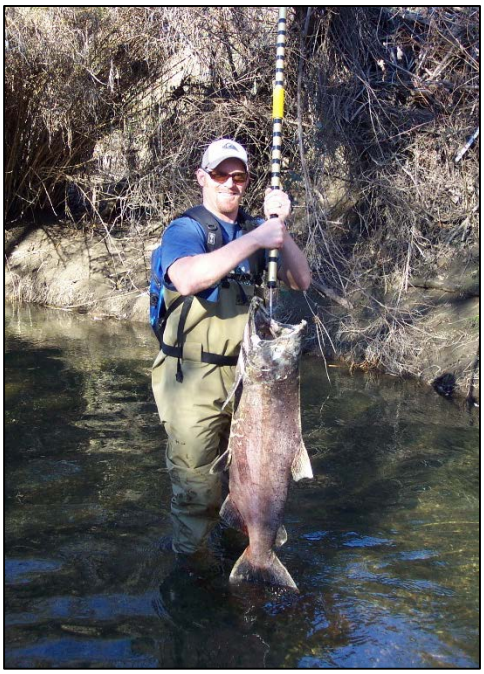
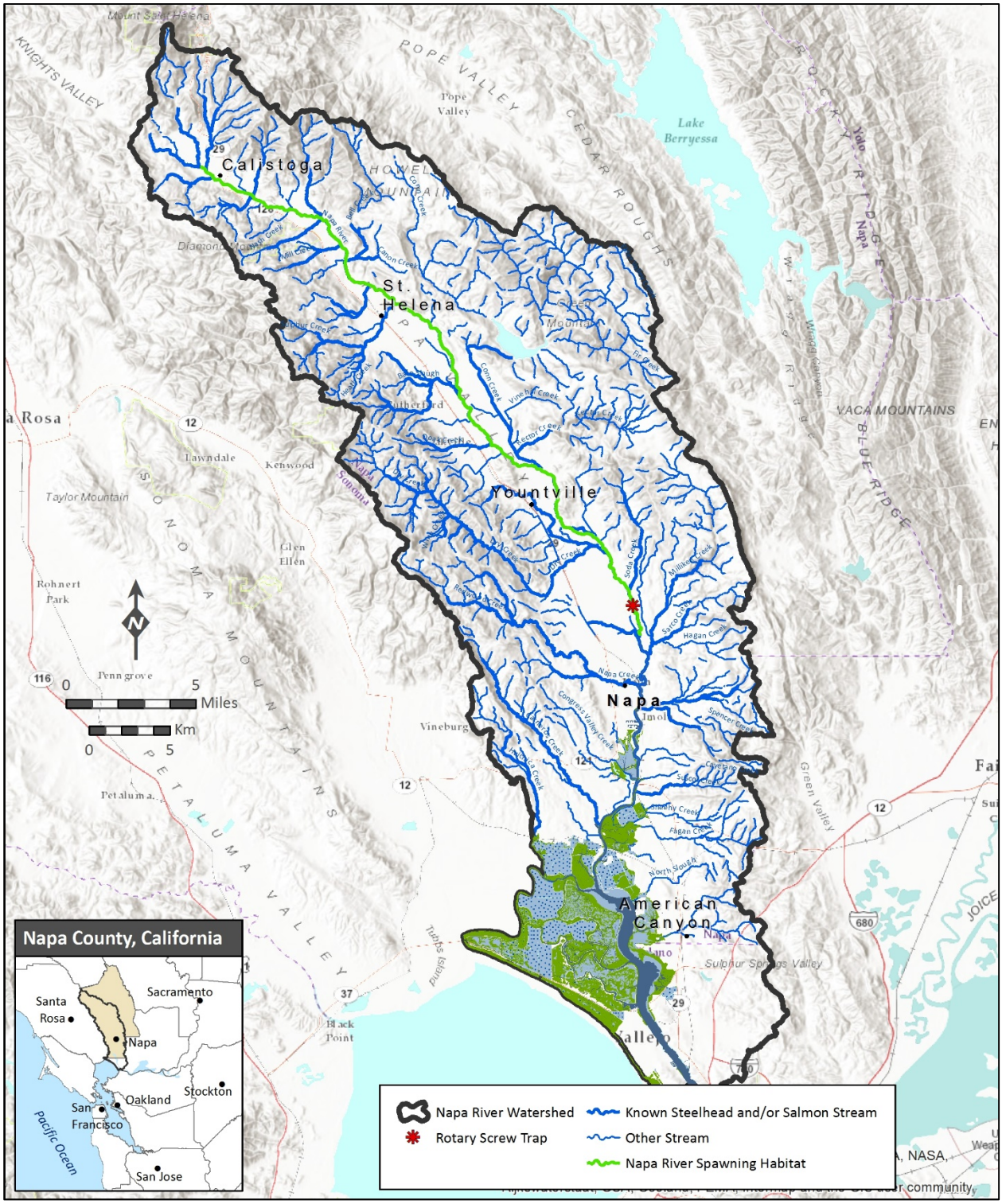
Napa River Watershed
Steelhead and Salmon Monitoring Program
www.naparcd.org

What monitoring is being done?

The Napa County Resource Conservation District (RCD) conducts fish monitoring in the Napa River watershed to collect information about native fish populations with emphasis on two salmonid species - steelhead trout (*Oncorhynchus mykiss*) and Chinook salmon (*Oncorhynchus tshawytscha)*. This monitoring program includes capturing and counting juvenile salmonids as they out-migrate to the ocean as "smolts", counting adult fish and mapping their spawning distributions, observing juveniles through snorkeling surveys, and long-term tracking of individual fish with implanted tags. Results and reports are available at www.naparcd.org.



Clockwise from top left: Napa River rotary screw trap, Chinook salmon carcass recovered during a spawner survey, snorkel surveying for juvenile salmonids, measuring and tagging a steelhead smolt on the Napa River.



Where is monitoring done?

The central component of the RCD's monitoring program is the rotary screw trap, which is located in the lower Napa River near Oak Knoll Avenue (see map above). This trap is installed at the lowest non-tidal reach of the river where we can collect steelhead and salmon smolts right as they enter the estuary. Other monitoring has been done throughout the watershed, with

salmon surveys focused on the mainstem Napa River and steelhead surveys focused more in the tributary streams.

The mainstem Napa River provides approximately 29.8 miles of viable salmonid spawning habitat (shown in green on the map above). Additionally, there are approximately 141 miles of tributary streams that support salmonid spawning and freshwater rearing. These totals exclude tidal reaches, which act as vital corridors and transition habitats between freshwater and the ocean.

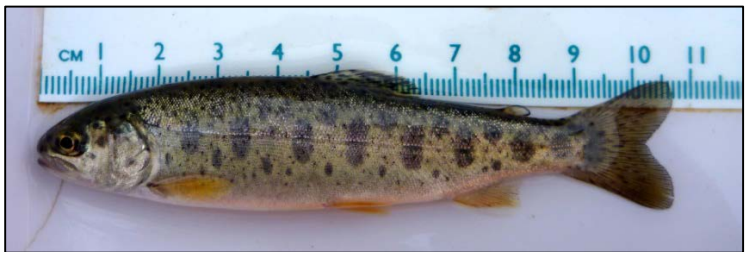
Focus Species - Steelhead

Steelhead in the Napa River watershed are part of the Central California Coast distinct population segment (DPS), which is listed as *Threatened* under the US Endangered Species Act. The listing was based on a long-term decline in steelhead abundance throughout the DPS, which stretches from just north of Ukiah south to Santa Cruz, and includes all streams tributary to the San Francisco Estuary.

Adult female steelhead captured and released in the Napa River rotary screw trap (April 2, 2013)

Adult steelhead return to the Napa River to spawn in the winter and spring, typically between January and March. In years with abundant late-season rainfall, adult fish have been observed spawning as late as May. Steelhead spawning is difficult to document in natural river systems because adults migrate primarily at night and spawn during winter storm flows when visibility is low. Therefore, not much is known about the specific movement patterns of adult steelhead in the Napa River watershed. In order to maximize access to steep and often intermittent streams, adult fish will migrate upstream on the receding limbs of winter storm flows. In years with below-average stream flows, access to small tributary streams, which this species prefers, can be limited or completely blocked. RCD has documented steelhead spawning in the mainstem Napa River frequently in recent years, although it appears to be most prevalent in dry years when access to more favorable tributary spawning habitat is limited by low streamflow.

Juvenile steelhead remain in freshwater for one or more years before migrating to the ocean as smolts (see pictures below). Juveniles (also called parr) typically remain in cool, shady streams with perennial flow for up to three years where they achieve lengths of around 125 to 200 millimeters (about five to eight inches) before smolting. During their freshwater growth phase, juvenile steelhead feed mostly on aquatic and terrestrial invertebrates and may move around within a stream and between streams at higher flows to seek out suitable habitat.



Typical Napa River steelhead parr with a fork length around 100millimeters (approximately 4 inches)

Typical Napa River steelhead smolt with a fork length around 185millimeters (approximately 7 inches)

Focus Species - Chinook salmon

Little is known about the historical abundance and distribution of Chinook salmon in the Napa River watershed (Leidy et al., 2005). Based on accounts of the Napa River's historical conditions and its proximity to the entrance to the Sacramento/San Joaquin River systems, it is likely that the watershed once supported a relatively large, sustainable population of Chinook salmon (Stillwater Sciences, 2002). Napa River salmon populations were not well documented during the early twentieth century and may have been extinguished completely for some period of time. During the last decade, however, juvenile salmon have been regularly collected in the Napa River and adult spawning has been observed in most years, suggesting that a process of recolonization may be underway.

The Napa River Chinook salmon population is not included in either of the nearby Chinook salmon Evolutionarily Significant Units (ESU): the Central Valley Fall/Late Fall Run and the California Coastal Chinook Salmon ESUs. However, recent genetic analysis of Napa River

Chinook samples found that ancestry of Chinook salmon from the Napa River is primarily from the Central Valley Fall/Late Fall Run (Garza and Crandall, 2013).

Adult female Chinook salmon on spawning nest (i.e. redd) in the Napa River (2006)

Chinook salmon enter the Napa River to spawn in the fall, typically around late September and early October. Adult fish will hold in the lower river and estuary for a month or more waiting for the first rains of the season. In some years, when these first rains do not arrive until early winter, salmon migrations are completely blocked and the fish presumably perish in the estuary or swim back out to the estuary to try another stream. In a more typical year, adult salmon swim immediately upstream with the first rains and stake out suitable spawning areas. Salmon quickly find mates and construct spawning nests (i.e. redds) in the streambed gravels and cobbles, typically within a day or two (see picture above). After spawning, spent salmon will remain in the area for up to several weeks protecting their redds until they ultimately die. Peak Chinook spawning activity occurs from November through early January.

Juvenile Chinook salmon spend several months rearing in the Napa River from January through June. Juveniles feed primarily on invertebrates during their freshwater rearing phase, which can last from two to five months. Chinook salmon smolts are typically 80 to 100 millimeters long (approximately three to four inches) when they leave the river and enter the estuary (see picture below). Outmigration occurs throughout the spring with a peak occurring in May.

Typical Napa River Chinook salmon smolt with a fork length of 90 millimeters (approximately 3.5 inches)

Why is monitoring valuable – what have we learned?

The health our fish community is a direct indicator of local stream conditions and helps us gauge how our watershed is functioning as a whole. Here are some of the questions this type of monitoring can help to answer:

What types of fish exist in the river?

As of 2016, we have documented 31 fish species in the rotary screw trap. However, five of these species occurred only once or twice, and therefore do not appear to have self-sustaining populations.

Is our fish community comprised of mostly native or non-native species?

Of the 26 fish species regularly captured in the rotary screw trap, 13 are native and 13 are non-native. Interestingly, native fish account for over 90% of the total catch every year; therefore, it appears that, although non-native species are present, the Napa River fish community is comprised of primarily native species.

How many steelhead and salmon spawn in the river each year?

This is highly variable and still not very well known. Based on our data, the number of steelhead spawning in the river each year likely ranges from hundreds to perhaps a thousand adult fish. Salmon are much more variable, with some years producing no spawning activity, and other years with relatively high abundance - perhaps as many as several hundred adults.

Are there trends in steelhead and salmon abundance over time?

Steelhead smolts have been consistently collected in all sampling years (2009-2016). Over the past eight years, steelhead smolt catch rates exhibit an increasing trend from 2009 to 2012, followed by a sharp decline in 2013 and continued lower catch rates through 2016. The cause of this trend is not well understood; however, there appears to be a correlation between steelhead abundance and rainfall, with the highest catch rates following relatively wet years and the lowest catch rates following relatively dry years. For Chinook salmon, our data do not show any clear trends during the past decade. The salmon population in Napa appears to be small and opportunistic, with the highest numbers occurring during years with more rainfall and early-season flow.

What is the average size and condition of smolts leaving the watershed?

Napa River steelhead smolts have been consistently large in all sampling years (2009-2016), with an average length of 189 millimeters (7.4 inches). It is well known that larger smolts have a significant survival advantage in the ocean and return to spawn at much higher rates than smaller smolts (less than about 6 inches). Based on the size of our smolts and existing literature, we estimate ocean survival at around 25%, meaning that perhaps one in four smolts returns to spawn as an adult.

What are the origins of steelhead and salmon in the Napa River?
No artificial stocking (i.e. planting) of hatchery steelhead occurs in the watershed. Therefore, it is presumed that the Napa River steelhead population is wild and self-propagating. The origins of Chinook salmon in the watershed are not as well-known, as described above in the "Focus Species" section. RCD is actively working to try to determine the origins of Chinook salmon in the watershed, which has proven difficult due to their sporadic presence and the challenge that poses for collecting tissue samples (e.g. genetics, otoliths) from a sufficiently large sample size.

Are habitat restoration efforts increasing steelhead and salmon counts?
With sufficient time (perhaps 15-20 years), we should be able to assess whether ongoing restoration efforts are affecting the number of steelhead and salmon smolts being produced. Large-scale restoration and fish passage barrier removal projects will take time to achieve their intended ecological benefits. Based on this reality, we simply have not been monitoring long enough to gauge the effects of these projects on fish populations in a meaningful way.

How is the drought affecting steelhead, salmon, and other native fishes?
Drought conditions are especially hard on salmonids because of their requirements for cool perennial flow. During the past four years we have seen decreased numbers of salmonids in the rotary screw trap, which suggests that the dry conditions have reduced their summer rearing habitats and thus limited their production. Other native fishes are well-adapted to California's warm dry summers, and appear to be weathering the drought just fine.

How long has monitoring been done, and how long should it continue?
The rotary screw trap has been operated annually in the same location since 2009. Adult spawner surveys have been conducted fairly regularly since 2004, most consistently in several restoration reaches of the Napa River. Other monitoring has been done opportunistically as funding was available over shorter times and in various locations throughout the watershed.

Ideally, fish monitoring should be conducted with approximately the same level of effort every year for at least three to four life-cycles of the target species. For steelhead and salmon, which live an average of four to six years, this means that monitoring for approximately 20 years would provide sufficient data to determine their status. Long-term fish count data are extremely limited for streams in this area; therefore, the longer this type of monitoring is done, the more valuable it becomes.

How much does monitoring cost and who pays for it?
Funding for fish monitoring has come from a number of sources including the California Department of Fish and Wildlife, NOAA's National Marine Fisheries Service, the California

Coastal Conservancy, California Department of Water Resources, the County of Napa, The Peter A. & Vernice H. Gasser Foundation, Napa River Steelhead, the Napa County Wildlife Conservation Commission, Napa Valley Vintners, and donations from individuals.

The cost to implement the fish monitoring program varies from year to year based on funding availability and whether natural environmental conditions (e.g. rainfall and streamflow patterns) are favorable for surveying or not. Total annual cost is approximately $50,000 to $75,000 depending on the duration of the sampling season and number of surveys conducted. Approximately 10-20% of this total has been provided by in-kind donations of time and services from volunteers and project partners.

Who is involved?

The Napa RCD coordinates and runs the program with volunteer assistance from local citizens coordinated through the local non-profit group *Napa River Steelhead*. Other project partners include Treasury Wine Estates, who provides RCD with land access and logistical assistance, and the Napa County Flood Control and Water Conservation District, who assists with landowner access. All of the funders listed above are also project partners and have greatly helped develop and shape the program over the years.

Literature Cited

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Leidy, R.A., G.S. Becker, and B.N. Harvey. 2005. Historical distribution and current status of steelhead/rainbow trout (Oncorhynchus mykiss) in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, California.

Stillwater Sciences and W.E. Dietrich. 2002. Napa River basin limiting factors analysis. Technical report. Prepared by Stillwater Sciences and W. E. Dietrich, Berkeley, California for the San Francisco Regional Water Quality Control Board and California State Coastal Conservancy.

Further Information

For additional information on the RCD's fish monitoring program, please visit the RCD's website at www.naparcd.org or contact:

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