D.W. ALLEY & Associates aquatic biology

# 2017 SUMMARY REPORT− Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Pajaro Watersheds, Santa Cruz County, CA

**Sampled Pool in Mainstem Soquel Creek Site #10, Adjacent Large Landslide Activated by Heavy Rainfall**


**D.W. ALLEY & Associates, Aquatic Biology**
**Don Alley and Chad Steiner, Fishery Biologists**
**With Field Assistance from Josie Moss, Inger Marie Laursen, Jessica Wheeler, Tanner Gilbert, Tyler Suttle and Judie Cole**


***Prepared for the*** **Santa Cruz County Environmental Health Department**
Government Center, 701 Ocean Street, Room 312, Santa Cruz, CA 95060


***Funding from the***

**San Lorenzo Valley Water District, Soquel Creek Water District, Scotts Valley Water District, Cities of Santa Cruz, Capitola and Watsonville and the County of Santa Cruz**


**April 2018** **Project # 200-15a**

## TABLE OF CONTENTS

# LIST OF TABLES

## LIST OF FIGURES

# A. EXECUTIVE SUMMARY

Water Year 2017 streamflows in spring and summer were much above the median streamflow statistic after 8 above bankfull stormflows in December−February. This was unlike 7 of the last 11 water years with baseflows below the median. Thus, adult spawning access was good in all 4 watersheds. But many spawning redds made before early March may have been destroyed or smothered in sediment by multiple bankfull events. Even so, relatively good spawning flows existed after February, leading to relatively good egg and YOY survival. Based on the level of YOY in Casserly Creek being comparable to the upper Corralitos-Browns subwatershed, it is likely that adult steelhead migrated into that creek through College Lake again to spawn. The much below average YOY densities in Soquel Creek and low lagoon population estimate in 2017 indicated that the Soquel Creek adult population has severely declined. The patchy abundance of YOY in the San Lorenzo system with low densities in Zayante and Bean creeks and continued low densities in the middle mainstem and Bear Creek indicate a much reduced adult population in that watershed, as well. However, 2 of our lower mainstem sites downstream of the Rincon riffle and the estuary (reportedly) had very high juvenile densities in 2017.

Rearing habitat improved from 2016 to 2017 in all 4 watersheds due to increased baseflow (more food, depth and rearing space), habitat deepening and more escape cover. The San Lorenzo River channel just upstream of the Rincon riffle had split into 3, making it more challenging for adult steelhead and coho spawning migration. We found little evidence of sedimentation at sampling sites in any of the 4 watersheds, with pool scour evident. However, upper Bear Creek had pools with soft sediment indicative of recent deposition, and 2 of the 6 pools snorkeled in the middle mainstem of the San Lorenzo had exposed sediment mounds at their tails. Instream wood was recruited at many sampling sites to increase escape cover. Instream wood increased at 8 of 27 sites in the San Lorenzo watershed. Major landsliding that temporarily dammed Soquel Creek in late February occurred in the mainstem Reach 7 above Moores Gulch. Four of 8 sites in Soquel Creek had additional instream wood. All 4 sampling sites in the Aptos-Valencia Creek watershed had increased large and small instream wood. One of 9 sites in the Corralitos-Browns subwatershed had increased large instream wood.

Although total and YOY steelhead densities increased in 2017 at most sites in 3 of 4 watersheds (excepting Soquel), 5 of 11 mainstem sites in the San Lorenzo system and 10 of 16 tributary sites were still below average. Despite this, 17 of 27 San Lorenzo sites had above average Size Class II/ III densities (soon-to-smolt) because a high proportion of YOY reached Size Class II at most sites. Exceptions to the rapid growth in 2017 and other years were sites in Fall, Boulder, and uppermost sites in Zayante, Bean and Branciforte creeks that were either heavily shaded or had low baseflow, or both. The trend in average Size Class II/III density increased substantially in the San Lorenzo in 2017 (5 fish/ 100 ft).

Similarly in Soquel Creek, total and YOY densities were below average at 7 of 8 sites. But Size Class II/III densities were above average at 5 of 8 Soquel sites because all YOY grew into Size Class II at mainstem and lower Branch sites, and half did at the upper East Branch site. While the trend in average total and YOY densities showed little improvement in Soquel in 2017, average Size Class II density increased 8 fish/ 100 ft.

Following the same pattern as in Soquel Creek, 3 of 4 Aptos watershed sites had below average total and YOY densities while 3 of 4 Aptos sites had above average Size Class II/III densities, and the trend in average density increased 8 fish/ 100 ft and exceeded the 11-year average. YOY and Size Class II densities increased at all 4 Aptos watershed sites in 2017.

YOY and Size Class II densities increased at all 9 sites in the Corralitos subwatershed (Shinglemill compared to 2014). Total and YOY steelhead densities in the Corralitos subwatershed were above average at 5 of 9 sites, translating to above average Size Class II/III densities in all 5 Corralitos sites and below average densities in the 2 Shinglemill and 2 Browns sites, where YOY growth was less. Corralitos trends in average total and Size Class II/III density increased greatly in 2017 (8 fish/ 100 ft). But it was still below the 11-year average. A positive relationship occurred between annual average Size Class II/III site density and the May−September average monthly baseflow in the San Lorenzo and Soquel watersheds.

Aptos Estuary was sampled for steelhead in 2017. The population estimate was 184, based on mark and recapture. This was improvement since 2014 when only 6 steelhead were captured. The 2011−2013 estimates were 32, 140 and 423, respectively. Pajaro Estuary was sampled for steelhead and tidewater goby. No steelhead and only 1 tidewater goby were captured, indicating further reduction in tidewater gobies in an inhospitable saline, estuarine spawning environment after large stormflows that may have washed many individuals out to sea.

# B. INTRODUCTION

### ***i. Scope of Work***

In fall 2017, 4 Santa Cruz County watersheds were sampled for juvenile steelhead to primarily compare juvenile abundance at multiple stratified sites in each watershed with past years to assess trends and compare habitat conditions at sampling sites and in limited habitat typed segments with those in 2016 and past years in selected reaches of the San Lorenzo, Soquel, Aptos and Corralitos watersheds. Results from steelhead and habitat monitoring are used to guide watershed management and planning (including implementation of public works projects) and enhancement projects for species recovery. Refer to the Santa Cruz County Environmental Health website for maps that delineate reaches and sampling sites. Hydrographs of all previous sampling years are also available at that website. Methods of data collection and tables of steelhead density by size and age class of past years may be found in the detailed analysis (**Appendix B**) of past reports available at the county website. Tables of 2017 fish densities are available upon request.

### ***ii. Study Area***

***San Lorenzo River.*** The mainstem San Lorenzo River and 7 tributaries were sampled at 27 sites (11 mainstem and 16 tributary sites). Sampled tributaries included Branciforte, Zayante, Bean, Fall, Newell, Boulder and Bear creeks. A former segment was added to upper Bear Creek (18b) after last being sampled in 2001. Five half-mile segments were habitat typed in the San Lorenzo system to assess habitat conditions and select habitats of average quality to sample for fish density. For the remaining 22 sites, the 2016 sites were replicated for fish sampling. Depth, cover, percent fines, embeddedness and percent tree canopy were measured at all sampling sites.

***Soquel Creek.*** Soquel Creek and its branches were sampled at 8 sites (4 mainstem and 4 branch sites). Two half-mile segments were habitat typed to assess habitat conditions and select habitats of average quality to sample for fish density. For the remaining 6 sites, the 2016 sites were replicated for fish sampling. Depth, cover, percent fines, embeddedness and percent tree canopy were measured at all sampling sites.

***Aptos Creek and Lagoon/Estuary.*** Aptos watershed was sampled at two Aptos and two Valencia creek sites in 2017. All 4 2016 sites were replicated for fish sampling. Depth, cover, percent fines, embeddedness and percent tree canopy were measured at all sampling sites. Aptos Estuary was also sampled for steelhead in October.

***Pajaro River and Lagoon/ Estuary.*** In the Corralitos sub-watershed of the Pajaro River drainage, fish sampling included 5 sites in Corralitos Creek, 2 sites in Shinglemill Gulch and 2 sites in Browns Creek. Two associated half-mile reach segments were habitat typed in Corralitos Creek below the diversion dam. Casserly Creek was again sampled downstream of the Mt. Madonna Road Bridge. The Pajaro River Estuary was sampled in late September and early October for steelhead and tidewater goby, and water quality conditions were measured during sampling.

# C. GLOSSARY

**Bankfull stage/ discharge:** Corresponds to the discharge (streamflow) at which channel maintenance is most effective. It is the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of stream channels. The bankfull discharge or greater discharges are channel-forming streamflows. The bankfull discharge has a recurrence interval of approximately 1.5 years.

**Baseflow:** Streamflow that is derived from natural storage i.e., groundwater outflow outside the net rainfall that creates surface runoff. It is the discharge (streamflow) sustained in the stream channel, not as a result of direct runoff and without the effects of regulation, diversion or other human activities. It is also called groundwater flow.

**Escape cover:** Where a fish hides from predators, including beneath surface turbulence and overhanging riparian vegetation and under unembedded boulders, within undercut banks and under instream wood.

**Fish Density:** Number of fish per 100 feet of stream channel in this report.

**Fish Habitat:** Where a fish lives that provides food and shelter necessary to survive. It is the aquatic environment and the immediate terrestrial environment that combine to provide biological and physical support systems required by fish species during various life stages.

**Fork Length (FL):** Fish length from snout to mid point in the tail's edge.
**Hydraulic control point:** The top of an obstruction in the stream channel in which streamflow must rise before passing over, or a point in the stream where the flow is constricted. The hydraulic control point determines the water surface elevation upstream to the next riffle or run. It is typically at the tail of a pool. Riffles and runs have no hydraulic controls except for very short distances at most.

**Hydrograph:** A graph showing the discharge (streamflow) or stage (water surface elevation) at a specific location with respect for time.

**Instream Wood cluster:** Logjam that extends into the summer low flow channel.

**Large woody debris:** A large piece of relatively stable instream wood having a diameter greater than 1 foot and length greater than 6 feet that extends into the stream channel, either at baseflow or during winter stormflows. We prefer to call it **large instream wood**.

**Low flow:** The lowest streamflow recorded over a specified period of time. Also called **minimum flow**.

**Mainstem:** The principal or dominating stream channel in a drainage (watershed) system. Tributary streams flow into the mainstem.

**Overwintering cover:** Where fish find refuge and resting places from fast water during stormflows. It may be along undercut banks or behind large boulders and/or large instream wood.

**Percent Embeddedness:** The percent buried in fine sediment or sand of large streambed particles (cobbles and boulders large enough for fish to hide under for escape cover).

**Percent fines:** The percent of the streambed area covered with silt and sand in this study.

**Pool:** A deeper stream habitat with no surface turbulence except at the head and has places where downstream water velocity is near zero or where water is backwatered with upstream eddies. Pools are formed by scour objects, such as large instream wood, large boulders, streambank tree roots or bedrock faces.

**Reach segment:** A specified length of stream within a stream reach. In this study, stream segments are ½ mile in length and are considered representative of habitat in the reach. Habitat characteristics and fish are sampled within historically designated reach segments to assess annual trends in habitat conditions and fish densities within reaches.

**Representative reach fish sampling:** For all stream reaches except the mainstem San Lorenzo River up to the Boulder Creek confluence, fish sampling sites are chosen within representative stream segments of stream reaches based on the pools within the sampling site having near-average pool depth and escape cover for the segment. Representative pools and adjacent fastwater habitats are sampled by electrofishing at the site. For the mainstem San Lorenzo River, representative fastwater riffles and runs regarding near-average stream depth are electrofished, and nearby historical pools are snorkel censused.

**Riffle:** Relatively shallow, fastwater habitat with surface turbulence and often exposed cobbles and boulders. It is where most of the aquatic insect larvae are produced and where insect drift rate is the highest.

**Riparian vegetation:** Vegetation growing on or near streambanks or other water bodies on soils that exhibit near or completely water saturated conditions during some portion of the growing season. Common native riparian tree species in the Santa Cruz Mountains include redwood, Douglas fir, California bay, tanoak, willow, alder, bigleaf maple, cottonwood, dogwood, sycamore and box elder. Acacia, a non-native riparian tree species, is becoming more common.

**Run:** Deeper than riffle, fastwater habitat without surface turbulence, but is moving.
**Scour:** The localized removal of material from the streambed by flowing water. It causes the stream channel to deepen and is the opposite of fill.

**Shade:** The percent canopy closure over the stream as estimated by a spherical densiometer.
**Size Class I steelhead/ coho salmon:** Juvenile steelhead or coho salmon captured in the fall that are less than 75 mm Standard Length.

**Size Class II steelhead/ coho salmon:** Juvenile steelhead or coho salmon captured in the fall that are between 75 and 150 mm Standard Length. Steelhead in this size class include fast-growing young-of-the-year and yearling juveniles.

**Size Class III steelhead:** Juvenile steelhead captured in the fall that are at least 150 mm Standard Length.

**Soon-to-smolt-steelhead:** Juvenile steelhead captured in the fall that are 75 mm Standard Length or larger and will likely smolt the following spring.

**Spawning Gravel:** Streambed particle size between one quarter and 3 and a half inches in diameter. Usually found within **spawning glides** at the tails of pools or runs just upstream of steep, focused riffles.

**Standard Fish Length (SL):** Fish length from snout to end of spinal column in the caudal peduncle before the tail.

**Steelhead/ coho salmon adult migration:** Adult steelhead are sexually mature and typically migrate upstream from the ocean through an open sandbar after several prolonged storms; the migration seldom begins earlier than December and may extend into May if late spring storms develop. Many of the earliest migrants tend to be smaller than those entering later in the season. Adult fish may be blocked by barriers such as bedrock falls, wide and shallow riffles and occasionally logjams. Man-made objects, such as culverts, bridge abutments, dams and remnant dam abutments are often significant barriers. Some barriers may completely block upstream migration, but many barriers in coastal streams are passable at higher streamflows. If the barrier is not absolute, some adult steelhead are usually able to pass in most years, since they can time their upstream movements to match optimal stormflow conditions. However, in drought years and years when storms are delayed, they can be serious barriers to steelhead and especially coho salmon spawning migration. Sexually mature adult coho salmon often have more severe migrational challenges because much of their migration period, November through early February, may be prior to stormflows needed to pass shallow riffles, boulder falls and partial logjam barriers. Access is also a greater problem for coho salmon because they die at maturity and cannot wait in the ocean an extra year if access is poor due to failure of sandbar breaching during drought or delayed stormflow.

**Steelhead/ coho salmon smolt migration:** Fish undergo physiological changes to their gills and kidneys to adapt to saltwater to prevent dehydration. Juveniles passively migrate with the current at night, downstream to the ocean, mostly in February through May. They may spend time in the estuary and become silvery with black-tipped fins before exiting the stream.

**Step-run:** A habitat that is turbulent like a riffle but has many hydraulic controls formed by larger cobbles and boulders to create slower, deeper pocket water as the stream's water surface stair-steps over the multiple hydraulic controls. Step-runs often have considerable escape cover in the form of surface turbulence and spaces under unembedded boulders.

**Streambank:** The portion of the stream channel cross section that restricts lateral movement of water at below bankfull flows. The streambank often has a gradient steeper than 45 degrees and exhibits a distinct break in slope from the stream bottom.

**Stream Gradient:** The slope or rate of change in vertical elevation of the water surface of a flowing stream per unit of horizontal distance.

**Stream Reach:** A relatively homogeneous section of a stream having a repetitious sequence of physical characteristics and habitat types, and it differs from adjacent reaches. Reach boundaries may be determined by changes in stream gradient that determine dominant particle size and habitat length, changes in streamflow and water temperature with the confluence of tributaries, changes in substrate composition associated with stream gradient and tributary sediment input, and changes in tree canopy (shade). As stream gradient lessens, pool length increases and pool to riffle ratios increase.

**Thalweg:** The line connecting the deepest points along a streambed (where the water depth is greatest). Most of the water volume with the fastest water velocity flows through the thalweg. Salmonids spawn in the thalweg of spawning glides.

**Tributary:** A smaller stream feeding, joining, confluencing with or flowing into a larger stream.

**Turbidity:** It is related to water clarity. It is a measure of the extent to which light passing through water is reduced due to suspended materials- can be suspended sediment or phytoplankton. Juvenile salmonids are visual feeders and require conditions of low turbidity to see their drifting prey.

**Undercut streambank:** A streambank with its base cut away by water scour action along man-made and natural overhangs in streams, such as those formed by rootmasses of riparian trees.

**Water Depth:** The vertical distance from the water surface to the streambed.

**Yearling steelhead:** Juvenile steelhead captured in the fall and hatched 2 springs previously.

**Young-of-the-year steelhead and coho salmon (YOY):** Juvenile steelhead and coho captured in the fall and hatched earlier in the spring

# D. RESULTS

## *i. Steelhead Abundance and Habitat Conditions in the San Lorenzo River Watershed*

**1.** WY2017 streamflows in spring-summer-fall were well above the median flow statistic, unlike 7 of the last 11 water years in which they were below (**Figure 1**). Six large storms and associated stormflows well above bankfull (9 stormflows 7,070−19,000 cubic feet per second (cfs)) came in December−February at the Felton Big Trees USGS Gage. Five below bankfull stormflows (below 2,000 cfs) came in March and April to maintain high baseflows during the important spring and early summer steelhead growth period. Thus, adult spawning migration was not likely impeded to headwater reaches. But many spawning redds made before March may have been destroyed or smothered with sediment by the 9 stormflows, 2− 6 times bankfull. Baseflow steadily declined from mid April onward, down to a minimum of 21 cfs in mid October at Big Trees Gage in Felton, with a much above average baseflow for the May−September period (**Figure 2**).

**2.** ***In the lower and middle mainstem in 2017***, rearing habitat quality improved from 2016 at all replicated sampling sites and habitat-typed Reach 2, due to increased baseflow (more food), increased depth and greater escape cover (**Tables 1−5 and 7**). In Reach 2, the channel split into 3 instead of the typical 2 channels after the abrupt Rincon bend and above the Rincon riffle, likely making the Rincon riffle more challenging to migrating adult steelhead than previously. The middle of the ½-mile habitat typed segment had one channel. But at the lower end of the segment, the channel split into 3 instead of the typical 2 channels. The main channel was habitat typed in these braided sections. Instream wood increased at upper San Lorenzo mainstem Site 12a, lower Zayante 13a, lower Bean Site 14a, upper Bean 14c-2 and lower Fall 15a. A major log jam had formed at Site 16 in Newell Creek, and logs piled up in a wood pool in upper Branciforte 21c. An alder had tipped over at upper mainstem Site 11 but not into the stream channel, offering some escape cover at its root ball.

**3.** Habitat quality improved in the ***upper mainstem and tributary steelhead sites/reaches*** in 2017 due to increased baseflow, pool depth and escape cover at nearly all sites (**Tables 1−7**). Exceptions were similar escape cover between 2016 and 2017 at the following sites; Site 10 in the upper mainstem below Kings Creek, upper Zayante 13i and lower Bean 14a.

**4.** ***Total and YOY densities in mainstem sites*** were above average at 6 of 11 sites, with some lower sites and all upper sites above average, indicating good spawning access (**Figures 3 and 4**). Middle mainstem sites had continued low densities, though juvenile densities increased in pool habitat at all mainstem sites except Site 0 in the leveed reach. Nine of 10 repeated mainstem sites had improved YOY densities in 2017 compared to 2016 (**Figure 5**).

**5.** ***Total and YOY densities in tributary sites*** were below average at 11 of 16 sites (**Figures 3 and 4**). Below average sites were 3 of 4 Zayante sites, 2 of 3 Bean Creek sites, 1 of 2 sites in Fall Creek both sites in Boulder Creek and both sites in Bear Creek. Both sites in Branciforte Creek had above average densities. Along with these, the uppermost sites in Zayante and Bean creeks had above average densities, indicating good spawning access. Newell Creek had average YOY density but below average total density due to much below YOY density in 2016 and resulting few yearlings in 2017 (**Figure 5**). Zayante site 13d below Mountain Charlie Gulch was much below average for total and YOY densities in 2017.

**6.** Two factors may explain the much below average YOY densities at the majority of sites. As in 2016, the main factor in 2017 may have been low adult returns. A second factor may have been poor egg survival in redds laid prior to the large January and February stormflows that may have scoured them out or covered them with sediment at all but tributary headwater sites. The higher YOY densities in the lower mainstem may have resulted from late spawners after March 1 and the high stormflows.

**7.** The 5-site, long term trend in average mainstem site ***total density*** increased from 2016 to 2017 (**Figure 6**). The 12-site mainstem average increased from 13 to 31 juveniles/100 ft in 2017. The 8-site, long term trend in average tributary site ***total density*** decreased from 2016 to 2017 due to the large decrease at Zayante 13d (**Figure 7**). The 16- site tributary average actually increased from 35 to 41 juveniles/100 ft in 2017.

**8.** ***Yearling densities*** were below average at 19 of 26 wetted sites after low recruitment from few YOY in 2016 and 5 moderate stormflow after March 1 along with high baseflows that may have encouraged out-migration. The only site that had a considerably above average yearling density was Mainstem SLR 12b (29.4 yearlings/100 ft). The 26-site average was 4.6 yearlings/100 ft in 2017 compared to 3.9 yearlings/100 ft in 2016.

**9.** Seventeen of 26 sites had above the multi-year average ***densities of Size Class II and III*** (=> 75 mm Standard Length) steelhead (**Figure 8**). Juveniles in these size classes are likely to smolt and out-migrate the following spring and will contribute most to adult returns. Four of the sites were less than 1 fish/ 100 ft greater than the multi-year average for those sites. Six sites had averages more than 5 fish/ 100 ft greater than the multi-year average for those sites. Those were Mainstem 1, 2, 10 and 12b, as well as Zayante 13c (highest in the watershed at 34.6 Size Class II/ 100 ft) and Boulder 17a. Four of the 9 below average sites were less than 1 fish/ 100 ft below the multi-year average for those sites, and Site Bean 14b had the average multi-year density. The sites that were most below their multi-year averages were Mainstem 8 and 9, Bear 18a and Branciforte 21c. Sites having below average smolt ratings were middle Mainstem Sites 6−8, Bean 14a and Bear 18a (**Table 2**). The causes for most sites with above average Size Class II and III densities, despite the majority having below average total and YOY densities, were that food supply was much increased with the higher baseflow while there were lower densities of YOY and yearlings at most sites, thus reducing competition and allowing a higher portion of YOY to reach Size Class II than in most years. This was especially the case at Mainstem 10, Zayante 13c and Boulder 17a. Mainstem Sites 1 and 2 had much above average Size Class II densities because they had high YOY densities in fastwater and heads of pools, which all reached Size Class II in 2017.

**10.** Regarding the ***trend in soon-to-smolt-densities***, the 5-site, long term mainstem San Lorenzo average increased from 3.7 in 2016 to 9.2 juveniles/ 100 ft in 2017 (**Figure 9**). The 8-site, long term San Lorenzo tributary average increased from 8.2 in 2016 to 14.5 juveniles/ 100 ft in 2017. A positive correlation was evident between average site densities of these larger juveniles and the 5-month baseflow average (**Figure 11**). A similar positive correlation was evident at 2 middle mainstem sites 6 and 8, though densities were much reduced from those in 1997 and 1998 (**Figure 12**). When baseflow was relatively high in the April to June growth period in tributaries, more YOY could reach Size Class II. This was evident in lower and middle Zayante Creek and middle Bean Creek in wetter years.

**11.** The increases in total, YOY and Size Class II/III densities from 2016 to 2017 in the San Lorenzo system were statistically significant, using the paired t-test for replicated sites.

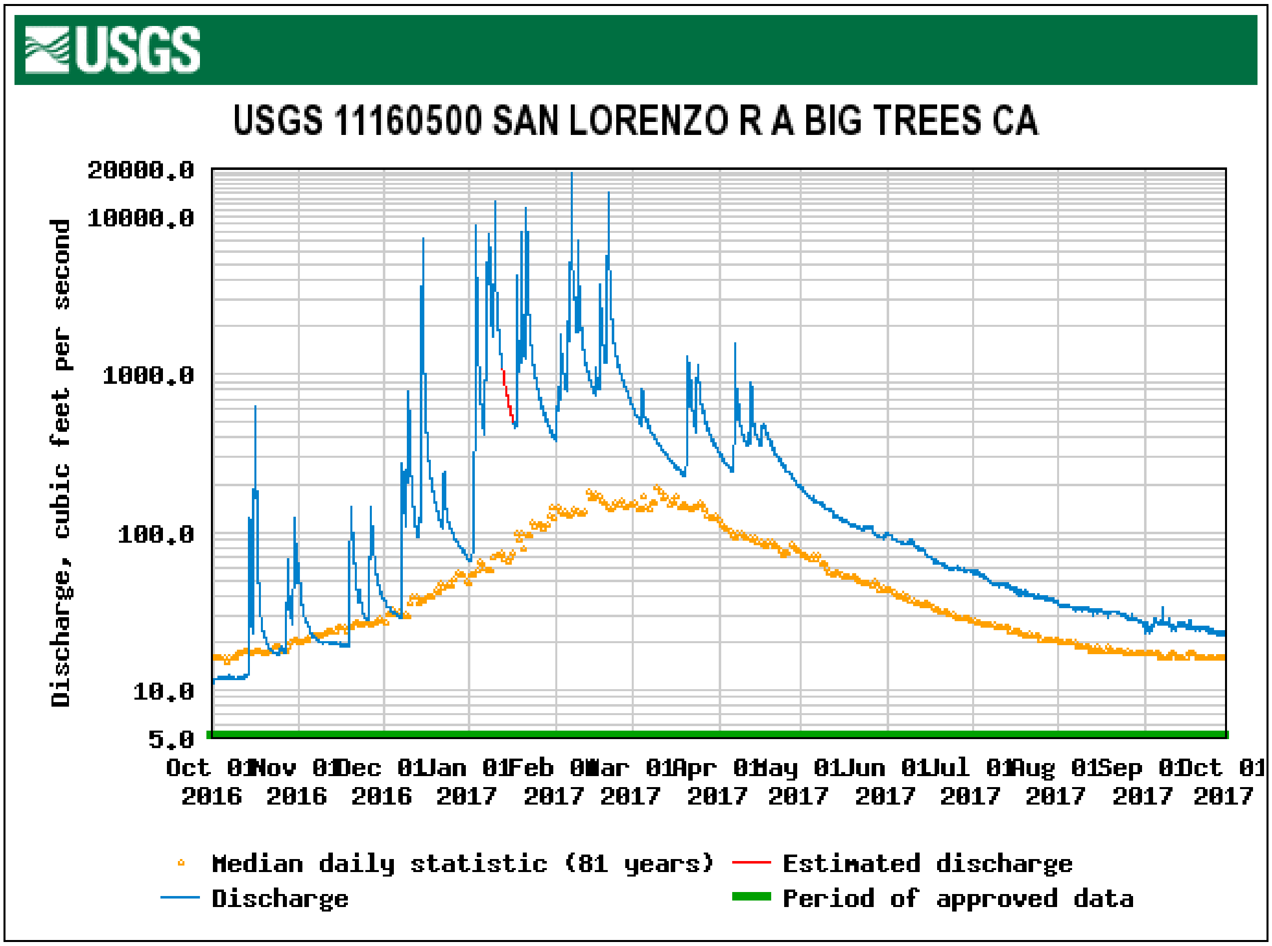


**Figure 1. The 2017 Discharge Flow of Record for the USGS Gage on the San Lorenzo River at Big Trees.**

**Table 1. Fall STREAMFLOW (cubic feet/ sec) measured at SAN LORENZO sampling sites before fall storms (or in 2011 when summer baseflow had resumed after early storm) by D.W. ALLEY & Associates.**

| Site # / Location | 1995 | 1996 | 1998 | 1999 | 2000 | 2001 | 2003 | 2004 | 2005 | 2006 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1- SLR/ Paradise Pk | 22.9 | 25.5 | 34.3 | 26.2 | 21.7 | 19.6 | | | | 26.2 | 18.7 | 27.6 | 17.2 | 12.9 | 8.0 | 7.81 | | 22.6 |
| 2- SLR/ Rincon | | | | 24.0 | 21.1 | 17.2 | | | | | | | | | | | | |
| 3-SLR Gorge | 23.3 | 20.5 | | | | | | | | | | | | | | | | |
| 4- SLR/Henry Cowell | 18.7 | | 32.7 | 23.3 | 21.8 | 15.5 | | | | 24.1 | | | | | | | | |
| 5- SLR/ Below Zay. | | | 31.9 | | | | | | | | | | | | | | | |
| 6- SLR/ Below Fall | 14.6 | | 23.4 | 12.8 | 11.6 | 9.4 | 10.6 | 8.8 | 18.9 | 14.3 | | | | | 3.7 | 3.25 | 6.99 | 12.9 |
| 7- SLR/ Ben Lomond | 5.8 | | | | 5.4 | 3.7 | 5.4 | 3.7 | 8.1 | | | | | | | | | |
| 8- SLR/ Below Clear | 4.2 | | 10.3 | 4.9 | 4.2 | 3.1 | 4.2 | 2.7 | 7.1 | 6.4 | 4.0 | | 2.8 | 1.7 | 0.95 | 1.11 | 2.35 | 4.71 |
| 9- SLR/ Below Bould. | 4.6 | | 7.2 | 3.5 | | 3.0 | 3.7 | 2.1 | 5.8 | | | | | | 0.80 | 0.88 | 1.82 | 4.02 |
| 10- SLR/ Below Kings | | | | 3.0 | 1.1 | 1.3 | 0.6 | 0.52 | 1.4 | | | | | | | | | |
| 11- SLR/ Teihl Rd | | | 1.7 | 0.8 | 0.8 | 0.4 | 0.9 | 0.63 | 1.5 | | 0.94 | 1.10 | 0.40 | 0.38 | 0.13 | 0.21 | | 1.07 |
| 12a-b SLR/ Lower Waterman | | | 1.0 | 0.7 | | | | | | | | | | 0.33 | 0.10 | 0.22 | | 0.85 |
| 13a/ Zayante below Bean | | | 8.5 | 6.3 | 5.2 | 4.7 | 5.4 | 5.1 | 7.4 | 7.8* | 4.9 | 7.2 | 4.4 | 3.9 | 3.2 | 2.9 | | 8.3 |
| 13b/ Zayante above Bean | | | 3.9 | 2.9 | 2.8 | 1.9 | 2.1 | 1.7 | 3.2 | 2.8 | | | | | | | | |
| 14b/Bean bel Lockhart G | 1.5 | | 1.1 | 1.1 | 1.0 | 1.1 | 1.1 | 0.77 | 1.0 | 1.1 | | | | | | 0.62 | | |
| 14c/Bean abv MacKenzie | | | | | | | | | | | 0.03 | 0.11 | Dry | Dry | Dry | Dry | Dry | 0.07 |
| 15a–b/ Fall | 2.0 Above Div. | | 3.4 Above Div. | 2.2 Above Div. | 1.7 Above Div. | 1.7 Above Div. | | | | | | | | | 1.0 below div. Bal. | 0.32 Below div. Bal. | 1.39 Below div. | 2.80 |
| 16/ Newell | 1.6 | | | | 0.51 | | | | | | 1.2 | 0.92 | 0.78 | 0.78 | 0.08 | 0.04 | | 1.05 |
| 17a/ Boulder | 2.0 | | 2.2 | | 1.1 | 1.0 | 1.25 | 0.9 | 1.6 | 1.7 | 1.6 | 2.2 | 1.1 | 1.1 | 0.76 (Balance | 0.66 (Balance | 1.39 (Balance | 1.76 |
| 18a/ Bear | | | | 0.45 | 0.61 | 0.34 | 0.6 | 0.51 | 0.90 | 1.1 | 0.68 | 1.3 | 0.23 | 0.16 | 0.03 | 0.02 | | 0.90 |
| 19a/ Lower Kings | | | 1.1 | 0.11 | 0.17 | 0.02 | | | | | | | | | | | | |
| 20a/ Lower Carbonera | 0.33 | 0.36 | | | | | | | | | | | | | | | | |
| 21a-2/ Branciforte | | | 0.80 | | | | | | | | 0.44 | 0.81 | 0.32 | 0.29 | | 0.13 | | |

***Streamflow in lower Zayante Creek done 3 weeks earlier in 2006 than usual and before other locations.**

**Table 2. 2017 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Average Smolt Size, with Physical Habitat Change since 2015.** (Red denotes ratings of 1−3 below average or negative habitat change; purple denotes ratings of 5−7. Methods for assessing ratings/habitat change are in earlier reports.

| Site | Multi-Year Avg. Potential Smolt Density Per 100 ft | 2017 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL | 2017 Numeric Smolt Rating (With Size Factored In) | 2017 Symbolic Rating (1 to 7) | Physical Habitat Change by Reach/Site Since 2016 |
|---|---|---|---|---|---|
| Low. San Lorenzo #0a | 8.5 | 7.6/ 160 mm | 4 | @@@@ | Site Positive |
| Low. San Lorenzo #1 | 7.4 | 14.0/ 106 mm | 5 | @@@@@ | Site Positive |
| Low. San Lorenzo #2 | 13.6 | 20.1/ 101 mm | 5 | @@@@@ | Reach Positive |
| Low. San Lorenzo #4 | 12.8 | 13.5/ 92 mm | 4 | @@@@ | Site Positive |
| Mid. San Lorenzo #6 | 3.8 | 3.9/ 82 mm | 1 | @ | Site Positive |
| Mid. San Lorenzo #8 | 5.3 | 3.9/ 90 mm | 2 | @@ | Site Positive |
| Mid. San Lorenzo #9 | 6.2 | 3.9/ 88 mm | 1 | @ | Site Positive |
| Up. San Lorenzo #10 | 5.7 | 13.1/ 92 mm | 4 | @@@@ | Site Positive |
| Up. San Lorenzo #11 | 6.2 | 10.5/ 98 mm | 4 | @@@@ | Site Positive |
| Up.San Loren #12a | 7.6 | 10.5/ 106 mm | 5 | @@@@@ | Site Positive |
| Up.San Loren #12b | 13.9 | 29.6/ 95 mm | 5 | @@@@@ | Site Positive |
| Zayante #13a | 9.2 | 11.6/ 89 mm | 4 | @@@@ | Site Positive |
| Zayante #13c | 16.3 | 34.6/ 90 mm | 6 | @@@@@@ | Site Positive |
| Zayante #13d | 16.2 | 16.9/ 99 mm | 5 | @@@@@ | Reach Positive |
| Zayante #13i | 7.2 | 6.7/ 105 mm | 4 | @@@@ | Site Positive |
| Bean #14a | 4.9 | 9.5/ 83 mm | 3 | @@@ | Site Positive |
| Bean #14b | 11.6 | 11.6/ 90 mm | 4 | @@@@ | Reach Positive |
| Bean #14c-2 | 6.3 | 5.4/ 112 mm | 4 | @@@@ | Site Positive |
| Fall #15a | 6.2 | 7.7/ 106 mm | 5 | @@@@@ | Site Positive |
| Fall #15b | 12.0 | 10.9/ 115 mm | 5 | @@@@@ | Site Positive |
| Newell #16 | 12.7 | 16.9/ 84 mm | 4 | @@@@ | Site Positive |
| Boulder #17a | 10.8 | 16.6/ 103 mm | 6 | @@@@@@ | Reach Positive |
| Boulder #17b | 10.3 | 9.2/ 100 mm | 4 | @@@@ | Site Positive |
| Bear #18a | 8.9 | 6.9/ 100 mm | 3 | @@@ | Site Positive |
| Bear #18b | 14.6 | 17.3/ 95 mm | 5 | @@@@@ | NA |
| Branciforte #21a-2 | 12.6 | 9.4/ 92 mm | 4 | @@@@ | Site Positive |
| Branciforte #21c | 8.1 | 4.8/ 124 mm | 4 | @@@@ | Site Positive |
| Soquel #1 | 3.5 | 2.9/ 126 mm | 3 | @@@ | Site Positive |
| Soquel #4 | 7.8 | 3.7/ 132 mm | 3 | @@@ | Reach Positive |
| Soquel #10 | 9.2 | 32.8/ 109 mm | 7 | @@@@@@@ | Site Positive |
| Soquel #12 | 7.9 | 11.1/ 134 mm | 5 | @@@@@ | Site Positive |
| East Branch Soquel #13a | 10.1 | 3.6/ 142 mm | 3 | @@@ | Site Positive |
| East Branch Soquel #16 | 10.0 | 27.0/ 90 mm | 5 | @@@@@ | Reach Positive |
| West Branch Soquel #19 | 6.2 | 12.3/ 104 mm | 5 | @@@@@ | Site Positive |
| West Branch Soquel #21 | 10.0 | 19.7/ 93 mm | 5 | @@@@@ | Site Positive |
| Aptos #3 | 8.7 | 11.0/ 92 mm | 4 | @@@@ | Site Positive |
| Aptos #4 | 9.8 | 23.4/ 88 mm | 4 | @@@@ | Site Positive |
| Valencia #2 | 9.0 | 4.4/ 102 mm | 3 | @@@ | Site Positive |
| Valencia #3 | 11.5 | 13.6/ 92 mm | 4 | @@@@ | Site Positive |
| Corralitos #0 | 17.4 | 29.5/ 97 mm | 5 | @@@@@ | NA |
| Corralitos #1 | 8.7 | 10.1/ 101 mm | 4 | @@@@ | Reach Positive |
| Corralitos #3 | 10.5 | 14.0/ 106 mm | 5 | @@@@@ | Site Positive |
| Corralitos #8 | 10.2 | 15.7/ 108 mm | 5 | @@@@@ | Site Positive |

| Site | Multi-Year Avg. Potential Smolt Density Per 100 ft | 2017 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL | 2017 Numeric Smolt Rating (With Size Factored In) | 2017 Symbolic Rating (1 to 7) | Physical Habitat Change by Reach/Site Since 2016 |
|---|---|---|---|---|---|
| Corralitos #9 | 15.9 | 22.7/ 102 mm | 6 | @@@@@@ | Site Positive |
| Shinglemill #1 | 9.4 | 8.1/ 104 mm | 5 | @@@@@ | Site Positive |
| Shinglemill #3 | 4.9 | 4.0/ 139 mm | 4 | @@@@ | Site Positive |
| Browns #1 | 13.7 | 9.1/ 114 mm | 5 | @@@@@ | Site Positive |
| Browns #2 | 11.4 | 6.0/ 108 mm | 4 | @@@@ | Site Positive |
| Casserly #3 | 4.6 | 6.66/ 115 mm | 4 | @@@@ | Site Positive |

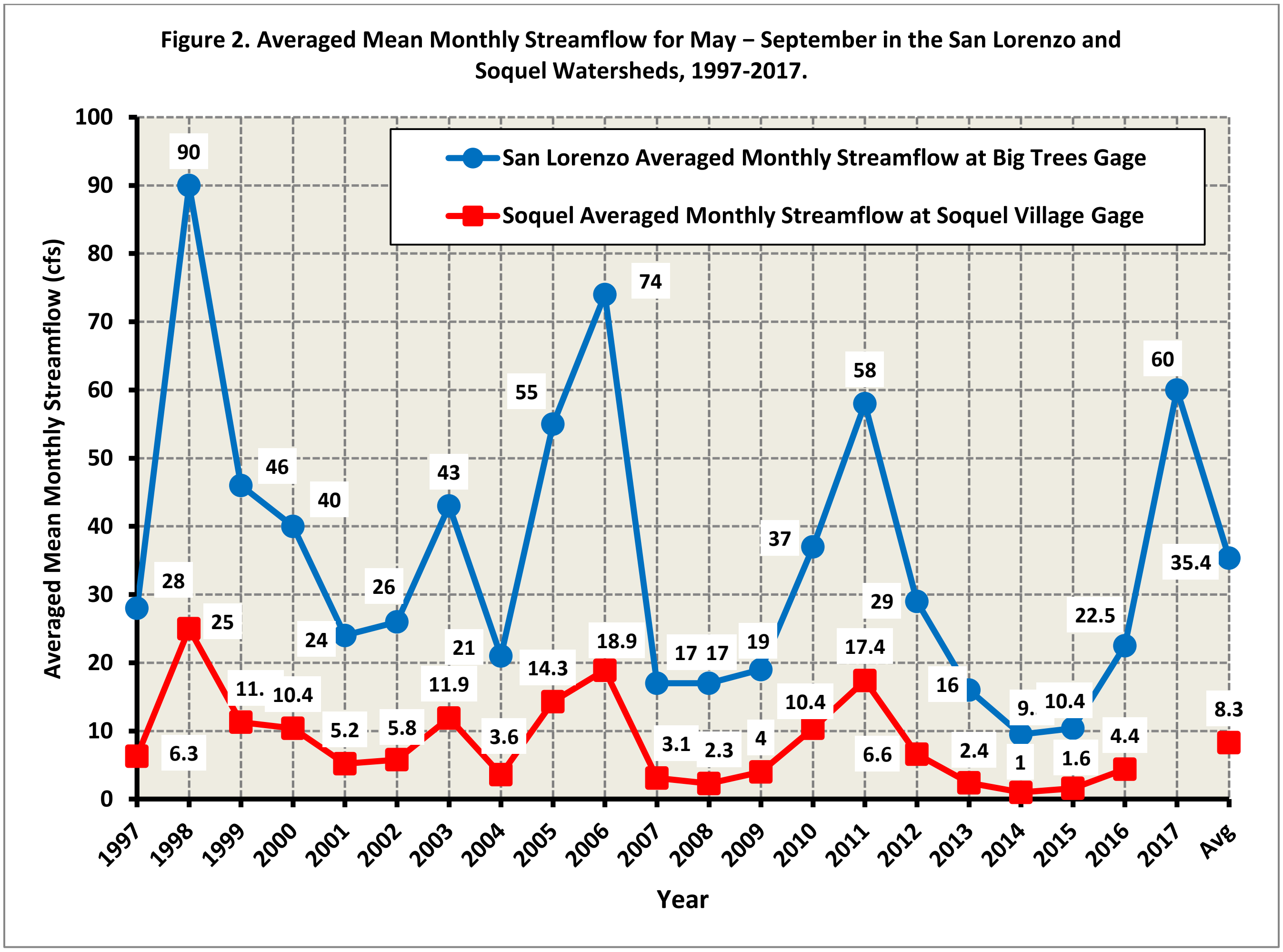


**Figure 2. Averaged Mean Monthly Streamflow for May−September in the San Lorenzo and Soquel Watersheds, 1997-2017.**

## Table 3. Averaged Mean and Maximum WATER DEPTH in SAN LORENZO Reaches Since 2011.

| Reach | Pool 2017 | Pool 2011 | Pool 2012 | Pool 2013 | Pool 2014 | Pool 2015 | Pool 2016 | Riffle 2017 | Riffle 2011 | Riffle 2012 | Riffle 2013 | Riffle 2014 | Riffle 2015 | Riffle 2016 | Run/ Step Run 2017 | Run/ Step Run 2011 | Run/ Step Run 2012 | Run/ Step Run 2013 | Run/Step Run 2014 | Run/ Step Run 2015 | Run/ Step Run 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1- L. Main | | | | | 1.9/ 3.1 | | | | | | | 0.6/ 0.9 | | | | | | | 0/9 1.4 | | |
| 2- L. Main | 3.1/ 4.8 | 2.9/ 5.4 Seg.Δ | 2.5/ 5.0 | 2.6/ 4.6 | 2.2/ 3.9 | 2.2/ 3.8 | 2.4/ 4.6 | 1.0/ 1.5 | 1.1/ 1.7 Seg.Δ | 1.1/ 1.7 | 0.9/ 1.5 | 0.8/ 1.3 | 0.7/ 1.2 | 0.9/ 1.4 | 1.7/ 2.4 | 1.6/ 2.5 Seg.Δ | 1.6/ 2.3 | 1.5/ 2.4 | 1.3/ 1.95 | 1.1/ 1.9 | 1.6/ 2.0 |
| 3- L. Main | | | | | | | | | | | | | | | | | | | | | |
| 4- L. Main | | | | | | 1.9/ 3.5 | | | | | | | 0.45/ 0.8 | | | | | | | 0.9/ 1.45 | |
| 5- L. Main | | | | | | | | | | | | | | | | | | | | | |
| 6- M. Main | | | | | | | | | | | | | | | | | | | | | |
| 7- M. Main | | | | | | | | | | | | | | | | | | | | | |
| 8- M. Main | | | | | 2.4/ 4.0 | | | | | | | 0.4/ 0.7 | | | | | | | 0.6/ 1.0 | | |
| 9- M. Main | 2.6/ 4.8 | | | 1.8/ 3.5 | | | | 0.8/ 1.2 | | | 0.4/ 0.7 | | | | 1.0/ 1.3 | | | 0.5/ 0.9 | | | |
| 10- U. Main | | | | | 1.2/ 2.4 | | | | | | | 0.1/ 0.3 | | | | | | | 0.2/ 0.3 | | |
| 11- U. Main | | | 1.1/ 2.0 | | | | 1.1/ 1.9 | | | 0.3/ 0.5 | | | | 0.3/ 0.5 | | | 0.5/ 0.7 | | | | 0.45/ 0.7 |
| 12- U. Main | | | | | | 1.05/ 1.7 | | | | | | | 0.3/ 0.6 | | | | | | | 0.4/ 0.7 | |
| 12b- U. Main | | | 1.1/ 1.9 | | | | | | | 0.3/ 0.7 | | | | | | | 0.5/ 0.8 | | | | |
| Zayante 13a | | | | | | | 1.3/ 2.3 | | | | | | | 0.4/ 0.7 | | | | | | | 0.6/ 0.9 |
| Zayante 13c | | 1.5/ 2.4 | | | | 1.3/ 2.2 | | | 0.5/ 0.8 | | | | 0.2/ 0.4 | | | 0.7/ 1.1 | | | | 0.35/ 0.6 | |
| Zayante 13d | 1.3/ 2.1 | 1.3/ 2.0 | 1.1/ 1.8 | 1.0/ 1.6 | 0.8/ 1.4 | 0.8/ 1.5 | 1.0/ 1.75 | 0.7/ 1.2 | 0.45/ 0.8 | 0.3/ 0.6 | 0.3/ 0.5 | 0.2/ 0.35 | 0.15/ 0.3 | 0.2/ 0.7 | 0.8/ 1.3 | 0.8/ 1.2 | 0.6/ 1.0 | 0.5/ 0.9 | 0.3/ 0.5 | 0.4/ 0.8 | 0.4/ 0.9 |
| Lom- pico 13e | | | | | | | | | | | | | | | | | | | | | |
| Zayante 13i | | | | | | 1.15/ 1.9 | | | | | | | 0.2/ 0.4 | | | | | | | 0.3/ 0.5 | |
| Bean 14a | | | | | | 1.2/ 2.0 | | | | | | | 0.4/ 0.6 | | | | | | | 0.5/ 0.8 | |
| Bean 14b | 1.3/ 2.4 | 1.2/ 2.0 | 1.2/ 2.1 | 1.0/ 1.9 | 0.9/ 1.5 | 1.0/ 1.8 | 1.0/ 1.85 | 0.4/ 0.6 | 0.3/ 0.6 | 0.3/ 0.5 | 0.3/ 0.5 | 0.3/ 0.5 | 0.25/ 0.5 | 0.2/ 0.4 | 0.55/ 1.0 | 0.5/ 0.8 | 0.4/ 0.9 | 0.4/ 0.7 | 0.4/ 0.6 | 0.35 0.6 | 0.4/ 0.8 |
| Bean 14c-2 | | 1.0/ 1.8 | | | | | 1.2/ 2.1 Seg. Δ | | 0.2/ 0.4 | | | | | None | | 0.3/ 0.5 | | | | | 0.2/ 0.4 |

| Reach | Pool 2017 | Pool 2011 | Pool 2012 | Pool 2013 | Pool 2014 | Pool 2015 | Pool 2016 | Riffle 2017 | Riffle 2011 | Riffle 2012 | Riffle 2013 | Riffle 2014 | Riffle 2015 | Riffle 2016 | Run/ Step Run 2017 | Run/ Step Run 2011 | Run/ Step Run 2012 | Run/ Step Run 2013 | Run/Step Run 2014 | Run/ step Run 2015 | Run/ step Run 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fall 15a | | | | | 0.7/ 1.1 | | | | | | | 0.3/ 0.6 | | | | | | | 0.4/ 0.8 | | |
| Fall 15b | | 1.3/ 1.9 | | | 0.8/ 1.2 | | | | 0.6/ 1.05 | | | 0.3/ 0.6 | | | | 0.8/ 1.25 | | | 0.5/ 0.7 | | |
| Newell 16 | | 1.4/ 2.3 | | | | | | | 0.3/ 0.5 | | | | | | | 0.5/ 0.8 | | | | | |
| Boulder 17a | | | | 1.4/ 2.4 | | | 1.6/ 2.55 | | | | 0.4/ 0.7 | | | 0.5/ 0.8 | | | | 0.6/ 1.0 | | | 0.7/ 1.1 |
| Boulder 17b | | | | 1.4/ 2.4 | | | | | | | 0.4/ 0.8 | | | | | | | 0.55/ 1.0 | | | |
| Boulder 17c | | | | | | | | | | | | | | | | | | | | | |
| Bear 18a | | | 1.4/ 2.2 | | | | | | | 0.2/ 0/4 | | | | | | | 0.4/ 0.7 | | | | |
| Bear 18b | 1.8/ 3.1 | | | | | | | 0.6/ 1.1 | | | | | | | 0.8/ 1.4 | | | | | | |
| Branciforte 21a-1 | | | | | | | | | | | | | | | | | | | | | |
| Branciforte 21a-2 | | | | | 0.95 / 1.6 | | | | | | | 0.25 / 0.5 | | | | | | | 0.5/ 0.7 | | |
| Branciforte 21b | | | 1.1/ 1.9 | 1.2/ 2.0 | | | 1.1/ 1.8 | | | 0.2/ 0.45 | 0.3/ 0.5 | | | 0.3/ 0.5 | | | 0.4/ 0.8 | 0.4/ 0.7 | | | 0.5/ 0.7 |

**Table 4. Averaged Mean and Maximum WATER DEPTH (ft) at REPLICATED San Lorenzo Sampling Sites Since 2011.**

| Site | Pool 2017 | Pool 2011 | Pool 2012 | Pool 2013 | Pool 2014 | Pool 2015 | Pool 2016 | Riffle 2017 | Riffle 2011 | Riffle 2012 | Riffle 2013 | Riffle 2014 | Riffle 2015 | Riffle 2016 | Run/ Step Run 2017 | Run/ Step Run 2011 | Run/Step Run 2012 | Run/Step Run 2013 | Run/Step Run 2014 | Run/Step Run 2015 | Run/Step Run 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0a | 1.7/ 2.9 | 1.6/ 2.0 | 1.3/ 2.5 | 2.2/ 3.5 | 1.2/ 1.9 | 0.9/ 1.4 | 1.4/ 2.4 | 0.55/ 1.0 | 1.1/ 1.8 | 0.6/ 0.9 | | | 0.7/ 1.5 | 0.7/ 1.5 | 0.6/ 1.4 | 1.0/ 1.8 | – | 1.8/ 3.0 | 0.6/ 1.2 | 1.0/ 1.5 | 1.0/ 1.7 |
| 1 | | | | | | | | 0.9/ 1.5 | 1.15/ 1.6 | 0.9/ 1.5 | 0.9/ 1.4 | 0.5/ 0.9 | 0.7/ 1.0 | 0.8/ 1.0 | 1.4/ 1.9 | 1.6/ 2.1 | 1.1/ 1.7 | 1.3/ 1.9 | 1.0/ 1.5 | 1.0/ 1.5 | 1.1/ 1.8 |
| 2 | | | | | | | | 1.5/ 1.9 | 1.3/ 1.5 | 1.1/ 1.5 | 1.0/ 1.8 | 0.9/ 1.4 | 0.85/ 1.1 | 1.0/ 1.5 | 2.0/ 2.5 | 1.7/ 2.95 | 1.9/ 2.6 | 1.9/ 2.5 | 1.5/ 2.2 | 1.4/ 2.2 | 1.6/ 2.0 |
| 4 | | | | | | | | 0.9/ 1.2 (Site Δ) | 0.85/ 1.1 | 0.6/ 1.0 | 0.6/ 0.9 | 0.5/ 0.7 | 0.6/ 1.0 | 0.5/ 1.5 (Site Δ) | 1.7/ 2.4 (Site Δ) | 1.55/ 2.0 | 1.2/ 1.65 | 1.3/ 1.6 | 1.05/ 1.45 | 1.0/ 1.4 | 1.9/ 2.8 (Site Δ) |
| 6 | | | | | | | | 0.75/ 0.9 | 0.65/ 1.0 | 0.6/ 1.05 | 0.5/ 0.9 | 0.4/ 0.6 | 0.35/ 0.8 | 0.6/ 0.9 | 1.15/ 1.5 | 0.7/ 1.2 | 0.7/ 1.1 | 0.75/ 1.05 | 0.5/ 0.9 | 0.6/ 1.6 | 0.5/ 1.5 |
| 8 | | | | | | | | 0.95/ 1.1 | 0.9/ 1.2 | 0.7/ 1.1 | 0.6/ 1.1 | 0.6/ 0.8 | 0.55/ 1.0 | 0.75/ 1.05 | 1.1/ 1.4 | 1.0/ 1.3 | 0.8/ 1.2 | 0.8/ 1.0 | 0.65/ 1.0 | 0.65/ 1.0 | 0.75/ 1.0 |
| 9 | | | | | | | | 0.75/ 1.05 | | | 0.4/ 0.7 | 0.4/ 0.85 | 0.45/ 0.75 | 0.6/ 1.0 | 1.0/ 1.3 | | | 0.6/ 1.0 | 0.5/ 0.7 | 0.6/ 0.9 | 0.8/ 1.0 |
| 10 | 1.8/ 2.8 | | | | 1.3/ 2.5 | 1.0/ 2.4 | 1.2/ 2.6 | 0.6/ 1.1 | | | | 0.1/ 0.15 | 0.1/ 0.2 | 0.25/ 0.4 | 0.9/ 1.4 | | | | 0.3/ 0.5 | 0.4/ 0.8 | 0.5/ 0.9 |
| 11 | 1.1/ 1.9 | 0.9/ 1.5 | 1.2/ 1.75 | 1.05 / 1.7 | 1.1/ 1.85 | 1.05 / 1.55 | 1.4/ 2.6 Δ Site | 0.4/ 0.6 | 0.3/ 0.45 | 0.45/ 0.6 | 0.4/ 0.7 | 0.15/ 0.4 | 0.15/ 0.4 | 0.4/ 0.6 Δ Site | 0.8/ 1.4 | 0.6/ 1.1 | 0.4/ 0.5 | 0.3/ 0.5 | 0.2/ 0.5 | 0.25/ 0.4 | 0.6/ 1.0 Δ Site |
| 12a | 1.2/ 2.3 | | | | | 1.1/ 1.8 | 0.8/ 1.3 | 0.4/ 0.6 | | | | | 0.4/ 0.55 | 0.3/ 0.6 | 0.8/ 1.4 | | | | | 0.4/ 0.6 | 0.6/ 0.9 |
| 12b | 1.2/ 2.25 | | 1.05/ 2.0 | 0.95 / 1.4 | 0.9/ 1.8 | | | 0.55/ 0.9 | | 0.45/ 0.8 | 0.5/ 0.8 | 0.3/ 0.6 | | | 0.65/ 1.4 | | 0.55/ 0.9 | 0.5/ 0.9 | 0.5/ 0.95 | | |
| Zayante 13a | 2.05/ 3.75 | 1.8/ 3.8 | 1.9/ 3.7 | 1.7/ 3.0 | 1.4/ 2.9 | 1.3/ 2.4 | 1.4/ 3.1 Δ Site | 0.5/ 0.9 | 0.5/ 0.8 | 0.4/ 0.7 | 0.6/ 1.0 | 0.35/ 0.6 | 0.3/ 0.5 | 0.3/ 0.5 Δ Site | 1.0/ 1.5 | 0.9/ 1.5 | 0.7/ 1.05 | 0.8/ 1.2 | 0.75/ 1.1 | 0.7/ 1.4 | 0.6/ 0.9 Δ Site |
| Zayante 13c | 1.4/ 2.4 | 1.1/ 1.85 | 1.1/ 1.75 | 1.05 / 1.85 | 0.95/ 1.75 | 1.0/ 1.85 | 1.1/ 2.05 | 0.3/ 0.9 | 0.6/ 0.9 | 0.3/ 0.7 | 0.3/ 0.5 | 0.2/ 0.5 | 0.15/ 0.4 | 0.25/ 0.8 | 0.5/ 1.1 | 0.7/ 0.95 | 0.5/ 0.75 | 0.55/ 0.85 | 0.4/ 0.5 | 0.4/ 0.5 | 0.5/ 0.9 |
| Zayante 13d | 1.15/ 2.3 Δ Site | | 1.1/ 1.95 | 0.8/ 1.2 Δ Site | 0.7/ 1.45 Δ Site | 065/ 1.0 | 0.8/ 2.0 Δ Site | 0.8/ 1.35 Δ Site | | | | | 0.2/ 0.4 | | 0.8/ 1.5 Δ Site | | 0.75/ 1.0 | 0.3/ 0.5 | 0.3/ 0.5 | 0.45/ 0.7 | 0.5/ 0.9 Δ Site |

| Site | Pool 2017 | Pool 2011 | Pool 2012 | Pool 2013 | Pool 2014 | Pool 2015 | Pool 2016 | Riffle 2017 | Riffle 2011 | Riffle 2012 | Riffle 2013 | Riffle 2014 | Riffle 2015 | Riffle 2016 | Run/ Step Run 2017 | Run/ Step Run 2011 | Run/ Step Run 2012 | Run/ Step Run 2013 | Run/ Step Run 2014 | Run/ Step Run 2015 | Run/ Step Run 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zayante 13i | 1.7/ 2.6 | | | | | 1.4/ 2.2 | 1.2/ 2.2 | 0.25/ 0.6 | | | | | 0.1/ 0.2 | 0.2/ 0.4 | 0.4/ 0.7 | | | | | 0.3/ 0.65 | 0.3/ 0.5 |
| Bean 14a | 1.2/ 3.2 | | | | | 0.8/ 1.7 | 0.8/ 1.8 | 0.5/ 0.9 | | | | | 0.5/ 0.7 | 0.4/ 0.75 | 0.7/ 1.0 | | | | | 0.5/ 0.8 | 0.7/ 1.0 |
| Bean 14b | 1.5/ 3.1 | 1.4/ 2.4 | 1.3/ 2.05 | 1.1/ 2.5 | 1.1/ 2.0 | 1.1/ 2.0 Δ Site | 1.0/ 2.5 | 0.25/ 0.4 | 0.5/ 0.7 | 0.35/ 0.6 | 0.1/ 0.2 | 0.15/ 0.2 | 0.15/ 0.3 | 0.2/ 0.5 | 0.5/ 0.8 | 0.5/ 0.7 | 0.5/ 0.8 | 0.5/ 0.7 | 0.4/ 0.5 | 0.3/ 0.7 | 0.4/ 0.9 |
| Bean 14c | 1.6/ 2.7 | 0.8/ 1.65 | 0.8/ 1.45 dry | Dry | Dry | Dry | 1.3/ 2.4 Δ Seg | 0.15/ 0.2 | 0.2/ 0.3 | 0.1/ 0.2 dry | Dry | Dry | Dry | None Δ Seg | 0.3/ 0.5 | 0.3/ 0.5 | 0.25/ 0.35 dry | Dry | Dry | Dry | 0.1/ 0.2 Δ Site |
| Fall 15a | 1.2/ 1.8 | | | | 0.7/ 0.95 | 0.7/ 1.2 | 0.8/ 1.35 | 0.6/ 1.5 | | | | 0.25/ 0.5 | 0.25/ 0.5 | 0.4/ 0.8 | 0.75/ 1.6 | | | | 0.45/ 0.8 | 0.65/ 0.9 | 0.5/ 0.8 |
| Fall 15b | 1.3/ 2.05 | 1.1/ 1.85 | 1.15/ 1.65 | 0.8/ 1.3 | 0.9/ 1.2 Δ Site | 0.75 / 1.05 | 0.95/ 1.35 | 0.6/ 1.0 | 0.7/ 1.4 | 0.45/ 0.8 | 0.3/ 0.6 | 0.35/ 0.55 | 0.3/ 0.6 | 0.4/ 0.9 | 0.9/ 1.1 | 0.9/ 1.4 | 0.6/ 1.1 | 0.45/ 0.8 | 0.4/ 0.5 | 0.4/ 0.6 | 0.45/ 0.8 |
| Newell 16 | 1.55/ 2.35 | 1.15/ 1.85 | 1.05/ 1.8 | 1.2/ 2.1 | 0.95/ 1.75 | 0.9/ 1.45 | 1.05/ 1.55 | 0.35/ 0.6 | 0.4/ 0.5 | 0.35/ 0.45 | 0.4/ 0.7 | 0.03/ 0.1 | 0.15/0.4 | 0.2/ 0.4 | 0.65/ 0.9 | 0.4/ 0.6 | 0.3/ 0.5 | 0.4/ 0.55 | 0.2/ 0.5 | 0.2/ 0.45 | 0.35/ 0.6 |
| Boulder 17a | 2.6/ 3.75 | 1.4/ 1.95 | 1.2/ 1.8 | 1.05 / 1.8 | 1.0/ 1.75 | 1.1/ 1.85 | 2.05/ 3.4 Δ Site | 0.65/ 0.9 | – | 0.5/ 1.0 | 0.5/ 0.7 | 0.35/ 0.6 | 0.35/ 0.6 | 0.5/ 0.7 Δ Site | 0.75/ 1.1 | 1.1/ 1.4 | 0.8/ 1.2 | 0.85/ 1.0 | 0.7/ 1.0 | 0.7/ 1.0 | 0.8/ 1.0 Δ Site |
| Boulder 17b | 1.2/ 2.05 | 1.2/ 1.85 | 1.3/ 1.9 | 1.05 / 1.85 Δ Site | 1.15/ 1.75 | 1.05 / 1.9 | 1.15/ 1.9 | 0.55/ 0.9 | 0.7/ 1.2 | 0.65/ 1.1 | 0.5/ 0.6 | 0.3/ 0.6 | 0.4/ 0.7 | 0.8/ 1.0 | | 0.8/ 1.4 | 0.6/ 1.2 | 0.4/ 0.85 | 0.4/ 0.7 | 0.45/ 0.7 | 0.4/ 1.0 |
| Bear 18a | 1.75/ 2.85 | 1.4/ 2.2 | 1.1/ 1.85 | 1.3/ 2.3 | 1.2/ 1.95 | 1.2/ 2.4 | 1.2/ 2.45 | 0.55/ 0.9 | 0.3/ 0.6 | 0.3/ 0.6 | 0.3/ 0.5 | 0.2/ 0.4 | 0.2/ 0.4 | 0.4/ 0.5 | 0.7/ 1.3 | 0.65/ 1.0 | 0.45/ 0.9 | 0.4/ 0.6 | 0.35/ 0.6 | 0.3/ 0.6 | 0.4/ 0.9 |
| Bear 18b | 1.45/ 2.65 | | | | | | | 0.7/ 1.1 | | | | | | | 0.65/ 1.0 | | | | | | |
| Branci 21a-2 | 0.9/ 1.45 | 1.0/ 2.0 | 1.2/ 1.9 | 0.8/ 1.65 | 1.15/ 1.45 Δ Site | | | 0.4/ 0.7 | 0.25/ 0.5 | 0.1/ 0.3 | 0.1/ 0.3 | 0.35/ 0.5 | | | 0.6/ 1.0 | 0.35/ 0.6 | 0.4/ 0.6 | 0.35/ 0.6 | 0.5/ 0.7 | | |
| Branci 21b | | | 1.2/ 1.95 | 1.05 / 1.75 Δ site | 1.05/ 1.65 | 0.9/ 1.65 | 1.1/ 1.6 | | | 0.3/ 0.6 | 0.4/ 0.6 | 0.2/ 0.4 | 0.25/ 0.5 | 0.4/ 0.6 | 0.45/ 0.7 | | 0.5/ 0.85 | 0.5/ 0.7 | 0.5/ 0.8 | 0.4/ 0.7 | 0.6/ 0.85 |
| Branci 21c | 1.8/ 2.8 | | | 1.2/ 2.35 | 1.4/ 2.5 | 1.45 / 2.4 | 1.4/ 2.55 | 0.3/ 0.4 | | | 0.1/ 0.15 | 0.05/ 0.1 | 0.1/ 0.2 | 0.1/ 0.2 | 0.45/ 0.7 | | | 0.3/ 0.4 | 0.2/ 0.4 | 0.15/ 0.3 | 0.25/ 0.45 |

**Table 5. ESCAPE COVER Indices (Habitat Typing Method*) in RIFFLE AND RUN HABITAT at MAINSTEM SAN LORENZO SAMPLING SITES Since 2009.**

| Sampling Site | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|
| Santa Cruz Levees 0a | 0.211 | 0.298 | 0.205 | 0.403 | 2.000 Floating veg. | 0.182 | 0.247 | 0.178 | 0.396 Floating veg. |
| Paradise Park 1 | 0.155 | 0.183 | 0.128 | 0.106 | 0.045 | 0.073 | 0.150 | 0.152 | 0.216 |
| Rincon 2 | | | 0.129 | 0.117 | 0.100 | 0.141 | 0.200 | 0.115 | 0.210 |
| Henry Cowell 4 | 0.537 | 0.479 | 0.374 | 0.308 | 0.307 | 0.320 | 0.379 | 0.230 Site ∆ | 0.295 Site ∆ |
| Below Fall Creek 6 | 0.113 | 0.230 | 0.109 | 0.088 | 0.183 | 0.141 | 0.223 | 0.059 | 0.093 |
| Below Clear Creek 8 | 0.082 | 0.194 | 0.154 | 0.163 | 0.148 | 0.054 | 0.104 | 0.122 | 0.142 |
| Below Boulder Creek 9 | 0.133 (2005) | | | | 0.035 | 0.060 | 0.122 | 0.106 | 0.018 |
| Below Kings Creek 10 | | | | | | 0 | 0.053 | 0.020 | 0.075 |
| Above Kings Creek Near Teihl Rd 11 | 0.0 | 0.024 | 0.036 | − | 0.041 | 0 | 0.020 | 0.080 Site ∆ | 0.167 |
| Waterman Gap 12b | | | | 0.000 | 0.031 | 0.038 | 0.008 (Site 12a) | 0.031 (Site 12a) | 0.093 |

***Habitat Typing Method = linear feet of escape cover divided by habitat typed channel length as riffle/ run habitat in reach segment.**

**Table 6. POOL ESCAPE COVER Indices (Habitat Typing Method*) at Replicated San Lorenzo Tributary Sites Since 2009, Including the Mainstem Below Kings Creek, Teihl and Waterman Gap Sites.**

| Site | Pool Escape Cover 2009 | Pool Escape Cover 2010 | Pool Escape Cover 2011 | Pool Escape Cover 2012 | Pool Escape Cover 2013 | Pool Escape Cover 2014 | Pool Escape Cover 2015 | Pool Escape Cover 2016 | Pool Escape Cover 2017 |
|---|---|---|---|---|---|---|---|---|---|
| Mainstem below Kings Cr. 10 | | | | | | 0.026 | 0.102 | 0.119 | 0.115 |
| Mainstem @ Teihl 11 | 0.058* | 0.094 | 0.033 | 0.039 | 0.081 | 0.085 | 0.120 | 0.051 Site Δ | 0.138 |
| Mainstem @ Waterman G 12a | | | | | | | 0.220 | 0.220 | 0.281 |
| Mainstem @ Waterman G 12b | | | | 0.091 | 0.124 | 0.155 | | | 0.215 |
| Zayante 13a | 0.140 | 0.103 | 0.167 | 0.222 | 0.122 | 0.060 | 0.379 | 0.116 Site Δ | 0.134 |
| Zayante 13c | | | 0.120 | 0.178 | 0.164 | 0.186 | 0.212 | 0.265 | 0.099 |
| Zayante 13d | 0.285 | 0.113 | 0.168 | 0.135 Site Δ | 0.135 Site Δ | 0.073 Site Δ | 0.096 | 0.113 Site Δ | 0.194 Site Δ |
| Zayante 13i | | | | | | | 0.223 | 0.126 | 0.117 |
| Bean 14a | | | | | | | 0.192 | 0.219 | 0.221 |
| Bean 14b | 0.145 | 0.120 | 0.165 | 0.175 | 0.137 | 0.181 | 0.424 Site Δ | 0.129 Site Δ | 0.182 |
| Bean 14c | | | 0.098 | 0.094 | Dry | Dry | Dry | 0.177 Seg Δ | 0.256 |
| Fall 15a | | | | | | 0.170 | 0.220 | 0.115 | 0.182 |
| Fall 15b | 0.302 | 0.571 | 0.429 | 0.500 | 0.357 | 0.174 Site Δ | 0.491 | 0.417 | 0.660 |
| Newell 16 | 0.150 | 0.118 | 0.101 | 0.154 | 0.142 | 0.033 | 0.037 | 0.073 | 0.381 |
| Boulder 17a | 0.066 | 0.094 | 0.110 | 0.092 | 0.060 | 0.041 | 0.096 | 0.071 Site Δ | 0.112 |
| Boulder 17b | 0.356 | 0.266 | 0.258 | 0.461 | 0.088 Site Δ | 0.138 | 0.109 | 0.087 | 0.163 |
| Bear 18a | | 0.138 | 0.101 | 0.050 Site Δ | 0.068 | 0.034 | 0.056 | 0.012 | 0.096 |
| Bear 18b | | | | | | | | | 0.085 |
| Branciforte 21a-2 | 0.051 | 0.068 | 0.040 | 0.107 | 0.070 | 0.173 Site Δ | | | 0.214 |
| Branciforte 21b | | | | 0.158 | 0.184 Site Δ | 0.254 | 0.225 | 0.209 | |
| Branciforte 21c | | | | | 0.252 | 0.286 | 0.280 | 0.235 | 0.387 |

***Habitat Typing Method = linear ft of escape cover divided by length of pool habitat sampled at site.**

**Table 7. Habitat Change in the SAN LORENZO MAINSTEM AND TRIBUTARIES from 2016 to 2017, Based on Reach Data Where Available and Site Data, Otherwise.**

| Reach Comparison or (Site Only) | Baseflow Avg. May-September (Most Important Parameter) | Pool Depth / Fastwater Habitat Depth in Mainstem below Boulder Cr. | Fine Sediment Pool/ Fastwater | Embed-dedness Pool/ Fastwater | Pool Escape Cover/ Fastwater Habitat Cover in Mainstem below Boulder Creek | Overall Habitat Change |
|---|---|---|---|---|---|---|
| (Mainstem 0a) | + | + / + | Similar / + | Similar | + / + | + |
| (Mainstem 1) | + | / + | / Similar | / − run | / + | + |
| Mainstem 2 | + | + / + | − / Similar | Similar/ Similar | + / + | + |
| (Mainstem 4) | + | / − | / − run | / Similar | / + | + |
| (Mainstem 6) | + | / + | / − | / + | / + | + |
| (Mainstem 8) | + | / + | / Similar | / + | / + | + |
| (Mainstem 9) | + | / + | / Similar | / + runs | / + | + |
| (Mainstem 10) | + | + / + | − / Similar | − / Similar | Similar/ | + |
| Mainstem 11 | + | − / + run | − / − run | Similar / − | + / | + |
| (Mainstem 12a) | + | + / + | Same/ Similar | Similar/ + run | + / | + |
| (Mainstem 12b) | + (since 2014) | + / + | – / - riffle | Similar/ + run | + / | + |
| Zayante 13a | + | + / Similar | + / + run | Similar / − | + / | + |
| (Zayante 13c) | + | + / + | Same/ Similar | Similar / + riffle; − run | − / | + |
| Zayante 13d | + | + / + | Similar | Similar/ + run; − riffle | +/ | + |
| (Bean 14a) | + | + / + riffle | Same/ − | + / Similar | Similar / | + |
| Bean 14b | + | + / + | + / + run | Similar / − riffle | + / | + |
| (Bean 14c-2) | + | + / + | + / Similar | + / − run | + / | + |
| (Fall 15a) | + | + / + | −/ − | + / + run | + / | + |
| (Fall 15b) | + | + / + | − / + run | − / − run | + / | + |
| (Newell 16) | + | +/ + | − / Similar | − /Similar | + / | + |
| (Boulder 17a) | + | + / + | Similar / Similar | Same/ + riffle; − run | + / | + |
| (Boulder 17b) | + | +/ + run | Similar/ Similar | Similar/ Similar | + / | + |
| (Bear 18a) | + | + / + | − / + riffle | Similar/+ | + / | + |
| (Branciforte 21a-2) | + (since 2014) | − / + | Similar/ Similar | + / + | + / | + |
| (Branciforte 21c) | + | +/ + | + / + run | + / − run | + / | + |

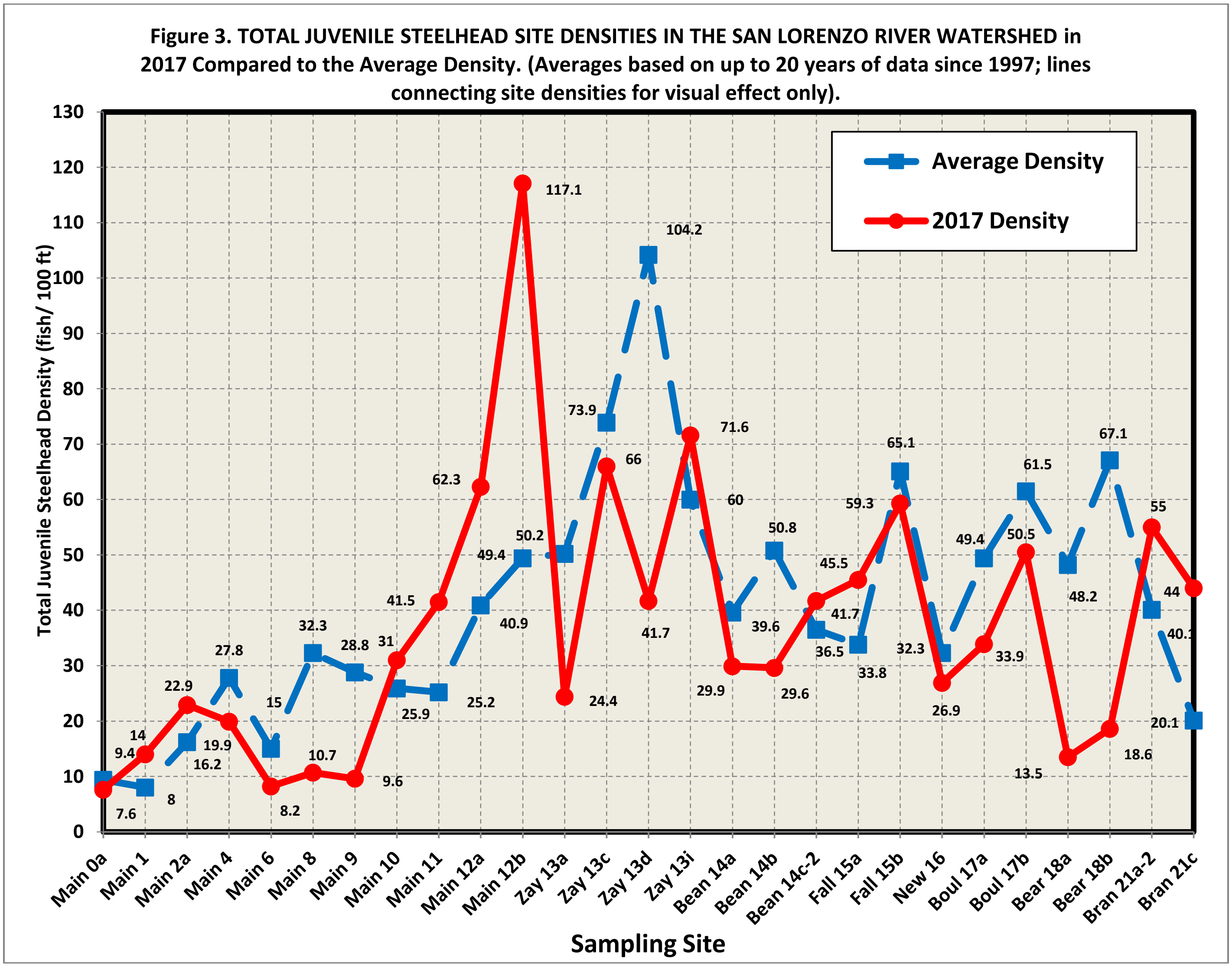


**Figure 3. Total Juvenile Steelhead Site Densities in the San Lorenzo River in 2017 Compared to Average Density. (Averages based on up to 20 years of data.)**

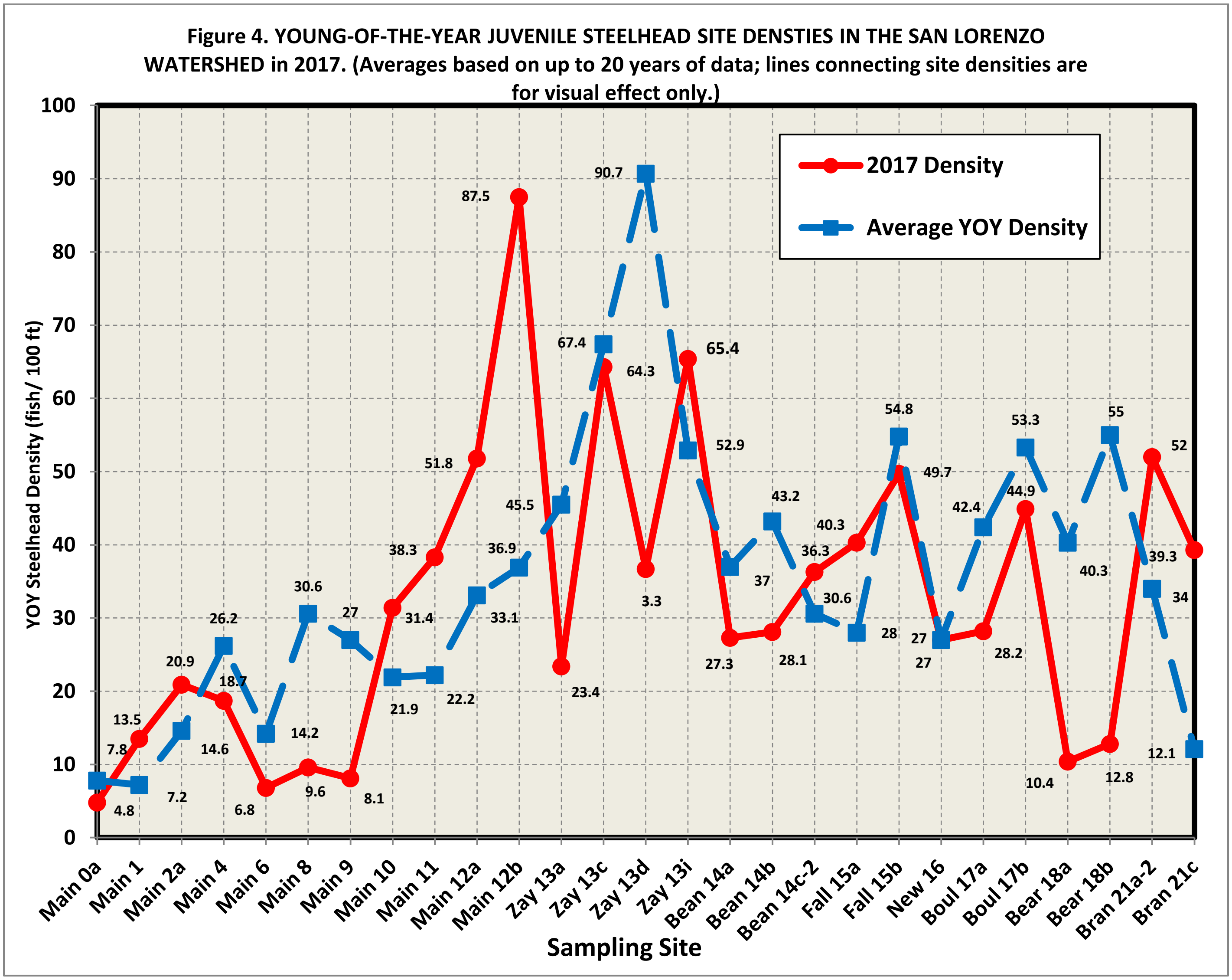


**Figure 4. Young-of-the-Year Steelhead Site Densities in the San Lorenzo River in 2017 Compared to Average Density. (Averages based on up to 20 years of data.)**

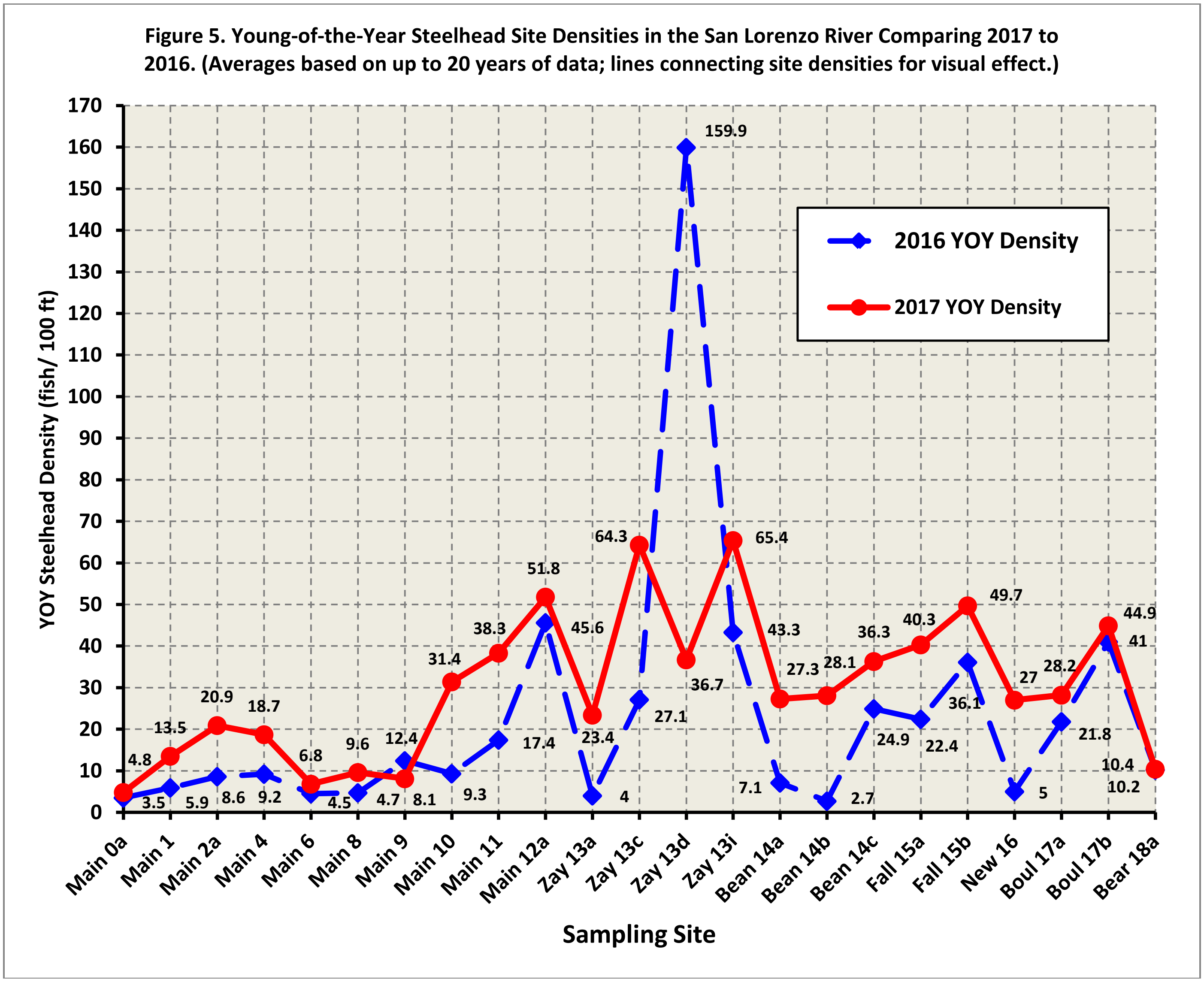


**Figure 5. Young-of-the-Year Site Densities in the San Lorenzo Watershed Comparing 2017 to 2016. (Averages based on up to 20 years of data.)**

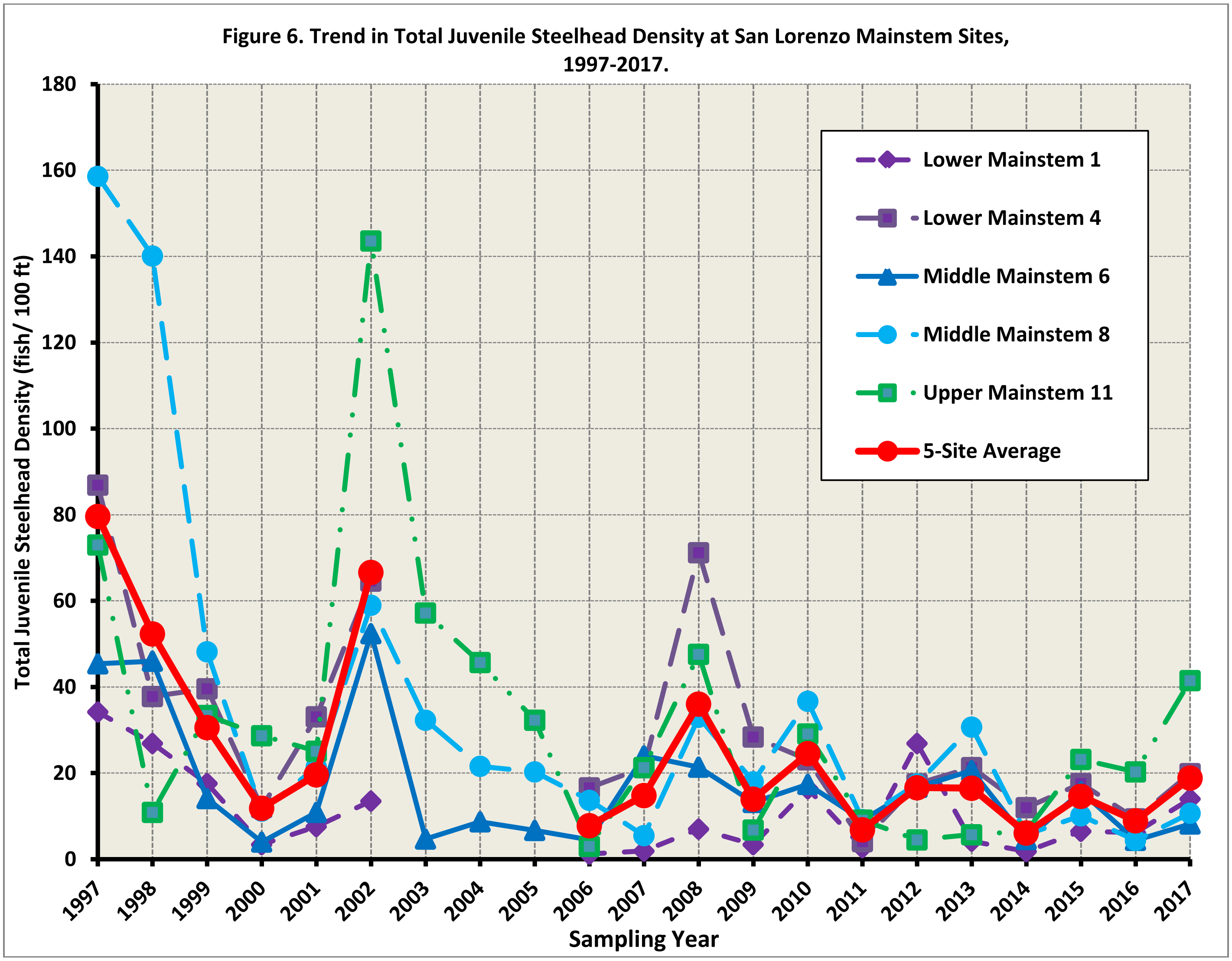


**Figure 6. Trend in Total Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2017.**

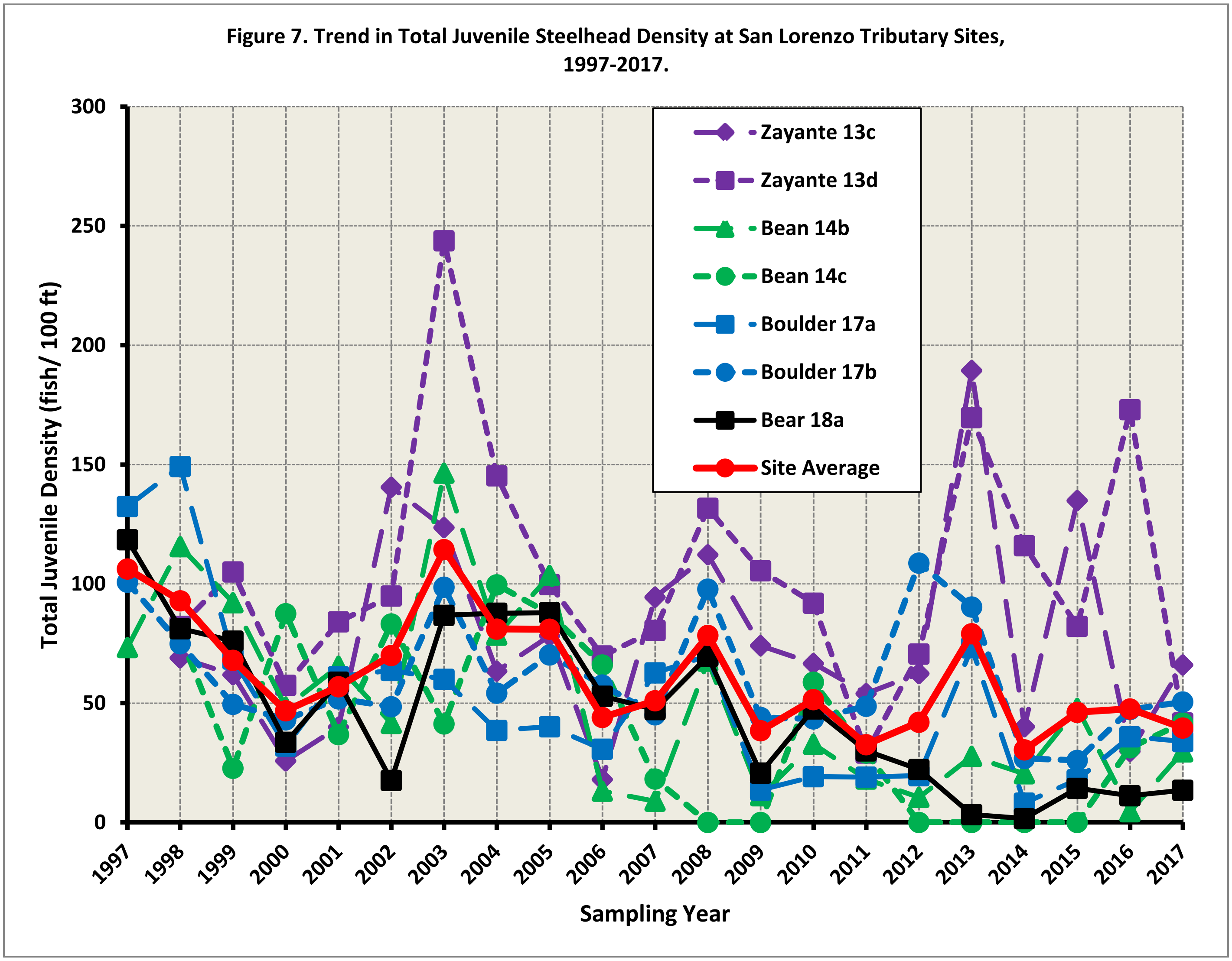


**Figure 7. Trend in Total Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2017.**

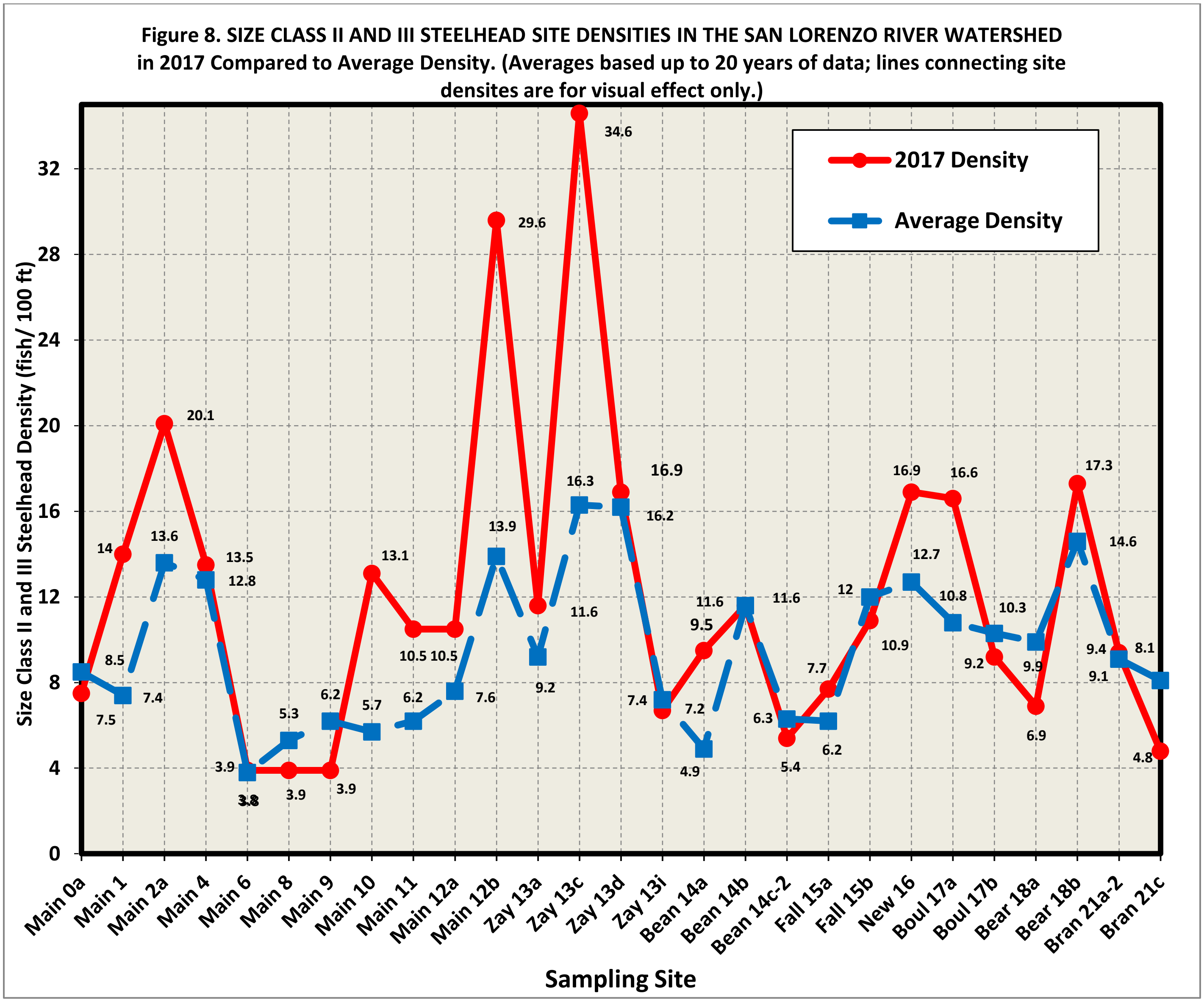


**Figure 8. Size Class II and III Steelhead Site Densities in the San Lorenzo River in 2017 Compared to Average Density. (Averages based on up to 20 years of data.)**

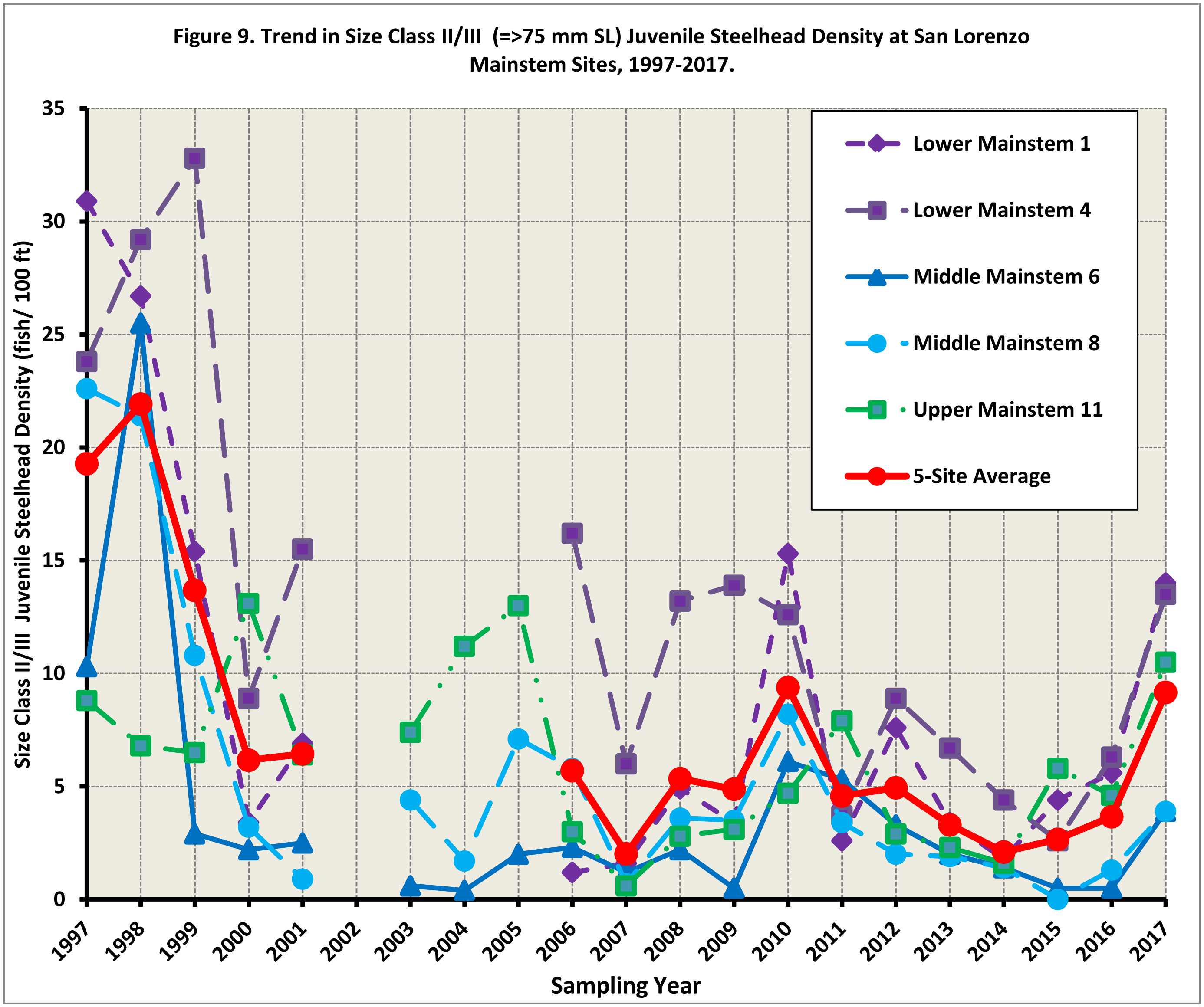


**Figure 9. Trend in Size Class II/III Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2017.**

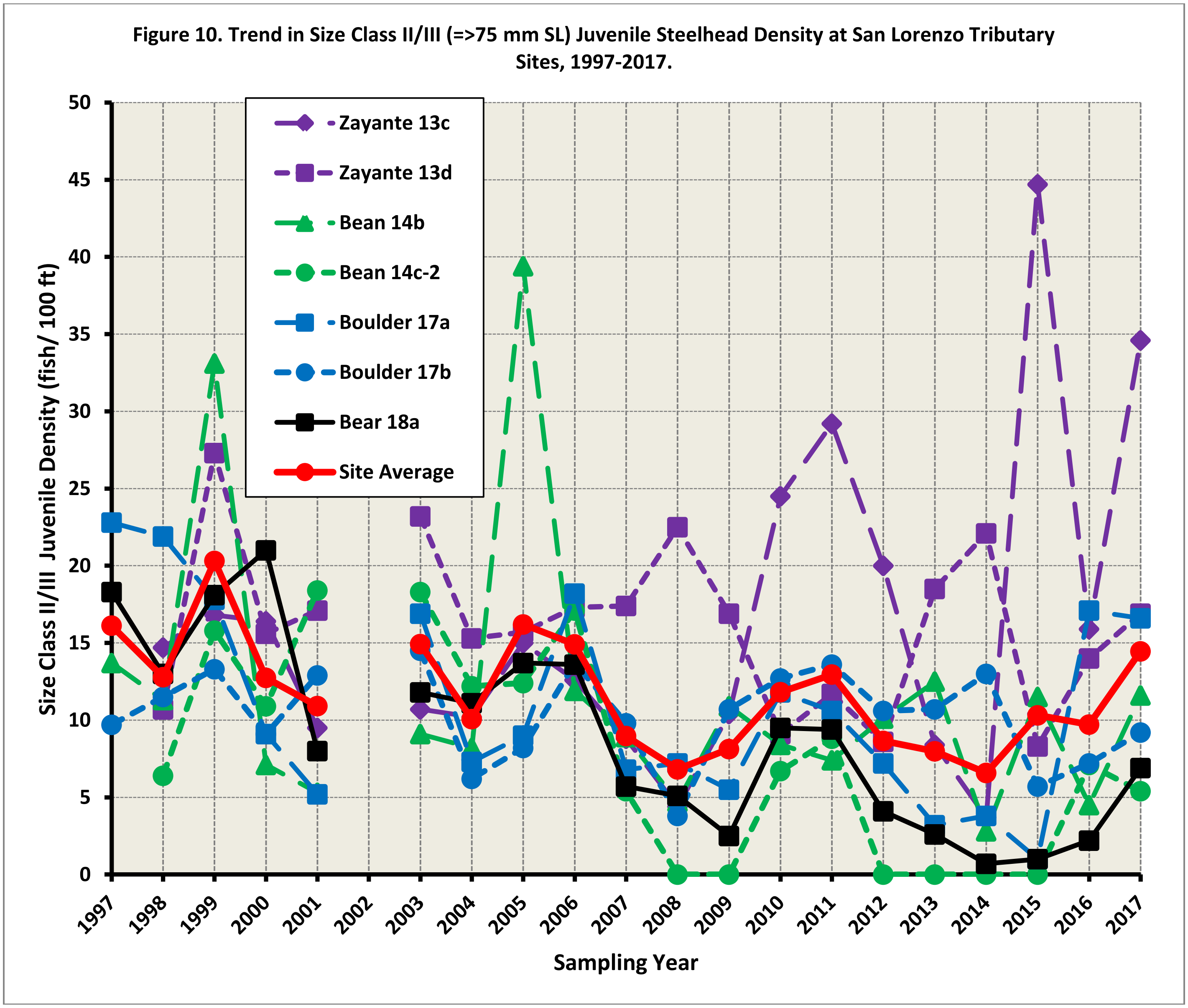


**Figure 10. Trend in Size Class II/III Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2017.**

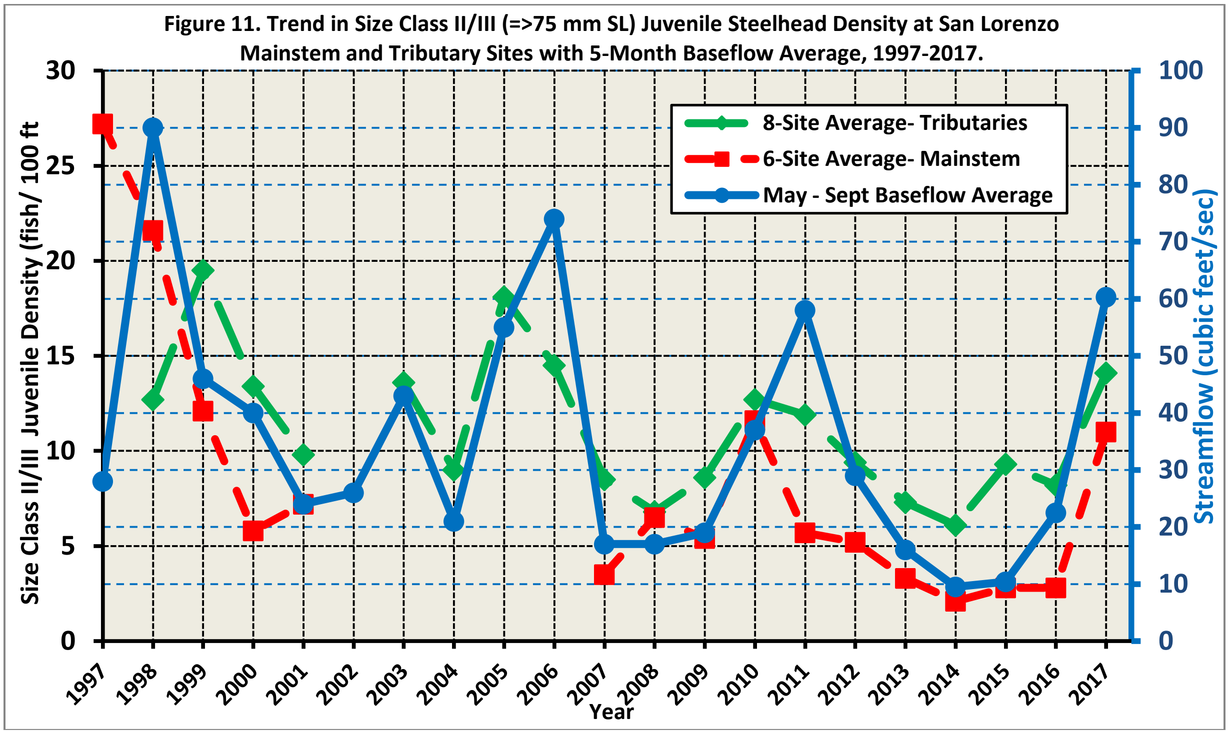


Figure 11. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem and Tributary Sites with 5-Month Baseflow Average, 1997-2017.

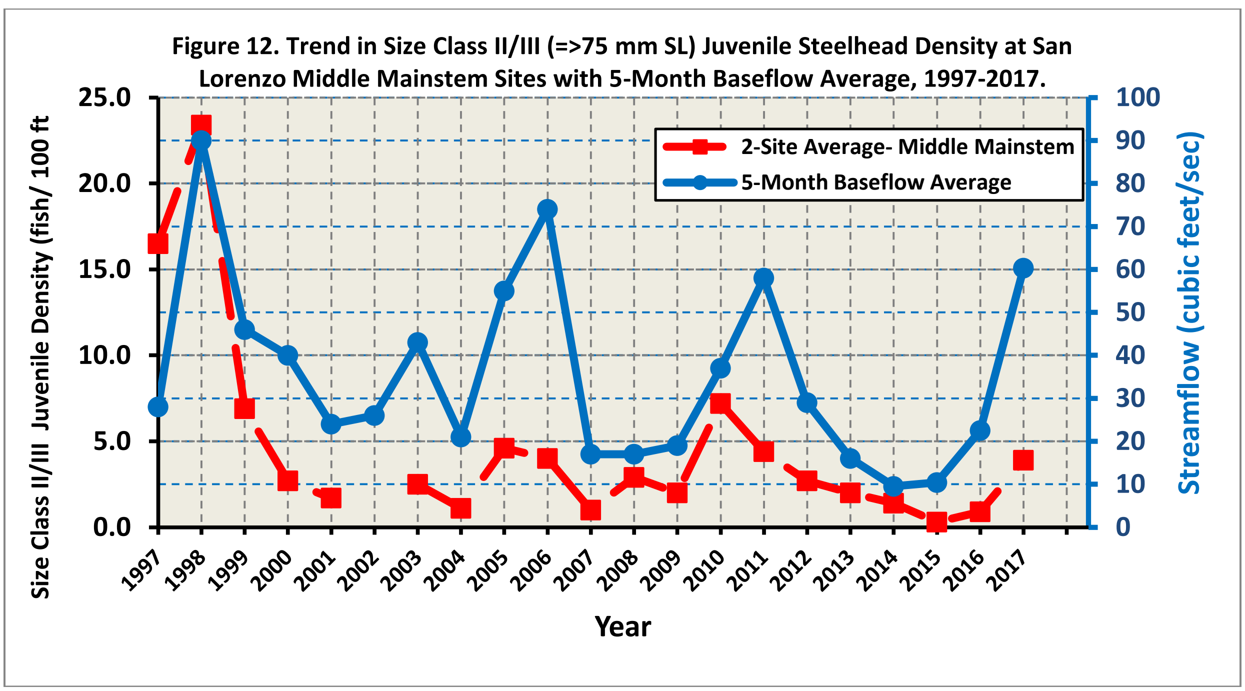


Figure 12. Trend in Average Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Middle Mainstem Sites with 5-Month Baseflow Average, 1997-2017.

## *ii. Steelhead Abundance and Habitat in the Soquel Creek Watershed*

1. WY2017 streamflows in spring-summer-fall were much above the median flow statistic, unlike 7 of the last 11 water years in which they were below (**Figure 13**). Six large storms and associated stormflows well above bankfull (11 stormflows between 2,000 and 6,000 cfs at the Soquel Village USGS Gage) came in December−February. Five below bankfull stormflows (below 1,000 cfs) came in March and April to maintain good spawning conditions and high baseflows during the important spring and early summer steelhead growth period. Thus, adult spawning migration was not impeded to headwater reaches on the East Branch into the Soquel Demonstration Forest and to Girl Scout Falls II on the West Branch. But many spawning redds made before late February may have been destroyed or smothered with sediment. Baseflow steadily declined from mid-April on, down to a minimum of 5.0 cfs in mid-October at the Soquel Village gage.

2. Habitat conditions improved at all sites in 2017 due to increased baseflow (more food), pool depth and escape cover at all sites and reaches surveyed (**Tables 8−11**). A major landslide occurred in Mainstem Reach 7 above Moores Gulch at the hairpin bend in February that blocked streamflow temporarily. The repeated Site 10 sampling site was adjacent to this slide (photo on the cover page of report). Site 10 had increased wood, as did Site 1 in Reach 1 above Walnut Street Bridge, Site 12 in Reach 8 below the Branch confluences and at Site 13a in Reach 9a on the East Branch below Mill Pond. Several cottonwoods fell into the channel at the beginning lower end of the Reach 9a segment. Percent fine sediment increased in pools at all 4 Branch sites.

3. ***Total and YOY juvenile steelhead densities*** increased in 2017 at 5 of 8 repeated sampling sites (the same total density at uppermost West Branch Site 21), with the greatest improvement at the mainstem landslide Site 10 and uppermost East Branch Site 16 in the Soquel Demonstration State Forest. But all densities were still below average for near average at Site 10 (**Figure 15**). The trend in total densities (consisting of mostly YOY) indicated a slight increase in 2017 (6-site average of 13.5 fish/ 100 ft, the third lowest average density in 20 years, compared to 8.1 in 2016- the lowest in 20 years) (**Figure 16**).

4. ***Yearling densities*** in 2017 were above average at 2 of 8 sites (upper mainstem Site 12, upper West Branch Site 21) and slightly more than in 2016 at Mainstem Sites 1, 4 and 10 (none captured at Sites 1 and 4 in 2016), with 8.4 fish/ 100 ft at the West Branch Site 21 compared to 2.8 in 2016.

5. ***Size Class II and III juvenile densities*** were well above average at 5 of 8 sites in 2017 (**Figure 17**) and improved over 2016 at 6 of 8 sites. The juvenile steelhead population in Soquel Creek consisted primarily of fast growing YOY in Size Class II. So, with generally below average densities of YOY and yearlings and relatively high baseflow (more food), competition for food was less a high percent of YOY reached Size Class II due to faster growth rate. In fact, all YOY reared at mainstem sites and lower East West Branch Sites 13a and 19 reached Size Class II (=>75 mm SL). Approximately ½ of the YOY at East Branch Site 16 and 1/3 of those at West Branch Site 21 reached Size Class II (size histograms included on the data sheets for each site). Lower Mainstem Sites 1 and 4 and East Branch Site 13a (Reach 9a) below Mill Pond had below average smolt ratings (**Table 2**), despite the much deeper pool habitat and much more escape cover from added instream wood at Site 13a (**Table 10**). We may assume that adult spawning was patchy from a small adult steelhead population.

6. The 6-site, long range trend in Size Class II and III densities showed a significant increase in 2017

due to high densities of large YOY at Sites 10 and 16 (**Figure 18**), despite the relatively low juvenile densities and likely small juvenile steelhead population. The 6-site, long term average for Size Class II/III density is correlated with average 5-month baseflow in some years (**Figure 19**).

**7.** The below average densities of YOY in 2017 were likely caused by a small adult population of returning adult steelhead and difficult egg survival in most reaches prior to March 1 due to repeated high stormflows in December 2016 – February 2017.

**8.** Soquel Lagoon is typically habitat for a sizeable juvenile steelhead population, as indicated by our long-term population censusing for the City of Capitola. It indicated a long-term average population size of 1,480 mostly soon-to-smolt sized steelhead (=>75 mm SL) between 1993 and 2013 and 2016–2017 (**Alley 2018**). In 2017, the lagoon population estimate was 259 with the median size in the 155-159 mm SL range and half being yearlings. The relatively small lagoon population and low proportion of YOY captured, indicated limited spawning and/or poor spawning success in reaches near the lagoon.

**9.** None of the increased site densities for size classes and age classes from 2016 to 2017 were statistically significant.

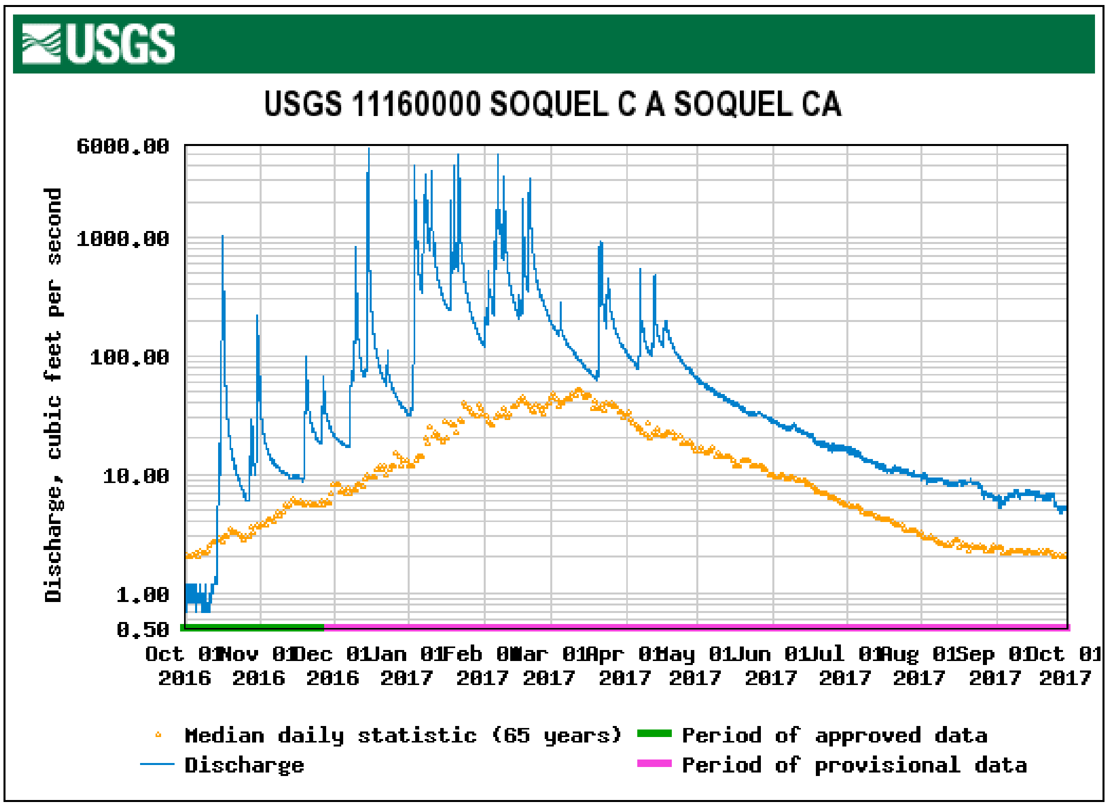


**Figure 13. The 2017 Discharge at the USGS Gage on Soquel Creek at Soquel Village.**

**Table 8. Fall/Late Summer STREAMFLOW (cubic feet/ sec) Measured by Santa Cruz County Staff in 2006−2017 and from Stream Gages; Measurements by D.W. ALLEY & Associates; 2010 (September), 2011−2015, 2017 (October) at fall baseflow conditions, County Staff (Date specified).**

| Location | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soquel Cr above Lagoon** | | | | | 2.3(DWA) | 4.9 (DWA) | 1.8 (DWA) | 0.33 (DWA) | 0.19 (DWA) (Walnut St.) | 0.18 (DWA) (Walnut St.) | | 3.98 (DWA) (Walnut St) |
| **Soquel Cr @ USGS Gage** | 6.6** | 1.4** | 0.65** | 1.2** | 3.4** | 5.8** | 1.8** | 0.36** | 0.35** | 0.36** 0.10 (9/9) | 1.4** 0.7(1 Oct) | 5.0 (12 Oct) |
| **Soquel Cr @ Bates Cr** | 5.73 | - | 1.08 | | 4.2 (9/1) | 7.3 (8/31) | 2.0 (9/19) | 0.95 (9/11) | 0.22 (9/17) | 0.35 (9/9) | 1.16 (10/4) | |
| **Soquel Cr above Moores Gulch** | | | | | 2.16 (DWA) | 4.3 (DWA) | 2.0 (DWA) | 1.26 (DWA) | 0.72 (7/16) 0.80 (DWA) | 0.54 (7/28) 0.56 (DWA) | | 4.46 (DWA) |
| **W. Branch Soquel Cr @ Old S.J. Road Olive Springs Bridge** | 2.2 | 1.75 After | – | – | 1.2 @ Mouth (DWA) | 2.2 @ Mouth (DWA); 3.0 (8/31) | 1.1 @ Mouth (DWA); 1.21 (9/05) | 0.91 @ Mouth (DWA) 1.73 (5/14) | 0.80 (9/16) 0.74 @ Mouth (DWA) | 0.58 (9/14) 0.59 @ Mouth (DWA) | | 1.85 @ Mouth (DWA) |
| **W. Branch Soquel Cr abv Hester Cr (Weir)** | 1.5 (15 Sep) | 1.0 (15 Sep) | – | – | – | – | – | – | | | | |
| **E. Branch Soquel Cr @ 152 Olive Springs Rd.** | - | 1.0 After | – | – | 0.77 @ Mouth (DWA) | 2.1 Mouth (DWA); 2.7 (8/31) | 0.54 Mouth (DWA); 0.43 (9/05) | 0.16 @ Mouth (DWA) 2.0 (5/14) | 0.0 (7/16) Trickle @ Mouth; Dry above (DWA) | Dry (DWA) | 0.67 (7/21) | 1.44 Mouth (DWA) |
| **E. Branch Soquel Cr below Amaya ; abv Olive Spgs Quarry(Weir)** | 1.5 (15 Sep) | 0.43 (15 Sep) | – | – | – | – | | | | | | |
| **E. Branch Soquel Cr abv Amaya C** | | | | Trickle (DWA) | 0.44 (DWA) | | | 0.03 (DWA) | Dry (DWA) | Dry (DWA) | | 0.71 (DWA) |
| **Aptos Cr below Valencia Cr** | 2.5 | 1.2 After | 0.77 | 0.53 | 0.85 (9/1) | | 0.87 (DWA); 1.10 (9/05) | 0.75 (DWA) 0.84 (9/11) (Valencia Cr. dry) | 0.47 (9/16) | | 0.46 (9/22) | 2.52 (DWA) |
| **Aptos Cr above Valencia Cr** | | | | | 0.97 (DWA) | 1.6 (DWA) | | | 0.63 (DWA) | 0.44 (DWA) | | |
| **Valencia Cr @ Aptos Cr** | | | 0.007 | 0.34 (May) | 0.09 School (DWA) | 0.8 School (7/27) | 0.20 (9/05) | 0.105 (9/11) | | | | |
| **Corralitos Cr below Browns Valley Road Br** | 15.9 (May) | 0.49 (May) | dry | 1.71 (May) | 0.47 (9/2) | 0.2 (9/8) | | 0.10 (9/5) Below Browns Cr. | 0.51 (9/11) Below Browns Cr. | 0.37 (9/9) | 0.73 (9/22) 0.33 (7/22) Below Browns Cr. | |
| **Corralitos Cr above Los Cosinos Rd Br** | | | | | 2.0 (DWA) | 2.6 (DWA) | 2.0 (DWA) | 1.54 (DWA) | 1.29 (DWA) | 1.21 (DWA) | | 3.05 (DWA) |
| **Corralitos Cr @ Rider Cr** | 3.35 | 2.5 After | 1.44 | – | 2.4 (9/2) | | 1.73 (9/13) | 1.12 (9/5) | 1.24 (9/11) | 1.01 (9/9) | 1.14 (9/21) | |
| **Corralitos abv Eureka G** | | | | | 0.63 (DWA) | 0.71 (DWA) | 0.23 (DWA) | 0.16 (DWA) | 0.07 (DWA) | 0.04 (DWA) | | 0.54 (DWA) |
| **Browns above diversion dam** | 0.96 | 0.30 After | 0.32 | – | 0.41 (DWA) | 0.79 (DWA); 0.5 (9/8) | 0.30 (DWA); 0.14 (9/13) | 0.10 (DWA) 0.21 (9/5) | 0.33 (DWA) 0.21 (9/11) | 0.13 (DWA) | | 0.64 (DWA) |

** Estimated from USGS Hydrographs for September 1.

**Table 9. Averaged Mean and Maximum WATER DEPTH (ft) of Habitat at Replicated SOQUEL CREEK Sampling Sites Since 2012.**

| Site (Reach) | Pool 2017 | Pool 2012 | Pool 2013 | Pool 2014 | Pool 2015 | Pool 2016 | Riffle 2017 | Riffle 2012 | Riffle 2013 | Riffle 2014 | Riffle 2015 | Riffle 2016 | Run/ Step Run 2017 | Run/ Step Run 2012 | Run/ Step Run 2013 | Run/ Step Run 2014 | Run/ Step Run 2015 | Run/ Step Run 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 (1) | 1.3/ 2.7 | 1.65/ 3.5 Site Δ | 1.65/ 3.6 | 1.3/ 3.1 Site Δ | 1.2/ 2.6 | 1.1/ 1.8 | 0.4/ 0.9 | 0.4/ 0.6 Site Δ | 0.05/ 0.3 | 0.2/ 0.4 Site Δ | 0.05/ 0.1 | 0.4/ 0.8 | 0.8/ 1.2 | 0.6/ 0.9 Site Δ | 0.25/ 0.4 | 0.3/ 0.4 Site Δ | 0/1/ 0.2 | 0.5/ 0.7 |
| 4 (3) | 1.9/ 3.1 | 1.7/ 2.6 | 1.4/ 2.2 | 1.35/ 2.0 | 1.3/ 1.7 | 1.0/ 1.4 | 0.4/ 0.7 | 0.3/ 0.5 | 0.3/ 0.7 | 0.3/ 0.5 | 0.3/ 0.6 | 0.35/ 0.7 | 0.6/ 1.0 | 0.5/ 0.9 | 0.6/ 1.0 | 0.3/ 0.5 | 0.5/ 0.7 | 0.6/ 1.0 |
| 10 (7) | 1.6/ 2.4 | 1.1/ 2.05 Site Δ | 1.55/ 2.35 | 0.9/ 1.6 Site Δ | 1.1/ 2.0 | 1.3/ 2.0 | | 0.5/ 0.9 Site Δ | 0.35/ 0.9 | 0.3/ 0.45 Site Δ | 0.2/ 0.35 | 0.4/ 0.8 | 1.0/ 2.3 | 0.8/ 0.9 | 0.5/ 0.85 | 0.3/ 0.9 Site Δ | 0.3/ 0.8 | 0.5/ 1.1 |
| 12 (8) | 1.8/ 2.9 | 1.8/ 2.6 | 0.9/ 2.0 Site Δ | 0.7/ 2.3 | 1.2/ 3.3 Site Δ | 1.4/ 2.4 | 0.45/ 0.9 | 0.45/ 0.95 | 0.3/ 0.5 | 0.3/ 0.5 | 0/2/ 0.6 | 0.3/ 0.9 | 0.7/ 1.1 | 0.8/ 1.1 | 0.6/ 0.8 | 0.45/ 0.7 | 0.4/ 0.6 | 0.5/ 1.1 |
| 13a (9a) | 1.6/ 3.9 | 1.2/ 1.9 | 0.95/ 1.95 Site Δ | 0.7/ 1.8 Site Δ | 0.75/ 1.6 | 0.9/ 1.6 | 0.45/ 0.9 | 0.3/ 0.6 | 0.1/ 0.3 | 0.3/ 0.4 Site Δ | 0.25/ 0.5 | 0.4/ 0/6 | 0.6/ 0.9 | 0.75/ 1.1 | 0.35/ 0.5 | 0.1/ 0.15 Site Δ | 0.1/ 0.25 | 0.5/ 0.9 |
| 16 (12a) | 1.1/ 1.7 Site Δ | 1.25/ 2.05 Site Δ | 0.5/ 0.85 Site Δ | Dry | Dry | 0.75/ 1.3 | 0.5/ 0.7 | 0.2/ 0.4 Site Δ | 0.1/ 0.15 | Dry | Dry | 0.25/ 0.5 | 0.8/ 1.1 | 0.4/ 0.9 Site Δ | 0.3/ 0.8 | Dry | Dry | 0.5/ 0.9 Site Δ |
| 19 (13) | 2.3/ 3.35 | 1.0/ 1.9 | 0.9/ 2.5 | 0.8/ 2.2 | 1.5/ 2.4 Site Δ | 1.3/ 2.4 | 0.35/ 0.55 | 0.4/ 0.8 | 0.35/ 0.6 | 0.3/ 0.5 | 0.25/ 0.4 Site Δ | 0.25/ 0.4 | 0.85/ 1.2 | 0.5/ 1.1 | 0.5/ 1.0 | 0.4/ 0.95 | 0.5/ 0.6 Site Δ | 0.7/ 1.0 |
| 21 (14b) | 1.3/ 2.3 | | | 1.55/ 2.5 Site Δ | 1.25/ 2.2 | 1.15/ 1.9 | 0.4/ 0.9 | | | 0.4/ 0.6 Site Δ | 0.2/ 0.4 | 0.25/ 0.6 | 0.55/ 0.9 | | | 0.35/ 0.6 Site Δ | 0.3/ 0.5 | 0.3/ 0.5 |

**Table 10. POOL ESCAPE COVER Indices (Habitat Typing Method*) in SOQUEL CREEK, at Replicated Sampling Sites Since 2009.**

| Site (Reach) | Pool Escape Cover 2009 | Pool Escape Cover 2010 | Pool Escape Cover 2011 | Pool Escape Cover 2012 | Pool Escape Cover 2013 | Pool Escape Cover 2014 | Pool Escape Cover 2015 | Pool Escape Cover 2016 | Pool Escape Cover 2017 |
|---|---|---|---|---|---|---|---|---|---|
| 1 (1) | 0.101* | 0.132 | 0.104 | 0.117 Site Δ | 0.178 | 0.140 Site Δ | 0.167 | 0.110 | 0.226 |
| 4 (3) | 0.102 | 0.067 | 0.085 | 0.191 | 0.086 | 0.094 | 0.111 | 0.162 | 0.169 |
| 10 (7) | | 0.124 | 0.254 | 0.096 Site Δ | 0.152 | 0.097 Site Δ | 0.102 | 0.130 | 0.333 Landslide Trees down |
| 12 (8) | | | 0.092 | 0.231 (Wood cluster) | 0.059 Site Δ | 0.089 (more wood) | 0.143 Site Δ | 0.034 | 0.165 New Wood Instream |
| 13a (9a) | | | 0.101 | 0.164 (Wood cluster) | 0.127 Site Δ | 0.111 | 0.128 | 0.059 Site Δ | 0.281 New wood Instream |
| 16 (12a) | | | 0.079 | 0.064 Site Δ | 0.093 Site Δ | Dry | Dry | 0.107 | 0.115 Site Δ |
| 19 (13) | 0.041 | 0.080 | 0.131 | 0.060 | 0.143 | 0.146 | 0.108 Site Δ | 0.077 | 0.134 |
| 21 (14b) | 0.029 | 0.017 | 0.021 | − | − | 0.048 Site Δ | 0.084 | 0.107 | 0.125 |

*** Habitat typing method = total ft of linear pool cover divided by total sampled length as pool habitat in sample site.**

**Table11. Habitat Change in SOQUEL CREEK WATERSHED Reaches (2016 to 2017) or Replicated Sites (2016 to 2017).**

| Reach Comparison or (Site Only) | Baseflow | Pool Depth | Fine Sediment | Embeddedness | Pool Escape Cover | Overall Habitat Change |
|---|---|---|---|---|---|---|
| (Site 1) Reach 1 | + | + | + pool/ − run | + run | + | + |
| Site 4 Reach 3a | + | + | + pool | Similar | + | + |
| (Site 10) Reach 7 | + | + | + run + pool | − Pool + run | + Landslide w/ downed trees | + |
| (Site 12) Reach 8 | + | + | + pool | − riffle − pool | + Down tree | + |
| (Site 13a) Reach 9a | + | + | − pool | − | + Wood cluster | + |
| Site 16 Reach 12a | + | + | − pool | + | + | + |
| (Site 19) W. Br. Reach 13 | + | + | − pool + riffle | − run − riffle | + | + |
| (Site 21) W. Br. Reach 14b | + | + | − pool − run | − pool | + | + |

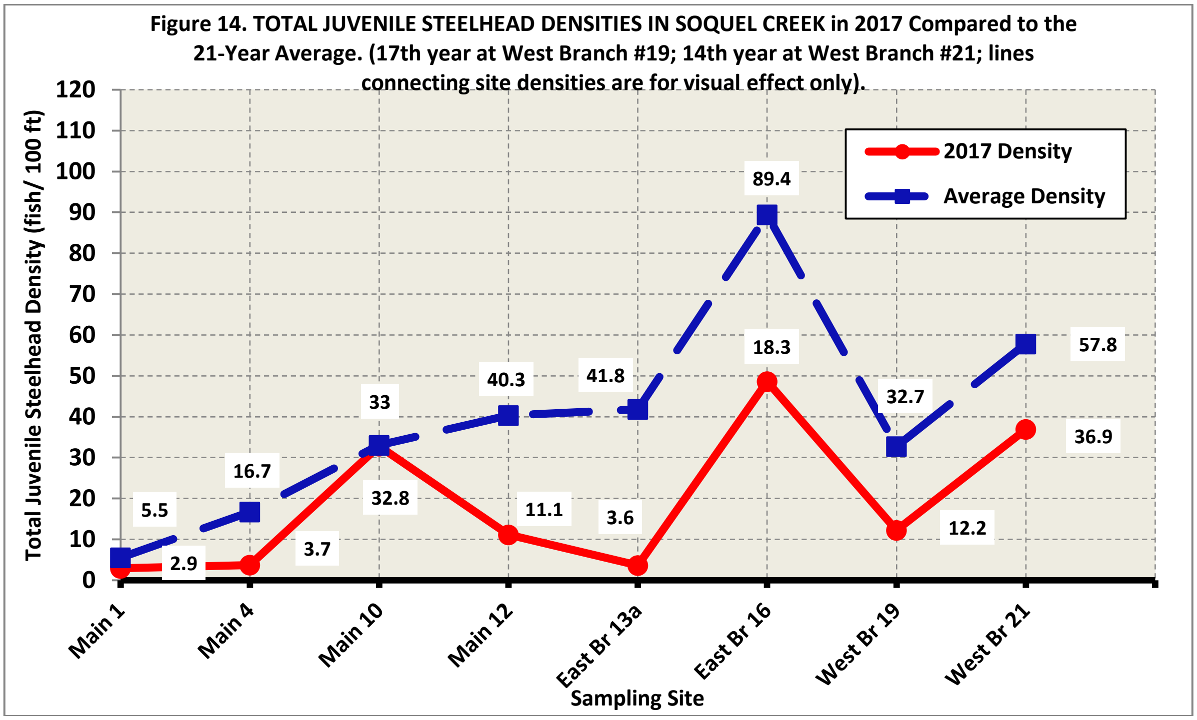


**Figure 14. Total Juvenile Steelhead Site Densities in Soquel Creek in 2017 Compared to the 21-Year Average (17th year for West Branch #19.)**

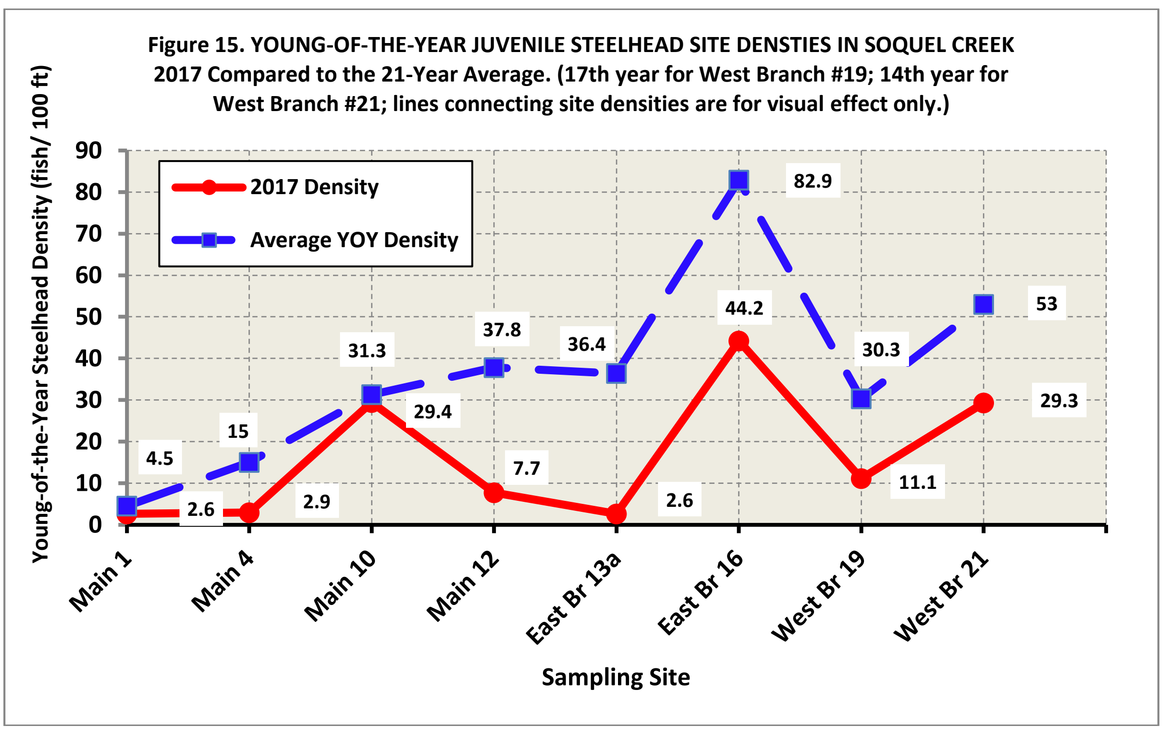


**Figure 15. Young-of-the-Year Steelhead Site Densities in Soquel Creek in 2017 Compared to the 21-Year Average (17th year for West Branch #19.)**

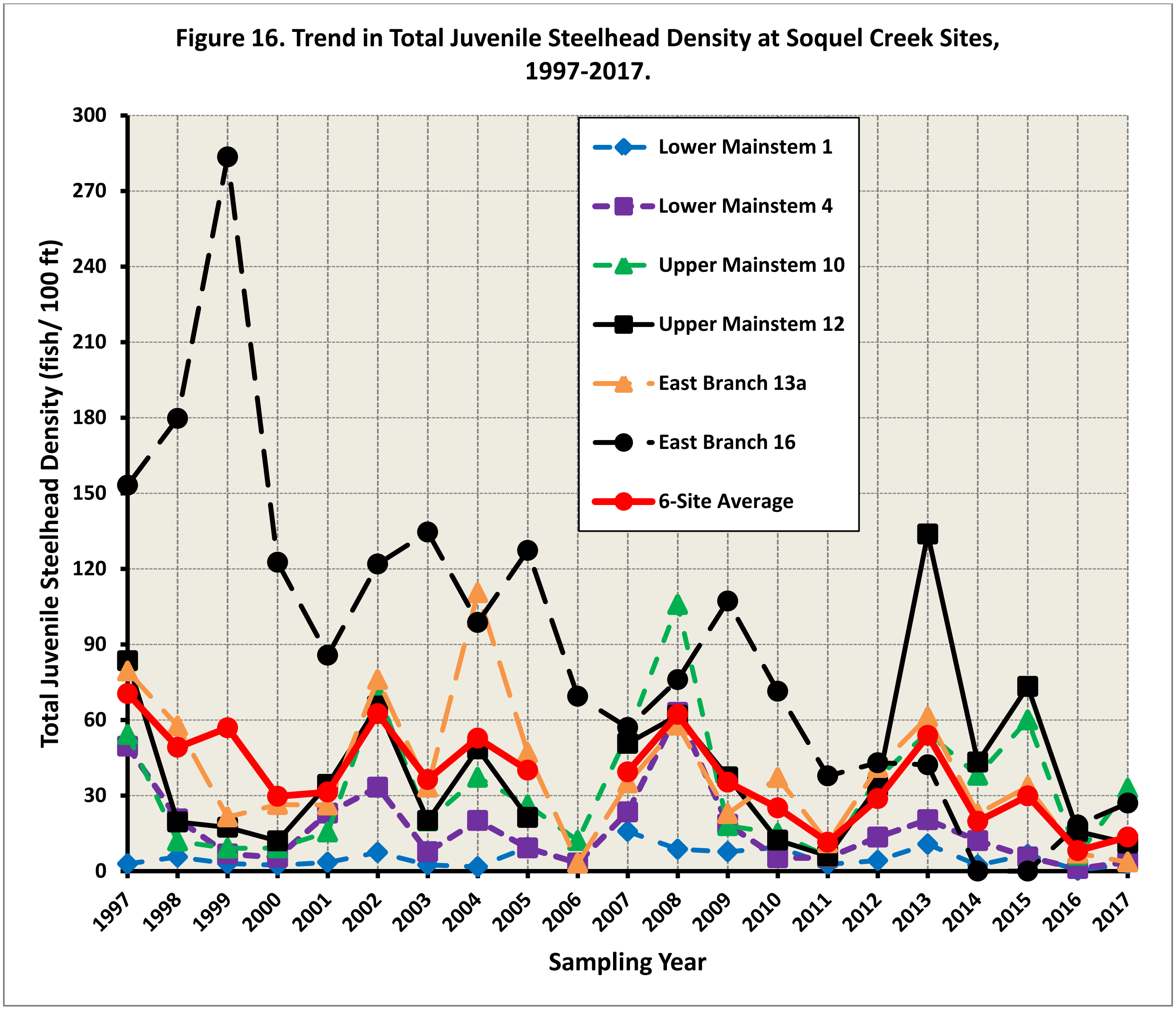


**Figure 16. Trend in Total Juvenile Steelhead Density at Soquel Creek Sites, 1997-2017.**

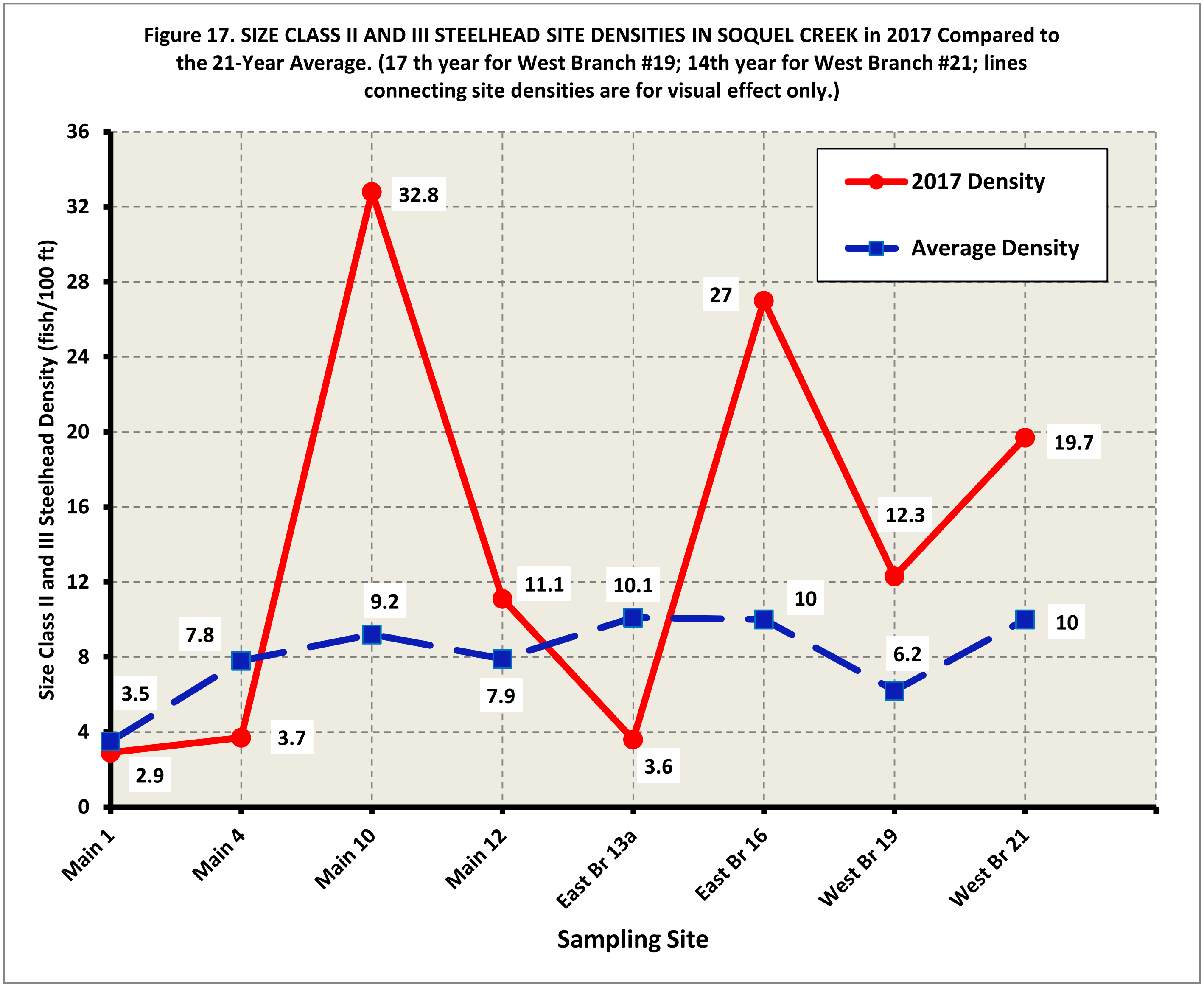


**Figure 17. Size Class II and III Steelhead Site Densities in Soquel Creek in 2017 Compared to the 21-Year Average (17th year for West Branch #19.)**

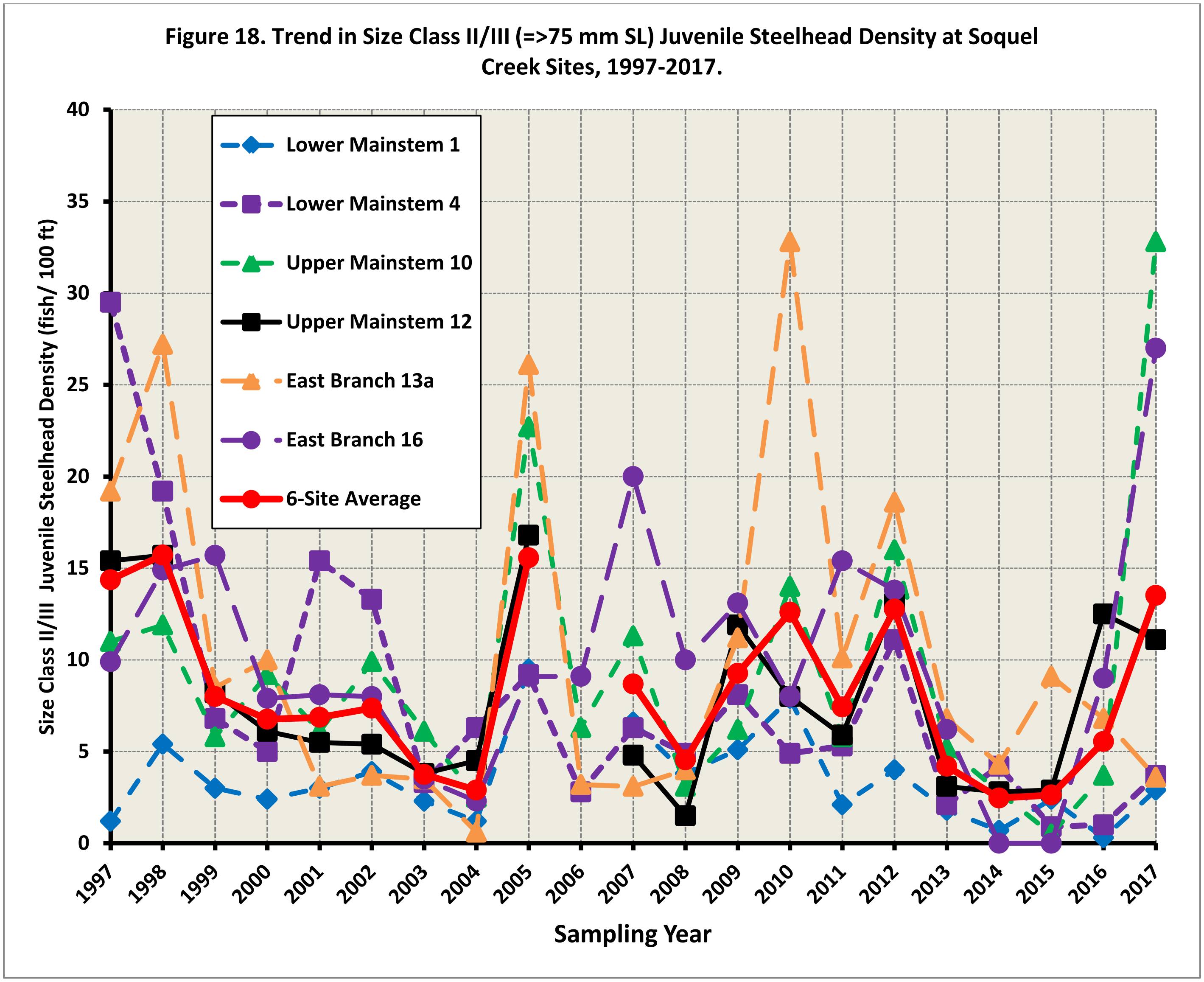


**Figure 18. Trend in Size Class II/III Juvenile Steelhead Density at Soquel Creek Sites, 1997-2017.**

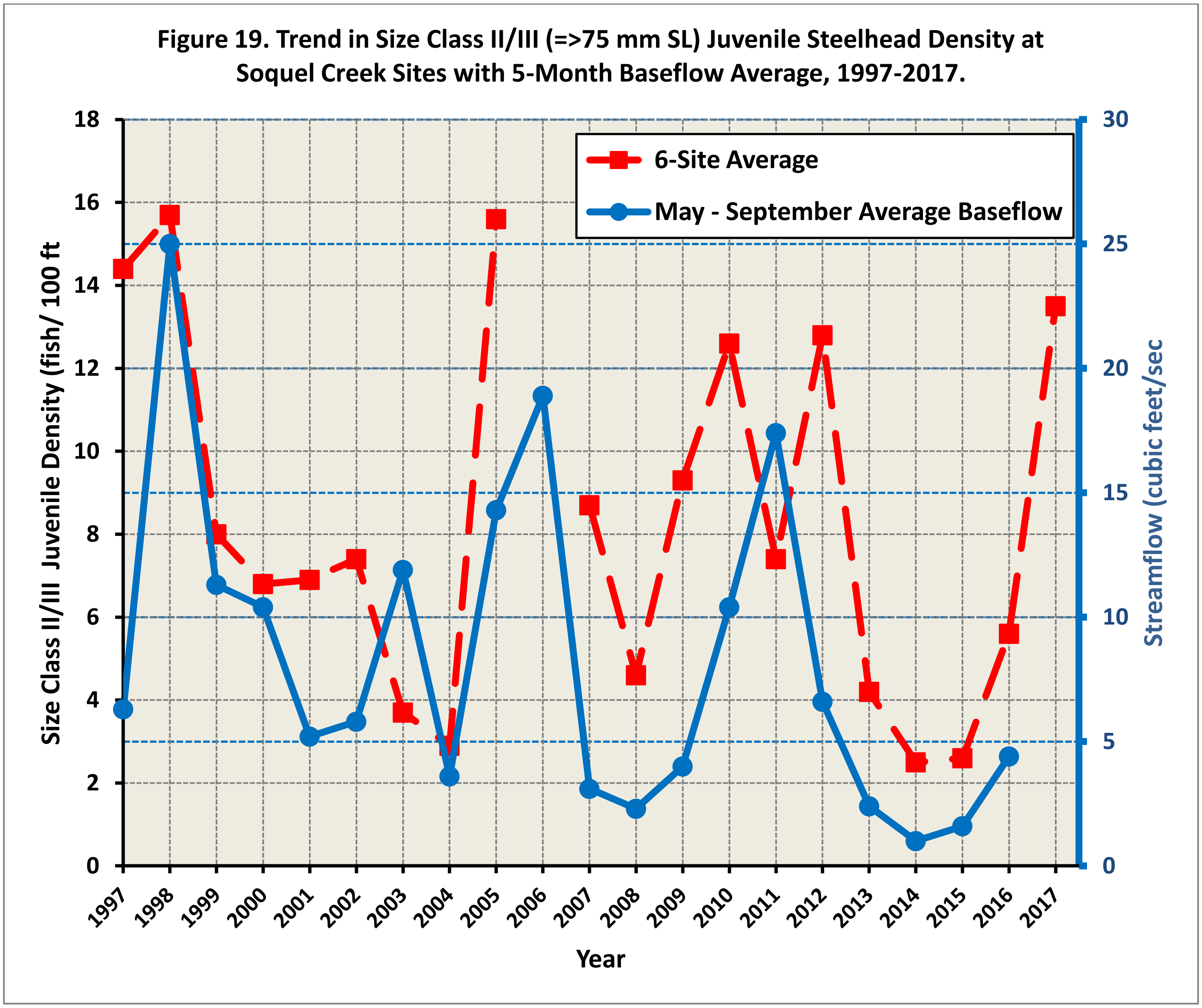


**Figure 19. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites with 5-Month Baseflow Average, 1997-2017.**

## *iii. Steelhead Abundance and Habitat in the Aptos Creek Watershed*

1. Aptos Creek likely had a 2017 WY hydrograph similar to those in the San Lorenzo and Soquel drainages, with stormflows at the same frequency and intensity, resulting in much above median baseflow in the dry season (**Table 8; Figures 1 and 13*)***. These streamflow levels made access to headwater reaches possible for adult steelhead and provided more food than during previous drought years.

2. ***Habitat quality*** improved from 2016 to 2017 at both Aptos Sites 3 and 4 and both Valencia Sites 2 and 3 due to increased baseflow and considerably deepening of pools with considerably more pool escape cover at all 4 sites (**Tables 12 and 13**). The sampled pool in lower Aptos Site 3 at the County Park had a newly downed tree to create cover. Upper Aptos Site 4 also had

increased instream wood, as did both Valencia Creek sites.Pool embeddedness remained similar and high at 50−65% at both Aptos and Valencia creek sites. Pool percent fines were reduced in 2017 at upper sites on Aptos and Valencia creeks. But they were still high, averaging 55% in Aptos 4 pools and 75% in Valencia 3 pools. Pool percent fines were 55% in lower Aptos 3 pools and 90% in lower Valencia pool-run-riffle habitat. Substantial sedimentation and habitat deterioration had occurred in Valencia Creek since 2009, after bankfull stormflows in 2010, 2011, 2016 and 2017. However, at least pool habitat was present at the lower Valencia Creek site in 2017, which was absent in 2014 and 2016.

3. ***Total, yearling and Size Class II/III densities*** increased in 2017 from 2016 at 3 of 4 sites, excepting lower Valencia 2. ***YOY density*** increased at all 4 sites compared to 2016, and it was statistically significant, using the paired t-test for replicated sites**.**

4. ***Total and YOY densities*** were below average at 3 of 4 sites, excepting upper Aptos Site 4 (**Figures 20 and 21**). ***Yearling densities*** were below average at all 4 sites. ***Size Class II and III densities*** were above average at 3 of 4 sites, excepting Valencia Site 2 (**Figure 22**). Lower Aptos Site 3 and upper Valencia Site 3 had above average Size Class II/III densities despite below average total and YOY densities because most YOY grew into Size Class II in the former and more than ½ did in the latter. The Size Class II/III density at upper Aptos Site 4 was more than double the average because it had above average YOY density and more than ½ of them grew into Size Class II.

5. The ***trend in the 4-site, long term density of Size Class II/III juveniles*** increased substantially from 4.1 in 2016 to 13.1 fish/ 100 ft in 2017, which was above the multi-year average of 9.9 (**Figure 23**). The soon-to-smolt density rating for Aptos #3, Aptos #4 and Valencia 3 was “fair” (**Table 2** above). Valencia Site 2 was rated “below average.”

6. Yearling and older steelhead density was higher at upper Valencia Site 3 than at Aptos Creek sites, despite poorer pool development higher sedimentation, poorer aquatic insect habitat (less food)and less baseflow (less food), because slower growing, older resident rainbow trout likely contributed more to the salmonid population in Valencia Creek and not so much so in Aptos Creek.  Previous scale analysis indicated 2+ individuals in Valencia Creek.

7. Aptos Estuary was sampled for steelhead with a 106-ft bag seine with 3/8 inch mesh. No tidewater gobies were captured with this large seine after 6 seine hauls on each of 2 days. Tidewater goby sampling was not intended and not done with the finer, 1/8-inch meshed goby seine, although tidewater gobies have occasionally been captured with the larger seine. Besides steelhead, other species captured were jack smelt, staghorn sculpin, starry flounder, bay pipefish (*Syngnathus leptorhynchus*) and threespine stickleback. The steelhead population estimate was 184, based on mark and recapture. This was improvement since 2014 when only 6 steelhead were captured in 2 days. The years 2011−2013 had estimates of 32, 140 and 423, respectively. The 2017 size histogram indicated a bimodal size distribution of age classes. Scale analysis indicated that fish longer than 160 mm SL were yearlings and that the 3 fish in the 305−314 mm SL range were at least 2+ years old. The largest steelhead at 350 mm SL (388 mm FL) was likely an adult. Conditions on the estuary bottom were very saline, making it inhospitable for tidewater goby nesting in the lower estuary. The estuary size was much reduced in 2017, with it occupying only area to the west of the jetty, with the east side excluded where backwater and overwintering cover had existed for tidewater gobies in past years. The estuary opened slightly to the west of the jetty.

**Table 12. POOL HABITAT CONDITIONS FOR REPLICATED SAMPLING SITES IN APTOS, VALENCIA, CORRALITOS, SHINGLEMILL and BROWNS Creeks Since 2011.**

| Reach #/ Sampling Site # | Avg Mean/ Max Pool Depth-2011 | Avg Mean/ Max Pool Depth-2012 | Avg Mean/ Max Pool Depth-2013 | Avg Mean/ Max Pool Depth-2014 | Avg Mean/ Max Pool Depth-2015 | Avg Mean/ Max Pool Depth-2016 | Avg Mean/ Max Pool Depth-2017 | Pool Escape Cover Index-2010 | Pool Escape Cover Index-2011 | Pool Escape Cover Index-2012 | Pool Escape Cover Index-2013 | Pool Escape Cover Index-2014 | Pool Escape Cover Index-2015 | Pool Escape Cover Index-2016 | Pool Escape Cover Index-2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aptos #2/#3- in County Park | 1.0/ 2.4 | 1.0/ 2.5 (Site Δ) | 0.85/ 1.75 (Site Δ) | 0.8/ 1.55 | 1.0/ 2.2 | 0.85/ 1.7 | 1.6/ 3.4 | 0.183 | 0.055 | 0.080 (Site Δ) | 0.179 (Site Δ) | 0.186 | 0.185 | 0.241 | 0.353 Tree down |
| Aptos #3/#4- Above Steel Br | 1.35/ 3.25 | 1.1/ 2.05 | 0.85/ 2.4 | 0.85/ 1.45 (Site Δ) | 1.35/ 2.7 | 0.85/ 1.85 | 2.65/ 4.2 | – | 0.156 | 0.177 | 0.170 | 0.064 (Site Δ) | 0.128 | 0.043 | 0.183 |
| Valencia #2/#2- Below Valencia Road | – | – | – | 0.15/ 0.4 Mostly run | – | 0.25/1.2 Run-riffle | 0.6/1.5 Pool-run-riffle | 0.156 | – | – | – | 0.015 mostly run | – | 0.28 Run-riffle | 0.187-Pool-run-riffle |
| Valencia #3/#3- Above Valencia Rd | – | – | – | 0.35/ 0.8 | – | 0.5/ 1.4 | 1.0/ 2.7 | 0.250 | – | – | – | 0.049 | – | 0.079 | 0.443 |
| Corralitos #0/#0- Below Dam | | | | | | 0.8/ 1.4 | 1.4/ 2.1 (Site Δ) | | | | | | | 0.131 | 0.134 (Site Δ) |
| Corralitos #1/#1- Below Dam | 0.9/ 1.25 | 1.05/ 1.4 | 0.85/ 1.7 (Site Δ) | 0.9/ 1.65 | 0.9/ 1.55 | 0.75/ 1.2 | 1.65/ 2.9 (Site Δ) | 0.087 | 0.120 | 0.156 | 0.083 | 0.111 | 0.109 | 0.124 | 0.123 (Site Δ) |
| Corralitos #3/#3- Above Colinas Rd | 0.95/ 1.95 | 1.35/ 2.2 (Site Δ) | 1.4/ 2.25 | 0.85/ 2.1 (Site Δ) | 1.1/ 2.1 | 1.4/ 2.4 | 1.85/ 2.8 | 0.173 | 0.231 | 0.121 (Site Δ) | 0.128 | 0.206 (Site Δ) | 0.150 | 0.160 | 0.187 |
| Corralitos #5-6//#8- Below Eureka G | 1.0/ 1.85 | 0.7/ 1.05 | 0.45/ 0.95 | 0.5/ 0.9 | 1.05/ 2.05 (Site Δ) | 0.85/ 1.75 | 1.25/ 2.4 | 0.048 | 0.033 | 0.061 | 0.053 | 0.067 | 0.054 | 0.173 | 0.160 |
| Corralitos #7/#9- Above Eureka G | 1.0/ 1.8 | 1.0/ 1.6 | 0.9/ 1.3 | 0.6/ 1.3 (Site Δ) | 0.7/ 1.3 | 0.9/ 1.5 | 1.2/ 1.9 | | 0.112 | 0.148 | 0.133 | 0.092 (Site Δ) | 0.102 | 0.133 | 0.258 |
| Shingle Mill #1/#1- Below 2nd Xing | 0.9/ 1.4 | 0.8/ 1.3 | 0.8/ 1.2 | 0.8/ 1.2 | – | – | 0.9/ 1.3 | 0.296 | 0.310 | 0.357 | 0.397 | 0.220 | – | – | 0.406 |
| Shingle Mill #3/#3- Above 3rd Xing | 1.0/ 1.5 | 0.9/ 1.4 | 1.0/ 1.7 | 0.9/ 1.4 | – | – | 1.3/ 1.9 | 0.139 | 0.173 | 0.145 | 0.168 | 0.233 | – | – | 0.344 |
| Browns Valley #1/#2- Below Dam | 1.3/ 2.05 | 1.1/ 1.6 | 1.5/ 2.3 (Site Δ) | 1.35/ 2.05 | 1.35/ 2.15 | 1.35/ 2.3 | 1.45/ 2.35 | 0.125 | 0.187 | 0.201 | 0.283 (Site Δ) | 0.219 | 0.255 | 0.267 | 0.374 |
| Browns Valley #2/#2- Above Dam | 1.35/ 1.85 | 1.25/ 1.8 | 1.3/ 1.75 (Site Δ) | 0.9/ 1.9 | 0.8/ 1.45 | 0.95/ 1.9 (Site Δ) | 1.1/ 1.8 | 0.243 | 0.203 | 0.272 | 0.210 (Site Δ) | 0.213 | 0.209 | 0.284 (Site Δ) | 0.174 |

*** Habitat typing method = total feet of linear pool cover divided by total sampled length as pool habitat in site.**

**Table 13. Habitat Change in Replicated Sites in the APTOS WATERSHED and Reaches and Replicated Sites in the CORRALITOS WATERSHED.**

| Reach Comparison or (Site Only Comparison) | Baseflow | Pool Depth | Pool Fine Sediment | Pool Embeddedness | Pool Escape Cover | Overall Habitat Change |
|---|---|---|---|---|---|---|
| (Aptos Site 3) Aptos 3 | + | + | Similar | Similar | + | + |
| (Aptos Site 4) Aptos 4 | + | + | + | Similar | + | + |
| (Valencia Site 2) Valencia 2 | + | + | Similar | Similar | + | + |
| (Valencia Site 3) Valencia 3 | + | + | + | Similar | + | + |
| Corralitos Site 1 Corralitos R-1 | + | + | + | Similar | + | + |
| (Corralitos Site 3) Corralitos R-3 | + | + | Similar | + | + | + |
| (Corralitos Site 8) Corralitos R- 5/6 | + | + | − | Similar | − | + |
| Corralitos Site 9 Corralitos R-7 | + | + | Similar | + | Similar | + |
| (Shingle Mill Site 1) | + | + | Similar | Same | + | + |
| (Shingle Mill Site 3) above fault line | + | + (Slightly) | Similar | Similar | + | + |
| (Browns Site 1) Brown R-1 | + | + | Similar | Similar | + | + |
| (Browns Site 2) Brown R-2 | + | + avg. depth; − max depth | Similar | Similar | − | + |

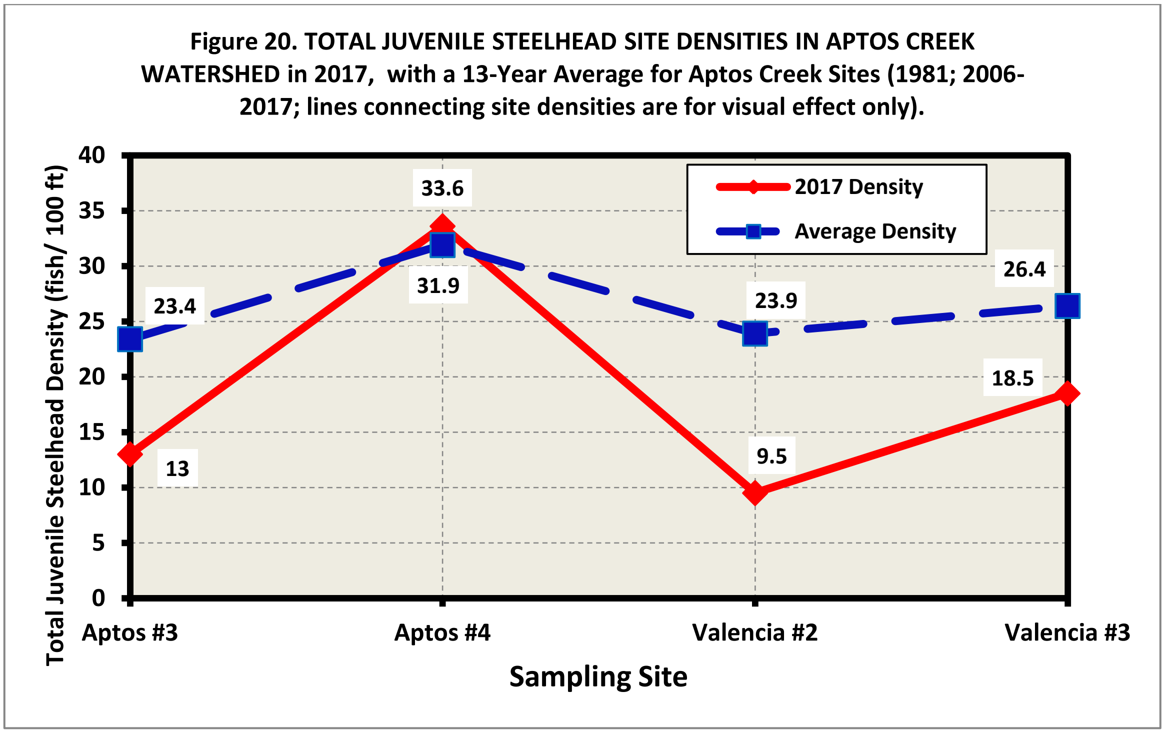


**Figure 20. Total Juvenile Steelhead Site Densities in Aptos Creek in 2017, with a 13-Year Average (1981; 2006-2017).**

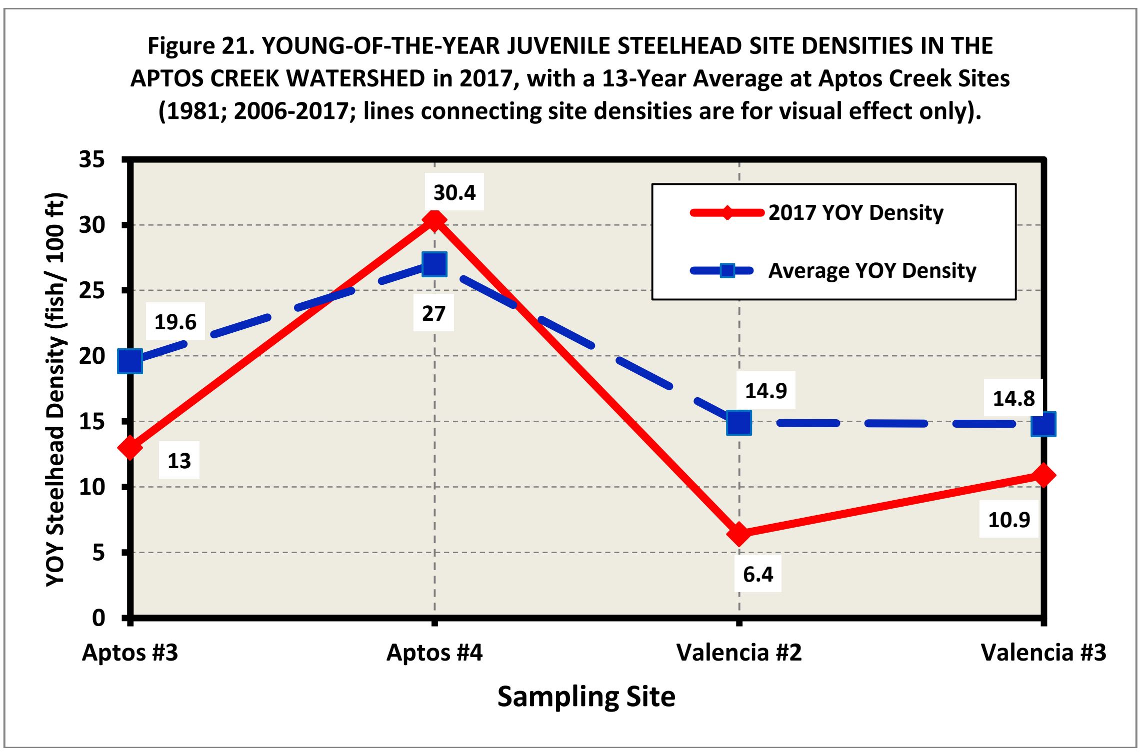


**Figure 21. Young-of-the-Year Steelhead Site Densities in Aptos Creek in 2017, with a 13-Year Average (1981; 2006-2017).**

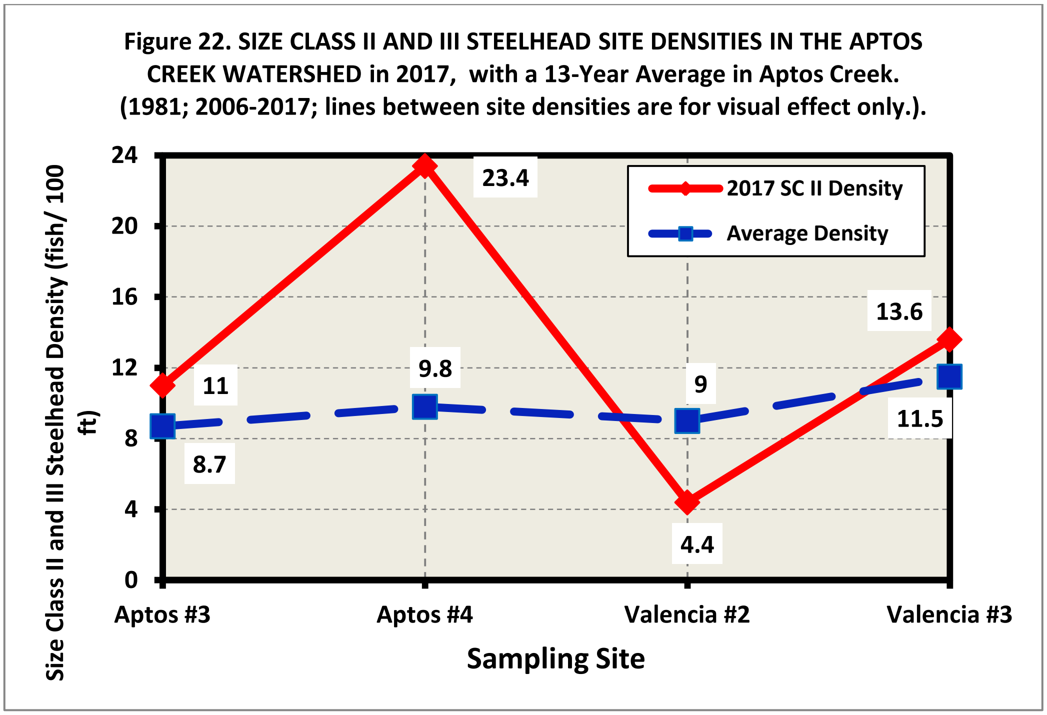


**Figure 22. Size Class II and III Steelhead Site Densities in Aptos Creek in 2017, with a 13-Year Average (1981; 2006-2017).**

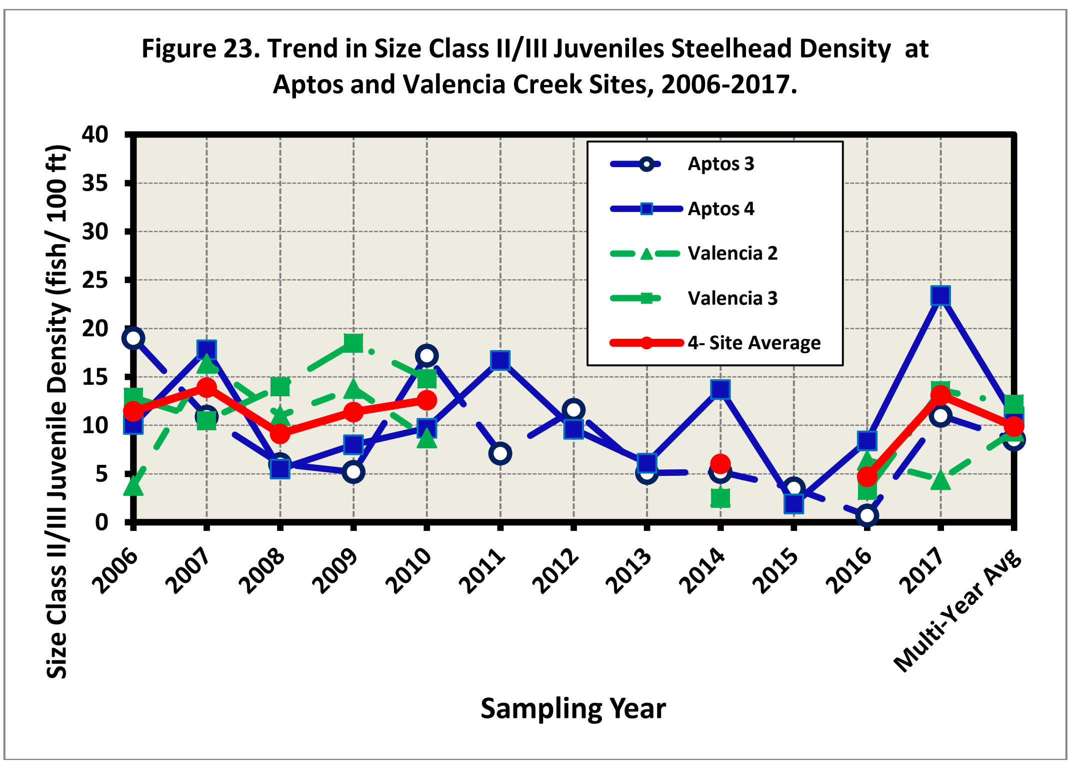


**Figure 23. Trend in Size Class II/III Juveniles Steelhead Density at Aptos and Valencia Creek Sites, 2006-2017.**

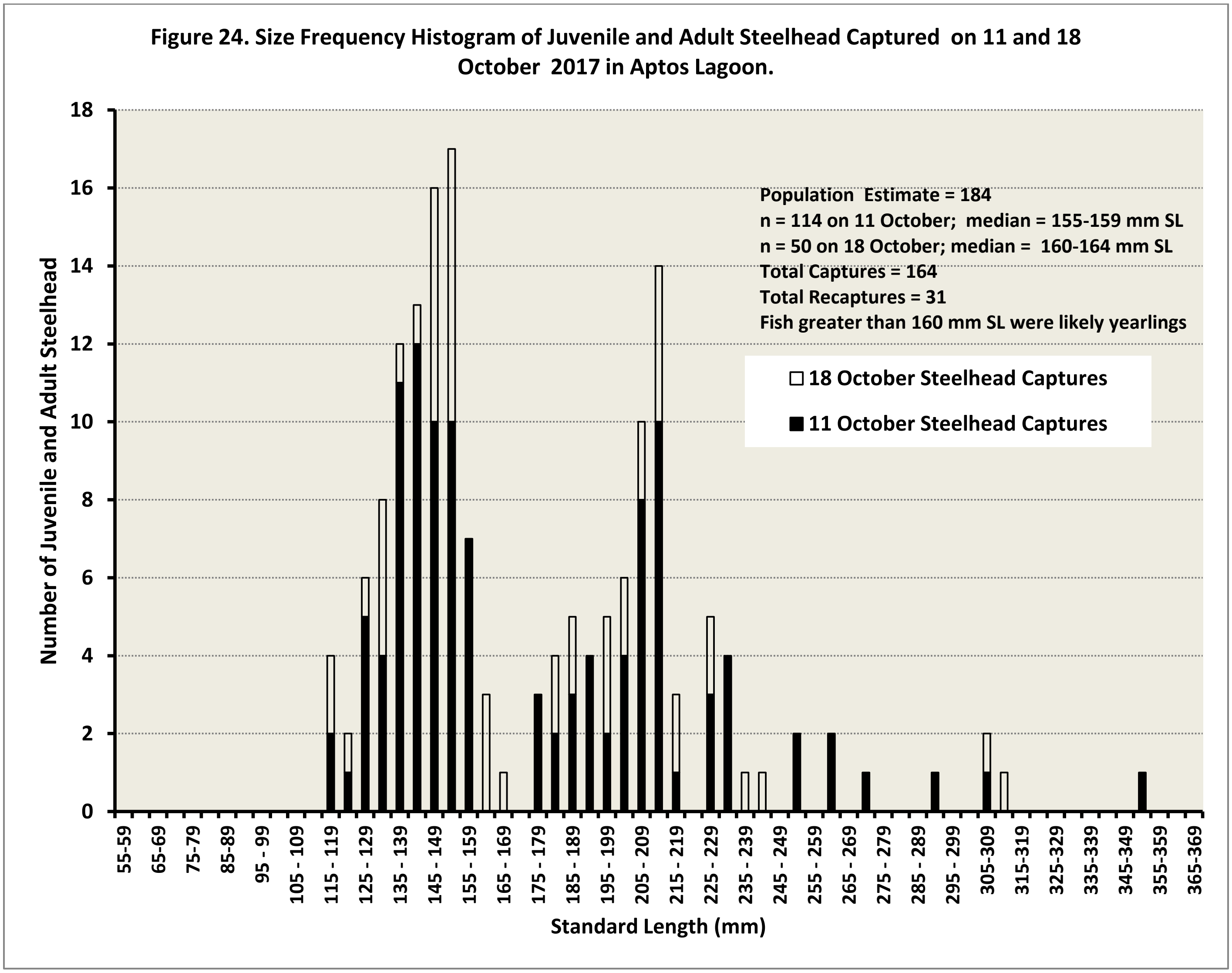


**Figure 24. Size Frequency Histogram of Juvenile and Adult Steelhead Captured in Aptos Lagoon, October 2017.**

## ***iv. Steelhead Abundance and Habitat in the Corralitos and Casserly Creek Sub-Watersheds***

**1.** Baseflow in 2017 was much above the median flow after 8 stormflows likely above bankfull in the December−February period (1,420−2,420 cfs range), followed by 5 moderate stormflows after March 1 (**Figures 25 and 26**). It was the highest baseflow since 2006 (See County Website and past reports), and surface flow reached the Freedom gage throughout the dry season, though it was intermittent immediately below Reach 0 (**Figure 27).** Adult steelhead spawning access to Corralitos and Browns creeks was good, and adult steelhead successfully passed above diversion dams on Browns and Corralitos creeks in 2017.

**2.** Overall habitat quality improved in the Corralitos-Browns-Shingle Mill sub-watershed in 2017 due to increased baseflow throughout and increased pool depth and escape cover at 7 of 8 replicated sites/ reaches (**Tables 12 and 13** above). Site numbers do not necessarily correspond to reach numbers because in earlier sampling years, more than one site was sampled per reach. Site 8 in Corralitos Creek canyon had a large tree trunk with rootwad providing significant escape cover in a sampled pool. There was little indication of increased pool sedimentation with increased pool depth and percent fines (20-58% range) and embeddedness (38-70% range) remaining similar to past conditions or improved. An exception was upper Browns Site 2, which had reduced maximum pool depth and less pool escape cover. Percent fines increased in Corralitos Site 8 pools. Most juvenile steelhead growth occurs in the spring-early summer when baseflow is higher and most important. With much higher streamflow in 2017, there was undoubtedly more food and faster growth rate in all reaches in 2017 than any year since 2006, especially when juvenile densities were low.

**3.** In 2017, ***total and YOY juvenile densities*** were above average at 5 of 9 sites, with overall higher densities at Corralitos sites (except Corralitos 1) than in Shinglemill and Browns creeks (**Figures 28 and 29**). Comparisons for Shinglemill were from 2014 and 2017. Total densities at sites ranged between 22.5 juveniles/ 100 ft in Browns Site 2 and 43.6 juveniles/ 100 ft in Corralitos Site 0. The trend in total densities (mostly YOY fish) for the 6-site average in Corralitos and Browns creek sites increased in 2017 from 2016 to 31.9 juveniles/ 100 ft but was still slightly below the 10-year average (**Figure 30**). Total and YOY densities increased considerably at all sites in the Corralitos-Browns sub-watershed in 2017 compared to 2016.

**4.** In 2017, ***yearling juvenile densities*** increased at 2 of 9 sites (2 sites− density unchanged) because of few 2016 YOY and possible early smolting in spring with high flows and rapid growth rate. Densities ranged from 2.7 at Corralitos 3 to 10.2 at Corralitos 8, averaging 5.6 yearlings/ 100 ft.

**5.** In 2017, ***Size Class II/III densities*** were above average for the 5 Corralitos sites and below average for the 4 Shinglemill and Browns sites (**Figure 31**). The trend in soon-to-smolt densities increased in 2017, with the 6-site average of 12.9 fish/ 100 ft and almost double the 6.6 fish/ 100 ft average in 2016 (**Figure 32**). The 2017 6-site average was above the 11-year average, resulting from ¼ to ½ of YOYs reaching Size Class II at Corralitos sites from modest YOY site densities (**Figure 29**). With relatively high baseflow (more food) and moderate competition from slightly below averaged total juvenile densities at sites, many YOY reached Size Class II.

**6.** Regarding sampling site ratings based on soon-to-smolt densities, 6 sites were rated “5” (good) and

3 were rated “4” (fair) (**Table 2** above). Seven of the 9 sites had average soon-to-smolt size greater than 102 mm SL, indicating good growth rate.

7. Total, YOY and Size Class II/III steelhead density in Casserly Creek increased slightly in 2017 compared to 2016 (**Figures 28, 29 and 31**). Total and YOY densities were close to the average for the upper Corralitos-Browns sub-watershed site densities. However, the Size Class II/III density at the Casserly Creek site was at the lower end of the range because few YOY reached Size Class II because of the small channel size and limited streamflow (food). Nearly all larger fish were yearlings or older and likely included resident rainbow trout.

8. The increases in total, YOY and Size Class II/III densities from 2016 to 2017 in the Corralitos-Browns subwatershed were statistically significant, using the paired t-test for replicated sites.

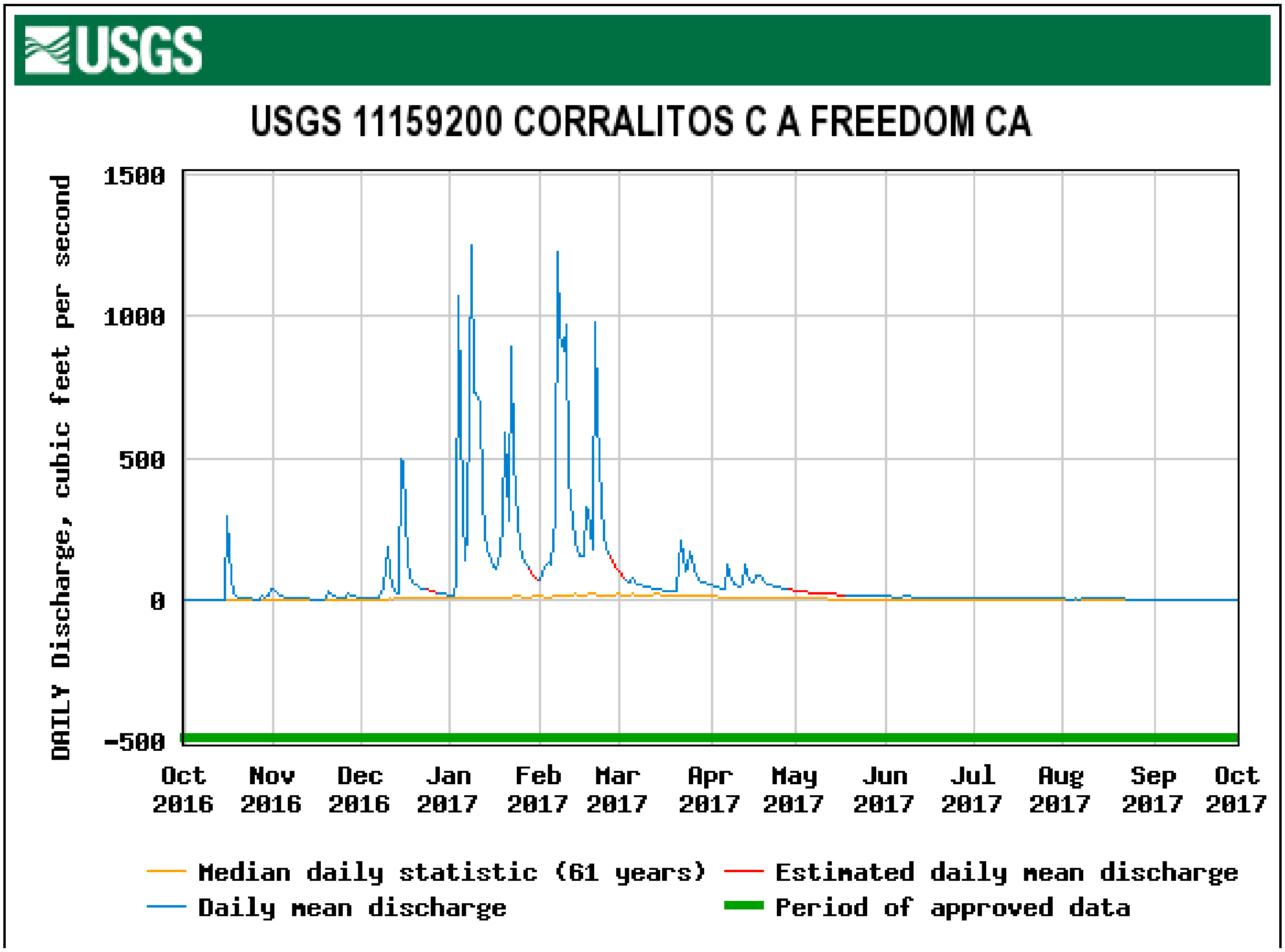


**Figure 25. The 2017 Daily Mean and Median Flow at the USGS Gage on Corralitos Creek at Freedom.**

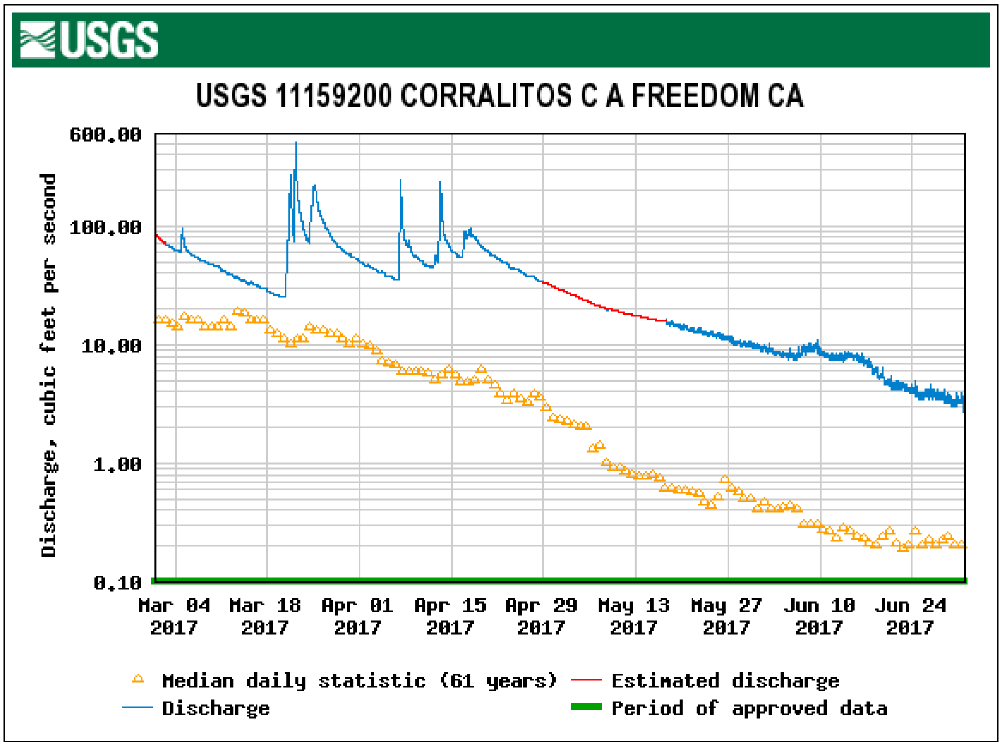


**Figure 26. The March−June 2017 Discharge at the USGS Gage on Corralitos Creek at Freedom.**

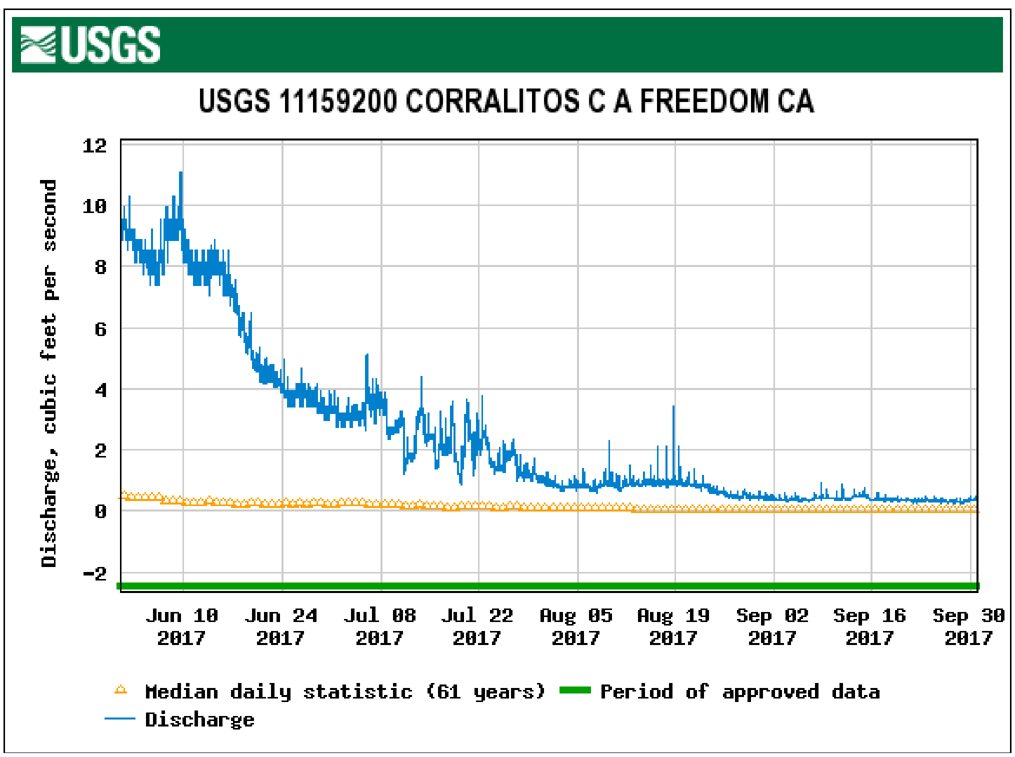


**Figure 27. The June−September 2017 Discharge at the USGS Gage on Corralitos Creek at Freedom.**

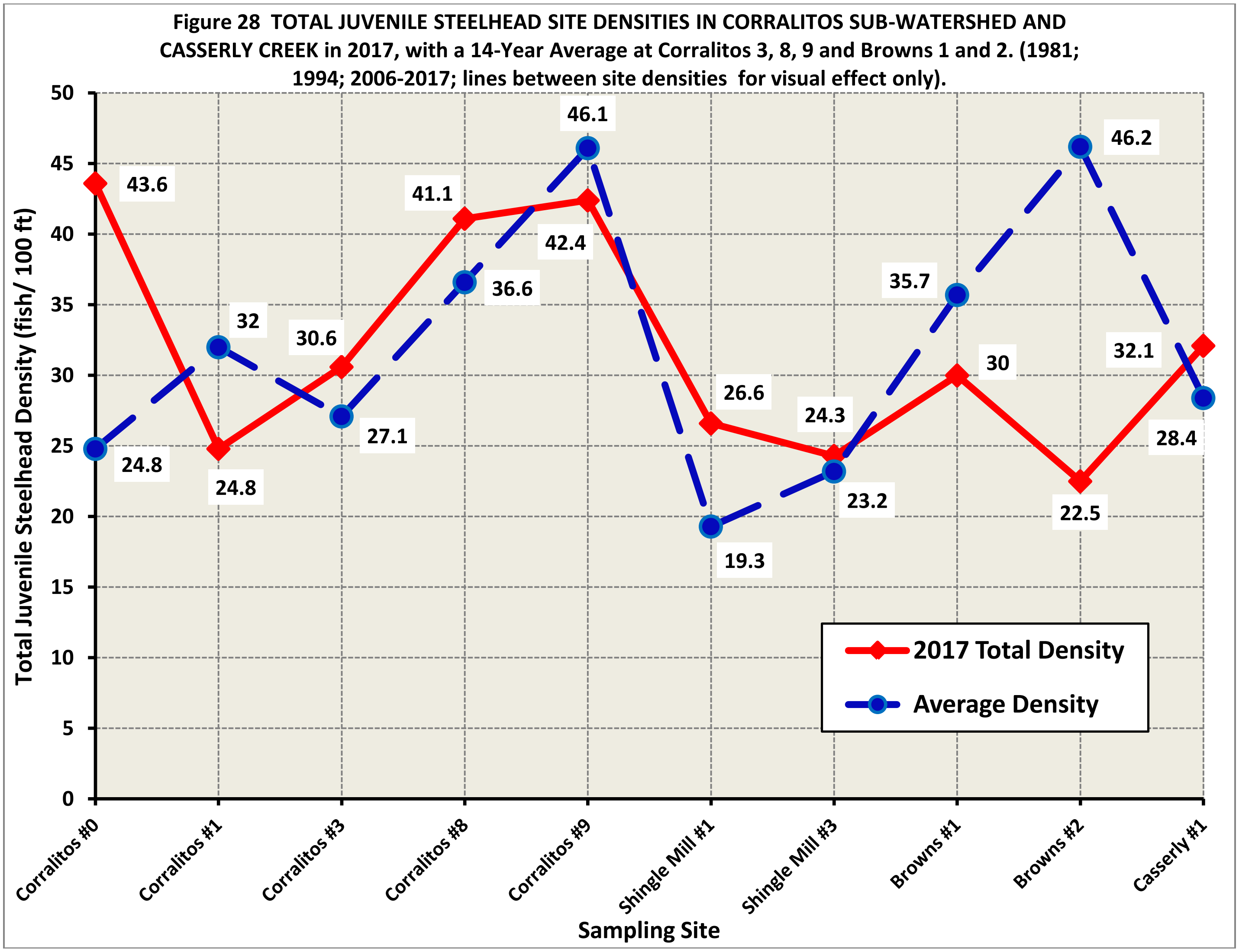


**Figure 28. Total Juvenile Steelhead Site Densities in Corralitos, Browns and Casserly Creeks in 2017, with a 14-Year Average (1981; 1994; 2006-2017).**

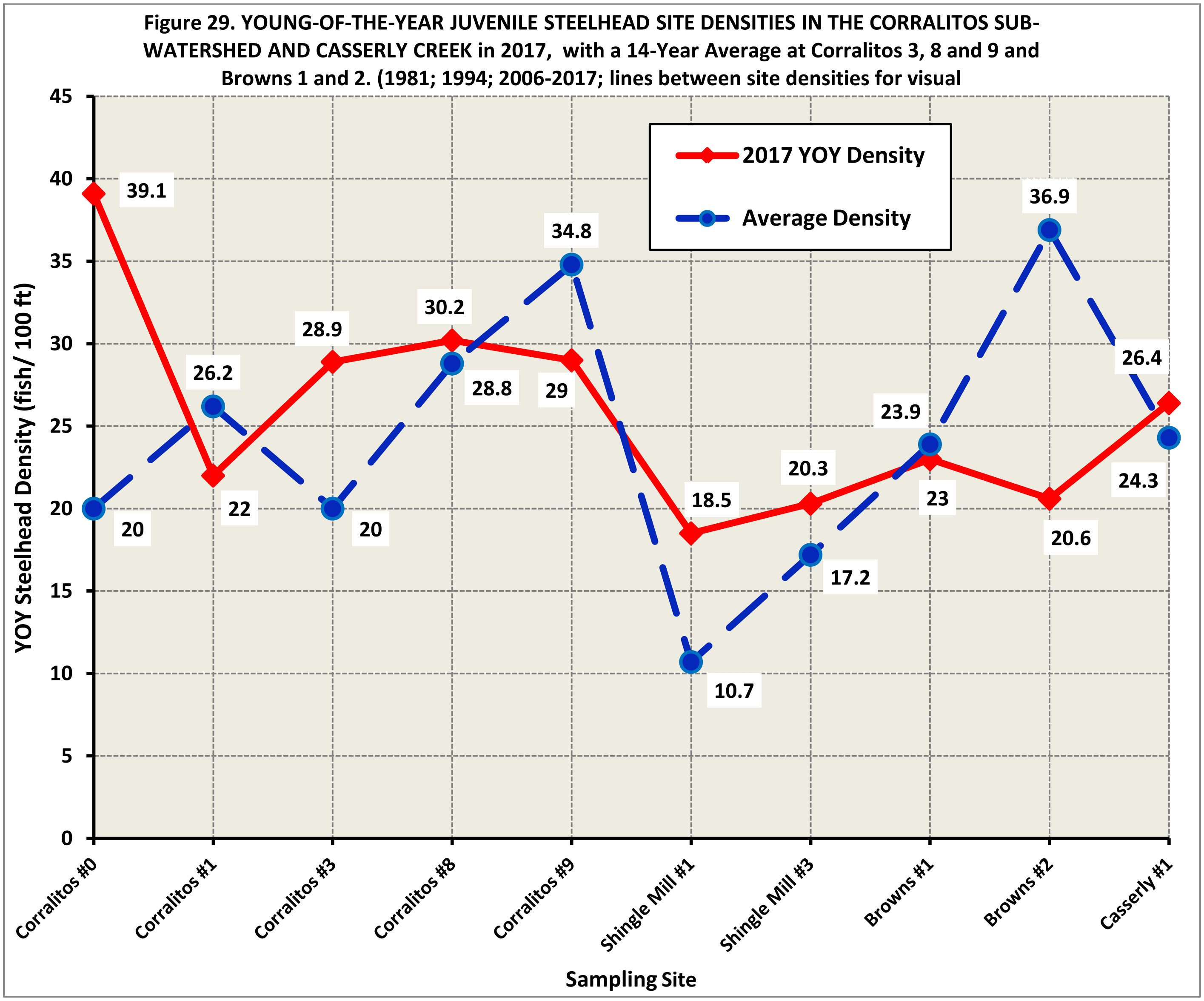


**Figure 29. Young-of-the-Year Steelhead Site Densities in Corralitos, Browns and Casserly Creeks in 2017, with a 14-Year Average (1981; 1994; 2006-2017).**

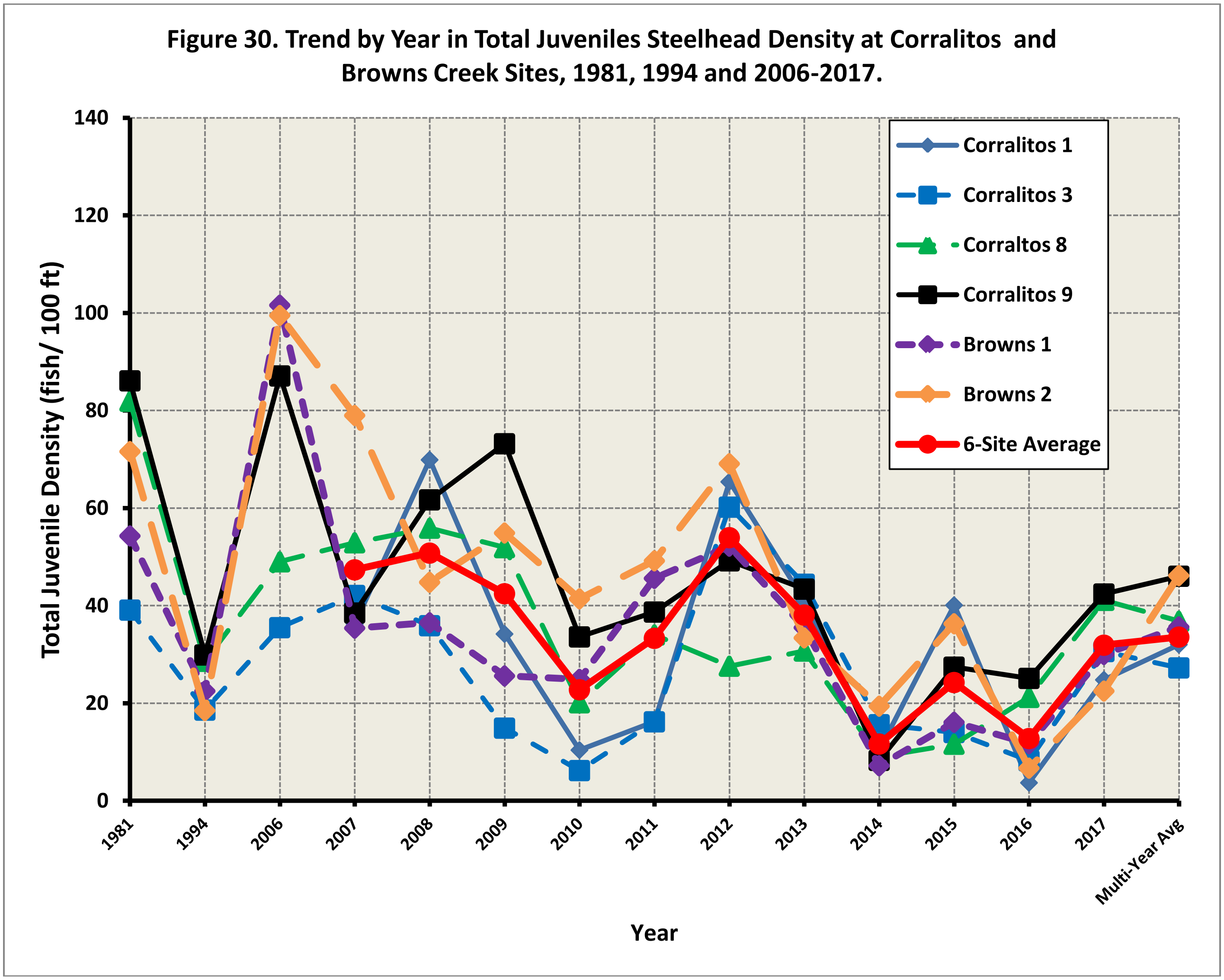


**Figure 30. Trend by Year in Total Juveniles Steelhead Density at Corralitos and Browns Creek Sites, 2006-2017.**

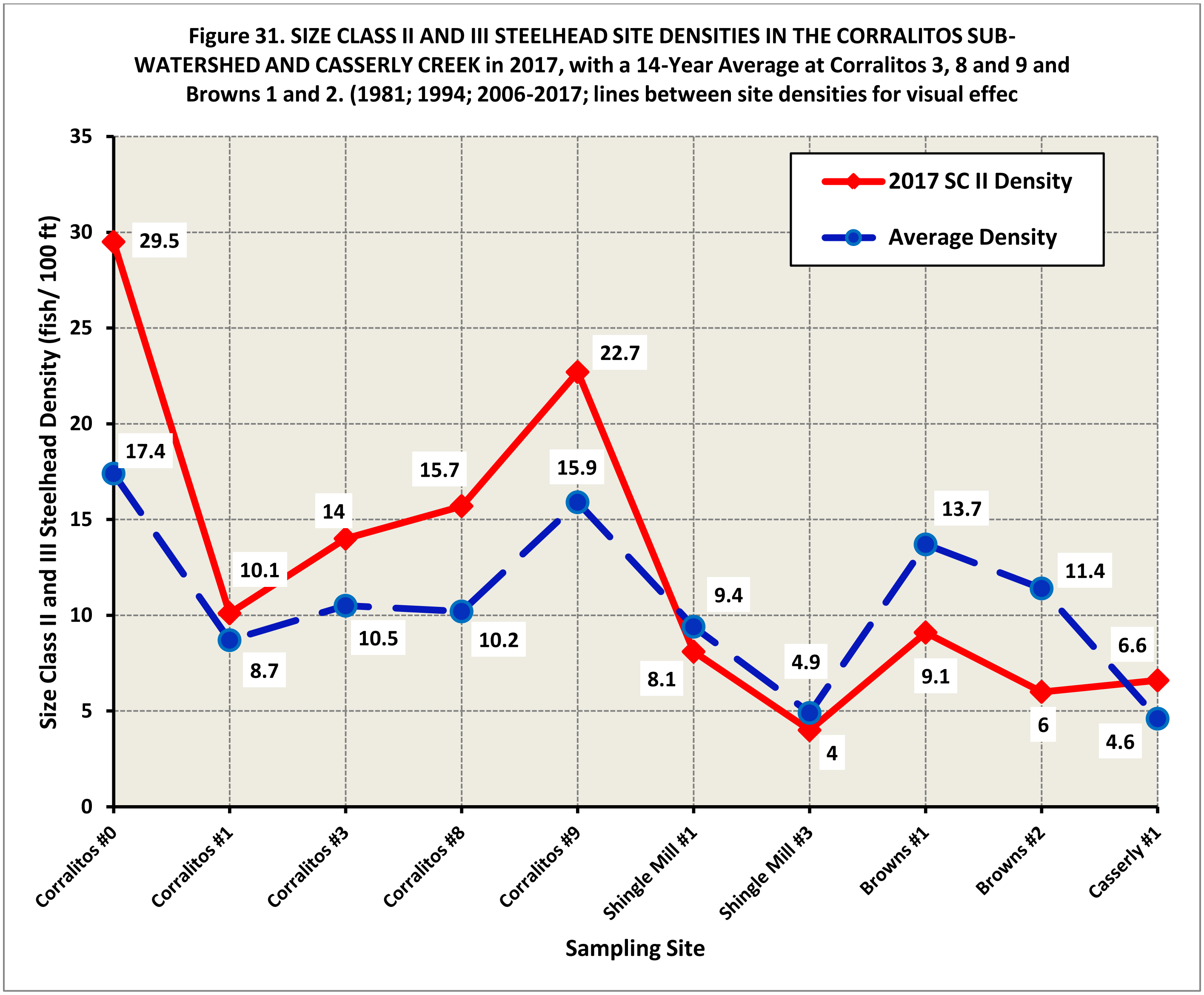


**Figure 31. Size Class II and III Steelhead Site Densities in Corralitos and Browns Creeks in 2017, with a 14-Year Average (1981; 1994; 2006-2017).**

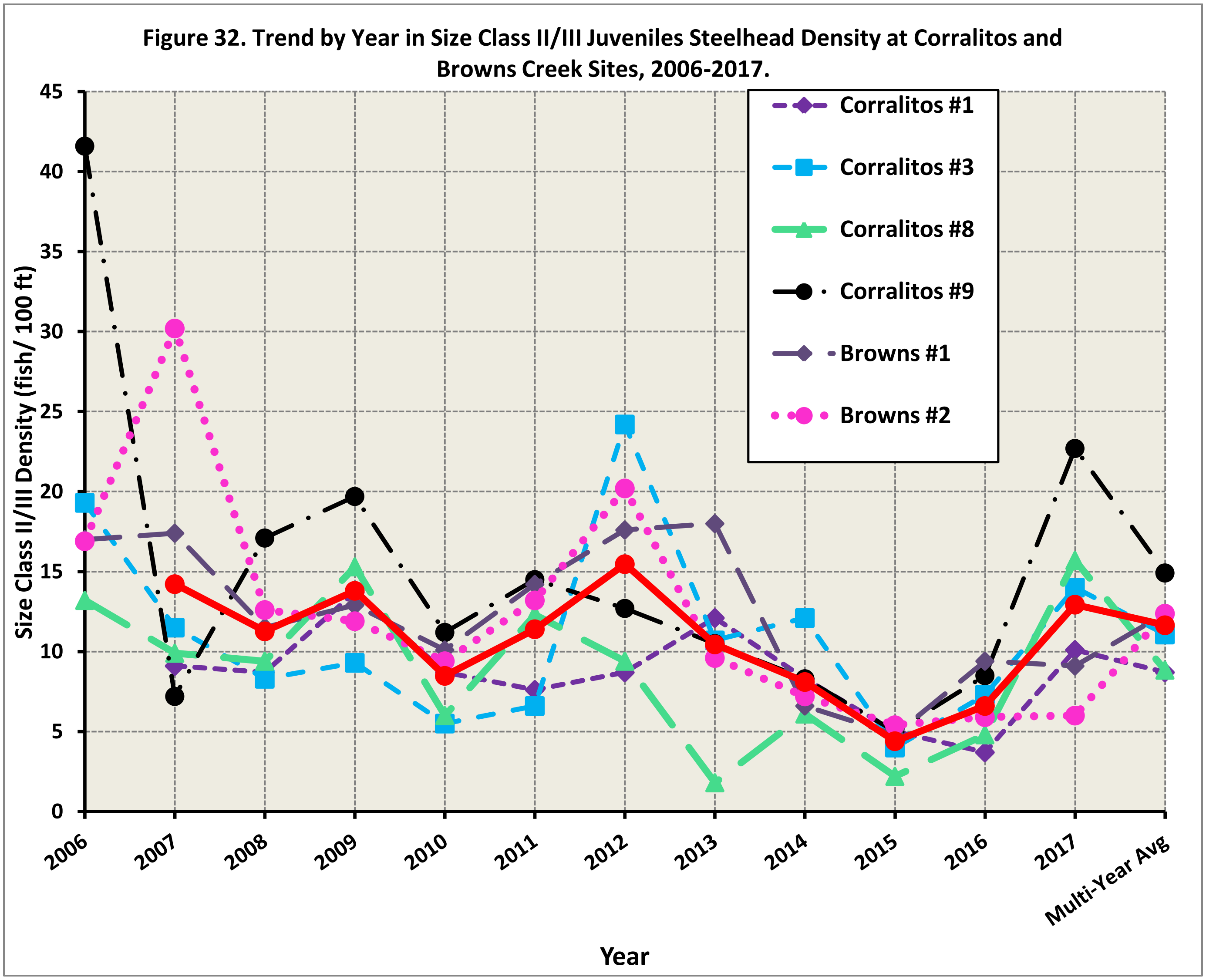


**Figure 32. Trend by Year in Size Class II/III Juveniles Steelhead Density at Corralitos and Browns Creek Sites, 2006-2017.**

## *v. Steelhead and Tidewater Goby Abundance and Habitat in the Pajaro River Lagoon*

A more detailed report of the fish sampling results and water quality conditions at Pajaro Estuary in 2017 is available from Santa Cruz County Environmental Health Department. No steelhead (nor striped bass) were detected in the Pajaro Estuary in 2017. With its daily tidal influence, the estuary was less favorable to juvenile steelhead for rearing and tidewater goby for spawning than a deeper freshwater lagoon would be without daily depth fluctuation and stratification of oxygen and water temperature. The estuary had high saline content throughout the water column and evidence of temporal oxygen fluctuations. Though oxygen concentrations were not prohibitively low for steelhead by late morning during sampling, they may have been stressfully low near the bottom near dawn, forcing steelhead to near the surface where they would be more vulnerable to predation. It appeared from the very limited water quality measurements, water temperature was prohibitively high for steelhead in the upper estuary from the airport upstream but tolerable for steelhead in the lower estuary along the beach. While water quality data were not collected throughout the summer and during periods of sandbar closure, habitat conditions for steelhead could have become difficult when the sandbar closed temporarily to form a lagoon with little stream inflow. After sandbar closure, trapped saltwater would create a stratified water column with higher water temperatures throughout and lower oxygen levels at greater depth. Much of the Pajaro Estuary was less than 1.25 meters deep at water quality stations, with a narrow thalweg present nearby in the lower estuary that was somewhat deeper.

A very small population of tidewater goby still existed in Pajaro Estuary in fall 2017, but again appeared absent in the lower estuary along the beach, as was the case in 2015 and 2016. Algae and submerged vegetation appeared absent in the lower estuary in the past 3 years. After a high flow winter of 2016−2017, only 1 tidewater goby was captured at the model airport site, with none detected at Thurwachter Bridge or the boat ramp where they were abundant in earlier years. Some tidewater gobies may have been flushed from the estuary during high stormflows during the winter, leaving a small population during the dry season. Water quality was adequate for tidewater goby survival during the dry season, though oxygen may have been low at times in some locations. They spawn along freshwater margins, which were absent at sampling sites in the 2017 estuary. Freshwater habitat may have existed at the very upper end of the estuary where the River entered the estuary during the dry season.

# REFERENCES AND COMMUNICATIONS

**Alley, D.W. 1995a.** Comparison of Juvenile Steelhead Densities in 1981 and 1994 with Estimates of Total Numbers of Mainstem Juveniles and Expected Numbers of Adults Returning to the San Lorenzo River, Soquel Creek and Corralitos Creek, Santa Cruz County, California.

**Alley, D.W. 1995b.** Comparison of Juvenile Steelhead Densities in 1981, 1994 and 1995 with an Estimate of Juvenile Population Size in the Mainstem San Lorenzo River, with Expected Numbers of Adults Returning from Juveniles Rear in the Mainstem River, Santa Cruz County, California.

**Alley, D.W. 1997.** Baseline Monitoring of Steelhead and Water Quality in Carbonera Creek for the Scotts Valley Water District Pilot Program of Groundwater Recharge, Santa Cruz County, CA.

**Alley, D.W. 2000.** Comparisons of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions for the San Lorenzo River, Santa Cruz County, California, 1995-1999; with an Index of Adult Returns.

**Alley, D.W. 2003a.** Comparison of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions in Soquel Creek, Santa Cruz County, CA, 1997-2002; with Index of Expected Adult Returns.

**Alley, D.W. 2003b.** Appendix C. Fisheries Assessment. Contained in the Soquel Creek Watershed Assessment and Enhancement Project Plan. November 2003. Prepared by D.W. ALLEY & Associates for the Resource Conservation District of Santa Cruz County.

**Alley, D.W. 2004.** Comparison of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions in Soquel Creek, Santa Cruz County, CA, 1997-2003; with Index of Expected Adult Returns.

**Alley, D.W. 2005.** Comparison of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions in Soquel Creek, Santa Cruz County, California, 1997-2004; with an Index of Adult Returns.

**Alley, D.W. 2008.** 2007 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With Trend Analysis in the San Lorenzo and Soquel Watersheds, 1997-2007.

**Alley, D.W. 2017.** 2016 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California.

**Alley, D.W. 2018.** Soquel Lagoon Monitoring Report, 2017. Prepared for the City of Capitola.

**Bond, M. H. 2006.** Importance of Estuarine Rearing to Central California Steelhead (Oncorhynchus mykiss) Growth and Marine Survival. Master's Thesis. Ecology and Evolutionary Biology. U.C.S.C.

**Casagrande, J. 2010.** Distribution, Abundance, Growth and Habitat Use of Steelhead in Uvas Creek, CA. Master's Thesis. Department of Biological Sciences. San Jose State University.

## **REFERENCES AND COMMUNICATIONS** (continued)

**Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey and B. Collins. 1998.** California Salmonid Stream Habitat Restoration Manual. State of California Resources Agency, Department of Fish & Game.

**Freund, E. 2005. Personal Communication.** NOAA Fisheries Laboratory, Santa Cruz, CA.

**Hecht, Barry. 2002. Personal Communication**. Geomorphologist. Balance Hydrologics. 800 Bancroft Way, Suite 101, Berkeley, CA 94710-2227. Phone no. 510-704-1000.

**H.T. Harvey & Associates. 2003.** Salmonid Monitoring in the San Lorenzo River, 2002. Prepared for the City of Santa Cruz. Project No. 2163-01.

**Holloway, Randall. 2011.** Water Temperature Data for San Lorenzo Watershed Sites in 2009 and 2010. City of Santa Cruz Water Department.

**Kittleson, Kristen. 2015a.** Draft Upper San Lorenzo River Mainstem Fish Passage Survey, 2012-2104. Santa Cruz County Environmental Health Department.

**Kittleson, Kristen. 2015b.** Draft Branciforte Creek Fish Passage Survey, 2012-2104. Santa Cruz County Environmental Health Department.

**Smith, J.J. 1982.** Fish Habitat Assessments for Santa Cruz County Stream.  Prepared for Santa Cruz County Planning Department by Harvey and Stanley Associates.

**Smith, J.J. and H.W. Li. 1983.** Energetic factors influencing foraging tactics of juvenile steelhead trout (Salmo gairdneri), D.L.G. Noakes et al. (4 editors) in The Predators and Prey in Fishes. Dr. W. Junk publishers, The Hague, pages 173-180.

**Smith, Jerry J. 2005. Personal Communication.** Biology Department. San Jose State University, San Jose, CA. Phone no. 408-924-4855.

**Smith, J.J. 2016.** Distribution and Abundance of Juvenile Coho and Steelhead in Gazos, Waddell and Scott Creeks in 2016. Dept. of Biological Sciences. San Jose State University.

**Sogard, S.M., T.H. Williams and H. Fish. 2009.** Seasonal Patterns of Abundance, Growth, and Site Fidelity of Juvenile Steelhead in a Small Coastal California Stream. Transactions of the American Fisheries Society 138:549–563.