2012 Summary Report on the Juvenile Salmonid and Stream Habitat Monitoring Program

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Summary

The Juvenile Salmonid and Stream Monitoring Program provides valuable data on local steelhead and coho salmon juvenile densities and stream habitat conditions in four watersheds – San Lorenzo, Soquel, Aptos and Corralitos. Seven local agencies collaborate to fund and direct the program, which is administered by the County of Santa Cruz.

Steelhead are listed as threatened under the federal Endangered Species Act (ESA). Coho salmon are listed as endangered under state and federal ESAs and are at high risk of extinction in both San Mateo and Santa Cruz counties. The data collected in this monitoring effort has already played an important role in shaping recovery recommendations; future data will help track and evaluate these essential conservation efforts. These data can be used to track steelhead and coho salmon spawning and rearing habitat conditions, prioritize restoration and conservation efforts, and inform land and water use decisions. This information can provide habitat and juvenile salmonid (steelhead and coho salmon) density information for permitting and monitoring restoration and public works projects. In addition, these data support an understanding of local population dynamics, which help focus and track conservation efforts.

Based on the significant findings described in this report, conservation efforts should focus on increasing dry season streamflow, providing winter refuge habitat for juveniles through protection of instream large woody material and increase efforts for riparian and watershed protection through existing and improved ordinances, policies and programs.

Introduction

This summary report describes current understanding of local steelhead and coho salmon juvenile density patterns in four Santa Cruz County watersheds: San Lorenzo, Soquel, Aptos and Corralitos. This report describes significant findings based on the past 6-15 years of data (depending on the watershed), consultant reports, and current scientific research. Current conservation priorities are discussed in the recommendations.

Steelhead trout *(Oncorhynchus mykiss)* occur in most Santa Cruz County streams. The steelhead population is very low compared to historical numbers

and is listed as threatened under the Federal Endangered Species Act (ESA). The San Lorenzo, Soquel and Aptos watersheds support steelhead that are part of the Central California Coast Distinct Population Segment (DPS). A federal recovery plan for this population is in development. In a 2011 status review, NOAA Fisheries determined that CCC steelhead are at moderate risk of extinction both because of a low population size which is more vulnerable to random events and because habitat conditions have not substantially improved since 2005. The Corralitos watershed is part of the South-Central California DPS; a draft Recovery Plan identifies the Pajaro River and tributaries as a Core 1 Priority Watershed.

Coho Salmon *(Oncorhynchus kisutch)* occur in just a few of their historical streams and are listed as endangered under both the state and federal ESAs. Coho salmon are critically endangered in Santa Cruz County. Six Santa Cruz County watersheds are considered priority watersheds to prevent the extinction of coho salmon south of San Francisco Bay. National Marine Fisheries Service (NOAA Fisheries) aims to recover coho salmon in the San Lorenzo, Soquel and Aptos watersheds, with the San Lorenzo playing a potentially key role in recovery due to its size. Waddell, Scott and San Vicente watersheds are also priority watersheds. The coho salmon captive broodstock program supports the population in Scott Creek and may be used in the future to support coho in other watersheds. The captive broodstock program raises coho salmon in captivity until maturity.

Understanding local patterns of steelhead and coho salmon juvenile densities can help identify conservation efforts that will be the most effective for increasing salmonid populations. While there is a considerable body of knowledge about salmonids in general, fish respond to local conditions to create unique patterns of distribution with specific limiting factors. Local conditions include geology, watershed flow dynamics and land use. In addition, the year-to-year variability in both ocean and stream conditions creates year-to-year variability in juvenile densities. Annual monitoring is able to capture this variability while tracking long-term trends. More sporadic sampling would be unable to distinguish between this variability and long-term trends.

This monitoring program is funded as a collaborative effort between the County of Santa Cruz and six local agencies that include San Lorenzo Valley Water District, City of Santa Cruz Water District, Scotts Valley Water District, Soquel Creek Water District, City of Capitola, and the City of Watsonville (see Table 1). This partnership creates a cost-effective program for collecting juvenile salmonid and habitat data in multiple watersheds.

Both NOAA Fisheries and California Department of Fish and Game (CDFG) are very supportive of this monitoring program and have recently begun to serve on the report review team. Data from this monitoring program assist CDFG and NOAA Fisheries in permitting and recovery planning efforts. In return, this

program benefits from new research conducted by the NOAA's Southwest Fisheries Science Center in Santa Cruz that conducts research on Scott and San Vicente creeks on the north coast. In the future, CDFG may collect additional data on adults or outmigrating juveniles, which will contribute to our understanding of local populations.

The fishery consultant team, D.W. ALLEY & Associates, has been conducting the monitoring program under partner funding since 2006. The principal, Don Alley, has over 30 years of experience sampling salmonids and interpreting data in Central Coast streams and has conducted work in local watersheds since 1981 H.T. Harvey & Associates sampled the San Lorenzo Watershed in 2002 for the City of Santa Cruz. D.W. ALLEY & Associates produces an annual report that is available at the Water Resources website

Life History

Steelhead and coho salmon exhibit a complex life history influenced by dynamic factors in both freshwater and marine environments. The following description summarizes their life history and highlights some of the factors that are discussed later in the report.

Steelhead. Adult steelhead migrate upstream from the ocean during the rainy season, anytime from November to March. Steelhead and coho salmon enter local streams only when sufficient streamflow has opened coastal lagoons through which the stream drains to the ocean. Steelhead spawn (mate and lay eggs) in gravel riffles throughout the watershed. Both eggs and newly hatched fish – called alevins – must survive subsequent winter storms that can scour or transport fine sediment that can smother redds (egg nests). When fry emerge, they seek slow-water areas, often at the stream margins. As they grow bigger, the young fish – called juveniles – move into faster water to feed on aquatic and terrestrial insects that are carried in streamflow (drift feeding). For this reason, streamflow is positively correlated to food resources – more flow brings more food. In addition, more flow creates more actual habitat area.

Juvenile steelhead rear in freshwater and lagoon habitats from 1 to 3 years, depending on their rate of growth. Recent research shows that steelhead must grow to at least 150 mm in order to survive the ocean habitat and return as adults (Bond, 2006). Larger steelhead use primarily pool habitat in upper mainstem and tributary reaches and use fast-water habitat in the lower and middle mainstem San Lorenzo River. Lagoons can provide productive rearing habitat due to abundant food resources if water quality is good. Some steelhead rear all summer in the lagoon while other use the lagoon as a transition to the ocean environment. In preparation for living in the ocean, young fish become smolts, a change that prepares them physiologically for the new environment. Juveniles migrate out to the ocean in winter or spring.

Steelhead usually spend 2-4 years in the ocean maturing. Steelhead can migrate into freshwater habitats multiple times to spawn and can even survive living in freshwater before or after spawning for periods of time. Steelhead that never enter the ocean and remain in freshwater streams are called resident trout.

Coho Salmon. Coho salmon have a similar, but more rigid lifecycle than steelhead. With little exception, coho salmon spend their first year in freshwater streams, migrate out to sea where they mature for two years, and return to their native creeks to spawn and die. Because all wild females are three years old, coho salmon develop three consecutive "year classes" in each stream. Coho juveniles prefer pool habitat and are more associated with large woody material than steelhead.

Coho salmon in Santa Cruz County are at the southern edge of their distribution range. They are vulnerable to extreme environmental conditions such as droughts and the timing of winter storms and floods, which open the sandbar for upstream migration and affects the survival of redds and juveniles. Most recently, juvenile coho salmon were impacted by poor ocean conditions (low food supply due to weak upwelling) that dramatically reduced adult returns throughout California.

Monitoring Methods

The monitoring program collects four categories of data; (1) habitat data within ½ mile stream segments; (2) fish and habitat data at specific sampling sites within the ½ mile stream segment; (3) quantity and type of large woody material within ½ mile stream segments and (4) steelhead occurrence in lagoons. Each year, the study scope is adjusted to reflect current data priorities and funding. The large woody material assessment and lagoon sampling are newer additions that increase the value of the monitoring program.

For habitat monitoring, ½ mile stream segments are habitat typed to CDFG Level III protocols and surveyed for additional habitat metrics, such as cover habitat. Habitat monitoring data include habitat types (pools, riffles, runs), width, depth, canopy cover and sediment conditions. Sediment conditions that are visually evaluated include the percent composition of substrate types, percent fines (sand and silt), and embeddedness, the percent that a cobble or boulder is surrounded by fine sediment. From the habitat monitoring data, a fish sampling site is chosen that reflects average habitat conditions for pool habitats in terms of length, depth and cover. The same fish sampling site is used in multiple years unless habitat data indicate that the site no longer reflects average habitat conditions for that reach.

Fish sampling sites include multiple habitat units of pools, riffles and runs. Fish are sampled using an electroshocker, which stuns fish temporarily so they can be

captured with hand nets. All juvenile salmonids are identified, measured and released. Other fish species are identified, counted and released. Additional habitat data is collected for fish sampling sites. The number of juvenile salmonids captured in a habitat is reported as a density – the number of fish per 100 feet of stream. Juvenile densities are calculated for 2 age and 3 size classes. These categories determine proportions of young-of-the-year and older fish, and growth rates. Divers conduct snorkel surveys in San Lorenzo River pools that are too deep to electrofish.

Large woody material assessments occur in randomly selected stream segments within the 1/2 mile stream reach. Standing and down wood is categorized within the riparian, bankfull and low-flow channel areas. The assessment classifies the type of wood (conifer or hardwood) and whether it is contributing to instream habitat. Conifer wood that is actively contributing to in-stream habitat provides the most benefit to salmonids.

Lagoon fish are sampled using a beach seine. A population estimate for Aptos Lagoon is calculated by conducting a mark and recapture over two consecutive weeks. In separate monitoring programs, the City of Santa Cruz samples San Lorenzo lagoon and the City of Capitola samples Soquel lagoon.

The methods used in this monitoring program rely on selecting sampling sites with average habitat quality and assuming that the data reflect an average density for that stream. An alternative would be to sample about 10% of the habitat and select sites randomly. While random sampling would provide more statistically robust data, it would be many times the cost and be more complex logistically. When the same habitat units are sampled in multiple years, the statistical T-test is use to compare densities between years. This analysis shows that many density changes are significant and not just a component of normal variation.

Significant Findings

Coho salmon are critically endangered in Santa Cruz County.
Juvenile coho salmon were collected just twice in the past twelve years; 2005 in Bean Creek and 2008 in East Branch Soquel Creek. Juveniles were not collected for the same year class in either 2008 (Bean Creek) or 2011 (Bean Creek or East Branch Soquel Creek).

Juvenile steelhead show three life history patterns depending on habitat productivity and migration access.
Young smolts. The first pattern are young-of-the-year (yoy) steelhead that grow large enough by the sampling period that they are expected to migrate out to the ocean the subsequent winter or spring. Young smolts live in highly productive habitats that include ***Aptos lagoon*** and the ***lower mainstem San Lorenzo***

River, mainstem Soquel or lagoon. A portion of young-of-the-year in larger tributaries such as ***Zayante, Bean and Corralitos*** will grow large enough to smolt in one year. The portion of juveniles that become young smolts depends on spring and summer streamflow, overall juvenile density and habitat quality that year.

*Older smolts**.*** Steelhead that take 2 (and sometimes 3) years to reach the size needed to outmigrate represent the second life history pattern. These steelhead live primarily in the tributaries and upper mainstem reaches which are the majority of the sampling sites and represent the greatest geographic area. For these fish, overwinter survival and dry season rearing conditions, especially flow and cover habitat, are critical. Older smolts grow better with lower young-of-the-year densities. These older smolts provide life history and genetic diversity that support steelhead populations in the long term. Older smolts live in portions of the ***San Lorenzo River, Soquel Creek*** and tributary creeks including ***Zayante, Bean, Lompico, Fall, Boulder, Bear, East and West Branch Soquel, Corralitos, Browns Valley,*** and ***Shingle Mill Gulch.***

Resident trout. The third pattern consists of resident trout that live in freshwater habitats all year around. Steelhead and resident rainbow trout are the same species with different life histories. While resident trout stay and grow to a larger size than steelhead juveniles in freshwater habitats, they have the capacity to migrate downstream to the ocean, reproduce with steelhead or have offspring that become ocean-going steelhead. Steelhead and resident trout can co-exist throughout the watershed, but resident trout are more common in stream reaches that are less accessible and less productive.

Total juvenile steelhead densities vary from year-to-year and show a decreasing trend in San Lorenzo and Soquel watersheds since 2009.
In 2011, young-of-the-year densities were the lowest of all years in San Lorenzo and Soquel watersheds and show a decreasing trend for total densities since 2009 (see Figures B-23 and B-25). While this could be a temporary decrease due to lower streamflows in 2007-2009, it could signal a decrease in the adult population. Aptos and Corralitos show no clear trend for total densities. Data for 2012 is not yet available.

Young-of-the-year densities correlate to winter and spring storm patterns.
Young-of-the-year densities reflect early survival, which includes survival as an egg, alevin (newly hatched fry with yolk sac) and young fry. Redds (egg nests) can be destroyed by high flow events that scour spawning gravels or deposit fine sediments that smother eggs or alevins. High flow events can affect fry survival if flow refuge (areas of low velocity) are limited.

Monitoring data show that young-of-the-year densities decrease in years with intense winter or spring storms. In contrast, young-of-the-year densities increase

when moderate winter or spring storms provide passage conditions for adults without subsequent intense storms.

Both these patterns indicate that early survival is sensitive to intense storm events. Conservation efforts to decrease fine sediments, increase flow refuge and attenuate rapid storm peaks will all contribute to improved early survival. Sediment control efforts will decrease fine sediments and improve survival for eggs and alevins. Retention of large wood and flood plain protection and restoration will increase flow refuge and improve survival for young fry, along with efforts to provide runoff retention and detention to attenuate rapid storm peaks.

Yearling densities correlate to intense winter storms and moderate spring storms. Yearling densities reflect multiple factors that are not monitored directly through this sampling program. Juvenile morality can result from predation, starvation, disease or physical trauma associated with intense winter storms.

Since the data show decreased yearling densities following intense winter or spring storms, a lack of winter high flow refuge is considered a primary factor in yearling survival. This finding aligns with assessment and recommendations in recovery plans for both steelhead and coho salmon.

Yearling densities also decrease following springs with moderate flows. These moderate flows provide excellent rearing habitat conditions (lots of flow and food) and it may be that some yearlings are able to grow large enough in the spring season to outmigrate instead of staying in the freshwater environment.

Juvenile steelhead show a trade-off between density and growth.
When early survival is good and there are more young-of-the-year steelhead, growth for all juvenile steelhead tends to be lower. When early survival is decreased, the fewer remaining juveniles tend to grow better. With less competition, the fewer fish are able to grow more.

Stream habitat conditions shows no overall trend. In general, stream habitat conditions fluctuate year to year depending on flow patterns which influence sediment, scour (depth and cover), dry season flow and habitat form. Recent sediment monitoring data support earlier conclusions that the County's existing ordinances, policies and programs have protected stream habitats from significant further degradation but have not resulted in significant improvement (Balance Hydrologics, 1996).

Stream habitat variables show weak correlation with juvenile densities.
Stream habitat monitoring serves two functions: it provides measures of stream condition for the ½ mile stream segments and it provides the data to select the fish sampling sites. Stream habitat conditions vary considerably between years and among sites but most conditions vary within a typical range.

The relationship between juvenile steelhead densities from specific sampling sites and stream habitat conditions from the ½ mile stream reaches is unclear. Habitat conditions reflect summer rearing habitat which may be secondary to overwintering survival under current watershed conditions. In addition, habitat is a combination of multiple factors so that direct linear relationships are weaker. In response to these results, the program has reduced habitat monitoring. A core set of sites are habitat monitored each year, while other sites are monitored about every 3 years.

Large Woody Material assessments create baseline for new policy. In 2009, the Board of Supervisors approved a new policy to retain more large wood in local streams. In 2010, this monitoring program began assessing large woody material in selected reaches to create a baseline dataset for evaluating the effect of the County's new policy. So far, the program has assessed large wood in 11 stream segments that correspond to sampled reaches. Large woody material has been surveyed on Bean, Zayante, Bear, Soquel, East Branch Soquel and Corralitos creeks. The goal is to track how the amount of large woody material changes with the new policy and see if there is a positive response in fish densities.

Densities of wood in Soquel, Bean and Corralitos compared favorably to NOAA Fisheries restoration goals and wood surveys conducted in other regional, but less developed watersheds, that include Gazos, Waddell and Scott. However, much of this wood was in a few logjams and did not contribute to multiple pool habitats.

Aptos Lagoon provides steelhead rearing habitat. Aptos lagoon was sampled in 2011 and 2012. Results varied between years, with a population estimate of 420 for 2011 and 140 for 2012. Captured steelhead were mostly larger than 150 mm and most were young-of-the-year. These results underscore the value of the lagoon for rearing habitat and the potential benefit of improving habitat in Aptos Lagoon. The City of Capitola funds lagoon sampling in Soquel Creek with annual population estimates; in 2012 steelhead estimates for Soquel Lagoon were only 220 and the lowest of all sampling years. The City of Santa Cruz funds San Lorenzo River lagoon sampling; steelhead population estimates for 2011 were 501 in early summer and 138 in fall.

Steelhead use at Pajaro Lagoon remains unknown. Pajaro Lagoon was sampled for the first time under this program in 2012. Steelhead were not captured during sampling at 8 sites in the main lagoon or at 2 sites upstream in the Pajaro River. Since Pajaro watershed supports a steelhead population, we know that steelhead adults and smolts use the lagoon for migration to and from the ocean, but we still do not know if steelhead attempt to rear in the lagoon during the spring or summer months.

Passage projects show results for steelhead access. The County of Santa Cruz has a long history of improving fish passage at natural and human barriers. Between 1985 and 1990, the County completed a number of fish passage projects at natural barriers and culvert crossings. Between 2003 and 2012, the County completed an additional 9 projects to improve fish passage at county road stream crossings. Two projects - a culvert retrofit at the Corralitos box culvert (Eureka Canyon Road at PM 2.95) and a fish ladder at a natural barrier on Zayante Creek, Quail Hollow Fish Ladder - show excellent steelhead access upstream. Passage projects on Valencia, Shingle Mill and Lompico creeks show that steelhead access is better in years with high, sustained flows.

Local streams continue to support native fish populations. This monitoring program documents the occurrence and general abundance of native fish including lamprey, Sacramento sucker, California roach and several sculpin species. Endangered tidewater goby were collected in both Aptos and Pajaro lagoons in 2012. The fact that Santa Cruz County continues to support a robust native fish fauna reflects well on general watershed health and indicates high potential for successful steelhead and coho salmon restoration.

Monitoring Recommendations

Continue to participate as a partner in the Juvenile Salmonid and Stream Habitat Monitoring Program.
This collaboratively funded program provides a cost-effective way to collect data that benefits multiple partners while also incorporating broader input and review. Encourage Zone 7 to continue participation to sample Pajaro Lagoon in multiple years.

Continue to adapt the monitoring program to best fit current data needs.
The monitoring program has become more flexible in recent years in order to collect the most valuable data in response to new priorities. Continue to review and adapt fieldwork, data analysis and report production to suit program partners and recovery needs.

Continue to develop database and alternative data analysis.
Environmental Health Services has been working to collect and organize data from this monitoring program into a more formal database. The core of the database is almost complete and can be used to analyze the data in new ways and to develop public outreach.

Policy and Program Recommendations

The following section describes several high priority, interconnected recommendations for watershed health as well as steelhead conservation and coho salmon recovery.

Participate in efforts to implement the 2012 Federal Coho Salmon Recovery Plan.
In order to prevent the extinction of coho salmon south of San Francisco Bay, agencies and county residents will need to make a strong commitment to protecting and improving stream habitats. Improving streamflow, sediment control and protection of large woody material for winter flow refuge stand out as the most urgent actions that will benefit both coho salmon recovery and steelhead conservation.

Support efforts to increase dry season streamflows.
The County should support its own and water agency efforts to increase dry season streamflows through water supply projects, groundwater recharge, water conservation and reduction of impervious surfaces.

Increase flow refuge for juveniles to support winter survival.
Young-of-the-year and older juvenile steelhead and young-of-the-year coho salmon need habitats to escape high stream velocities during storm events. These flow refuge habitats include cover habitat such as undercut streambanks, large woody material and boulders. Channel complexity such as backwater pools, side channels and floodplains also provide refuge from high stream velocities. In the short term, the quickest way to increase flow refuge will be to preserve and protect large woody material in streams. In the longer term, efforts to restore channel complexity including the restoration of floodplain habitats will be important. In addition, efforts to reduce impervious surfaces and thereby reduce stream flashiness should benefit overwintering survival.

Balance steelhead conservation efforts between highly productive and intermediate habitats.
Maintaining life history diversity in steelhead will be critical for long term population sustainability. Accordingly, conservation efforts should be distributed throughout the watershed to support habitat for both young and older smolts. The County should support restoration efforts for lagoons to promote these highly productive habitats. Physical restoration and sand bar management, streamflow and water quality are essential components of lagoon restoration. The County should also protect and restore habitats that support both young and older smolts. Streamflow, flow refuge and riparian protection are essential components of intermediate habitats.

Improve riparian corridor protection.
Riparian corridors provide multiple benefits to stream habitats including shade to maintain cold water temperatures, a source of organic material to fuel the stream food web and large woody material when riparian trees fall. Riparian corridors protect water quality by trapping pollutants and providing properties with flood and bank protection.

The County's Riparian policies, including enforcement, property owner education and incentives, and planning policies should be reviewed to ensure that polices are strengthened so they not only protect but provide for significantly improved condition of riparian habitat along Santa Cruz County streams. Impacts from County roads should be considered also. Review the effectiveness of the Riparian Corridor Protection Ordinance and investigate ways to improve implementation and/or enforcement. Support outreach to private landowners about riparian corridors, large woody material and watershed stewardship.

Conclusion

The Juvenile Salmonid and Stream Habitat Monitoring Program continues to provide essential data on steelhead and coho salmon juvenile densities and habitat conditions to seven local agencies. The San Lorenzo, Soquel, Aptos and Corralitos watersheds provide water supply, wildlife habitat, flood capacity, recreation and beauty for local residents. Conservation efforts to protect and restore steelhead and coho salmon will also protect these important watershed values. By tracking stream habitats and salmonid juveniles, this monitoring program shows our success and helps identify future needs for protecting our local watershed resources.

Figures

The following figures show the trend in total juvenile steelhead density for each sampling site. Sites in the San Lorenzo are divided between mainstem and tributary sites (D.W. ALLEY & Associates, 2012).

Figure B-21. Trend in Total Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2011.

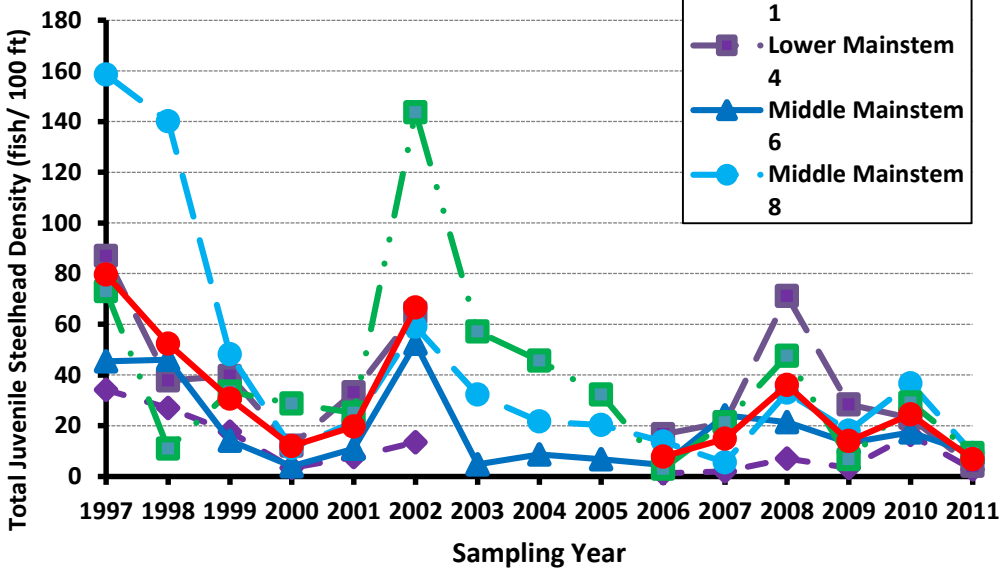


Figure B-23. Trend in Total Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2011.

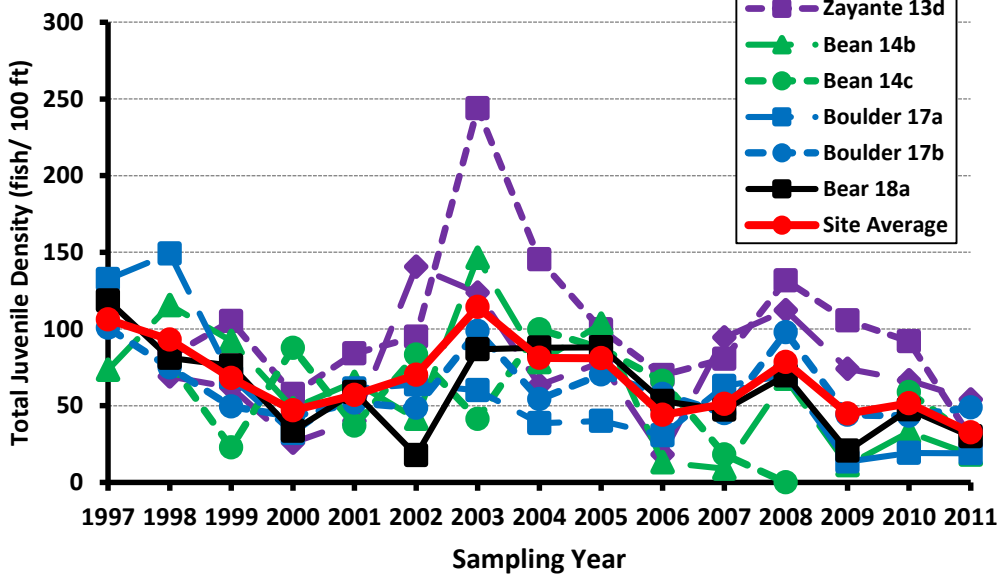


Figure B-25. Trend in Total Juvenile Steelhead Density at Soquel Creek Sites, 1997-2011.

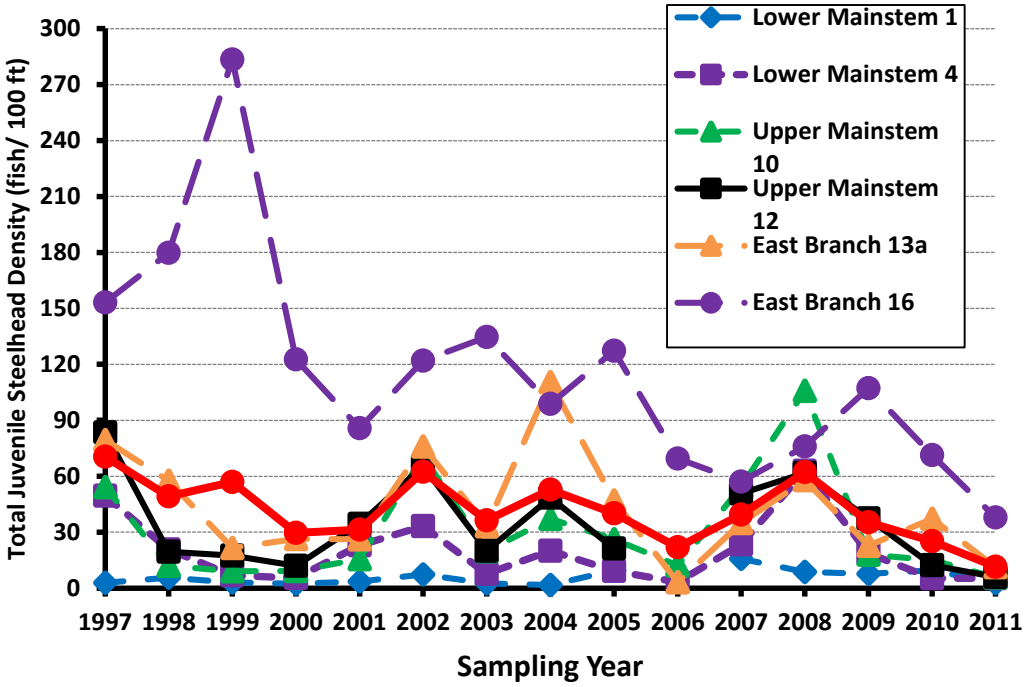
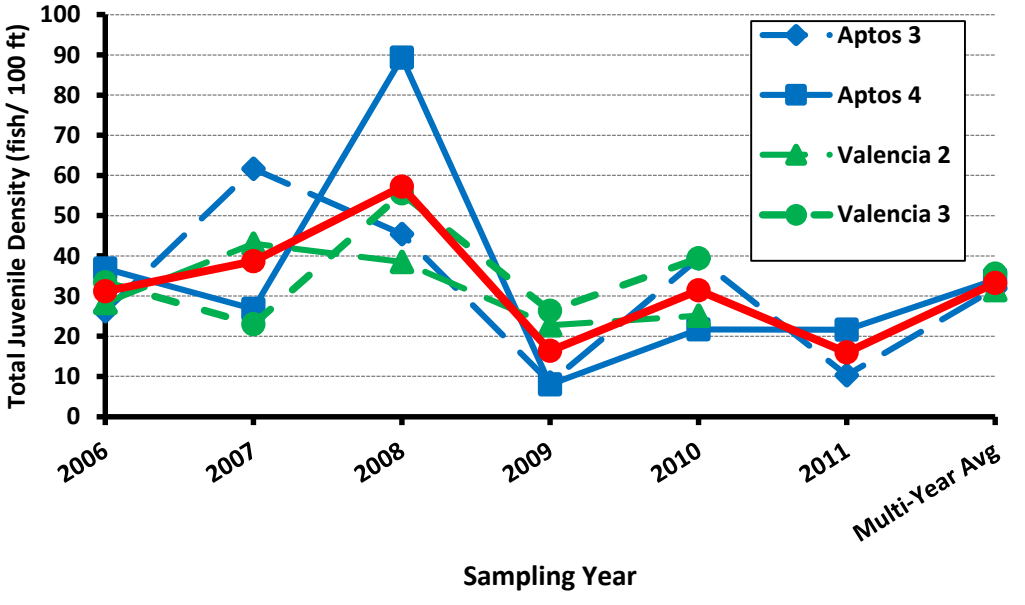
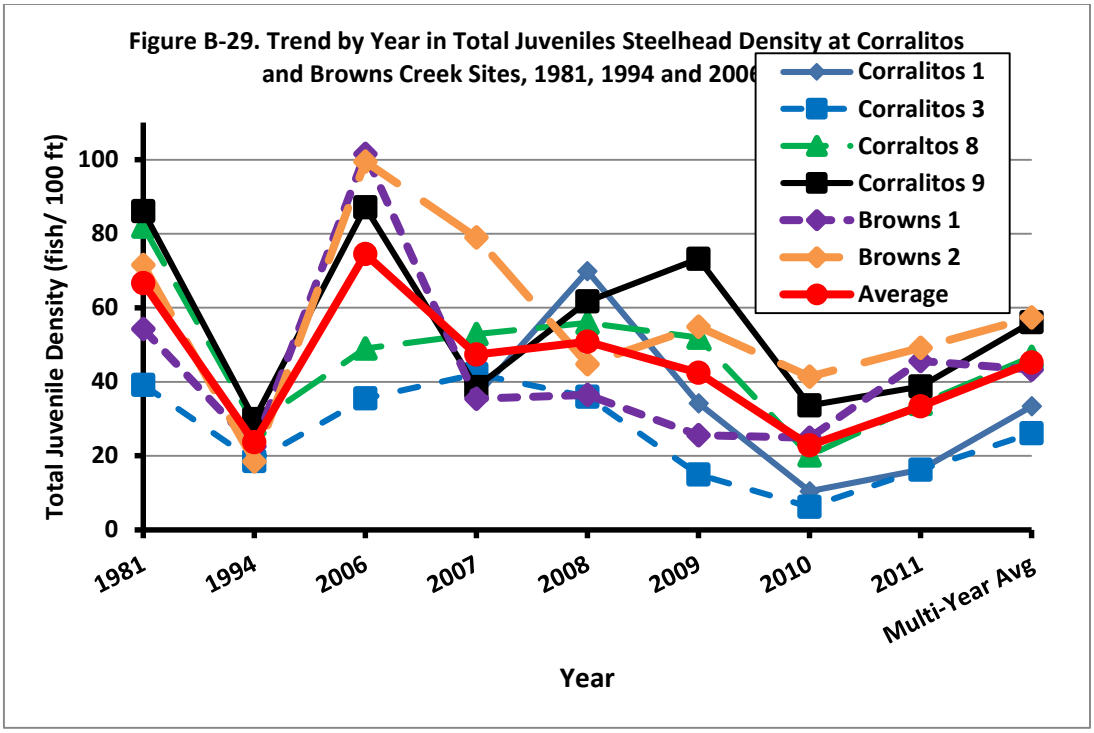


Figure B-27. Trend in Total Juvenile Steelhead Density in Aptos and Valencia Creek Sites, 2006-2011.





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