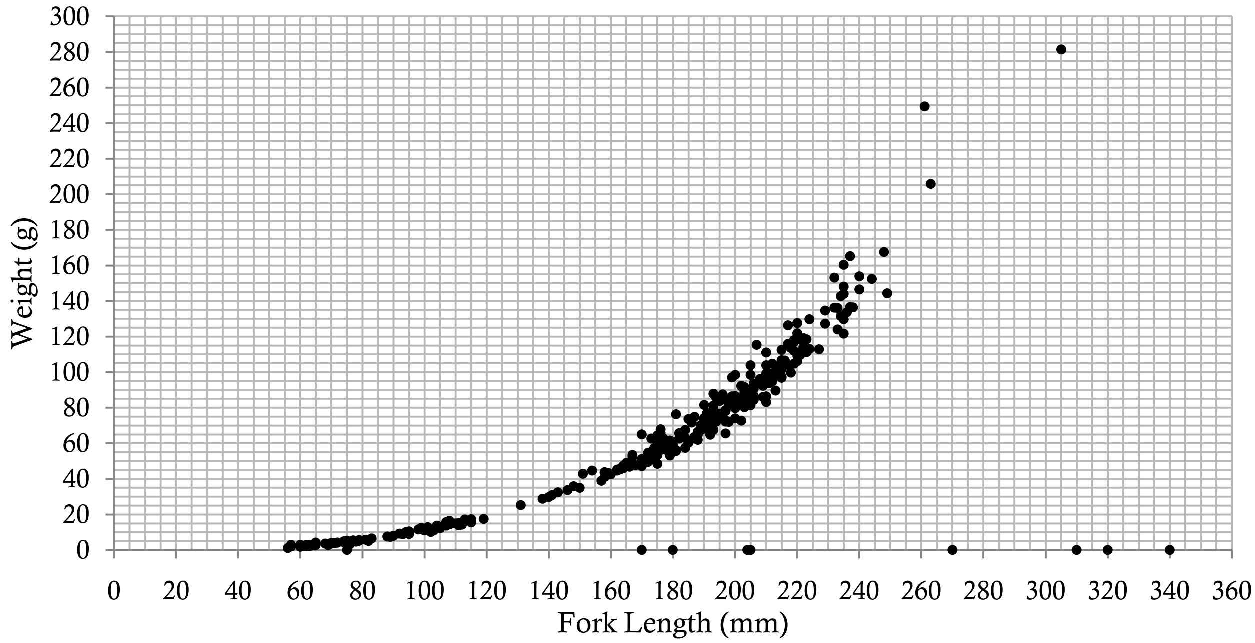


Figure 2. Box plot of steelhead smolt length data from 2009 and 2010.
Note: the bottom and top of the box are the 25th and 75th percentiles respectively, the band near the middle of the box is the median, and the vertical lines (whiskers) represent the lowest and highest values within 1.5 times the inter-quartile range of the lower and upper quartile respectively. The maximum outlier values represent the largest individual measurement for each year.

Species	Steelhead Smolts		Chinook Smolts	
Sampling Year	**2009**	**2010**	**2009**	**2010**
Total Number Caught	119	224	1	1,371
Median Length (mm)	178	198	n/a	88
Maximum Length (mm)	239	270	n/a	126
Minimum Length (mm)	126	131	n/a	70
Median Weight (g)	58.1	81.3	n/a	8.0
Maximum Weight (g)	142.0	249.5	n/a	24.6
Minimum Weight (g)	21.5	25.3	n/a	3.3

Table 5. Steelhead and salmon biometric data from 2009 and 2010. Summary statistics were not calculated for Chinook in 2009 due to low catch rates.



Note: several individuals were measured for length but not weighed and are therefore plotted directly on the X-axis.

Figure 3. Length-to-weight ratios for all steelhead (includes parr, smolts, and adults)

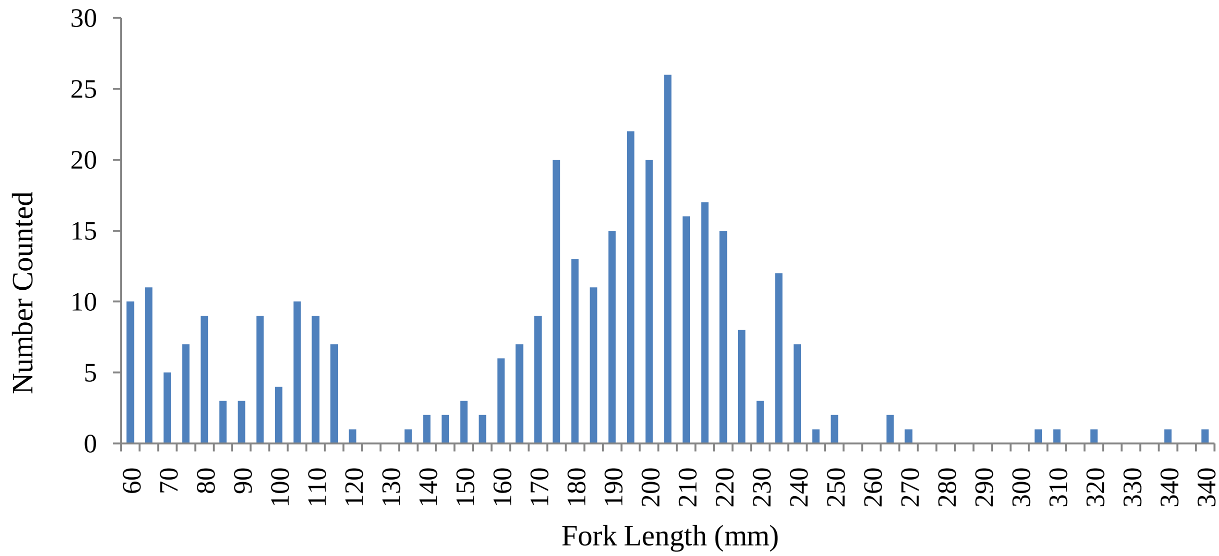


Figure 4. Length-frequency distribution for all steelhead captured in 2010

Steelhead were captured fairly consistently throughout the entire trapping period with the highest numbers captured on March 31. The highest catches typically corresponded with elevated flows following storms (Figure 5). A more detailed stream flow record of the entire sampling period is shown in Appendix A.

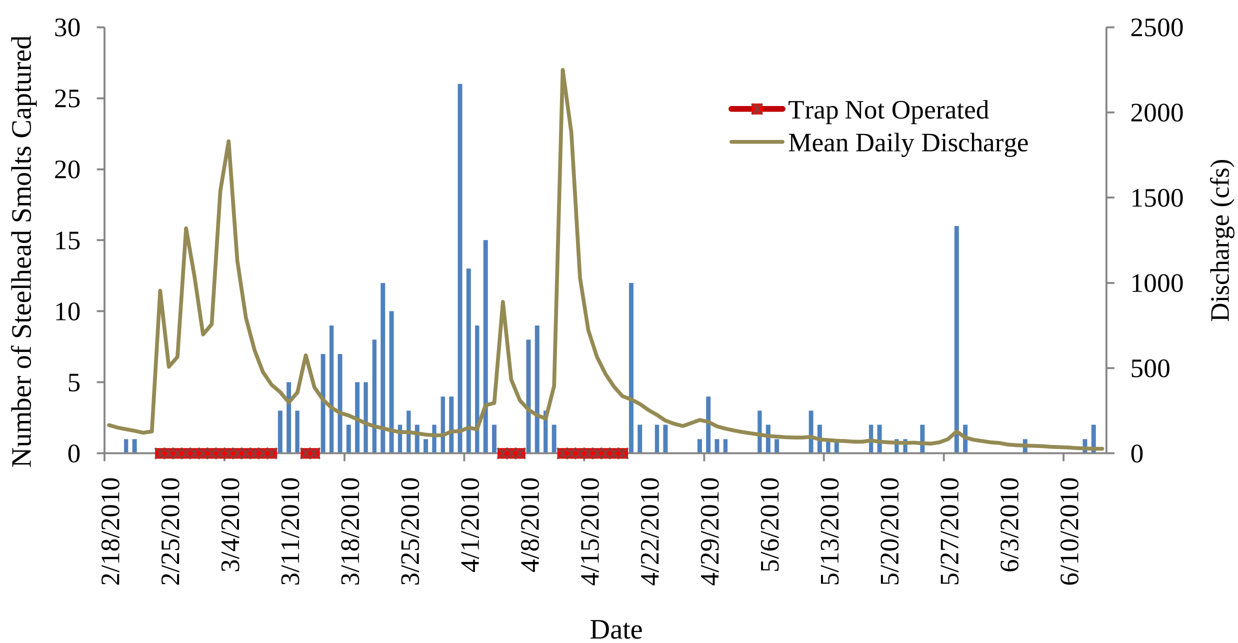


Figure 5. Steelhead smolt catch relative to flow during the entire sampling period.

Chinook catch rates peaked on May 14; the last Chinook smolt was captured on June 11. The unidentified salmonid species (presumably *O. nerka*) was first captured as fry (~35-40mm FL) on March 10 and peaked on March 12. A steady stream of these fish was captured in March and April and the last individual was captured on May 17 (Figure 6).

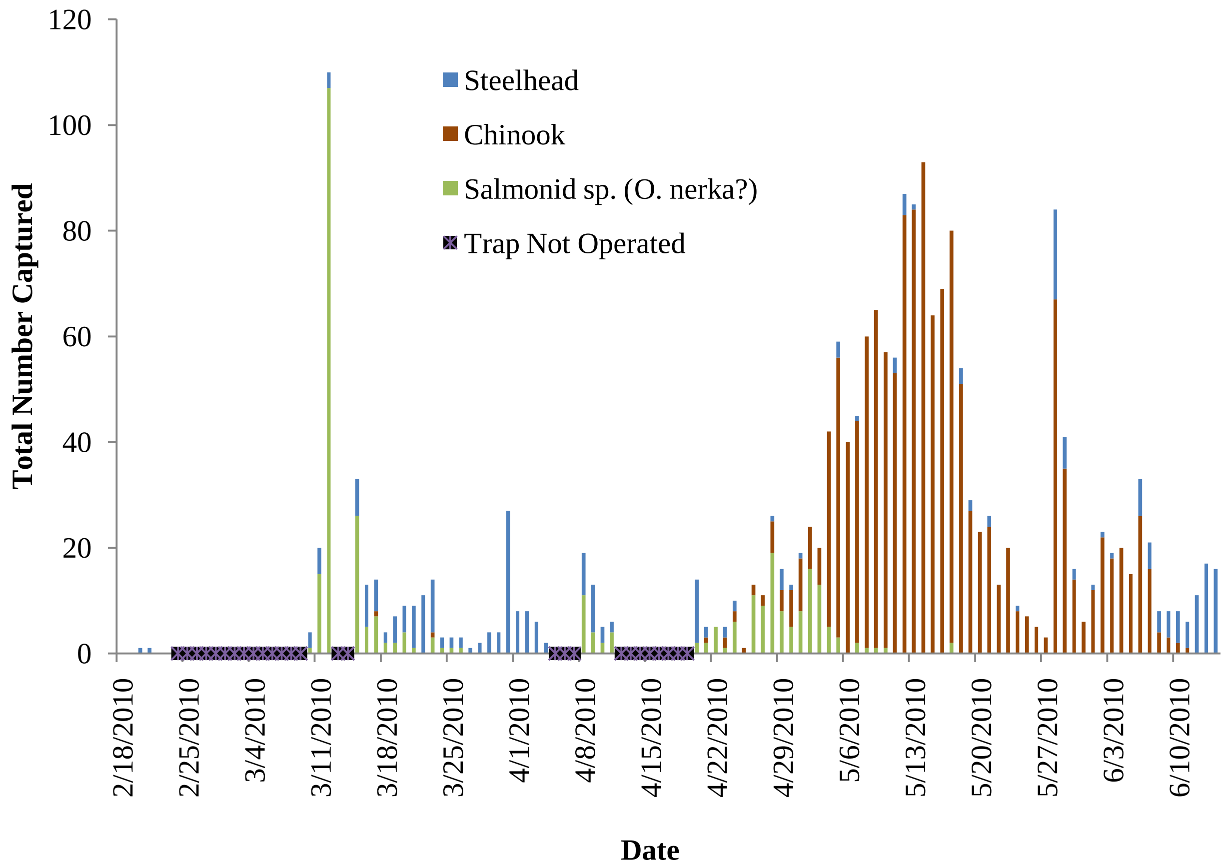


Figure 6. Salmonid catch results during the entire sampling period. Data include all lifestages.

A total of 1,373 Chinook salmon were captured including 1,371 smolts and 2 parr. Chinook length was highly variable and ranged from 70 - 126 mm with a median length of 88 mm. Chinook weights ranged from 3.3 to 24.6 g with a median weight of 8.0 g. At least two distinct size classes of Chinook were evident by examining smolt length data (Figure 7). In addition, several larger Chinook smolts were captured early in the sampling season, which suggests that they may have spent a year rearing in freshwater, exhibiting a stream-type life history pattern. Genetic analysis of these fish may be able to determine if both stream-type and ocean-type Chinook were present in our samples.

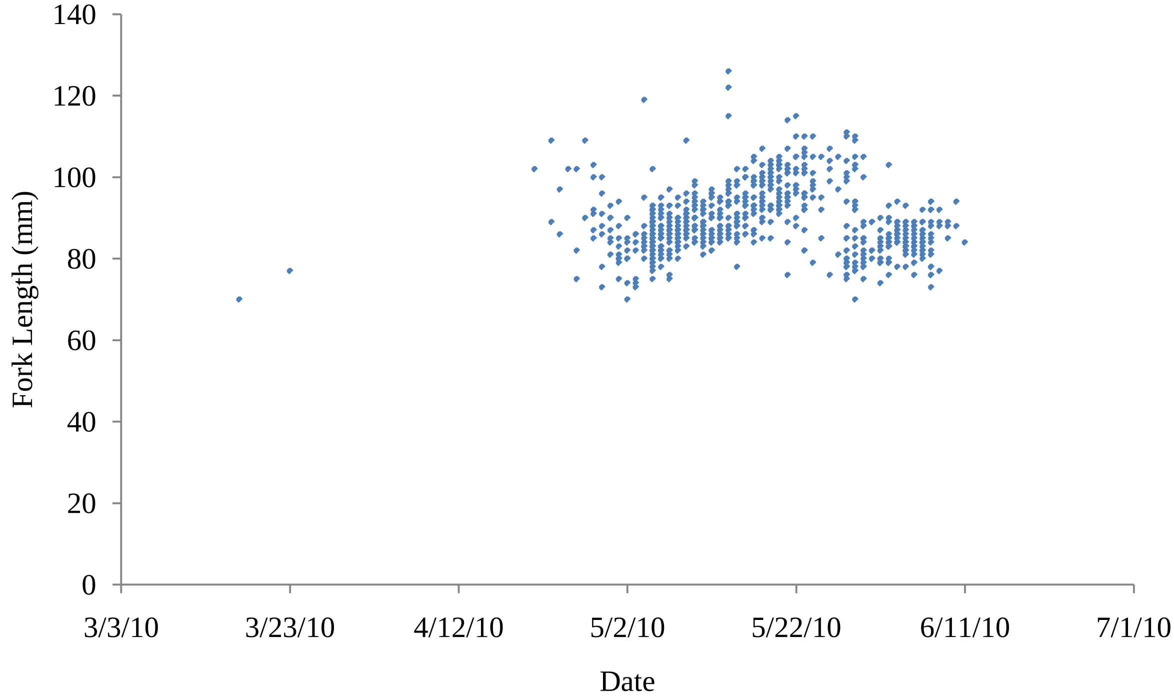


Figure 7. Chinook salmon smolt length by date. Note: the two distinct data clusters suggest early and late spawning cohorts. Also note the few larger size smolts captured early in the season and throughout May – these fish may represent stream-type Chinook that were smolting after a year in freshwater.

Trap Efficiency

Throughout the sampling period, a total of 198 steelhead smolts and 702 Chinook were marked with fin clips and released upstream to determine trap efficiency. A total of 22 steelhead and 139 Chinook were recaptured. Estimated trapping efficiencies over the entire sampling period for each species are given in Table 6.

Species	Total number of fish captured	Number of marked fish released upstream	Number of marked fish recaptured	Estimated trapping efficiency
Steelhead	224	198	22	11.1%
Chinook	1,371	702	139	19.8%

Table 6. Trapping efficiency estimates over the entire sampling period

Population Estimates

A comparison of population (or total passage) estimates using both the Peterson and Carlson methods is shown in Table 7. These values represent the total number of each species estimated to have passed the trap site during our 2010 sampling period. It is likely, and almost certain, that a substantial fraction of the entire steelhead and salmon outmigration window was missed before the trap was installed, after it was taken out, and during periods of high flow when it was not operated.

Results of the Peterson and Carlson methods were similar in terms of total population estimates as well as error estimates, although the Carlson method yielded a slightly higher value for both species.

Species	Peterson Population Estimate 2010	Carlson Population Estimate 2010
Steelhead	1,946 (±738)	2,005 (± 816)
Chinook	6,888 (± 1,077)	7,325 (± 1,460)

Table 7. 2010 population estimates for steelhead and Chinook using both methods.

We operated the trap for a total of 90 days in 2010 compared to 69 days in 2009; therefore total catch would be expected to be higher in 2010 from the additional 21 days of sampling. To correct for this discrepancy in sampling period, we calculated catch-per-unit-effort (CPUE) for steelhead smolts by dividing the total number of smolts captured by the total number of days sampled. In 2009, our CPUE was 1.72 smolts per day, and in 2010, our CPUE was 2.48 smolts per day.

Due to extremely low recapture rates during the 2009 season, population estimates generated from our 2009 data had a high degree of potential error and should be interpreted with this limitation in mind. However, for comparison purposes, 2009 and 2010 population estimates are given in Table 8.

Year	Release Begin Date	Release End Date	Steelhead		Chinook	
			Observed	Estimated*	Observed	Estimated*
2009	April 13	May 26	71	2,519 (± 2,810)	1	N/A
2010	February 20	June 13	224	1,946 (±738)	1,371	6,888 (± 1,077)

*Population estimates using the Peterson method for comparison to 2009 data

Table 8. Smolt trapping efficiency release dates, observed catch during this period, and estimated total passage of steelhead and Chinook smolts.

DISCUSSION

The 2010 sampling year was notably more productive with higher catches of steelhead and Chinook salmon than 2009. However, it is not possible to know whether our improved catch rates were a result of operating the trap more effectively or reflected a real increase in salmonid production within the basin. We operated the trap for a full 21 days longer in the 2010 season, which undoubtedly increased our total catch. However when standardized for catch-per-unit-effort, we still captured substantially more steelhead smolts than in the previous year: 2.48 smolts per day in 2010 compared to 1.78 smolts per day in 2009. The same trend was true for Chinook, although it appears that there is a high degree of variability associated with Chinook spawning from year to year. Long-term monitoring that spans at least two lifecycles (i.e. a minimum of ten years) is needed to accurately assess their population trends within the Napa River watershed.

The origin of the unidentifiable salmonid fry captured during the 2010 season is currently being determined by NOAA Fisheries through genetic marker analysis. As of this report, we assume that all of these fish were sockeye/kokanee salmon either from naturally spawning adults or hatchery strays. Our initial identification efforts included distributing photographs to experts in Washington who are familiar with identification of juvenile salmonids. Several biologists suggested that at least some of these fish looked like pink and/or chum salmon. Both chum and pink salmon have been captured in Bay Area streams in the past decade (Leidy 2007) and juvenile chum salmon were captured in the Napa River as recently as 2005 (Stillwater Sciences, 2006). There are very few records of sockeye/kokanee within California and none for the Napa River (Moyle 2002; Leidy 2007). However, genetic analysis proved that these fish, at least the three that were analyzed, were indeed sockeye/kokanee. Given the life history requirements of sockeye/kokanee and the general lack of suitable coldwater rearing habitat in the mainstem Napa River, it is unlikely that a self-sustaining run is present or will become established here in Napa. However, future monitoring will be an important tool to track the presence of these fish.

Our 2010 results suggest that there were as many as three distinct groups of Chinook salmon outmigrants in the Napa River this year. Length-by-date data show two distinct clusters, suggesting each were the progeny from early and late spawning cohorts. It is not clear whether these were from distinct runs of adults (i.e. fall-run and late fall-run) or just variability in reproductive timing within the same group of adults. Somewhat surprisingly, we also captured several Chinook smolts early in the season, which were distinctly larger than average (see photo comparison in Appendix B). These larger fish may have been stream-type Chinook that spend a year in freshwater rather than the typical fall-run pattern of emigrating in the first year. A few Chinook parr have been documented in the Napa River and tributaries in late summer (Stillwater 2007), but given the limited number of observations, this appears to be rare. In Napa, Chinook spawning occurs primarily in the mainstem and lower reaches of a few large tributary streams. Although quite limited, these reaches do contain suitable steelhead rearing habitat and could therefore potentially support juvenile salmon occupying the same area. Future monitoring and further genetic analysis will help us determine what fraction of the Chinook population is exhibiting this life history strategy.

One goal of our 2010 monitoring effort was to install the trap as early in the year as possible in order to more accurately bracket the full salmonid outmigration period. It appears that we were mostly successful at capturing the main peak for all three observed salmonid species. However, the capture of a few steelhead early in the sampling period suggests that steelhead outmigration is somewhat diffuse throughout late winter and early spring. It is possible that steelhead exhibit a bimodal outmigration pattern with some fraction of the population leaving in late fall and winter while another fraction remains in freshwater longer and emigrates as smolts in spring.

The average size steelhead was relatively large in 2010, which was consistent with findings from last year. Bond et al (2008) documented the relationship between size at smolting and ocean survival for steelhead, citing a crucial threshold of 150 mm needed to improve a fish's odds of returning as an adult. Our results from 2009 and 2010 yield an average smolt length of 178mm and 198mm respectively, suggesting that, based upon a minimum length criterion of 150 mm, Napa River steelhead would be expected to have relatively high marine survival rates.

CONCLUSIONS

1. We captured significantly more Chinook salmon and steelhead smolts in 2010 than in 2009. The increased catch rate was evident even when the data were converted to catch-per-unit-effort to correct for differences in sampling duration from one year to the next.

2. Steelhead smolt size was larger in 2010 than 2009; the median length was 20 mm longer and the median weight was 23 g greater.

3. The peak outmigration period for steelhead occurred in March and April. The peak outmigration period for Chinook occurred in May and June.

4. Overall trapping efficiency was approximately 11% for steelhead smolts and approximately 20% for Chinook smolts.

5. Our trapping data from the past two years shows that the non-estuarine Napa River fish community is comprised primarily of native species.

6. A rotary screw trap is an effective monitoring tool for tracking abundance and life history details of salmonids and other fishes of the Napa River.

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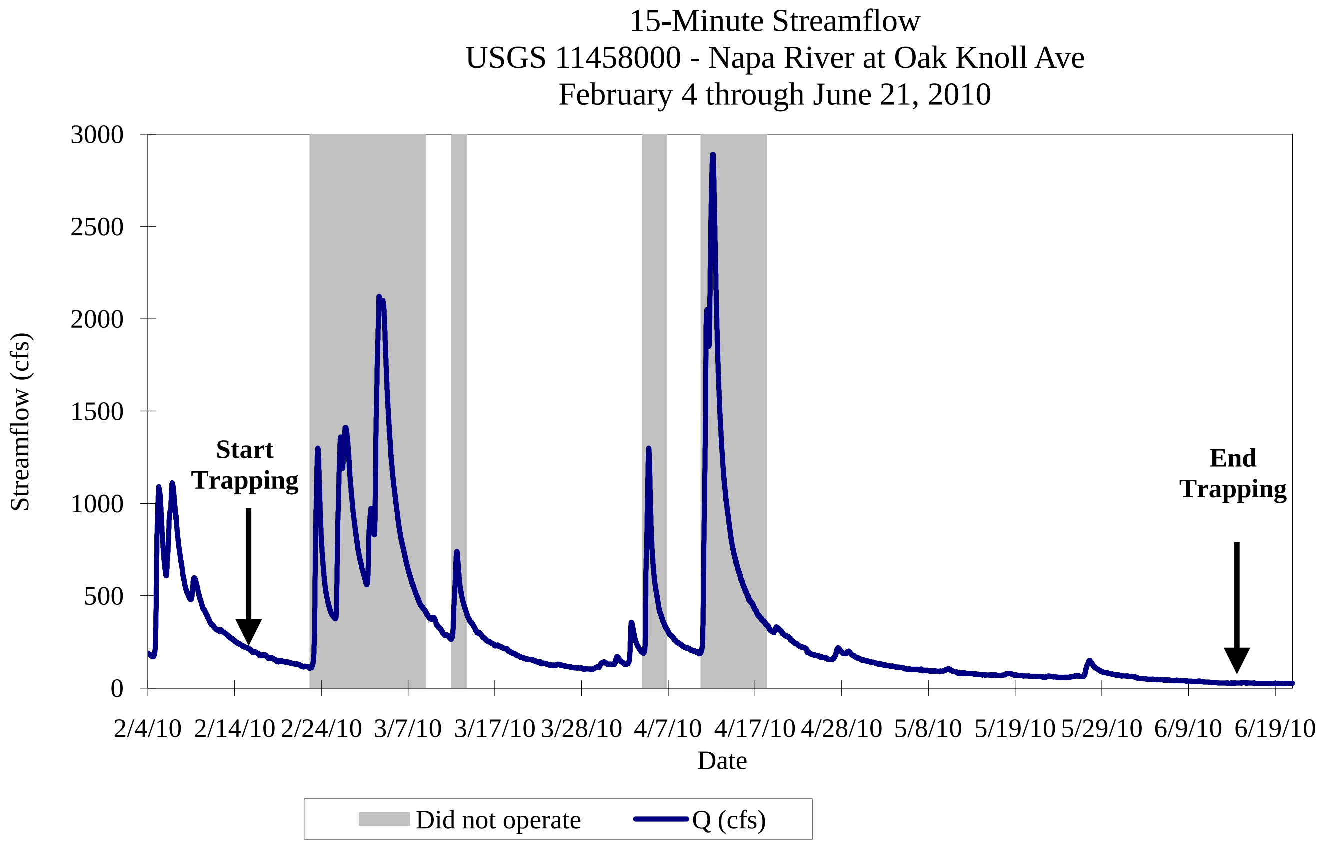
APPENDICES

APPENDIX A: NAPA RIVER HYDROGRAPH

APPENDIX B: PHOTOS

APPENDIX C: SALMONID SPECIES COMPARISON

Appendix A: Napa River Hydrograph



APPENDIX B: PHOTOS

Rotary screw trap with cone tilted during high flows (1,200 cfs)

Fish processing station

Steelhead Parr

Steelhead smolt

Steelhead adult (possible resident rainbow trout)

Chinook smolts (showing variable size classes)

Unidentified salmonid species fry (presumed *O. nerka*)

Tule perch

Sacramento sucker

Prickly sculpin


Pacific lamprey Sucking disc


River lamprey Sucking disc

Western brook lamprey Sucking disc

Striped bass

Largemouth bass larvae


Bluegill

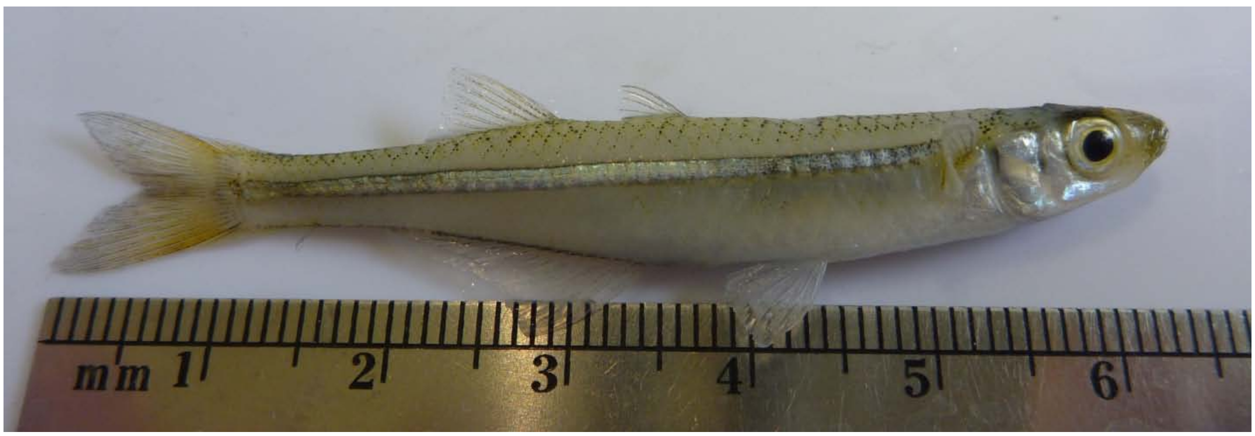
Redear sunfish

Green sunfish

Brown bullhead

White catfish

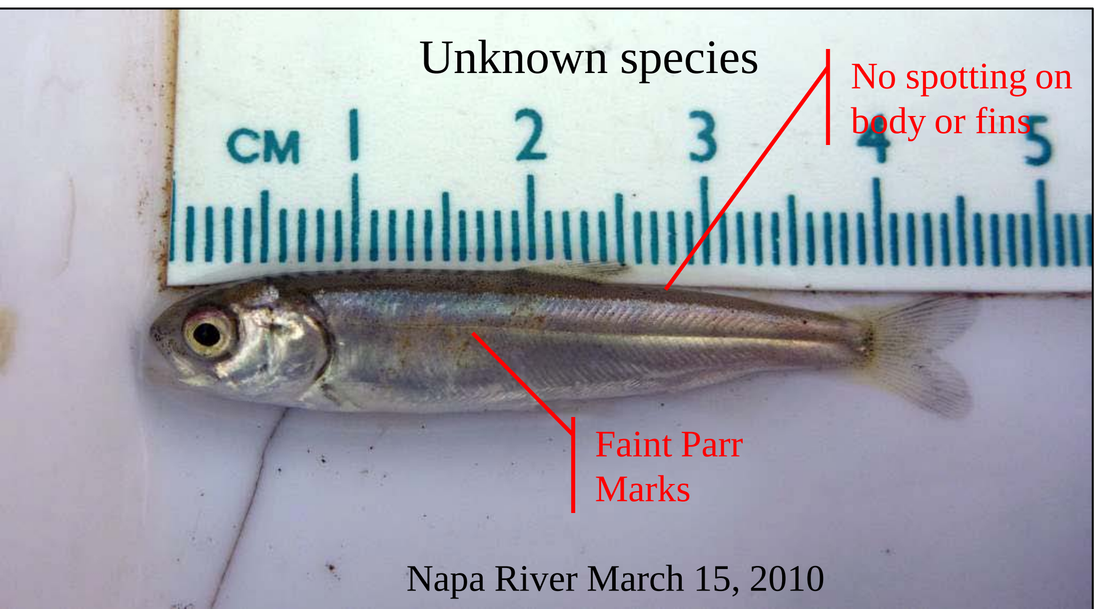
Wakasagi



Inland silverside

Golden shiner

Unidentified salmonid fry captured in the Napa River March 13, 2010



On March 13, 2010, the Napa County RCD started catching hundreds of unusual looking salmonid fry in our rotary screw trap in the Napa River. RCD biologists could not determine what species these fish were based on morpholgy.

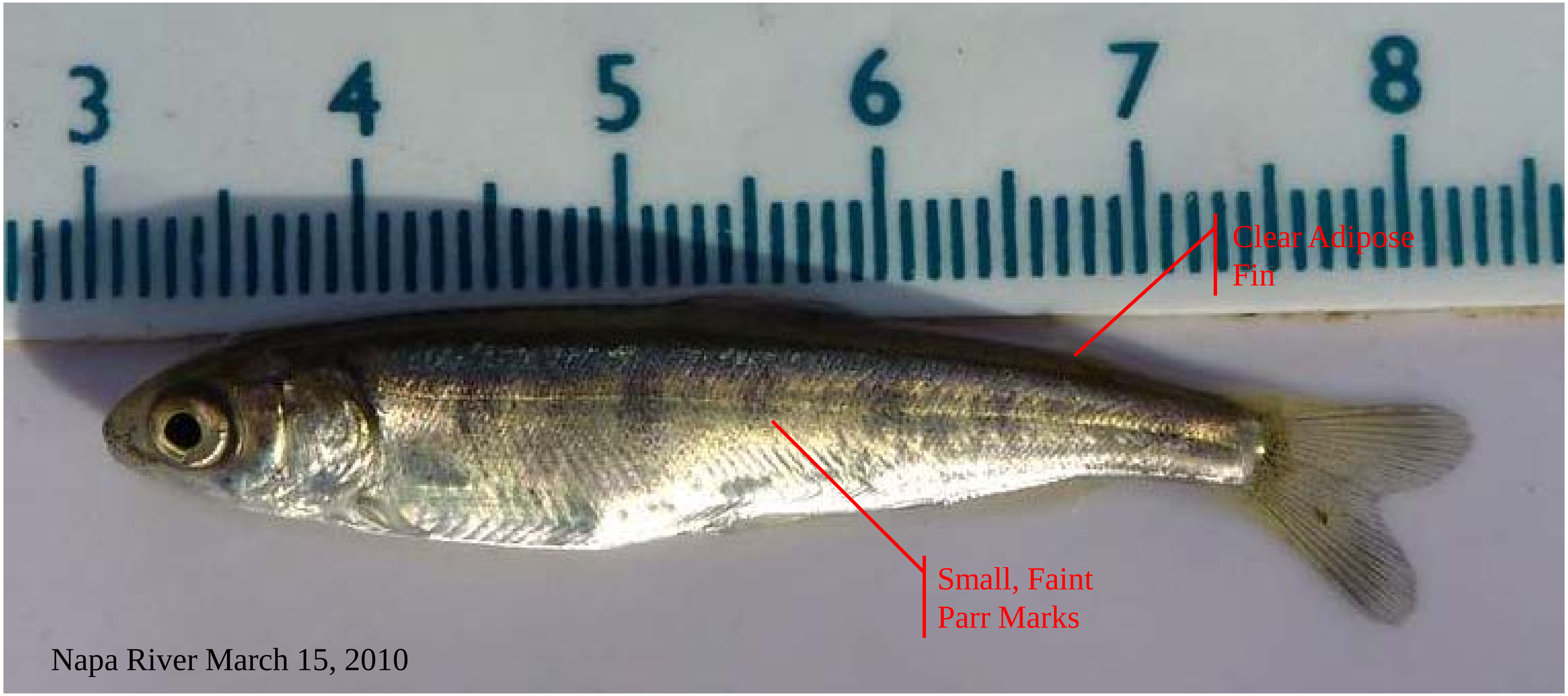
Several photographs, including those at left, were distributed to fisheries experts in California and Washington for identification. The tentative conclusion reached by the group was that they appeared to be a mix of chum and pink salmon.

Genetic analysis by NOAA Fisheries (Seattle) in July 2010 determined that these specimens were **not chum salmon**. Subsequent analysis found three samples were sockeye / kokanee salmon (*Oncorhynchus nerka*). Further genetic analysis of the remaining 151 tissue samples collected by the RCD will be done in late 2010 to determine if all specimens were *O. nerka*, or a mix of species as previously thought.

The unknown species had the following physical characteristics:

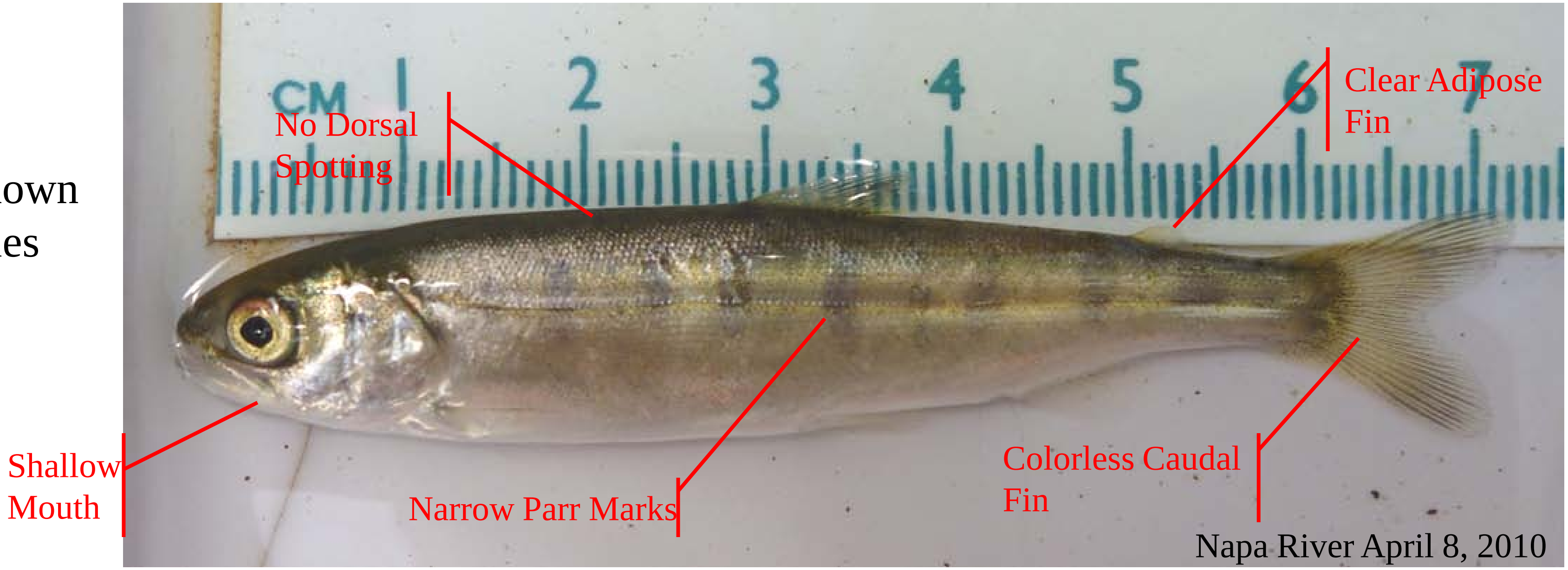
1. Clear adipose fin with no rim of pigment
2. Colorless fins
3. No spotting on any fins
4. Narrow, faint parr marks (parr marks completely absent on smallest specimens)
5. No spotting on dorsal body surface

Unknown Species

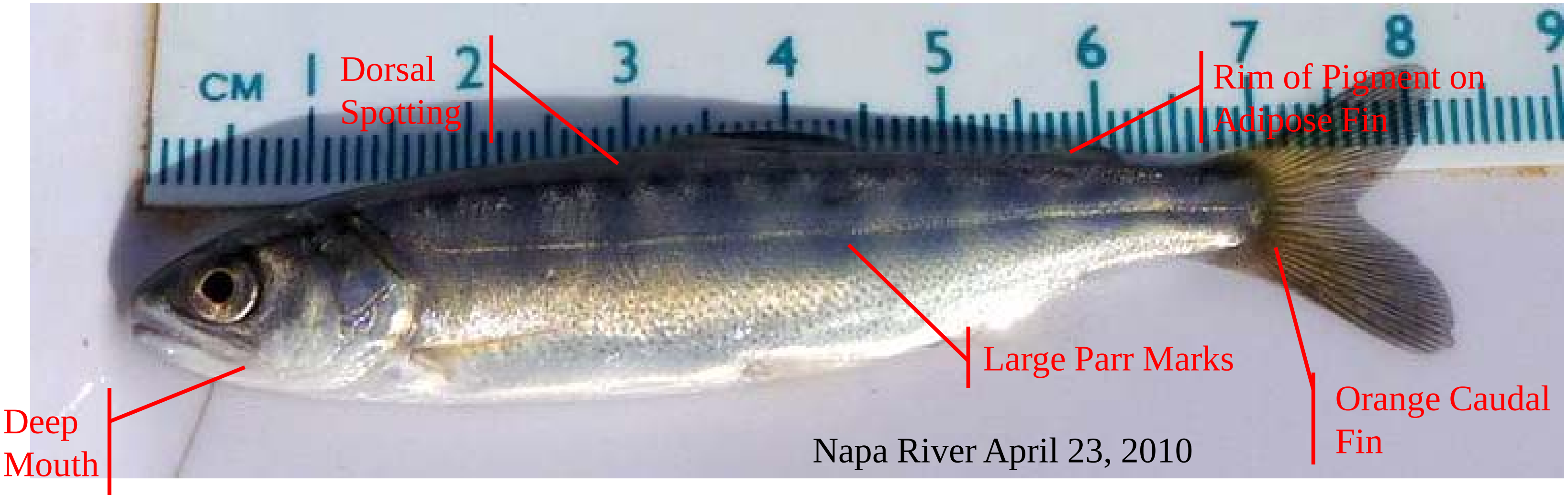


Comparison of unknown species (top photo) with known Chinook (bottom photo)

Unknown Species



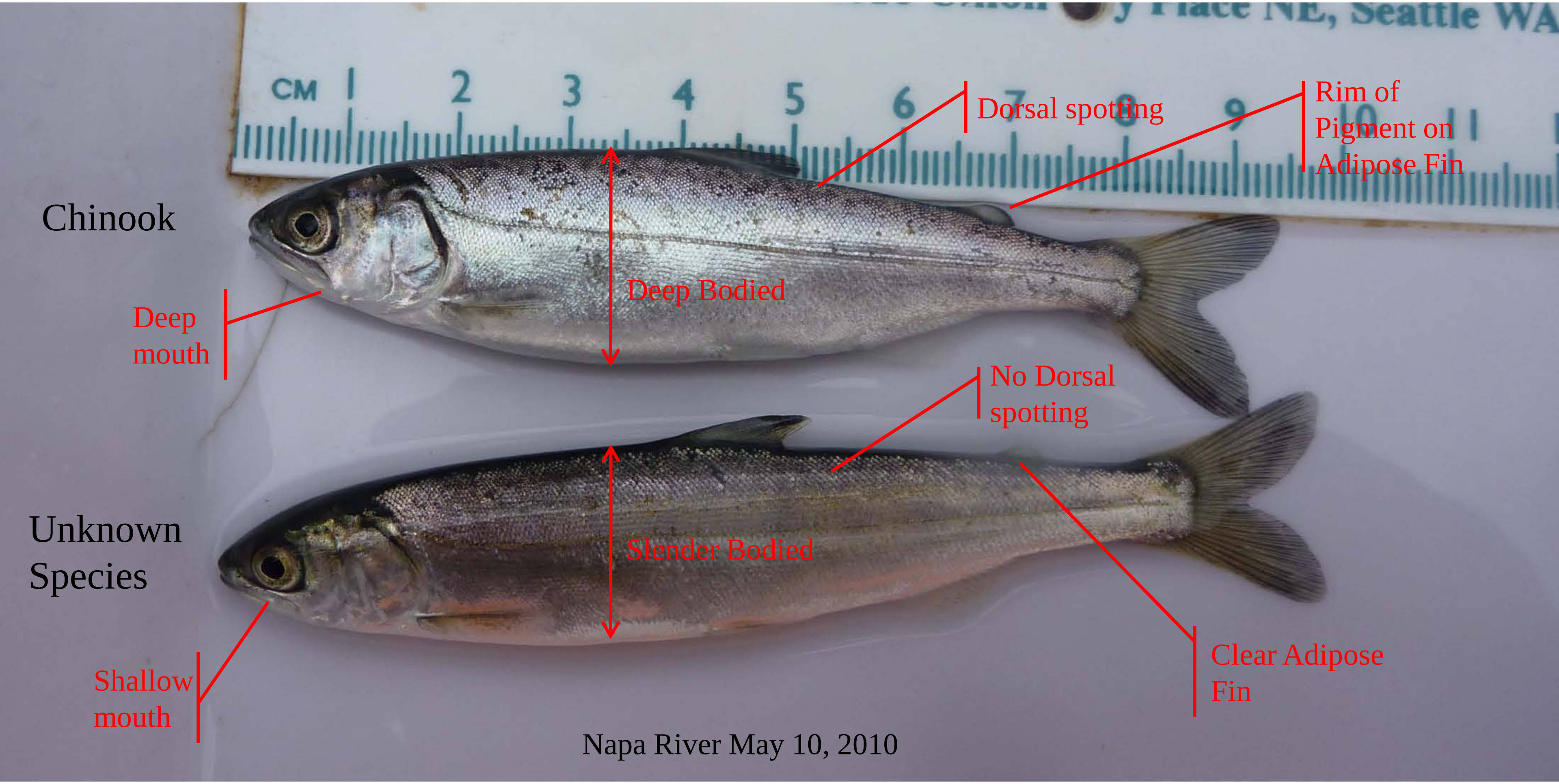
Chinook



Chinook

Unknown Species

Comparison of unknown species (bottom) with known Chinook (top)



Typical Napa River Chinook Smolt

Typical Napa River Steelhead Parr