D.W. ALLEY & Associates aquatic biology

2013 SUMMARY REPORT− Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, CA

Excellent Escape Cover beneath Old Growth Redwood Providing Undercut Bank– Headwaters of Branciforte Creek

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A. EXECUTIVE SUMMARY

In fall 2013, 4 Santa Cruz County watersheds were sampled for juvenile steelhead to compare juvenile abundance and habitat conditions with past years. Watersheds included the San Lorenzo River, Soquel Creek, Aptos Creek and Corralitos Creek. Both Aptos and Pajaro Lagoons were also sampled. Thanks to local water agencies and municipalities, we began sampling the San Lorenzo in 1994. We have sampled Soquel Creek annually since 1997 and in 1994. Our annual sampling of Aptos and Corralitos creeks began in 2006, with previous sampling of Aptos in 1981 and Corralitos in 1981 and 1994.

i. Steelhead Abundance in All Watersheds

Water Year (WY) 2013 streamflows in spring and early summer were much below the median daily streamflow statistic after a mostly dry, mild winter. Two stormflows occurred in December which were approximately 2 to 3 times the bankfull flow. For the remainder of the winter and spring, only two minor stormflows of less than 200 cfs came in March and early April at the Big Trees Gage on the San Lorenzo River. With this hydrograph, steelhead spawning likely occurred early and then late, after March 1. With the late minor storms in the second mild winter in a row, small young-of-the-year steelhead (YOY) were locally much above average abundance at some sites in the larger San Lorenzo and Soquel watersheds, but not in Aptos or Corralitos.

The wide variation in YOY densities within watersheds, with high densities at some sites and low densities at others relative to the long term average, indicated that there were insufficient late adult spawners to saturate habitat after limited, localized spawning effort. Adult fish passage opportunities were limited during the mild 2012-2013 winter with few storm events after December, but spawning access appeared to be successful with good YOY survival at most upper tributary sites after the December 2012 storms. Exceptions were to the upper mainstem San Lorenzo, Bear Creek, and upper East Branch Soquel. YOY abundance and total juvenile densities were mostly above average in Soquel Creek (except in the SDSF) and mostly below average in the Aptos and Corralitos watersheds. YOY densities were below average in Browns Creek. However, this may have resulted from food shortage accompanying very low baseflow.

Few YOY grew into Size Class II to become the soon-to-smolt group because food was in short supply, resulting from low baseflow. Also, yearling survival/retention was poor over the 2012−2013 winter except at upper tributary sites, presumably due primarily to mortality from large stormflows in December 2012, with some yearlings likely migrating in spring before sampling due to high water clarity and efficient feeding in the absence of turbid stormflows. The smaller Aptos and Corralitos drainages had better yearling survival/retention than the larger San Lorenzo and Soquel watersheds. Loss of yearlings in 2013 was unlike the previous mild winter which had only one stormflow approaching bankfull, which resulted in higher yearling densities in fall 2012. In 2013, with poor yearling survival and slow YOY growth rates, densities of soon-to-smolt size classes (II and III) were below average at most sites throughout the 4 watersheds. Aptos Estuary had a relatively small steelhead population in 2013 under highly stratified, poor water quality conditions, and no steelhead were detected in Pajaro Estuary for the second year.

Rearing habitat quality declined at the majority of sites in 2013 due to decreased streamflow (less food), shallower habitat and often less escape cover. However, escape cover remained similar or improved in the Aptos and Corralitos drainages, though habitat quality declined overall. Exceptions to the shallowing trend occurred where good scour objects existed and sediment was transported out by the large December 2012 storms. Of the 38 sites/ reaches examined, 12 had deeper pool habitat than the previous data collection time, despite lower baseflow. This was due to the presence of good scour objects except at the lower San Lorenzo Site 0a between the levees, where the sandy streambed was rearranged with different hydraulic controls created.

Densities of the important Size Class II and III steelhead were generally below average in the San Lorenzo watershed, except for near average or above average at uppermost tributary sites. Densities of these soon-to-smolt sized juveniles were below average at all sites in Soquel and Aptos creeks and below average in 5 of 7 sites in the Corralitos sub-watershed. Twenty-four of 38 sites (63%) had reduced soon-to-smolt-size rating from 2012, primarily due to reduced YOY growth rate and/or fewer yearlings surviving in 2013.

Table S-1. Summary of Sampling Site Ratings in 2006–2013, based on Potential Smolt-Sized Densities.

Year	Very Poor	Poor	Below Average	Fair	Good	Very Good
2006 (n=34)	1	6	5	11	10	1
2007 (n=37)	5	2	12	12	6	0
2008 (n=36)	5	6	9	10	6	0
2009 (n=37)	2	4	11	13	6	1
2010 (n=39)	0	1	9	16	12	1
2011 (n=37)	1	2	7	18	8	1
2012 (n=38)	2	1	6	9	17	3
2013 (n=38)	5	6	10	9	7	1

ii. Steelhead Abundance and Habitat in the San Lorenzo River Watershed

In the lower and middle mainstem in fall 2013, overall habitat quality declined at most replicated sampling sites and reaches (as it did in 2012 compared to the wet year 2011) primarily due to decreased baseflow, shallower fastwater habitat and less escape cover. The average mean monthly streamflow for May–September in 2013 at the Big Trees gage was the lowest in 17 years of calculations (16 cfs with a 17-year average of 38 cfs). The exception to reduced habitat quality was the lowermost site between the levees where rearing habitat in pools improved, though fastwater habitat was largely absent. Seven of 12 wetted tributary reaches and sites had reduced habitat quality primarily due to reduced baseflow, generally shallower pool habitat and less pool escape cover. Five tributary sites/reaches had improved habitat quality (mostly deeper pools and more escape cover) despite reduced streamflow, except where baseflow was artificially managed in Newell Creek and in the lower San Lorenzo below the Tait Street diversion. A relatively low percentage of YOY reached Size Class II in 2013 (also in 2012) due to late spawning combined with below median baseflows in spring, summer and fall in the usually fast-growth sites of the lower mainstem and sometimes fast-growth sites of the middle mainstem and lower/middle Zayante Creek.

In the San Lorenzo River drainage in 2013, about half of the sites had below average total and YOY densities, though sites in Zayante, Fall and Boulder creeks were above average. About three-quarters of the sites had below average densities of yearlings and Size Class II and III steelhead. Yearlings likely immigrated early or did not survive during the two large storms in December 2013. Below average densities of larger juveniles were left after most yearlings were gone and few YOY grew into the larger size class with the much reduced baseflow and food availability in 2013. The trend in fish densities between 2012 and 2013 was analyzed by using a paired t-test. Comparisons were made for total density, age class densities and size class densities (Total, AC1, AC2, and SC2). The two-tailed, paired t-test was used to test the difference in mean density (labeled "mean difference" in the analysis) of repeated sites. The null hypothesis was that the difference in mean density was zero. With 16 comparable sites in the San Lorenzo drainage, none of the differences in density in 2013 were statistically significant. SLR Site 12b was excluded from the analysis because it was judged to resident rainbow trout and not steelhead. Zayante Site 13d was excluded because the sampling location changed. With 7 comparable sites in the San Lorenzo mainstem only, no changes in density were found to be statistically significant.

Densities of larger Size Class II and III steelhead are most important because they will most likely soon smolt and contribute to the adult return. The most substantial declines in soon-to-smolt-size ratings were in the mainstem San Lorenzo and lower and middle Zayante, where ratings ranged from “very poor” to “below average” when they had ranged from “fair” to “very good” in 2012. Three sites in the San Lorenzo drainage improved substantially. Upper Zayante 13d went from “good” to “very good” and Lompico 13e went from “below average” to “good,” both due to higher yearling densities. Newell 16 went from “below average” to “good” due to higher YOY densities than 2012 with better YOY growth into Size Class II. The better YOY growth perhaps resulted from earlier successful spawning in 2013 that gave YOY a longer growth period. The upper Branciforte Site 21b remained in the “good” range in 2013.

The trap in the fish ladder at the City of Santa Cruz Felton Diversion dam was operated by volunteers from the Monterey Bay Salmon and Trout Project for 46 days during the winter of 2012-2013 (20 days in December, 11 days in January, 5 days in February, 9 days in March and 1 day in April). The 2013 trapping (as the previous 5 years) encompassed stormflows of the winter/spring. In 2013, a total of 341 adult steelhead were captured; 57 (17%) were hatchery clipped. One adult male coho was captured on 18 December at the trap, and 109 steelhead were retained for hatchery propagation during the winter/spring season.

iii. Steelhead Abundance and Habitat in the Soquel Creek Watershed

Although important habitat parameters such as pool depth and escape cover remained similar or improved substantially in 2013 at 3 of 7 sites compared to 2012, overall habitat quality was judged reduced due to much lower baseflow. The average mean monthly streamflow for May−September in 2013 at the Soquel Village gage was the second lowest in 17 years of records (2.4 cfs with a 17-year average of 9.3 cfs). With habitat typed Reaches 3, 8 and 9a there was significant pool filling and reduced fastwater habitat depth since 2011, resulting in reduced overall habitat quality. However, Reach 3 had substantially more escape cover, and substrate conditions remained similar or improved somewhat in all 3 reaches.

The juvenile steelhead population consisted primarily of an above average abundance of small Size Class 1 YOY steelhead at all sites except Site 16 in the SDSF. Total densities increased in 2013 at 6 of 7 sites, and YOY densities increased at all 7 sites compared to 2012. Total and YOY densities were above average at 6 of 7 sites, with Site 16 in the SDSF much below average, as it has been since 2010. With 6 comparable sites in the Soquel watershed, increases in total density and YOY density, as well as decreases in Size Class II/III density in 2013 were statistically significant. Apparently, there were insufficient spawners to seed the SDSF site with YOY in 2013 after December, and YOY survival was likely poor due to very low baseflows through the summer. 2013 yearling densities showed a similar pattern to those in the San Lorenzo, with a decline at 4 of 7 sites, generally low yearling densities throughout and near the typically low average at all sites. The high survival/retention of yearlings in the mild winter of 2012 was not repeated in 2013 in which two large December stormflows occurred. Increased total and YOY densities and decreased Size Class II/III densities in 2013 compared to 2012 were statistically significant.

Despite the higher density of YOY's at all sites in 2013, the trend in Size Class II and III densities declined precipitously in Soquel Creek to a low level not seen since the dry year of 2008. This was because few YOY grew into these soon-to-smolt size classes compared to past years and few yearlings remained in the watershed due to the high stormflows in December. 2013 densities of Size Class II and III juveniles were less than in 2012 and below average at all 7 sites. Spring and early summer baseflows were substantially below median statistic to hinder YOY from growing into the soon-to-smolt size class. Soon-to-smolt density ratings declined at 6 of 7 sites, while 6 sites were rated between "very poor" and "below average".

The 2013 juvenile steelhead population in Soquel Lagoon was an estimated 1,681, which was the fifth highest in 21 years of population estimates and above the 21-year average of 1,599 (inflated by a few abundant years). The relatively large 2013 population size fit the typical pattern expected for drier years when more spawning occurs near the lagoon and lagoon numbers are up.

iv. Steelhead and Tidewater Goby Abundance and Habitat in the Aptos Creek Watershed

Based on hydrographs from stream gages in other watersheds, it is likely that the Aptos watershed also had similarly low baseflow in 2013 compared to 2011 and 2012, and considerably below the median daily streamflow statistic in spring and summer. Measured streamflow in fall in lower Aptos Creek confirmed lower baseflow in 2013 than 2012 (dry year) and much lower than in 2011. This provided less food and slower growth rate in all reaches in 2013 compared to the previous 2 years.

Habitat conditions had reduced quality in the lower Reach 2 in Aptos Creek from 2012 due primarily to lower baseflow and shallower pools, though escape cover rebounded to 2011 levels in 2013. The upper Aptos Reach 3 in Nisene Marks had reduced habitat quality compared to 2012, based on conditions at Site 4. Baseflow was less there; though maximum pool depth increased somewhat while average mean depth lessened. Escape cover was similar as was embeddedness, while percent fines increased. The wood cluster at the lower pool had become lessened in 2012 with significant sedimentation, which had been partially scoured out in 2013.

Below average YOY densities in Aptos Creek (only increased slightly at the lower Aptos 3 site and decreased substantially at the upper Aptos 4 site) were consistent with reduced habitat quality. With only 2 comparable sites in Aptos watershed, no statistical tests were made. Like in other watersheds, YOY were smaller at least at the lower site from likely late spawning and low baseflow. Reduced YOY growth in 2013 was exemplified by the much lower percent of YOY reaching Size Class II in 2013 at the upper Aptos site compared to 2012 and 2011 (**Figures 19a−b**). Consistent with reduced habitat quality and declines in the San Lorenzo and Soquel Watersheds, yearling densities were down and below average in 2013. Lack of overwintering cover may have prevented yearlings from staying after the large December stormflows.

Size Class II and III densities were below average and less than in 2012 at both sites (**Table 35; Figures 11 and 19a−b**). Average Size Class II and III density increased from 2008 to 2010, but declined steadily after that to a 2013 low level, the lowest thus far calculated. This low soon-to-smolt density likely resulted from many yearlings being lost or forced to immigrate early due to the large December storms, poor YOY production and then poor growth of YOY fish at the lower site due to low baseflow in spring and early summer. Soon-to-smolt ratings declined from “good” to “fair” at both sites with about half the 2012 density at each.

Aptos estuary/lagoon in fall 2013 had a much smaller juvenile steelhead population than the two previous years, with the typical rapid growth rate compared to those captured in stream habitat. There were no steelhead mortalities during 2 days of sampling, with an estimated population size of only **32** in 2013 compared to **140** in 2012 and **423** in 2011. The small estuary population estimate indicated possibly much lower YOY production in the lower watershed to supply the lagoon with YOY. The small 2013 estuary estimate could be attributed to the poor water quality in a highly stratified estuary that never converted to freshwater. We would have expected a closed sandbar under such low stream inflow rate to the estuary, based on 15+ years of monitoring sandbar dynamics on other similar sized streams, San Simeon and Santa Rosa Creek lagoons near Cambria, California. Therefore, we suspect that the sandbar was maintained open by artificial means. Tidewater gobies were captured on each sampling day, indicating a small, sustaining population.

v. Steelhead Abundance and Habitat in the Corralitos Creek Sub-Watershed and Pajaro Lagoon

All reaches had lower spring and summer/fall baseflow in 2013 compared to 2012 and much below the median daily statistic. Lower baseflow provided less food and slower growth rate in all reaches and was the overriding factor that caused habitat quality to decline in all but the lower Shingle Mill site. Water depth in pools was less in most sites in Corralitos and escape cover was similar at most sites.

Pool depth and escape cover increased in upper Shingle Mill and in both Browns creek reaches (compared to 2009), despite reduced streamflow.

With regard to adult steelhead passage above the Corralitos Creek diversion dam, adult steelhead passage through the fish ladder was successful. YOY densities at the 3 Corralitos sites above the dam were similar to that below the dam, and the upstream site closest to the dam (Site #3) had above average YOY density.

YOY densities decreased at 6 of 8 sites in the sub-watershed and were above average at only Site #3 on Corralitos. Unlike in the San Lorenzo and Soquel watersheds where yearling steelhead densities were down, yearling densities increased slightly at 4 of 8 sites in the Corralitos sub-watershed compared to 2012 and were above average at 4 sites. Total juvenile densities followed a similar pattern to YOY densities. However, with higher survival/retention of yearlings at the lower Browns Creek site brought total density closer to average. With 6 comparable sites in the Corralitos sub-watershed, the decrease in total density was found to be statistically significant. Since sampling locations changed for the Browns Creek sites, they were excluded from the analysis.

In 2013, Size Class II densities were less than in 2012 at 6 of 8 sites, below average at 5 of 8 sites and close to average at the others. The mostly below average densities of YOY and Size Class II steelhead and the reductions from 2012 were consistent with lower baseflow that reduced habitat quality. Average or below average densities of yearlings at other sites, along with the absence of YOY reaching Size Class II (low baseflow) lead to relatively low densities of the larger, Size Class II fish.

Four of 8 sites remained in the “good” range in the Corralitos sub-watershed. These sites all had good yearling survival, unlike most other sites. The upper Shingle Mill Site #3 was rated “poor,” while the Corralitos Site #8 below Eureka Gulch was rated “very poor” and still had very degraded habitat from streambed sedimentation.

No steelhead were captured during sampling of Pajaro Lagoon in early October, though water quality conditions at that time were not prohibitive for the species. Tidewater goby were present and most abundant at a site that was 3 miles upstream of the beach berm.

B. INTRODUCTION

i. Scope of Work

In fall 2013, 4 Santa Cruz County watersheds were sampled for juvenile steelhead to compare juvenile abundance with past years and habitat conditions at sampling sites and in limited habitat typed segments with those in 2011. 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 maps in **Appendix A** that delineate reaches and sampling sites. Tables and figures referenced in this summary report and not included may be found in

Appendix B, the detailed analysis report. Hydrographs of all previous sampling years are included in **Appendix E**.

ii. Study Area

San Lorenzo River. The mainstem San Lorenzo River and 8 tributaries were sampled at 22 sites (9 mainstem and 13 tributary sites). Sampled tributaries included Branciforte, Zayante, Lompico, Bean, Fall, Newell, Boulder and Bear creeks. A new reach with sampling site was added to Branciforte Creek (21c) in 2013. Six 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 16 sites, the 2012 sites were replicated for fish sampling, and depth and cover measurements were made at all sampling sites.

Soquel Creek. Soquel Creek and its branches were sampled at 7 sites (4 mainstem and 3 Branch sites). Four half-mile segments were habitat typed to assess habitat conditions and select habitats of average quality to sample for fish density. For the remaining 3 sites, the 2012 sites were replicated for fish sampling, and depth and cover measurements were made at all sampling sites.

Aptos Creek. Aptos Creek was sampled at two stream sites and in the estuary/lagoon. The lower Aptos reach was habitat typed in a half-mile segment to assess habitat conditions and select habitats of average quality to sample for fish density. For the upper Aptos reach, the 2012 site was replicated for fish sampling, and depth and cover measurements were made at all sampling sites.

Corralitos Creek. In the Corralitos sub-watershed of the Pajaro River drainage, fish sampling included 4 sites in Corralitos Creek, 2 sites in Shingle Mill Gulch and 2 sites in Browns Creek, along with 2 associated half-mile reach segments habitat typed in Browns Creek up and downstream of the diversion dam. Depth and cover measurements were made at all sampling sites.

C. METHODS

i. Habitat Assessment

Refer to the Detailed Analysis **Appendix B** for more information. Section M-6 in **Appendix B** describes methods of assessing change in rearing habitat quality. Monitored watersheds included the San Lorenzo, Soquel, Aptos and Corralitos, a sub-watershed of the Pajaro River. Maps of sampling sites, habitat typed segments and reaches contained in **Appendix A** are provided below.

In the San Lorenzo and Soquel watersheds since 1998 and in the Aptos and Corralitos watersheds since 2006, half-mile reach segments were habitat-typed using a modified CDFG Level IV habitat inventory method in mainstem and tributary reaches; with fish sampling sites chosen within each segment based on average habitat conditions. See sampling methods in **Appendix B** for more details. Habitat types were classified according to the categories outlined in the California Salmonid Stream Habitat Restoration Manual (**Flosi et al. 1998**). Some habitat characteristics were estimated according to the manual's guidelines, including length, width, mean depth, maximum depth, shelter rating, substrate composition and tree canopy. Additional data were collected for escape cover, however, to better quantify it.

ii. Fish Sampling

Prior to 2006 juvenile steelhead abundance was estimated by reach. An index of juvenile steelhead population size was estimated by reach and by watershed in the San Lorenzo and Soquel drainages. Indices of adult steelhead population size were also calculated from indices of juvenile population size. Prior to 2006, estimated reach density and fish production could be compared between years and between reaches because fish densities by habitat type were extrapolated to reach density and an index of reach production with habitat proportions within reaches factored in. Since 2006, indices of juvenile population size per watershed were no longer possible because the number of sampling sites had been reduced. Santa Cruz County staff decided in 2006 that indices of juvenile reach production were no longer useful. However, they are now rethinking this decision.

Since 2006, fish abundance at sampling sites of average habitat quality in previously determined reach segments of 4 Santa Cruz County watersheds (San Lorenzo, Soquel, Aptos and Corralitos) have been compared to past years' abundances. Comparisons in this report go back to 1997 in the San Lorenzo and Soquel watersheds, 2006 in the Aptos watershed and 1981 in the Corralitos sub-watershed, although consecutive years began in 2006. Previous steelhead sampling and habitat assessment was also completed in 1994−1996 in the San Lorenzo and in 1994 in Soquel. The proportion of habitat types sampled at each site within a reach was kept similar between years so that site fish densities could be compared between years in each reach. However, site fish density did not necessarily reflect fish densities for entire reaches because the habitat proportions sampled were not exactly similar to the habitat proportions of the reach. In most cases, habitat proportions at sites were roughly similar to habitat proportions in reaches because sampling sites were more or less continuous and lengths of each habitat type were roughly similar to others within reaches. However, in reaches where pools are less common, such as Reach 12a on the East Branch of Soquel Creek and Reach 2 in lower Valencia Creek, a higher proportion of pool habitat was sampled than exists in these respective reaches. More pool habitat was sampled because larger yearlings almost exclusively utilize pool habitat in small streams, and changes in yearling densities in pools are the most important to monitor. In these two cases, site densities of yearlings were higher than reach densities.

Electrofishing was used to measure steelhead abundance at sampling sites. Captured juvenile steelhead were grouped into two juvenile age classes and three size classes. Block nets were used at all sites to separate habitats during electrofishing. A three-pass depletion process was used to estimate fish densities. If there was poor depletion in 3 passes, a fourth pass was performed, and the fish captured in 4 passes were assumed to be a total count in the habitat. Electrofishing mortality rate has been approximately 1% or less over the years. Snorkel-censusing was used in deeper pools that could not be electrofished at sites in the mainstem reaches of the San Lorenzo River, downstream of the Boulder Creek confluence. For catch data in the lower and middle mainstem reaches included in **Appendix C**, underwater censusing of deeper pools was incorporated into density estimates with electrofishing data from more shallow habitats.

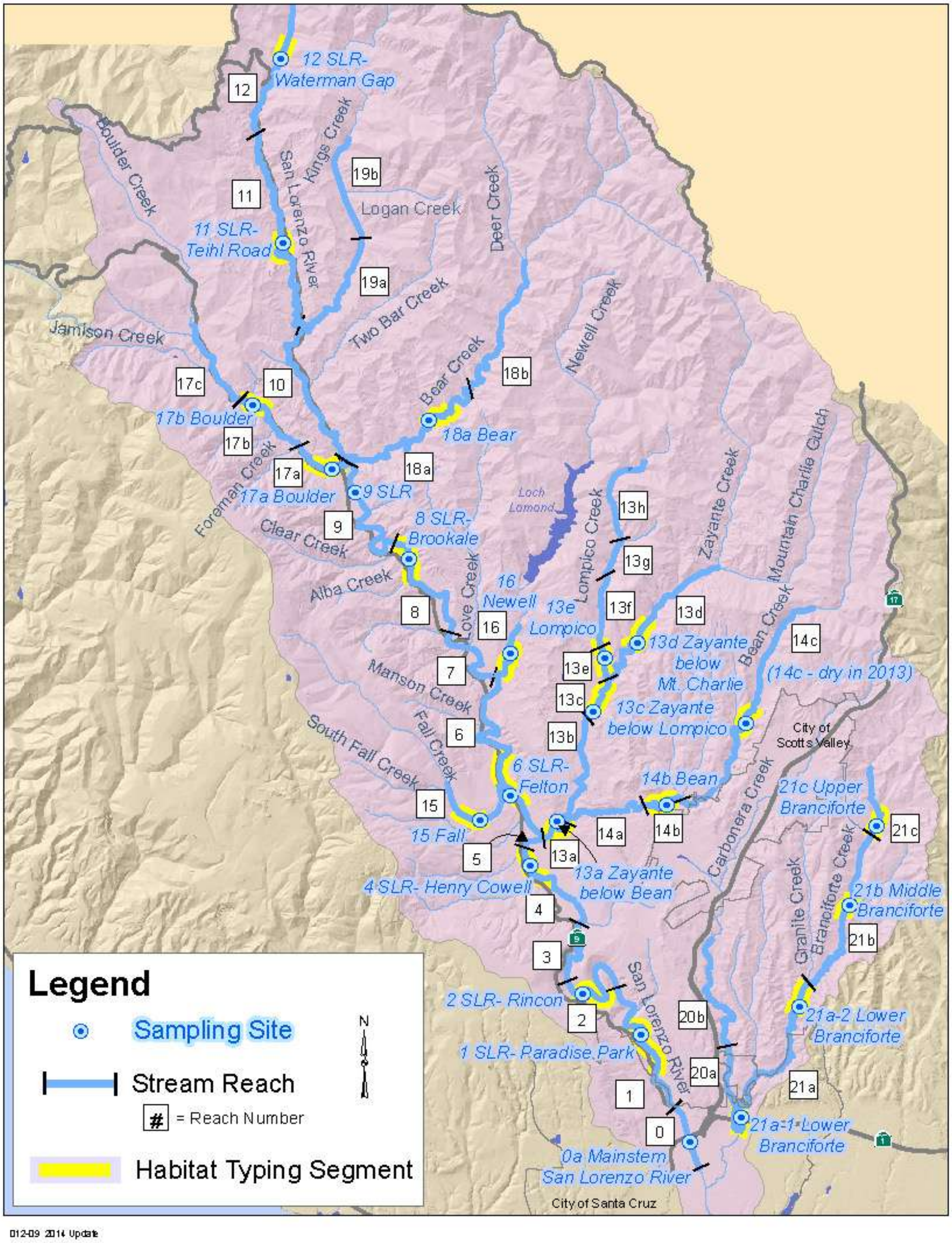

Figure A-2. San Lorenzo River Watershed.

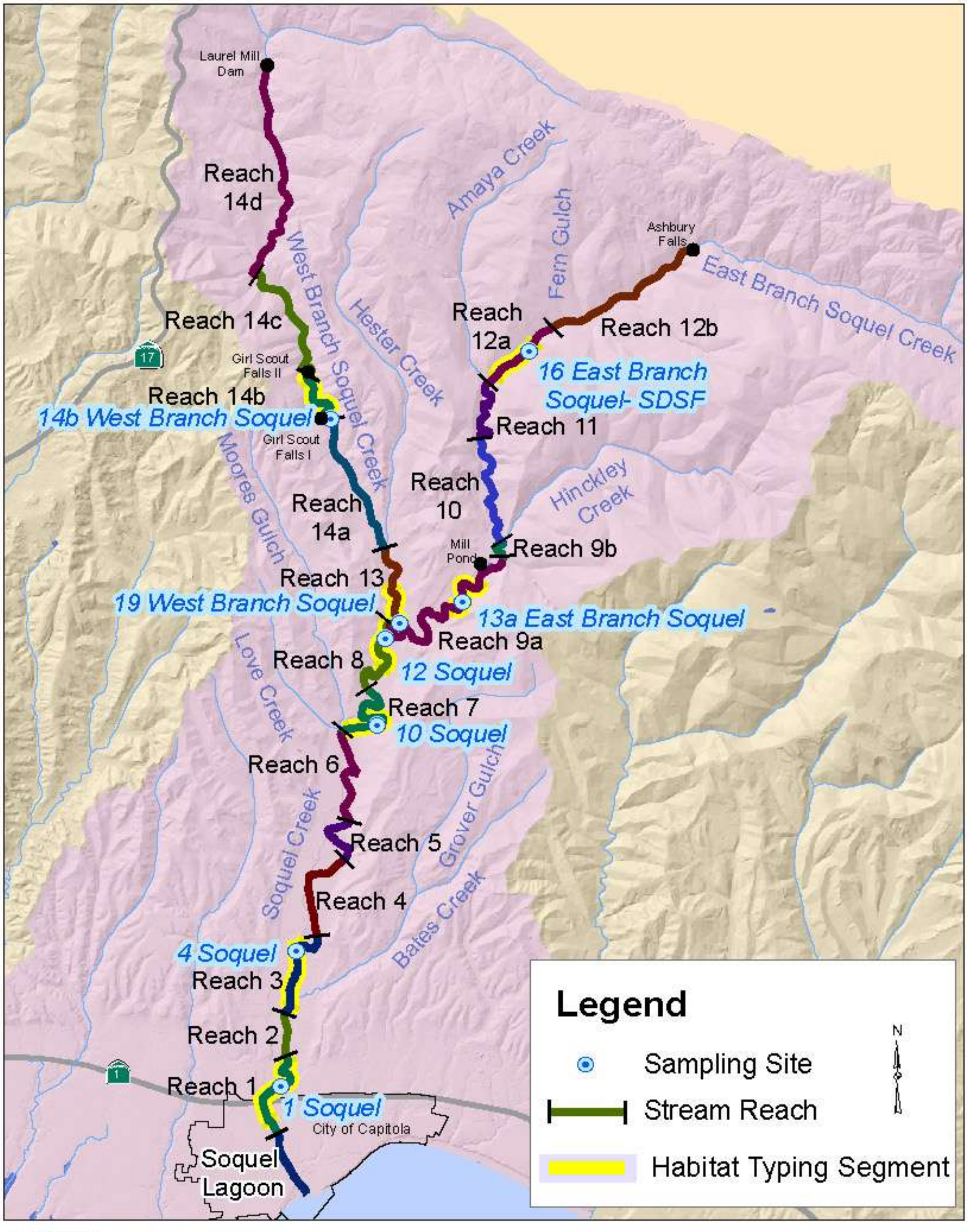

Figure A-3. Soquel Creek Watershed.

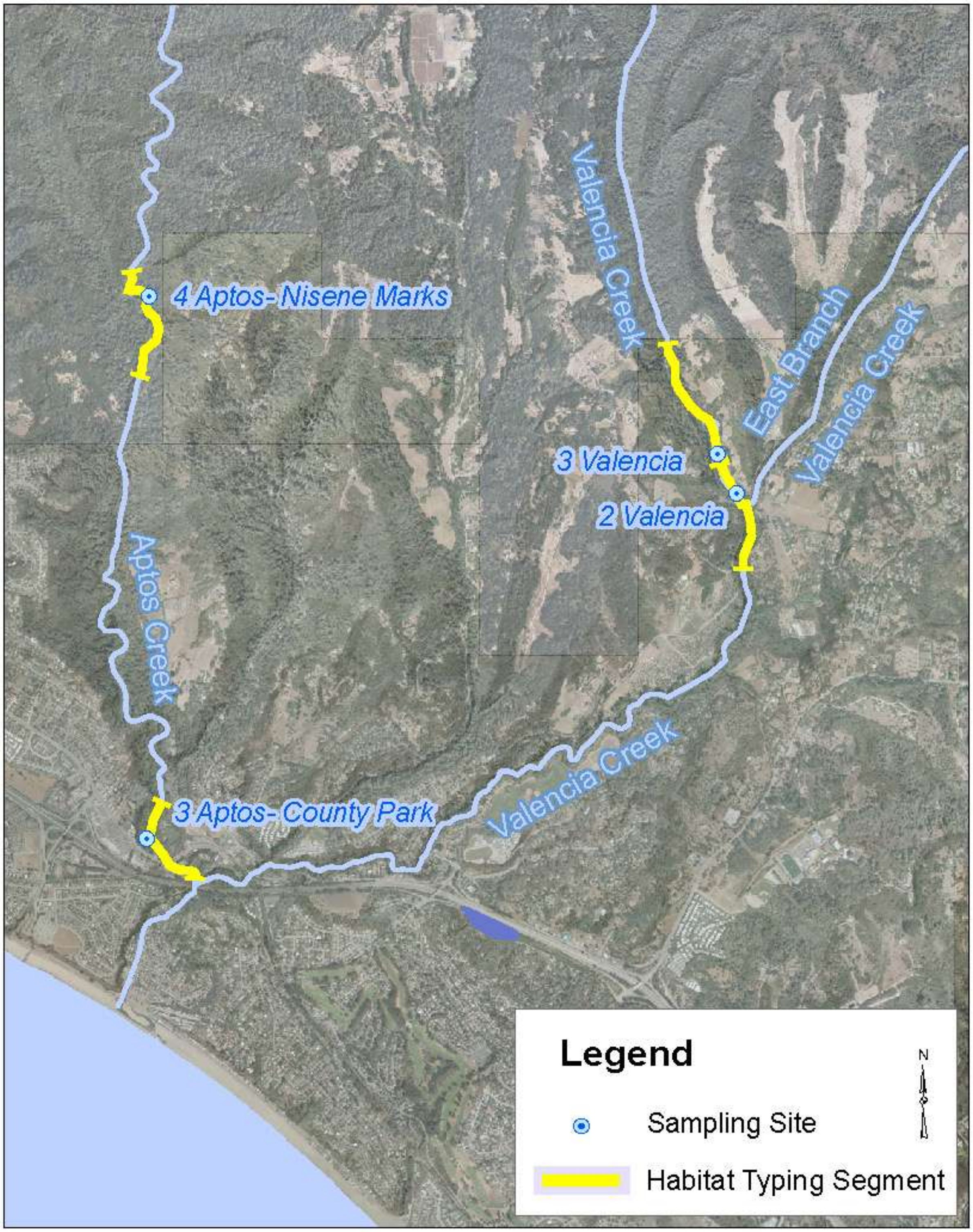

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Figure A-6. Aptos Creek Watershed.

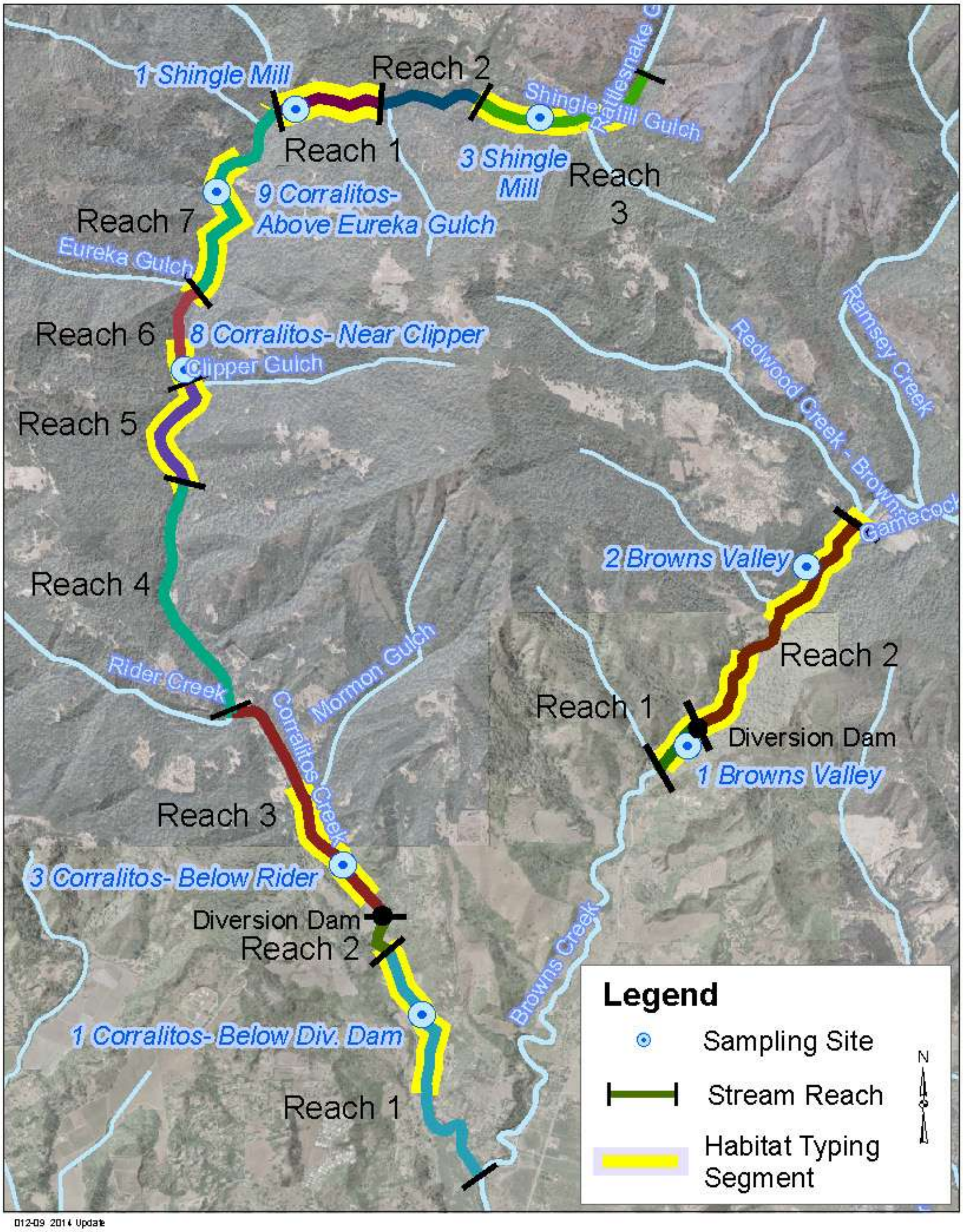


Figure A-7. Corralitos Creek Sub-Watershed.

D. RESULTS

Figures and tables contained in this summary report were extracted from the detailed analysis found in **Appendix B.**

i. Steelhead Abundance and Habitat Conditions in All Watersheds

1. WY2013 streamflows in spring-summer-fall were below the median daily flow statistic. They were lower than in WY2012, which had near the median flow until August when they declined below. With the exception of two large stormflows in December 2012, the winter season was dry except for two small storms occurring in March and early April. Streamflow comparisons between years were made for 5-month averages (May − September) expressed in ***Figure B-42*** *below*.

2. Rearing habitat quality declined at the majority of sites due to decreased streamflow (less food), shallower habitat and sometimes less escape cover. Exceptions were sites where more instream wood had accumulated to greatly increase escape cover or where scour objects (large wood, rootwads, large boulders, streamside vegetation and bedrock) had scoured deeper pool habitat during the large December stormflows.

3. Of the 38 sites/ reaches examined, 12 had deeper pool habitat than the previous data collection time, despite lower baseflow. This occurred in the mainstem *San Lorenzo 0a* site (change in hydraulic control) *Lompico Site 13e* (bedrock scour), middle *Bean Reach 14b* (large wood scour), *Newell Site 16* (scour from large wood and large boulders), *Bear Site 18* (bedrock scour), *Branciforte Reach 21b* (boulder and bedrock scour), middle mainstem *Soquel Site 10* (boulder scour), West Branch *Soquel Site 19* (large wood scour), upper *Aptos Site 4* (large wood scour), upper *Shingle Mill Site 3* (rootwad scour) and *Browns Reaches 1 and 2* (scour from tree rootwads, bedrock and large boulders). In addition, Soquel Lagoon was the deepest in 23 years of monitoring and 0.75 m (2 ft) deeper than 2012 under the Stockton Bridge due to scour.

4. 2013 abundance of YOY was generally below average in the mainstem San Lorenzo and near or above average at most tributary sites. YOY abundance was mostly near or above average in Soquel Creek and below average in the other 2 watersheds, Aptos and Corralitos.

5. The wide variation in YOY densities within watersheds, with high densities at some sites and low densities at others relative to the long term average, indicated that there were insufficient numbers of late adult spawners to saturate habitat after localized spawning effort.

6. Despite limited adult salmonid passage opportunities during the mild 2012-2013 winter after December and with only 2 small storm events in March and early April, spawning access to most upper watershed sites did occur. However, passage into the upper San Lorenzo mainstem above Boulder Creek and in Bear Creek were apparently impeded, and YOY densities in upper East Branch Soquel were especially low.

7. Following December stormflows that were likely 2–3 times bankfull, yearling survival was likely low, and yearling densities were below average in all 4 watersheds except for 3 of 8 sites in the Corralitos sub-watershed.

8. Soon-to-smolt abundance ratings (Size Class II and III steelhead) in many sites were shifted downward because of the low yearling densities and very low proportion of YOY reaching Size Class II in usually fast-growth sites (***Tables S-1, S-2 and S-3*** *below*).

9. Paralleling YOY densities, total density for all sizes of juvenile steelhead were 1) below average at most sites in the mainstem San Lorenzo and mostly near or above average at tributary sites, 2) either near or above average in Soquel Creek except much below average in the Soquel Demonstration State Forest (SDSF), 3) below average in Aptos Creek, and 4) mostly below average in the Corralitos/Browns Creek complex. Sites with average or above average total densities had average or above average densities of small YOY.

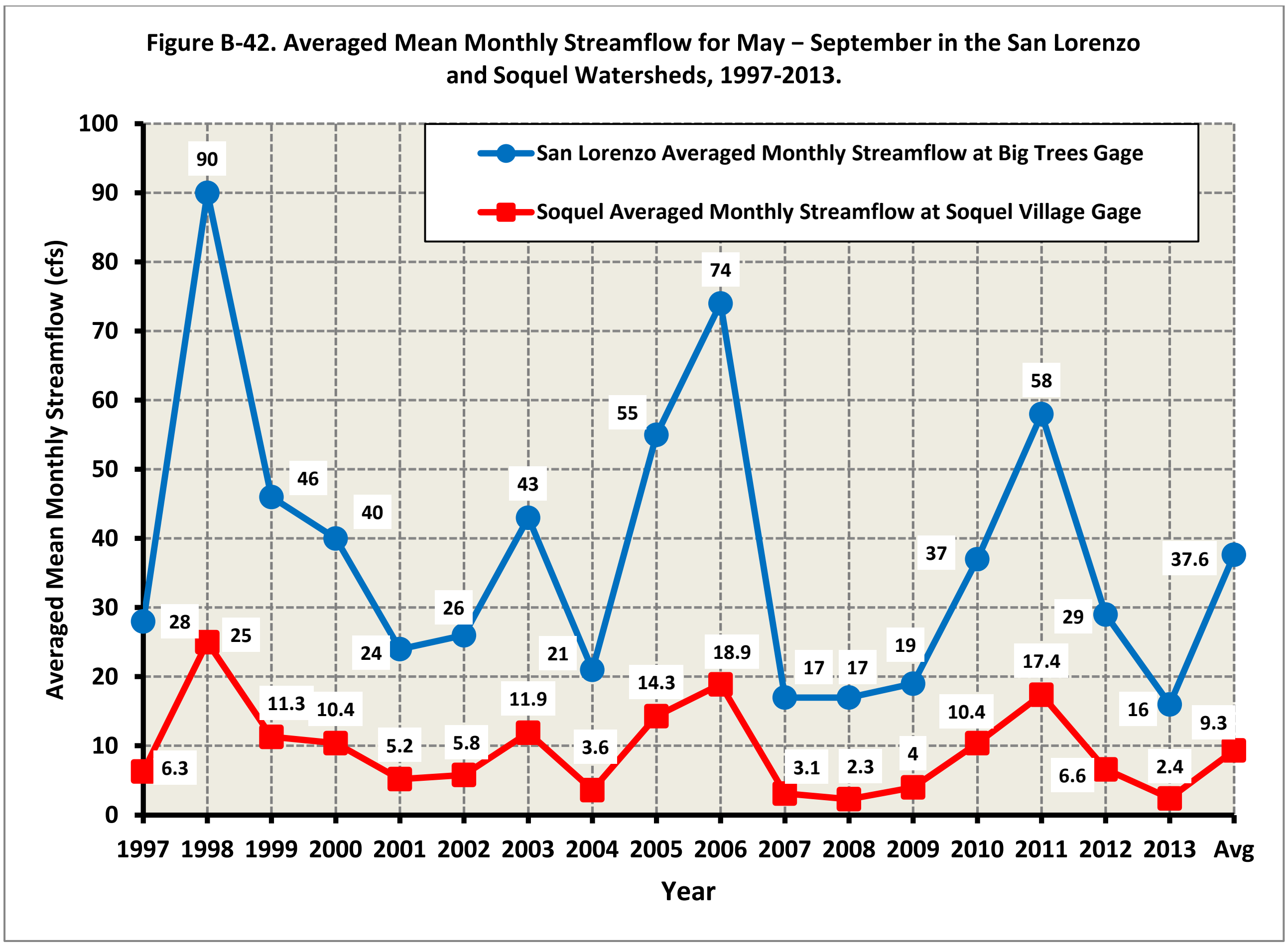


Figure B-42. Averaged Mean Monthly Streamflow for May – September in the San Lorenzo and Soquel Watersheds, 1997-2013.

Table S-1. Summary of Sampling Site Ratings in 2006–2013, based on Potential Smolt-Sized Densities.

Year	Very Poor	Poor	Below Average	Fair	Good	Very Good
2006 (n=34)	1	6	5	11	10	1
2007 (n=37)	5	2	12	12	6	0
2008 (n=36)	5	6	9	10	6	0
2009 (n=37)	2	4	11	13	6	1
2010 (n=39)	0	1	9	16	12	1
2011 (n=37)	1	2	7	18	8	1
2012 (n=38)	2	1	6	9	17	3
2013 (n=38)	5	6	10	9	7	1

Table S-2. Rating of Steelhead Rearing Habitat For Small, Central Coastal Streams.* (From Smith 1982.)

1. Very Poor- less than 2 potential smolt-sized** fish per 100 ft of stream.

2. Poor*** - from 2 to 4 " " "

3. Below Average - 4 to 8 " " "

4. Fair - 8 to 16 " " "

5. Good - 16 to 32 " " "

6. Very Good - 32 to 64 " " "

7. Excellent - 64 or more " " "

* Drainages sampled included the Pajaro, Soquel and San Lorenzo systems, as well as other smaller Santa Cruz County coastal streams. Nine drainages were sampled at over 106 sites.

** Potential smolt-sized fish were at least 3 inches (75 mm) Standard Length at fall sampling and would be large enough to smolt the following spring.

***The average standard length for potential smolt-sized fish was calculated for each site. If the average was less than 89 mm SL, then the density rating according to density alone was reduced one level. If the average was more than 102 mm SL, then the rating was increased one level.

Table S-3. 2013 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Average Smolt Size, with Physical Habitat Change since 2012. (Red denotes ratings of 1−3 or negative habitat change; italicized purple denotes ratings of 5−7. Methods for habitat change in M-6 of Appendix B).

Site	Multi-Year Avg. Potential Smolt Density Per 100 ft (Years of data)	2013 Potential Smolt Density (per 100 ft)/ Avg Smolt Size (mm)	2013 Smolt Numeric Rating	Symbolic Rating (1 to 7)	Physical Habitat Change by Reach or Site Since 2012 (except where specified)
Low. San Lorenzo #0a	10.1 (n=6)	4.1/ 94 mm	3	***	Site Positive
Low. San Lorenzo #1	9.5 (n=12)	3.4/ 96 mm	2	**	Site Negative
Low. San Lorenzo #2	15.3 (n=12)	6.2/ 88 mm	2	**	Reach Negative
Low. San Lorenzo #4	14.7 (n=13)	6.7/ 81 mm	2	**	Site Negative
Mid. San Lorenzo #6	4.3 (n=16)	2.0/ 108 mm	3	***	Site Negative
Mid. San Lorenzo #8	6.2 (n=16)	1.9/ 90 mm	1	*	Site Negative
Mid. San Lorenzo #9	7.9 (n=9)	2.3/ 86 mm	1	*	Reach Negative (since 2005)
Up. San Lorenzo #11	6.3 (n=16)	2.3/ 114 mm	3	***	Reach Negative
Up. San Lorenzo #12b (may not be steelhead)	*11.4 (n=9)*	*10.0/ 111 mm*	*5*	*****	Site Negative
Zayante #13a	10.5 (n=15)	2.7/ 98 mm	2	**	Site Negative
Zayante #13c	14.2 (n=15)	8.4/ 87 mm	3	***	Site Negative
Zayante #13d	*15.8 (n=15)*	18.5/ 105 mm	*6*	******	Site Negative
Lompico #13e	*7.0 (n=8)*	*8.7/ 104 mm*	*5*	*****	*Site Positive*
Bean #14b	12.6 (n=16)	12.5/ 90 mm	4	****	Site Negative
Bean #14c	8.8 (n=15)	Dry	1	*	Site Negative
Fall #15	13.6 (n=11)	12.1/ 98 mm	4	****	Site Negative
Newell #16	*15.0 (n=10)*	*23.7/ 89 mm*	*5*	*****	*Site Positive*
Boulder #17a	11.3 (n=16)	3.2/ 118 mm	3	***	Reach Negative (since 2009)
Boulder #17b	10.7 (n=16)	10.7/ 96 mm	4	****	Reach Negative (since 2008)
Bear #18a	10.5 (n=16)	2.6/ 115 mm	3	***	Site Positive
Branciforte #21a-2	9.5 (n=13)	6.0/ 106 mm	4	****	Site Positive
Branciforte #21b	14.8 (n=7)	13.3/ 100 mm	4	****	Site Positive
Soquel #1	4.0 (n=16)	1.8/ 94 mm	2	**	Site Negative
Soquel #4	9.1 (n=17)	2.1/ 110 mm	3	***	Site Negative
Soquel #10	9.0 (n=17)	5.2/ 87 mm	2	**	Site Negative
Soquel #12	8.1 (n=16)	3.1/ 82 mm	1	*	Reach Negative (since 2011)
E. Branch Soquel #13a	11.0 (n=17)	6.8/ 106 mm	4	****	Site Negative
E. Branch Soquel #16	10.3 (n=17)	6.2/ 92 mm	3	***	Reach Negative
W. Branch Soquel #19	6.4 (n=13)	3.4/ 105 mm	3	***	Site Negative
Aptos #3	10.3 (n=9)	5.1/ 103 mm	4	****	Reach Negative
Aptos #4	9.9 (n=9)	6.1/ 120 mm	4	****	Site Negative
Corralitos #1	*9.8 (n=7)*	*12.1/ 110 mm*	*5*	*****	Reach Negative (since 2009)
Corralitos #3	*10.9 (n=10)*	*10.7/ 105 mm*	*5*	*****	Site Negative
Corralitos #8	11.3 (n=10)	1.8/ 130 mm	2	**	Site Negative
Corralitos #9	*17.8 (n=10)*	*10.5/ 108 mm*	*5*	*****	Site Negative
Shingle Mill #1	10.1 (n=10)	6.9/ 94 mm	3	***	Site Similar
Shingle Mill #3	5.0 (n=9)	3.1/ 86 mm	1	*	Site Negative
Browns Valley #1	*16.2 (n=10)*	*18.0/ 96 mm*	*5*	*****	Reach Negative (since 2009)
Browns Valley #2	13.6 (n=10)	9.6/ 101 mm	4	****	Reach Negative (since 2009)

ii. Steelhead Abundance and Habitat Conditions in the San Lorenzo River Watershed

1. ***In the lower and middle mainstem***, habitat quality declined at most replicated sampling sites and habitat-typed Reach 2 primarily due to decreased baseflow (less food), shallower fastwater habitat and usually less escape cover(***Table S-3*** *above*). However, there was much deeper pool habitat and escape cover at the lower most Site 0a (***Table B-13b*** *below*). With late spawning and reduced baseflow in spring and summer, food was insufficient to allow as high a portion of YOY to reach Size Class II by fall 2013 as occurred in 2012 (***Figure B-17a*** *below*; ***size histograms in Appendix D***).

2. ***Most other reaches and sites*** had reduced habitat quality except Lompico 13e, Newell 16, Bear 18a and Branciforte 21b. Reduced habitat quality resulted from lower baseflow in 2013, much below the median statistic after major stormflows in December 2012 (7,340 and 12,100 cfs at Big Trees gage) (***Figures B-34a−b*** *below*), and many had shallower habitat and/or less escape cover, creating lower quality habitat (***Table B-13b*** *below*) with a lower proportion of YOY reaching Size Class II (except Newell 16 which had a sustained baseflow of approximately 1 cfs) (***Figure B-17a*** *below*; ***size histograms in Appendix D***).

3. ***In San Lorenzo River tributary sites/ reaches which had improved habitat quality***, pool depth and/or escape cover increased and fall baseflow was similar to 2012 (Lompico 13e, Newell 16, Bear 18a, Branciforte 21b) (***Table B-13b*** *below;* ***Tables 6a, 7, 8, 12a, 13a and 13b in Appendix B***).

4. ***YOY densities in the mainstem*** were higher at 6 of 9 sites compared to 2012 and 2005 (Site 9), despite reduced habitat quality in most reaches and sites, but were below average at 7 of 9 sites (***Table 18 in Appendix B; Figure B-2*** below). With the mild winter/spring after December, YOY survival was likely better than usual. YOY recruitment into the mainstem from tributaries has apparently been minimal from 1999 onward, except for possibly at Site 4 in 2008 from lower Zayante Creek.

5. ***YOY densities in tributaries*** increased at 6 of 12 sites compared to 2012 and were above average at 7 of 12 sites (***Table 23 in Appendix B; Figure B-2*** below). Late spawning and low baseflow created more and smaller YOY in 2013 at some sites, especially at all 3 sites in Zayante, both sites in Boulder and sites in Fall and upper Branciforte. The highest YOY density was found at middle Zayante 13c (second highest since monitoring began at 188 YOY/ 100 ft), which had good cover provided by overhanging willow and dogwood. YOY densities were also high at upper Zayante 13d. (Lines drawn between data points do not imply changes in density between sites.)

Table 13b. Habitat Change in the SAN LORENZO MAINSTEM AND TRIBUTARIES from 2012 to 2013, Based on Reach Data Where Available and Site Data, Otherwise.

Reach Comparison or (Site Only)	Baseflow (Most Important Parameter)	Pool Depth / Fastwater Habitat Depth in Mainstem below Boulder Cr.	Fine Sediment	Embed-dedness	Pool Escape Cover/ Fastwater Habitat Cover in Mainstem below Boulder Creek	Overall Habitat Change
(Mainstem 0a)	Similar (in fall)	+ / +	Similar	Similar	+/+	+
(Mainstem 1)	−	NA / Similar	− (run)	+ (riffle)	/−	−
Mainstem 2	−	− / −	Similar	Similar	−/−	−
(Mainstem 4)	−	NA / −	Similar	Similar	/Similar	−
(Mainstem 6)	−	NA / −	Similar	−	/+	− (lower flow)
(Mainstem 8)	−	NA / −	− (run)	− (riffle)	/−	−
Mainstem 9 (2005 to 2013)	−	− (fastwater) Similar in pools	+ (pool)	−	−	−
(Mainstem Near Teihl 11)	Similar (in fall)	−	−	Similar	−	−
(Mainstem Waterman Gap 12b)	NA	−	Similar	Similar	+	−
(Zayante 13a)	−	−	− (pool) − (run)	+ (pool)	−	−
(Zayante 13c)	−	Similar	Similar	+ (riffle)	− (slightly)	− (lower flow)
Zayante 13d	−	−	Similar	Similar	−	−
(Lompico 13e)	−	+	+ (riffle) − (run)	Similar	+	+
Bean 14b	−	+	−	+	−	−
(Bean 14c)	(Went dry sooner in 2013)					Dry both years
(Fall 15)	−	−	+ (pool) − (run)	+	−	−
(Newell 16)	Same (late summer/fall)	+	+ (pool)	−	− (slightly less)	+
Boulder 17a	Same (in fall)	− (since 2009)	− (pool) (since 2009)	− (pool) (since 2009)	− (since 2009)	−
Boulder 17b	Similar (in fall)	− (since 2008)	− (pool) (since 2008)	Similar (since 2008)	− (pool) (since 2008)	−
(Bear 18a)	−	+	− pool) + (fastwater)	+ (pool)	+	+
(Branciforte 21a-2)	Similar (in fall)	−	− (pool)	Similar	+	−
Branciforte 21b	NA	+	Similar	Similar	+	+

***NA = Not available.**

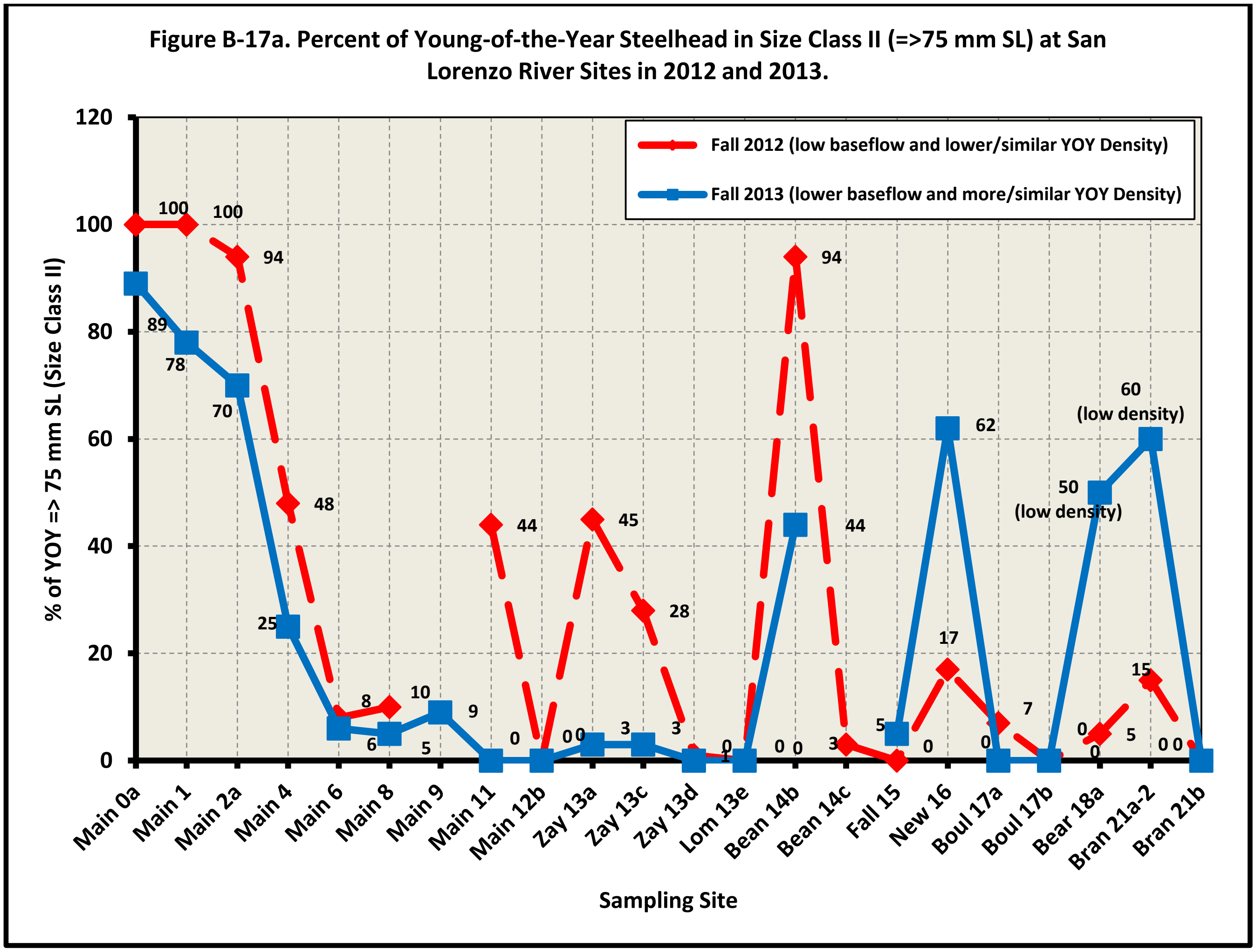


Figure B-17a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at San Lorenzo River Sites in 2012 and 2013.

Figure B-34a. The 2013 Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

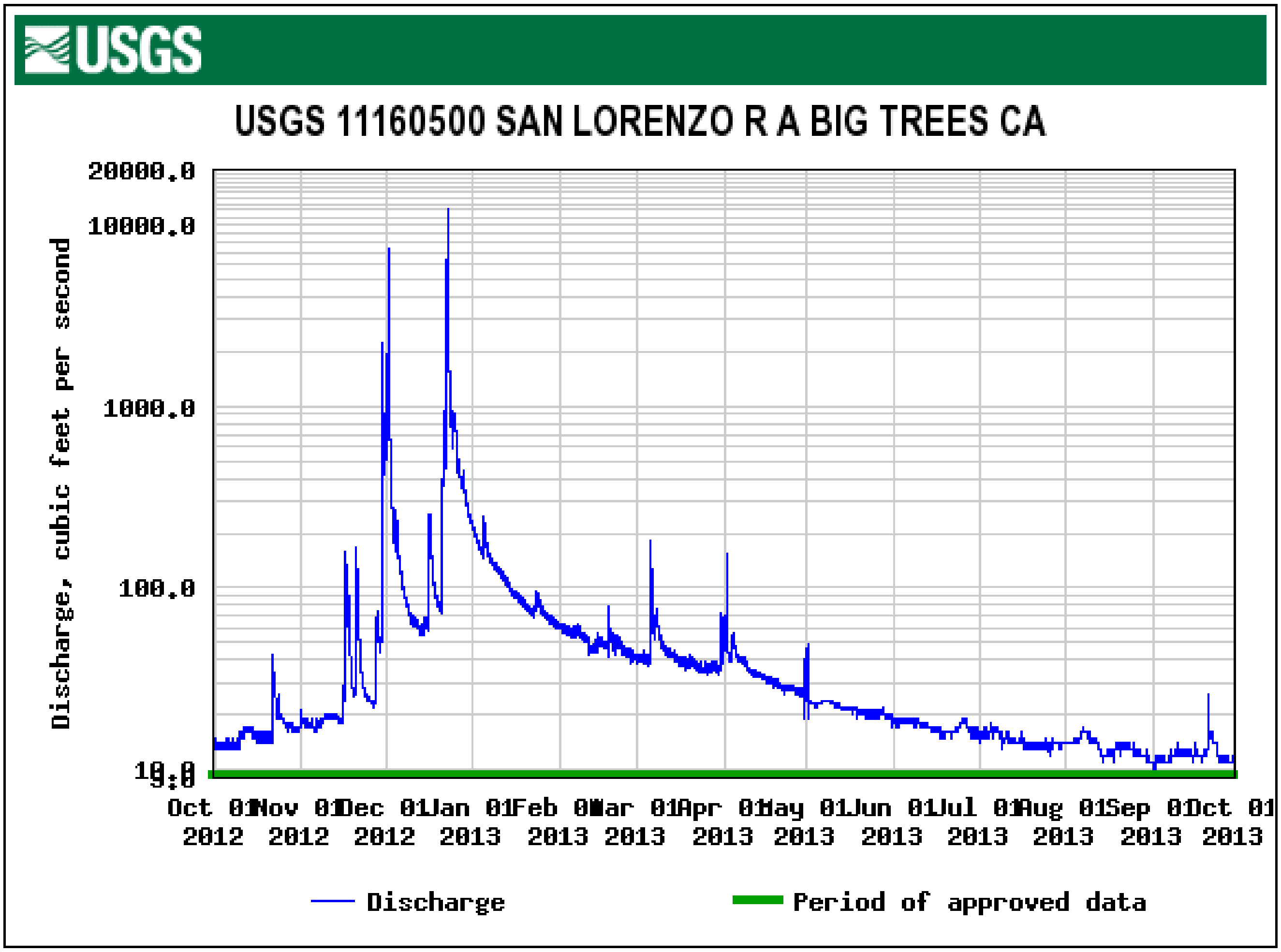
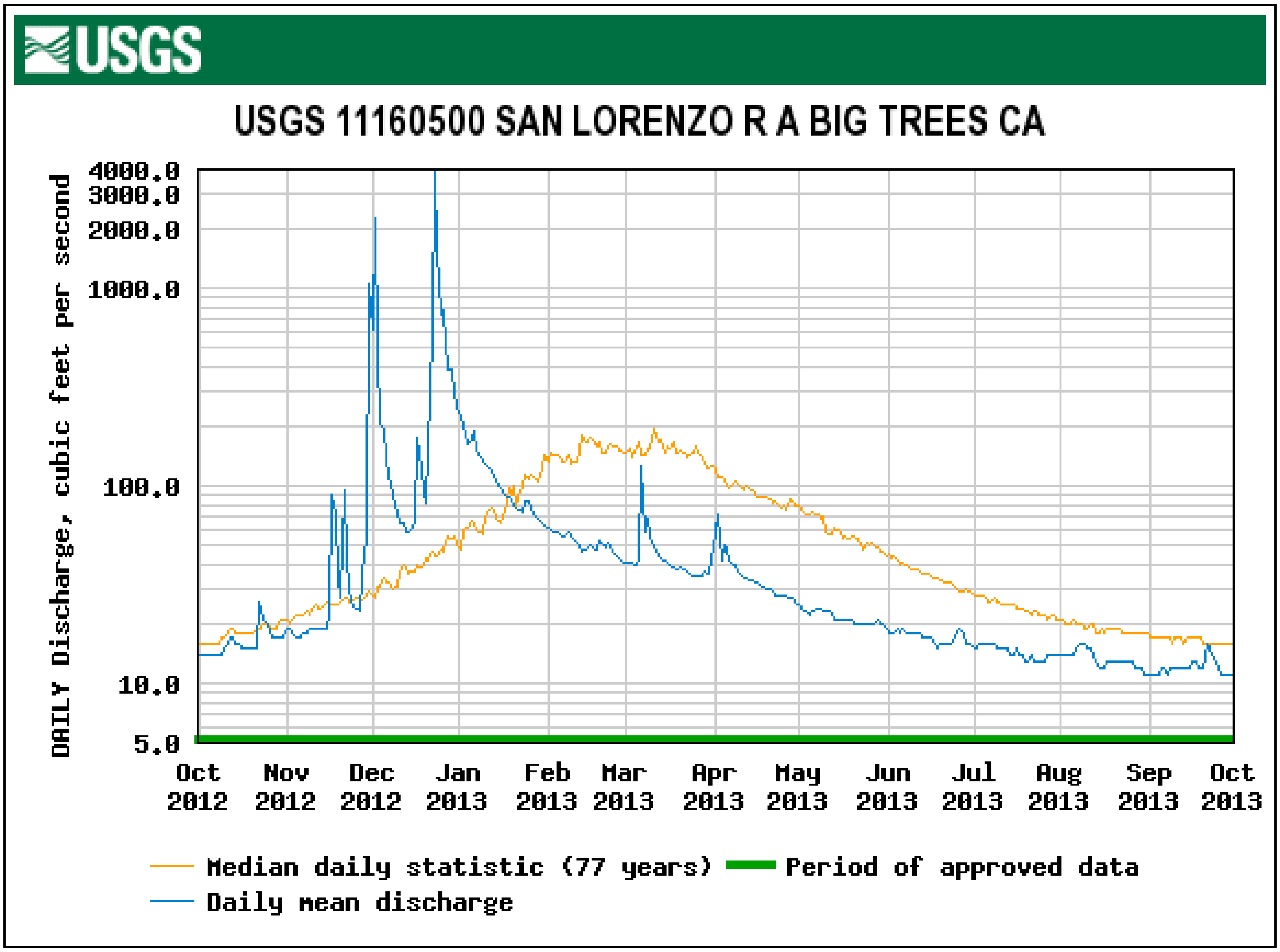


Figure B-34b. The 2013 Daily Average Discharge and Median Daily Flow of Record for the USGS Gage On the San Lorenzo River at Big Trees.



6. ***Yearling densities*** were relatively low in the mainstem and tributaries and mostly less than in 2012 and below average at 15 of 21 sites (***Figure B-3*** *below;* ***Tables 19 and 24 in Appendix B***). The sites that retained above average densities of yearlings were upper watershed sites, Zayante 13d, Lompico 13e, Boulder 17b, Branciforte 21b and SLR 12b (may be resident rainbow trout).

7. ***Densities of important larger Size Class II and III steelhead*** (=>75 mm SL; soon-to-smolt) ***at mainstem sites*** were lower in 2013 than 2012 at all 9 mainstem sites (***Table 21 in Appendix B***) and below average (***Figure B-4*** *below*). Their densities were much below average at the 4 lower mainstem sites below the Zayante Creek confluence. Relatively low densities of the important soon-to-smolt fish in these typically high growth reaches was due to below average densities of YOY and the reduced percent that grew into Size Class II in a low baseflow year with less drifting food compared to 2012 and 2011 (***Figure 17a*** *above*). The trend in Size Class II and III densities went down in the mainstem (***Figure B-22*** *below*). With the exception of Site 12b in Waterman Gap (which may be a rainbow trout population), all other mainstem sites were rated between "very poor" and "below average," with 4 of 8 decreasing in rating in 2013 (***Table B-40*** *below*). Low ratings resulted from fewer YOY reaching Size Class II after a late spawn, reduced baseflow and slower growth. Three sites had "very poor" ratings due to below average YOY and yearling densities and the small size of the category II fish (<=75 mm SL).

8. ***Size Class II and III abundance in tributaries*** were less than in 2012 at 8 of 12 tributary sites and below average at 8 of 12 sites (***Table 25 in Appendix B; Figure B-4*** *below*). The largest increase in density was at Newell Site 16, resulting from a high proportion of YOY reaching Size Class II with artificially high baseflow coming from the Loch Lomond dam. The trend in Size Class II and III abundance went down in tributaries (***Figure B-24*** *below*). Soon-to-smolt ratings declined at 9 of 12 tributary sites in 2013, with improvements at Zayante 13d, Lompico 13e and Newell 16 (***Table B-40*** *below*). Ratings were "poor" at lower Zayante 13a and "below average" at middle Zayante 13c (despite very high YOY density), lower Boulder 17a and lower Bear 18a. Ratings were "fair" at 5 tributary sites (Bean 14b, Fall 15, Boulder 17b, and Branciforte 21a-2 and 21b). Ratings were "good" at Lompico 13e (relatively high overwinter survival and retention of yearlings in an upper watershed site where non-flow habitat conditions improved) and Newell 16 (good YOY growth rate) and "very good" at Zayante 13d (relatively high overwinter survival and retention of yearlings in an upper watershed site).

9. ***Total densities*** mirrored YOY densities as they were below average at 8 of 9 mainstem sites and above average at 8 of 12 tributary sites (***Figure B-1*** *below)*, though they generally increased over 2012 densities 13 of 21 sites due to the higher YOY densities (***Tables 17 and 22 in Appendix B***). The trend in total densities went down slightly in the mainstem and increased in the tributaries due to patterns in YOY density (***Figures B-21 and B-22*** *below*).

10. No juvenile coho or chinook salmon were detected at any stream sites.

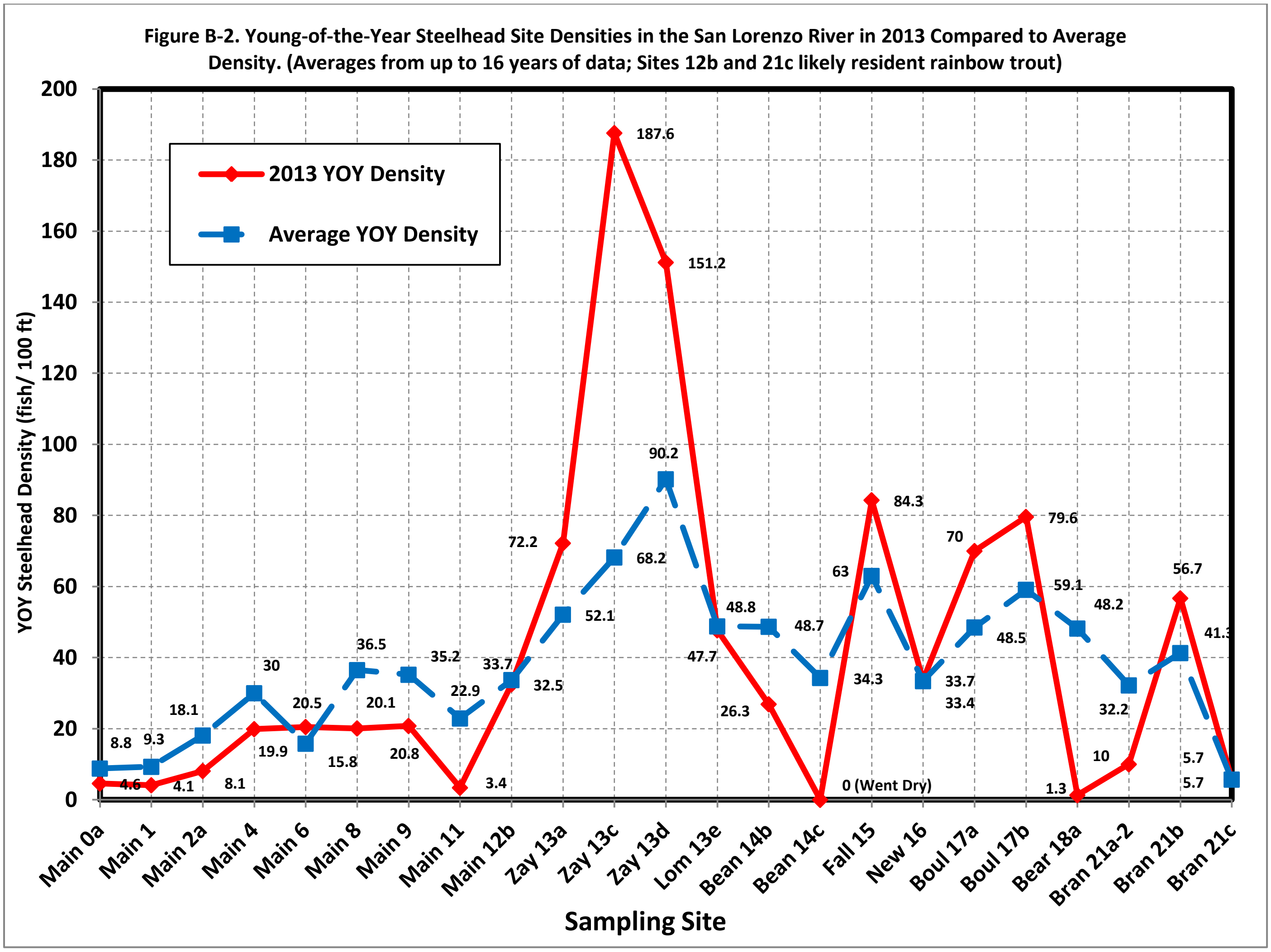


Figure B-2. Young-of-the-Year Steelhead Site Densities in the San Lorenzo River in 2013 Compared to Average Density. (Averages based on up to 16 years of data.)

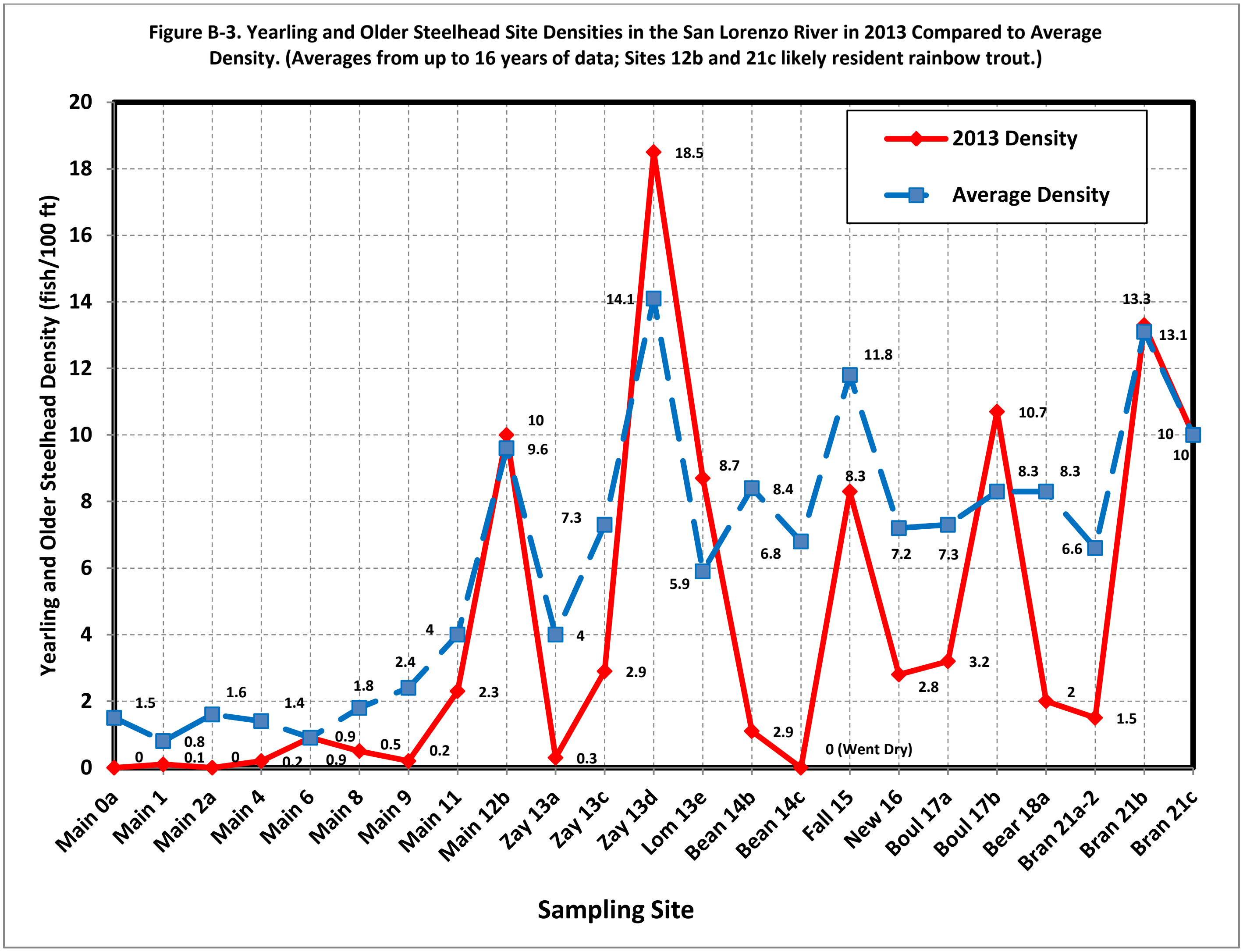


Figure B-3. Yearling and Older Steelhead Site Densities in the San Lorenzo River in 2013 Compared to Average Density. (Averages based on up to 16 years of data.)

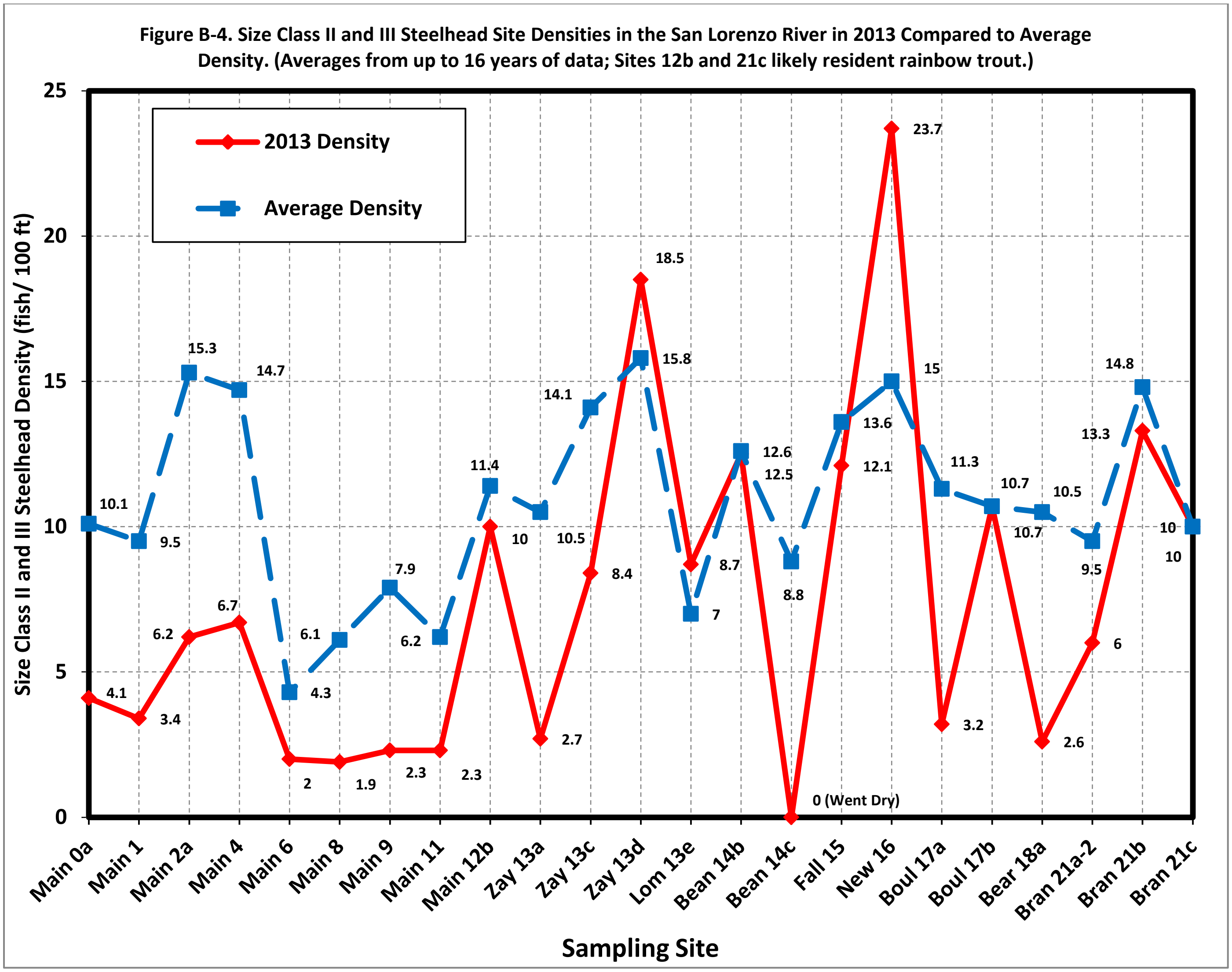


Figure B-4. Size Class II and III Steelhead Site Densities in the San Lorenzo River in 2013 Compared to Average Density. (Averages based on up to 16 years of data.)

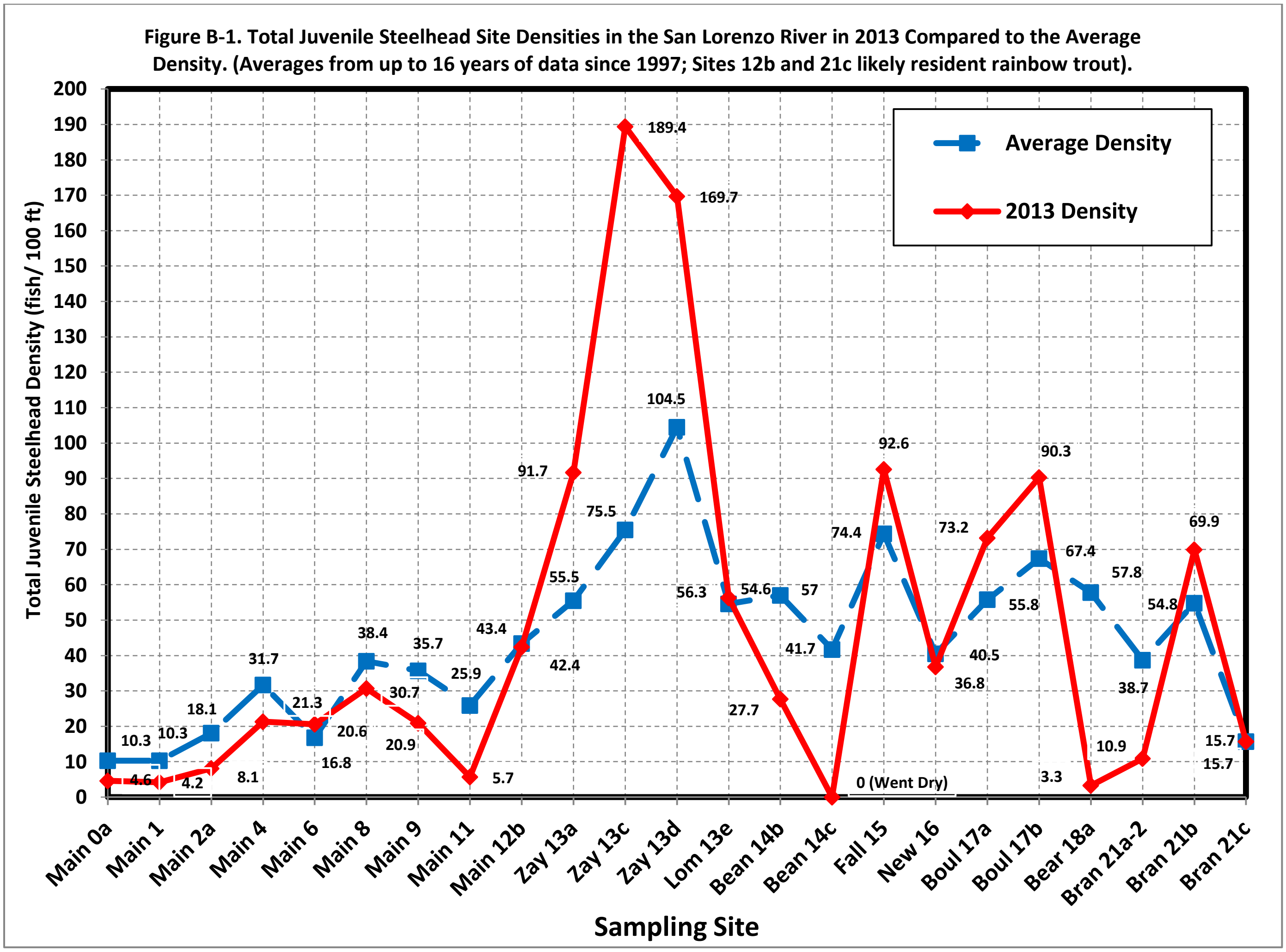


Figure B-1. Total Juvenile Steelhead Site Densities in the San Lorenzo River in 2013 Compared to the Average Density. (Averages based on up to 16 years of data since 1997).

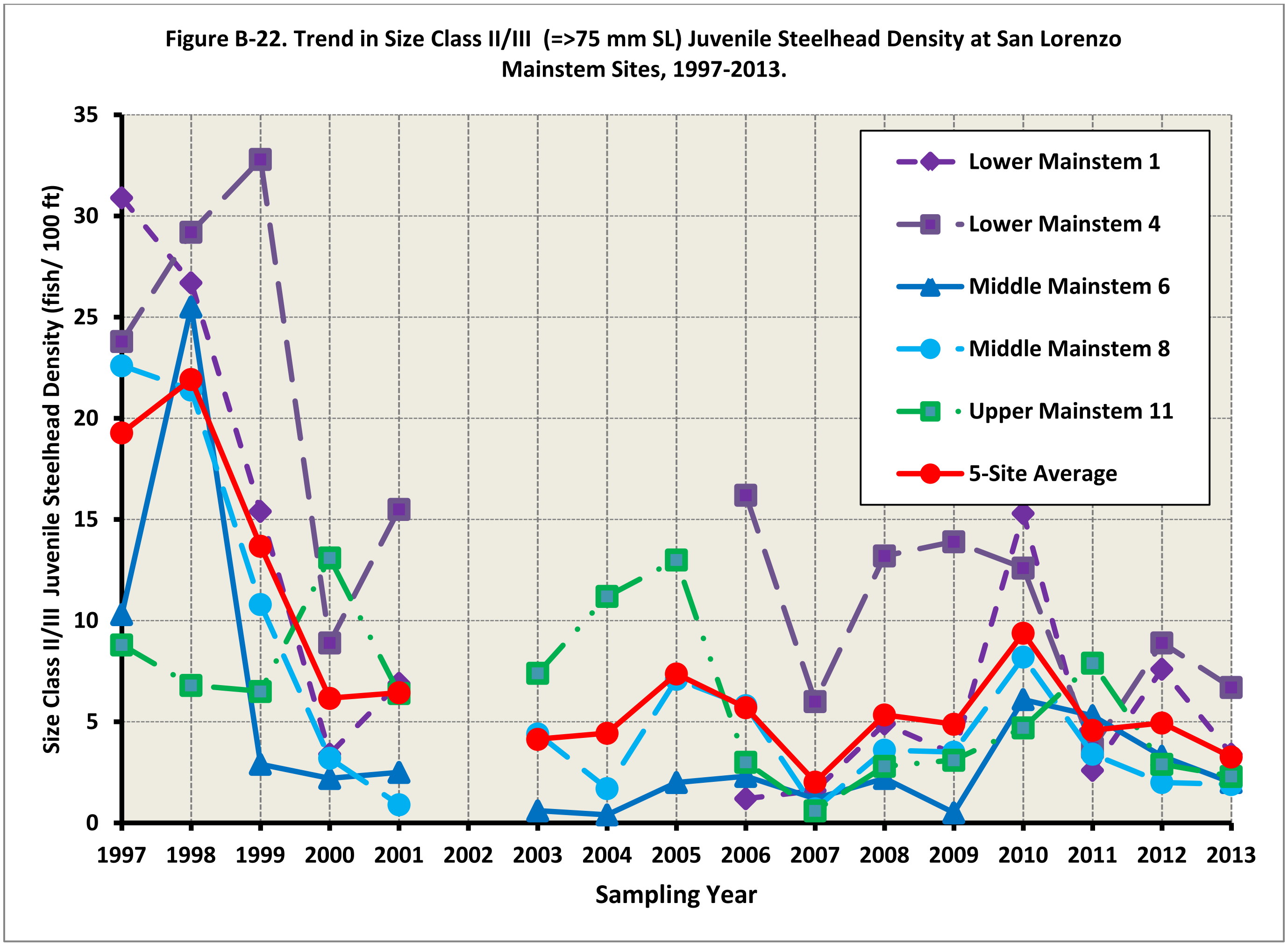


Figure B-22. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2013.

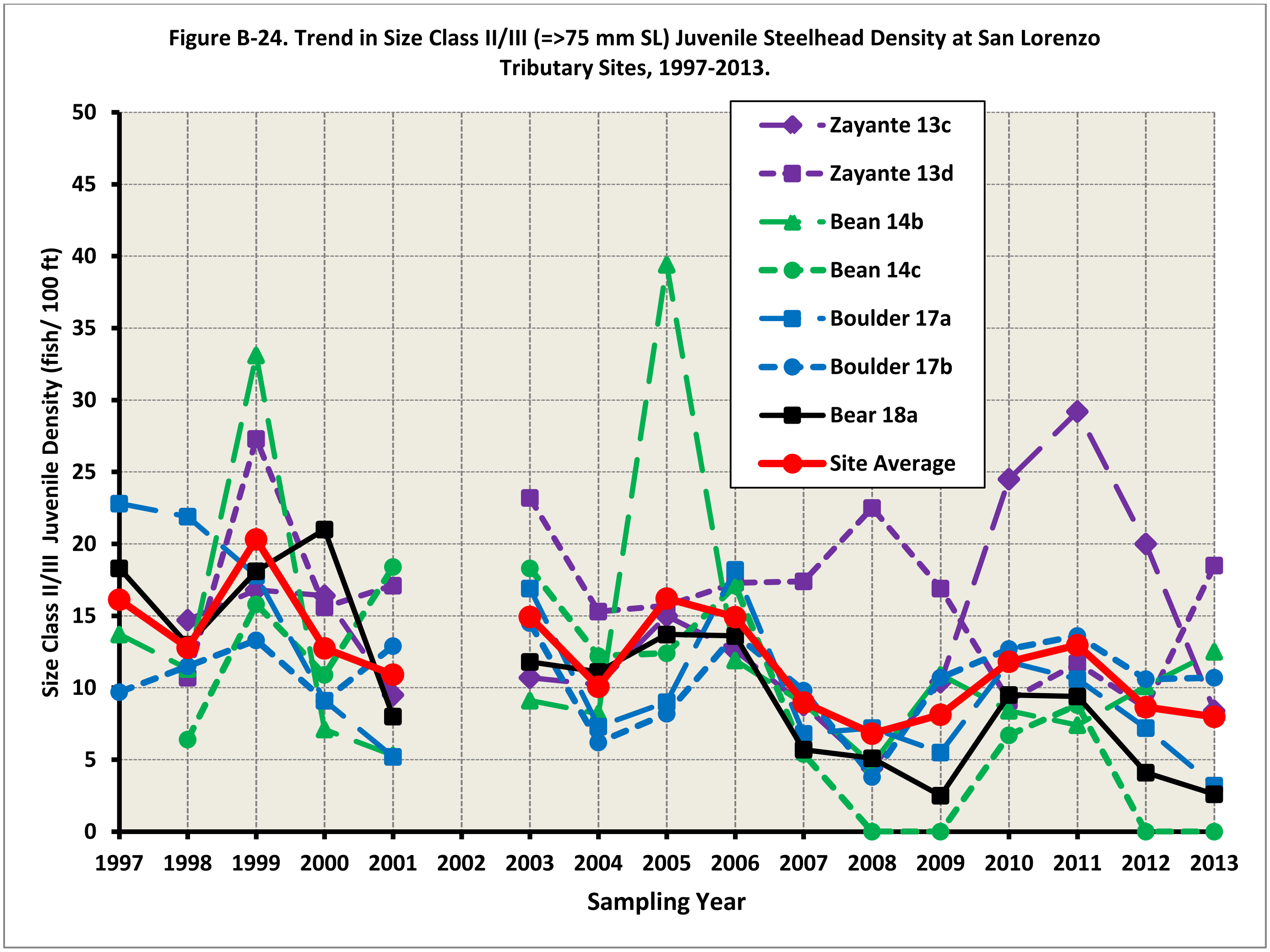


Figure B-24. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2013.

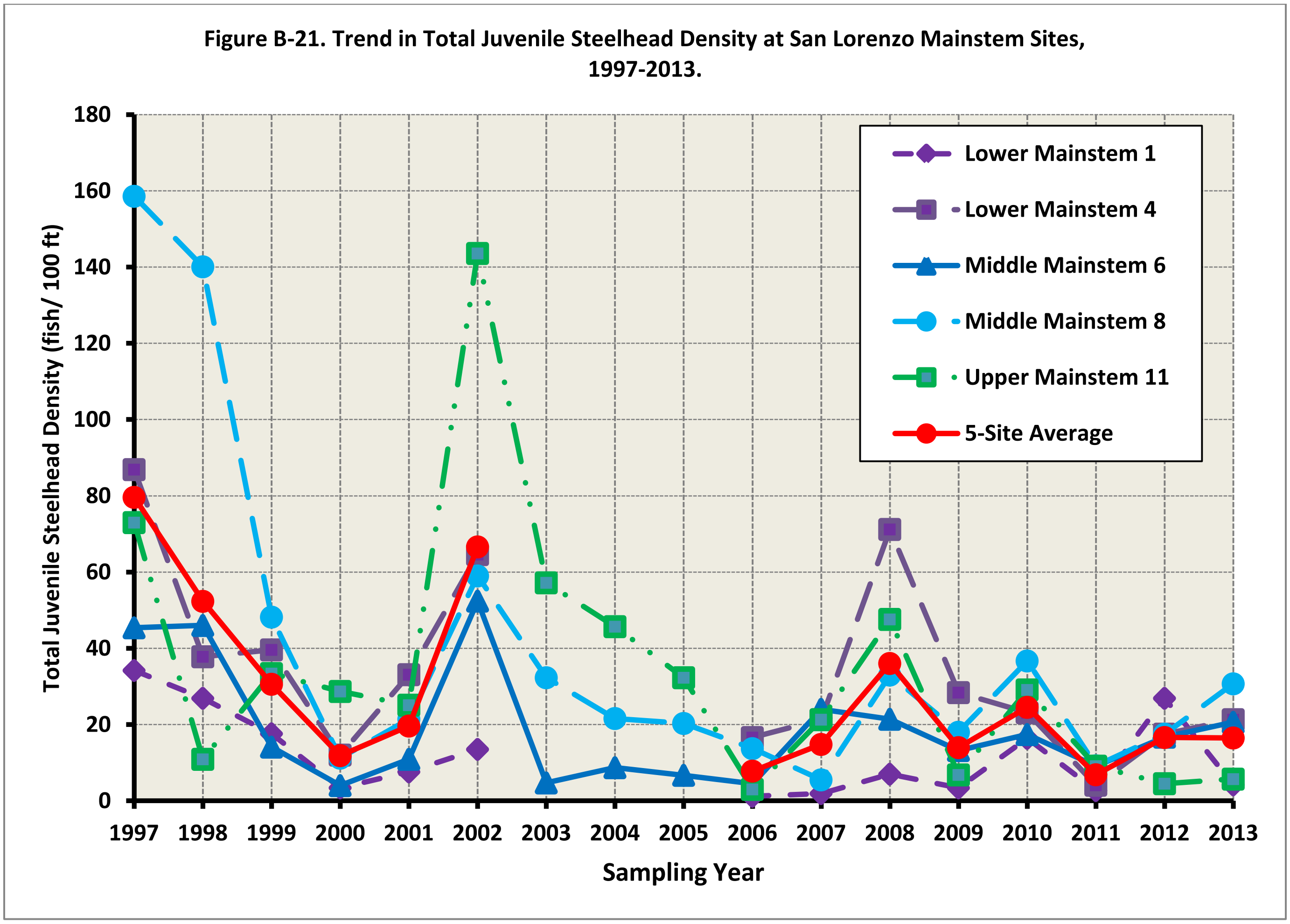


Figure B-21. Trend in Total Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2013.

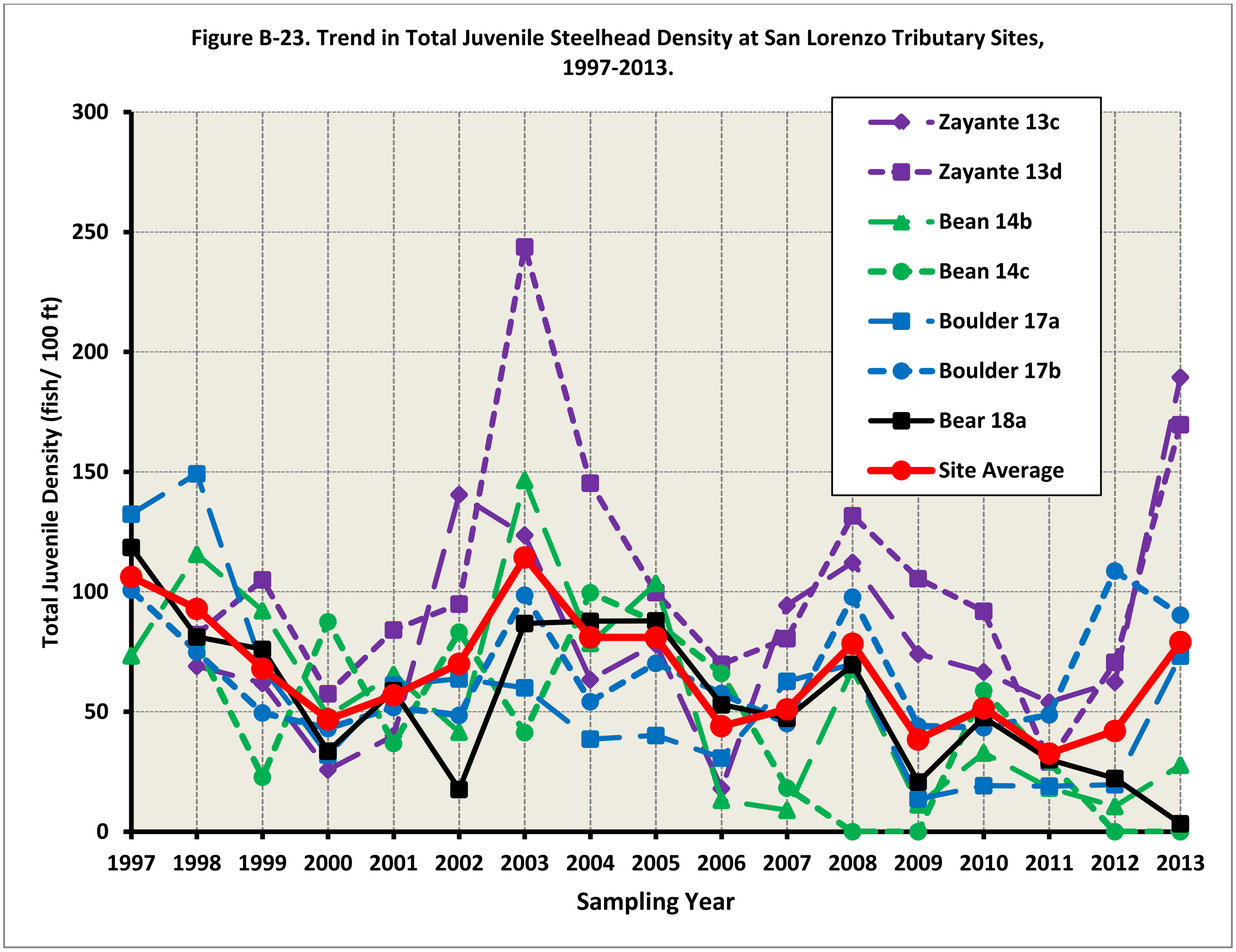


Figure B-23. Trend in Total Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2013.

Table B-40. 2013 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Their Average Size in Standard Length Compared to 2012, with Physical Habitat Change Since 2012 Conditions.

(Red denotes ratings of 1−3 (as in Table S-3) and negative habitat change and italicized purple denotes ratings of 5−7. Methods for habitat change in M-6 of **Appendix B**.)

Site	2012 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL (mm)	2012 Smolt Rating (With Size Factored In)	2013 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL (mm)	2013 Smolt Rating (With Size Factored In)	Physical Habitat Change by Reach/Site Since 2012
Low. San Lorenzo #0a	26.9/ 135 mm	***Very Good***	4.1/ 94 mm	**Below Average**	+
Low. San Lorenzo #1	7.6/ 119 mm	Fair	3.4/ 96 mm	**Poor**	**–**
Low. San Lorenzo #2	6.6/ 111 mm	Fair	6.2/ 88 mm	**Very Poor**	**–**
Low. San Lorenzo #4	8.9/ 87 mm	**Below Average**	6.7/ 81 mm	**Very Poor**	**–**
Mid. San Lorenzo #6	3.3/ 86 mm	**Very Poor**	2.0/ 108 mm	**Below Average**	**–**
Mid. San Lorenzo #8	2.0/ 81 mm	**Very Poor**	1.9/ 90 mm	**Poor**	**–**
Mid. San Lorenzo #9	–	–	2.3/ 86 mm	**Very Poor**	
Up. San Lorenzo #11	2.9/ 101 mm	**Poor**	2.3/ 114 mm	**Below Average**	**–**
Up. San Lorenzo #12b (may not be steelhead)	11.3/ 112 mm	***Good***	10.0/ 111 mm	***Good***	**–**
Zayante #13a	14.2/ 107 mm	***Good***	2.7/ 98 mm	**Poor**	**–**
Zayante #13c	20.0/ 90 mm	***Good***	8.4/ 87 mm	**Below Average**	**–**
Zayante #13d	8.6/ 127 mm	***Good***	18.5/ 105 mm	***Very Good***	**–**
Lompico #13e	2.3/ 127 mm	**Below Average**	8.7/ 104 mm	***Good***	+
Bean #14b	10.1/ 122 mm	***Good***	12.5/ 90 mm	Fair	**–**
Bean #14c	5.2/ 120 mm	Fair (**went dry**)	**Dry**	**Dry**	**Dry both years**
Fall #15	13.0/ 113 mm	***Good***	12.1/ 98 mm	Fair	**–**
Newell #16	7.3/ 93 mm	**Below Average**	23.7/ 89 mm	***Good***	+
Boulder #17a	7.2/ 131 mm	Fair	3.2/ 118 mm	**Below Average**	**–**
Boulder #17b	10.6/ 104 mm	***Good***	10.7/ 96 mm	Fair	**–**
Bear #18a	4.1/ 115 mm	Fair	2.6/ 115 mm	**Below Average**	+
Branciforte #21a-2	12.3/ 114 mm	***Good***	6.0/ 106 mm	Fair	+
Branciforte #21b	27.3/ 96 mm	***Good***	13.3/ 100 mm	Fair	+
Soquel #1	4.0/ 115 mm	Fair	1.8/ 94 mm	**Poor**	**–**
Soquel #4	11.1/ 101 mm	Fair	2.1/ 110 mm	**Below Average**	**–**
Soquel #10	16.0/ 94 mm	***Good***	5.2/ 87 mm	**Poor**	**–**
Soquel #12	13.1/ 93 mm	Fair	3.1/ 82 mm	**Very Poor**	**–**
East Branch Soquel #13a	18.6/ 94 mm	***Good***	6.8/ 106 mm	Fair	**–**
East Branch Soquel #16	13.8/ 105 mm	***Good***	6.2/ 92 mm	**Below Average**	**–**
West Branch Soquel #19	6.1/ 91 mm	**Below Average**	3.4/ 105 mm	**Below Average**	**–**
Aptos #3	11.6/ 103 mm	***Good***	5.1/ 103 mm	Fair	+
Aptos #4	9.6/ 120 mm	***Good***	6.1/ 120 mm	Fair	**–**
Corralitos #1	8.7/ 108 mm	***Good***	12.1/ 110 mm	***Good***	**–**
Corralitos #3	24.2/ 114 mm	***Very Good***	10.7/ 105 mm	***Good***	**–**
Corralitos #8	9.4/ 100 mm	Fair	1.8/ 130 mm	**Poor**	**–**
Corralitos #9	12.7/ 105 mm	***Good***	10.5/ 108 mm	***Good***	**–**
Shingle Mill #1	4.2/ 101 mm	**Below Average**	6.9/ 94 mm	**Below Average**	**Similar**
Shingle Mill #3	5.7/ 91 mm	**Below Average**	3.1/ 86 mm	**Very Poor**	**–**
Browns #1	17.6/ 98 mm	***Good***	18.0/ 96 mm	***Good***	**–**
Browns #2	20.2/ 97 mm	***Good***	9.6/ 101 mm	Fair	**–**

iii. Steelhead Abundance in the Soquel Creek Watershed

1. Two large stormflows occurred in December 2012 (4,800 and 6,470 cfs at the Soquel Village gage), with very little stormflow afterwards (***Figure B-37a*** *below*). All reaches had lower spring-summer-fall baseflow in 2013 than 2012 that was below the median statistic (***Figure B-37b*** *below*). The average mean monthly streamflow for May−September in 2013 at the Soquel Village gage was the second lowest in 17 years of calculations (2.4 cfs with a 17-year average of 9.3 cfs) (***Figure B-42*** *above*). With low baseflow, food availability was low for YOY growth in 2013, especially in the important spring and early summer period. Low food levels resulted in a smaller proportion of YOY reaching Size Class II in 2013 (***Figure 18a*** *below*).

2. Although important habitat parameters such as pool depth and escape cover remained similar or improved substantially in 2013 at mainstem Sites 1, 10 and West Branch Site 19 compared to 2012, overall habitat quality was judged reduced at all sites due to much lower baseflow (***Tables 5b, 14b, 15d, 15f in Appendix B and B-15g*** *below*). All 3 habitat typed reaches in 2013 had reduced overall habitat quality due to reduced baseflow and shallower conditions compared to reach data last collected in 2011 (***Tables 14a, 15a, 15c, 15e in Appendix B and B-15g*** *below*). However, Reach 3 had substantially more escape cover, and substrate conditions remained similar or improved somewhat in all 3 reaches. Soquel Lagoon scoured out during the winter, it being 2 feet deeper under Stockton Bridge than the previous summer.

3. ***Total and YOY densities*** were above average at 6 of 7 sites, with Site 16 in the SDSF much below average, as it has been since 2010 (***Figures B-5 and B-6*** *below*). Total densities increased in 2013 at 6 of 7 sites, and YOY densities increased at all 7 sites compared to 2012 (***Tables 26 and 27 in Appendix B***). Site 12 in Reach 8 of the upper mainstem was abundant with small YOY (134 YOY/ 100 ft). The trend in total densities increased in 2013 (***Figure B-25*** *below*). The increases in total and YOY densities were statistically significant.

4. Apparently, there were insufficient late spawners to seed the SDSF site with YOY again in 2013 (based on much below average YOY densities (***Figure B-6*** *below*)), with only 2 small stormflows of less than 55 cfs at Soquel Village after December 2012. YOY survival was likely poor in the SDSF due to very low baseflows through the summer.

5. 2013 yearling densities showed a similar pattern to those in the San Lorenzo, with a decline at 4 of 7 sites, generally low yearling densities throughout and near average at all sites (***Table 28 in Appendix B; Figure B-7*** *below*). The high survival/retention of yearlings in the mild winter of 2012 was not repeated in 2013 with the two large December stormflows.

6. With relatively low ***yearling densities*** in 2013 and a small portion of YOY growing into Size Class II at all sites (***Figure B-18*** *below*), densities of Size Class II and III juveniles were less

than in 2012 and below average at all 7 sites (***Table 30 in Appendix B; Figure B-8*** *below*). The trend in Size Class II and III densities declined precipitously in Soquel Creek to a low level not seen since the dry year of 2008 (***Figure B-26*** *below*). The decrease in Size Class II and III densities was statistically significant.

7. Soon-to-smolt density ratings declined at 6 of 7 sites in 2013, while 6 sites were rated between "very poor and "below average" (***Table B-40*** *above*). Only Site 19 in the West Branch was rated as good as "fair." This was likely because a wood cluster existed at the sampling site and a few larger yearling steelhead were retained there to increase the rating from "below average" to "fair."

8. Our steelhead population estimate for Soquel lagoon for fall 2013 was 1,681. This was the fifth highest estimate in 21 years and slightly above the average of 1,599 (skewed high by a few abundant years) (**Alley 2014**). The 2013 population size fit the typical pattern expected for drier years when more spawning occurs near the lagoon and the lagoon is seeded by more YOY than in wetter years when spawning occurs more in the upper watershed.

9. No coho or chinook salmon juveniles were detected in the lagoon or any stream sites.

Figure B-37a. The 2013 Discharge at the USGS Gage on Soquel Creek at Soquel Village.

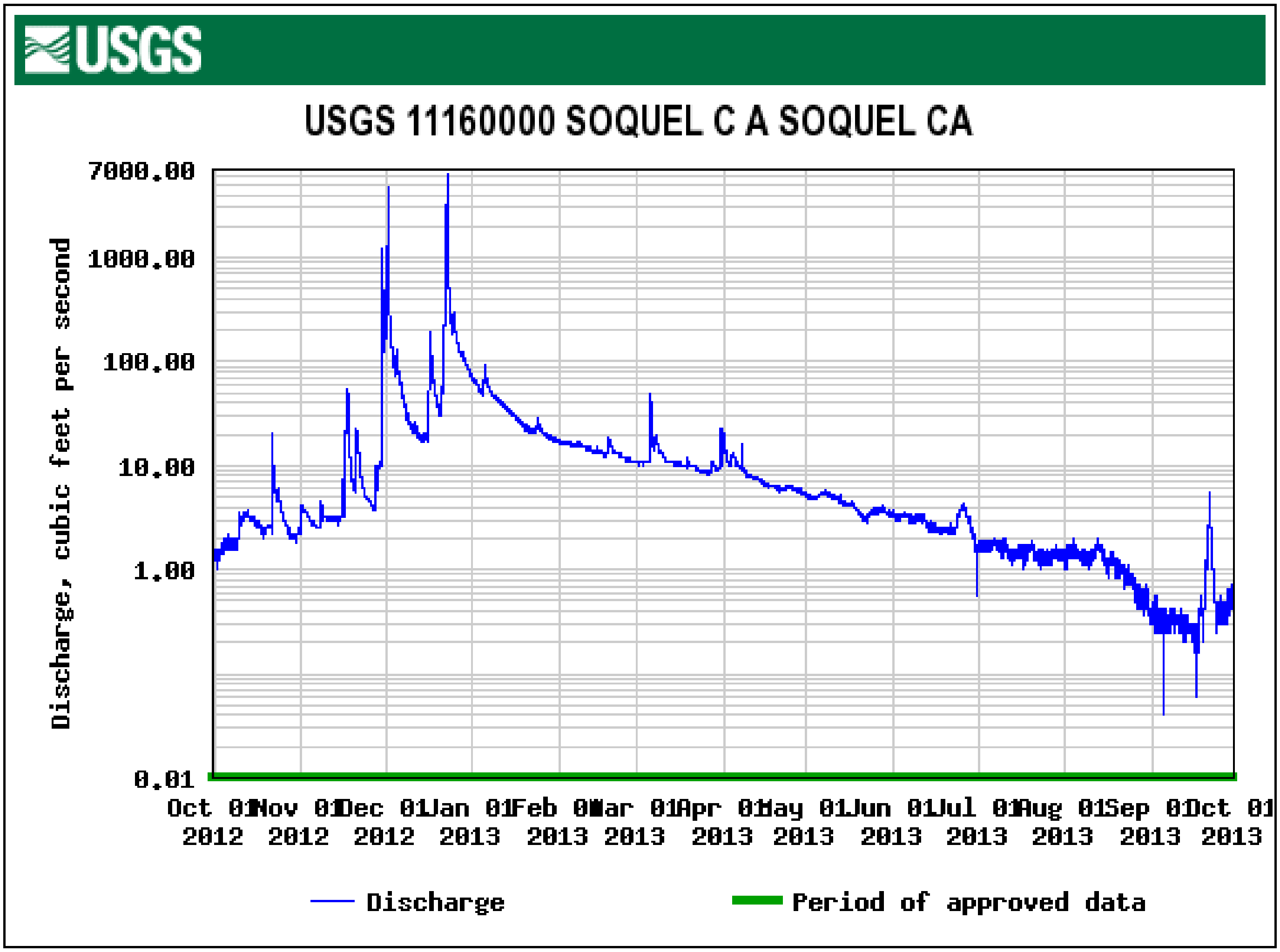
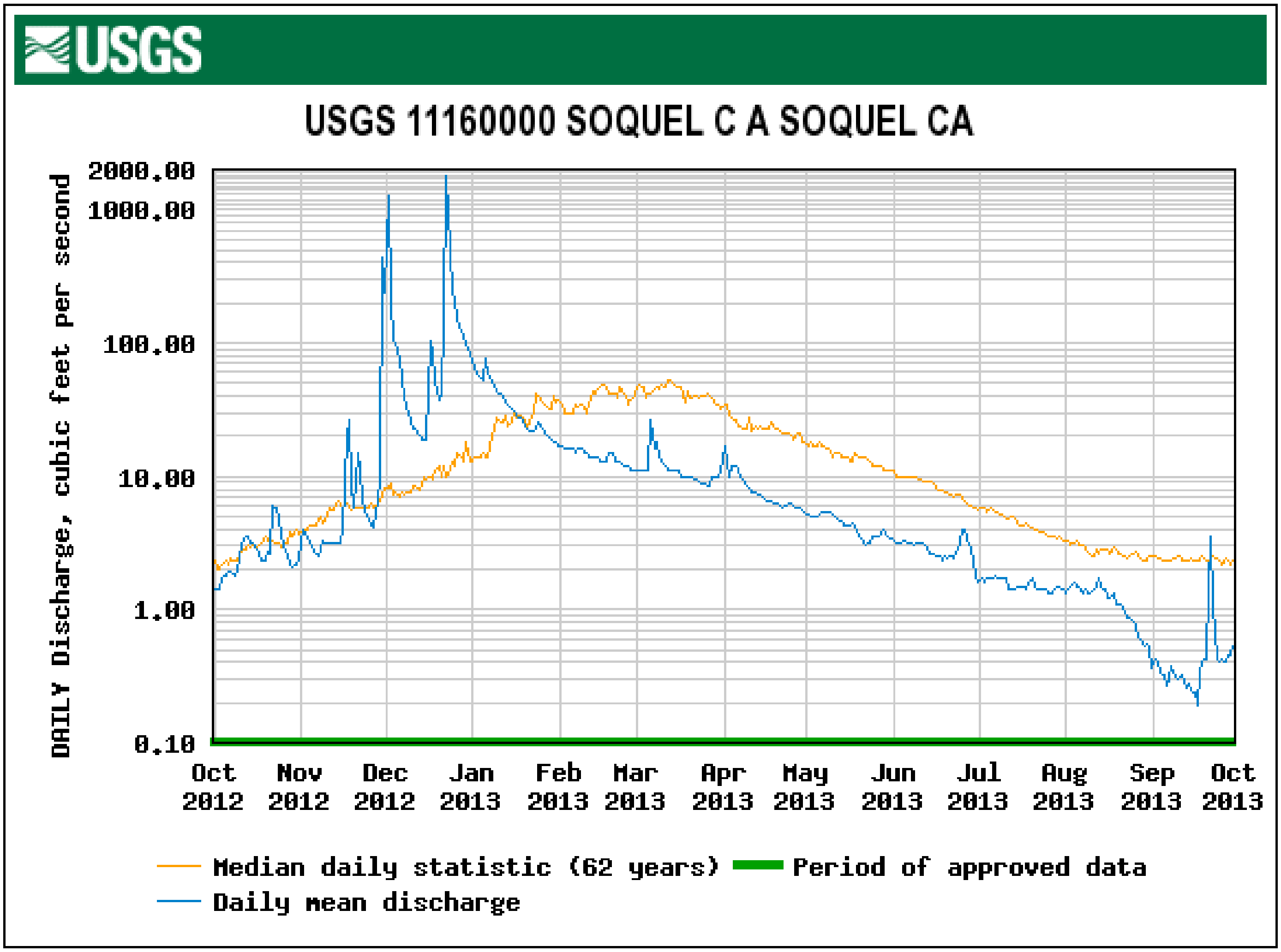


Figure B-37b. The 2013 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel Village.



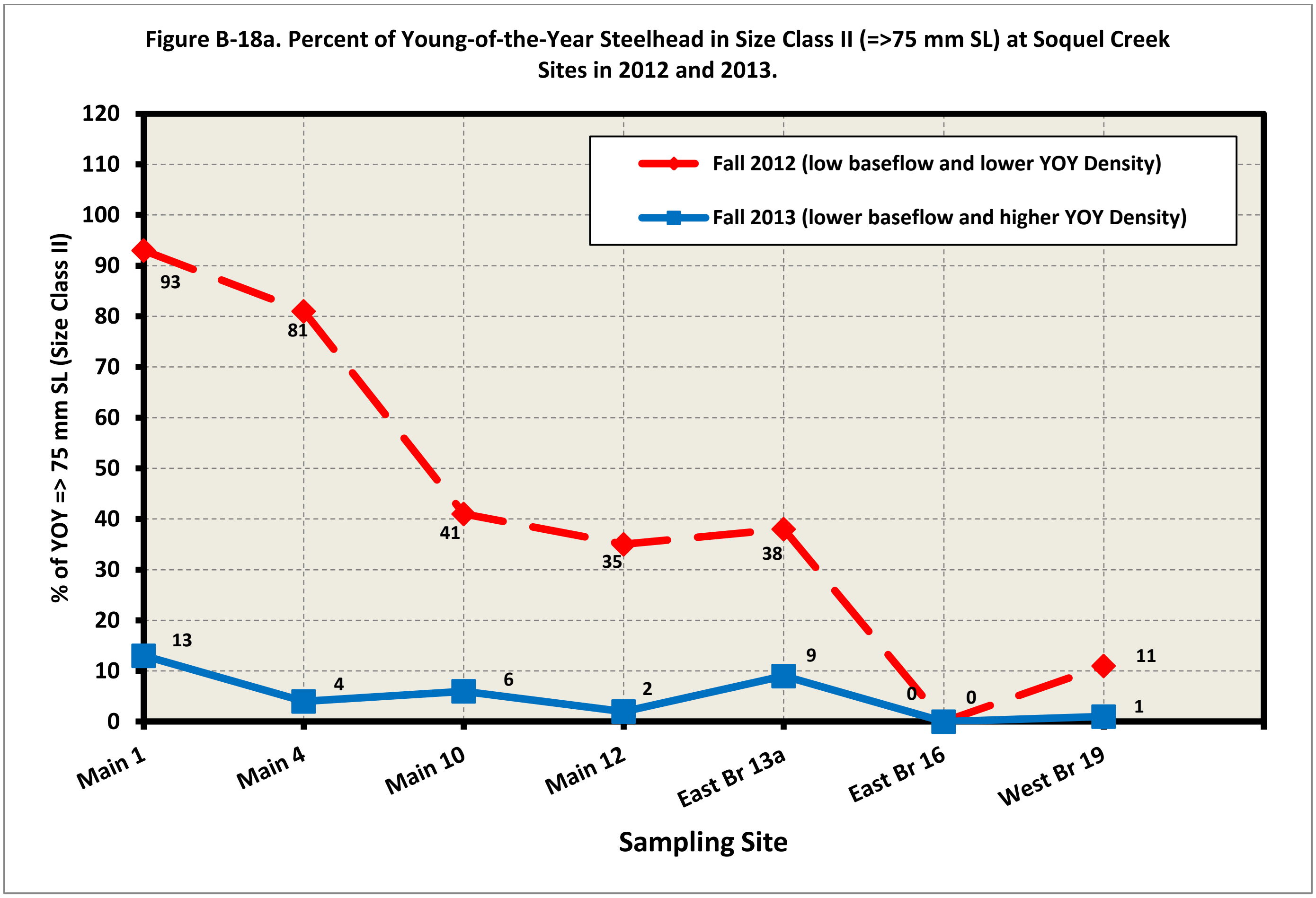


Figure B-18a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Soquel Creek Sites in 2012 and 2013.

Table B-15g. Habitat Change in SOQUEL CREEK WATERSHED Reaches (2011 to 2013 or 2012-2013) or Replicated Sites (2012 to 2013).

Reach Comparison or Site Only	Baseflow	Pool Depth	Fine Sediment	Embeddedness	Pool Escape Cover	Overall Habitat Change
Site 1 (Reach 1)	−	Similar	+	− (pool)	+	− (lower flow)
Reach 3a	−	−	−	− (pool) + (run)	+ (large)	−
Site 10 (Reach 7)	−	+ (pool)	+	+ (pool)	+	− (lower flow)
Reach 8	−	−	Similar	Similar	−	−
Reach 9a	−	−	+ (run)	+ (pool)	−	−
Reach 12a	−	−	+ (pool)	Similar	−	−
Site 19 (Reach 13)	−	+	Similar	+ (pool) − (fastwater)	+	− (lower flow)

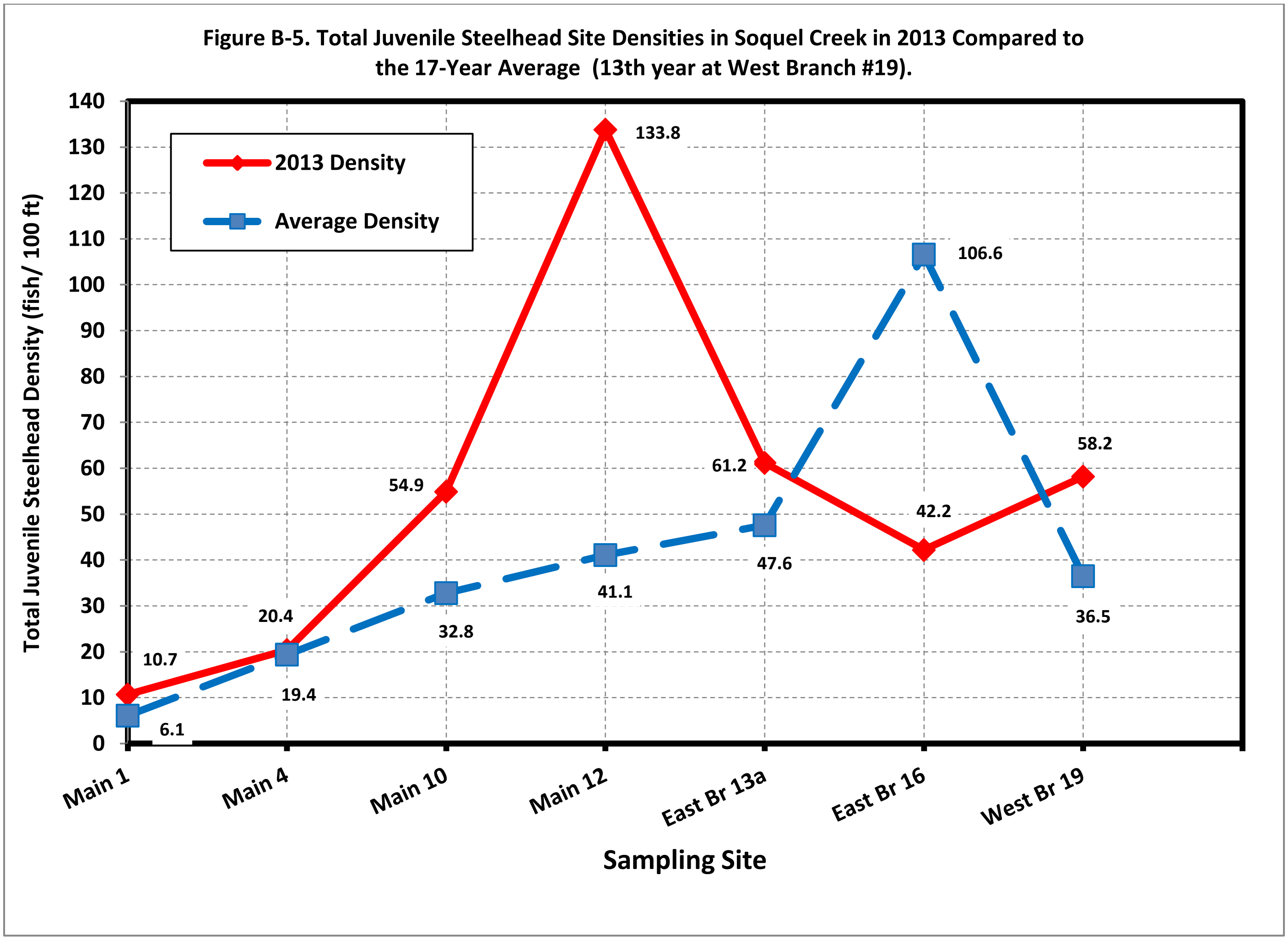


Figure B-5. Total Juvenile Steelhead Site Densities in Soquel Creek in 2013 Compared to the 17-Year Average (13th year at West Branch #19).

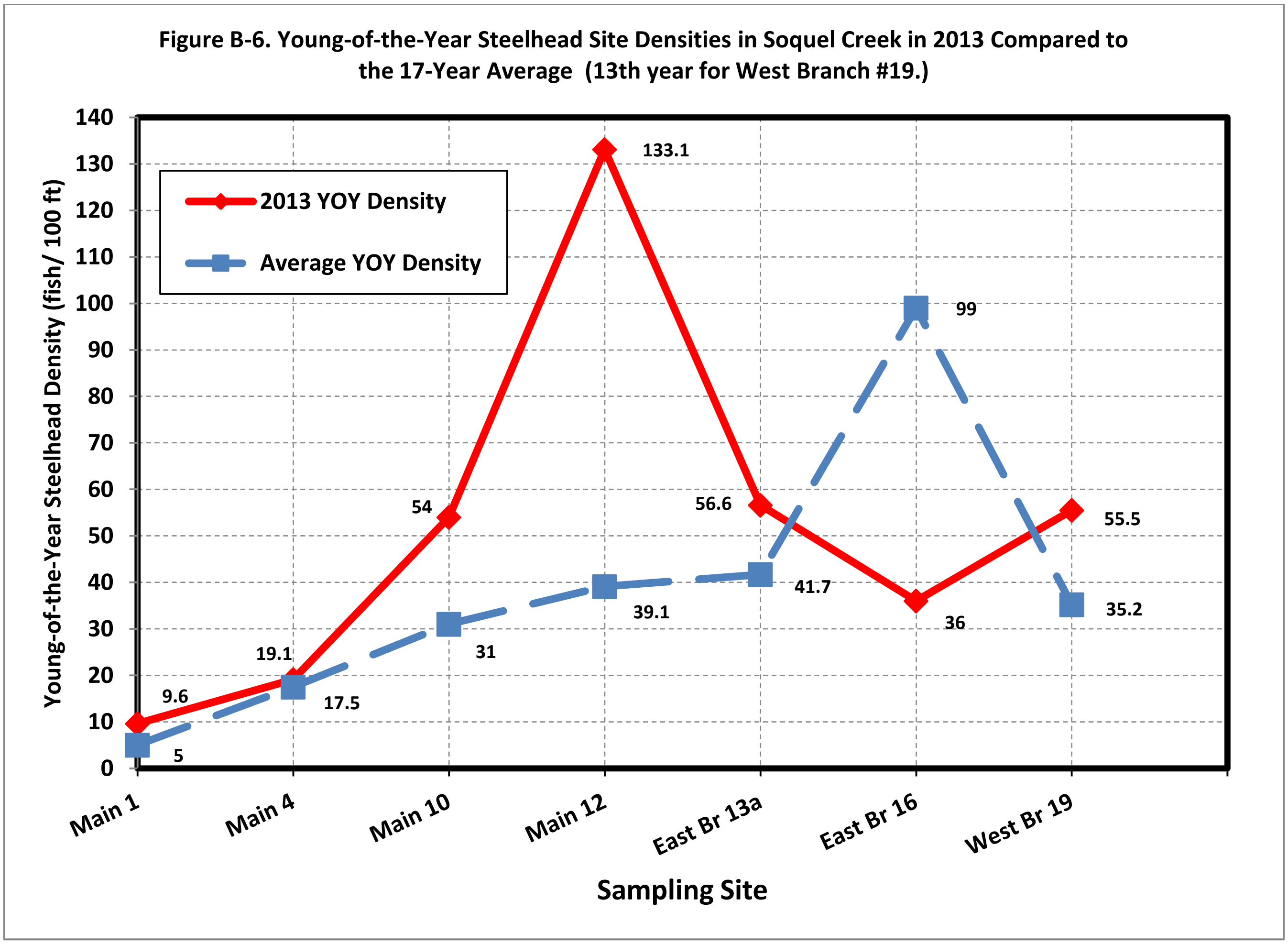


Figure B-6. Young-of-the-Year Steelhead Site Densities in Soquel Creek in 2013 Compared to the 17-Year Average (13th year for West Branch #19.)

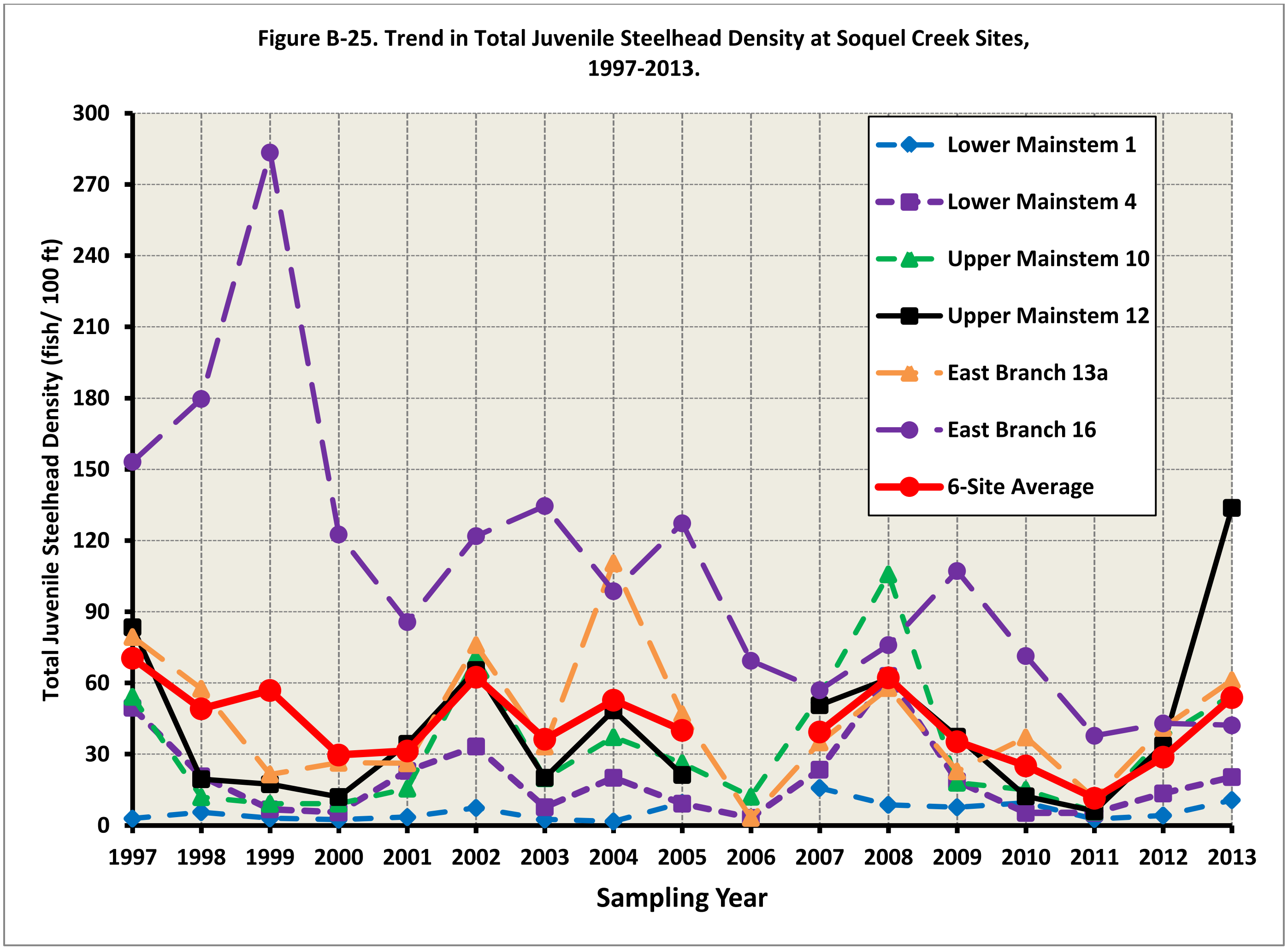


Figure B-25. Trend in Total Juvenile Steelhead Density at Soquel Creek Sites, 1997-2013.

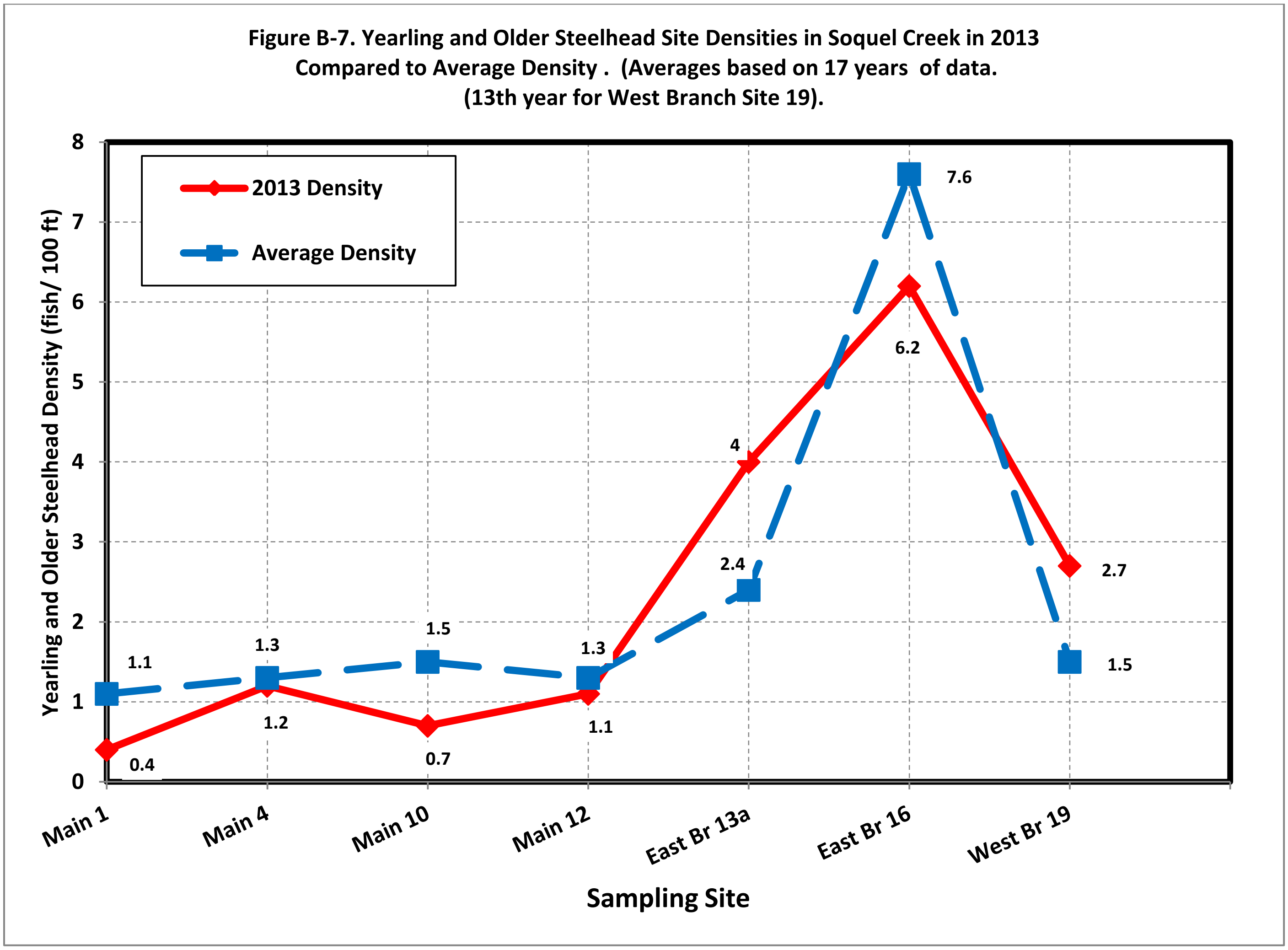


Figure B-7. Yearling and Older Steelhead Site Densities in Soquel Creek in 2013 Compared to Average Density. (Averages based on 17 years of data. (13th year for West Branch Site 19).

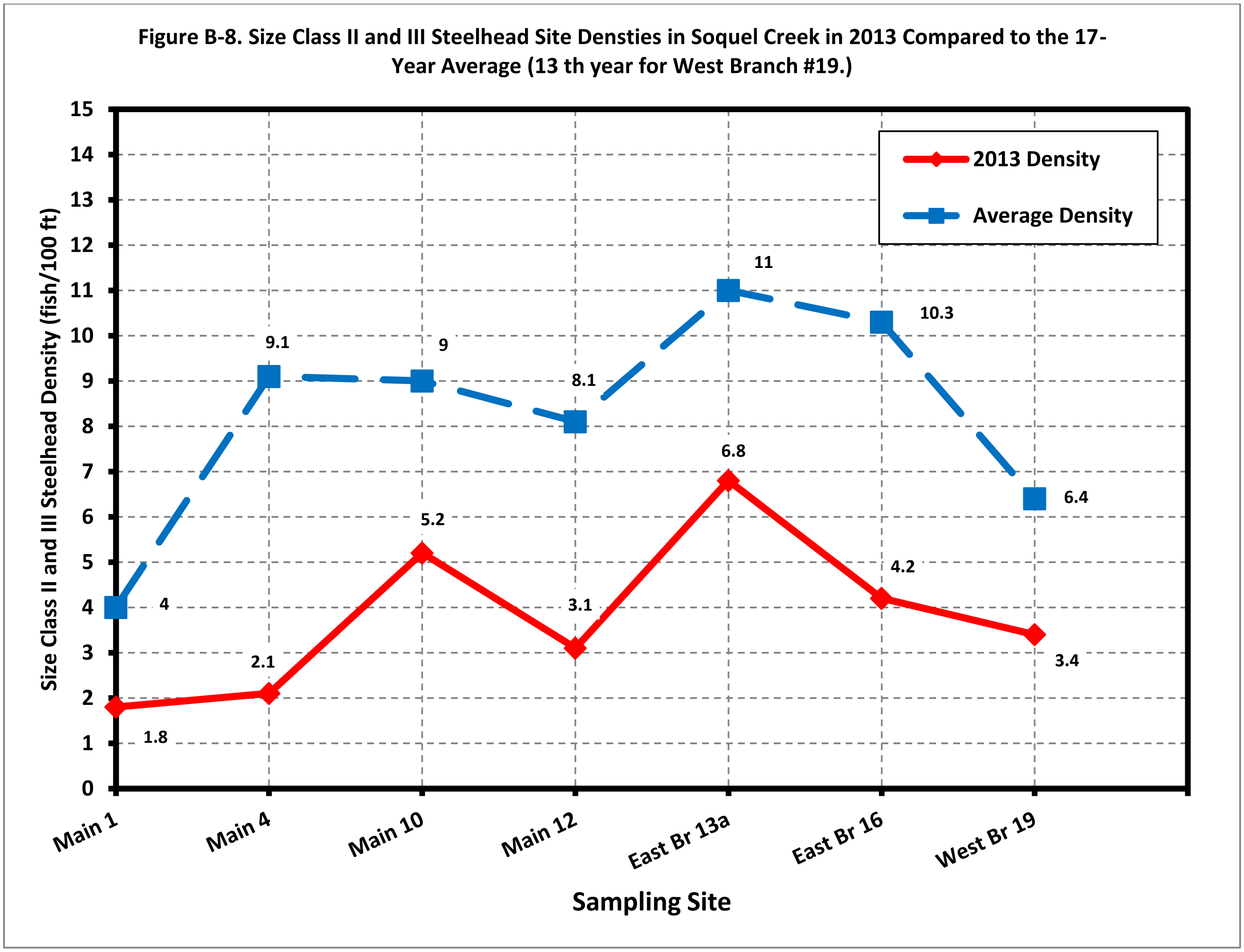


Figure B-8. Size Class II and III Steelhead Site Densities in Soquel Creek in 2013 Compared to the 17-Year Average (13th year for West Branch #19.)

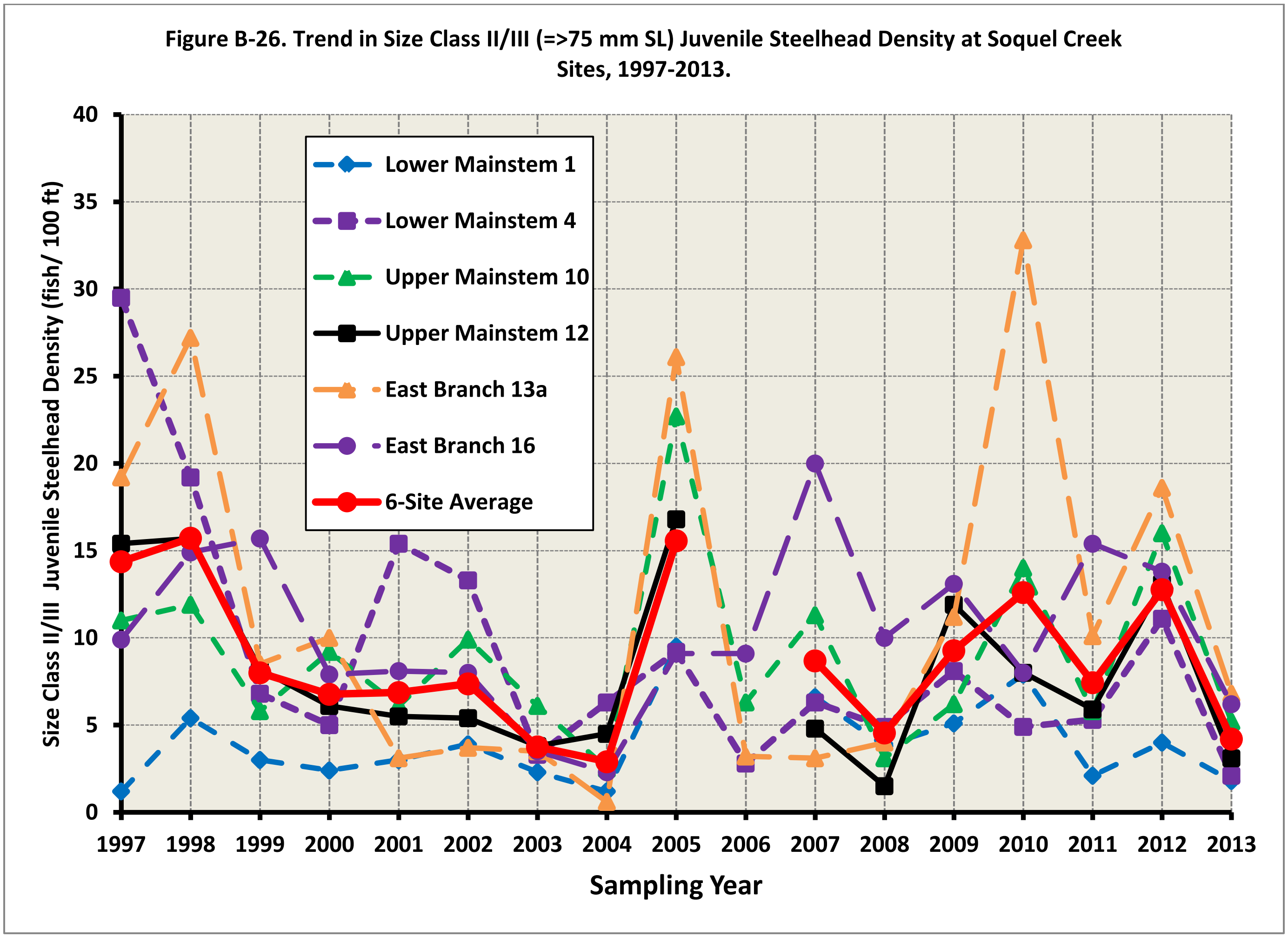


Figure B-26. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites, 1997-2013.

iv. Steelhead Abundance and Habitat in the Aptos Creek Watershed

1. Based on hydrographs from stream gages in other watersheds (***Figures 33-41 in Appendix B***), it is likely that this watershed also had similarly lower baseflow in 2013 compared to 2012, probably well below the median baseflow in spring-summer-fall. This provided less food and slower growth rate in all reaches in 2013 compared to the previous 3 years. Measured streamflow in fall in Aptos Creek confirmed lower baseflow than in 2012 but less of a decrease than in other watersheds (***Table 5b in Appendix B***). The portion of YOY that reached Size Class II was again low in 2013 (***Figure B-19a*** *below*).

2. ***Habitat quality*** declined in the lower Reach 2 in 2013 due primarily to lower baseflow and shallower pools, though escape cover rebounded to 2011 levels in 2013 (***Table B-16c*** *below**;** **Summarized from Tables 5b, 16a−b in Appendix B***). Most escape cover was undercut banks. Habitat quality declined in upper Aptos Reach 3 in Nisene Marks, based on conditions at Site 4. Though baseflow was less, maximum pool depth increased somewhat while average mean depth lessened. Escape cover was similar to 2012 but fine sediment had increased. The wood cluster pool had partially scoured out but considerable sediment remained.

3. ***Total and YOY densities*** DID NOT increase in 2013 as had occurred at some sites in the San Lorenzo and Soquel watersheds, and densities were below average (***Tables 31b and 32 in Appendix B; Figures B-9 and B-10*** *below*). This may indicate a declining adult steelhead population. The trend in total density declined in 2013 and has fluctuated considerably through the years of monitoring (***Figure B-27*** *below*).

4. Yearling densities declined in 2013 and were below average, following the pattern in other watersheds (***Table 33 in Appendix B; Figure B-11*** *below*).

5. With lower retention of yearlings and a small portion of YOY reaching Size Class II, the ***Size Class II and III densities*** were below average at both sites (***Table 35 in Appendix B; Figure B-12*** *below*). The trend in Size Class II and III densities continued downward for the third year, reaching levels similar to those during the dry years of 2008 and 2009 (***Figure B-28*** *below*). Soon-to-smolt ratings declined from "good" to "fair" at both sites (***Table B-40*** *above*).

6. Aptos Lagoon/Estuary was sampled twice in September for steelhead and tidewater goby. Based on recapture data, the 2013 steelhead population estimate was 32 compared to 140 in 2012 and 423 in 2011. Juvenile steelhead were large (median size 175-179 mm SL the first day and 170-175 mm SL the second) and had a bimodal size distribution similar to 2011 and were larger than the two previous years when populations were larger (***Figures B-43, B-44a and B44b*** *below*). A total of 170 tidewater gobies were captured from 11 seine hauls east and west of the jetty on the two days of seining. Other species captured included 6 pipefish (*Syngnathus*

leptorhynchus), 2 prickly sculpin (*Cottus asper*), 24 smelt and numerous threespine sticklebacks (*Gasterosteus aculeatus*).

7. The Aptos estuary was open to the ocean during both fish samplings, with well-defined stratification in salinity, temperature and oxygen through the water column that made for poor water quality (***Table 31a in Appendix B***). We would have expected a closed sandbar under such low stream inflow rate to the estuary, based on 15+ years of monitoring sandbar dynamics on other similar sized streams, San Simeon and Santa Rosa Creek lagoons near Cambria, California. Therefore, we suspect that the sandbar was maintained open by artificial means.

8. No coho or chinook salmon juveniles were detected in the lagoon or stream sites.

Table B-16c. Habitat Change in APTOS Reaches (2012 to 2013) AND CORRALITOS WATERSHED Reaches (2009 to 2013) and Replicated Sites (2012 to 2013).

Reach Comparison or (Site Only Comparison)	Baseflow	Pool Depth	Fine Sediment	Embeddedness	Pool Escape Cover	Overall Habitat Change
Aptos 2	−	−	Same	Similar	+ (large rebound)	− (lower baseflow)
(Aptos 4)	−	+	−	Similar	Similar	−
Corralitos 1 (2009 to 2013)	−	Similar	+	Similar	Similar	−
Site 3 (Corralitos 3)	−	−	Similar	− (riffle and run)	Similar	−
Site 8 (Corralitos 5/6)	−	−	Similar	−	Similar	−
Site 9 (Corralitos 7)	−	−	Similar	−	−	−
Site 1 (Shingle Mill 1)	−	Similar	Similar	Similar	+	Similar
Site 3 (Shingle Mill 3) (above fault line)	−	+	Similar	−	+	− (lower baseflow)
Browns 1 (2009 to 2013)	−	+	Similar	Similar	+	− (lower baseflow)
Browns 2 (2009 to 2013)	−	+	+	+	+	− (lower baseflow)

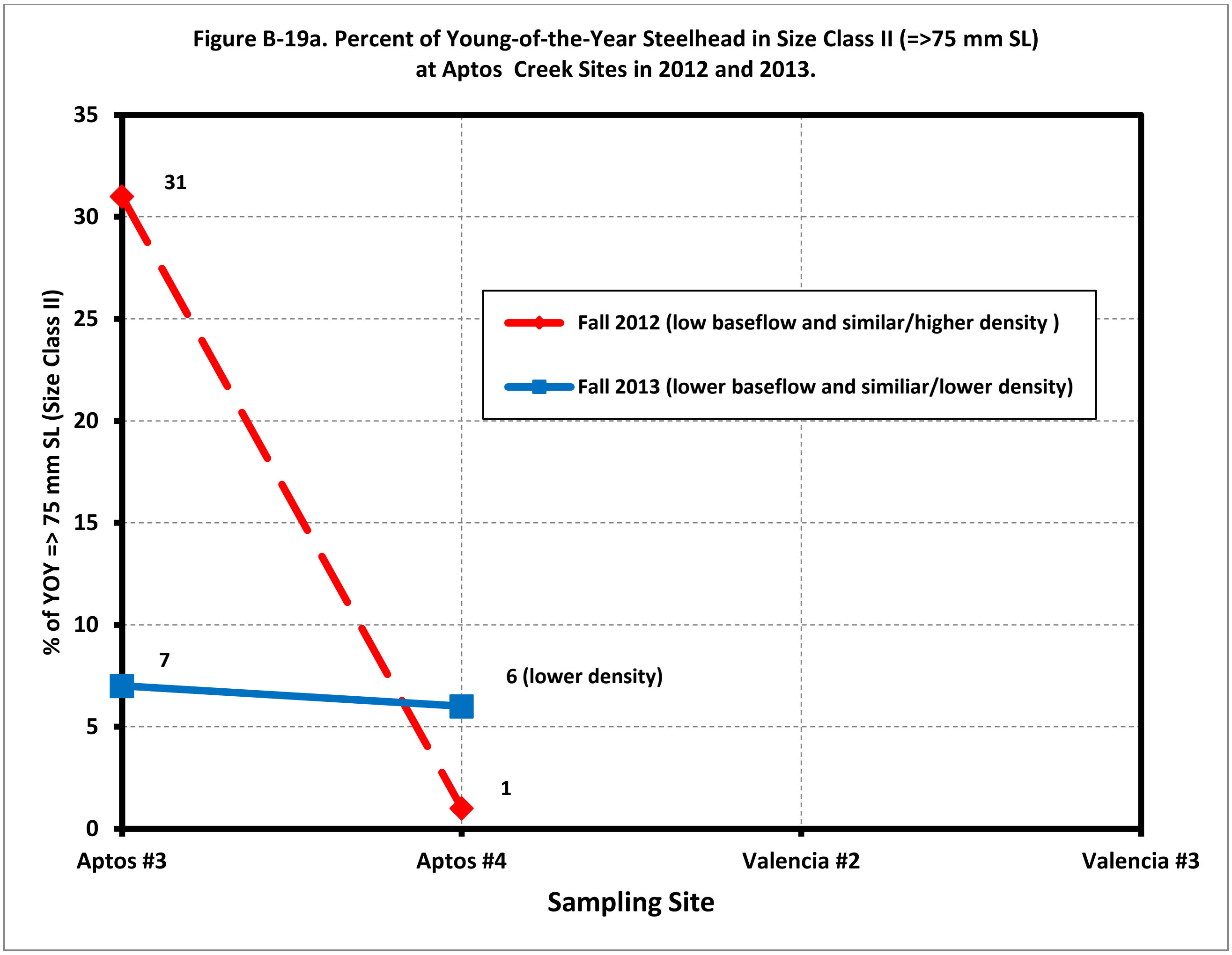


Figure B-19a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Aptos Creek Sites in 2012 and 2013.

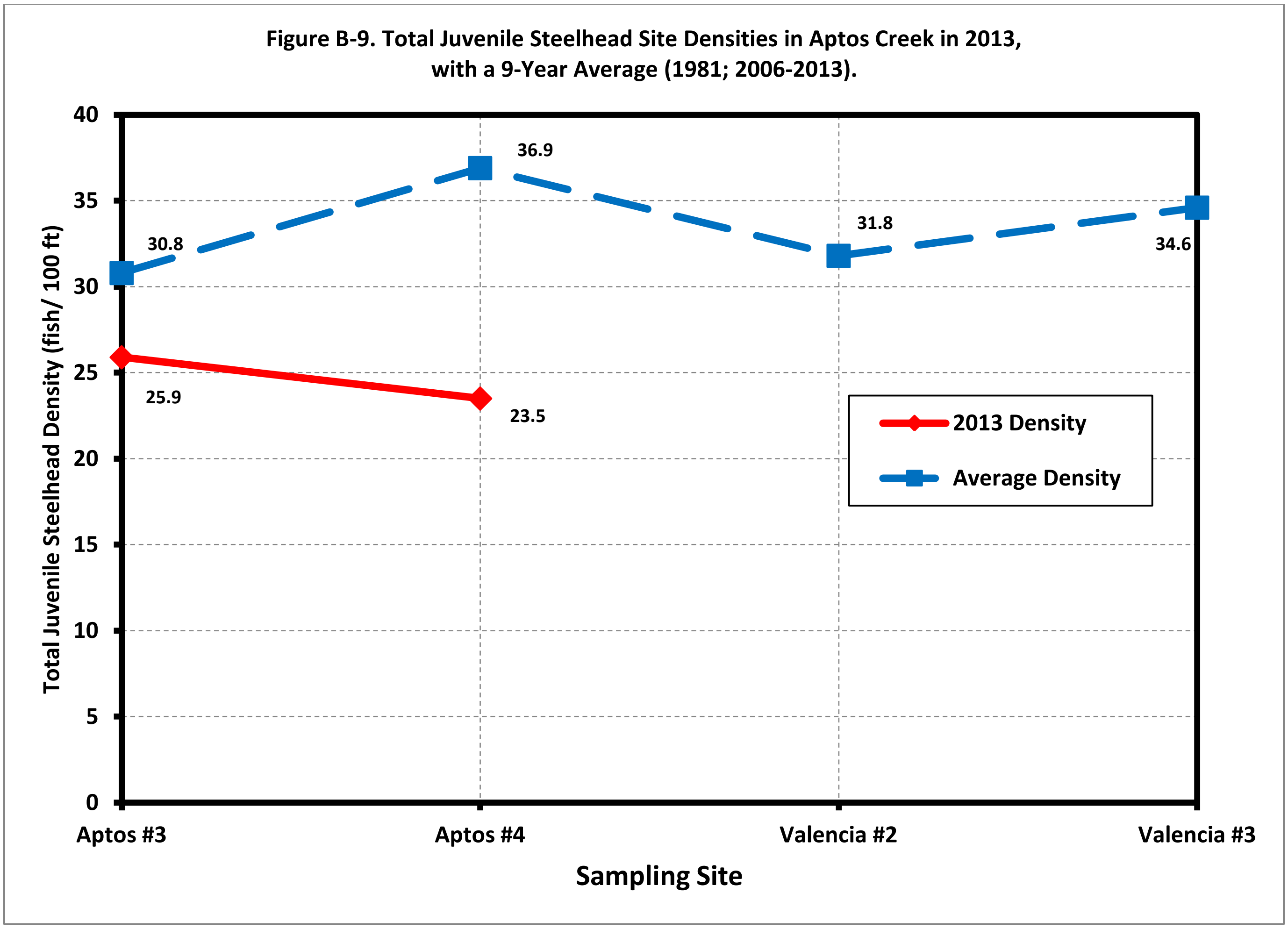


Figure B-9. Total Juvenile Steelhead Site Densities in Aptos Creek in 2013, with a 9-Year Average (1981; 2006-2013).

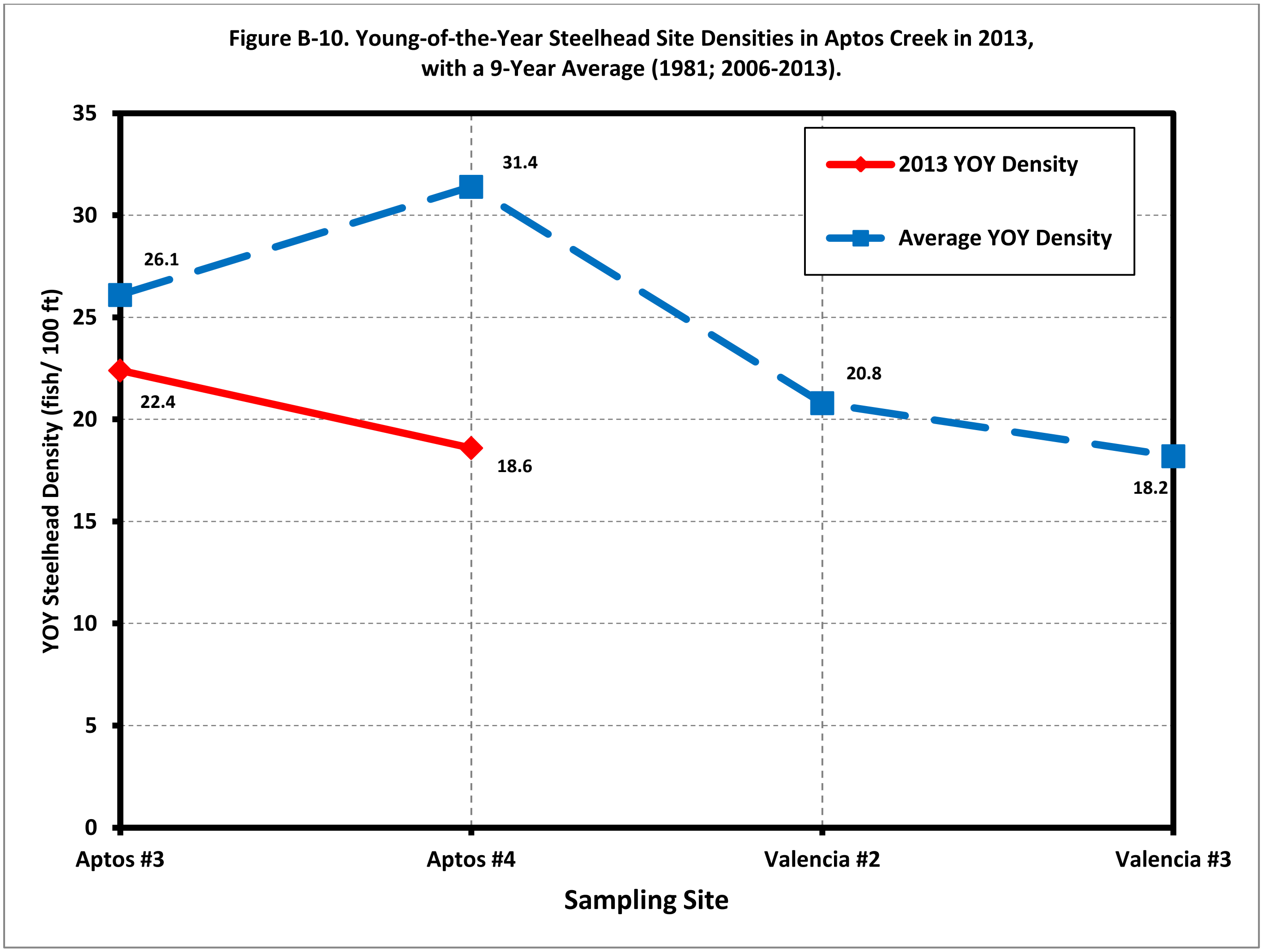


Figure B-10. Young-of-the-Year Steelhead Site Densities in Aptos Creek in 2013, with a 9-Year Average (1981; 2006-2013).

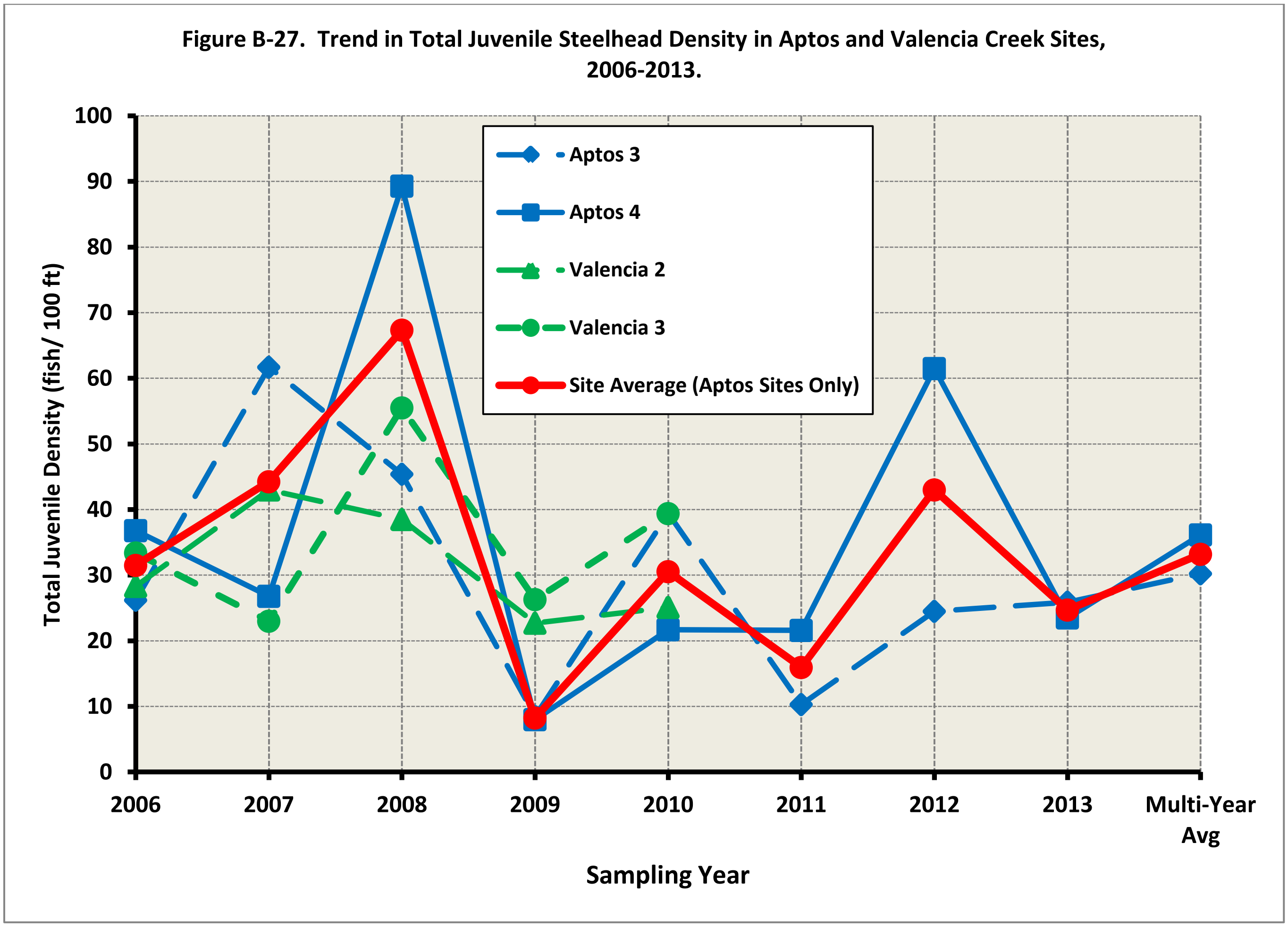


Figure B-27. Trend in Total Juvenile Steelhead Density in Aptos and Valencia Creek Sites, 2006-2013.

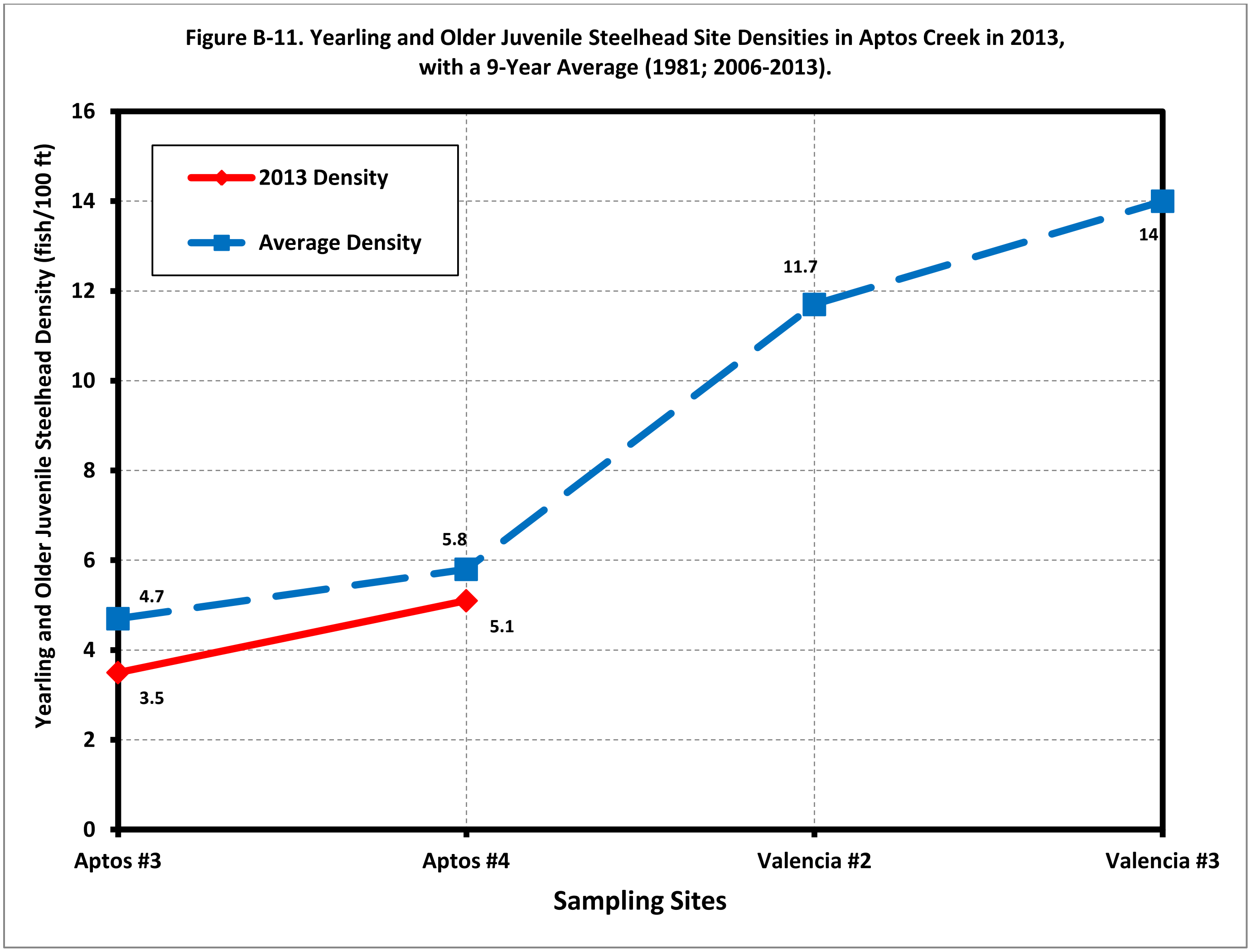


Figure B-11. Yearling and Older Juvenile Steelhead Site Densities in Aptos Creek in 2013, with a 9-Year Average (1981; 2006-2013).

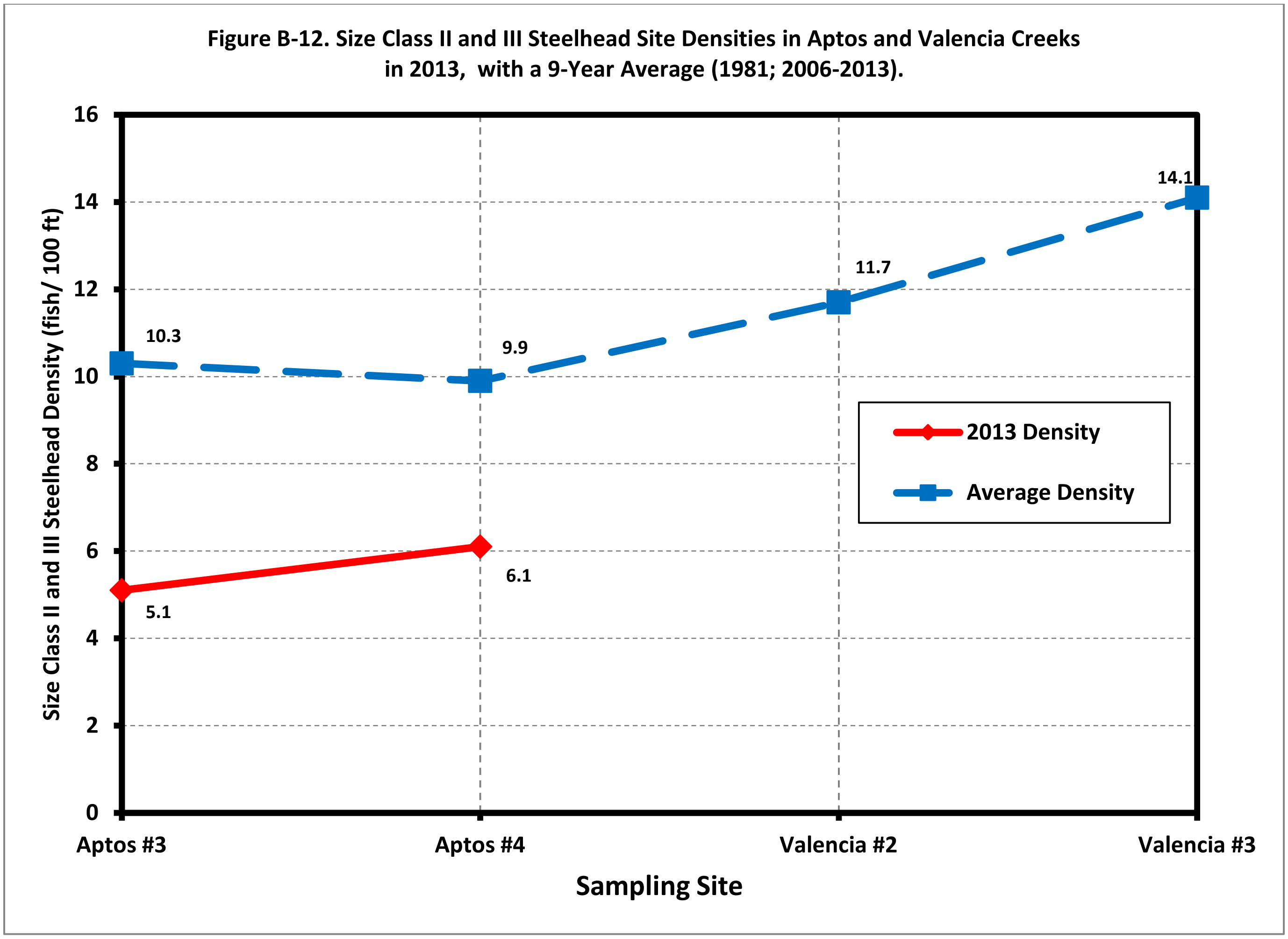


Figure B-12. Size Class II and III Steelhead Site Densities in Aptos and Valencia Creeks in 2013, with a 9-Year Average (1981; 2006-2013).

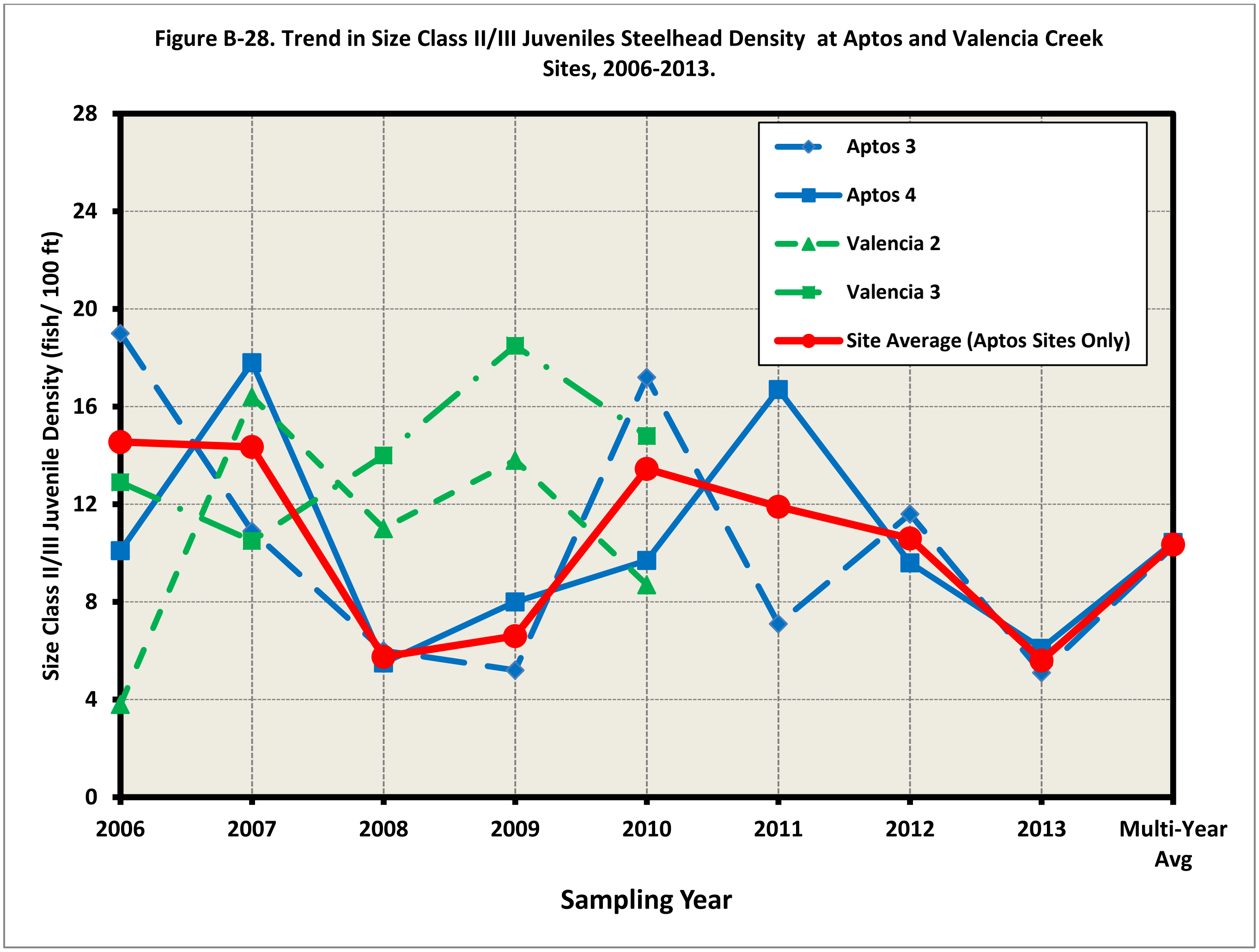


Figure B-28. Trend in Size Class II/III Juveniles Steelhead Density at Aptos and Valencia Creek Sites, 2006-2013.

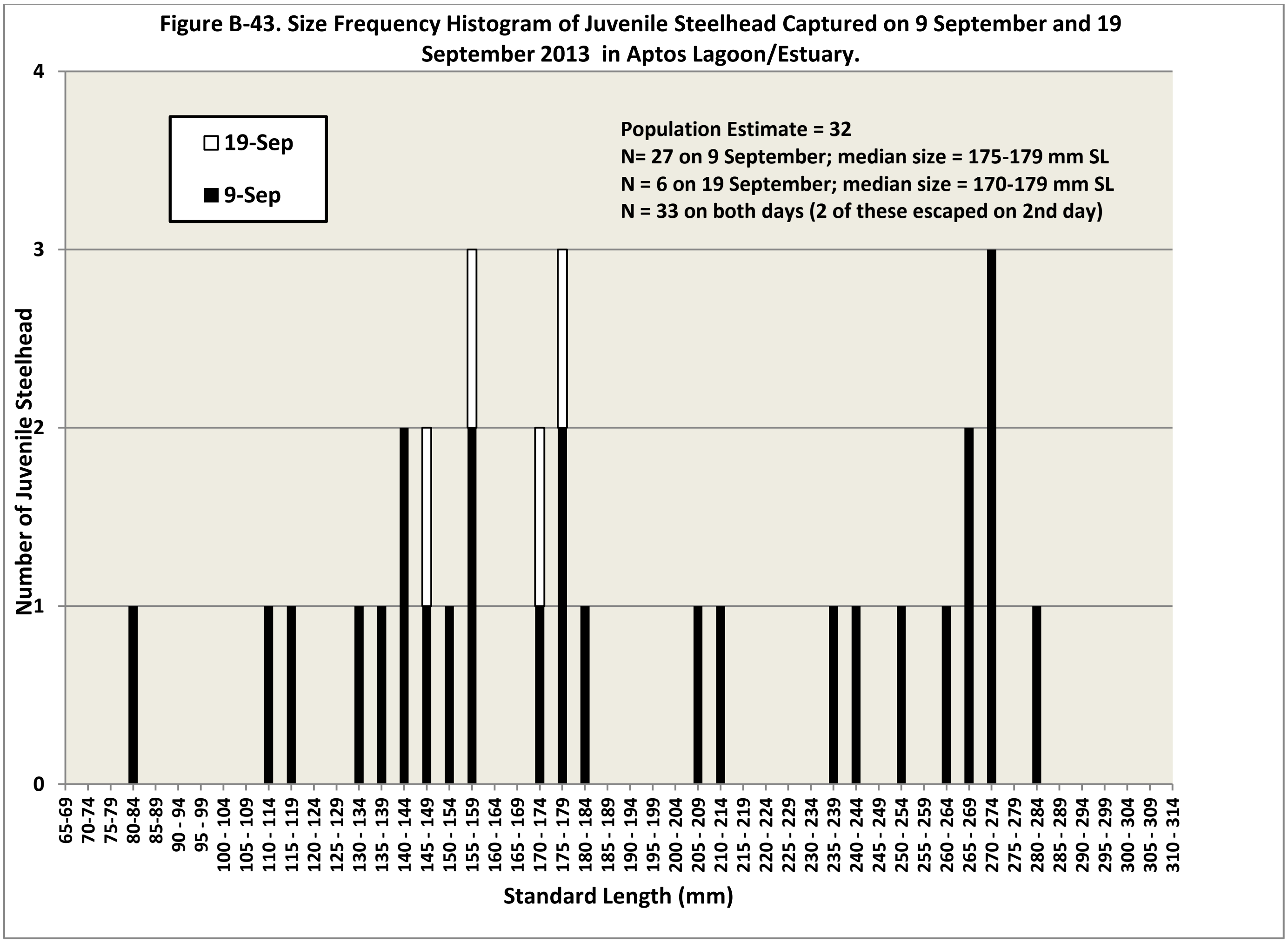


Figure B-43. Size Frequency Histogram of Juvenile Steelhead Captured on 9 September and 19 September 2013 in Aptos Lagoon/Estuary.

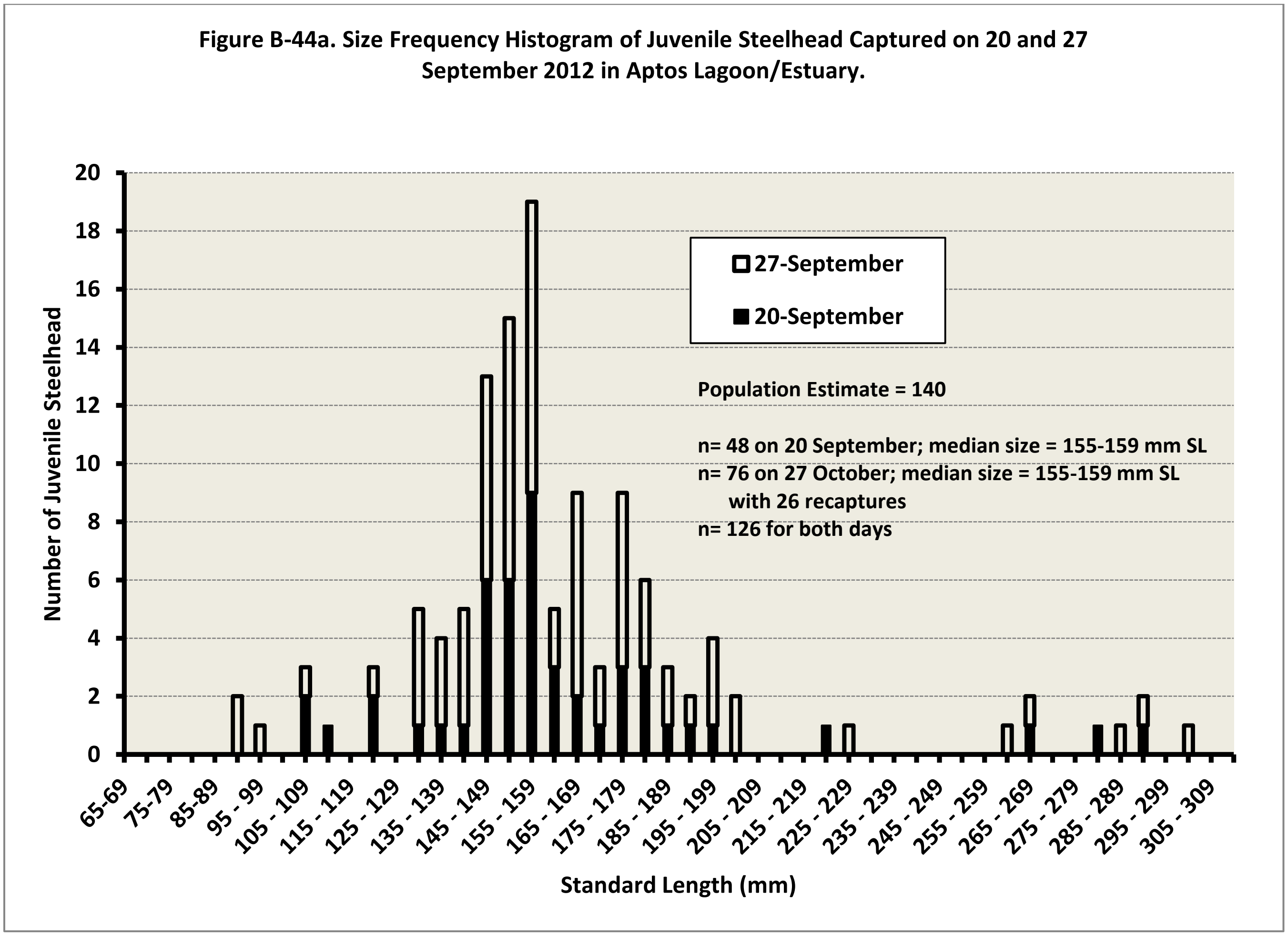


Figure B-44a. Size Frequency Histogram of Juvenile Steelhead Captured on 20 and 27 September 2012 in Aptos Lagoon/Estuary.

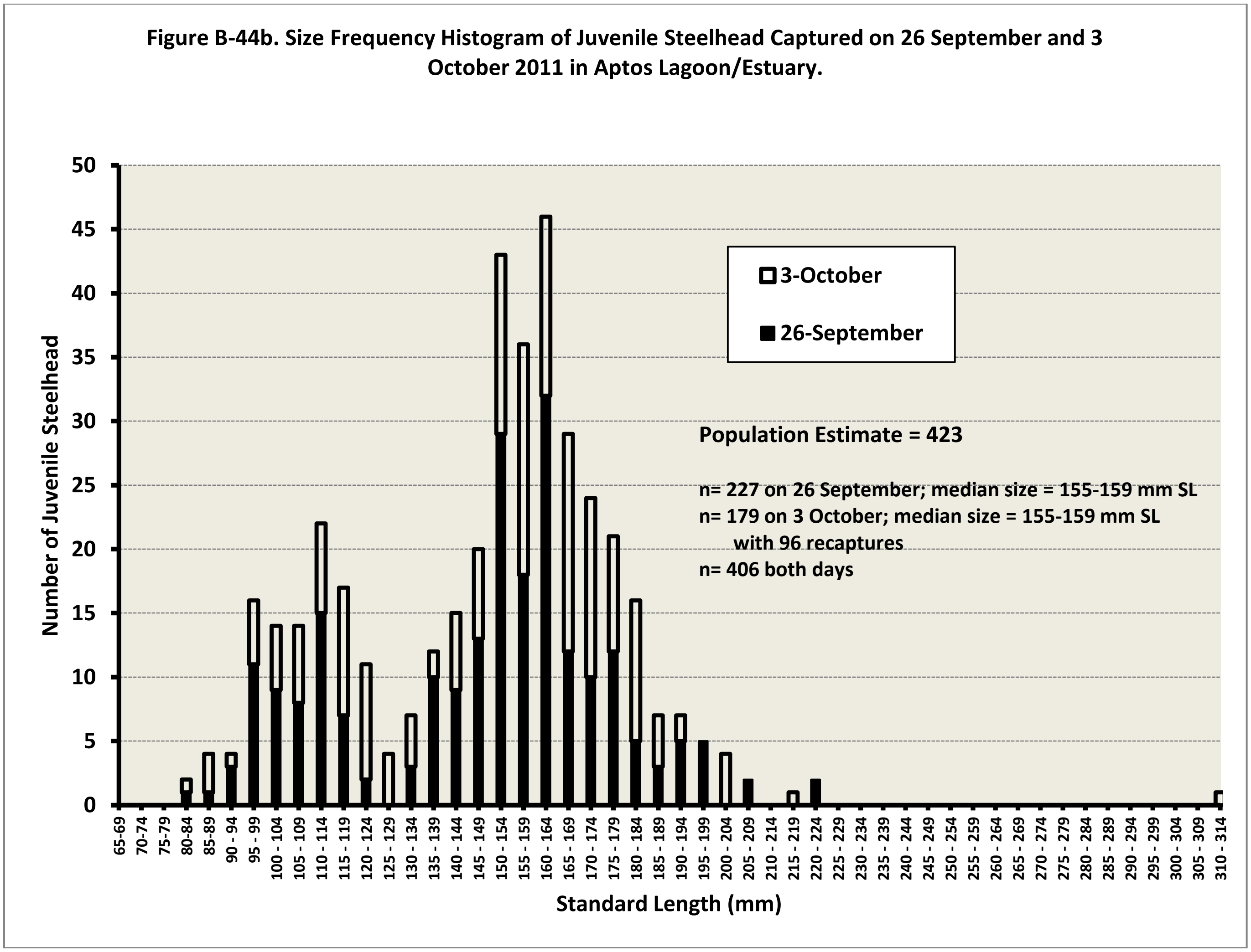


Figure B-44b. Size Frequency Histogram of Juvenile Steelhead Captured on 26 September and 3 October 2011 in Aptos Lagoon/Estuary.

v. Steelhead Abundance and Habitat in the Corralitos Creek Sub-Watershed

1. Habitat quality declined in 7 of 8 reaches (***Tables S-3*** *below* ***and B-16c*** *above* ***and Tables 16a-b in Appendix B***). After the two large stormflows in December, all reaches had lower spring-summer-fall baseflow in 2013 compared to 2012 and much below the median statistic (***Table 5b in Appendix B; Figures B-40a−b and B-41*** *below*). Lower baseflow provided less food and slower growth rate in all reaches. Slow YOY growth was exemplified by the lower percent of YOY reaching Size Class II in 2013 at all sites as was the case in 2012, though a much higher percent reached that size in the much wetter year of 2011 (***Figures B-20a−b*** *below*).

2. Unlike at some sites in the San Lorenzo and Soquel watersheds, ***YOY densities*** were generally below average or close to average in this sub-watershed and less than in 2012 at 7 of 8 sites (***Table 32 in Appendix B; Figure B-14*** *below*). The two Browns Creek sites were the most below average and had very low fall baseflow (0.1 cfs above the Browns Creek dam) (***Table 5b in Appendix B***). YOY densities above and below the Corralitos dam were similar, indicating successful adult fish passage through the fish ladders.

3. ***Total juvenile densities*** followed a similar pattern to YOY densities. However, with higher survival/retention of yearlings at the lower Browns Creek site brought total density closer to average (***Table 31b in Appendix B; Figure B-13*** *below)*. The decrease in total juvenile densities at sites was statistically significant. The trend in total densities declined in 2013 (***Figure B-29*** *below*).

4. ***Yearling densities*** varied widely at sites, with half being above average and the majority being less than in 2012 (***Table 33 in Appendix B; Figure B-15*** *below*).

5. As was the pattern in other watersheds in 2013, ***Size Class II and III densities*** were less than those in 2012 at 6 of 8 sites and below average at 5 of 8 sites and close to average at the others (***Table 35 in Appendix B; Figure B-16*** *below*). Relatively high survival of yearlings at Browns Site 1 gave it the highest density of soon-to-smolt fish (18 fish/ 100 ft). The trend in Size Class II and III densities declined in 2013 (***Figure B-31*** *below*).

6. Three of the 4 sites in Corralitos Creek remained in the "good" range for ***soon-to-smolt ratings*** (***Table B-40*** *below*). Shingle Mill sites 1 and 3 had "below average" and "very poor" ratings. Browns 1 remained "good" while Browns 2 declined to "fair."

7. As in other watersheds, the adult spawning steelhead population entering the watershed when passage flows were available in March and April may have been small in 2013. This may have lead to insufficient reproduction to saturate reaches with redds and egg production afterwards.

8. No steelhead were captured during sampling of Pajaro Lagoon in early October, though water quality conditions at that time were not prohibitive for the species. Tidewater goby were present and most abundant at a site that was 3 miles upstream of the beach berm.

Table S-3. 2013 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Average Smolt Size, with Physical Habitat Change since 2012. (Red denotes ratings of 1−3 or negative habitat change; italicized purple denotes ratings of 5−7. Methods for habitat change in M-6 of Appendix B).

Site	Multi-Year Avg. Potential Smolt Density Per 100 ft (Years of data)	2013 Potential Smolt Density (per 100 ft)/ Avg Smolt Size (mm)	2013 Smolt Numeric Rating	Symbolic Rating (1 to 7)	Physical Habitat Change by Reach or Site Since 2012 (except where specified)
Low. San Lorenzo #0a	10.1 (n=6)	4.1/ 94 mm	3	***	Site Positive
Low. San Lorenzo #1	9.5 (n=12)	3.4/ 96 mm	2	**	Site Negative
Low. San Lorenzo #2	15.3 (n=12)	6.2/ 88 mm	2	**	Reach Negative
Low. San Lorenzo #4	14.7 (n=13)	6.7/ 81 mm	2	**	Site Negative
Mid. San Lorenzo #6	4.3 (n=16)	2.0/ 108 mm	3	***	Site Negative
Mid. San Lorenzo #8	6.2 (n=16)	1.9/ 90 mm	1	*	Site Negative
Mid. San Lorenzo #9	7.9 (n=9)	2.3/ 86 mm	1	*	Reach Negative (since 2005)
Up. San Lorenzo #11	6.3 (n=16)	2.3/ 114 mm	3	***	Reach Negative
Up. San Lorenzo #12b (may not be steelhead)	*11.4 (n=9)*	*10.0/ 111 mm*	*5*	*****	Site Negative
Zayante #13a	10.5 (n=15)	2.7/ 98 mm	2	**	Site Negative
Zayante #13c	14.2 (n=15)	8.4/ 87 mm	3	***	Site Negative
Zayante #13d	*15.8 (n=15)*	18.5/ 105 mm	*6*	******	Site Negative
Lompico #13e	*7.0 (n=8)*	*8.7/ 104 mm*	*5*	*****	*Site Positive*
Bean #14b	12.6 (n=16)	12.5/ 90 mm	4	****	Site Negative
Bean #14c	8.8 (n=15)	Dry	1	*	Site Negative
Fall #15	13.6 (n=11)	12.1/ 98 mm	4	****	Site Negative
Newell #16	*15.0 (n=10)*	*23.7/ 89 mm*	*5*	*****	*Site Positive*
Boulder #17a	11.3 (n=16)	3.2/ 118 mm	3	***	Reach Negative (since 2009)
Boulder #17b	10.7 (n=16)	10.7/ 96 mm	4	****	Reach Negative (since 2008)
Bear #18a	10.5 (n=16)	2.6/ 115 mm	3	***	Site Positive
Branciforte #21a-2	9.5 (n=13)	6.0/ 106 mm	4	****	Site Positive
Branciforte #21b	14.8 (n=7)	13.3/ 100 mm	4	****	Site Positive
Soquel #1	4.0 (n=16)	1.8/ 94 mm	2	**	Site Negative
Soquel #4	9.1 (n=17)	2.1/ 110 mm	3	***	Site Negative
Soquel #10	9.0 (n=17)	5.2/ 87 mm	2	**	Site Negative
Soquel #12	8.1 (n=16)	3.1/ 82 mm	1	*	Reach Negative (since 2011)
E. Branch Soquel #13a	11.0 (n=17)	6.8/ 106 mm	4	****	Site Negative
E. Branch Soquel #16	10.3 (n=17)	6.2/ 92 mm	3	***	Reach Negative
W. Branch Soquel #19	6.4 (n=13)	3.4/ 105 mm	3	***	Site Negative
Aptos #3	10.3 (n=9)	5.1/ 103 mm	4	****	Reach Negative
Aptos #4	9.9 (n=9)	6.1/ 120 mm	4	****	Site Negative
Corralitos #1	*9.8 (n=7)*	*12.1/ 110 mm*	*5*	*****	Reach Negative (since 2009)
Corralitos #3	*10.9 (n=10)*	*10.7/ 105 mm*	*5*	*****	Site Negative
Corralitos #8	11.3 (n=10)	1.8/ 130 mm	2	**	Site Negative
Corralitos #9	*17.8 (n=10)*	*10.5/ 108 mm*	*5*	*****	Site Negative
Shingle Mill #1	10.1 (n=10)	6.9/ 94 mm	3	***	Site Similar
Shingle Mill #3	5.0 (n=9)	3.1/ 86 mm	1	*	Site Negative
Browns Valley #1	*16.2 (n=10)*	*18.0/ 96 mm*	*5*	*****	Reach Negative (since 2009)
Browns Valley #2	13.6 (n=10)	9.6/ 101 mm	4	****	Reach Negative (since 2009)

Figure B-40a. The 2013 Discharge at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide a logarithmic scale of discharge).

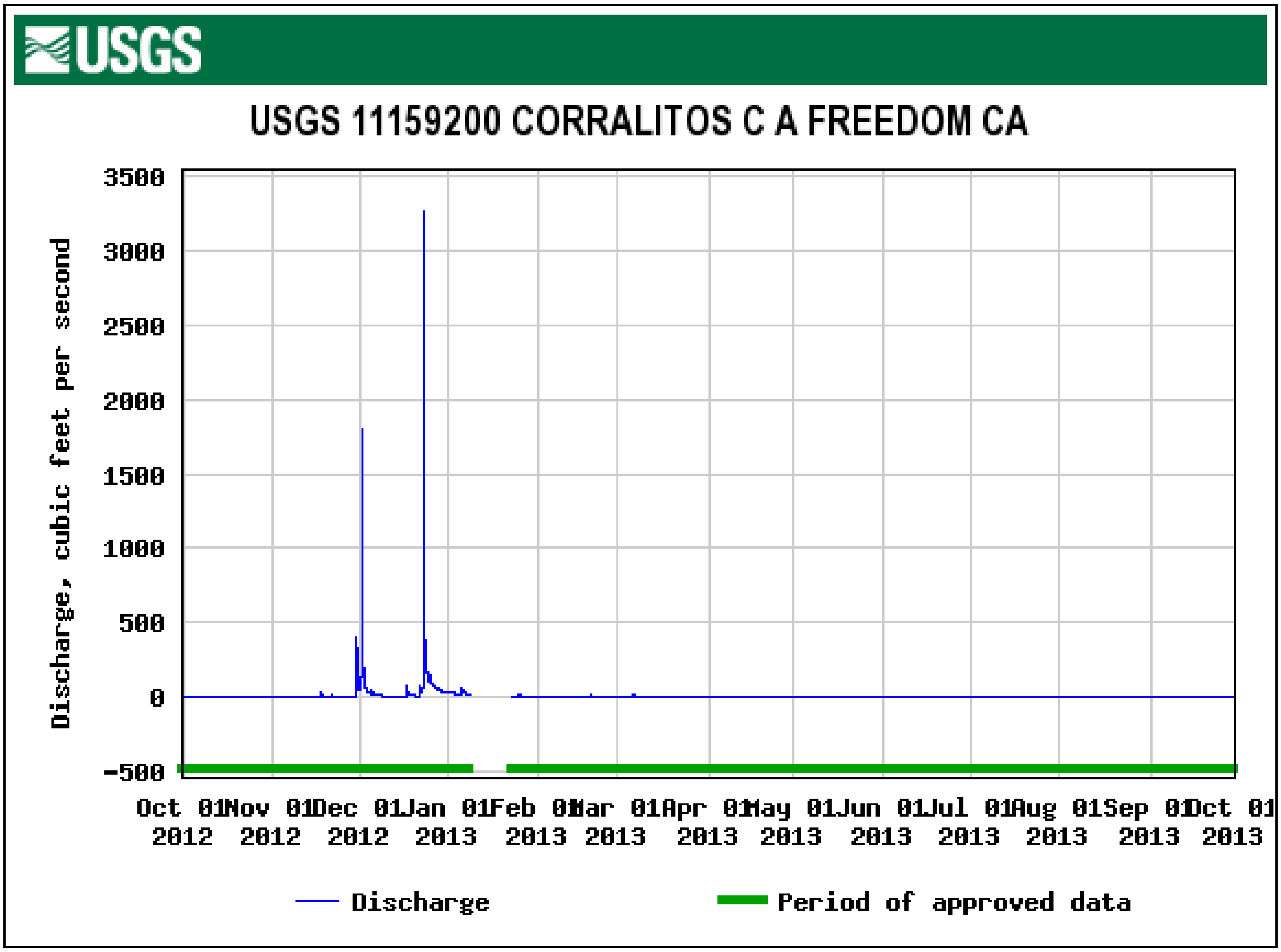


Figure B-40b. The 2013 Daily Mean and Median Flow at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide a logarithmic scale of discharge).

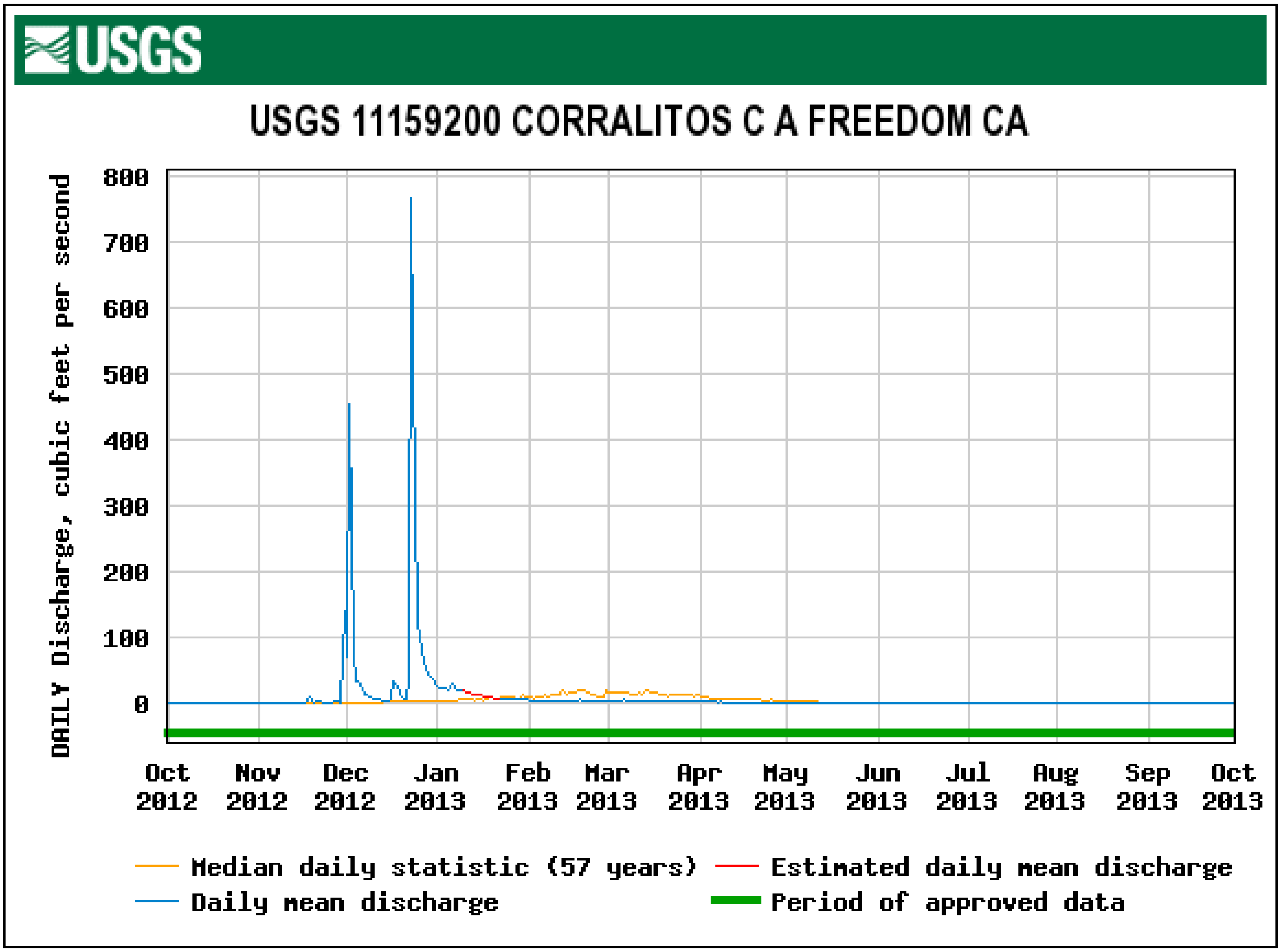
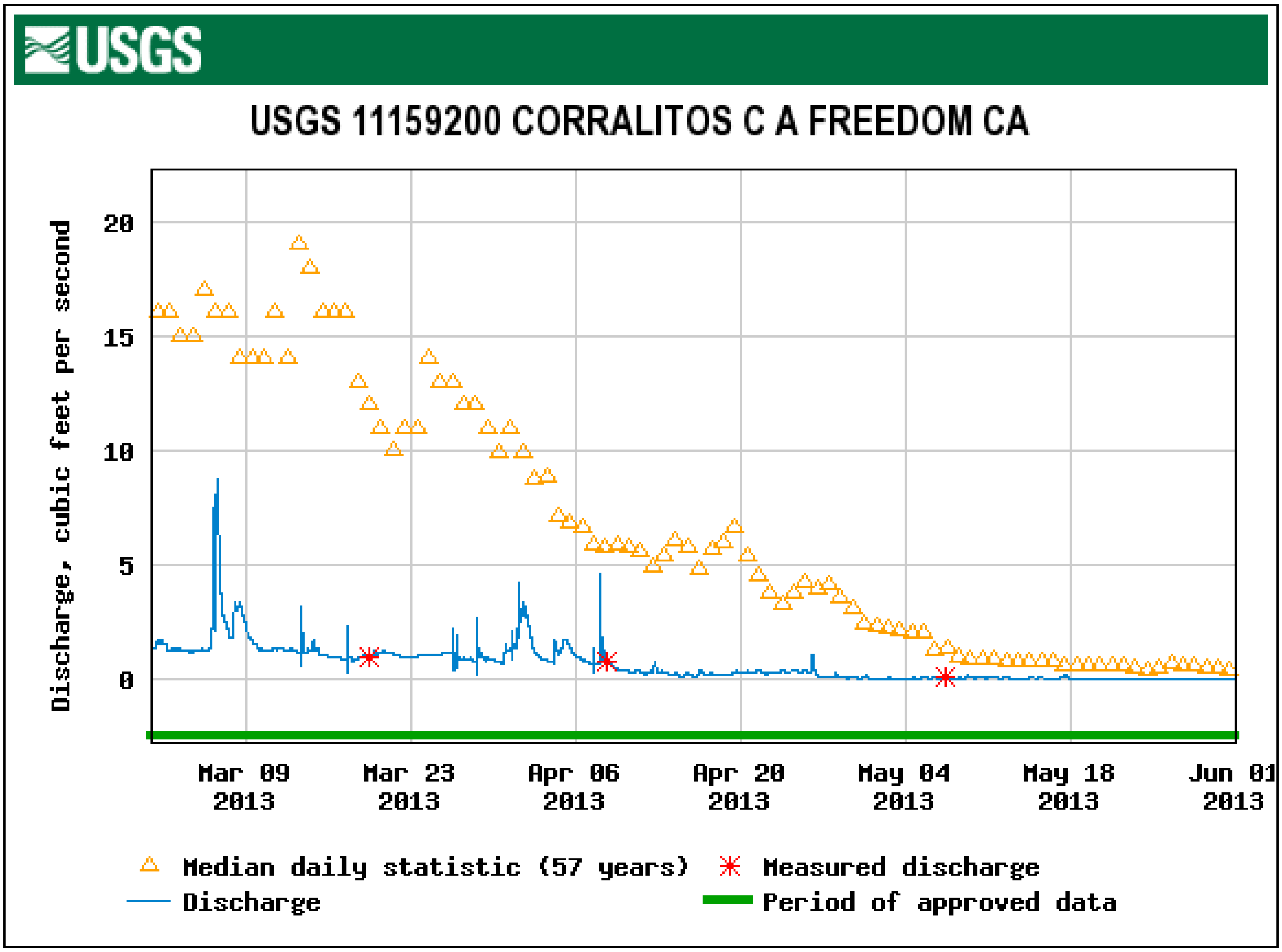


Figure B-41. The March–May 2013 Discharge of Record for the USGS Gage on Corralitos Creek at Freedom.



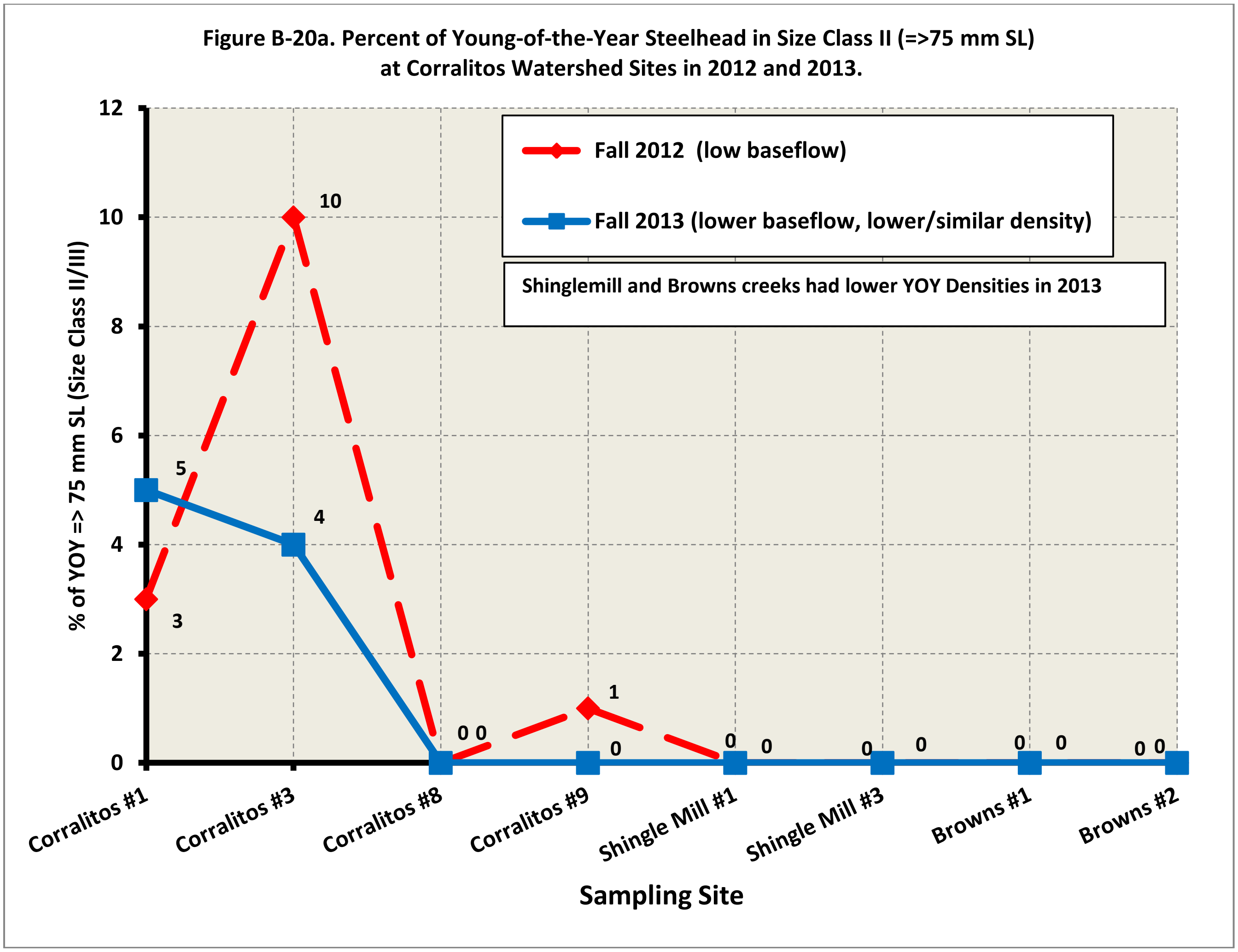


Figure B-20a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Corralitos Sub-Watershed Sites in 2012 and 2013.

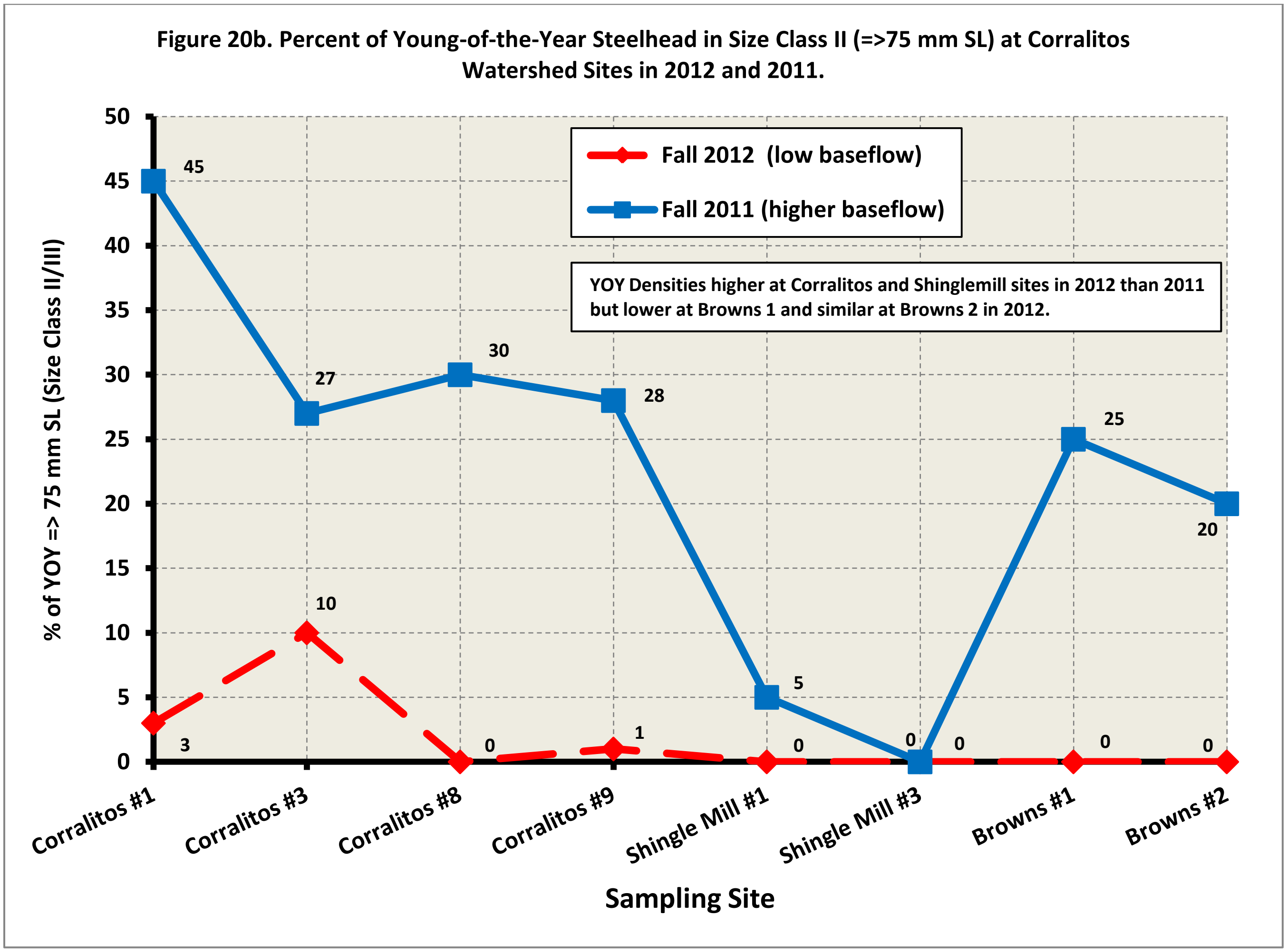


Figure 20b. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Corralitos Sub-Watershed Sites in 2011 and 2012.

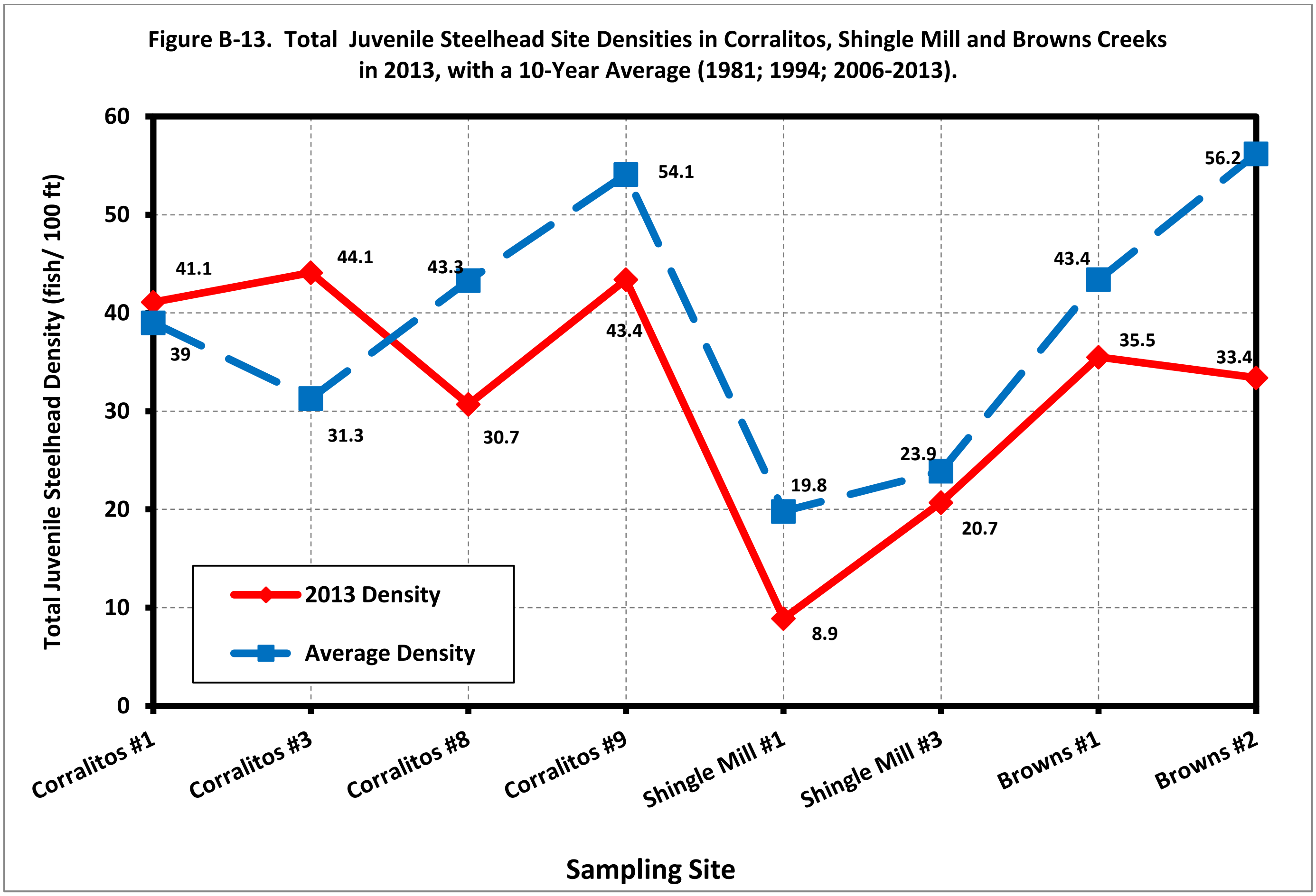


Figure B-13. Total Juvenile Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2013, with a 10-Year Average (1981; 1994; 2006-2013).

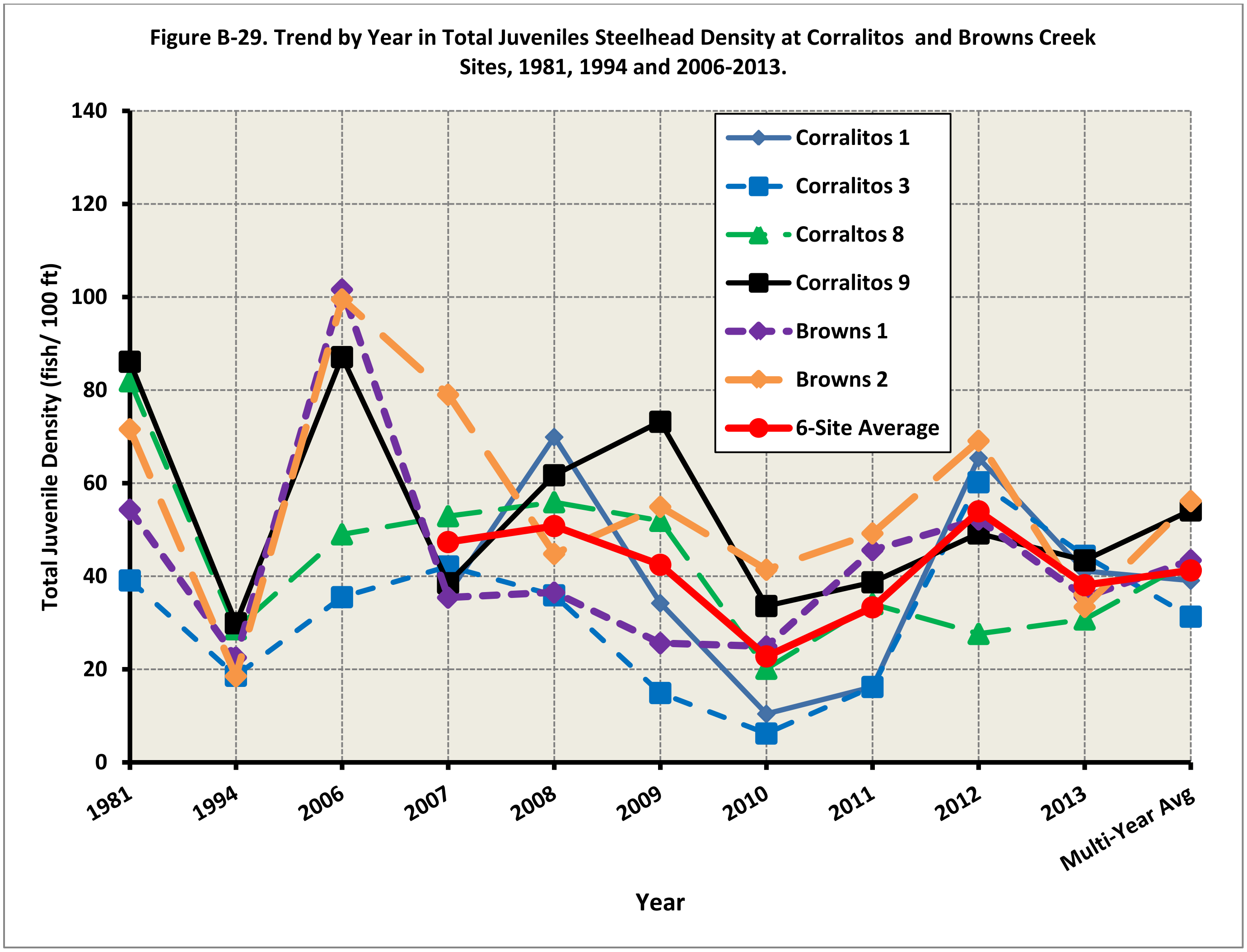


Figure B-29. Trend by Year in Total Juveniles Steelhead Density at Corralitos and Browns Creek Sites, 1981, 1994 and 2006-2013.

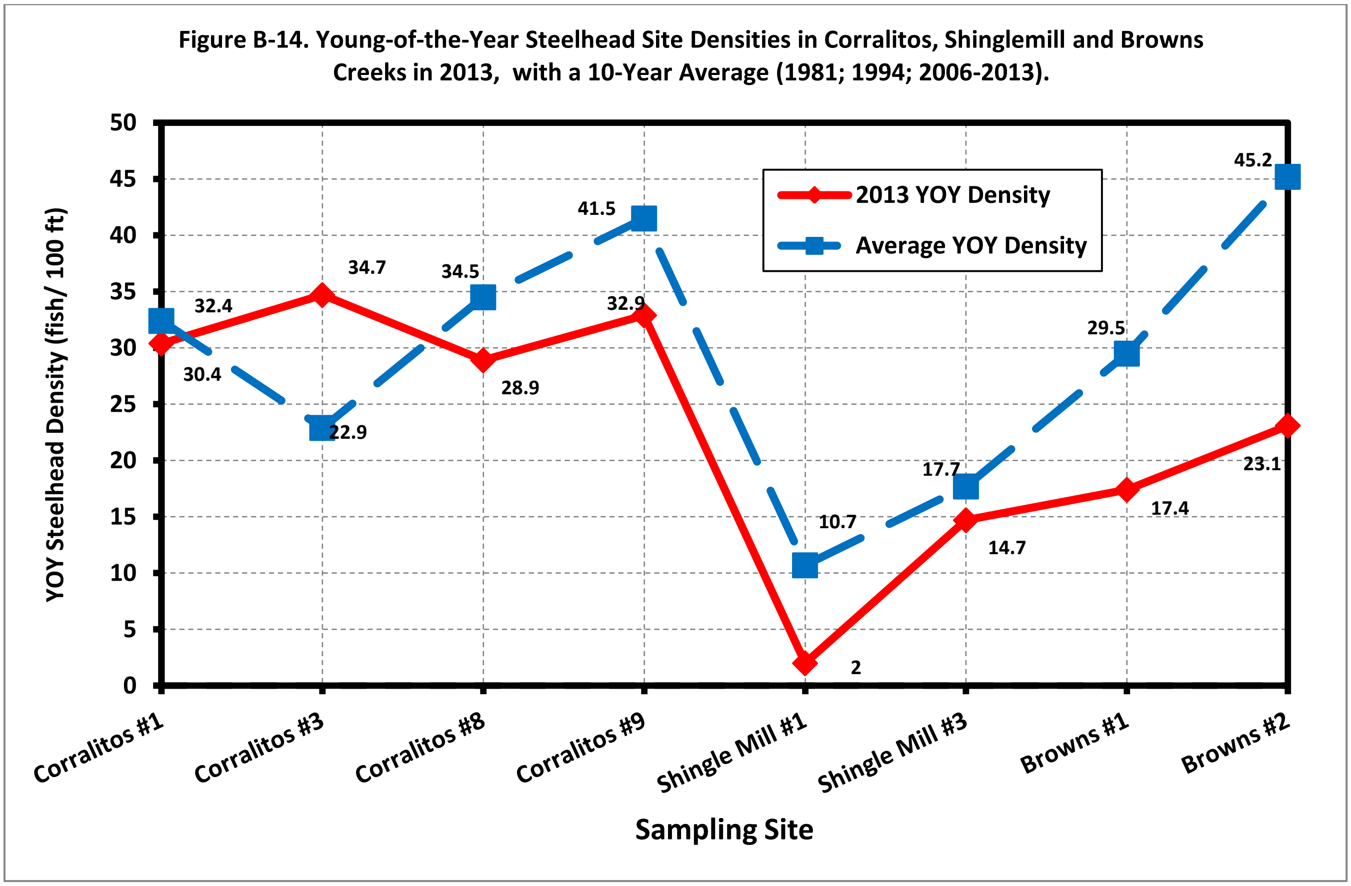


Figure B-14. Young-of-the-Year Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2013, with a 10-Year Average (1981; 1994; 2006-2013).

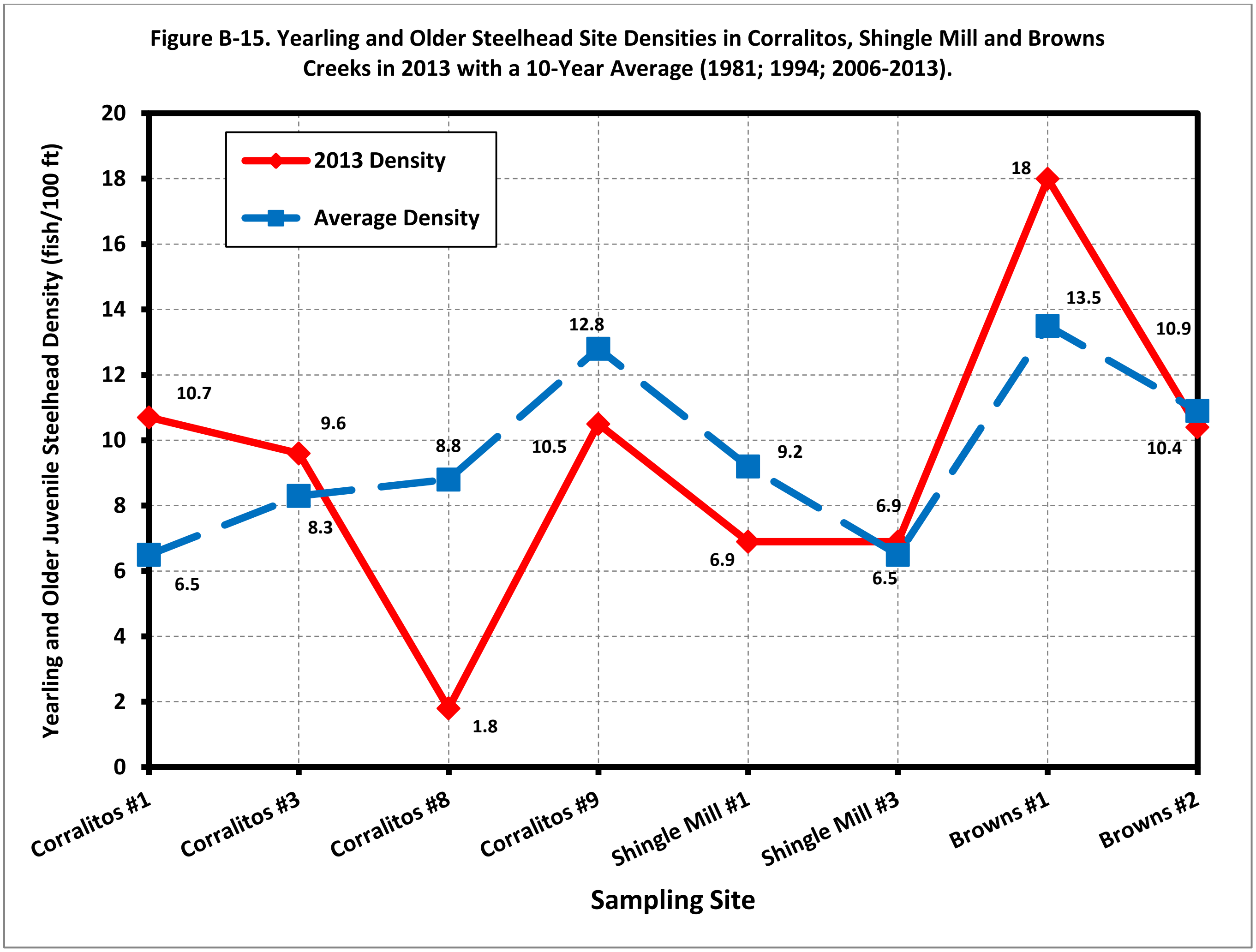


Figure B-15. Yearling and Older Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2013 with a 10-Year Average (1981; 1994; 2006-2013).

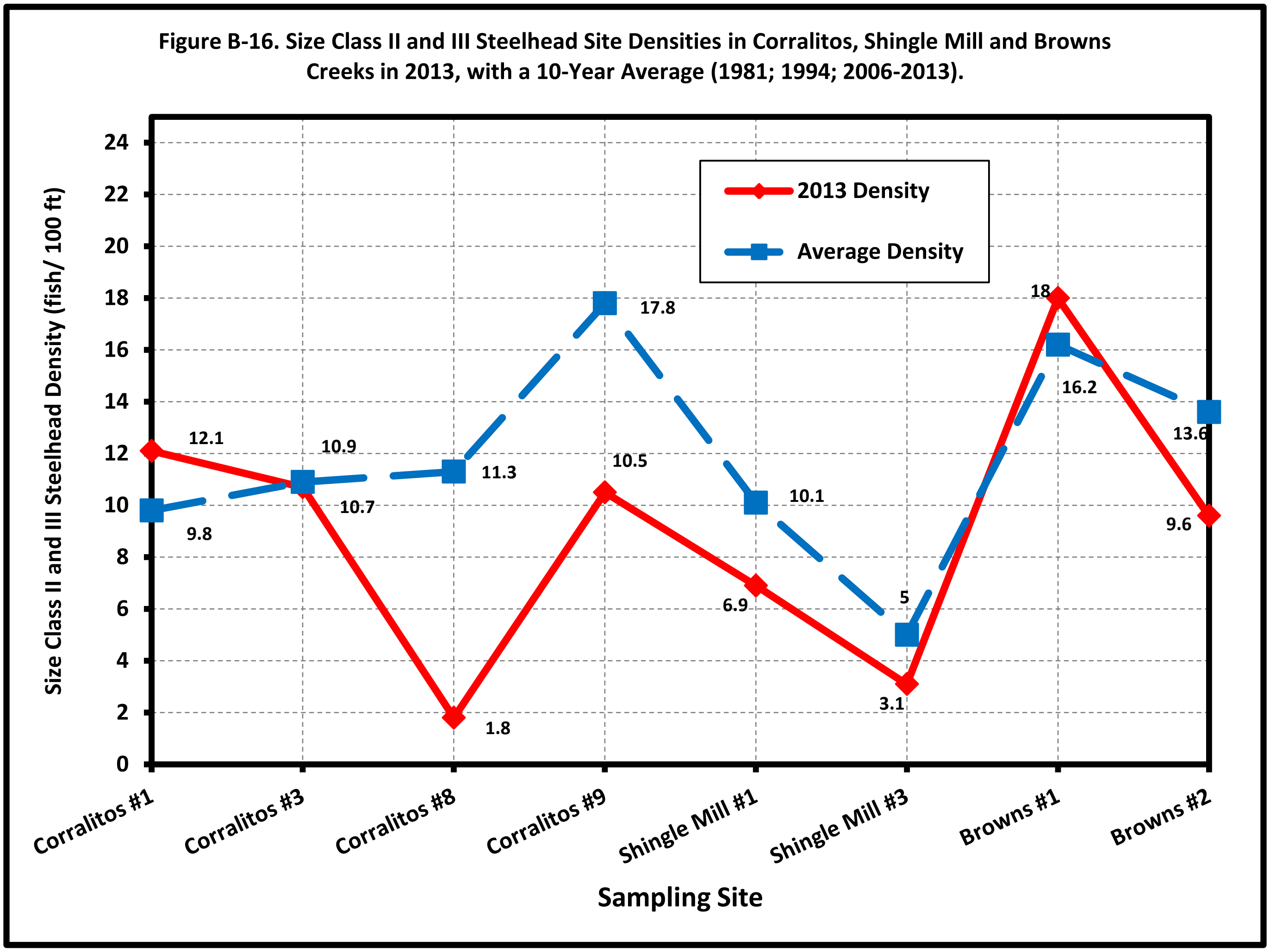


Figure B-16. Size Class II and III Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2013, with a 10-Year Average (1981; 1994; 2006-2013).

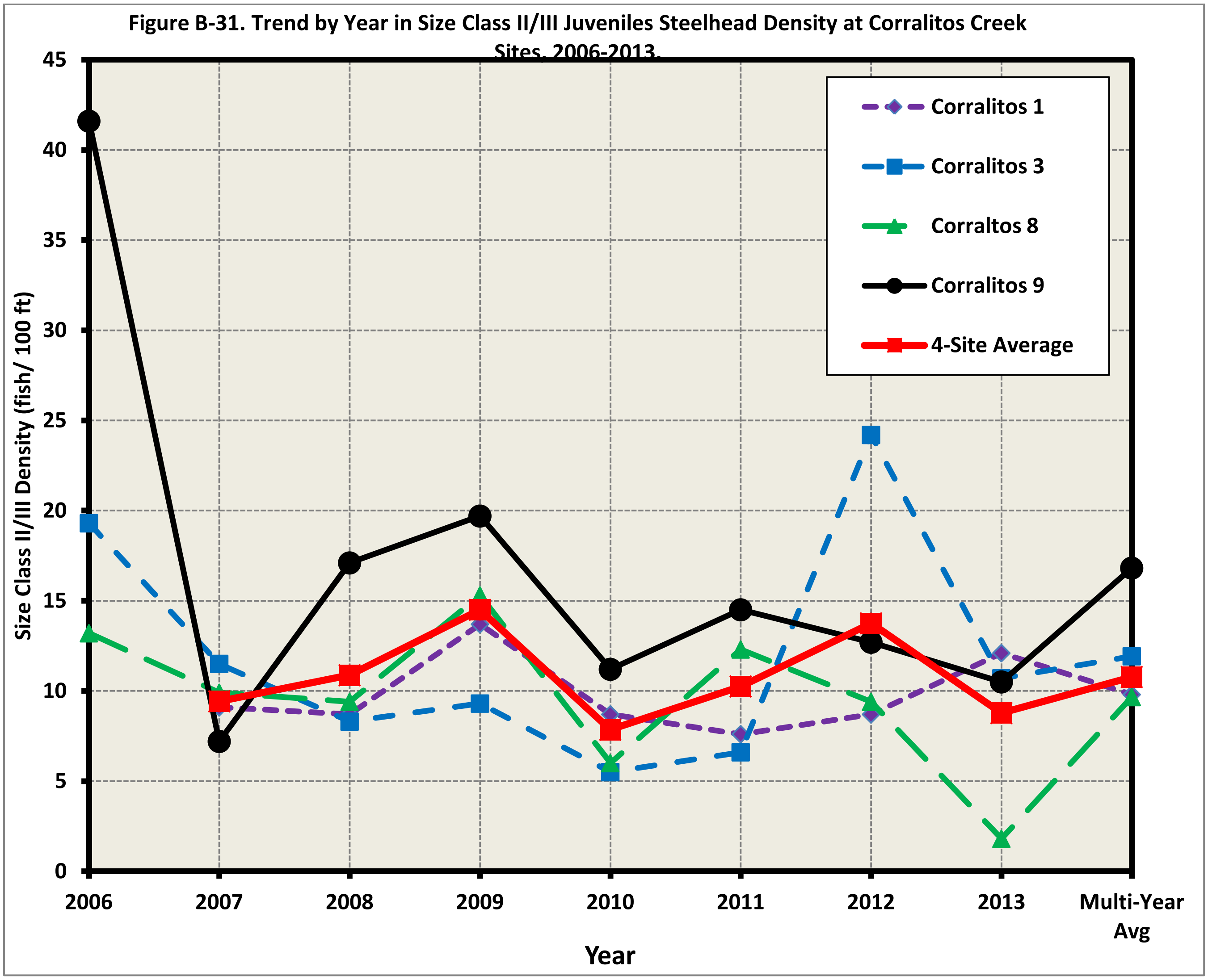


Figure B-31. Trend by Year in Size Class II/III Juveniles Steelhead Density at Corralitos Creek Sites, 2006-2013.

Table B-40. 2013 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Their Average Size in Standard Length Compared to 2012, with Physical Habitat Change Since 2012 Conditions.

(Red denotes ratings of 1−3 (as in Table S-3) and negative habitat change and italicized purple denotes ratings of 5−7. Methods for habitat change in M-6 of **Appendix B**.)

Site	2012 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL (mm)	2012 Smolt Rating (With Size Factored In)	2013 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL (mm)	2013 Smolt Rating (With Size Factored In)	Physical Habitat Change by Reach/Site Since 2012
Low. San Lorenzo #0a	26.9/ 135 mm	*Very Good*	4.1/ 94 mm	**Below Average**	+
Low. San Lorenzo #1	7.6/ 119 mm	Fair	3.4/ 96 mm	**Poor**	–
Low. San Lorenzo #2	6.6/ 111 mm	Fair	6.2/ 88 mm	**Very Poor**	–
Low. San Lorenzo #4	8.9/ 87 mm	**Below Average**	6.7/ 81 mm	**Very Poor**	–
Mid. San Lorenzo #6	3.3/ 86 mm	**Very Poor**	2.0/ 108 mm	**Below Average**	–
Mid. San Lorenzo #8	2.0/ 81 mm	**Very Poor**	1.9/ 90 mm	**Poor**	–
Mid. San Lorenzo #9	–	–	2.3/ 86 mm	**Very Poor**	
Up. San Lorenzo #11	2.9/ 101 mm	**Poor**	2.3/ 114 mm	**Below Average**	–
Up. San Lorenzo #12b (may not be steelhead)	11.3/ 112 mm	*Good*	10.0/ 111 mm	*Good*	–
Zayante #13a	14.2/ 107 mm	*Good*	2.7/ 98 mm	**Poor**	–
Zayante #13c	20.0/ 90 mm	*Good*	8.4/ 87 mm	**Below Average**	–
Zayante #13d	8.6/ 127 mm	*Good*	18.5/ 105 mm	*Very Good*	–
Lompico #13e	2.3/ 127 mm	**Below Average**	8.7/ 104 mm	*Good*	+
Bean #14b	10.1/ 122 mm	*Good*	12.5/ 90 mm	Fair	–
Bean #14c	5.2/ 120 mm	Fair (**went dry**)	**Dry**	**Dry**	**Dry both years**
Fall #15	13.0/ 113 mm	*Good*	12.1/ 98 mm	Fair	–
Newell #16	7.3/ 93 mm	**Below Average**	23.7/ 89 mm	*Good*	+
Boulder #17a	7.2/ 131 mm	Fair	3.2/ 118 mm	**Below Average**	–
Boulder #17b	10.6/ 104 mm	*Good*	10.7/ 96 mm	Fair	–
Bear #18a	4.1/ 115 mm	Fair	2.6/ 115 mm	**Below Average**	+
Branciforte #21a-2	12.3/ 114 mm	*Good*	6.0/ 106 mm	Fair	+
Branciforte #21b	27.3/ 96 mm	*Good*	13.3/ 100 mm	Fair	+
Soquel #1	4.0/ 115 mm	Fair	1.8/ 94 mm	**Poor**	–
Soquel #4	11.1/ 101 mm	Fair	2.1/ 110 mm	**Below Average**	–
Soquel #10	16.0/ 94 mm	*Good*	5.2/ 87 mm	**Poor**	–
Soquel #12	13.1/ 93 mm	Fair	3.1/ 82 mm	**Very Poor**	–
East Branch Soquel #13a	18.6/ 94 mm	*Good*	6.8/ 106 mm	Fair	–
East Branch Soquel #16	13.8/ 105 mm	*Good*	6.2/ 92 mm	**Below Average**	–
West Branch Soquel #19	6.1/ 91 mm	**Below Average**	3.4/ 105 mm	**Below Average**	–
Aptos #3	11.6/ 103 mm	*Good*	5.1/ 103 mm	Fair	+
Aptos #4	9.6/ 120 mm	*Good*	6.1/ 120 mm	Fair	–
Corralitos #1	8.7/ 108 mm	*Good*	12.1/ 110 mm	*Good*	–
Corralitos #3	24.2/ 114 mm	*Very Good*	10.7/ 105 mm	*Good*	–
Corralitos #8	9.4/ 100 mm	Fair	1.8/ 130 mm	**Poor**	–
Corralitos #9	12.7/ 105 mm	*Good*	10.5/ 108 mm	*Good*	–
Shingle Mill #1	4.2/ 101 mm	**Below Average**	6.9/ 94 mm	**Below Average**	**Similar**
Shingle Mill #3	5.7/ 91 mm	**Below Average**	3.1/ 86 mm	**Very Poor**	–
Browns #1	17.6/ 98 mm	*Good*	18.0/ 96 mm	*Good*	–
Browns #2	20.2/ 97 mm	*Good*	9.6/ 101 mm	Fair	–

vi. Annual Trend in YOY and Yearling Abundance Compared to Other Coastal Streams

YOY steelhead densities in 2013 continued to be below average at all sites in Gazos, especially at the upper two sites (**Figure 45;** data from **Smith 2013**) and at all sites in Scott (near average in Big Creek at Swanton Road) (**Figure 46;** data from **Smith 2013**). Their YOY densities averaged for all sites continued to decline in 2013 from 2012 (**Figure 49; data from Smith 2013**). The average YOY density for Waddell Creek increased from 2012 to 2013. Below average YOY densities in Scott and Gazos creeks were consistent with below average YOY densities at San Lorenzo mainstem sites and some lower tributary sites in the San Lorenzo watershed, the upper East Branch Soquel site, both sites in Aptos Creek and 6 of 8 sites in the Corralitos sub-watershed.

In Scott Creek, average YOY steelhead site densities for 2007─2013 were 49, 20, 24, 45, 41, 33 and 27 fish/ 100 ft, respectively, with a 23-year average to 2013 of 51 (**Figure B-49** data from **Smith 2013**). The average Waddell Creek YOY site densities for 2007─2013 were 13, 23, 10, 13, 8, 13 and 20 fish/ 100 ft and much below the 23-year average of 36. The average Gazos Creek YOY site densities for 2007 and 2009─2013 were 21, 17, 16, 28, 30 and 17 fish/ 100 ft and below the 19-year average to 2013 of 34. YOY densities in Gazos may have been much lower than the two previous years because adult spawning access through existing and new logjams may have been more difficult, if not impossible, in 2013 (**Smith 2013**).

Densities of yearling juveniles were below average at 7 of 8 sites in Gazos Creek in 2013 (data from **Smith 2013**), consistent with poor survival/retention of yearlings in all but headwater sites in the San Lorenzo, the typical poor survival/retention of yearlings in Soquel Creek and slightly below average yearling densities in Aptos Creek. However, in Scott Creek the yearling densities were above average at some and below average at other sites (data from **Smith 2013**), consistent with the Corralitos sub-watershed. Average 1+/2+ densities in Scott Creek for 2007─2013 were 14, 8, 7, 7, 2, 4 and 6 fish/ 100 feet, with a 23-year average of 8.3 fish/ 100 feet (**Figure B-50;** data from **Smith 2013**). Average 1+/2+ density in Waddell Creek for 2007─2013 were 2, 1, 2, 1, 0.4, 1 and 1.5 fish/ 100 ft, with a 23-year average being 5.1 fish/ 100 ft. Average 1+/2+ density in Gazos Creek for 2007 and 2009−2013 were 4, 9, 4, 6, 9 and 3.7 fish/ 100 ft, with 20-year average being 7.4 fish/ 100 ft.

In these 3 creeks' sites, yearlings were likely the only fish reaching Size Class II. So, the very low Size Class II and III densities in all of these creeks of less than 6 fish/ 100 ft were similar to poorer sites in our 4 watersheds in 2013, such as San Lorenzo mainstem sites (0a−11) and lower tributary sites in Boulder, Zayante and Branciforte. Their site densities were similar to Size Class II densities in all sites in Soquel and Aptos creeks in 2013 but only 1 site in the Corralitos sub-watershed.

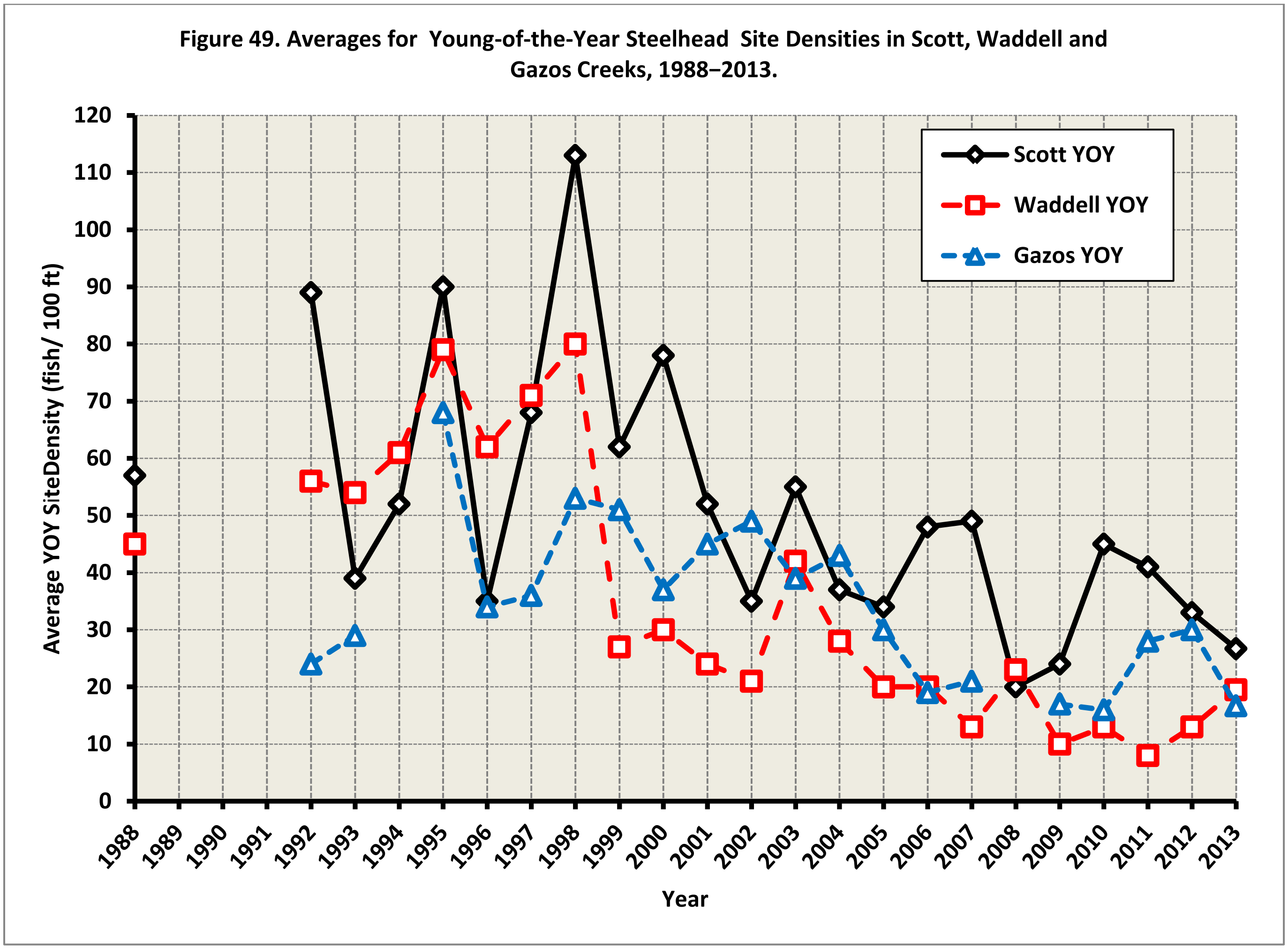


Figure B-49. Averages for Young-of-the-Year Steelhead Site Densities in Scott, Waddell and Gazos Creeks, 1988–2013.

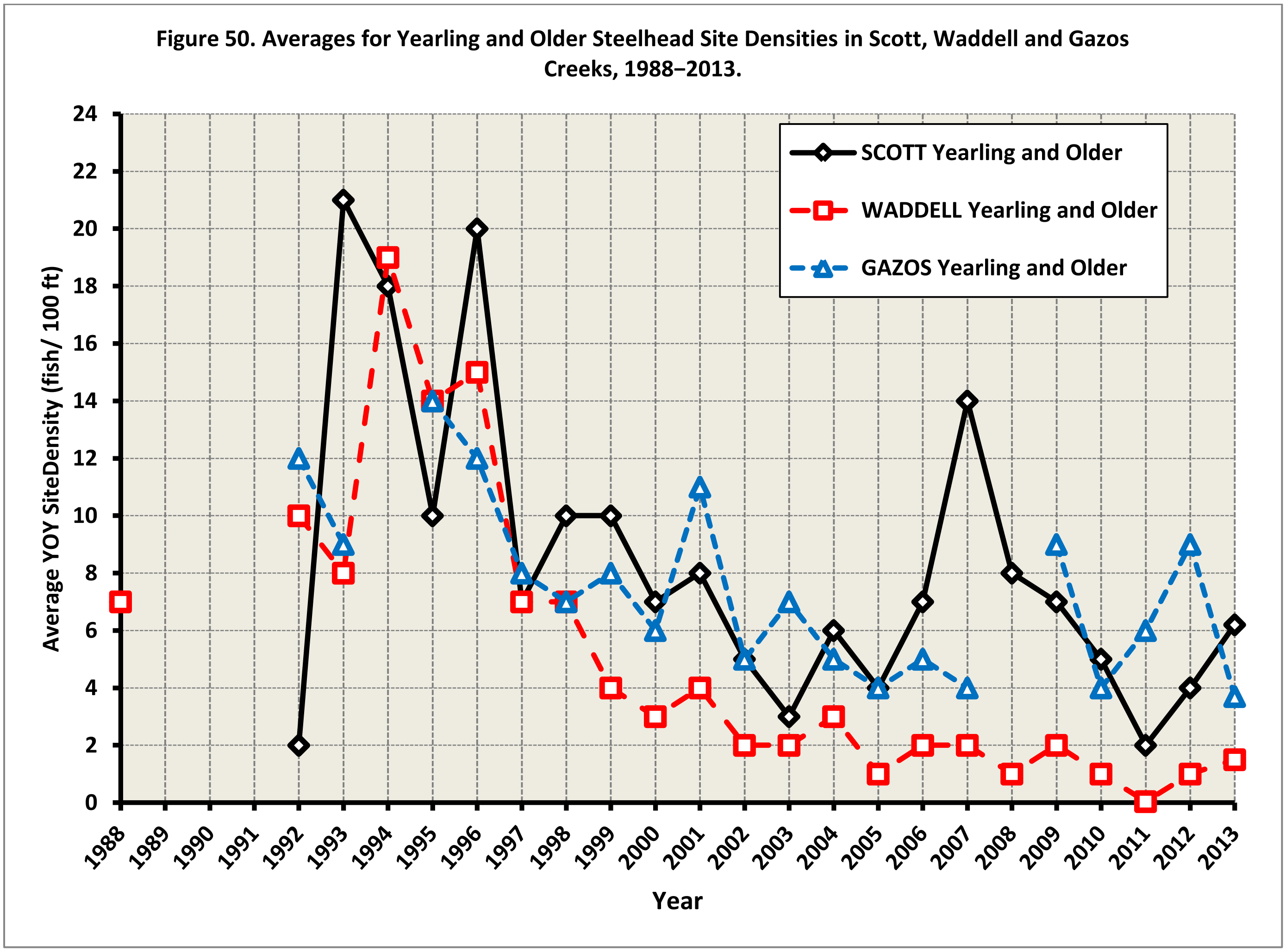


Figure B-50. Averages for Yearling and Older Steelhead Site Densities in Scott, Waddell and Gazos Creeks, 1988–2013.

E. MANAGEMENT RECOMMENDATIONS

1. Implement the fishery-related recommendations and projects identified in the Soquel Creek Watershed Assessment and Enhancement Project Plan, especially in Appendix C (**SCRCD 2003**). High priority would be improvement of adult steelhead passage at Girl Scout Falls II on the West Branch to allow steelhead passage to 4 additional miles of habitat on a regular basis. Another would be to restore the redwood/Douglas Fir forest within and outside the riparian corridor, upstream of Moores Gulch.

2. In Soquel Creek, develop better water management and conservation, with the goal of reducing spring and early summer water diversion/pumpage and maximize baseflow. With increased baseflows, growth rate and densities of soon-to-smolt sized juvenile steelhead will likely increase. Educational outreach to capture and store more winter rains should be directed to streamside landowners, agriculturalists and nurseries.

3. Perform erosion control at the Highland Way slide on the East Branch Soquel Creek to reduce chronic sedimentation from that site.

4. Implement the fishery enhancement projects identified in the San Lorenzo River Salmonid Enhancement Plan (**Alley et al. 2004**). The Barker Dam in Reach 9 if the mainstem River is a formidable adult salmonid passage barrier at low winter streamflows and should be modified. (See photo below.)

5. Survey Reaches 10−12 on the mainstem San Lorenzo between the Boulder Creek confluence and Waterman Gap to identify any adult salmonid passage impediments. Photo-document, locate by GPS and remediate them as necessary. The juvenile steelhead density at the Teihl Site 11 has been very low for several years, indicating poor adult passage. The San Lorenzo salmonid population in Waterman Gap (above the Highway 9 culvert and concrete apron- see photo below) has the size structure of a typical resident rainbow trout population.

6. Dismantle all log weirs previously constructed in the Waterman Gap 12b reach of the San Lorenzo River, upstream of Highway 9. They inhibit natural scour, reduce fastwater insect habitat, prevent proper flow dynamics for drift feeding by salmonids at heads of pools and have created a passage impediment in at least one case.

7. Retain more large, instream wood throughout all four watersheds under study. More instream wood will promote scour, deepen pools, create patches of coarser spawning gravel and provide escape cover for juvenile steelhead rearing and overwinter yearling survival. The goal is to increase steelhead spawning success and juvenile production to at least the level seen in the late 1990's.

8. Retain more winter storm runoff in Scotts Valley and Felton to reduce stormflow flashiness that causes streambank erosion and sedimentation, leading to poor spawning and rearing conditions in

the mainstem. Better storm runoff retention will also increase winter recharge of aquifers to increase spring and summer baseflow, which will increase YOY steelhead growth into Size Classes II and III in Bean Creek, Zayante Creek and the lower mainstem.

9. Support efforts to capture high winter stormflows in the San Lorenzo River for conjunctive use among water agencies within the watershed and with the Soquel Creek Water District to rest Scotts Valley groundwater aquifers (Lompico and Santa Margarita) and the Soquel Creek groundwater aquifer. The goal is to increase spring/summer baseflow, steelhead growth rate and densities of soon-to-smolt sized juveniles in both watersheds.

10. The San Lorenzo Lagoon provides important steelhead habitat in the watershed. Support efforts to allow the sandbar to form naturally, allow enough stream inflow to convert the lagoon to freshwater as quickly as possible after sandbar closure, and deter artificial summer breaching.

11. Along Bean Creek, perform educational outreach and better water conservation and winter storage (reduce summer well pumping). The goal is to maintain surface streamflow in the heavily used steelhead segment between Ruins and MacKenzie creek confluences, which go dry annually.

12. In Fall Creek, notch the fallen old-growth Douglas fir across the channel to improve adult passage.

13. In Fall Creek, seal the leakage under the concrete weirs at the San Lorenzo Valley Water District diversion structure. Reduce the jump heights through the first and last of 4 weirs and remove debris as needed to prevent blockage.

14. In Lompico Creek, YOY production widely fluctuates, indicating problems with adult passage and spawning success. Investigate passage issues in the lower reaches including the bedrock cascade above the fish ladder and the abandoned flashboard dam spillway between the ladder and the sampling site. Continue to maintain the fish ladder.

15. In Branciforte Creek, prioritize and remove/modify remaining man-made structures that create adult steelhead passage impediments.

16. Aptos Lagoon should be closely monitored for unauthorized sandbar breaching, juvenile abundance and water quality. Individuals who illegally breach the sandbar in summer should be prosecuted.

17. Develop an Aptos Lagoon management plan which protects residential and commercial property, as well as the important fishery value of the lagoon with minimal sandbar manipulation.

18. In the Corralitos Creek watershed (especially in the Eureka Gulch sub-watershed), identify the sources of sedimentation stemming from the Summit Fire and institute erosion control and revegetation measures to reduce future sedimentation.

19. Carry out a study to examine the passability of the Pajaro drainage to out-migrant smolts and in-migrant adult steelhead to and from the Corralitos sub-watershed. If passability proves to be difficult in drier years, develop a program of well pumping, water diversion and aquifer recharge that is compatible with successful steelhead migration.

20. The sandbar at the mouth of the Pajaro River should be allowed to close naturally as flows decline in the summer. Artificial breaching should be prohibited in summer.

21. Spatial heterogeneity should be protected in the Pajaro Lagoon/estuary. Slackwater areas with overhanging riparian vegetation should be allowed to form to provide rearing and breeding habitat for tidewater goby during the dry season. Tule beds are valuable rearing habitat and provide winter refuge. Natural training of the Pajaro River outlet channel to the east, as occurs at other local creek mouths, results in a long lateral extent of the summer lagoon to the east of Watsonville Slough. This is significant summer habitat along the beach berm for tidewater goby and arrow goby.

22. Emergency breaching of the Pajaro River sandbar for flood control should be minimized. Breaching should be done so that lagoon draining is as slow as possible and with a maximum residual backwater depth in the estuary after draining. Breaching at high tide will encourage this. Pursue projects that will reduce the need for emergency breaching.

23. Add County streamflow monitoring sites that would better supplement the fishery work. Add sites in Bean Creel near fish sampling sites, as well as more mainstem San Lorenzo sites below Kings, Boulder, Love and Fall Creek confluences. Measurements in the fall, as well as ones in early summer are important. The SLVWD has established stream gages on Fall and Boulder creeks.

Barker Dam on the Mainstem San Lorenzo River– Reach 9 (below Boulder Creek confluence).

Highway 9 Culvert and Concrete Apron at Waterman Gap on the San Lorenzo River

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APPENDIX A. WATERSHED MAPS.

Figure 1. Santa Cruz County Watersheds.

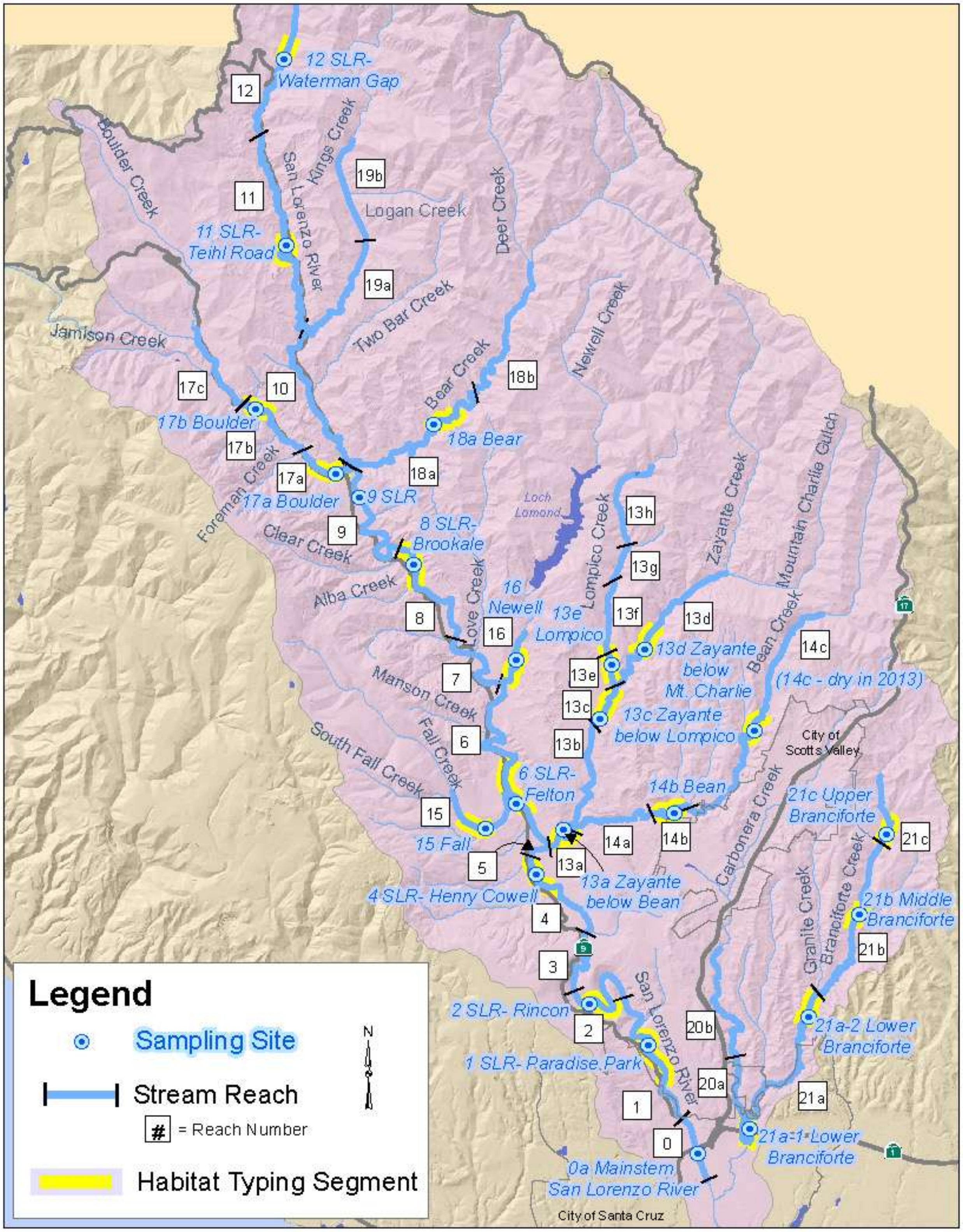

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Figure 2. San Lorenzo River Watershed− Sampling Sites and Reaches.

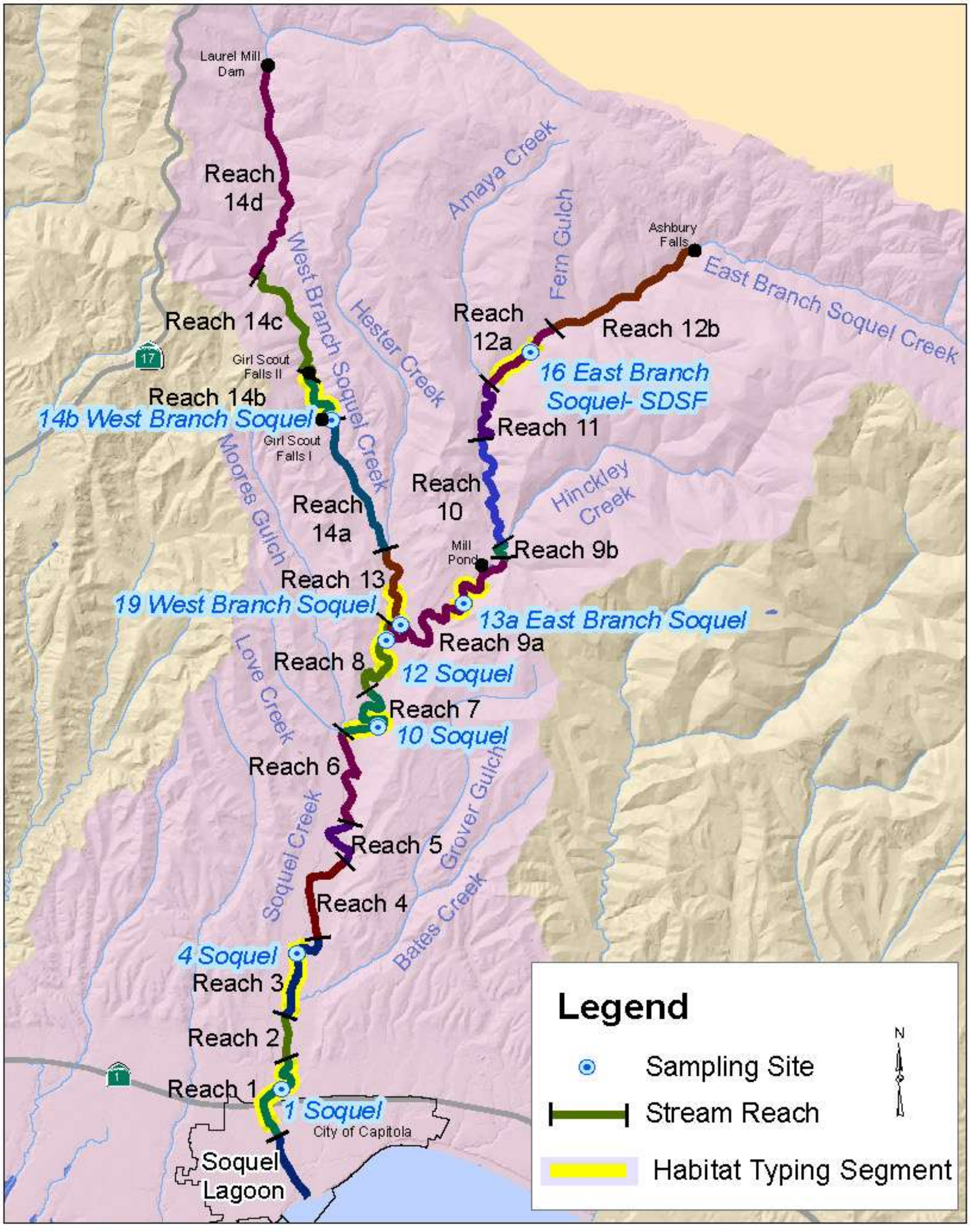

Figure 3. Soquel Creek Watershed.

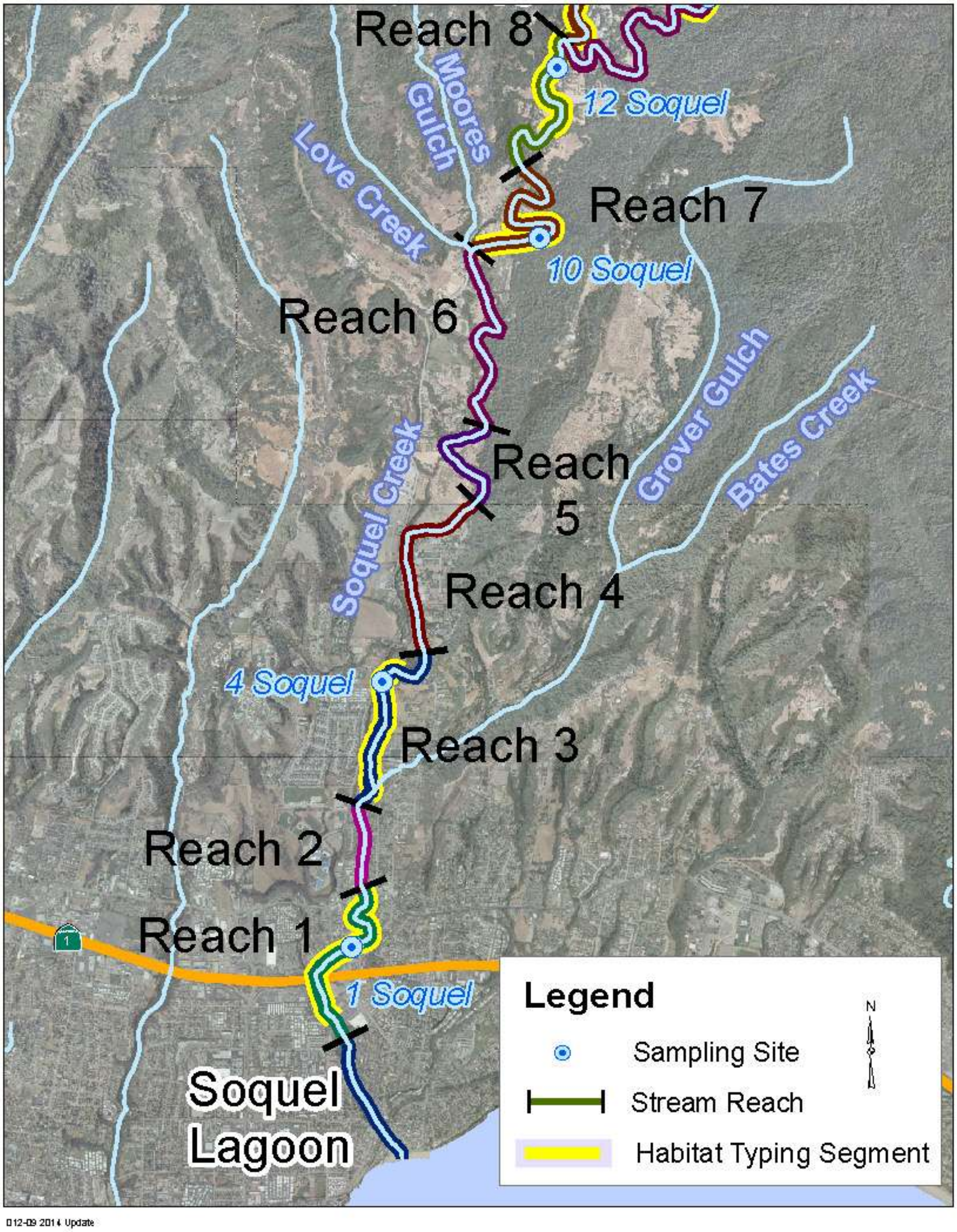

Figure 4. Lower Soquel Creek (Reaches 1–8 on Mainstem).

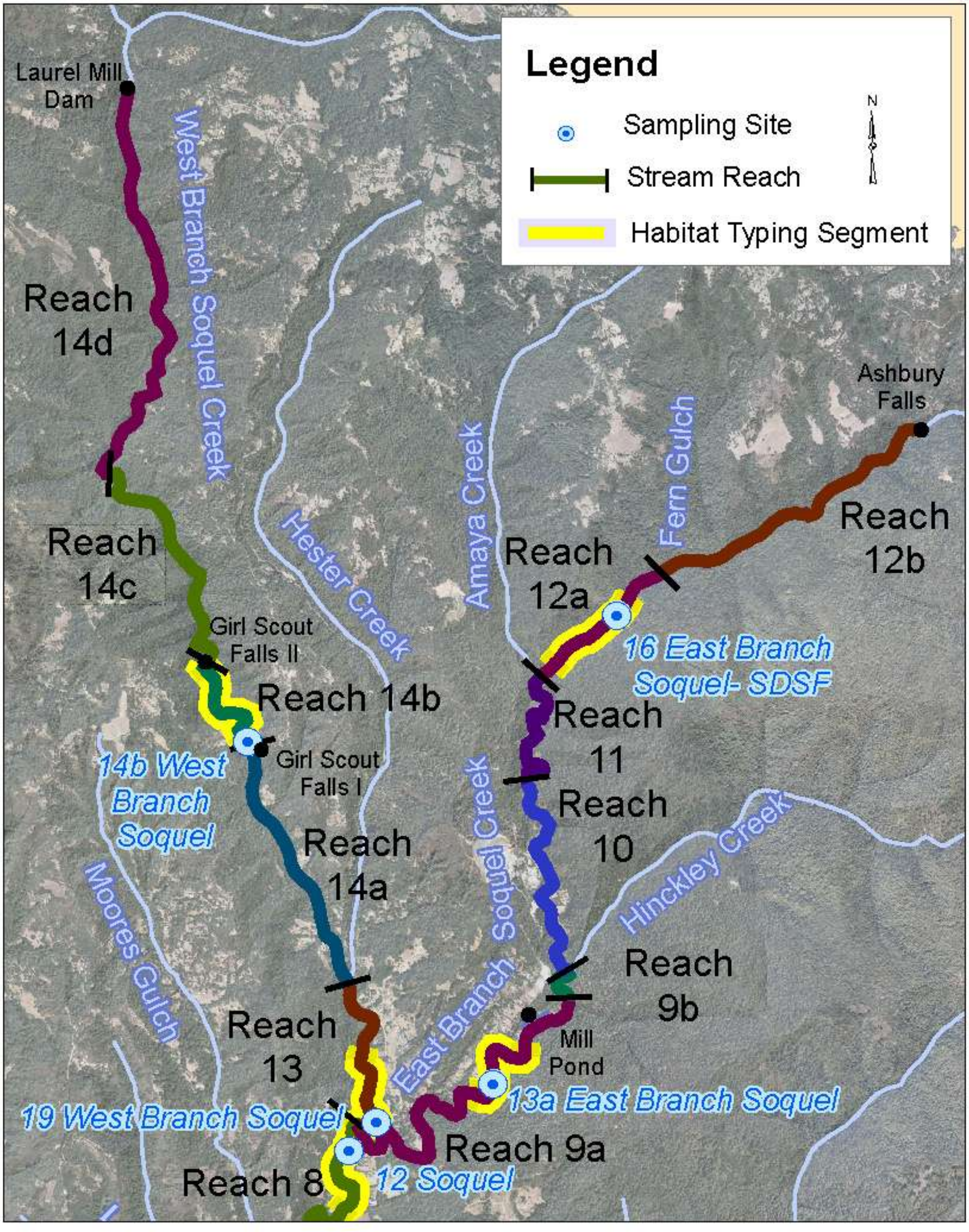

Figure 5. Upper Soquel Creek Watershed (East and West Branches).

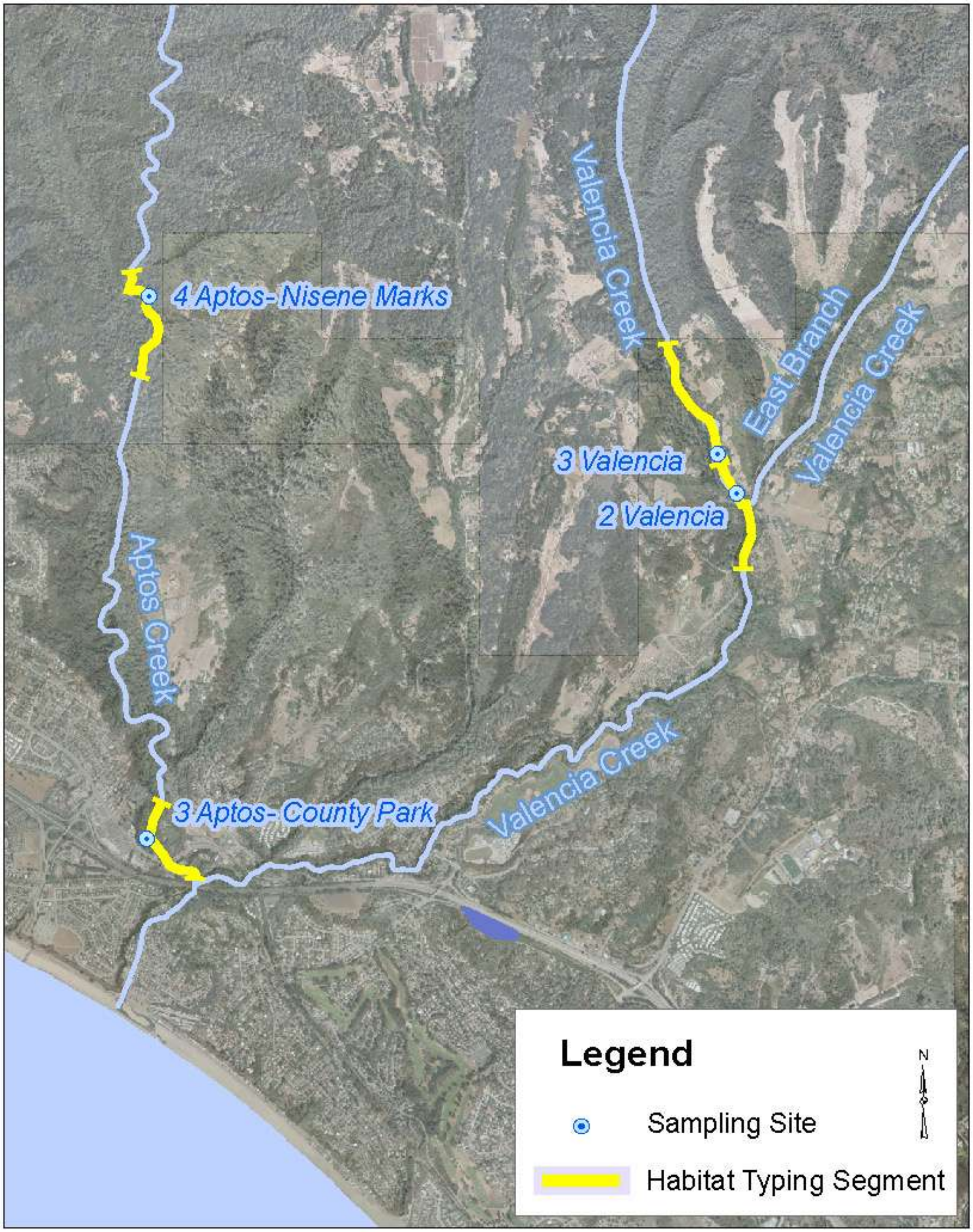

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Figure 6. Aptos Creek Watershed.

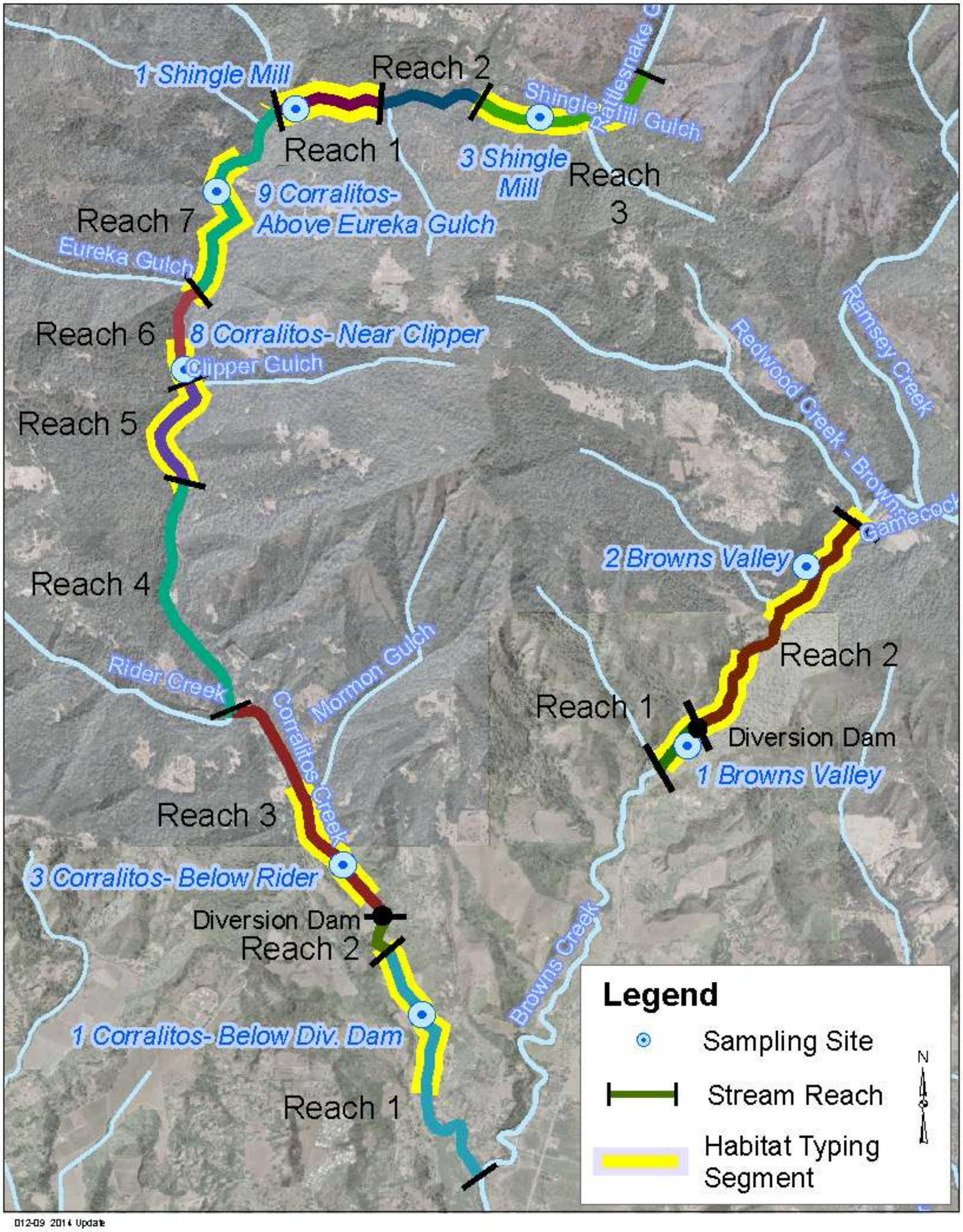

Figure 7. Upper Corralitos Creek Sub-Watershed of the Pajaro River Watershed.

APPENDIX B. DETAILED ANALYSIS OF 2013 STEELHEAD MONITORING IN THE SAN LORENZO, SOQUEL, APTOS AND CORRALITOS WATERSHEDS

(Provided electronically in a separate PDF file.)

APPENDIX C. SUMMARY OF 2013 CATCH DATA AT SAMPLING SITES.
(Provided electronically in Excel files.)

APPENDIX D. HABITAT AND FISH SAMPLING DATA WITH SIZE HISTOGRAMS.

(Provided electronically in a separate PDF file.)

APPENDIX E. HYDROGRAPHS OF SAN LORENZO, SOQUEL AND CORRALITOS WATERSHEDS.

(Provided electronically in a separate PDF file.)