D.W. ALLEY & Associates aquatic biology

2014 SUMMARY REPORT− Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, CA

Girl Scout Falls II (Hidden Falls) on West Branch Soquel Creek

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

Prepared For the

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

Funding From the

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

June 2015 **Project # 200-12a**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

A. EXECUTIVE SUMMARY

In fall 2014, 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 have sampled the San Lorenzo annually since 1994 except for 2002. 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.

<u>i. Steelhead Abundance in All Watersheds</u>

WY2014 streamflows in spring and early summer were much below the median streamflow statistic after a very dry, mild winter. Four minor stormflows occurred in February – April, with only one at the end of February that provided good passage conditions (about 850 cfs at the Big Trees Gage in the San Lorenzo River; about 350 cfs at the Soquel Village Gage in Soquel Creek; about 175 cfs at the Freedom gage in Corralitos Creek) for adult steelhead spawners. For the remainder of the winter and spring the baseflow was near summertime levels.

Although we have no estimates of adult returns to the 4 watersheds that were sampled, it appears that there were insufficient adult steelhead returns after the 4 relatively small stormflows in 2014 to saturate reaches of the 4 sampled watersheds with redds or egg production. Young-of-the-year (YOY) densities were much below average, dominating the juvenile populations with small YOY in all 4 watersheds.

Densities of the important Size Class II and III steelhead (soon-to-smolt) were generally rated below average in all 4 watersheds in 2014 (**Tables S-1 and S-2** *below*). Ratings for 3 sites in the San Lorenzo drainage improved from 2013. Eleven San Lorenzo sites (46%) had decreased ratings from the already reduced ratings in 2013. In the San Lorenzo drainage, 18 of 24 sampled sites (75%) were rated very poor (5), poor (7) and below average (6). Bean 14c was dry. Only 3 sites were rated fair; San Lorenzo 0a, Fall 15b and Boulder 17b. Only the two likely rainbow trout sites in 2014, San Lorenzo 12b and Branciforte 21c, and steelhead site Zayante 13d were rated good due to increased retention of yearlings after a mild winter.

In the Soquel drainage in 2014, no sites were rated fair or better for densities of soon-to-smolt juveniles. The ratings went from very poor (1) to poor (4) to below average (2). Site 16 in the SDSF went dry. In the Aptos drainage in 2014, lower Aptos #3 had the highest rating of fair due to the larger size of a few yearlings. Aptos #4 was rated below average, with its low juvenile density and only 10% of its YOY reaching Size Class 2. Lower Valencia #2 was rated very poor with absence of pool habitat. Upper Valencia #3 was rated below average, with its low steelhead density and few large fish.

The Corralitos sub-watershed had the best overall soon-to-smolt ratings. Half of the sites were rated below average (4), with the others rated fair (4). Fair ratings were achieved because there was yearling retention through a mild winter, and some of the few YOY present had reached Size Class II.

Table S-1. Sampling Site Ratings in 2006–2014, based on Soon-to-Smolt Sized Steelhead 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 (+ 1 dry)	6	9	10	6	0
2009 (n=37)	2 (+ 1 dry)	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 dry)	1	6	9	17	3
2013 (n=38)	5 (+ 1 dry)	6	10	9	7	1
2014 (n=39)	6 (+ 2 dry)	10	13	8	2	0

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.

Comparisons between indices of Size Class II and III abundance declined from the slightly above median baseflow year 2010 to the dry year 2014 for the 4 sampled watersheds (63% reduction for the San Lorenzo; 75% reduction for Soquel; 30% reduction for Corralitos).

Four factors may explain the much below average YOY densities at most sites in all 4 watersheds. The first factor was likely low adult returns during the previous winter/spring. Six of the last 8 years have been on the dry side, including 2012 and 2013, which has resulted in slower juvenile growth rates leading to smaller smolt populations and individual smolt size. The cumulative effect of multiple dry years has likely reduced juvenile survival to adulthood and adult returns. Trapping data from Scott Creek indicated substantially decreased adult steelhead returns in winter 2013-2014, where adult escapement estimates in water years 2006–2014 were 219, 259, 293, 126, 109, 214, 167 and 50, respectively (**Sean Hayes and Joe Kiernan, NOAA Fisheries personal communications**). No adult steelhead made it to San Clemente Dam on the Carmel River in water year 2014 due to limited surface flow (**Chaney 2014**). So, no annual index of adult returns was possible at the dam.

The sporadic distribution of YOY in the San Lorenzo system in fall 2014 indicated limited spawning activity by a reduced number of returning adults. The three sites with the highest YOY densities were upper Zayante 13d (near average), upper Fall 15b (above average) and lower Branciforte Creek 21a-2 (below average), with well below average densities elsewhere. In the Soquel drainage, the only near to or above average YOY densities occurred at the 2 upper mainstem sites. In the Aptos system, the continued below average YOY density in 2014 is attributable to sporadic spawning effort by a potentially small adult steelhead population. YOY densities were very low at the lower Aptos site and both Valencia sites. An Aptos lagoon juvenile population estimate was impossible in 2014 because only 6 juveniles were captured on two days of sampling, with no recaptures. This further indicated a very small adult steelhead population. Sporadic spawning of a very small adult population was also observed in the Corralitos sub-watershed, where much below average YOY densities were found at all sites, with the highest densities occurring at Corralitos 3 and Browns 2.

A second likely factor contributing to low 2014 YOY densities in the San Lorenzo and other watersheds was that adult steelhead spawning passage was restricted to narrow windows of time. Several low flow passage impediments likely became factors in such a 2013-2014 low flow winter/spring in either preventing adult steelhead passage or slowing it down. If many of the remnant flashboard dam abutments with associated walls and openings collect instream wood in the future, they may become very significant impediments even in wetter winters, as they may have been in the past. These often low flow impediments may significantly inhibit coho recovery if not addressed, because entire year classes may be weakened if adult access to the watershed is largely prevented when early winter storms are lacking. The cold water refuges required for coho rearing are located in the upper mainstem and tributaries of the upper watershed, where access must be insured. In the Branciforte sub-watershed, more than 6 impediments that will impede adult salmonid passage during mild winters were identified, including the Branciforte flood control channel (**Kittleson 2015a**). At least 6 impediments that will impede adult salmonid passage during mild winters were present in the lower and middle mainstem San Lorenzo, including the Barker's Dam between the Erwin Way bridges (**Alley et al. 2004**). At least 6 potentially significant impediments during mild winters were present in the upper mainstem above the Boulder Creek confluence, including the flashboard dam abutment upstream of the Brimblecom Road Bridge (**Kittleson 2015b**). The low

YOY densities in the upper mainstem San Lorenzo above the Boulder Creek confluence since 2006 leads one to believe that a passage impediment periodically develops after especially wet years, perhaps logs collecting on remnant flashboard dams. The near absence of YOY at the Bear Creek site in 2013 and 2014 indicates that the flashboard dam abutment on lower Bear Creek near Lanktree Bridge is a significant passage impediment.

In the Soquel drainage, the primary passage impediments were Girl Scout Falls I and II on the West Branch. A few adults spawned above Girl Scout Falls I in 2014, but we suspect that Girl Scout Falls II is a complete passage barrier in most years. In the Aptos drainage, Valencia Creek had one potential passage impediment that may have narrowed the passage window of time to 2 minor stormflows for adult passage in such a low flow year as 2014. It was the baffled fishway near the mouth (under Highway 1). In 2014, baseflow receded to near summertime flow between storm events, making it questionable if the baffles worked at low flows. The culvert under Valencia Road had been improved for fish passage and was likely more passable than the Highway 1 baffles. Furthermore, with extremely poor pool development after substantial sedimentation of Valencia Creek (perhaps occurring during the wet 2011 winter), with its long stretches of shallow run habitat below Valencia Road culvert, the stream channel, in general, may have been difficult for adult steelhead to pass.

Adult steelhead passage from the Bay to the monitored reaches of Corralitos and Browns creeks may have been restricted to just 1 short stormflow at the end of February. This storm provided a peak flow of about 175 cfs at Freedom, CA, with an open sandbar at the mouth of the Pajaro River. Streamside residents observed adult steelhead in Browns Creek in two different locations (one below the diversion dam and one above) over the previous winter, indicating successful adult steelhead passage above its dam during the winter. Consistent with adult sightings, YOY were detected in higher density at Browns Site 2 above the dam than elsewhere in the watershed. The relatively higher YOY density (second highest in the Corralitos sub-watershed in 2014) at Corralitos 3 above the Corralitos diversion dam indicated that it was passable also. However, the very low YOY densities at the uppermost Corralitos Site 9 indicated that the bedrock cascade in Reach 7 may have been a passage impediment. The box culvert at the beginning of Reach 5 (CM12.46) may have had depth issues between storms but was likely passable during the end-of-February storm because it is baffled. This box culvert is likely not an impediment except in mild winters like 2014.

A third likely factor contributing to low 2014 YOY densities was insufficient winter/spring baseflow to provide much spawning success or good egg incubation, resulting in poor egg survival during rapidly declining streamflow after storms passed. Between stormflows, streamflows declined to near summertime levels (streamflow in the 15−30 cfs range at Big Trees gage in the San Lorenzo for much of the February−April egg incubation period). Water percolation through spawning gravels to oxygenate eggs and remove metabolic wastes would have been much reduced at such low baseflows. Pool tail-outs have the best quality spawning gravel and fastest percolation rates, located just before the pools' hydraulic breaks. But under the low streamflows in 2014, these areas were too shallow for spawning, and adult steelhead likely moved further upstream into the pools beyond the breaks to find sufficient depth in which to spawn. However, most pools in the Santa Cruz Mountains have a high sand component, and the spawning fish likely resorted to spawning in more sandy substrate further upstream of the hydraulic break under these low flow conditions (**J. Smith pers. observation from 1988**). Also, the high sand component in the spawning gravels would further impede water percolation and oxygenation of eggs. This would reduce egg survival.

A fourth likely factor contributing to low YOY densities was reduced rearing habitat quality for juveniles that resulted from reduced streamflow, higher water temperature, shallower depth, reduced escape cover and less food for YOY. This likely caused starvation of many YOY where spawning was successful but competition was higher. The averaged mean monthly streamflows for May−September in the San Lorenzo and Soquel watersheds were the lowest in the past 18 years since 1997 (**Figure B-45** *below*). The preponderance of small YOY (except where their density was very low) and small Size Class II yearlings throughout the watersheds indicated slow growth rate in 2014. Furthermore, Corralitos Creek was still recovering from the Summit Fire of 2008 that caused high sedimentation to Corralitos Creek during the 2009-2010 winter, mostly downstream of Eureka Gulch. Although habitat in Reaches 5 and 6 was improving, pool scouring was still very limited due to still highly sedimented conditions. This contributed to poor rearing conditions for YOY survival, along with very low baseflows (less food) upstream of Rider Creek confluence.

Higher water temperature increased food requirements for juvenile steelhead in 2014 by increasing metabolic rate at a time when less food was available as insect drift. Slower water velocities and lower baseflow reduced insect drift rate and riffle insect production zones. 2014 temperature monitoring in San Lorenzo tributaries (Boulder, Fall and Zayante creeks) and in the middle mainstem San Lorenzo, downstream of Clear and Fall creek confluences, indicated that summer water temperatures were 2−3˚C warmer than in the wetter Water Year of 2005. Habitat typing data in 2014 indicated a smaller proportion of riffle habitat per stream length and less surface area in riffles for insect production due to narrower stream channels associated with lower baseflow, further reducing food supply for steelhead.

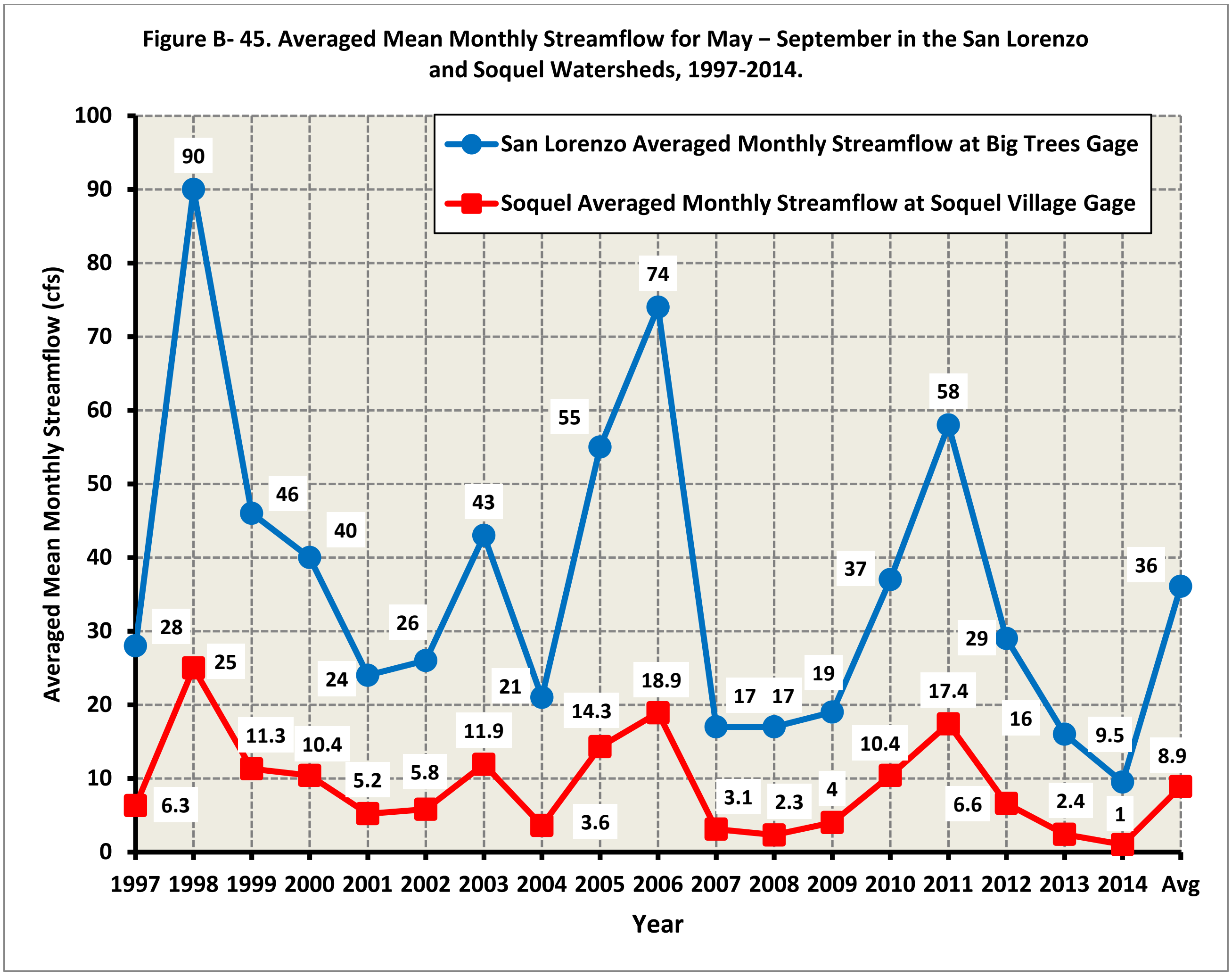


Figure B-45. Averaged Mean Monthly Streamflow for May−September in the San Lorenzo and Soquel Watersheds, 1997-2014.

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

Overall habitat quality declined at all replicated sampling sites and reaches in 2014 as it did at the majority of sites in 2012 and 2013. This was primarily due to decreased baseflow, shallower fastwater habitat and less escape cover. The average mean monthly streamflow for May−September in 2014 at the Big Trees gage was the lowest in 18 years of calculations (9.5 cfs with an 18-year average of 36 cfs). A relatively low number of YOY reached Size Class II in 2014 (also in 2012 and 2013) due to very low densities of YOY in the high growth potential reaches of the lower mainstem, combined with low YOY density and below median baseflows in spring, summer and fall that reduced the percent of YOY reaching Size Class II in the sometimes fast-growth sites of the middle mainstem and lower/middle Zayante Creek.

In the San Lorenzo River drainage in 2014, all steelhead sites had below average total and YOY densities, except for Zayante 13d and Branciforte 21a-2. Only 2 of 22 steelhead sites had above average yearling and Size Class II/III densities, those being Zayante 13d and Boulder 17b. Yearlings either immigrated early, in spring, with little turbidity to obstruct visual feeding or did not survive the winter/spring despite the limited winter stormflow. 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 2014. The reduced site densities from 2013 to 2014 of YOY, Size Class II/III fish and all sizes for repeated mainstem and tributary sites combined were statistically significant. Reduced site densities of YOY and all sizes combined were statistically significant for mainstem sites only, as well. The Waterman Gap Site 12b was considered to be a resident rainbow trout site and was not included in statistical analysis. Upper Bean Creek Site 14c above MacKenzie Creek confluence went dry again in 2014 as it had in 2012 and 2013.

Densities of larger Size Class II and III steelhead are most important because they will soon smolt and contribute to the adult return. Sites that typically have fair to very good ratings in wetter years (based on soon-to-smolt densities) but had very poor to below average ratings in 2014 were 10 important sites: SLR 1, SLR 2, Zayante 13a, Zayante 13c, Bean 14b, Bean 14c (dry), Newell 16, Boulder 17a, Bear 18a and Branciforte 21b. Only 2 sites had improved ratings in 2014; SLR 0a (below average in 2013 to fair in 2014) and SLR 4 (poor in 2013 to below average in 2014). Eleven sites declined in ratings, with the largest decline at Newell 16 (good in 2013 to below average in 2014). Adult spawning was likely very limited in Newell Creek with most stormflow captured behind the dam and much reduced baseflow leading to loss in hydraulic continuity at times when residential water extraction exceeded dam releases.

For the San Lorenzo watershed in the slightly above median baseflow Water Year 2010, the reach index total for 18 reaches (not including the lagoon) was 21,000 Size Class II and III juveniles. The reach index total in dry Water Year 2014 was 7,800, it being only 37% of the 2010 index. Since it is this size class of juveniles that will soon smolt and contribute most to adult returns, the potential for adult returns from juvenile production in 2014 from stream habitat was only about 1/3 that in 2010 for the San Lorenzo drainage.

iii. Steelhead Abundance and Habitat Conditions in the Soquel Creek Watershed

Although the important habitat parameter of pool escape cover improved in all mainstem sites/reaches in Soquel Creek, and substrate conditions (percent fine sediment and embeddedness) were similar or improved compared to recent years in mainstem sites/ reaches, the overall habitat quality of the watershed was reduced due to much lower baseflow (less food) and reduced pool depth. Much of the East Branch Soquel went dry, with its often important contribution of soon-to-smolt size fish as fast growing YOY in Reach 9a and its contribution of relatively higher densities of yearlings from Reach 12a in the Soquel Demonstration State Forest (SDSF). Reach 12a has also produced high densities of YOY in the past. The average mean monthly streamflow for May−September in 2014 at the Soquel Village gage was the lowest in 18 years of calculations, it being only 1 cfs (**Figure B-45** *above*).

The juvenile steelhead population consisted primarily of near average abundance of little Size Class 1 YOY steelhead in the mainstem sites and below average YOY densities in the branches where there was perennial flow. Total densities mirrored YOY densities. There were near to or above average yearling densities at all watered sites, indicating an increase in yearling retention and overwinter survival during an extremely mild winter. But yearling densities were still low, and some yearlings likely smolted early, in spring, after a low turbidity spring growing period. Site 16a in the SDSF that typically has higher yearling densities than other sites went dry. Densities of Size Class II/III juveniles were less than half the long-term averages at all sites due to the very small juvenile densities at the lower 2 mainstem sites and the absence of YOY reaching Size Class II at upper mainstem and lower branch sites, as typically occurs in wetter years. Spring and early summer baseflows were substantially below the median statistic, to hinder YOY from growing into the soon-to-smolt size class. Soon-to-smolt density ratings declined at 3 of 7 sites from already low 2013 ratings, and another went dry. Ratings ranged from very poor in Reach 1 to below average at Soquel 4 and East Branch 13a. Reach 1 likely went intermittent some nights due to night-time water diversions, as indicated by nightly drops in streamflow at the Soquel Village gage. Site 1 had the lowest Size Class II/III density measured in 18 years of monitoring, though it has been very low in the past.

For the Soquel watershed in slightly above median baseflow Water Year 2010, the reach index total for 8 reaches (not including the lagoon) was 3,800 Size Class II and III juveniles. The reach index total in dry Water Year 2014 was 900, it being only 24% of the 2010 index. Since it is this size class of juveniles that will soon smolt and contribute most to adult returns, the potential for adult returns from juvenile production in 2014 from stream habitat was only about 1/4 that in 2010 for the Soquel drainage. Big losses were sustained in 2014 because a significant portion of the East Branch went dry. The difference would have been greater if the lagoon juvenile population was factored in. In 2010, the lagoon estimate was about 1,200 soon-to-smolt size fish (**Alley 2014a**). In 2014, only 10 fish were captured during 2 sampling days, and no recaptures were made (**Alley 2015**). The 2014 lagoon population was likely less than 100. There were apparently insufficient spawners in the lower mainstem to seed the lagoon with YOY. The lagoon had very few juveniles when it was sampled in October (**Alley 2015**). The overall decreases in total, YOY and Size Class II/III densities in 2014 from 2013 were not statistically significant, with only 4 repeated sites to compare.

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

Based on hydrographs from stream gages in other watersheds, it is likely that the Aptos watershed also had only minor winter/spring stormflow in 2014 and considerably below the median streamflow statistic in spring and summer, comparable to low baseflow in 2012 and 2013. Measured streamflow in fall in lower Aptos Creek confirmed low baseflow in 2014, slightly less than in 2013. These 2014 flow conditions provided even less food and caused continued slow juvenile growth rate in all reaches in 2014, as in 2013.

Habitat conditions had reduced quality in Aptos sites due primarily to lower baseflow and shallower pools, and escape cover had declined at the upper site. Conditions in Valencia Creek had deteriorated at both sites since 2010 due to substantial sedimentation that filled in pools and stormflow in the past 4 years that had dislodged and removed instream wood that had provided escape cover at the upper site.

The lowest YOY densities since the drought year of 2009 were measured in 2014, much below average. This translated into very low, below average total juvenile densities at all sites. Yearling densities were near average at the 2 Aptos sites, indicating average overwinter survival and retention. But yearling and older densities were much below average at the 2 Valencia sites, likely due to very poor habitat conditions.

Size Class II and III densities were below average and slightly less than the low densities in 2013 at both Aptos sites. As in 2013, few YOY reached Size Class II due to less food and growth associated with low baseflow. The two Valencia sites had much below average soon-to-smolt densities, mirroring low yearling densities. The highest soon-to-smolt rating was fair at lower Aptos 3. The other 3 sites ranged from very poor to below average.

Aptos lagoon in fall 2014 had a much smaller juvenile steelhead population than even in 2013. Only 6 steelhead were captured on 2 sampling days, without recaptures. Therefore, no population estimate was possible. There may have been less than 30 juvenile steelhead present in the lower lagoon. The few steelhead captured were in poor condition. There were no steelhead mortalities during 2 days of sampling. The 2013 estimated population size of only ***32*** compared to ***140*** in 2012 and ***423*** in 2011. The low density of juveniles detected in 2014 indicated possibly even lower YOY production in the lower watershed than in 2013. The YOY density at the lower Aptos 3 site was much below average. The presumably small lagoon population may also have been attributed to the poor water quality in a badly stratified estuary that may not have converted to freshwater. Unfortunately, we have no water quality measurements prior to significant tidal overwash on the day of our first sampling. The sandbar was closed.

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

All reaches had lower spring and early summer baseflow in 2014 compared to 2013, based on measurements at the Freedom gage which were much below the median statistic. Lower baseflow provided less food and slower growth rate in all reaches in spring and early summer and was the overriding factor that caused habitat quality to decline in all sites/reaches. Non-flow aspects of habitat improved at the 3 lower Corralitos sites/reaches, with similar depths to 2013 levels despite reduced baseflow. Escape cover increased at these lower Corralitos sites/reaches, indicating further that Corralitos Creek continued to recover from the Summit Fire of 2008. The important Reach 7 above Eureka Gulch declined in habitat quality with much reduced streamflow, shallower pools and less escape cover. Lower Browns 1 had shallower pool depth and less escape cover. Most non-flow aspects of habitat were similar at upper Browns 2 in 2014 to 2013 except for increased pool depth in 2014. And October baseflow was slightly higher than in 2013.

Adult steelhead successfully passed above diversion dams on Browns and Corralitos creeks in 2014. Adult steelhead were observed above Browns Creek dam, and evidence of YOY was found at Browns

Site 2. YOY densities at Corralitos Site 3 above the Corralitos Creek dam was higher than below and the highest in Corralitos Creek in 2014.

In 2014, YOY densities were very low and well below average at all sites in this sub-watershed and less than in 2013 all sites except Shingle Mill 1. The slight increase in YOY densities at Shingle Mill 3 may have resulted from resident rainbow trout spawning in the headwaters. Decreased YOY juvenile densities at sites from 2013 to 2014 were statistically significant. 2014 yearling densities were less than in 2013 at all sites except Corralitos 8 near Clipper Gulch (improved habitat) and were below average at all 8 sites. Decreased yearling densities at sites from 2013 to 2014 were statistically significant.

Total juvenile densities followed the same pattern as YOY densities in comparison to 2013 densities and long-term average densities. Total densities were the lowest measured in 7-10 years of monitoring at Corralitos Sites 1, 8 and 9 and Browns Sites 1 and 2. The trend in total densities for the 6 Corralitos and Browns creek sites continued to decline in 2014 since 2012 to its lowest in the 11 years of monitoring. Decreased total juvenile densities at sites from 2013 to 2014 were statistically significant.

In 2014, Size Class II densities were less than those in 2013 at 5 of 8 sites, below average at 6 of 8 sites and close to average at the other 2 sites. The trend in soon-to-smolt densities declined since 2013, with the 8-site average being the lowest in 11 years of monitoring but very similar to the 2010 average after sedimentation from the Summit Fire. The highest density of soon-to-smolt fish in 2014 was at Corralitos 3 above the dam. Near average or below average densities of yearlings at all sites, along with the small number of YOY reaching Size Class II (low baseflow), lead to relatively low densities of larger juveniles compared to 2013. Site ratings based on soon-to-smolt densities declined at 5 of 8 sites in 2014 from 2013. Four sites had "below average" ratings and 4 had "fair" ratings. The 2014 "fair" sites were rated "good" in 2013. Corralitos 9 typically is rated "good" but dropped to "fair" in 2014, with the bedrock cascade in Reach 7 likely being a passage impediment for adult spawners. The mostly below average densities of Size Class II consisting of few yearlings and a preponderance of YOY reaching Size Class II because YOY density was very low with less competition.

The abundance index for soon-to-smolt sized steelhead in sampled stream reaches indicated a substantial decrease from the slightly above median baseflow Water Year 2010 (3,300) to the dry Water Year 2014 (2,300). The 30% decrease resulted from very low 2014 YOY densities in high growth potential reaches that provided much fewer YOY in Size Class II compared to 2010. Since it is this size class of juveniles that will soon smolt and contribute most to adult returns, the potential for adult returns from juvenile production in 2014 from stream habitat was only about 7/10 that in 2010 for the Corralitos sub-watershed.

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 near the confluence with Watsonville Slough and at upper sites at Thurwachter Bridge and at a boat ramp 3 miles upstream of the beach berm.

B. INTRODUCTION

i. Scope of Work

In fall 2014, 4 Santa Cruz County watersheds were sampled for juvenile steelhead to primarily compare juvenile abundance with past years and habitat conditions at sampling sites and in limited habitat typed segments with those in 2013. 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 24 sites (10 mainstem and 14 tributary sites). Sampled tributaries included Branciforte, Zayante, Lompico, Bean, Fall, Newell, Boulder and Bear creeks. A new reach with sampling site was added to Fall Creek (15a) below the diversion dam in 2014. The mainstem Reach 10 and its sampling site were sampled for the first time since 2005. Nine 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 15 sites, the 2013 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 2013 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 at the lagoon. Two sites last sampled in Valencia Creek in 2010 were revisited. The upper 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 other 3 sites, the 2010 and 2013 sites were replicated for fish sampling. 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 Corralitos Creek upstream 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

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 did not begin until 2006 for the latter two watersheds. 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, fish densities at sites 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. When reach abundance indices were calculated, reach proportions of habitats were factored in.

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 1−9 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, fastwater habitats.

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. In 2014, reach abundance indices were once again estimated for soon-to-smolt sized steelhead in the San Lorenzo, Soquel and Corralitos watersheds for juvenile populations in 2010 and 2014.

iii. Index of Soon-to-Smolt Juvenile Abundance

Habitat proportions in reach segments were factored in with reach length and soon-to-smolt juvenile densities by habitat type in sampling sites. Then abundance indices were calculated for each sampled reach in each watershed. An overall watershed index of abundance was then calculated for the sample reaches combined. Indices were compared for 2010 (a slightly above median baseflow year) and 2014 (a very dry baseflow year). Refer to the methods section of Appendix B for more details.

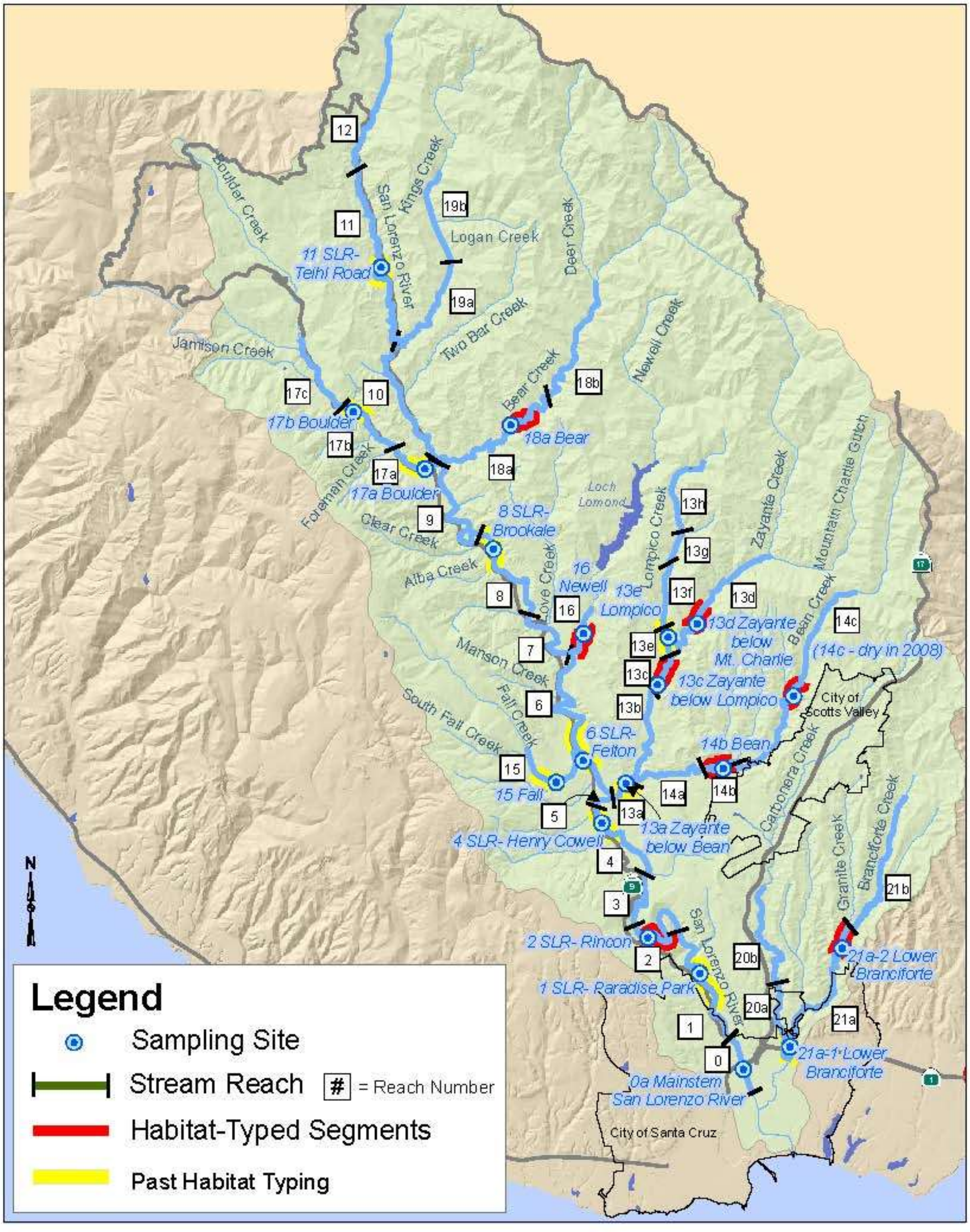


Figure A-2. San Lorenzo River Watershed.

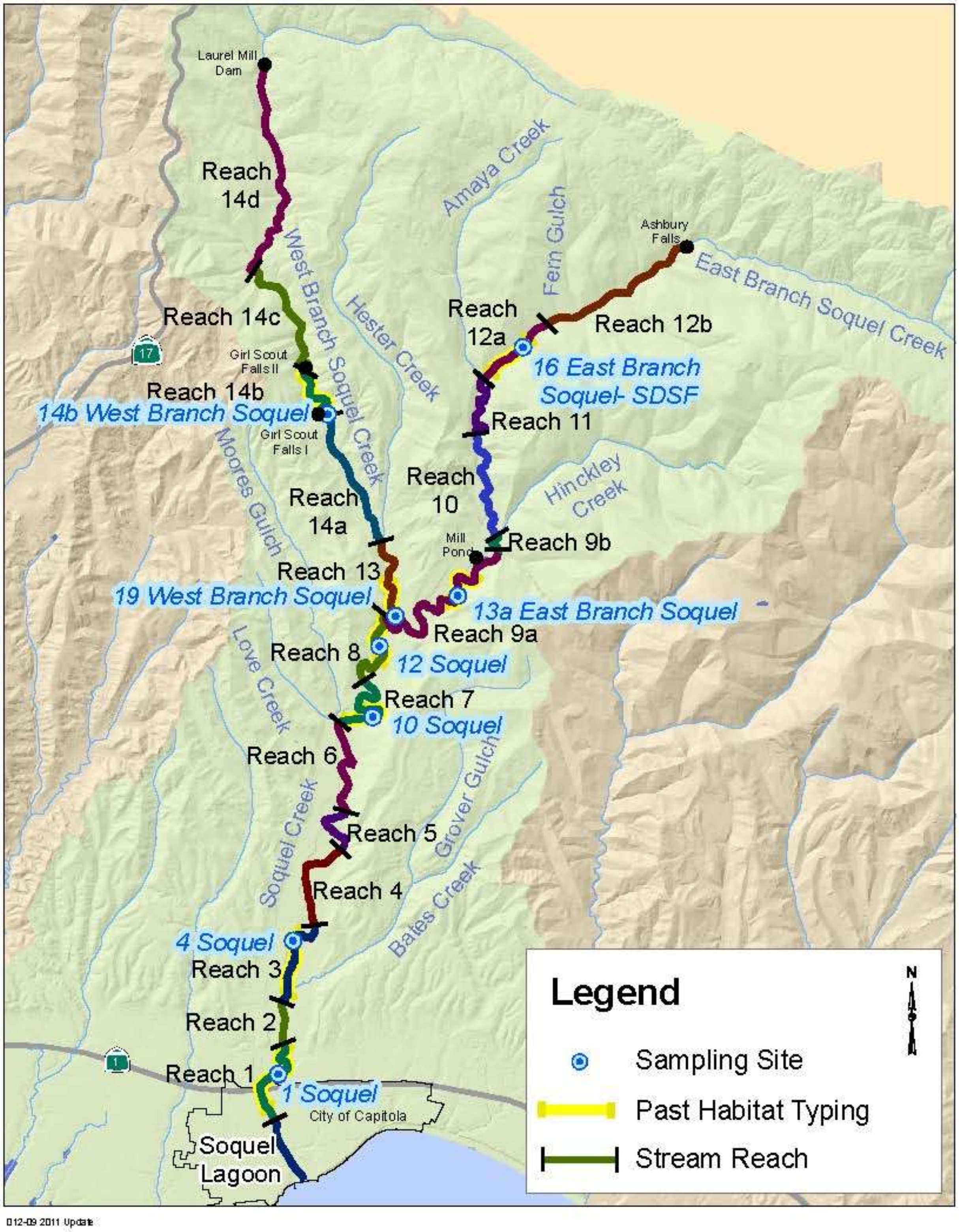
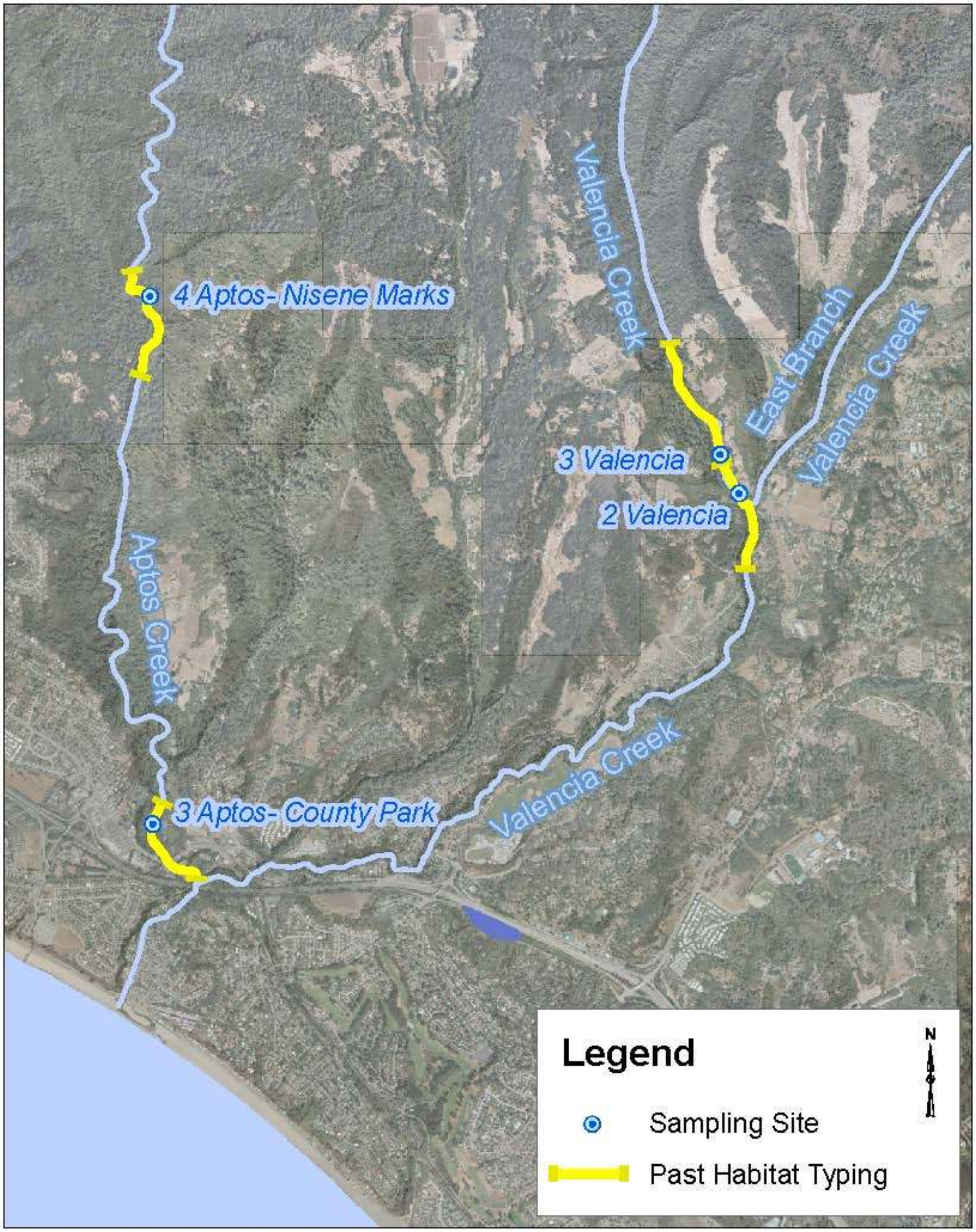


Figure A-3. Soquel Creek Watershed.



012-09 2011 Update

Figure A-6. Aptos Creek Watershed.

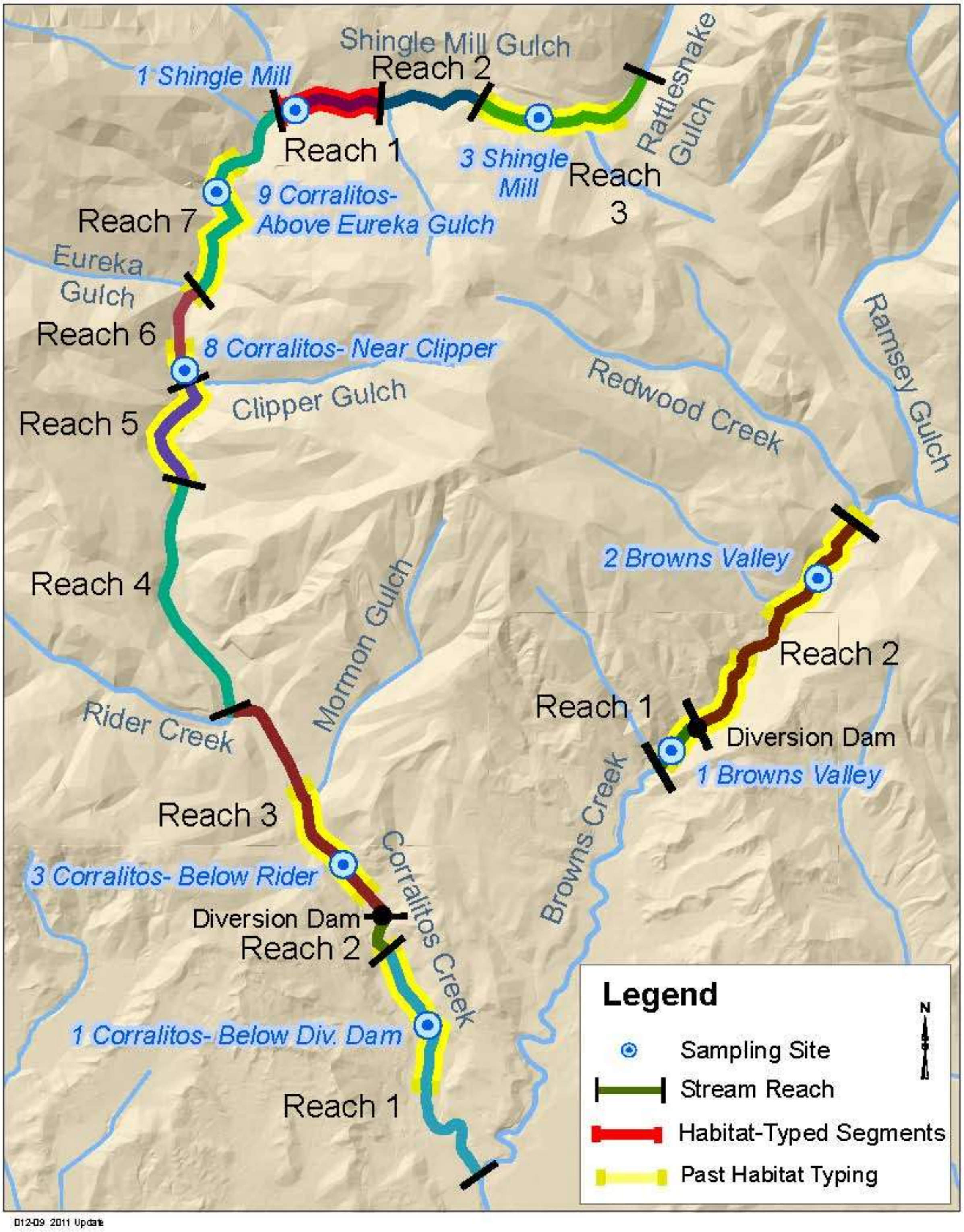


Figure A-7. Corralitos Creek Sub-Watershed.

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. WY2014 streamflows in spring-summer-fall were well below the median flow statistic, as they had been in WY2013. There were 4 small stormflows in February−April 2014, with steadily declining baseflow from mid-April on (less than 20 cfs at Big Trees Gage in the San Lorenzo and less than 10 cfs at the Soquel Village Gage in Soquel Creek). Streamflow comparisons between years were made for San Lorenzo and Soquel stream gages, comparing annual 5-month averages (May − September) expressed in ***Figure B-45*** *below*. 2014 had the lowest average in 18 years.

2. Rearing habitat quality declined at all repeated fish sampling sites and habitat typed reach segments due to decreased streamflow (less food), mostly shallower habitat and mostly less escape cover. Exceptions were improvement in the two upper sites in Branciforte Creek regarding pool depth and escape cover; improved escape cover in the 4 mainstem sites of Soquel Creek; improved escape cover in the lower 3 sites in Corralitos Creek and upper Browns; similar pool depths to previous conditions at the 3 lower Corralitos sites and increased pool depth at the upper Browns site. Surprisingly, fall baseflow increased in Browns Creek above the diversion dam compared to 2013, but spring and early summer flows were less in 2014. Habitat quality declined in all 4 Aptos/ Valencia sites with less streamflow, shallower habitat and less escape cover, except for similar escape cover in the upper Aptos reach.

3. 2014 abundance of YOY steelhead were mostly below average at sites in all 4 watersheds. It was below average in the mainstem San Lorenzo (7 of 9 site densities near or at the lowest so far) and mostly below average at tributary sites. YOY abundance was below average at all sites in Soquel, Aptos and Corralitos (7 of 8 site densities near or at the lowest so far), except for two upper mainstem sites in Soquel Creek.

4. Indications were that low numbers of adult spawners did not saturate habitat with YOY after only localized spawning activity. Indications included 1) very low YOY densities in all watersheds except at a few sites with near to or above average YOY densities, 2) limited windows of adequate stormflow for spawning migration, 3) reduced adult escapement as measured on Scott Creek, 4) very low YOY densities at sites in 2014 that had much higher YOY density in 2013, despite similar escape cover in both years and 5) cumulative effects of repeated dry years, reducing smolt numbers and smolt size when entering the ocean.

5. Despite limited adult salmonid passage opportunities during the mild 2013-2014 winter/spring, spawning access to upper tributary sites occurred in the San Lorenzo (Fall 15b, Boulder 17b and Zayante 13d) and Soquel drainages. Though the SDSF site on East Branch Soquel went dry by

fall, YOY were captured there in high numbers in July, beforehand. However, very low YOY densities in Bear Creek above the flashboard dam abutment, San Lorenzo River above Boulder Creek confluence, Valencia Creek (Aptos drainage) and Corralitos Creek (above the box culvert upstream of Rider Creek confluence and above the bedrock cascade upstream of Eureka Gulch confluence) indicated little or no adult spawning there.

6. Yearling densities were generally below average in 3 watersheds (San Lorenzo, Aptos and Corralitos) except at some upper tributary sites in the San Lorenzo (Boulder 17b and Zayante 13d). They were near to or above average at Soquel sites that remained watered, though they were still very low.

7. Soon-to-smolt abundance ratings (Size Class II and III steelhead) at most sites were shifted downward from 2013, and many were well below average because of low yearling densities and a very low proportion of YOY reaching Size Class II in usually fast-growth sites (***Tables S-1, S-2 and S-3*** *below*).

8. Paralleling low YOY densities in 2014, total density for all sizes of juvenile steelhead were 1) well below average at all steelhead sites in the mainstem San Lorenzo and mostly below average at tributary sites except Zayante 13d and Branciforte 21a-2, 2) below average at Soquel Creek sites except slightly above average at the two upper mainstem sites, 3) much below average at all sites in the Aptos/Valencia watershed and the Corralitos/Browns sub-watershed.

9. Indices of watershed abundance (production) of Size Class II and III steelhead for sampled reaches were calculated to compare annual differences with reach lengths incorporated with site densities. 2010 abundance was compared to 2014 abundance to contrast production in a year with a near median statistic of baseflow in late spring through fall (2010) with production in a very dry year (2014). This contrast would better describe the extreme reduction in abundance in a critically dry year more so than just comparing site densities. Abundance indices for soon-to-smolt sized steelhead in sampled stream reaches indicated a substantial decrease in the very dry 2014 year compared to the slightly above median baseflow 2010 year. From 2010 to 2014, the San Lorenzo River index decreased from 21,000 to 7,800; the Soquel Creek index decreased from 3,800 to 900; the Corralitos/Browns creek index decreased from 3,300 to 2,300. Substantial reductions resulted from very low 2014 YOY densities in high growth potential reaches of lower mainstem San Lorenzo, lower/middle Zayante, Newell, mainstem Soquel, lower East Branch Soquel (mostly went dry) and Corralitos. These typically high growth potential reaches provided much fewer YOY in Size Class II in 2014 compared to 2010. The Soquel Creek index was further reduced by few yearlings remaining in the East Branch when much of it went dry in 2014.

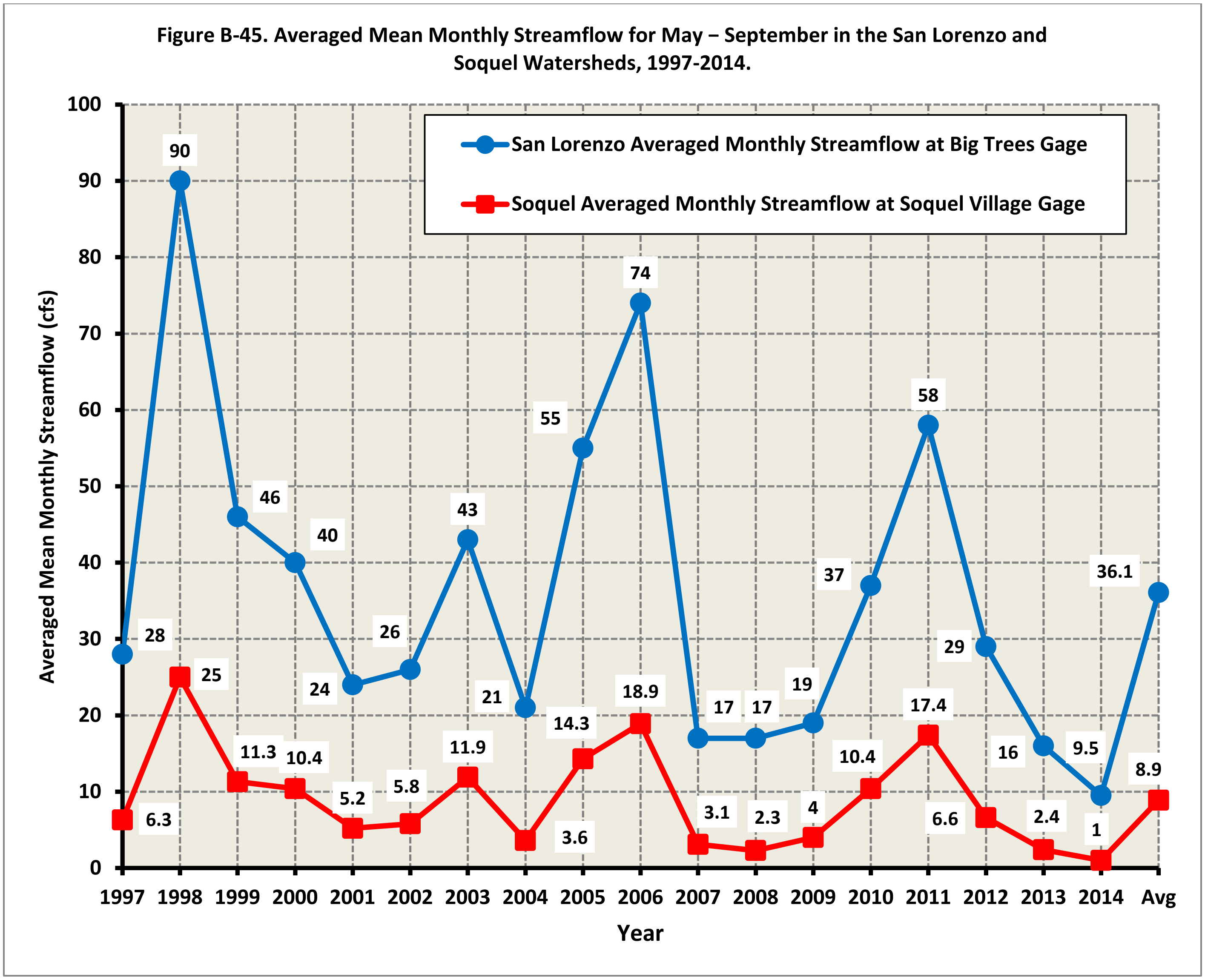


Figure B-45. Averaged Mean Monthly Streamflow for May – September in the San Lorenzo and Soquel Watersheds, 1997-2014.

Table S-1. Summary of Sampling Site Ratings in 2006−2014, 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 (+ 1 dry)	6	9	10	6	0
2009 (n=37)	2 (+ 1 dry)	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 dry)	1	6	9	17	3
2013 (n=38)	5 (+ 1 dry)	6	10	9	7	1
2014 (n=39)	6 (+ 2 dry)	10	13	8	2	0

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. 2014 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Average Smolt Size, with Physical Habitat Change since 2013. (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	2014 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2014 Numeric Smolt Rating (With Size Factored In)	2014 Symbolic Rating (1 to 7)	Physical Habitat Change by Reach/Site Since 2013
Low. San Lorenzo #0a	9.6	6.2/ 108 mm	4 (Fair)	@@@@	Site Negative
Low. San Lorenzo #1	7.2	1.8/ 125 mm	2 (Poor)	@@	Site Negative
Low. San Lorenzo #2	14.3	2.4/ 98 mm	2	@@	Reach Negative
Low. San Lorenzo #4	14.0	4.4/ 89 mm	3 (Below Avg)	@@@	Site Negative
Mid. San Lorenzo #6	4.2	1.4/ 80 mm	1 (Very Poor)	@	Site Negative
Mid. San Lorenzo #8	5.9	1.4/ 92 mm	1	@	Reach Negative
Mid. San Lorenzo #9	7.2	0.6/ 92 mm	1	@	Site Negative
Up. San Lorenzo #10	5.5	None	1	@	Reach Negative (Since 2005)
Up. San Lorenzo #11	6.0	1.6/ 112 mm	2	@@	Site Negative
Up.San Loren #12b (res.Rt)	*12.4*	*21.3/ 92 mm*	*5 (Good)*	*@@@@*	Site Negative
Zayante #13a	9.7	2.4/ 89 mm	2	@@	Site Negative
Zayante #13c	13.5	3.7/ 81 mm	1	@	Site Negative
Zayante #13d	*16.2*	*22.1/ 93 mm*	*5*	*@@@@@*	Reach Negative
Lompico #13e	6.9	6.7/ 94 mm	3	@@@	Site Negative
Bean #14b	12.0	2.8/ 101 mm	2	@@	Reach Negative
Bean #14c	8.3	Dry	Dry	Dry	Dry
Fall #15a	2.7	2.7/ 103 mm	3	@@@	New
Fall #15b	13.1	7.3/ 103 mm	4	@@@@	Reach Negative
Newell #16	14.0	3.1/ 109 mm	3	@@@	Site Negative
Boulder #17a	10.8	3.8/ 91 mm	2	@@	Site Negative
Boulder #17b	10.8	13.0/ 90 mm	4	@@@@	Site Negative
Bear #18a	9.9	0.7/ 116 mm	2	@@	Site Negative
Branciforte #21a-2	9.1	4.6/ 98 mm	3	@@@	Reach Negative
Branciforte #21b	13.9	7.3/ 98 mm	3	@@@	Site Negative
Branciforte #21c (res. Rt)	*11.7*	*13.3/103 mm*	*5*	*@@@@@*	Site Negative
Soquel #1	3.8	0.7/ 102 mm	1	@	Reach Negative
Soquel #4	8.8	4.2/ 98 mm	3	@@@	Site Negative
Soquel #10	8.7	2.8/ 89 mm	2	@@	Reach Negative
Soquel #12	7.8	2.8/ 95 mm	2	@@	Site Negative
East Branch Soquel #13a	10.7	4.3/ 100 mm	3	@@@	Reach Negative
East Branch Soquel #16	9.7	Dry	Dry	Dry	Reach Negative
West Branch Soquel #19	6.2	2.4/ 92 mm	2	@@	Site Negative
West Branch Soquel #21b	10.4	4.7/ 87 mm	2	@@	Reach Negative
Aptos #3	9.8	4.7/ 117 mm	4	@@@@	Site Negative
Aptos #4	9.4	4.7/ 95 mm	3	@@@	Reach Negative
Valencia #2	10.1	0.3/ 83 mm	1	@	Site Negative
Valencia #3	12.4	3.0/ 108 mm	3	@@@	Site Negative
Corralitos #1	9.6	8.3/ 97 mm	4	@@@@	Site Negative
Corralitos #3	11.0	12.1/ 95 mm	4	@@@@	Reach Negative
Corralitos #8	10.9	6.1/ 97 mm	3	@@@	Site Negative
Corralitos #9	16.9	8.3/ 94 mm	4	@@@@	Reach Negative
Shingle Mill #1	9.5	4.2/ 97 mm	3	@@@	Site Negative
Shingle Mill #3	5.0	5.2/ 84 mm	3	@@@	Site Negative
Browns #1	15.3	6.6/ 106 mm	4	@@@@	Site Negative
Browns #2	13.0	7.2/ 92 mm	3	@@@	Site Negative

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

1. ***In the lower and middle mainstem***, rearing habitat quality declined at all replicated sampling sites and habitat-typed Reaches 2 and 8, primarily due to decreased baseflow (less food) (**Figure B-45** *above*), shallower fastwater habitat and usually less escape cover (***Table S-3*** *above*). Even with late spawning and reduced baseflow in spring and summer, food was sufficient to allow high a portion of the very low number of YOY present at some lower mainstem sites to reach Size Class II by fall 2014 (***Figure B-17a*** *below*; ***size histograms in Appendix D***). However, the total number of these larger YOY fish was relatively small. Steelhead captured at Sites 0 and 1 were scanned for PIT tags. None were detected.

2. ***Upper mainstem and tributary sites/reaches*** had reduced habitat quality primarily due to reduced baseflow (less food). Also, most had shallower pool habitat (8 of 14 steelhead sites) and many had less escape cover (6 of 14 steelhead sites) due to less instream wood, less surface area and fewer crevices under unembedded boulders (**Table B-13b** *below*). Upper Bean 14c was dry. Steelhead sites/reaches with more escape cover in 2014 included Zayante 13c, Bean 14b, Boulder 17b and Branciforte 21b.

3. ***YOY densities in the all mainstem sites*** were below average and lower at 7 of 9 sites compared to 2013 and 2005 (Site 10) (***Table 18 in Appendix B; Figure B-2*** below). The density decrease at mainstem sites alone was statistically significant (***Table 45 in Appendix B***). 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. (Lines drawn between data points do not imply changes in density between sites.)

4. ***YOY densities in tributary sites*** were below average at 10 of 12 sites decreased at 11 of 12 sites compared to 2013 (***Table 23 in Appendix B; Figure B-2*** below). The density decrease in mainstem and tributary sites combined was statistically significant (***Table 44 in Appendix B***). The highest YOY density was found at upper Zayante 13d, with the 2013 highest site, Zayante 13c, having less than half the long term average density despite good cover provided by overhanging willow and dogwood. All tributary sites were dominated by very small YOY in 2014 except Newell 16 and Bear 18a, where YOY were nearly absent (*size histograms in* ***Appendix D***). Very few YOY reached soon-to-smolt-size in 2014 in tributaries due to low baseflow and very limited insect drift.

5. ***Total densities*** mirrored YOY densities at mainstem and tributary sites. They were below average at all 9 mainstem sites and less than in 2013 at 7 of 9 sites (***Table 17 in Appendix B; Figure B-1*** below). They were below average at 10 of 12 sites and less than in 2013 at 9 of 12 sites (***Table 22 in Appendix B; Figure B-2*** below). The decreases in mainstem sites alone and in mainstem and tributary sites combined were statistically significant (***Tables 44 and 45 in Appendix B***). The trend in total densities went down in the mainstem and tributaries to their lowest points (***Figures B-21 and B-23*** *below*).

6. ***Yearling densities*** were relatively low in the mainstem and tributaries (below average at 9 of 9 mainstem and 9 of 12 tributary steelhead sites) and mostly slightly more than in 2013 (4 of 9 mainstem and 9 of 12 tributary sites) (***Figure B-3*** *below;* ***Tables 19 and 24 in Appendix B***). Sites that retained above average densities of yearlings were some upper watershed sites, Zayante 13d, Lompico 13e and Boulder 17b, as they did in 2013.

7. ***Densities of important larger Size Class II and III steelhead*** (=>75 mm SL; soon-to-smolt) ***at mainstem sites*** in 2014 were lower than in 2013 at 8 of 9 sites (***Table 21 in Appendix B***), and all were below average, as in 2013 (***Figure B-4*** *below*). Relatively low densities of soon-to-smolt fish in typically high growth reaches of the lower River were due to much below average densities of YOY in a low adult spawning year with poor spawning success. ***In tributaries***, Size Class II and III densities were less than in 2013 at 8 of 12 sites and below average at 10 of 12 sites (***Table 25 in Appendix B; Figure B-4*** *below*). The density decrease for mainstem and tributary sites combined was statistically significant (***Table 44 in Appendix B***). The trend in Size Class II and III densities went down in the mainstem and tributaries (***Figures B-22 and B-24*** *below*). With the exception of Site 0a (rated fair) and Site 12b in Waterman Gap (rated good but was likely a rainbow trout population), all other mainstem sites were rated between mostly "very poor" and "below average" (***Table B-42*** *below*).

8. ***The abundance index for soon-to-smolt sized steelhead*** in sampled reaches decreased from 2010 (21,000) to 2014 (7,800). The 63% reduction resulted primarily from very low 2014 YOY densities in high growth potential reaches (lower mainstem San Lorenzo, lower/middle Zayante and Newell) (***Figure B-33*** *below*).

Table B-13b. Habitat Change in the SAN LORENZO MAINSTEM AND TRIBUTARIES from 2013 to 2014, 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)	−	− / −	NA	NA	−/−	−
Mainstem 1	−	− (Since 2008)	+ (Since 2008)	Similar (Since 2008)	−/− (Since 2008)	−
Mainstem 2	−	− / −	−	Similar	− (pools)/ + riffles	−
(Mainstem 4)	−	NA / −	Similar	+ (run)	/Similar	−
(Mainstem 6)	−	NA / −	Similar	− (fastwater)	/−	−
Mainstem 8	−	− / − (Since 2009)	Similar pools/ + (riffles) (Since 2009)	− (pools)/ − (fast water) (Since 2009)	− (pools)/ − (riffles) (Since 2009)	−
(Mainstem 9)	−	− (fastwater) Similar in pools	+ (run)	− (riffle)	NA/+	−
(Mainstem Near Teihl 11)	−	Similar	Similar	− (pool and run)	Similar/−	−
(Mainstem Waterman Gap 12b)	−	+ (pool) − (run)	Similar	Similar	+/+	−
(Zayante 13a)	−	−/−	+ (pool)	− (run)	−	−
(Zayante 13c)	−	Similar	− (pool)	+ (pool) − (run)	+ (slightly)	−
Zayante 13d	−	−/−	+ (pool)	Similar	Similar	−
(Lompico 13e)	−	−/−	Similar	−	−	−
Bean 14b	−	−/−	− (run)	− (pools)	+	−
(Bean 14c)						Dry
Fall 15b	−	−/− (Since 2009/2011)	+ (pool) − (run) (Since 2011)	Similar (Since 2011)	− (Since 2009/ 2011)	−
(Newell 16)	−	−/−	− (pool)	+	−	−
(Boulder 17a)	−	Similar- pool −(fastwater)	+ (pool)	− (fastwater)	_	−
(Boulder 17b)	−	Similar- pool −(fastwater)	Similar	Similar	+	−
(Bear 18a)	−	−/−	Similar	+ (run)	−	−
Branciforte 21a-2	−	− (pool) (Since 2009/2010)	Similar (Since 2010)	Similar (Since 2010)	Similar (Since 2010)	−
(Branciforte 21b)	−	+ (pool)	− (pool)	Similar	+ (substantial)	− (flow)
(Branciforte 21c)	−	+ (pool)	+ (pool)	−	+	− (flow)

***NA = Not available.**

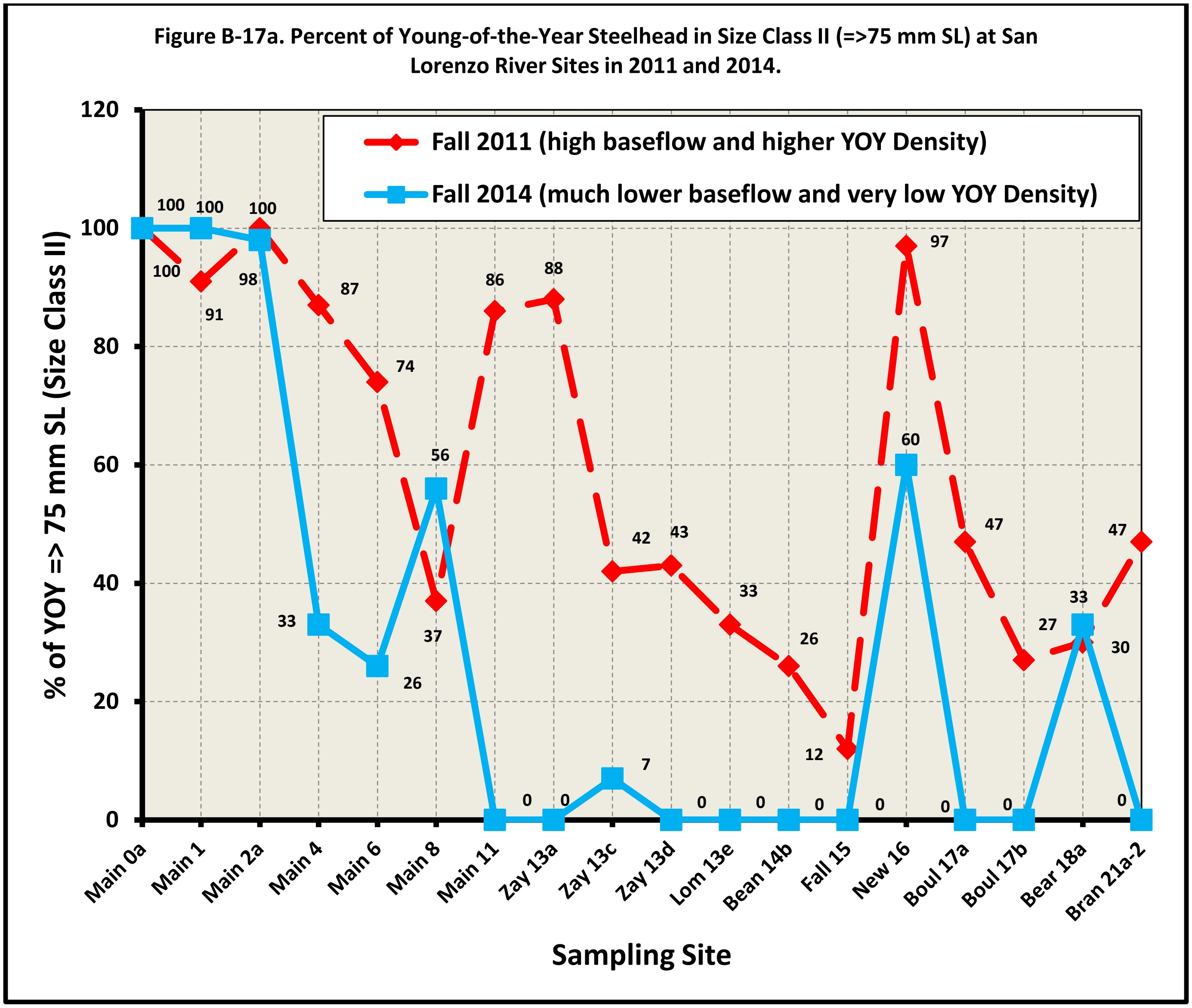


Figure B-17a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at San Lorenzo River Sites in 2011 and 2014.

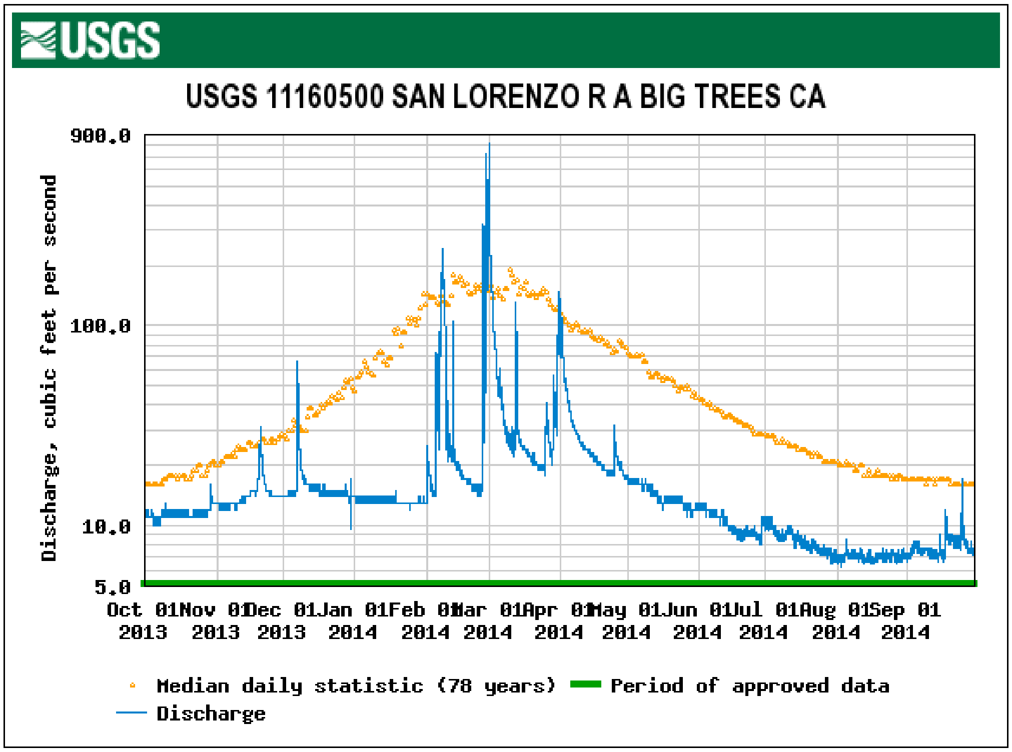


Figure B-37a. The 2014 Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

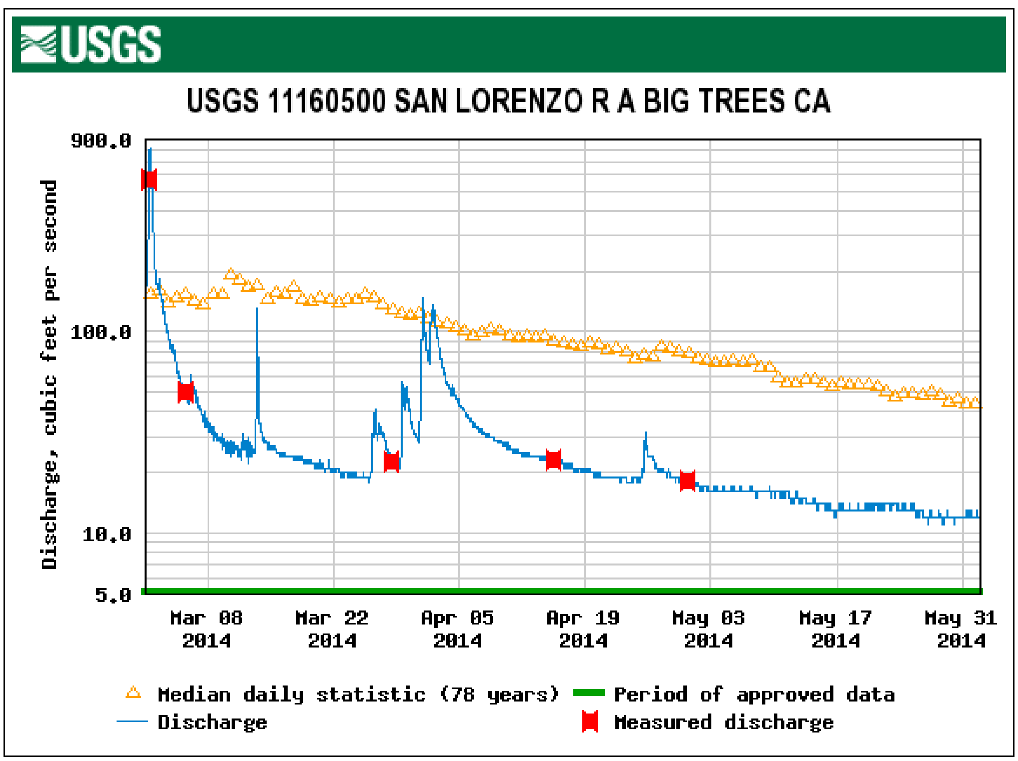


Figure B-38. The March–May 2014 Discharge of Record for the USGS Gage On the San Lorenzo River at Big Trees.

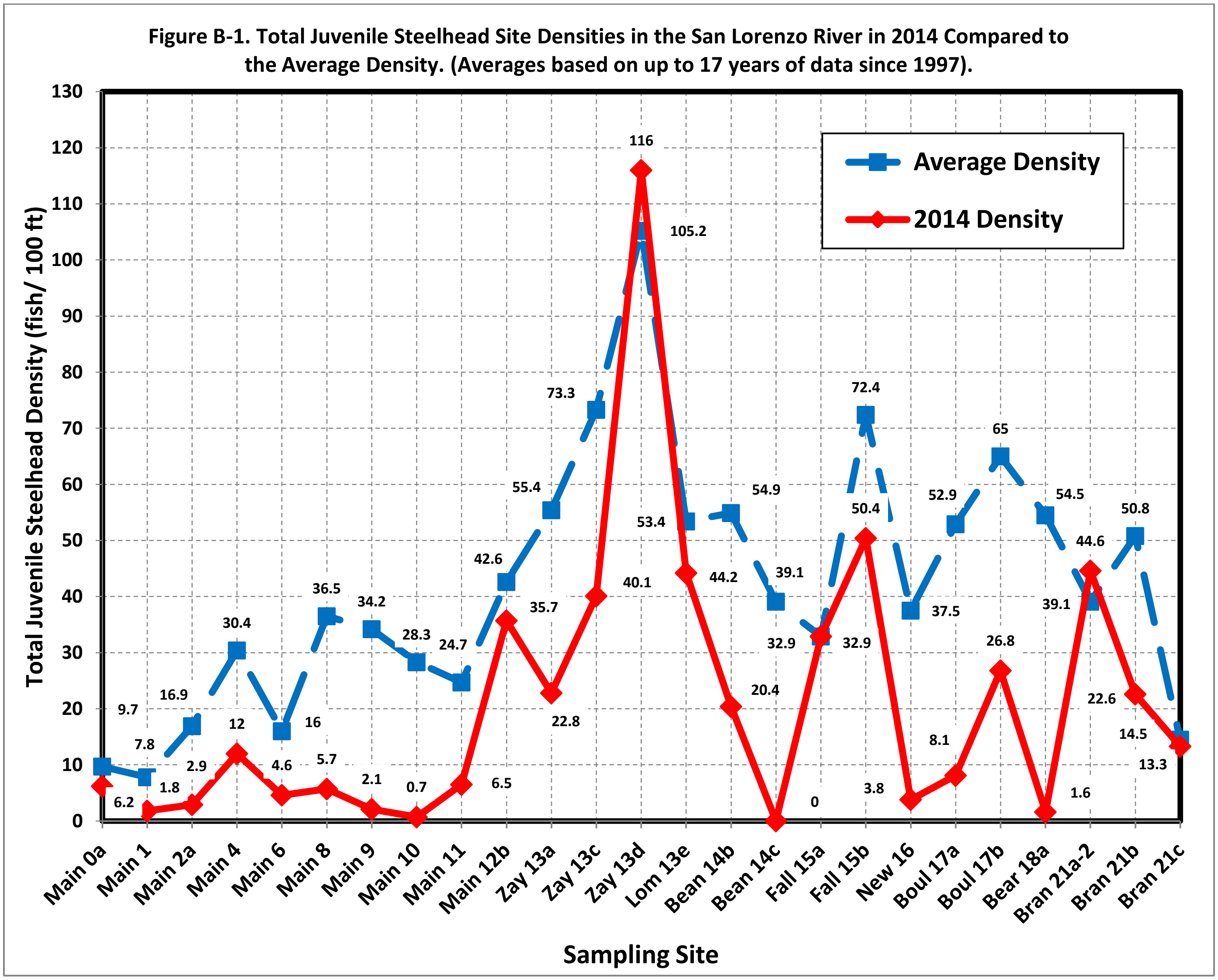


Figure B-1. Total Juvenile Steelhead Site Densities in the San Lorenzo River in 2014 Compared to the Average Density. (Averages based on up to 17 years of data since 1997).

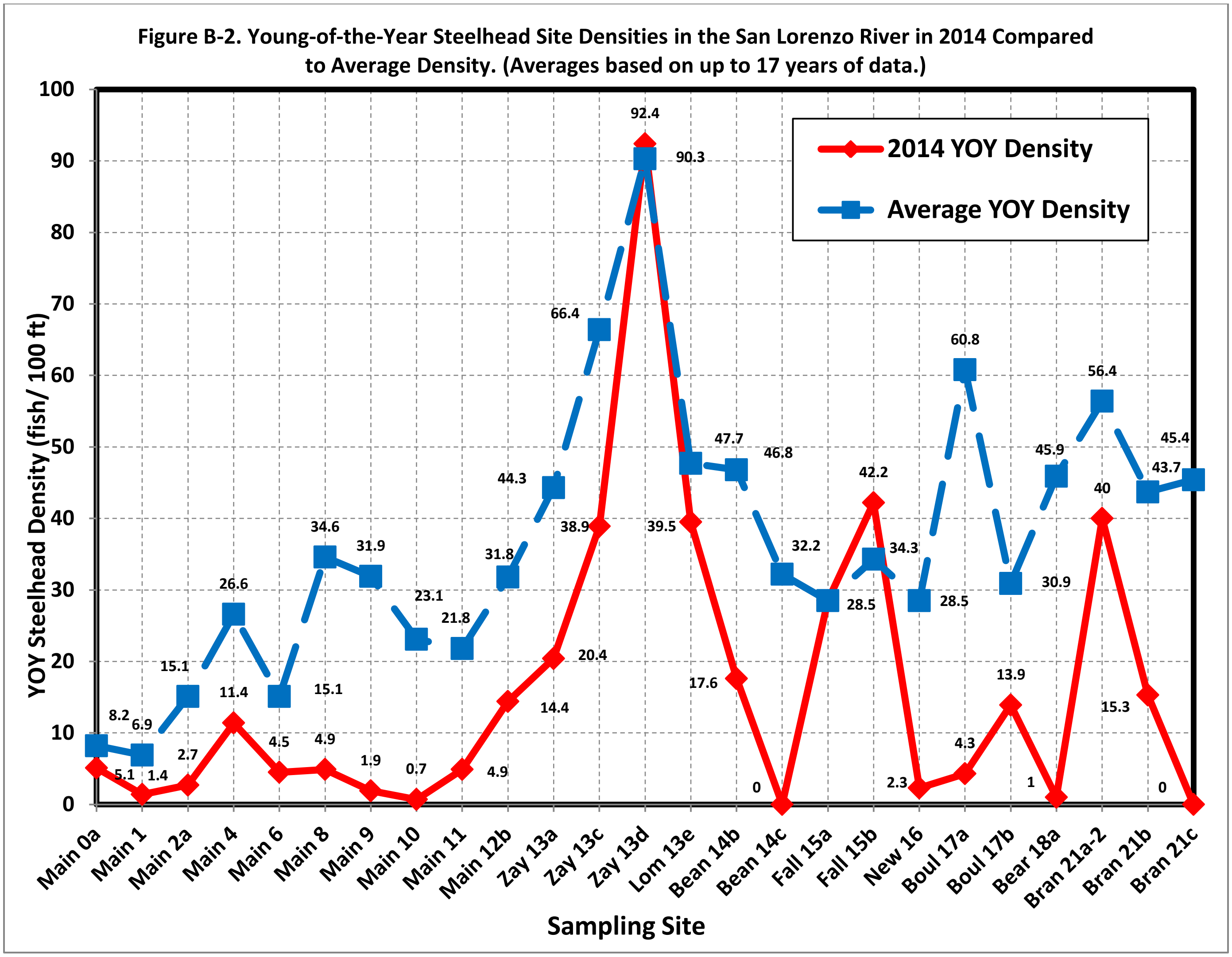


Figure B-2. Young-of-the-Year Steelhead Site Densities in the San Lorenzo River in 2014 Compared to Average Density. (Averages based on up to 17 years of data.)

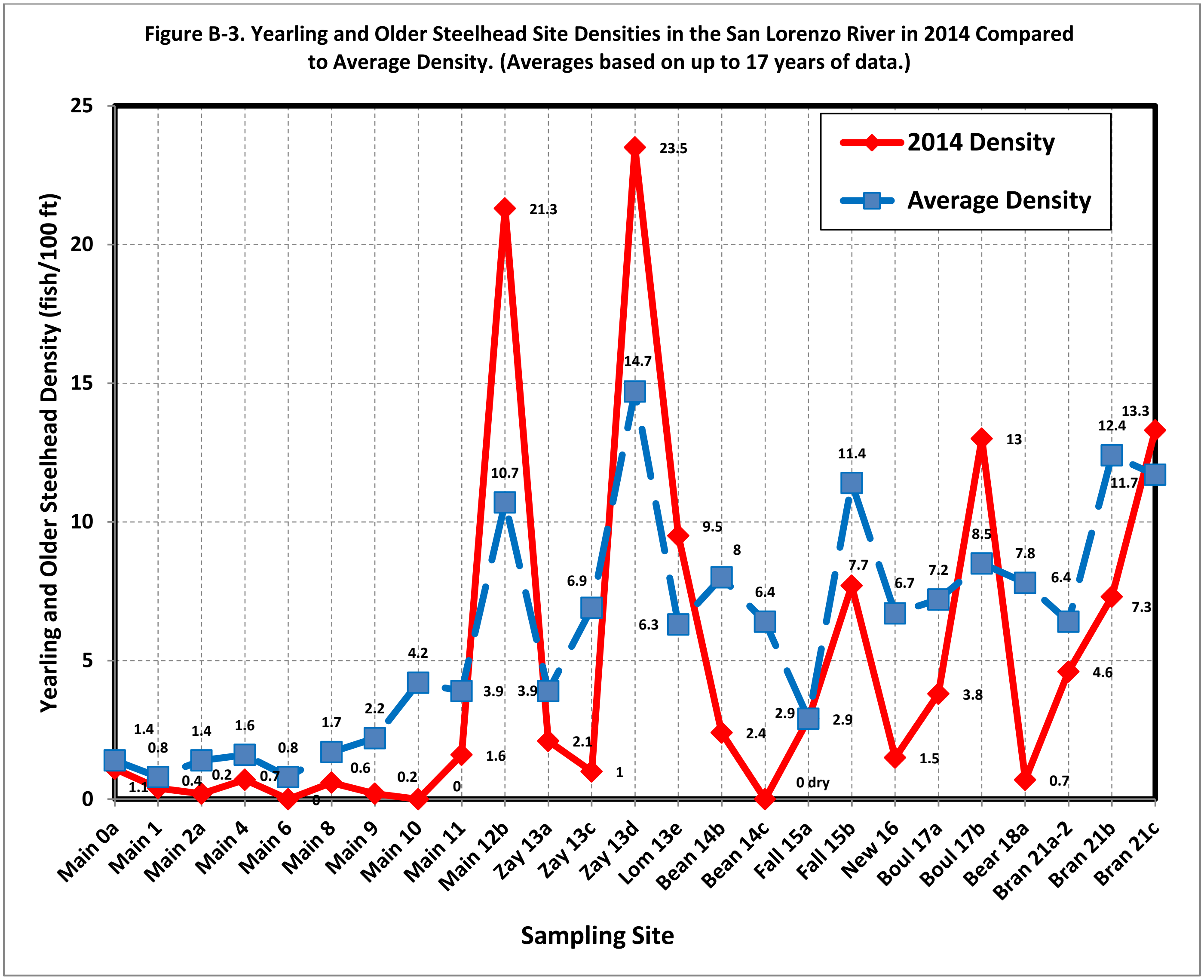


Figure B-3. Yearling and Older Steelhead Site Densities in the San Lorenzo River in 2014 Compared to Average Density. (Averages based on up to 17 years of data.)

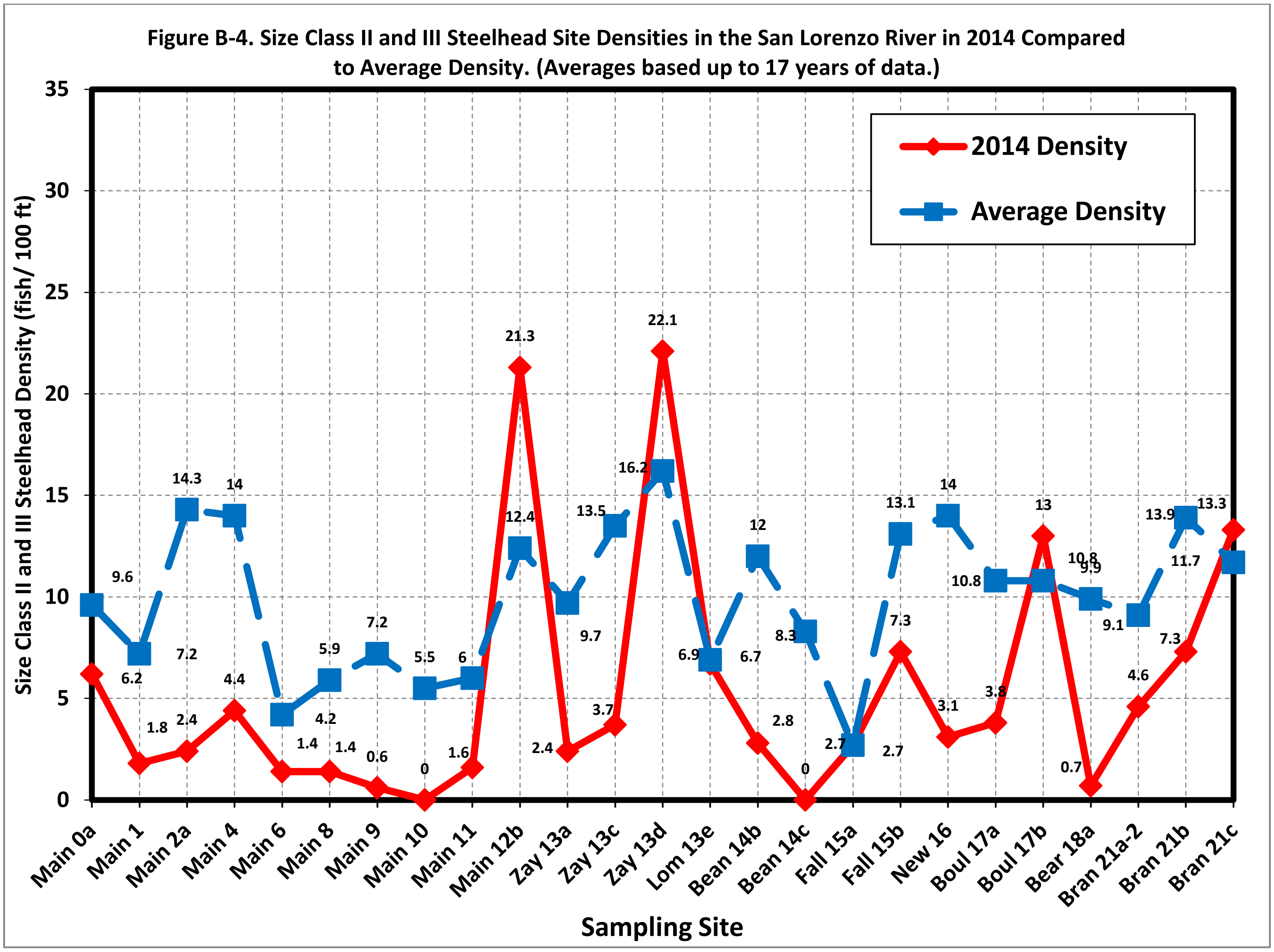


Figure B-4. Size Class II and III Steelhead Site Densities in the San Lorenzo River in 2014 Compared to Average Density. (Averages based on up to 17 years of data.)

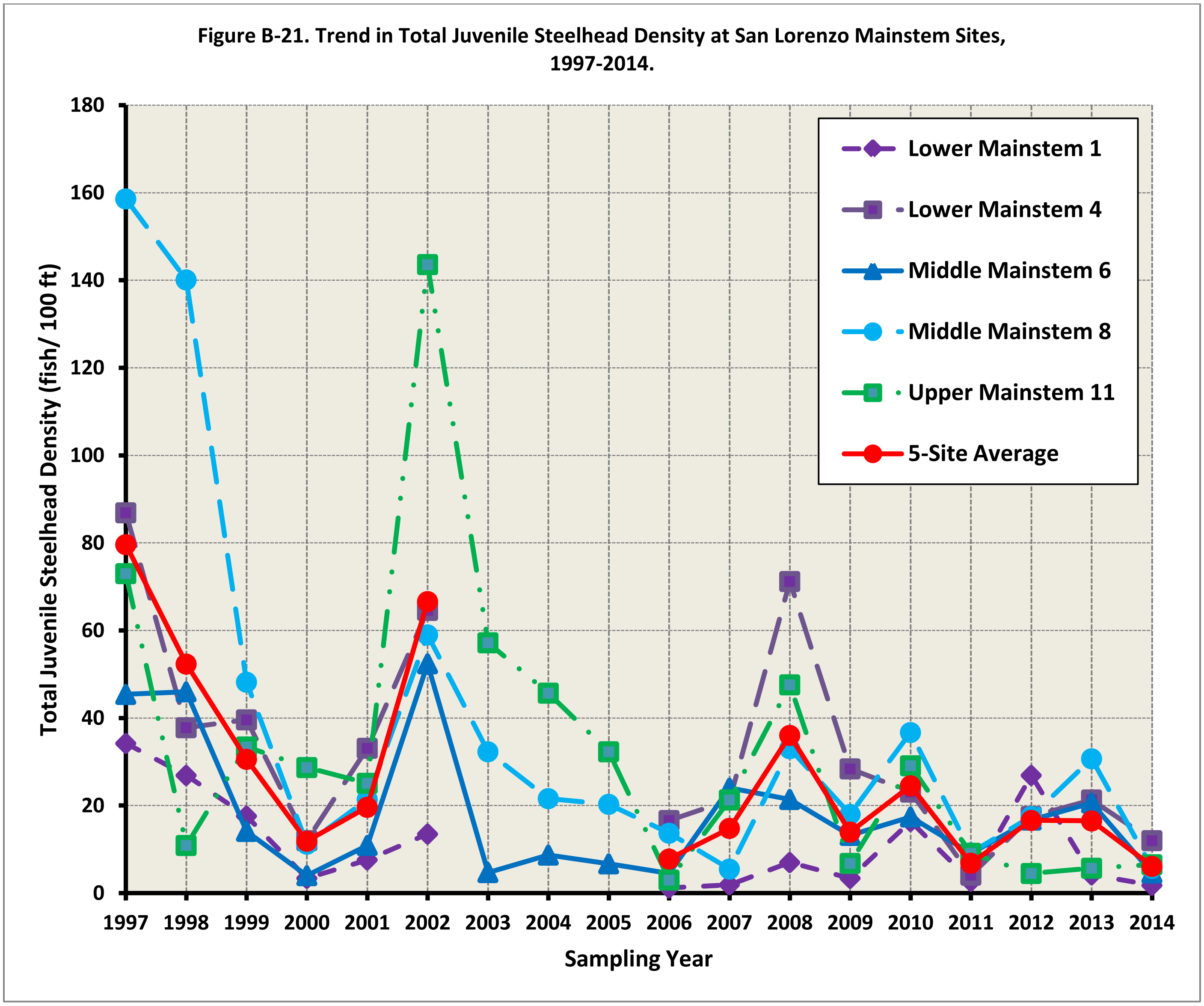


Figure B-21. Trend in Total Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2014.

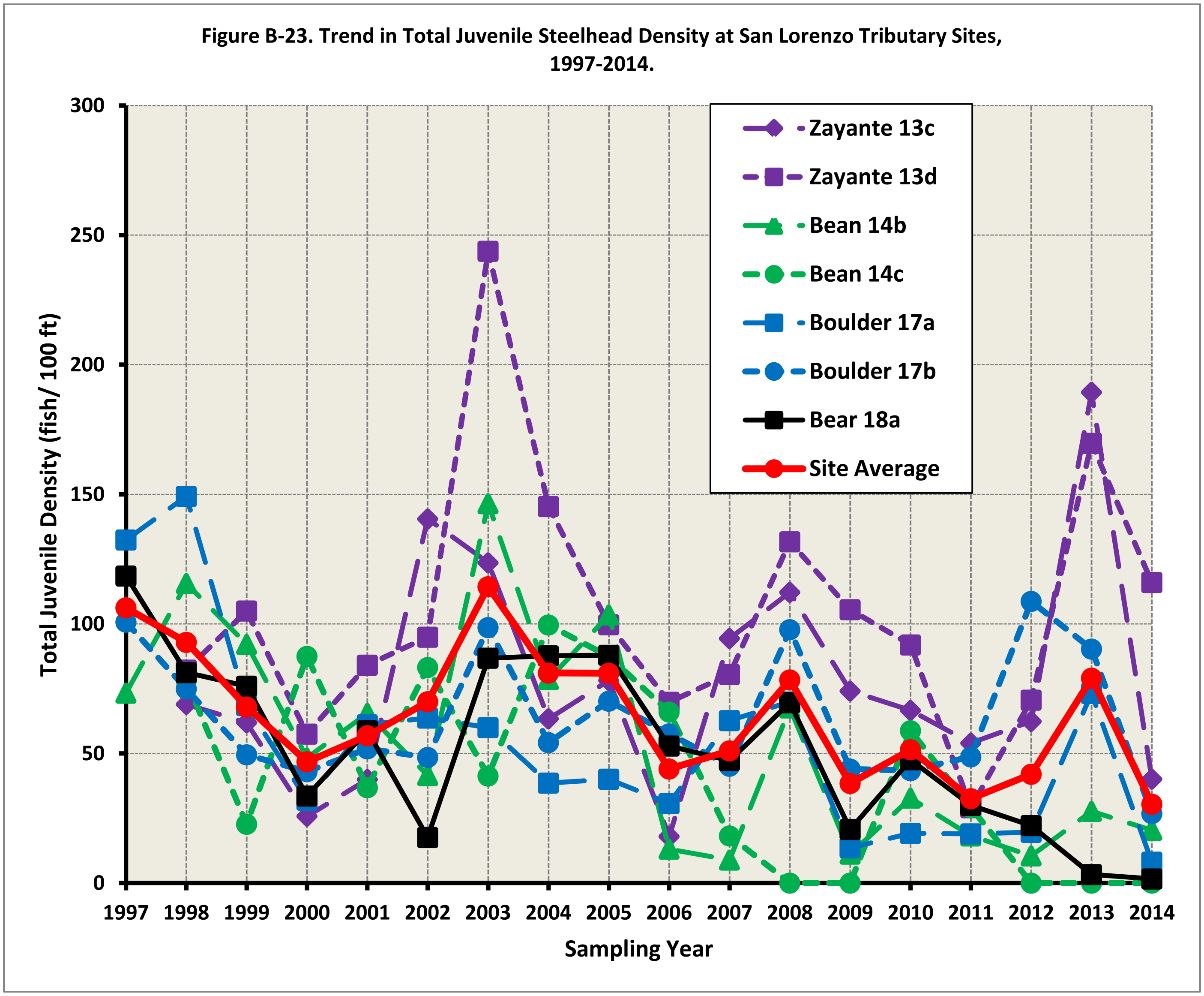


Figure B-23. Trend in Total Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2014.

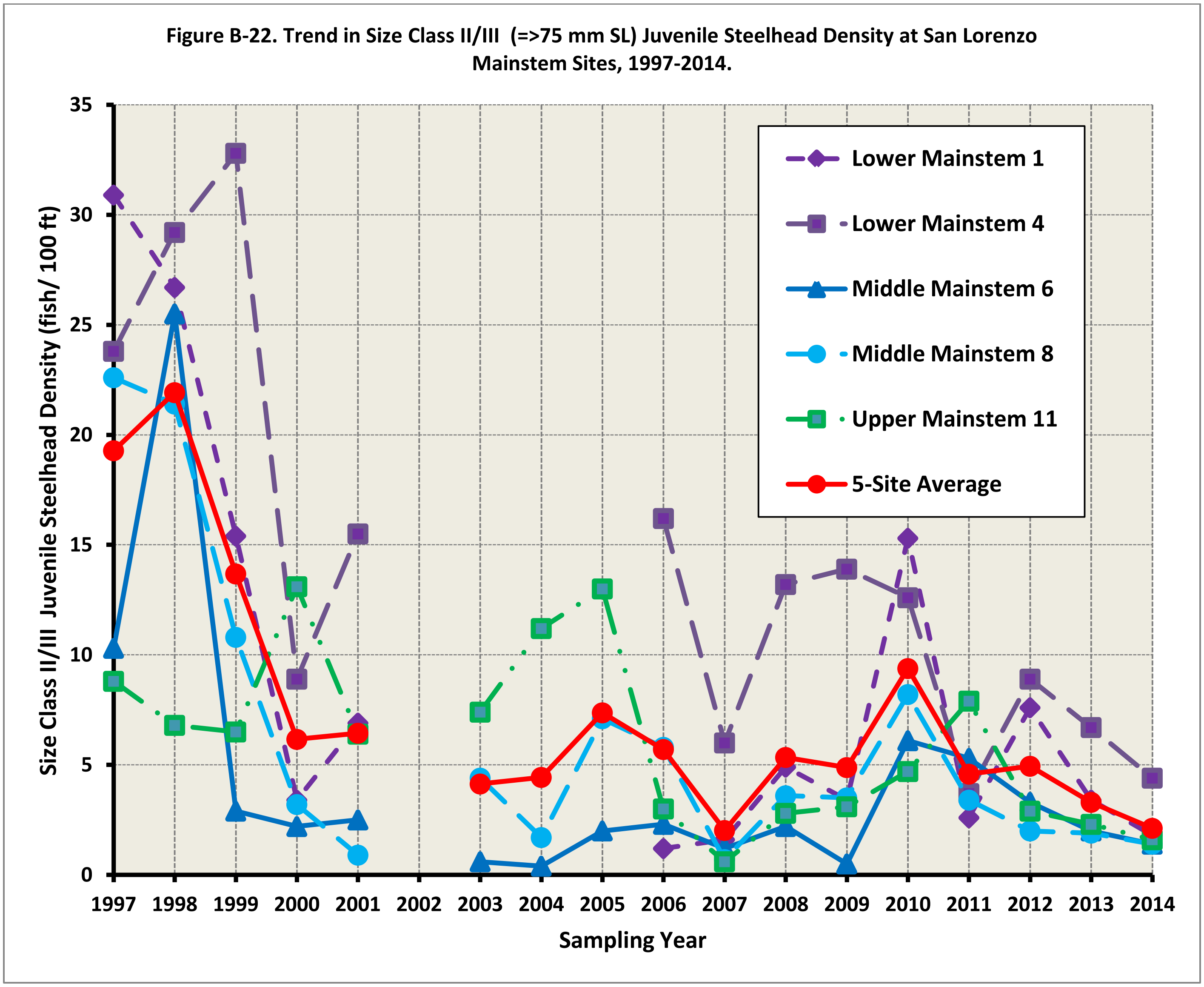


Figure B-22. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2014.

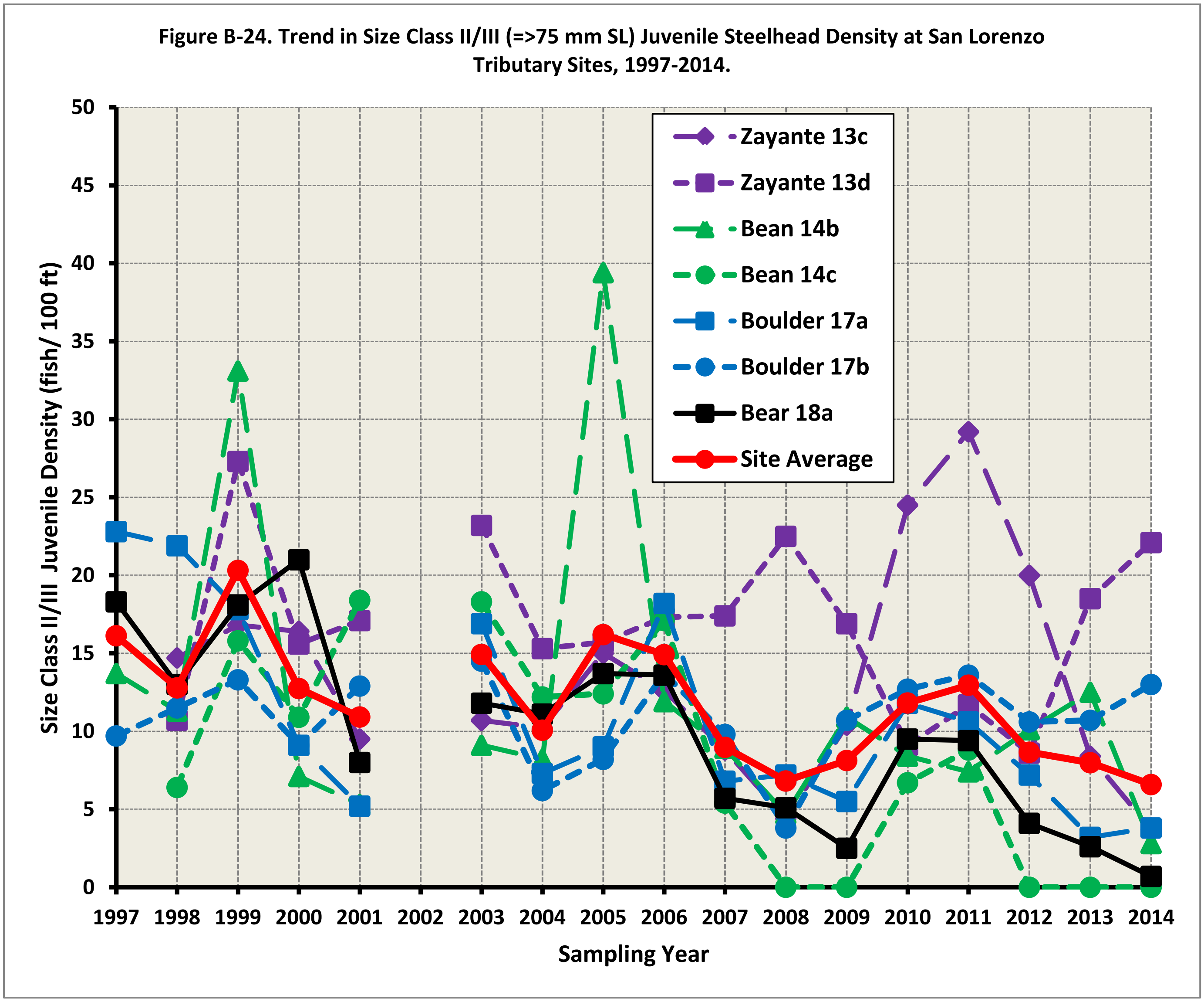


Figure B-24. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2014.

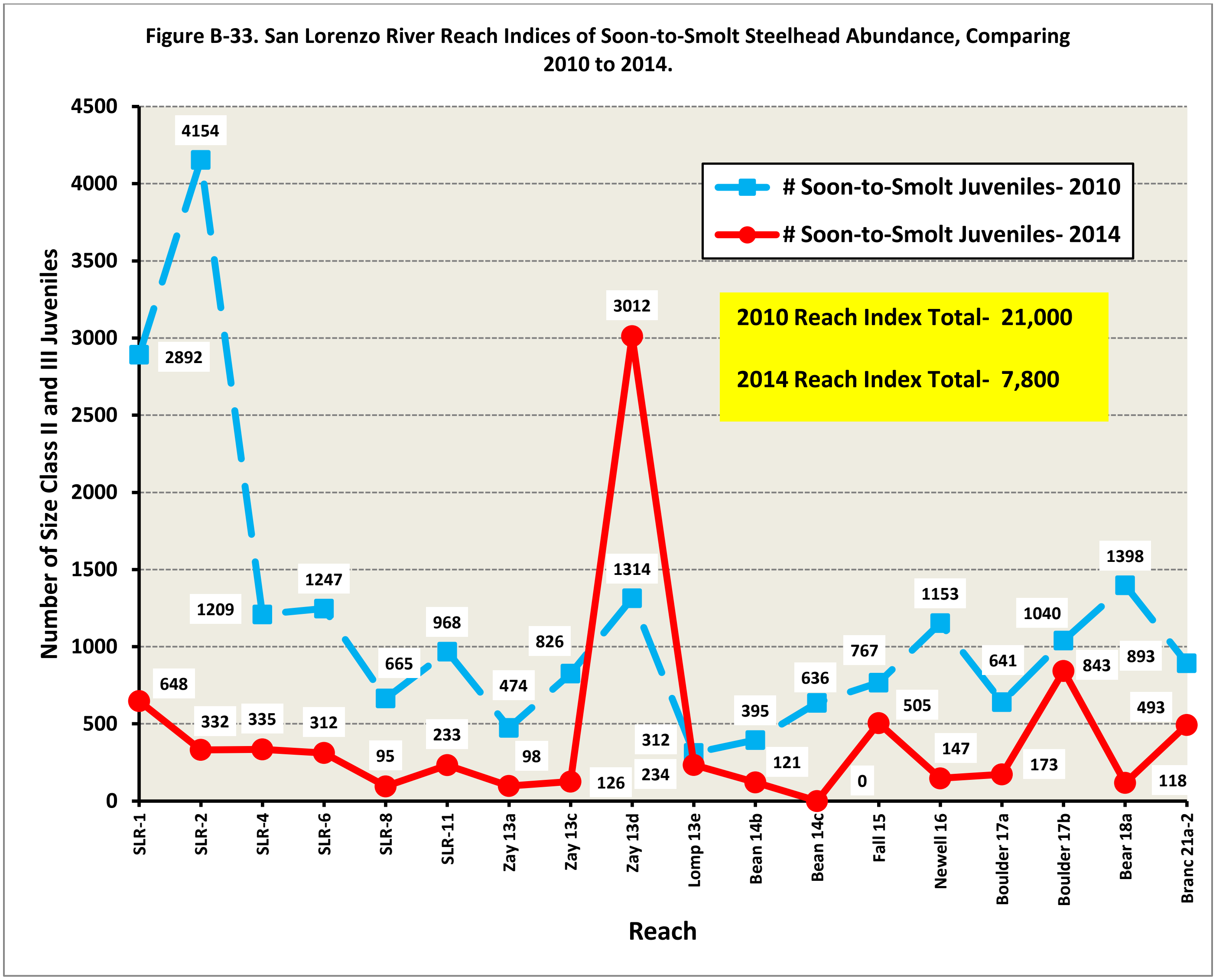


Figure B-33. San Lorenzo River Reach Indices of Soon-to-Smolt Steelhead Abundance, comparing 2010 to 2014.

Table B-42. 2014 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Their Average Size in Standard Length Compared to 2013, with Physical Habitat Change Since 2013 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	2014 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2014 Smolt Rating (With Size Factored In)	2013 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2013 Smolt Rating (With Size Factored In)	Physical Habitat Change by Reach/Site Since 2013
Low. San Lorenzo #0a	6.2/ 108 mm	**Fair**	4.1/ 94 mm	**Below Average**	−
Low. San Lorenzo #1	1.8/ 125 mm	**Poor**	3.4/ 96 mm	**Poor**	−
Low. San Lorenzo #2	2.4/ 98 mm	**Poor**	6.2/ 88 mm	**Poor**	−
Low. San Lorenzo #4	4.4/ 89 mm	**Below Average**	6.7/ 81 mm	**Poor**	−
Mid. San Lorenzo #6	1.4/ 80 mm	**Very Poor**	2.0/ 108 mm	**Below Average**	−
Mid. San Lorenzo #8	1.4/ 92 mm	**Very Poor**	1.9/ 90 mm	**Very Poor**	−
Mid. San Lorenzo #9	0.6/ 92 mm	**Very Poor**	2.3/ 86 mm	**Very Poor**	−
Up. San Lorenzo #10	None	**Very Poor**	−	−	**− (since 2005)**
Up. San Lorenzo #11	1.6/ 112 mm	**Poor**	2.3/ 114 mm	**Below Average**	−
Up.San Loren #12b (res. Rt)	21.3/ 92 mm	***Good***	10.0/ 111 mm	***Good***	−
Zayante #13a	2.4/ 89 mm	**Poor**	2.7/ 98 mm	**Poor**	−
Zayante #13c	3.7/ 81 mm	**Very Poor**	8.4/ 87 mm	**Below Average**	−
Zayante #13d	22.1/ 93 mm	***Good***	18.5/ 105 mm	***Very Good***	−
Lompico #13e	6.7/ 94 mm	**Below Average**	8.7/ 104 mm	***Good***	−
Bean #14b	2.8/ 101 mm	**Poor**	12.5/ 90 mm	**Fair**	−
Fall #15a	2.7/ 103 mm	**Below Average**	−	−	
Fall #15b	7.3/ 103 mm	**Fair**	12.1/ 98 mm	**Fair**	−
Newell #16	3.1/ 109 mm	**Below Average**	23.7/ 89 mm	***Good***	−
Boulder #17a	3.8/ 91 mm	**Poor**	3.2/ 118 mm	**Below Average**	−
Boulder #17b	13.0/ 90 mm	**Fair**	10.7/ 96 mm	**Fair**	−
Bear #18a	0.7/ 116 mm	**Poor**	2.6/ 115 mm	**Below Average**	−
Branciforte #21a-2	4.6/ 98 mm	**Below Average**	6.0/ 106 mm	**Fair**	−
Branciforte #21b	7.3/ 98 mm	**Below Average**	13.3/ 100 mm	**Fair**	**− (flow)**
Branciforte #21c (res. Rt)	13.3/103 mm	***Good***	10.0/ 100 mm	**Fair**	**− (flow)**
Soquel #1	0.7/ 102 mm	**Very Poor**	1.8/ 94 mm	**Poor**	−
Soquel #4	4.2/ 98 mm	**Below Average**	2.1/ 110 mm	**Below Average**	−
Soquel #10	2.8/ 89 mm	**Poor**	5.2/ 87 mm	**Poor**	−
Soquel #12	2.8/ 95 mm	**Poor**	3.1/ 82 mm	**Very Poor**	−
East Branch Soquel #13a	4.3/ 100 mm	**Below Average**	6.8/ 106 mm	**Fair**	−
West Branch Soquel #19	2.4/ 92 mm	**Poor**	3.4/ 105 mm	**Below Average**	−
West Branch Soquel #21b	4.7/ 87 mm	**Poor**	−	−	**- (Since 2009)**
Aptos #3	4.7/ 117 mm	**Fair**	5.1/ 103 mm	**Fair**	−
Aptos #4	4.7/ 95 mm	**Below Average**	6.1/ 120 mm	**Fair**	−
Valencia #2	0.3/ 83 mm	**Very Poor**	-	-	−
Valencia #3	3.0/ 108 mm	**Below Average**	-	-	**− (Since 2009)**
Corralitos #1	8.3/ 97 mm	**Fair**	12.1/ 110 mm	***Good***	−
Corralitos #3	12.1/ 95 mm	**Fair**	10.7/ 105 mm	***Good***	−
Corralitos #8	6.1/ 97 mm	**Below Average**	1.8/ 130 mm	**Poor**	−
Corralitos #9	8.3/ 94 mm	**Fair**	10.5/ 108 mm	***Good***	−
Shingle Mill #1	4.2/ 97 mm	**Below Average**	6.9/ 94 mm	**Below Average**	−
Shingle Mill #3	5.2/ 84 mm	**Below Average**	3.1/ 86 mm	**Very Poor**	−
Browns #1	6.6/ 106 mm	**Fair**	18.0/ 96 mm	***Good***	−
Browns #2	7.2/ 92 mm	**Below Average**	9.6/ 101 mm	**Fair**	−

iii. Steelhead Abundance in the Soquel Creek Watershed

1. Three relatively small stormflows occurred in February−mid April 2014 that provided passage flows for adult migration. The largest of these occurred at the end of February, with a peak flow of about 350 cfs at the Soquel Village gage (***Figure B-40a*** *below*). All reaches had even lower spring-summer-fall baseflow in 2014 than in 2013 that was below the median statistic (***Figure B-40b*** *below*). The average mean monthly streamflow for May−September in 2014 at the Soquel Village gage was the lowest in 18 years of calculations (1 cfs with an 18-year average of 8.9 cfs) (***Figure B-42*** *above*). With low baseflow, food supply was less for YOY growth in 2014, especially in the important spring and early summer period. Low food levels resulted in a smaller proportion of YOY reaching Size Class II in 2014 than in wetter year, except at Site 4 where YOY density was very low and competition less (***Figure 18a*** *below*).

2. Although the important habitat parameter, pool escape cover, improved in all mainstem sites/reaches, and substrate conditions (percent fine sediment and embeddedness) were similar or improved compared to recent years in mainstem sites/ reaches, the overall rearing habitat quality of the watershed was poorer due to much lower baseflow (less food) and reduced pool depth (***Tables 5b, 14b, 15d, 15f in Appendix B and B-15g*** *below*). Much of the East Branch Soquel went dry, with its often important contribution of soon-to-smolt size fish as fast growing YOY in Reach 9a and its contribution of relatively higher densities of yearlings from Reach 12a lost in 2014. Reach 12a has also produced high densities of YOY in the past.

3. ***Total and YOY densities*** decreased at 6 sites compared to 2013 and was similar density at Site 21b as in 2012 (***Tables 26 and 27 in Appendix B; Figures B5 and B6*** *below*). However, the decreases were not statistically significant (***Table 46 in Appendix B***)..YOY densities were below average at 5 of 7 sites; plus Site 16 in the SDSF was dry. Lower Reach 12a in the SDSF had surface flow in July and good densities of YOY (134 YOY/ 100 ft on 17 July), indicating that adult steelhead reached the SDSF despite limited winter stormflow. However, the segment typically sampled in Reach 12a was dry by sampling time, as was the reach. Three-quarters of lower East Branch Reach 9a was also dry. The trend in total densities (consisting of mostly YOY) for the watershed showed a decrease in 2014, with the second lowest 6-site average since 1997 (19.8 fish/ 100 ft) (**Figure B-25** *below*). Total densities have steadily declined through the years at the SDSF Site 16 to zero in 2014, when Reach 12a went dry.

4. ***Yearling densities*** increased slightly at 6 of 7 wetted sites from 2013 and were above average at 5 of 7 sampled sites (***Table 28 in Appendix B;*** **Figure B-7** *below*). However, the increase was not statistically significant (***Table 44 in Appendix B***). Overwinter retention/survival of yearlings may have been improved in 2014 after a very mild winter, though yearling density was still very low at all sites (maximum of 4.7 yearlings/ 100 ft at Site 21b).

5. ***Size Class II and III juvenile densities*** decreased at 6 of 7 sites in 2014 and were below average at 7 of 7 sites (***Table 30 in Appendix B;*** **Figure B-8** *below*). However, the decrease from 2013 was not statistically significant (***Table 44 in Appendix B***). This was partly because few YOY were present to grow into the soon-to-smolt size class in the lower mainstem and few yearlings remained in the watershed, despite only mild winter stormflows. Also, spring and early summer baseflows were substantially below the median statistic (less food) (**Figure B-41** *below*) to hinder YOY from growing into the soon-to-smolt size class in the upper mainstem and lower branch sites compared to wetter years (**Figure B-18a** *below*). The trend in Size Class II and III (soon-to-smolt) densities has fluctuated through the years, mostly depending on the number of YOY reaching soon-to-smolt size, which is positively related to streamflow. The trend continued to decline since 2012 to the lowest 6-site average (2.5 fish/ 100 ft) since 1997 (**Figure B-26** *below*). Based on soon-to-smolt size densities, 3 of 6 sampled sites decreased in ratings compared to 2013, and Site 16 was dry (**Table B-42** *above*). The 7 sampled sites ranged in ratings from "very poor" to "below average."

6. Soquel Lagoon is typically habitat for a sizeable juvenile steelhead population, as indicated by our long-term population censusing for the City of Capitola (**Alley 2015**). However, only 10 juveniles were captured in Soquel Lagoon in 2014 without recaptures. The 2014 population size was likely less than 100 soon-to-smolt sized steelhead. This likely indicated limited spawning and/or poor spawning success in reaches near the lagoon.

7. The abundance index for soon-to-smolt steelhead in sampled stream reaches decreased from 2010 (3,800) to 2014 (900). The 76% reduction resulted primarily from very low 2014 YOY densities in high growth potential reaches (mainstem Soquel, lower West Branch and lower East Branch Soquel (mostly dry) that provided much fewer YOY in Size Class II compared to 2010 (**Figure B-34** *below*). Much fewer yearlings remained in 2014 because much of the lower East Branch in Reach 9a and the upper East Branch Reach 12a in the Soquel Demonstration State Forest went dry, further reducing the index

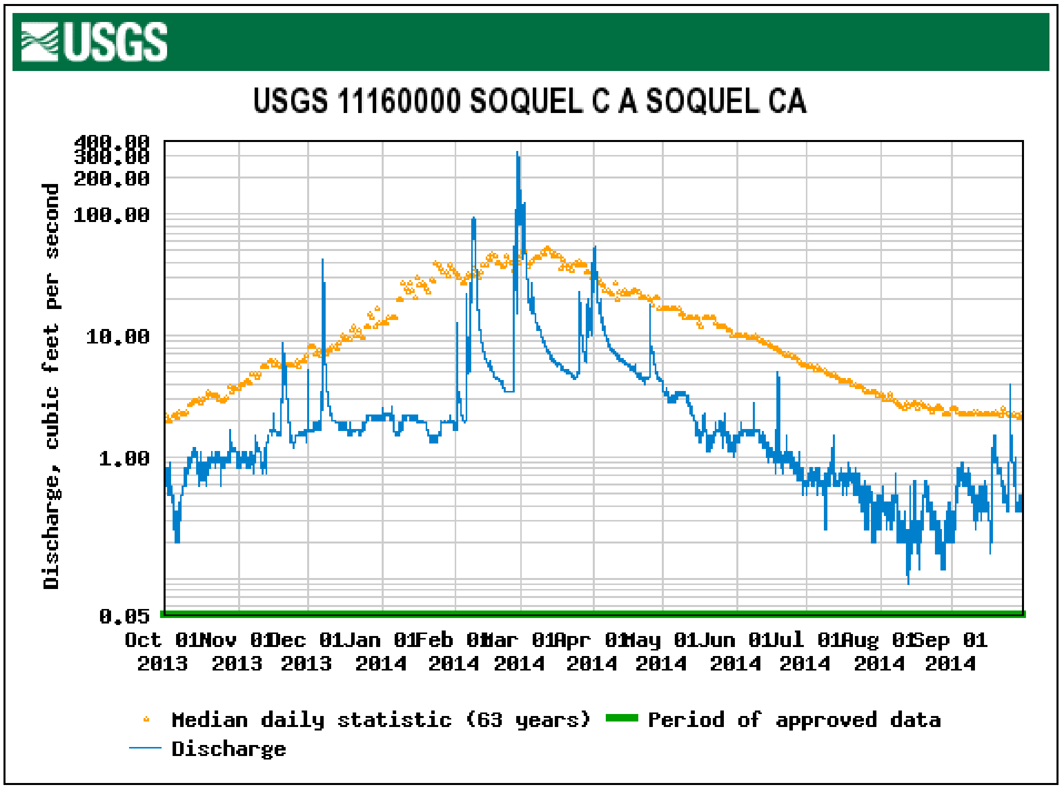


Figure B-40a. The 2014 Discharge at the USGS Gage on Soquel Creek at Soquel Village.

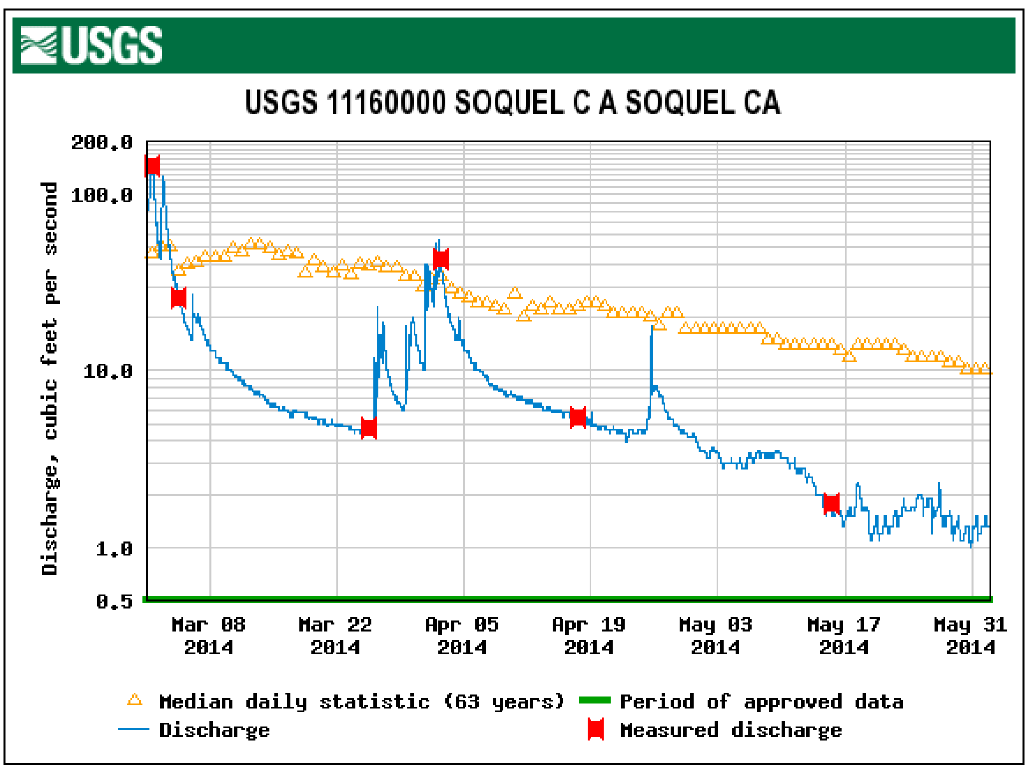


Figure 41. The March–May 2014 Discharge of Record for the USGS Gage on Soquel Creek at Soquel Village.

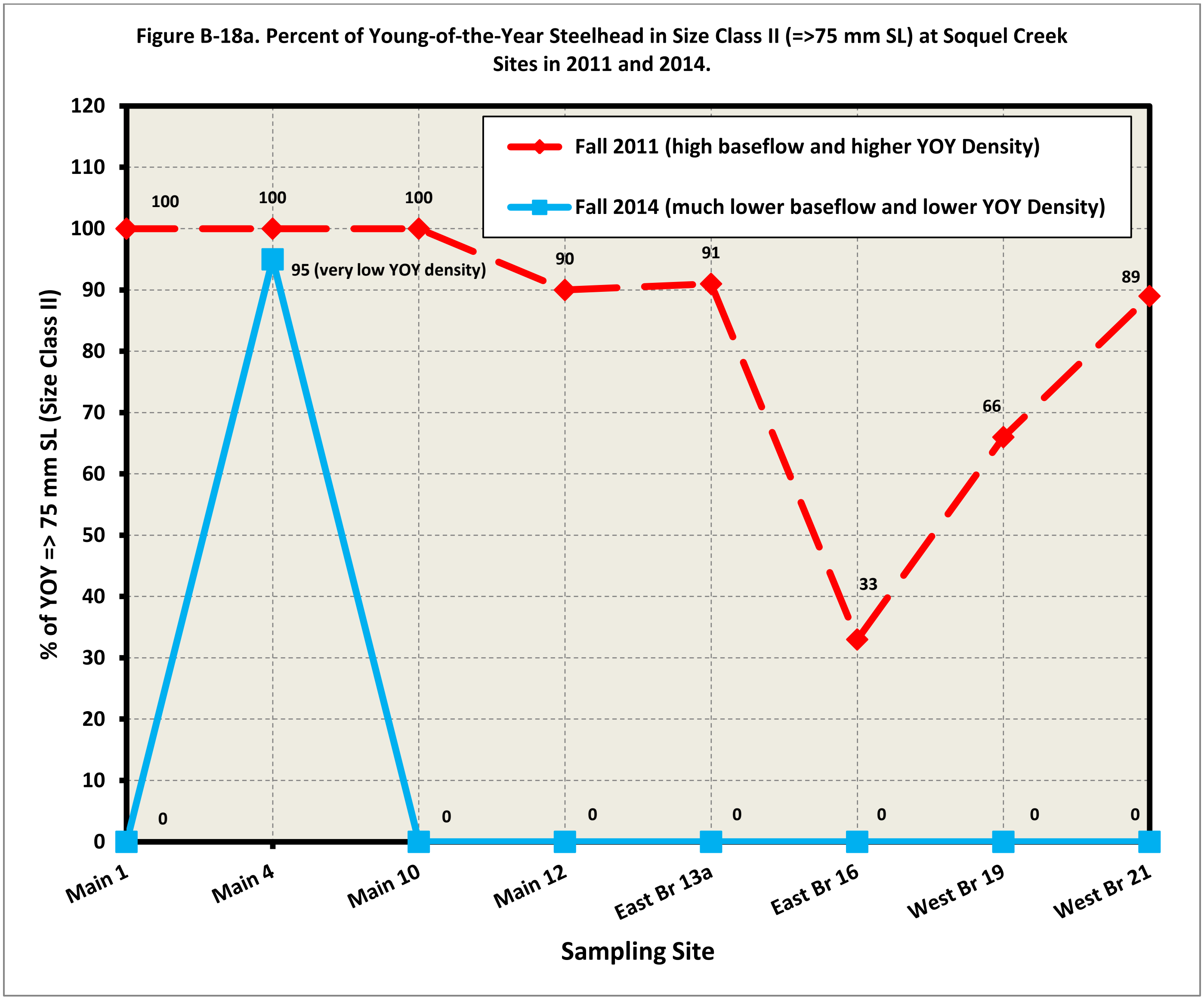


Figure B-18a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Soquel Creek Sites in 2011 and 2014.

Table B-15g. Habitat Change in SOQUEL CREEK WATERSHED Reaches (2011 to 2014, 2012-2014 or 2013-2014) or Replicated Sites (2013 to 2014).

Reach Comparison or Site Only	Baseflow	Pool Depth	Fine Sediment	Embeddedness	Pool Escape Cover	Overall Habitat Change
Reach 1	−	−	Similar	Similar	+	−
Site 4 (Reach 3a)	−	−	+ (run)	Similar	+	−
Reach 7	−	−	+ (pool)	Similar	+	−
Site 12 (Reach 8)	−	−	− (pool) + (run)	− (riffle)	+	−
Reach 9a	−	−	Similar	−	−	−
Reach 12a	Dry					−
Site 19 (Reach 13)	−	−	− (pool)	+ (run)	Similar	−
Reach 14b	−	−	+ (pool)	−	−	−

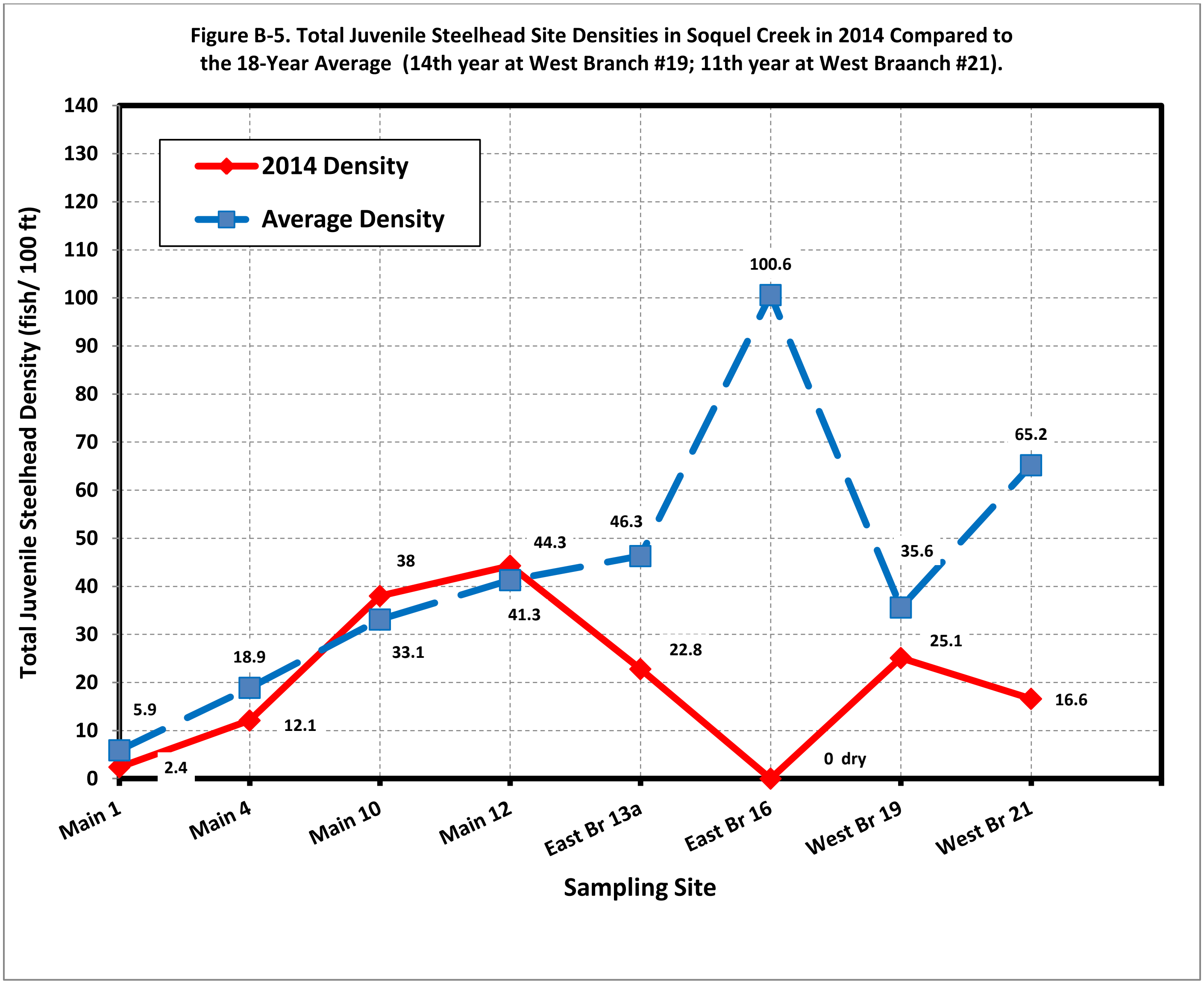


Figure B-5. Total Juvenile Steelhead Site Densities in Soquel Creek in 2014 Compared to the 18-Year Average (13th year at West Branch #19).

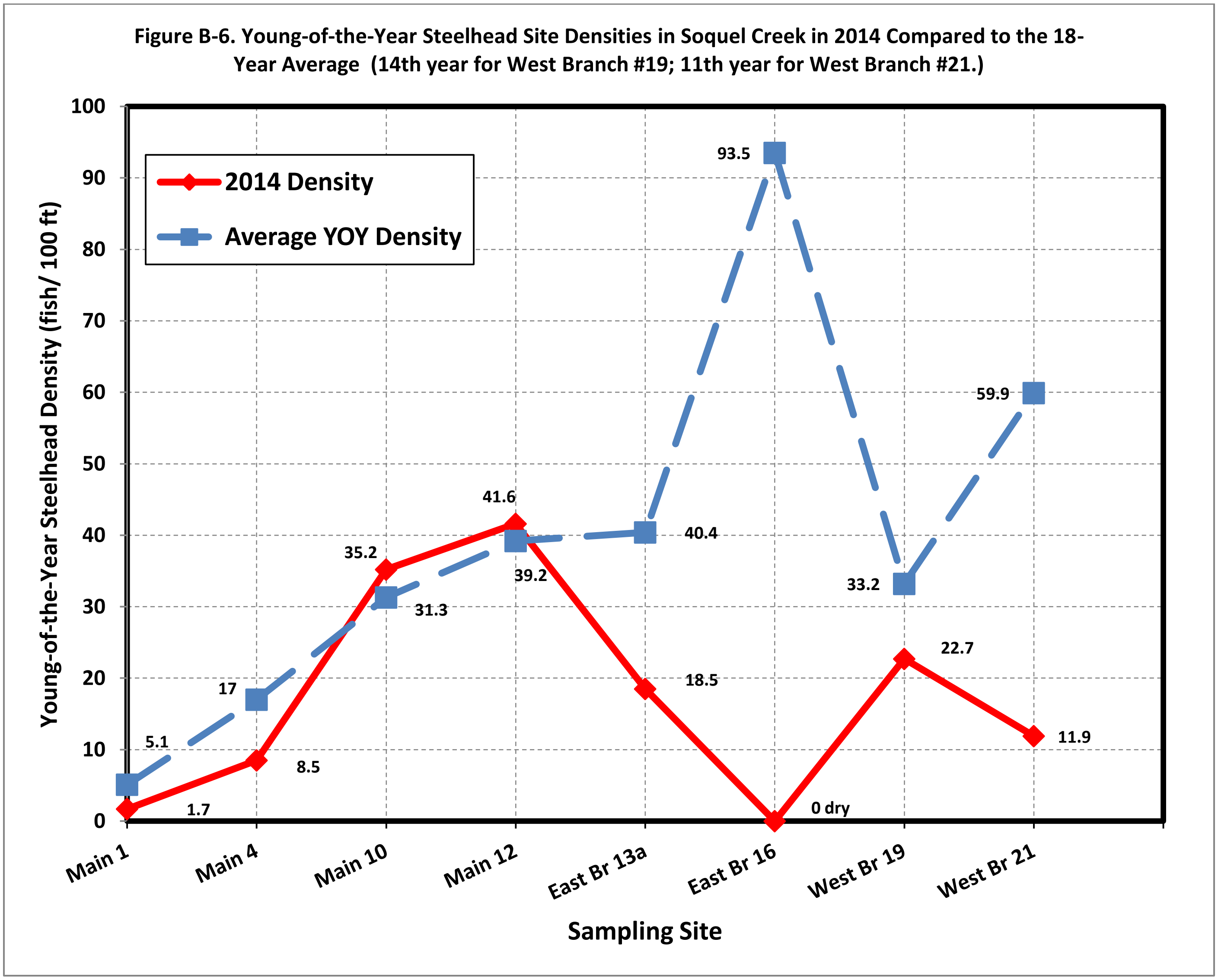


Figure B-6. Young-of-the-Year Steelhead Site Densities in Soquel Creek in 2014 Compared to the 18-Year Average (14th year for West Branch #19.)

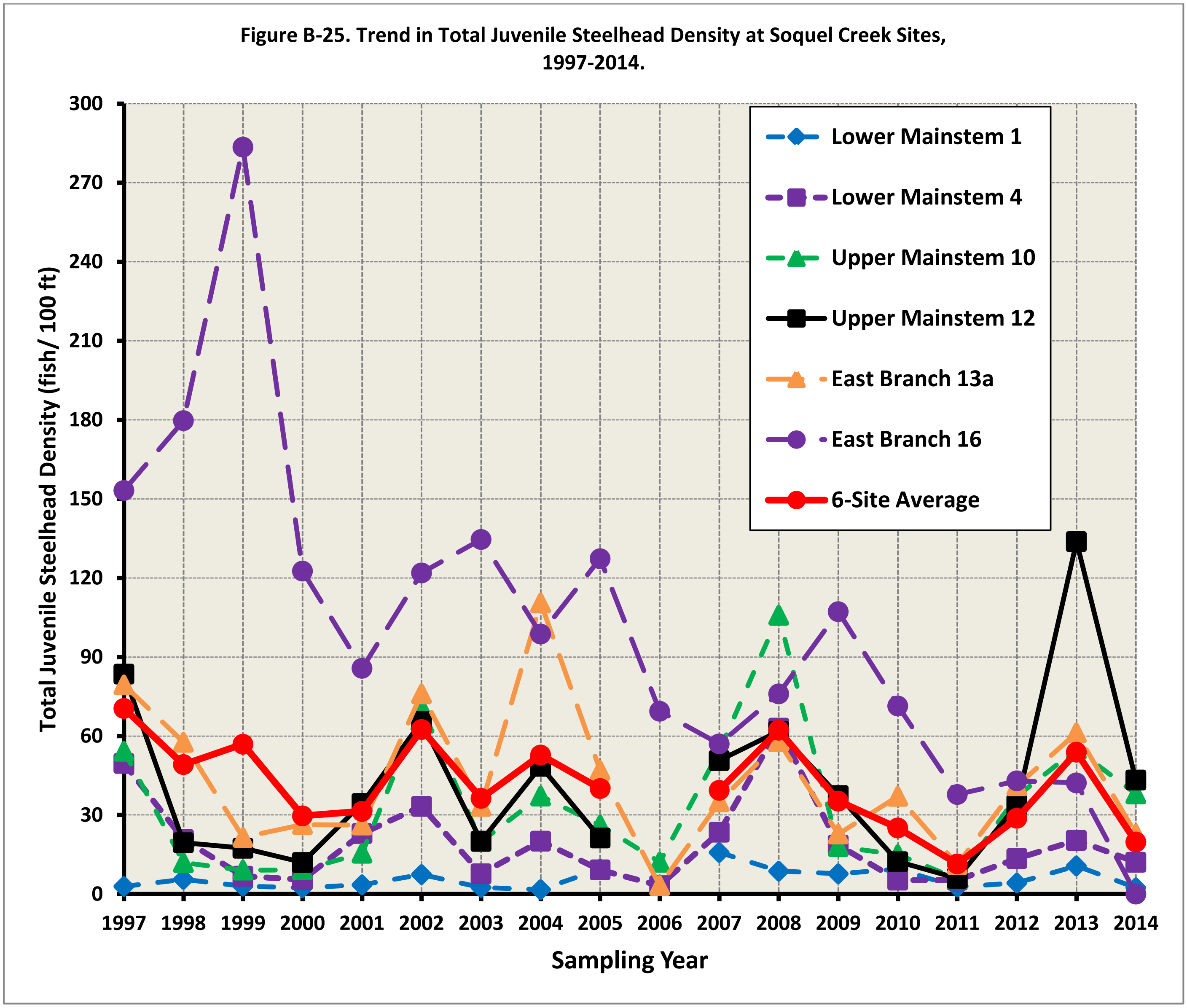


Figure B-25. Trend in Total Juvenile Steelhead Density at Soquel Creek Sites, 1997-2014.

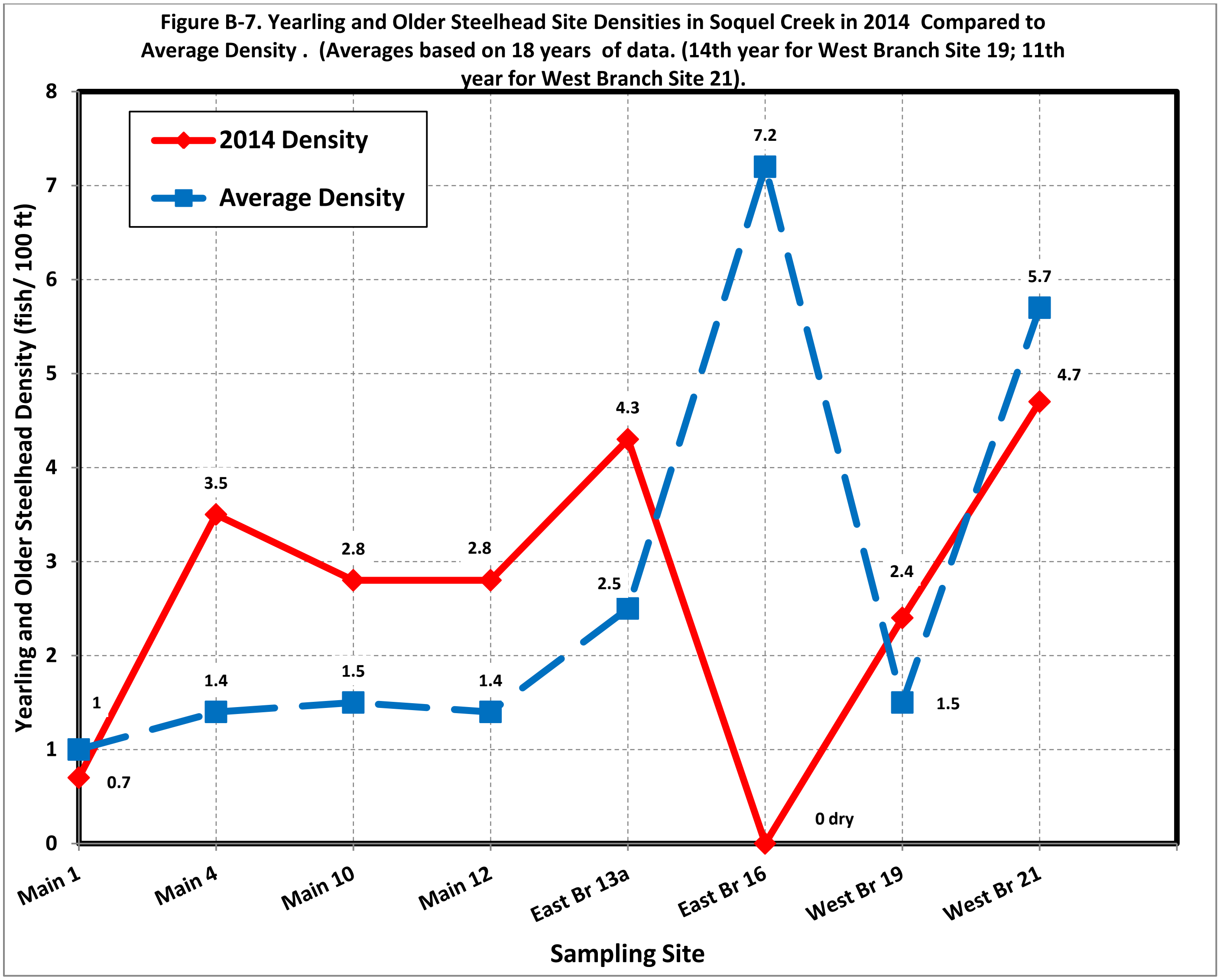


Figure B-7. Yearling and Older Steelhead Site Densities in Soquel Creek in 2014 Compared to Average Density. (Averages based on 18 years of data. (14th year for West Branch Site 19).

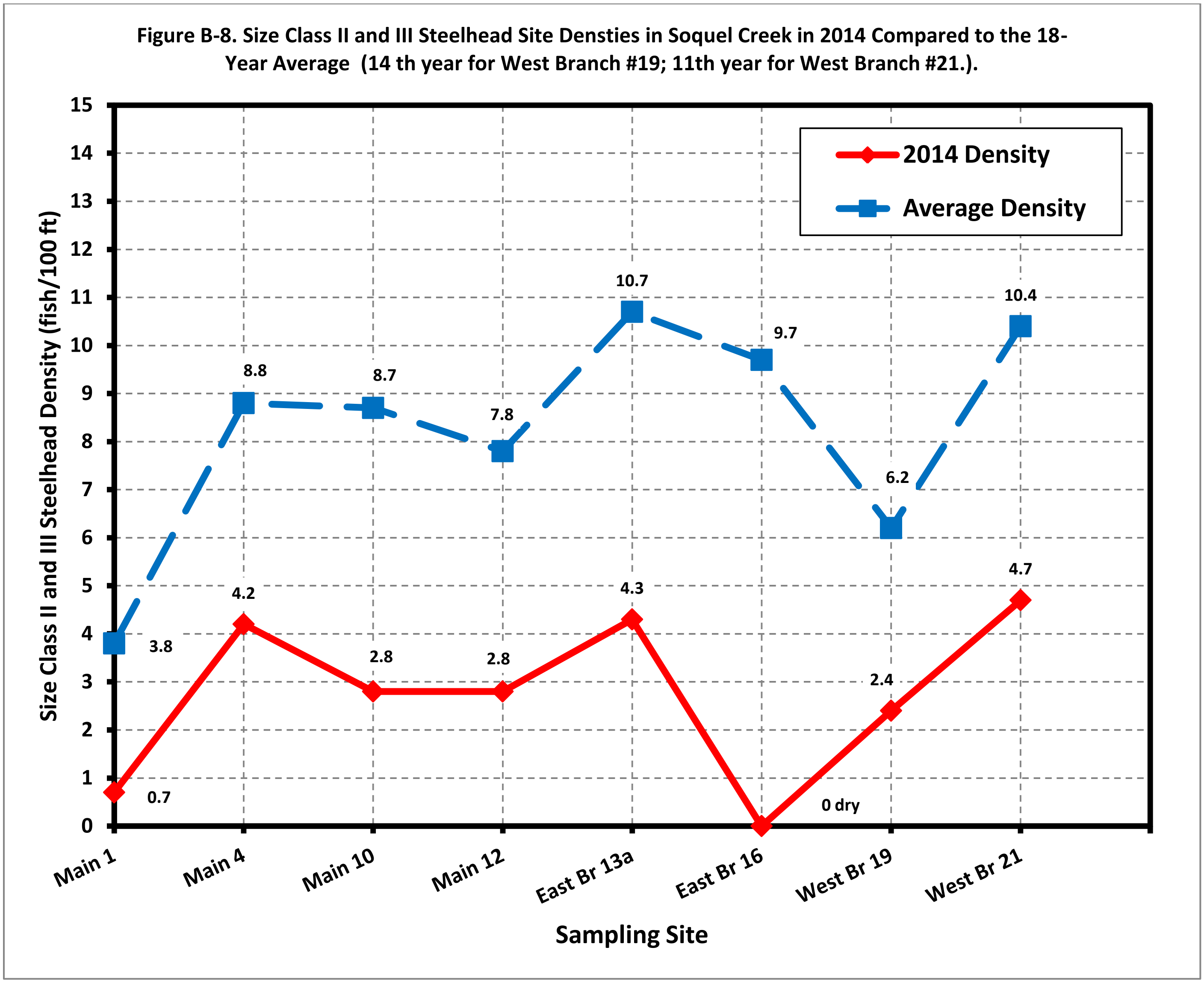


Figure B-8. Size Class II and III Steelhead Site Densities in Soquel Creek in 2014 Compared to the 18-Year Average (14th year for West Branch #19.)

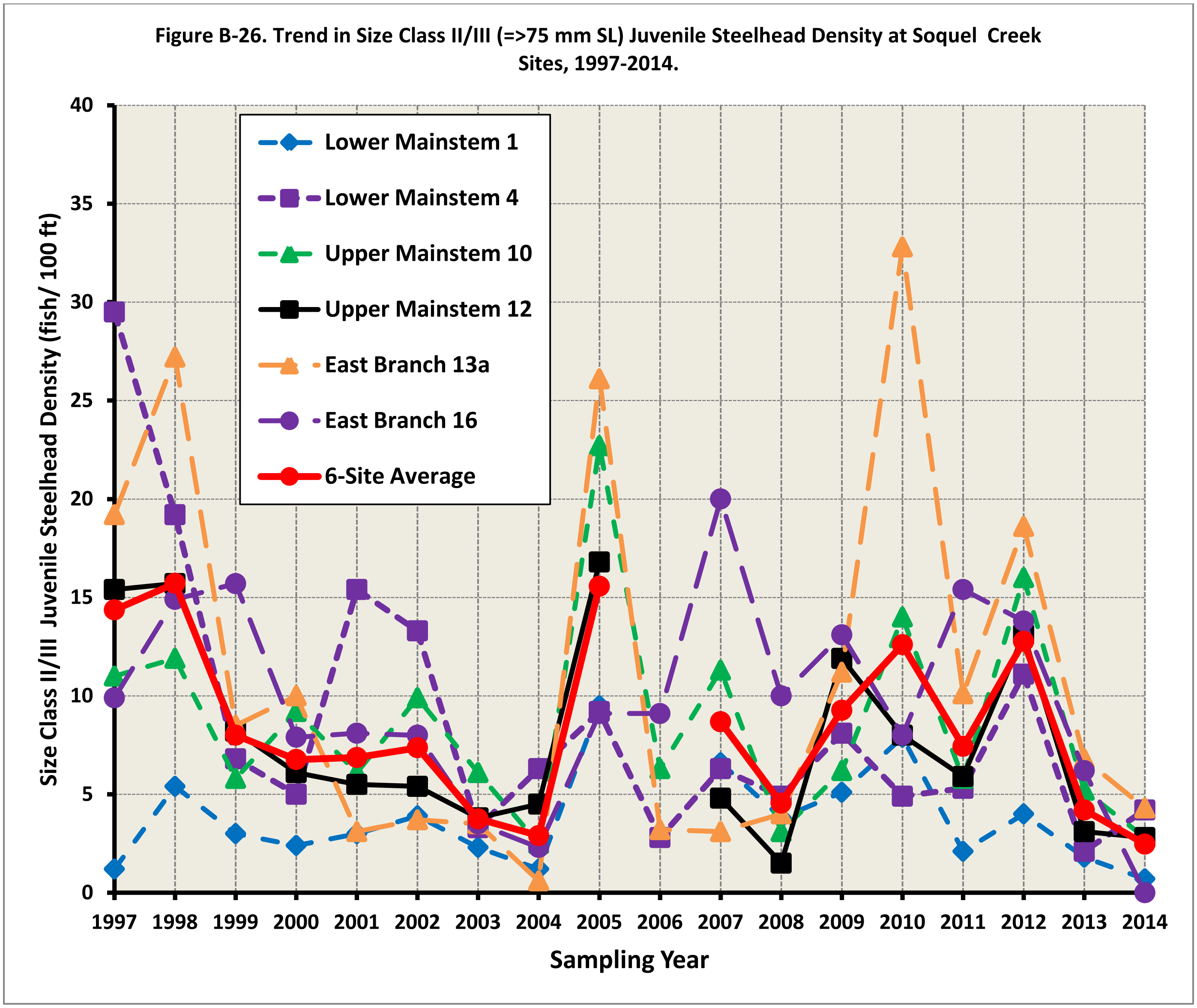


Figure B-26. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites, 1997-2014.

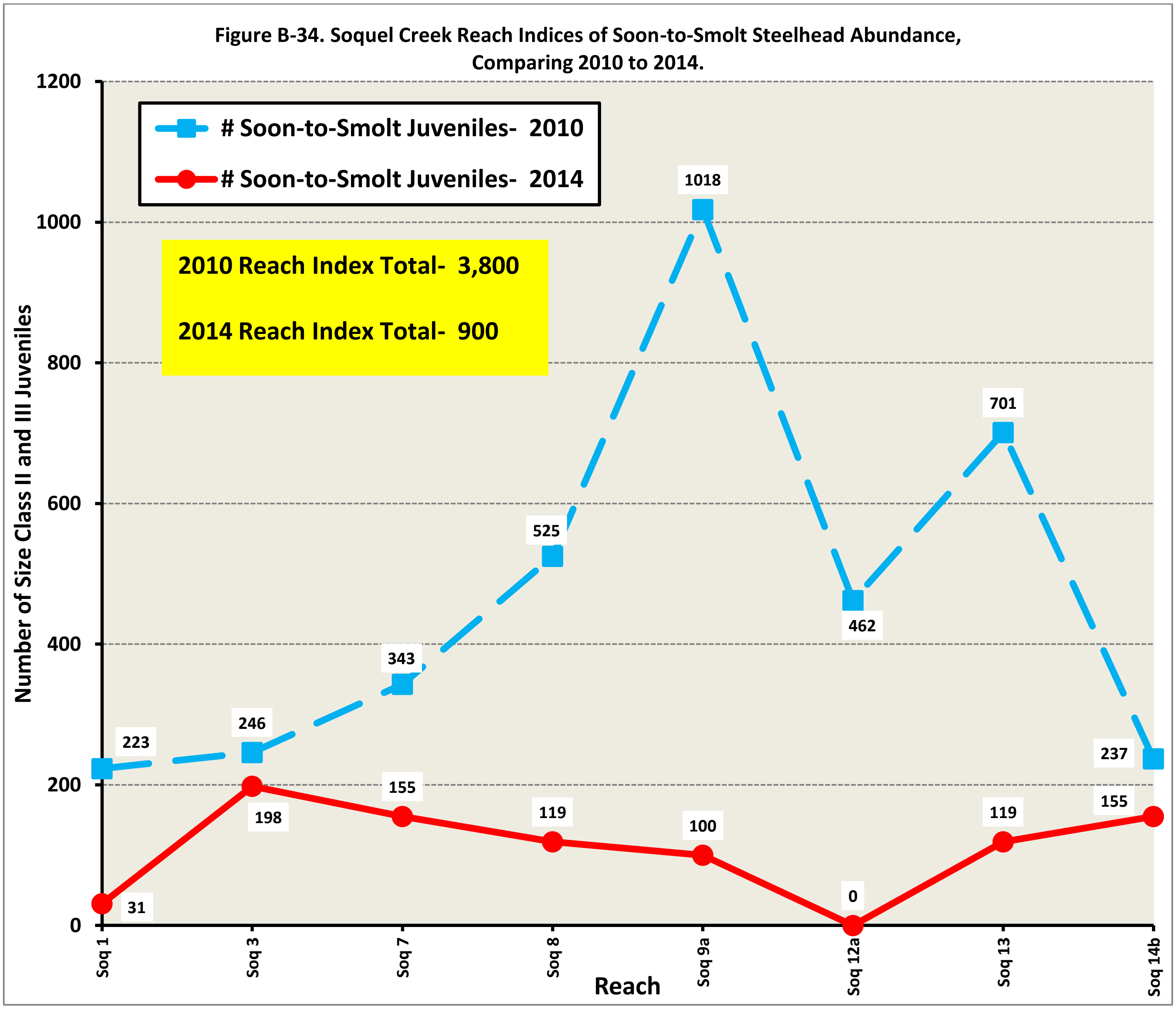


Figure B-34. Soquel Creek Reach Indices of Soon-to-Smolt Steelhead Abundance, Comparing 2010 to 2014.

iv. Steelhead Abundance and Habitat in the Aptos Creek Watershed

1. Based on hydrographs from stream gages in other watersheds (***Figures 36-41 in Appendix B***), it is likely that this watershed also had similarly lower baseflow in 2014 compared to 2013, probably well below the median baseflow in spring-summer-fall. This provided less food and slower growth rate in all reaches in 2014 compared to the previous 4 years. Measured streamflow in fall in Aptos Creek confirmed lower baseflow than in 2013 but less of a decrease than in other watersheds (***Table 5b in Appendix B***).

2. ***Habitat quality*** was poorer compared to 2013 at both the lower Aptos Site 3 above Valencia Creek confluence and in the upper Aptos Reach 3 (with Site 4) in Nisene Marks due to reduced baseflow and pool depth in both and reduced escape cover in Reach 3 (***Tables 16a-c in Appendix B***). Substrate conditions regarding percent fines and embeddedness were similar to previous measured conditions. Habitat conditions at both Valencia Creek sites had declined drastically since 2010, with no pool habitat left at Site 2 and much reduced pool depth at Site 3 (***Table 16b in Appendix B***). The escape cover index for remaining run habitat at Site 2 (pools filled in with sediment) was much less (1.5 feet per 100 feet of stream) than escape cover present in pool habitat in 2010 (15.6 feet per 100 ft of stream). Pool escape cover at Site 3 was greatly reduced in 2014 due to the loss of instream wood.

3. ***YOY and total densities*** decreased in 2014, as occurred at most sites in the San Lorenzo and Soquel watersheds, and they were below average (***Tables 31b and 32 in Appendix B; Figures B-9 and B-10*** *below*). Aptos Site #3 had the lowest YOY and total densities in the past 10 years of sampling. The two Valencia Creek sites had the lowest YOY and total densities in the past 7 years of sampling. The trend in total densities declined to a 9-year low (9.2 juveniles/ 100 ft), with the low Valencia Creek densities averaged in (***Figure B-27*** *below*).

4. ***Yearling densities*** also declined in 2014 from past samplings and were below average at all 4 sites (just slightly less at Aptos #3) (***Table 33 in Appendix B; Figure B-11*** *below*).

5. With low yearling densities and a lower percent of YOY reaching Size Class II, the ***Size Class II and III densities*** were below average and less than in 2013 (Aptos sites) and 2010 (Valencia sites) (***Table 35 in Appendix B; Figure B-12*** *below*). In Aptos Creek, the trend in average Size Class II and III density increased from 2008 to 2010, but declined steadily after that to a 2013 low level (5.6 fish/ 100 ft), the lowest thus far calculated (***Figure B-28*** *below*). With Valencia sites averaged into the 4-site average for 2014, the trend increased slightly (to 6 fish/ 100 ft) in 2014 with the higher Aptos 4 density being offset by low Valencia 2 and 3 densities. Low soon-to-smolt densities were due to few YOY (likely few adult spawners), poor overwinter yearling retention and few YOY fish reaching Size Class (***Figure B-19a*** *below*). Soon-to-smolt ratings declined from fair to below average at upper Aptos 3; remained fair at lower Aptos 3; was very

poor at Valencia 2 and below average at Valencia 3 (larger fish) (***Table B-40*** *above*).

6. Aptos Lagoon (closed sandbar) was sampled twice in September for steelhead and tidewater goby. With only 6 steelhead captured, there were no recaptures and no population estimate was possible in 2014. Previous estimates in 2011−2013 were 423, 140 and 32, respectively. There were likely less than 30 juvenile steelhead in the lower 2014 lagoon. Size distributions of captured fish were graphed (***Figures B-46 and B-47a−C*** *below*). A total of 158 tidewater gobies were captured from 9 seine hauls, east of the jetty on the one day of seining with the small seine. In addition, 43 tidewater gobies were captured with the larger seine on two days of sampling, west of the jetty. Other fishes captured included 1 prickly sculpin (*Cottus asper*), 8 staghorn sculpin (*Leptocottus armatus*) hundreds of smelt (*Atherinops spp.*) and 50+ threespine stickleback (*Gasterosteus aculeatus*).

7. The Aptos Lagoon was closed to the ocean during both fish samplings. Cool, oxygenated saltwater disrupted any stratification of water temperature and oxygen on 18 September (**Table 31a in Appendix B**). However, a week later, stratification was well-developed on 25 September. At that time, salinity went from 4.4 ppt at the surface to 22.4 ppt at the bottom. Water temperature had increased above 25˚C in early afternoon at 0.5 meter from the surface and increased at greater depth. Oxygen dropped from 10.15 mg/ l to 1 mg/l at 0.75 meter, and conditions were nearly anoxic at greater depth. With such poor water quality, steelhead were likely restricted to a 0.5 meter layer at the surface or less in the afternoon and early evening and perhaps down to 0.75 meters in late night and early morning, at best.

Table B-16c. Habitat Change in APTOS Reaches (2011 to 2014) AND CORRALITOS WATERSHED Reaches (2012 or 2013 to 2014) and Replicated Sites (2013 to 2014).

Reach Comparison or (Site Only Comparison)	Baseflow	Pool Depth	Fine Sediment	Embeddedness	Pool Escape Cover	Overall Habitat Change
(Aptos Site 3)	−	−	Similar	Similar	Similar	−
Aptos 4	−	−	Similar	Similar	−	−
(Corralitos Site 1)	−	Similar	−	Similar	+	−
Corralitos 3	−	Similar	Similar	− (riffle and run)	+	−
(Corralitos Site 8)	−	Similar	+	+	+	−
Corralitos 7	−	−	Similar	−	−	−
(Shingle Mill Site 1)	−	Similar	Similar	+	−	−
(Shingle Mill Site 3) above fault line	−	−	+	+	+	−
(Browns Site 1)	−	−	Similar	+	−	− (spring/early summer flow)
(Browns Site 2)	−	+	Similar	Similar	Similar	− (spring/early summer flow)

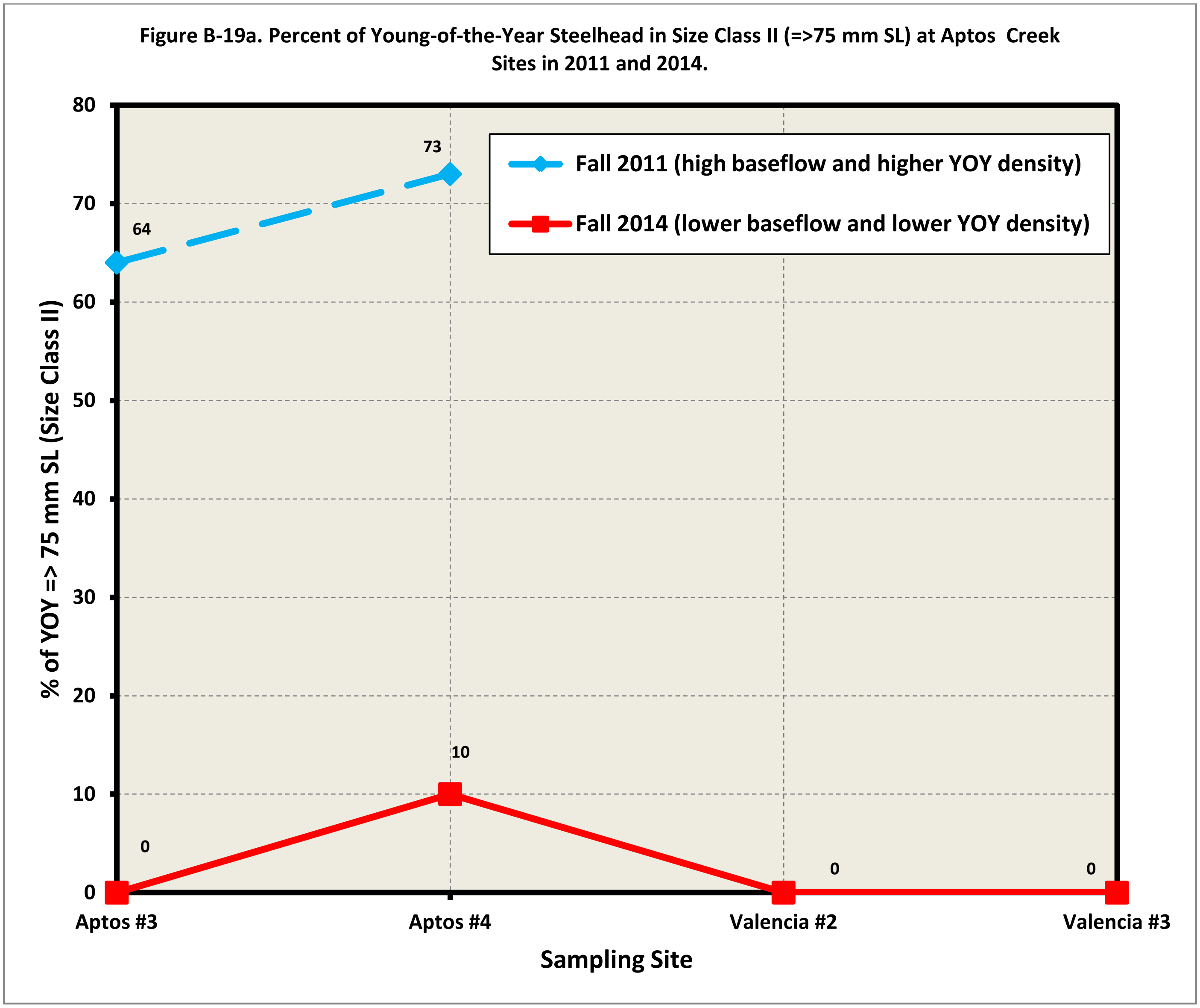


Figure B-19a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Aptos Creek Sites in 2011 and 2014.

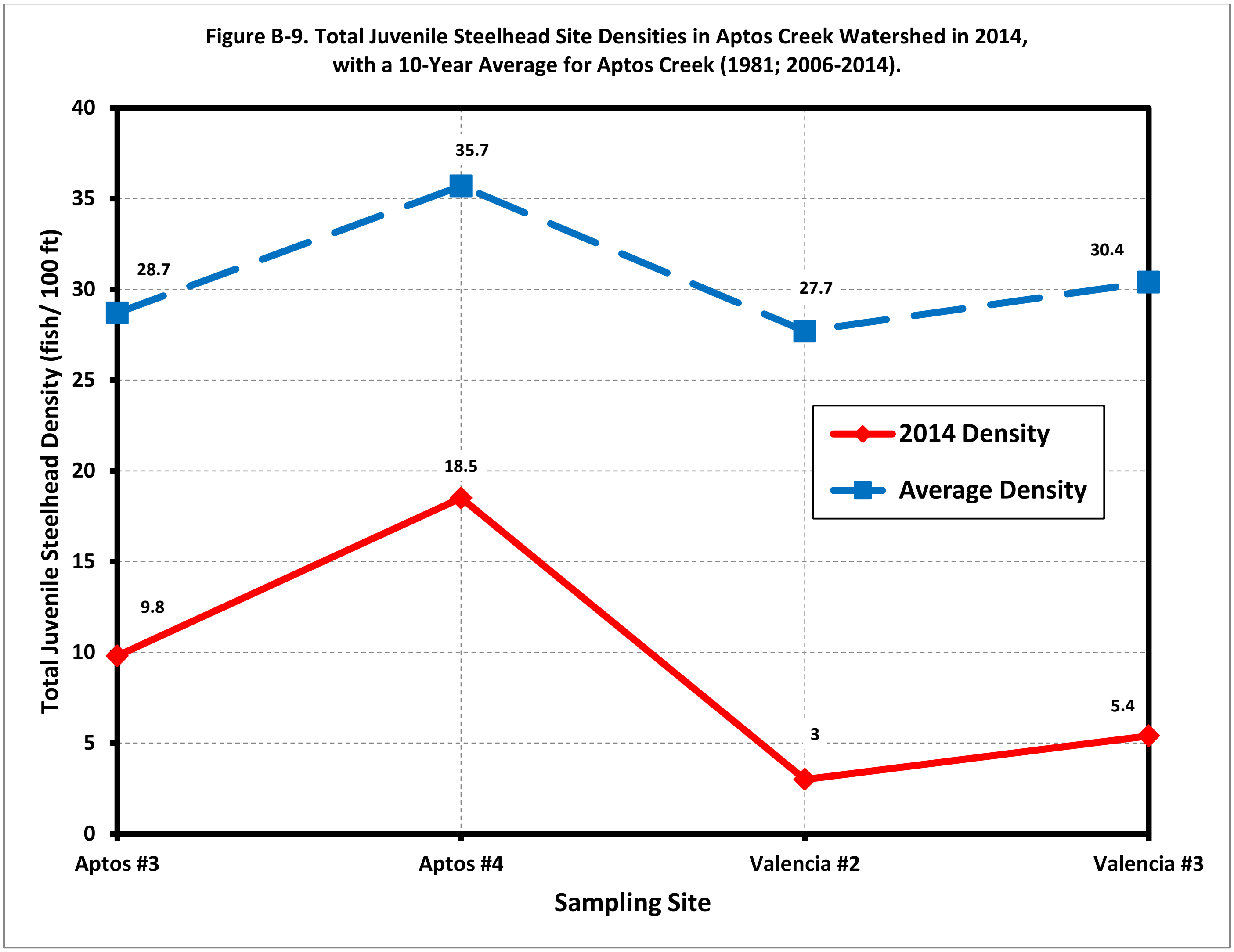


Figure B-9. Total Juvenile Steelhead Site Densities in Aptos Creek in 2014, with a 10-Year Average (1981; 2006-2014).

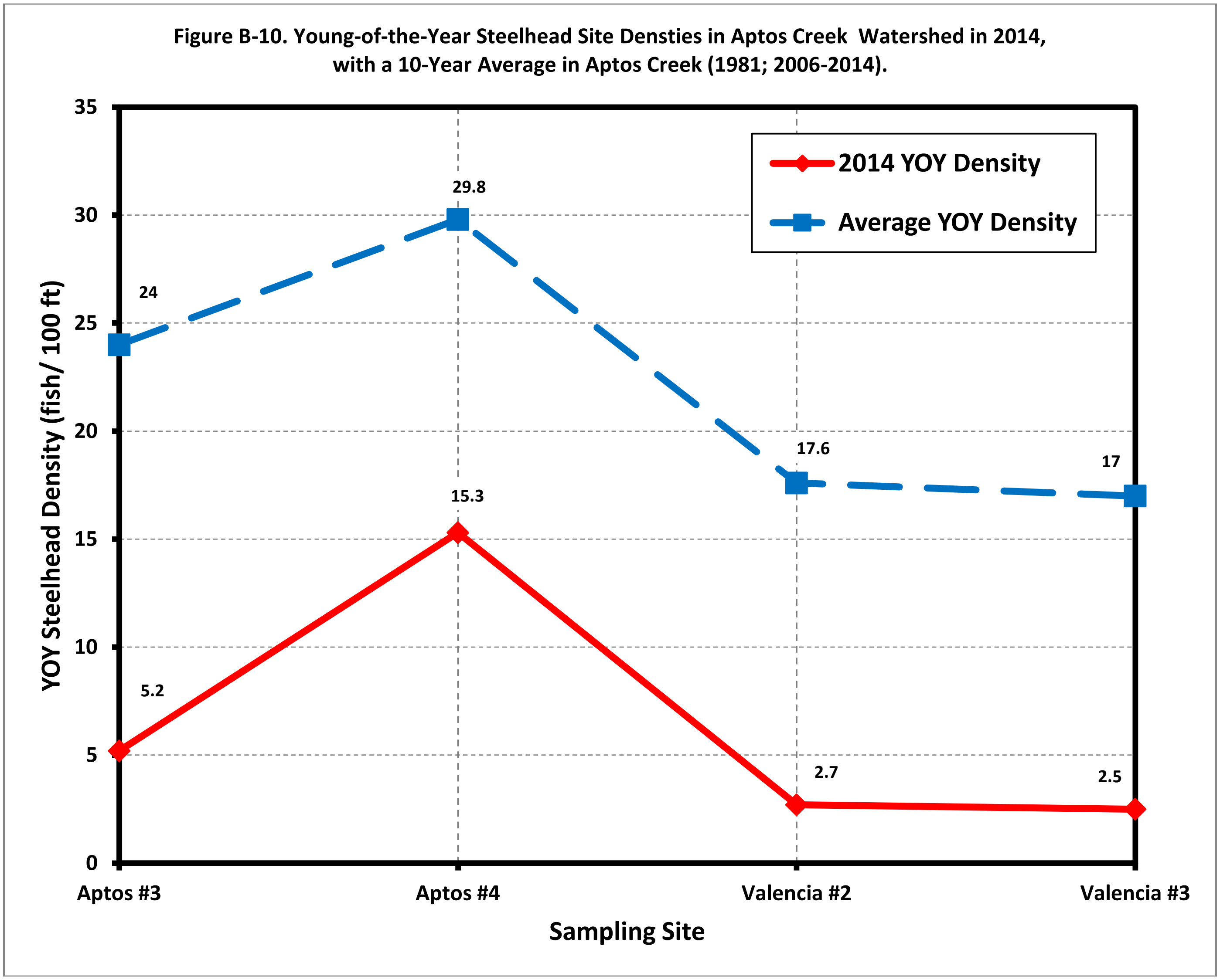


Figure B-10. Young-of-the-Year Steelhead Site Densities in Aptos Creek in 2014, with a 10-Year Average (1981; 2006-2014).

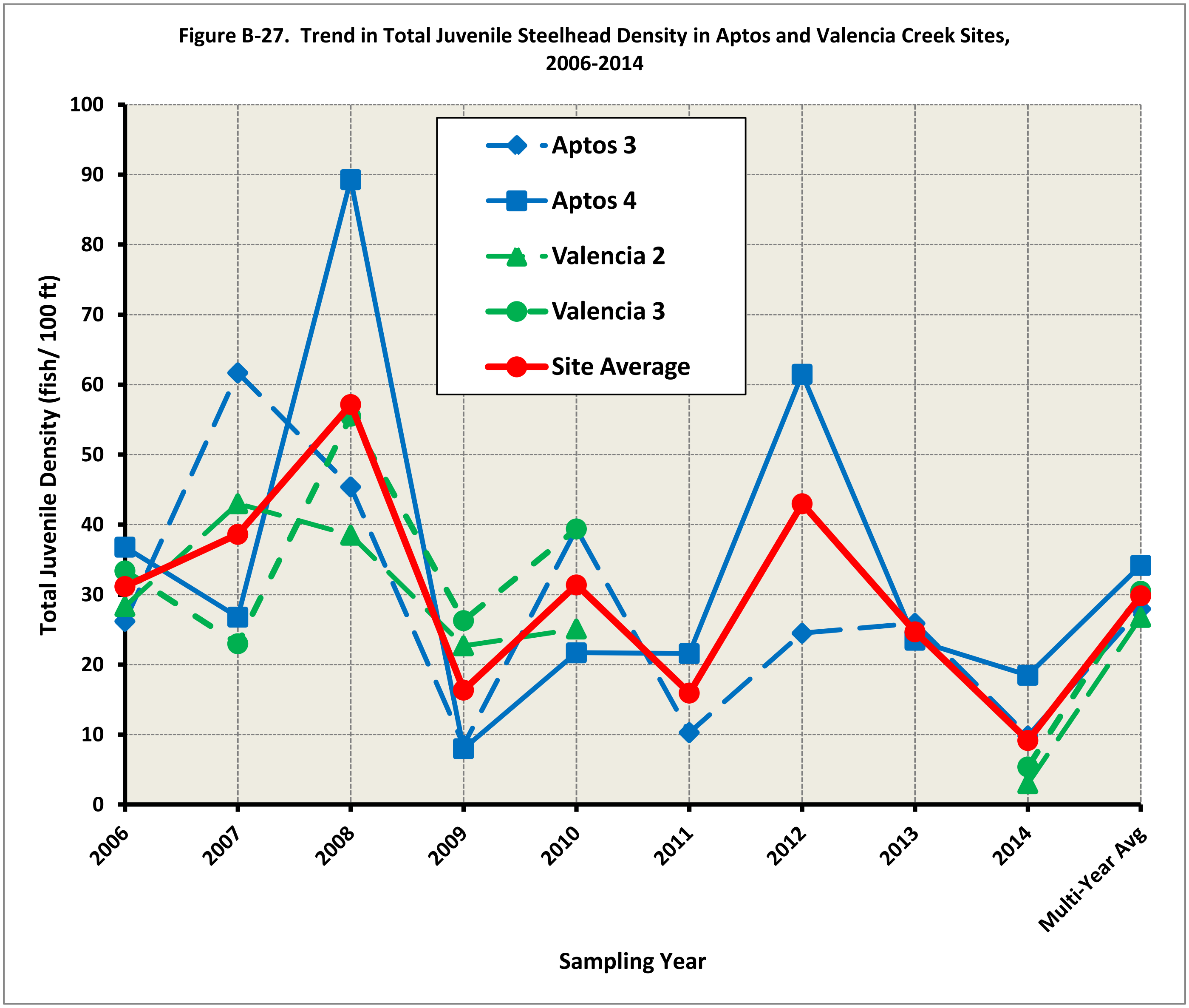


Figure B-27. Trend in Total Juvenile Steelhead Density in Aptos and Valencia Creek Sites, 2006-2014.

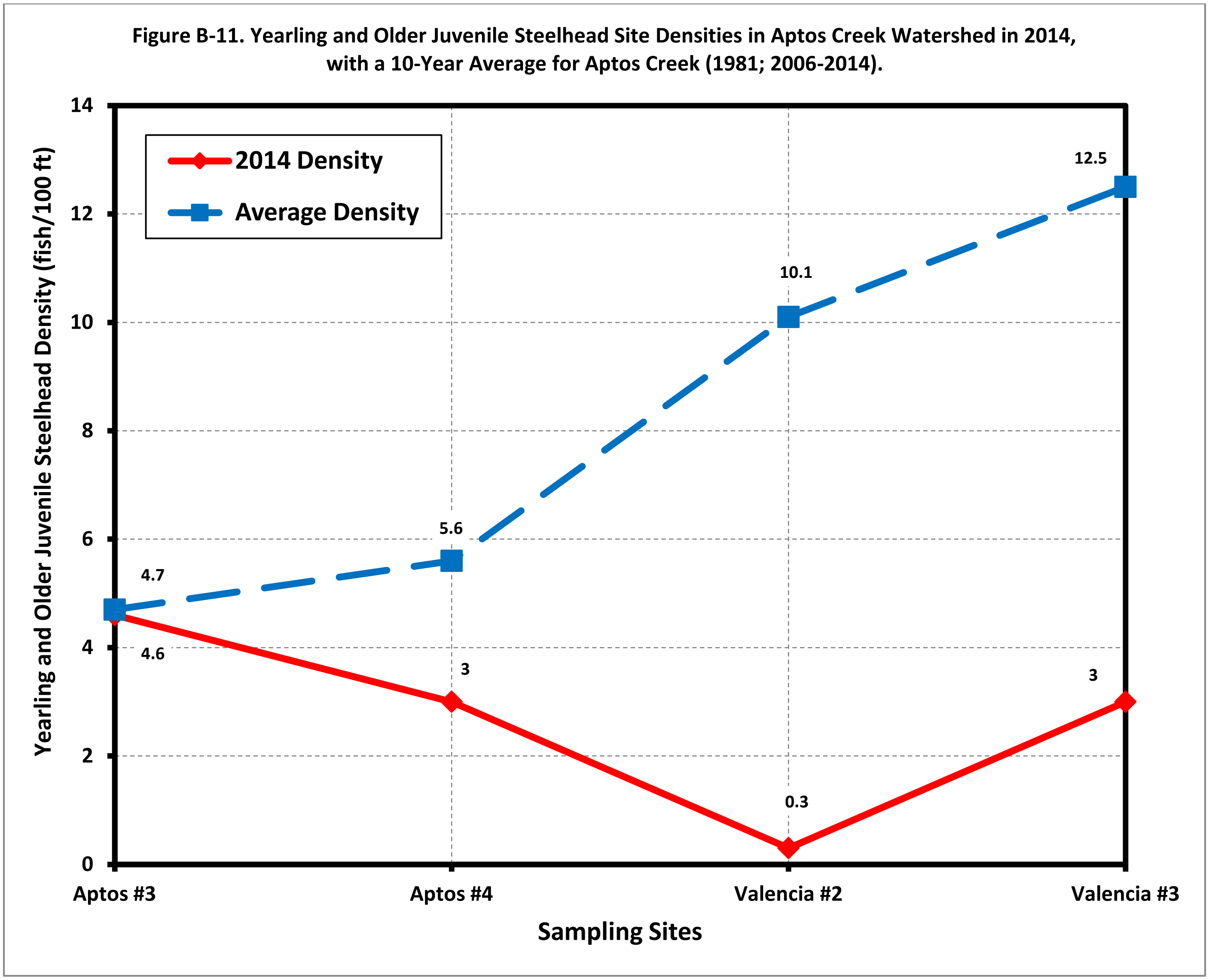


Figure B-11. Yearling and Older Juvenile Steelhead Site Densities in Aptos Creek in 2014, with a 10-Year Average (1981; 2006-2014).

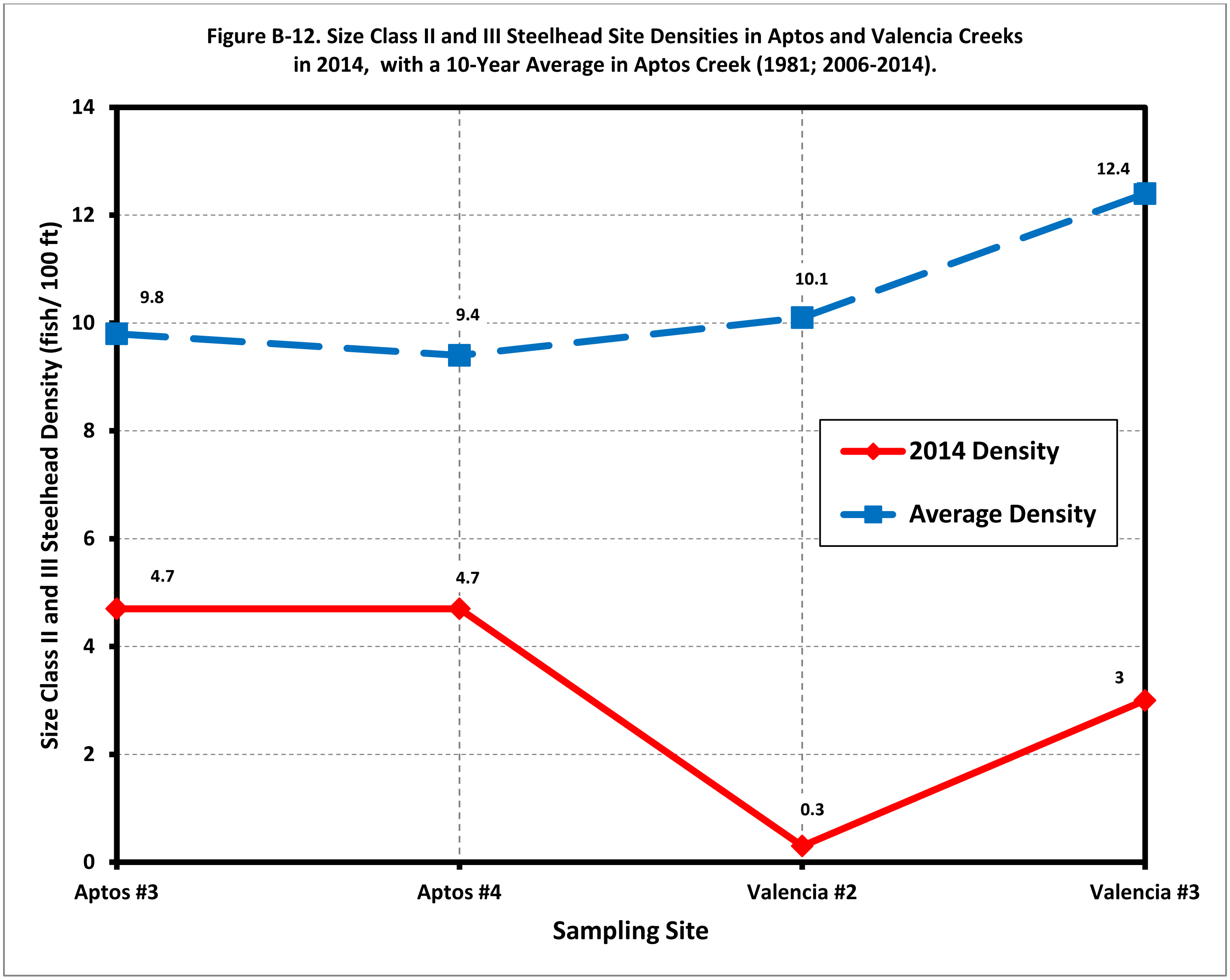


Figure B-12. Size Class II and III Steelhead Site Densities in Aptos and Valencia Creeks in 2014, with a 10-Year Average (1981; 2006-2014).

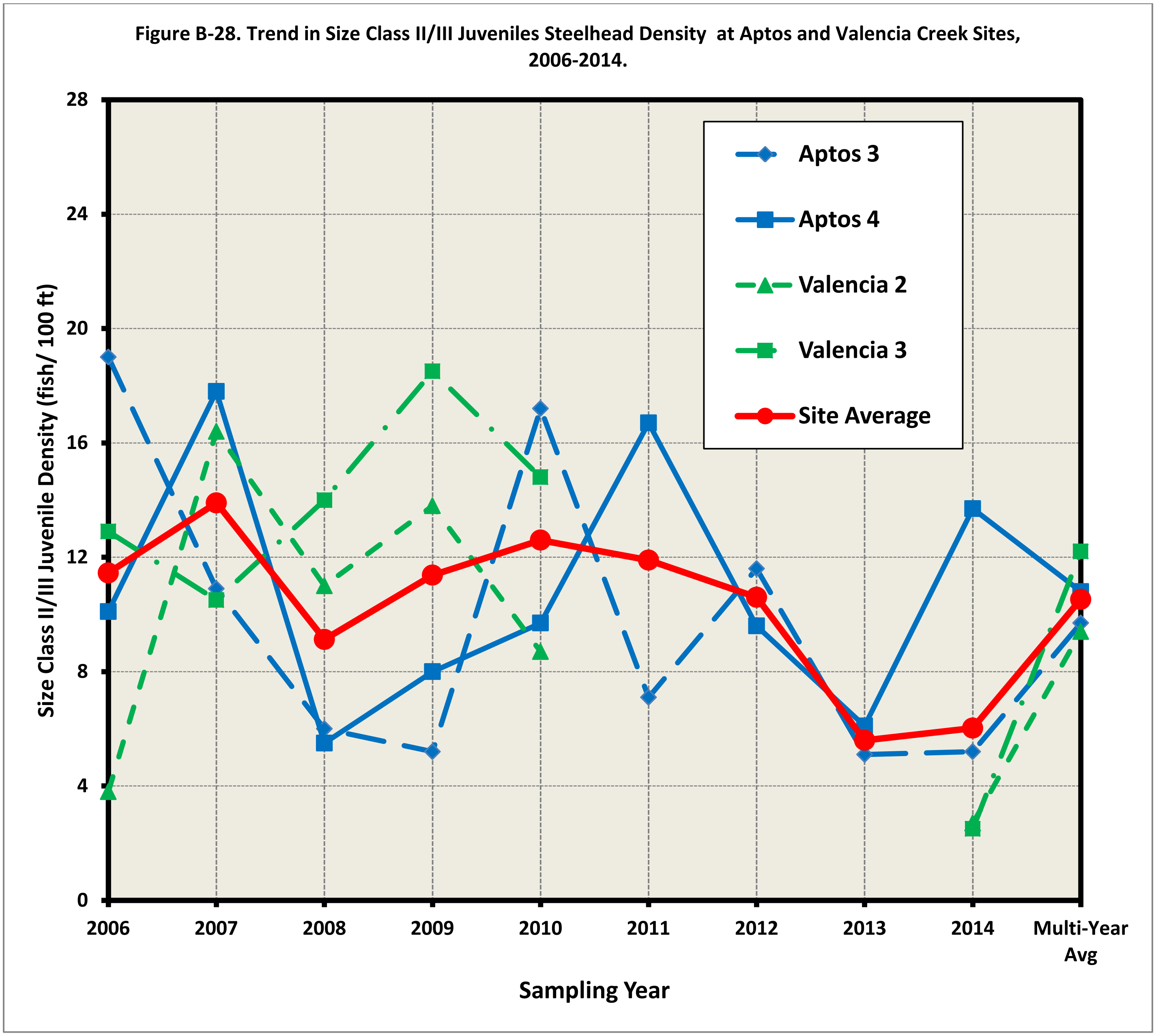


Figure B-28. Trend in Size Class II/III Juveniles Steelhead Density at Aptos and Valencia Creek Sites, 2006-2014.

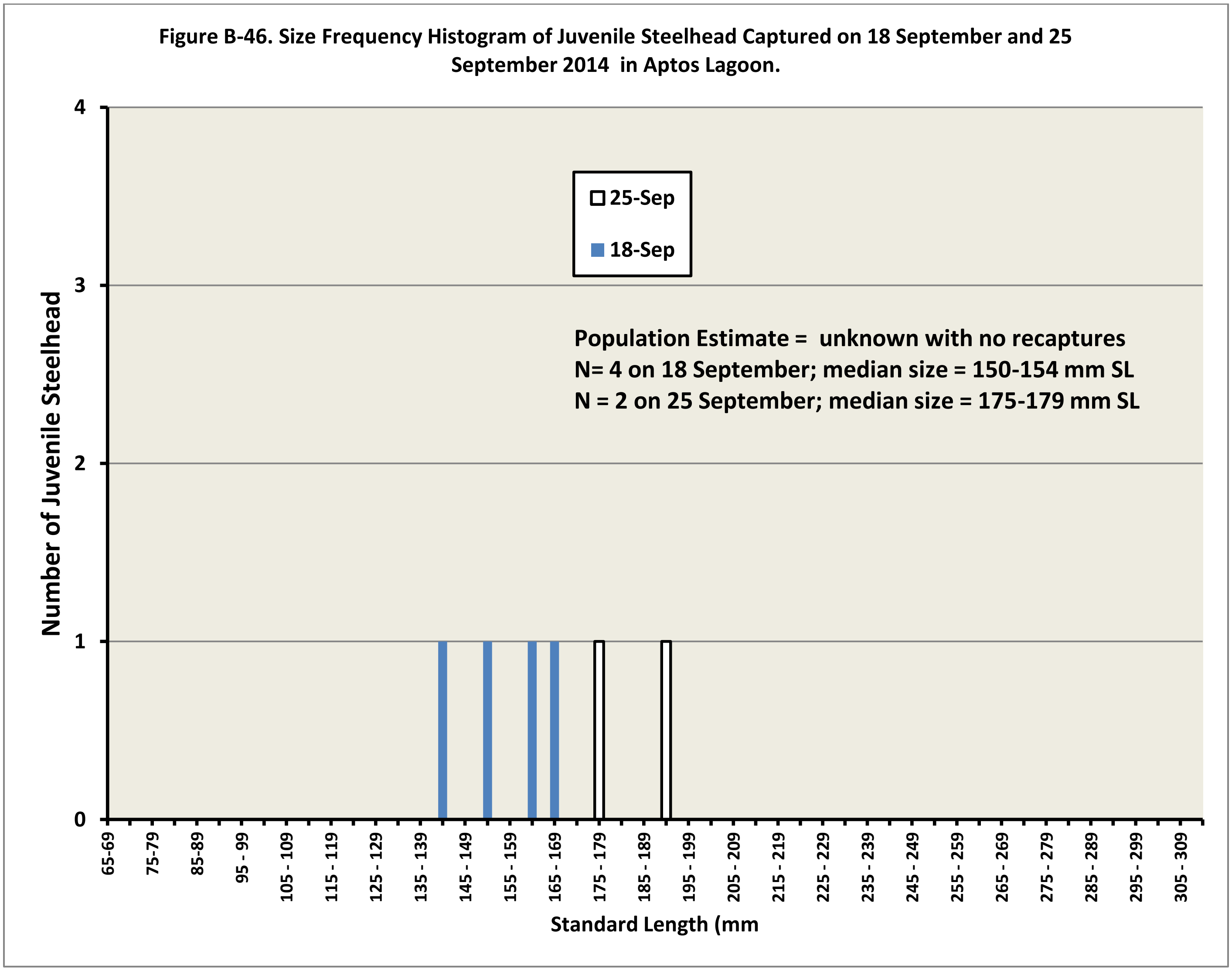


Figure B-46. Size Frequency Histogram of Juvenile Steelhead Captured on 18 September and 25 September 2014 in Aptos Lagoon/Estuary.

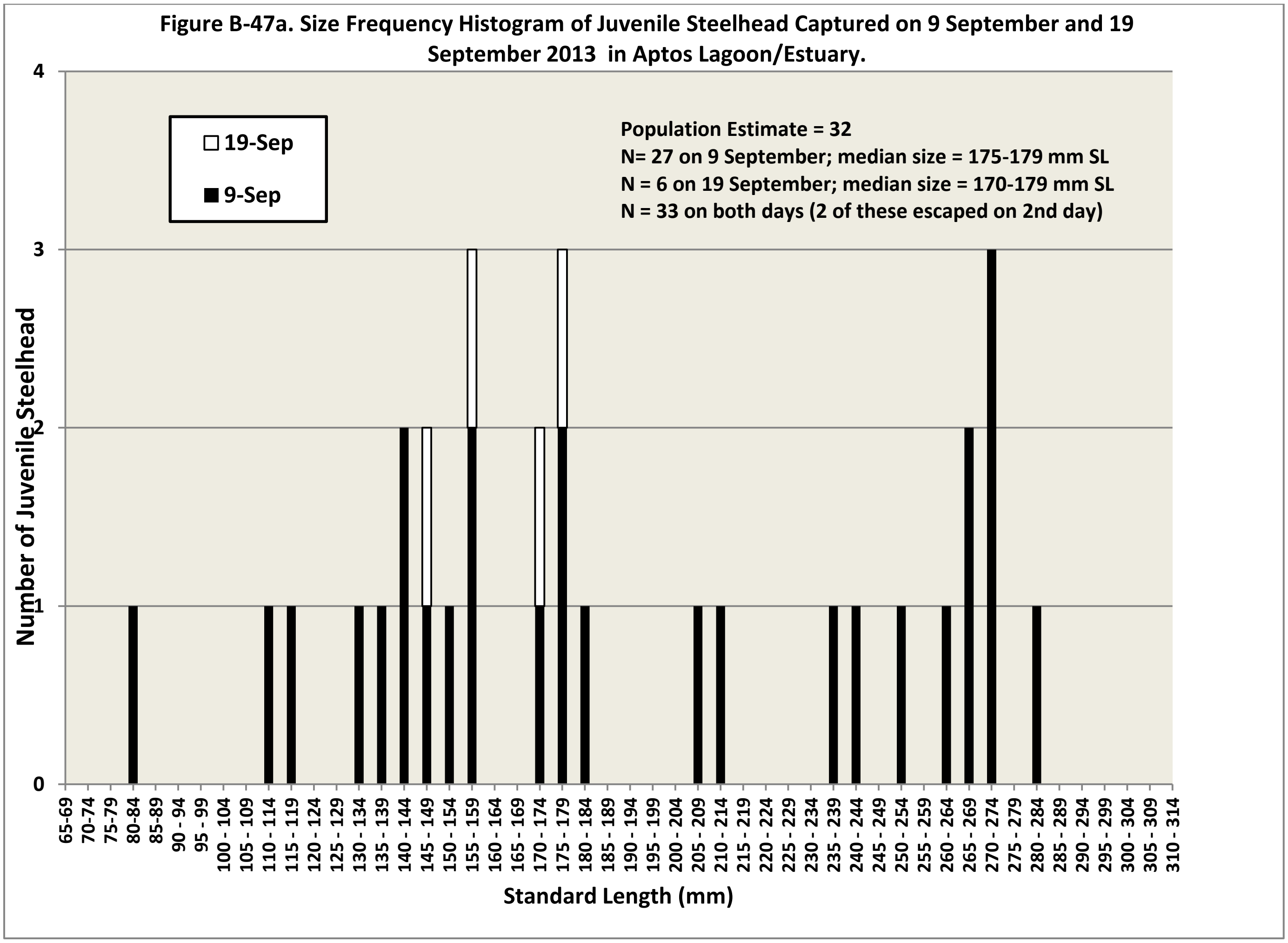


Figure B-47a. Size Frequency Histogram of Juvenile Steelhead Captured on 9 September and 19 September 2013 in Aptos Lagoon/Estuary.

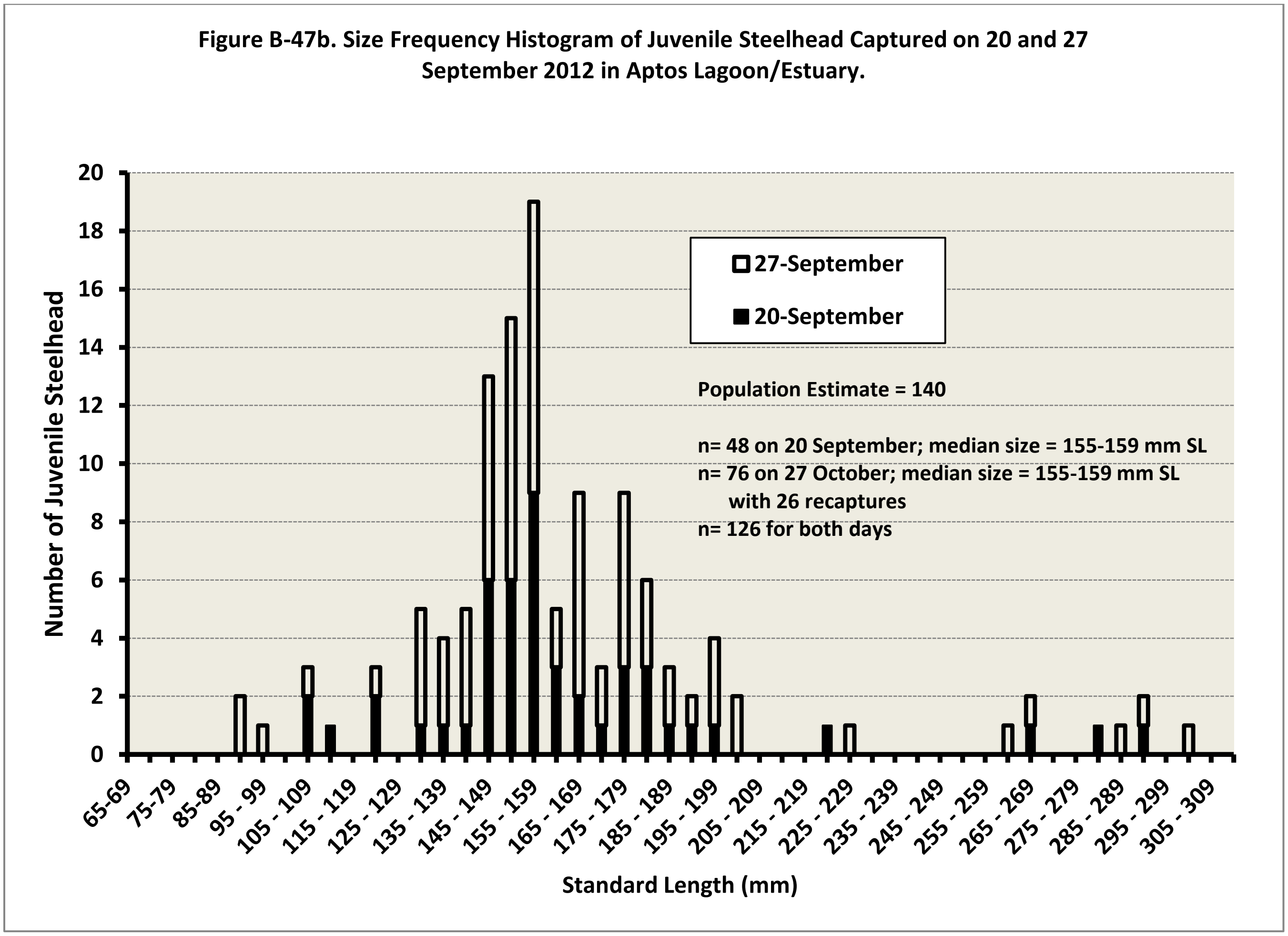


Figure B-47b. Size Frequency Histogram of Juvenile Steelhead Captured on 20 and 27 September 2012 in Aptos Lagoon/Estuary.

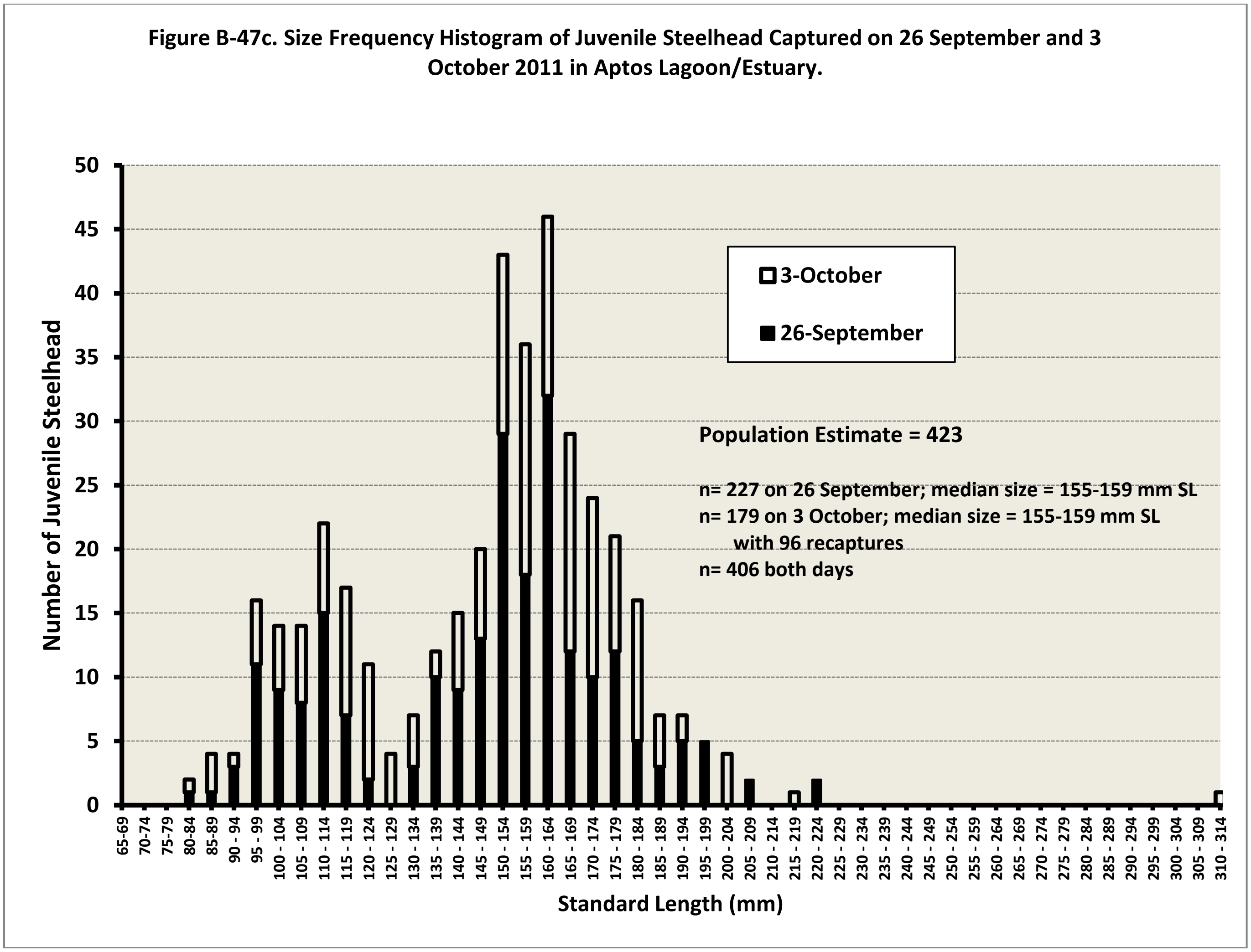


Figure B-47c. Size Frequency Histogram of Juvenile Steelhead Captured on 26 September and 3 October 2011 in Aptos Lagoon/Estuary.

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

1. Overall habitat quality declined in all reaches of the Corralitos-Browns-Shingle Mill sub-watershed in 2014, primarily due to lower baseflow in spring and early summer, as indicated by the hydrograph at the Freedom stream gage (***Tables S-3*** *below,* ***Figures B-43a-b*** *below* ***and B-16c*** *above* ***and Tables 16a-b in Appendix B***). Non-flow aspects of habitat improved in the lower 3 Corralitos sites/reaches in that escape cover increased and pool depth remained similar to 2013, despite reduced baseflow. This indicated further recovery from sedimentation caused by the 2008 Summit Fire. However, Corralitos Reach 7 above Eureka Gulch experienced negative habitat change in pool depth, embeddedness and escape cover in 2014, with very low baseflow (***Table 5b in Appendix B***). Likewise, lower Browns 1 had shallower pool depth and less escape cover. Most non-flow aspects of habitat were similar at upper Browns 2 in 2014 to 2013 except for increased pool depth in 2014.

2. ***YOY densities*** were very low in 2014 and well below average and less than in 2013 at all steelhead sites (***Table 32 in Appendix B; Figure B-14*** *below*). 2014 YOY densities were the lowest measured in 7−10 years of monitoring at all steelhead sites except Corralitos 3 (slightly less in dry year 1994). We suspect that adult steelhead did not access Shingle Mill sites in 2014. Decreased YOY juvenile densities at sites from 2013 to 2014 were statistically significant (***Table 47 in Appendix B***). Poor adult access to Browns and Corralitos creeks led to low YOY densities in 2014, with limited migratory opportunities during probably only 1 stormflow event at the end of February when the sandbar was open (***Figures 43a−b and 44*** *below*). Then, of the eggs that were laid, mortality may have been high with low winter and spring flows. Shallow conditions in spawning glides likely forced adults to spawn further upstream into sandy pools to further limit water percolation through the redds of eggs.

3. ***Total juvenile densities*** in 2014 followed the same pattern as YOY densities compared to 2013 densities and long term average densities (***Table 31b in Appendix B; Figure B-13*** *below)*. Total densities were the lowest measured in 7-10 years of monitoring at 3 of 4 Corralitos sites and both Browns sites. The trend in total densities for Corralitos and Browns creek sites declined in 2014 since 2012 to its lowest in the 11 years (***Figure B-29*** *below*). Decreased total juvenile densities from 2013 to 2014 were statistically significant (***Table 47 in Appendix B***).

4. ***Yearling densities*** in 2014 were less than in 2013 and below average at all 8 sites (***Table 33 in Appendix B; Figure B-15*** *below*). Decreased yearling densities from 2013 to 2014 were statistically significant (***Table 47 in Appendix B***).

5. ***Size Class II and III densities*** in 2014 were less than in 2013 at 5 of 8 sites, were below average at 6 of 8 sites and were close to average at 2 other sites (***Table 35 in Appendix B; Figure B-16*** *below*). The trend in soon-to-smolt densities had declined since 2012, with the 8-site average (7.8 fish/ 100 ft) being the lowest in 11 years, but was very similar to the 2010 average (***Figure B-32***

below). Relatively low densities of larger juveniles were present in 2014 due to near average or below average densities of yearlings and the small number of YOY reaching Size Class II compared to a wet year, such as 2011 (***Figure B-20a*** below). The proportion of YOY reaching Size Class II was higher in 2014 than in either 2012 or 2013 because there were so few YOY in 2014 and much less competition for food (***Figure B-20b*** below).

6. Sampling site ratings based on soon-to-smolt densities declined at 5 of 8 sites in 2014 (***Table B-42*** *below*). Four sites had "below average" ratings and 4 had "fair" ratings. The "fair" sites were rated "good" in 2013. Corralitos 9 typically is rated "good" but dropped to "fair" in 2014.

7. No steelhead were captured during sampling of Pajaro Lagoon in early October, though water quality conditions at that time were unstratified and not prohibitive for the species. Tidewater goby were present and most abundant near the confluence of Watsonville Slough and upper sites at Thurwachter Bridge and the boat ramp. ***Refer to Appendix B for methods, species tables (36−38) and water quality tables (39 and 40).***

8. The abundance index for soon-to-smolt sized steelhead in sampled stream reaches indicated a substantial decrease in the very dry 2014 (2,300) compared to the slightly above median baseflow 2010 (3,300). The 30% decrease resulted from very low 2014 YOY densities in high growth potential reaches that provided much fewer YOY in Size Class II compared to 2010 (***Figure B-35*** *below*). The 2010 index would have been much higher if habitat quality had not been seriously compromised by sedimentation from the 2008 Summit Fire in Corralitos Creek.

Table S-3. 2014 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Average Smolt Size, with Physical Habitat Change since 2013. (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	2014 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2014 Numeric Smolt Rating (With Size Factored In)	2014 Symbolic Rating (1 to 7)	Physical Habitat Change by Reach/Site Since 2013
Low. San Lorenzo #0a	9.6	6.2/ 108 mm	4 (Fair)	@@@@	Site Negative
Low. San Lorenzo #1	7.2	1.8/ 125 mm	2 (Poor)	@@	Site Negative
Low. San Lorenzo #2	14.3	2.4/ 98 mm	2	@@	Reach Negative
Low. San Lorenzo #4	14.0	4.4/ 89 mm	3 (Below Avg)	@@@	Site Negative
Mid. San Lorenzo #6	4.2	1.4/ 80 mm	1 (Very Poor)	@	Site Negative
Mid. San Lorenzo #8	5.9	1.4/ 92 mm	1	@	Reach Negative
Mid. San Lorenzo #9	7.2	0.6/ 92 mm	1	@	Site Negative
Up. San Lorenzo #10	5.5	None	1	@	Reach Negative (since 2005)
Up. San Lorenzo #11	6.0	1.6/ 112 mm	2	@@	Site Negative
Up.San Loren #12b (res.Rt)	*12.4*	*21.3/ 92 mm*	*5 (Good)*	*@@@@*	Site Negative
Zayante #13a	9.7	2.4/ 89 mm	2	@@	Site Negative
Zayante #13c	13.5	3.7/ 81 mm	1	@	Site Negative
Zayante #13d	*16.2*	*22.1/ 93 mm*	*5*	*@@@@@*	Reach Negative
Lompico #13e	6.9	6.7/ 94 mm	3	@@@	Site Negative
Bean #14b	12.0	2.8/ 101 mm	2	@@	Reach Negative
Bean #14c	8.3	Dry	Dry	Dry	Reach Negative
Fall #15a	2.7	2.7/ 103 mm	3	@@@	New
Fall #15b	13.1	7.3/ 103 mm	4	@@@@	Reach Negative
Newell #16	14.0	3.1/ 109 mm	3	@@@	Site Negative
Boulder #17a	10.8	3.8/ 91 mm	2	@@	Site Negative
Boulder #17b	10.8	13.0/ 90 mm	4	@@@@	Site Negative
Bear #18a	9.9	0.7/ 116 mm	2	@@	Site Negative
Branciforte #21a-2	9.1	4.6/ 98 mm	3	@@@	Reach Negative
Branciforte #21b	13.9	7.3/ 98 mm	3	@@@	Site Negative
Branciforte #21c (res. Rt)	*11.7*	*13.3/103 mm*	*5*	*@@@@@*	Site Negative
Soquel #1	3.8	0.7/ 102 mm	1	@	Reach Negative
Soquel #4	8.8	4.2/ 98 mm	3	@@@	Site Negative
Soquel #10	8.7	2.8/ 89 mm	2	@@	Reach Negative
Soquel #12	7.8	2.8/ 95 mm	2	@@	Site Negative
East Branch Soquel #13a	10.7	4.3/ 100 mm	3	@@@	Reach Negative
East Branch Soquel #16	9.7	Dry	Dry	Dry	Reach Negative
West Branch Soquel #19	6.2	2.4/ 92 mm	2	@@	Site Negative
West Branch Soquel #21b	10.4	4.7/ 87 mm	2	@@	Reach Negative
Aptos #3	9.8	4.7/ 117 mm	4	@@@@	Site Negative
Aptos #4	9.4	4.7/ 95 mm	3	@@@	Reach Negative
Valencia #2	10.1	0.3/ 83 mm	1	@	Site Negative
Valencia #3	12.4	3.0/ 108 mm	3	@@@	Site Negative
Corralitos #1	9.6	8.3/ 97 mm	4	@@@@	Site Negative
Corralitos #3	11.0	12.1/ 95 mm	4	@@@@	Reach Negative
Corralitos #8	10.9	6.1/ 97 mm	3	@@@	Site Negative
Corralitos #9	16.9	8.3/ 94 mm	4	@@@@	Reach Negative
Shingle Mill #1	9.5	4.2/ 97 mm	3	@@@	Site Negative
Shingle Mill #3	5.0	5.2/ 84 mm	3	@@@	Site Negative
Browns #1	15.3	6.6/ 106 mm	4	@@@@	Site Negative
Browns #2	13.0	7.2/ 92 mm	3	@@@	Site Negative

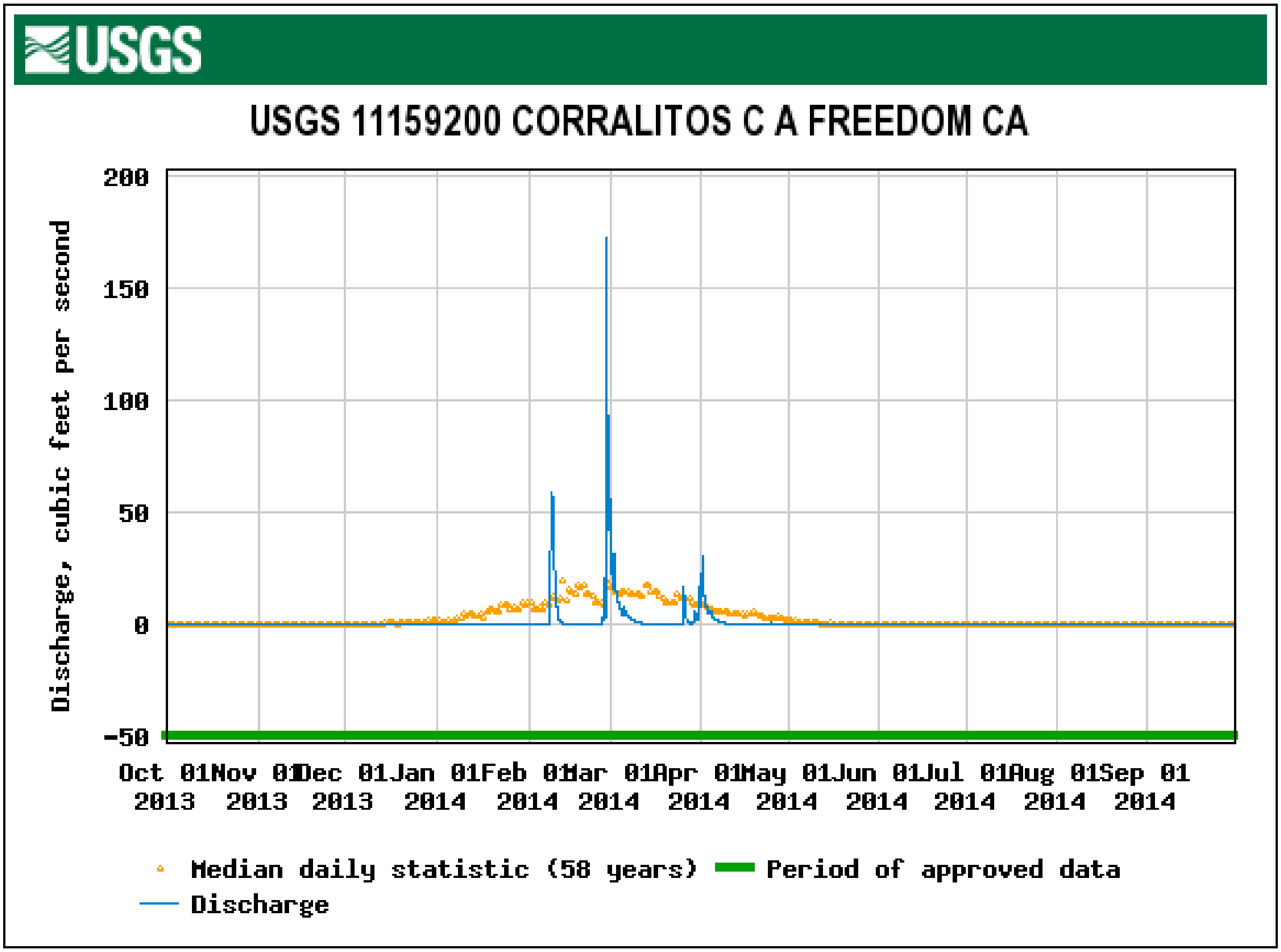


Figure B-43a. The 2014 Discharge at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide a logarithmic scale of discharge).

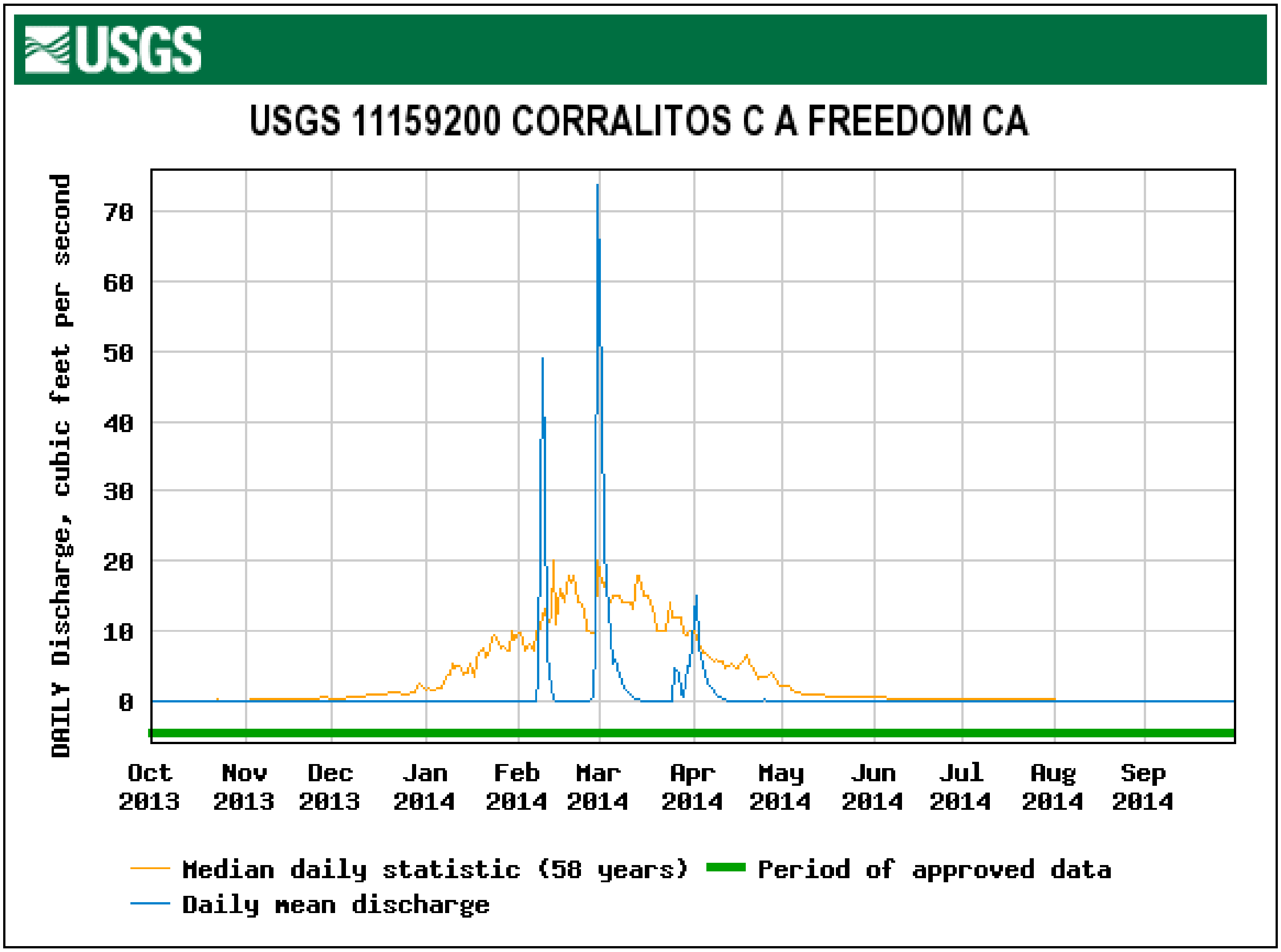


Figure B-43b. The 2014 Daily Mean and Median Flow at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide a logarithmic scale of discharge).

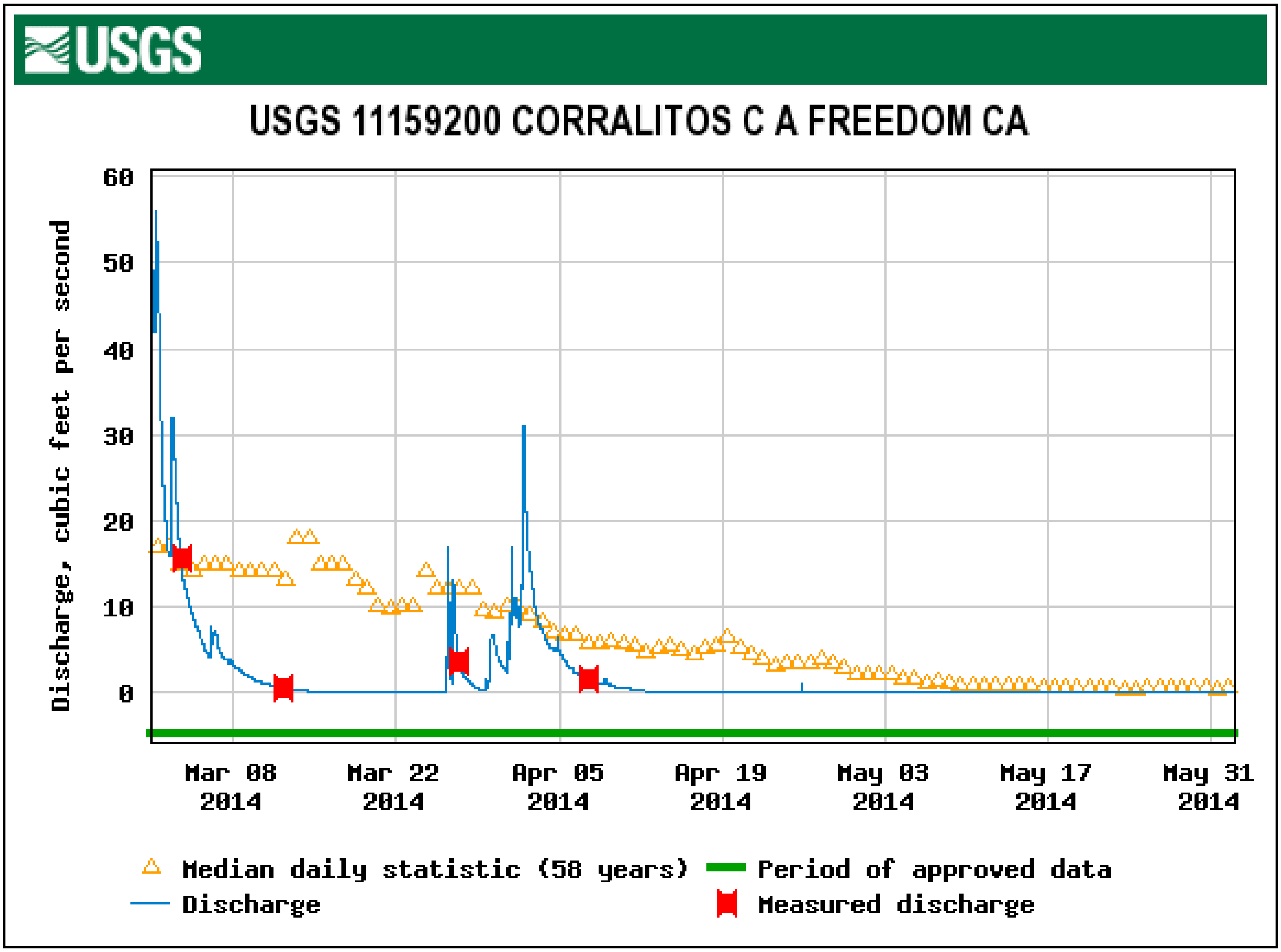


Figure B-44. The March–May 2014 Discharge of Record for the USGS Gage on Corralitos Creek at Freedom.

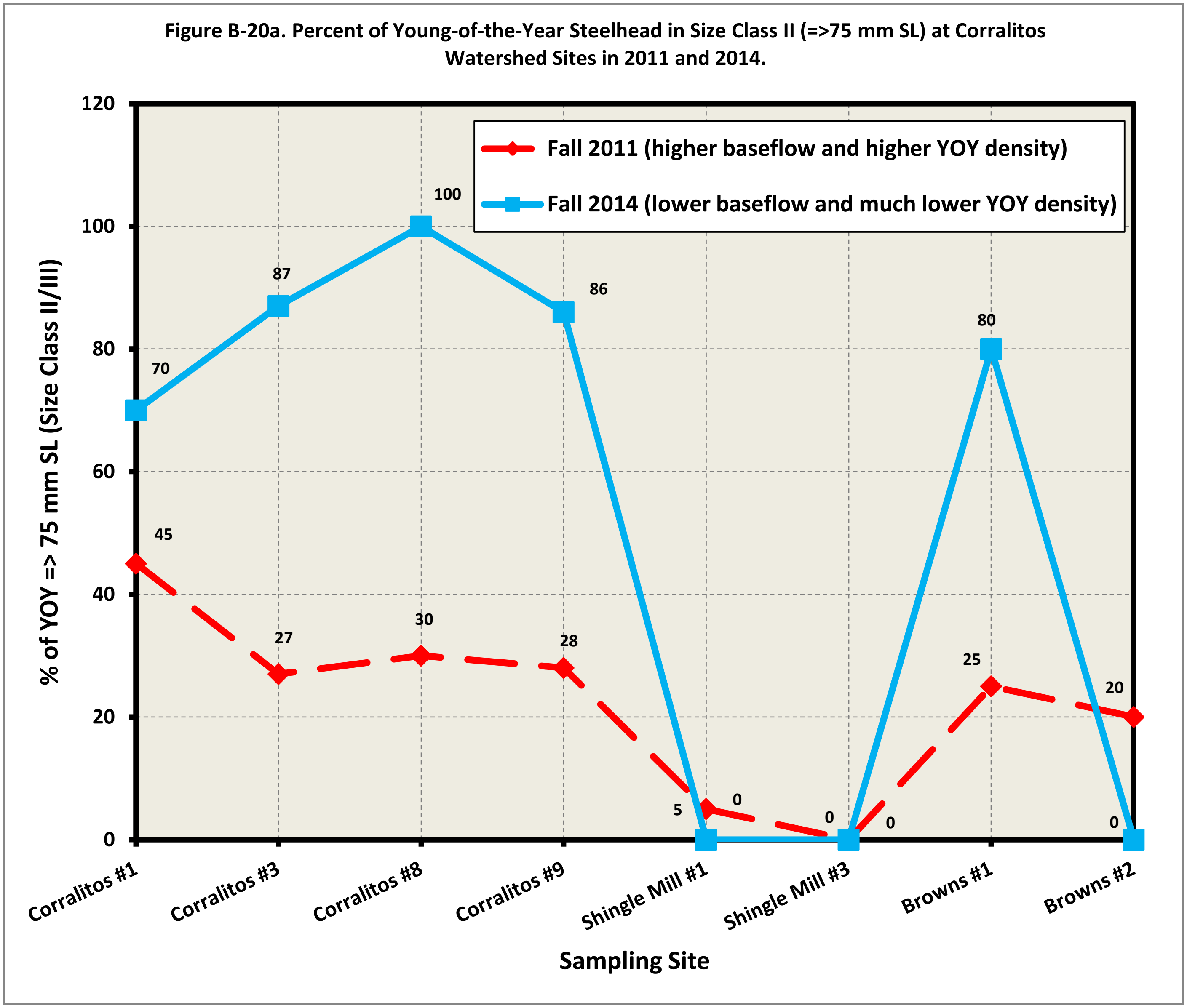


Figure B-20a. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Corralitos Sub-Watershed Sites in 2011 and 2014.

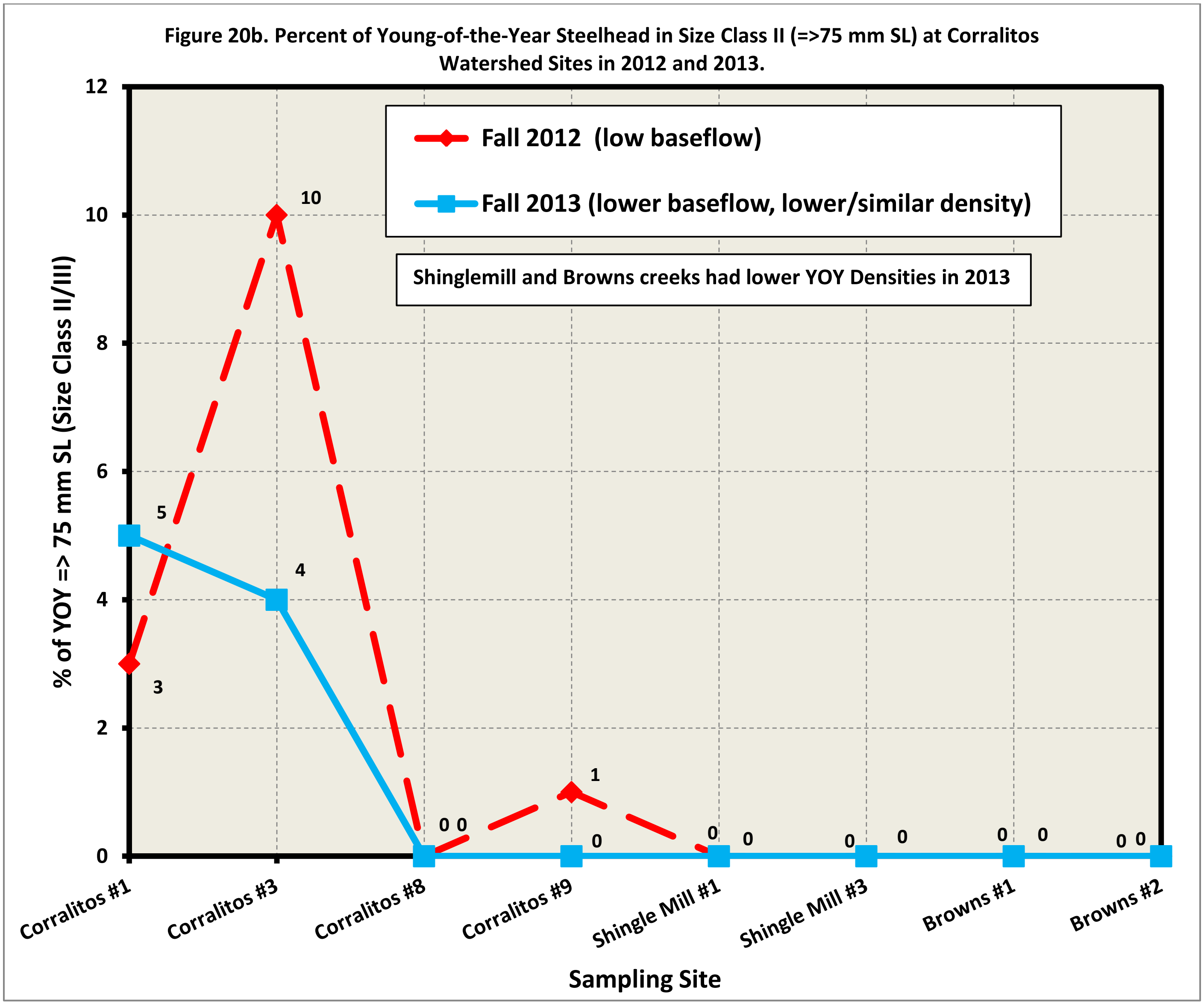


Figure 20b. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Corralitos Sub-Watershed Sites in 2012 and 2013.

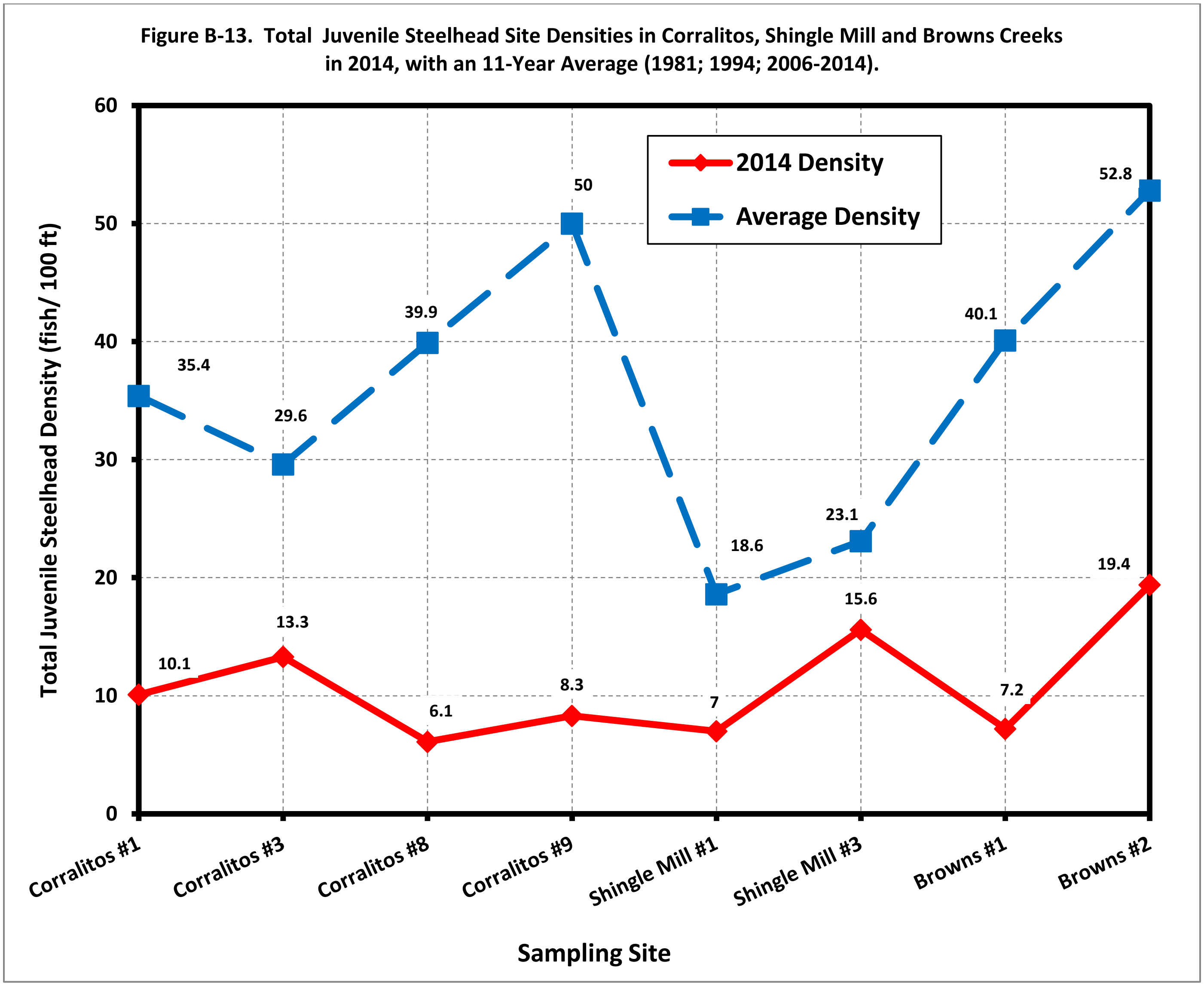


Figure B-13. Total Juvenile Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2014, with an 11-Year Average (1981; 1994; 2006-2014).

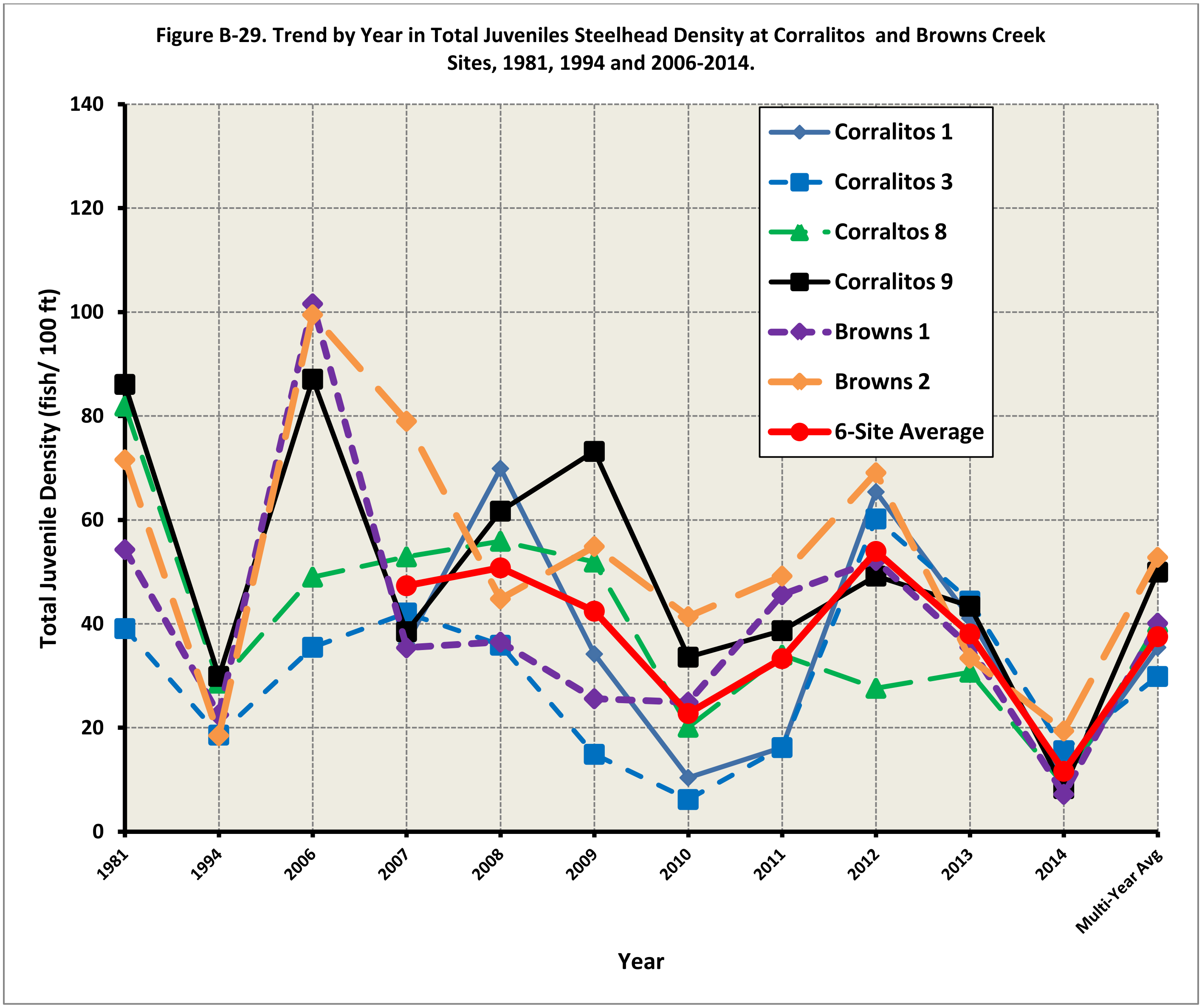


Figure B-29. Trend by Year in Total Juveniles Steelhead Density at Corralitos and Browns Creek Sites, 1981, 1994 and 2006-2014.

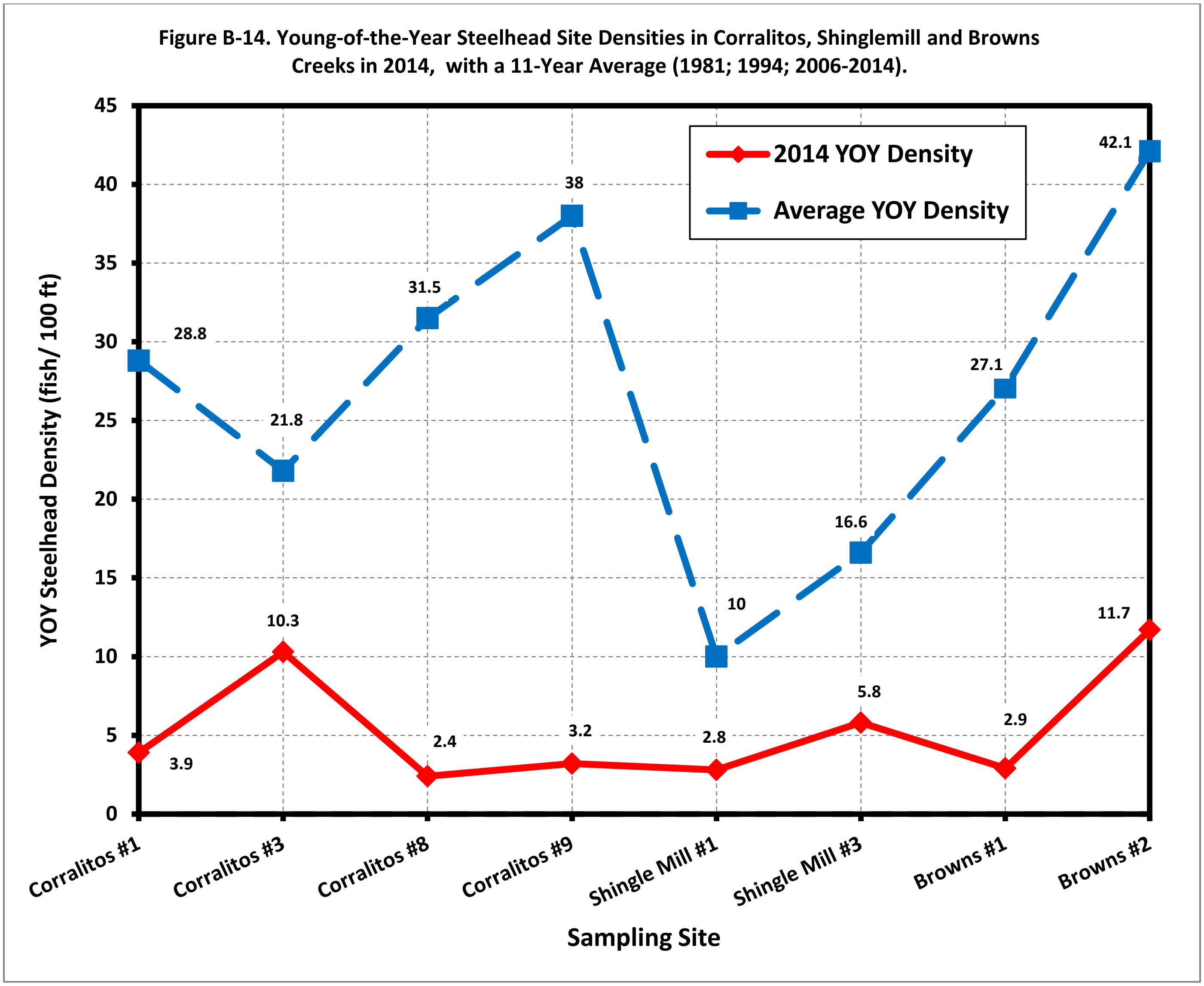


Figure B-14. Young-of-the-Year Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2014, with a 11-Year Average (1981; 1994; 2006-2014).

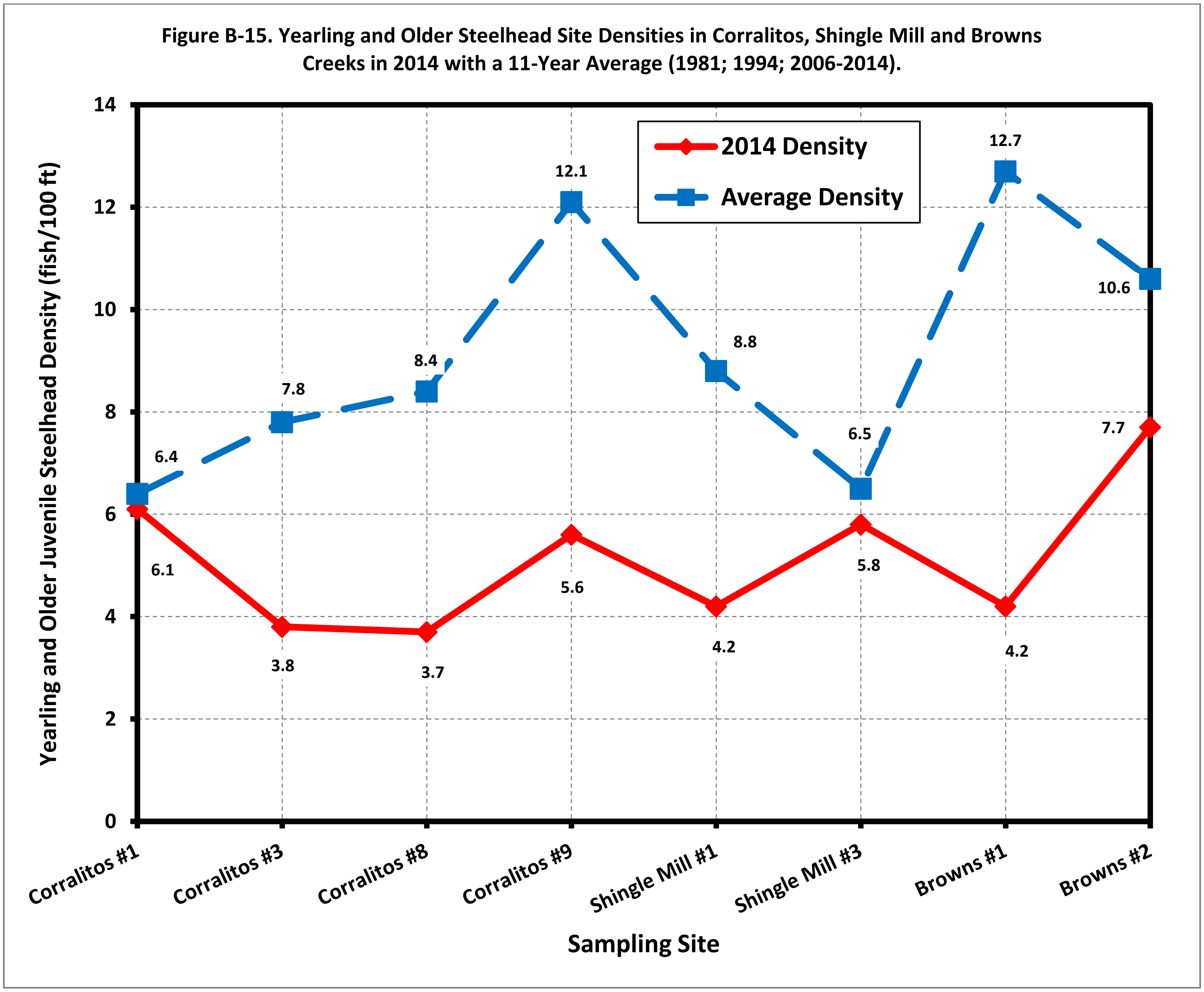


Figure B-15. Yearling and Older Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2014 with a 11-Year Average (1981; 1994; 2006-2014).

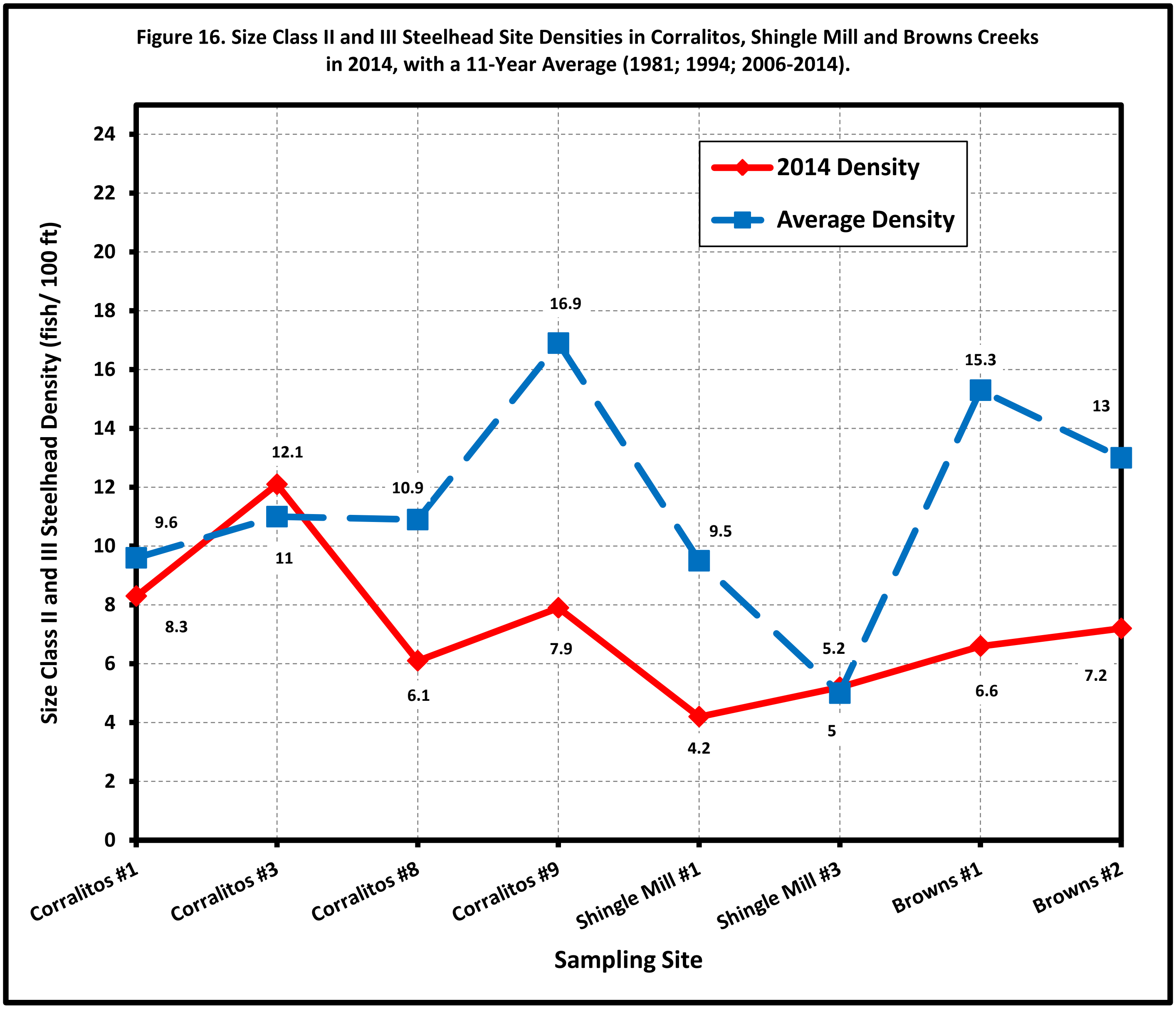


Figure B-16. Size Class II and III Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2014, with a 11-Year Average (1981; 1994; 2006-2014).

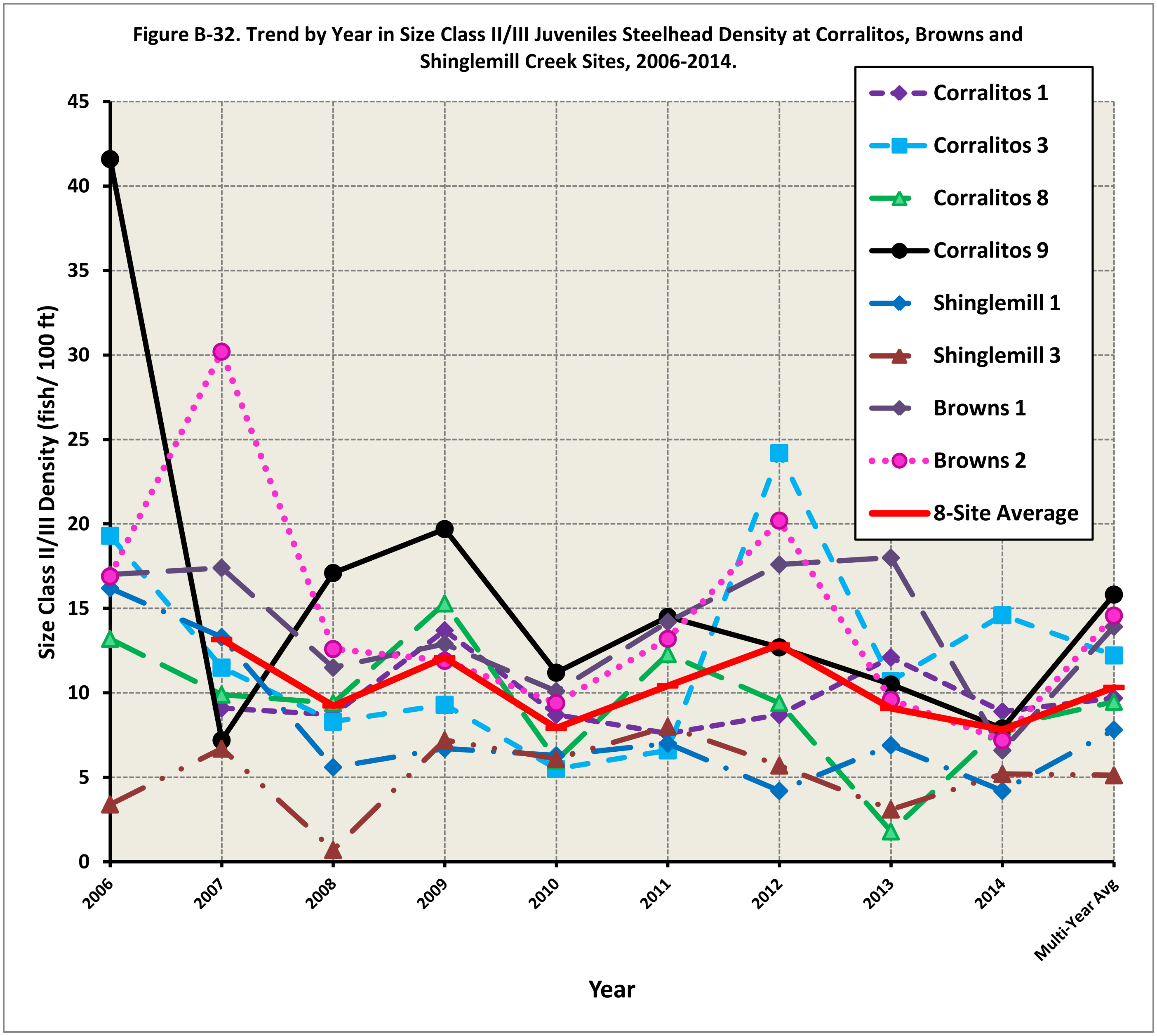


Figure B-32. Trend by Year in Size Class II/III Juveniles Steelhead Density at Corralitos Sub-Watershed Sites, 2006-2014.

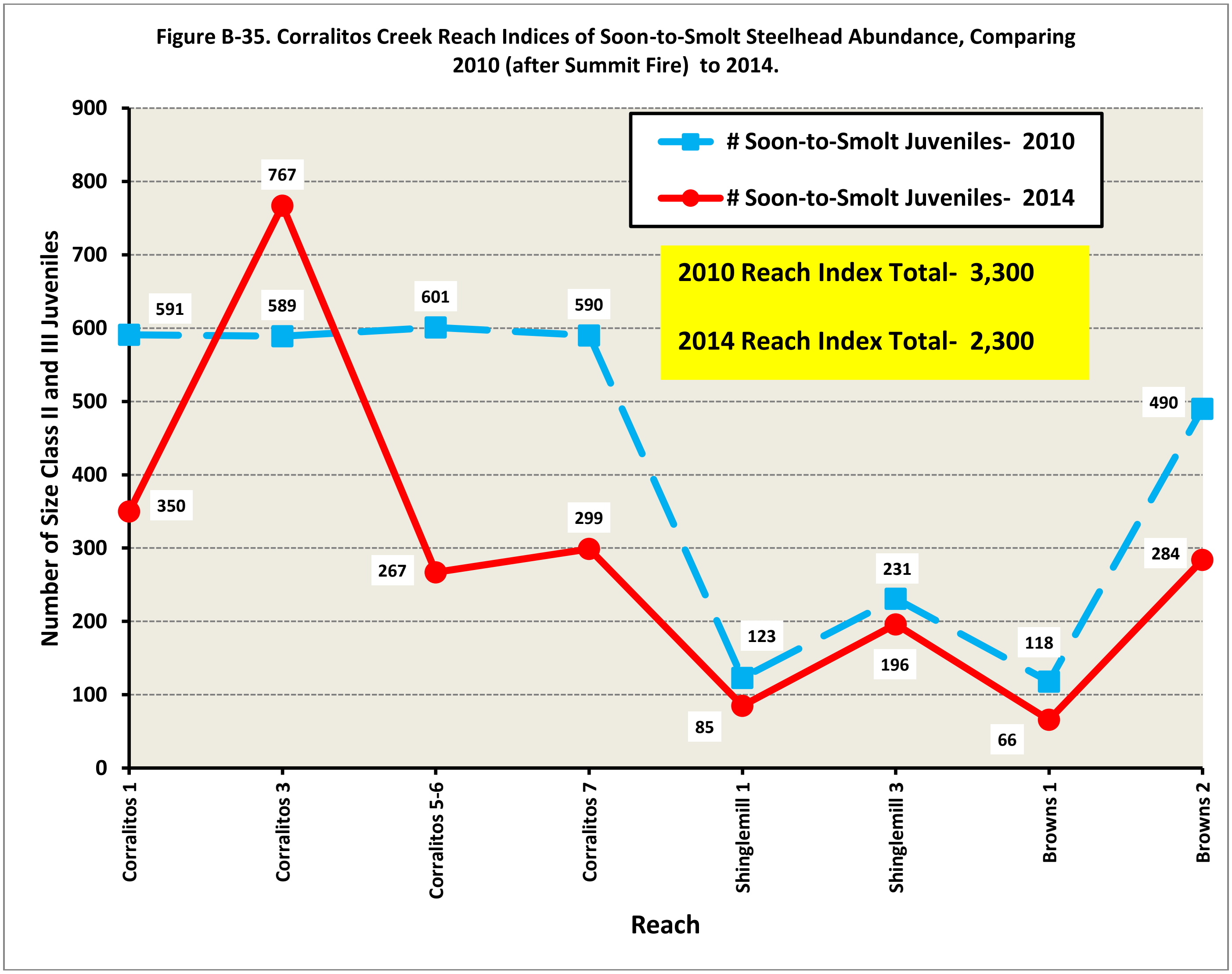


Figure B-35. Corralitos Creek Reach Indices of Soon-to-Smolt Steelhead Abundance, Comparing 2010 to 2014.

Table B-42. 2014 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Their Average Size in Standard Length Compared to 2013, with Physical Habitat Change Since 2013 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	2014 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2014 Smolt Rating (With Size Factored In)	2013 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2013 Smolt Rating (With Size Factored In)	Physical Habitat Change by Reach/Site Since 2013
Low. San Lorenzo #0a	6.2/ 108 mm	**Fair**	4.1/ 94 mm	**Below Average**	−
Low. San Lorenzo #1	1.8/ 125 mm	**Poor**	3.4/ 96 mm	**Poor**	−
Low. San Lorenzo #2	2.4/ 98 mm	**Poor**	6.2/ 88 mm	**Poor**	−
Low. San Lorenzo #4	4.4/ 89 mm	**Below Average**	6.7/ 81 mm	**Poor**	−
Mid. San Lorenzo #6	1.4/ 80 mm	**Very Poor**	2.0/ 108 mm	**Below Average**	−
Mid. San Lorenzo #8	1.4/ 92 mm	**Very Poor**	1.9/ 90 mm	**Very Poor**	−
Mid. San Lorenzo #9	0.6/ 92 mm	**Very Poor**	2.3/ 86 mm	**Very Poor**	−
Up. San Lorenzo #10	None	**Very Poor**	−	−	**− (Since 2005)**
Up. San Lorenzo #11	1.6/ 112 mm	**Poor**	2.3/ 114 mm	**Below Average**	−
Up.San Loren #12b (res. Rt)	21.3/ 92 mm	***Good***	10.0/ 111 mm	***Good***	−
Zayante #13a	2.4/ 89 mm	**Poor**	2.7/ 98 mm	**Poor**	−
Zayante #13c	3.7/ 81 mm	**Very Poor**	8.4/ 87 mm	**Below Average**	−
Zayante #13d	22.1/ 93 mm	***Good***	18.5/ 105 mm	***Very Good***	−
Lompico #13e	6.7/ 94 mm	**Below Average**	8.7/ 104 mm	***Good***	−
Bean #14b	2.8/ 101 mm	**Poor**	12.5/ 90 mm	**Fair**	−
Fall #15a	2.7/ 103 mm	**Below Average**	−	−	
Fall #15b	7.3/ 103 mm	**Fair**	12.1/ 98 mm	**Fair**	−
Newell #16	3.1/ 109 mm	**Below Average**	23.7/ 89 mm	***Good***	−
Boulder #17a	3.8/ 91 mm	**Poor**	3.2/ 118 mm	**Below Average**	−
Boulder #17b	13.0/ 90 mm	**Fair**	10.7/ 96 mm	**Fair**	−
Bear #18a	0.7/ 116 mm	**Poor**	2.6/ 115 mm	**Below Average**	−
Branciforte #21a-2	4.6/ 98 mm	**Below Average**	6.0/ 106 mm	**Fair**	−
Branciforte #21b	7.3/ 98 mm	**Below Average**	13.3/ 100 mm	**Fair**	**− (flow)**
Branciforte #21c (res. Rt)	13.3/103 mm	***Good***	10.0/ 100 mm	**Fair**	**− (flow)**
Soquel #1	0.7/ 102 mm	**Very Poor**	1.8/ 94 mm	**Poor**	−
Soquel #4	4.2/ 98 mm	**Below Average**	2.1/ 110 mm	**Below Average**	−
Soquel #10	2.8/ 89 mm	**Poor**	5.2/ 87 mm	**Poor**	−
Soquel #12	2.8/ 95 mm	**Poor**	3.1/ 82 mm	**Very Poor**	−
East Branch Soquel #13a	4.3/ 100 mm	**Below Average**	6.8/ 106 mm	**Fair**	−
West Branch Soquel #19	2.4/ 92 mm	**Poor**	3.4/ 105 mm	**Below Average**	−
West Branch Soquel #21b	4.7/ 87 mm	**Poor**	−	−	**- (Since 2009)**
Aptos #3	4.7/ 117 mm	**Fair**	5.1/ 103 mm	**Fair**	−
Aptos #4	4.7/ 95 mm	**Below Average**	6.1/ 120 mm	**Fair**	−
Valencia #2	0.3/ 83 mm	**Very Poor**	-	-	−
Valencia #3	3.0/ 108 mm	**Below Average**	-	-	**− (Since 2009)**
Corralitos #1	8.3/ 97 mm	**Fair**	12.1/ 110 mm	***Good***	**—**
Corralitos #3	12.1/ 95 mm	**Fair**	10.7/ 105 mm	***Good***	**—**
Corralitos #8	6.1/ 97 mm	**Below Average**	1.8/ 130 mm	**Poor**	**—**
Corralitos #9	8.3/ 94 mm	**Fair**	10.5/ 108 mm	***Good***	**—**
Shingle Mill #1	4.2/ 97 mm	**Below Average**	6.9/ 94 mm	**Below Average**	**—**
Shingle Mill #3	5.2/ 84 mm	**Below Average**	3.1/ 86 mm	**Very Poor**	**—**
Browns #1	6.6/ 106 mm	**Fair**	18.0/ 96 mm	***Good***	**—**
Browns #2	7.2/ 92 mm	**Below Average**	9.6/ 101 mm	**Fair**	**—**

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, to cool water temperatures for coho re-introduction.

2. In Soquel Creek, develop better water management and conservation, with the goal of reducing spring and early summer water diversion/pumpage and maximizing baseflow. Much of East Branch Soquel went dry in 2014. Educational outreach to capture and store more winter rains should be directed to streamside landowners, quarry owners, agriculturalists and nursery owners to maintain surface flow and increase baseflow. With increased baseflows, steelhead growth rate and densities of soon-to-smolt sized juveniles will likely increase.

3. Perform erosion control at the Highland Way slide on East Branch Soquel Creek to reduce chronic sedimentation from that site that presently degrades spawning and rearing habitat for more than 15 miles downstream to the lagoon.

4. Implement the fishery enhancement projects identified in the San Lorenzo River Salmonid Enhancement Plan (**Alley et al. 2004**). There are multiple low flow passage impediments which may substantially impede or prevent adult salmonid passage in mild winters like 2013 and 2014. Remove or modify fish passage impediments that were identified in the 2004 Plan and those rated as high and moderate priority in surveys performed recently by Santa Cruz County staff (**Kittleson 2015a; 2015b**). If many of the remnant flashboard dam abutments with associated walls and openings collect instream wood in the future, they may become very significant impediments even in wetter winters if they become jammed with wood, as they may have been in the past. Such flashboard dams should be routinely inspected to detect any log jams that may have formed on them during winter/spring stormflows. These low flow impediments may significantly inhibit coho recovery if not addressed, because entire year classes may be weakened if adult access to the watershed is largely prevented when early winter storms are lacking. The cold water refuges required for coho rearing are located in the upper mainstem and tributaries of the upper watershed, where access must be insured. At least 6 impediments that will impede adult salmonid passage during mild winters were present in the lower and middle mainstem San Lorenzo (**Alley et al. 2004**). They included the Rincon riffle, Four Rock boulder field (partially modified), the Huckleberry Island flashboard dam in Brookdale and the Barker's Dam between the Erwin Way bridges (**see photo below**) (**Alley et al. 2004**).

5. Prioritize and remove/modify high and moderate priority adult salmonid passage impediments identified in Reaches 10−12 on the upper mainstem San Lorenzo between the Boulder Creek

confluence and Waterman Gap (**Kittleson 2015b**). At least 6 potentially significant impediments during mild winters were present in the upper mainstem above the Boulder Creek confluence. They included the flashboard dam abutment upstream of the Brimblecom Road Bridge, the collapsed flashboard dam abutment above the Kings Creek confluence, the concrete sill downstream of the Either Way Bridge, the San Lorenzo Woods remnant dam abutment just upstream of the Fern Drive Bridge, the Highway 9 culvert apron in Waterman Gap (**see photo below**) and the Waterman Gap road ford. The juvenile steelhead density at the Teihl Site 11 has been very low for several years, indicating poor adult passage. The same was true for Site 10 below the Kings Creek confluence in 2014. The San Lorenzo salmonid population in Waterman Gap (above the Highway 9 culvert and concrete apron and above the concrete road ford) has the size structure of a typical resident rainbow trout population. Steelhead redds have been observed above Highway 9 in the past (**K. Kittleson pers. observation**).

6. After passage at the Highway 9 culvert is improved, 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 location.

7. Remove/modify the remnant flashboard dam on lower Bear Creek. It is located downstream of the Lanktree bridge. Based on results at our Bear Creek 18a sampling site, it appeared to be a total adult steelhead barrier in 2013 and 2014 because it periodically collects jams of instream wood (**see photo below**). The walls that create a narrow opening through this remnant dam should be removed, at the very least.

8. 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.

9. 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.

10. 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.

11. The San Lorenzo Lagoon provides important steelhead habitat in the watershed. Support efforts to allow the sandbar to form naturally and to allow sufficient stream inflow to convert the lagoon to freshwater as quickly as possible after sandbar closure.

12. Prevent artificial summertime breaching of the sandbar at the mouth of the San Lorenzo River.

13. Along Bean Creek (tributary to Zayante Creek) and East Branch Soquel Creek, perform educational outreach to promote better water conservation and winter water storage to reduce summer well pumping and water diversion. The goal is to maintain surface streamflow in the heavily used steelhead segment between Ruins and MacKenzie creek confluences, which go dry annually, as well as in the reach between MacKenzie creek confluence and at least the Redwood Glen Camp upstream, which goes dry in drier years.

14. In Fall Creek, notch the fallen old-growth Douglas fir across the channel to improve adult passage. Dislodge the redwood logs previously installed across the stream channel, downstream of the island below the bridge to improve adult steelhead passage.

15. 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.

16. In Branciforte Creek, prioritize and remove/modify high and moderate priority man-made adult steelhead passage impediments identified in recent county surveys. Some of the more important ones included the Branciforte flood control channel (**see photo below**), the logjam at De Laveaga Park, the Santa Vida ford, the Happy Valley dam remnant #1, a collapsed bridge, the remnant Santa Cruz diversion dam abutment and the Casa de Montgomery rock dams (**Kittleson 2015b**).

17. Aptos Lagoon should be closely monitored for unauthorized sandbar breaching, juvenile abundance and water quality. Install educational signs that explain the importance of leaving the sandbar alone once it naturally forms in summer. Individuals who illegally breach the sandbar in summer should be prosecuted.

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

19. 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.

20. 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, as appeared to be the case in 2014, develop a program of well pumping, water diversion and aquifer recharge that is compatible with successful steelhead migration to and from the Corralitos sub-watershed.

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

22. 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.

23. 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.

24. Add County streamflow monitoring sites that would better supplement the fishery work. Add sites in Bean Creek 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 temporary stream gages on Zayante, Boulder and Fall creeks as part of a streamflow monitoring project.

Branciforte Creek Flood Control Channel

Barker Dam on the middle mainstem San Lorenzo River− Reach 9
(below Boulder Creek confluence at Spring Creek confluence).

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

Flashboard dam on Bear Creek, downstream of Lanktree Bridge.

REFERENCES AND COMMUNICATIONS

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

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

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

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

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

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

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

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

Alley, D.W. 2013. 2012 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California.

Alley, D.W. 2014. Soquel Lagoon Monitoring Report, 2013. Prepared for the City of Capitola.

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

REFERENCES AND COMMUNICATIONS (continued)

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

Casagrande, J. 2012. Uvas and Llagas Creek Juvenile Steelhead Distribution and Abundance, 2011. Unpublished report. 49 pp.

Casagrande, J. 2012. Personal Communication. NOAA Fisheries Biologist. Santa Rosa, CA.

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

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

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

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

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

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

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

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

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

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

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

APPENDIX A. WATERSHED MAPS.

Figure 1. Santa Cruz County Watersheds.

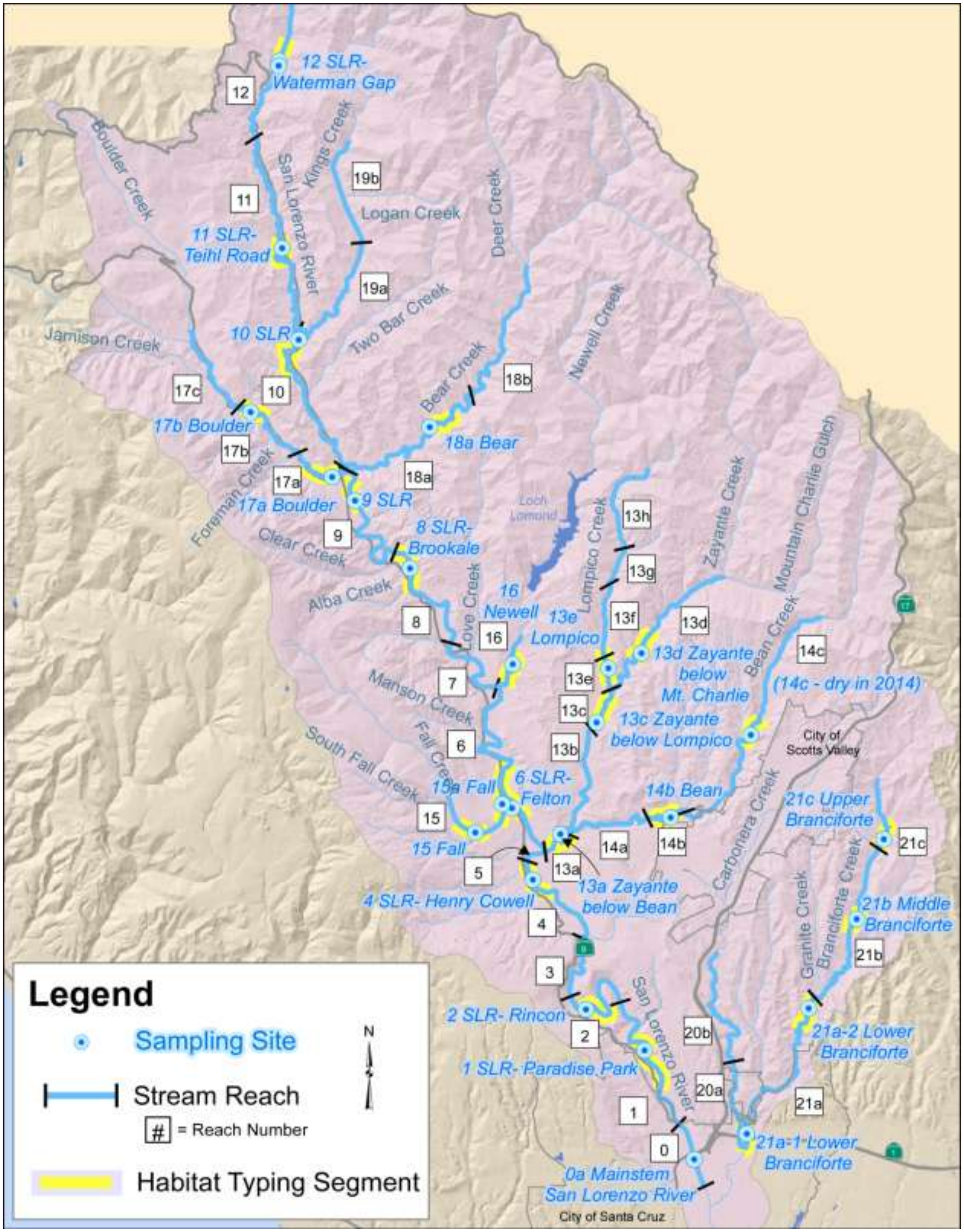


Figure 2. San Lorenzo River Watershed– Sampling Sites and Reaches.

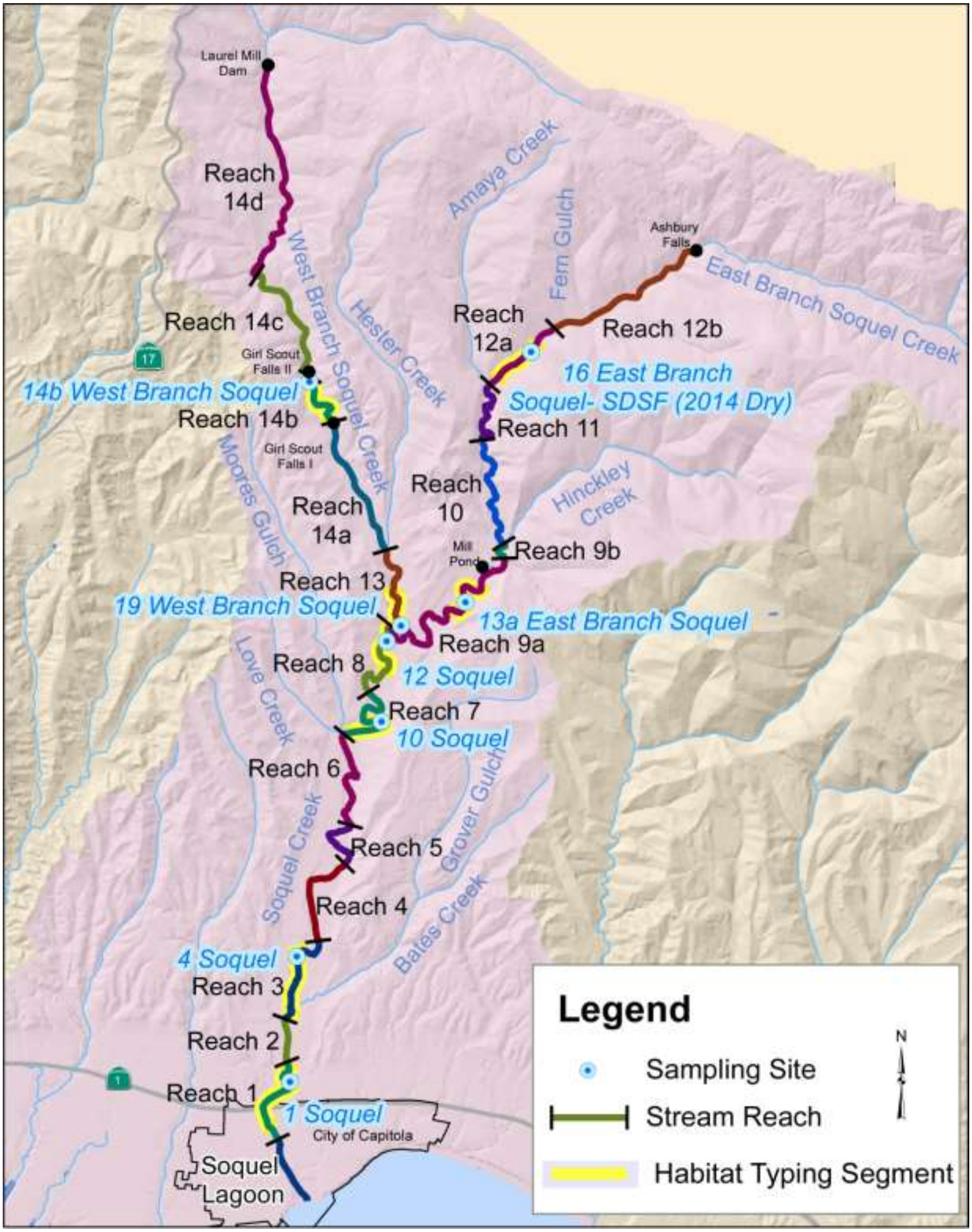


Figure 3. Soquel Creek Watershed.

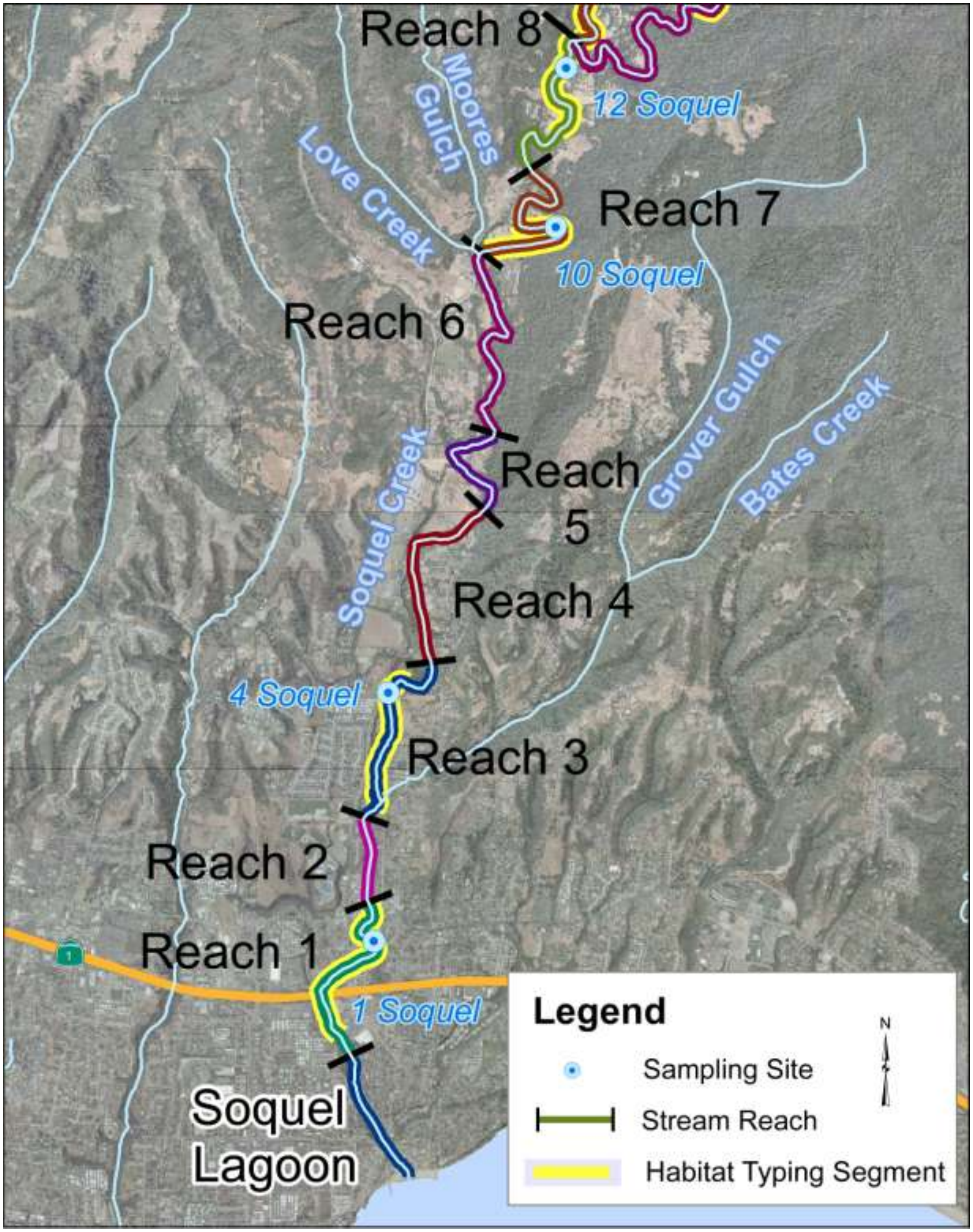


Figure 4. Lower Soquel Creek (Reaches 1–8 on Mainstem).

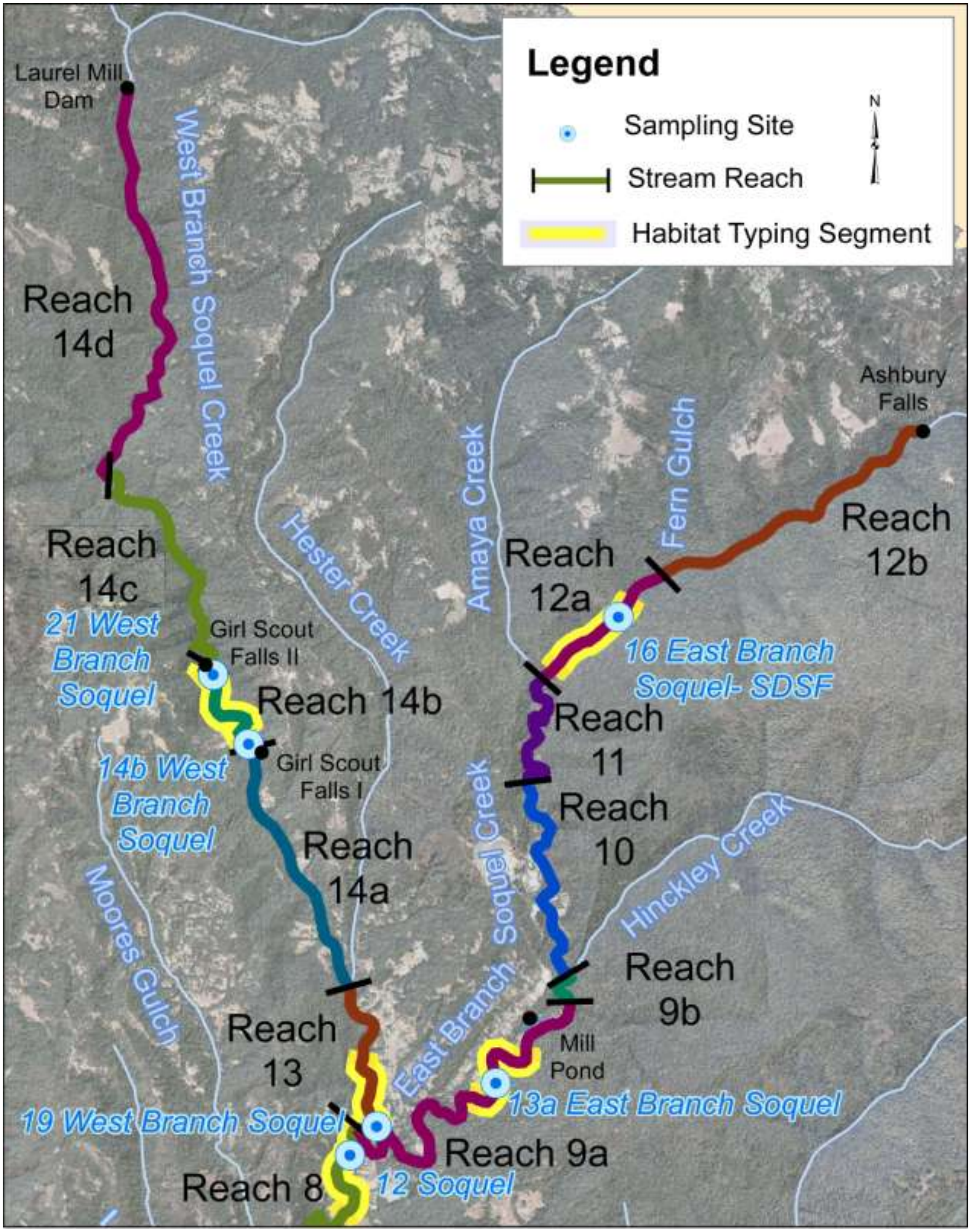


Figure 5. Upper Soquel Creek Watershed (East and West Branches; Reach 9a below habitat-typed segment and Reach 12a were dry in 2014).

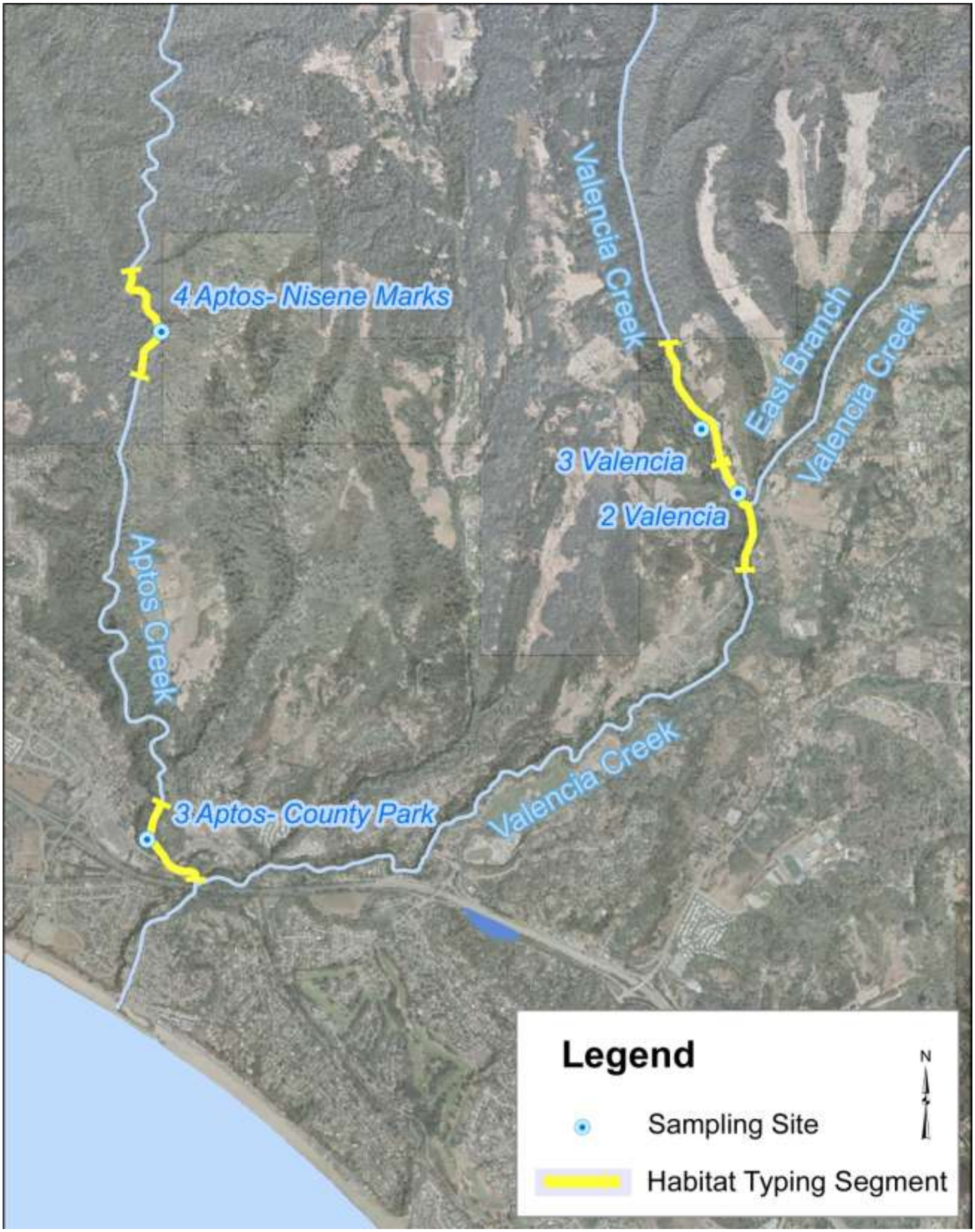


Figure 6. Aptos Creek Watershed (Aptos Lagoon also sampled).

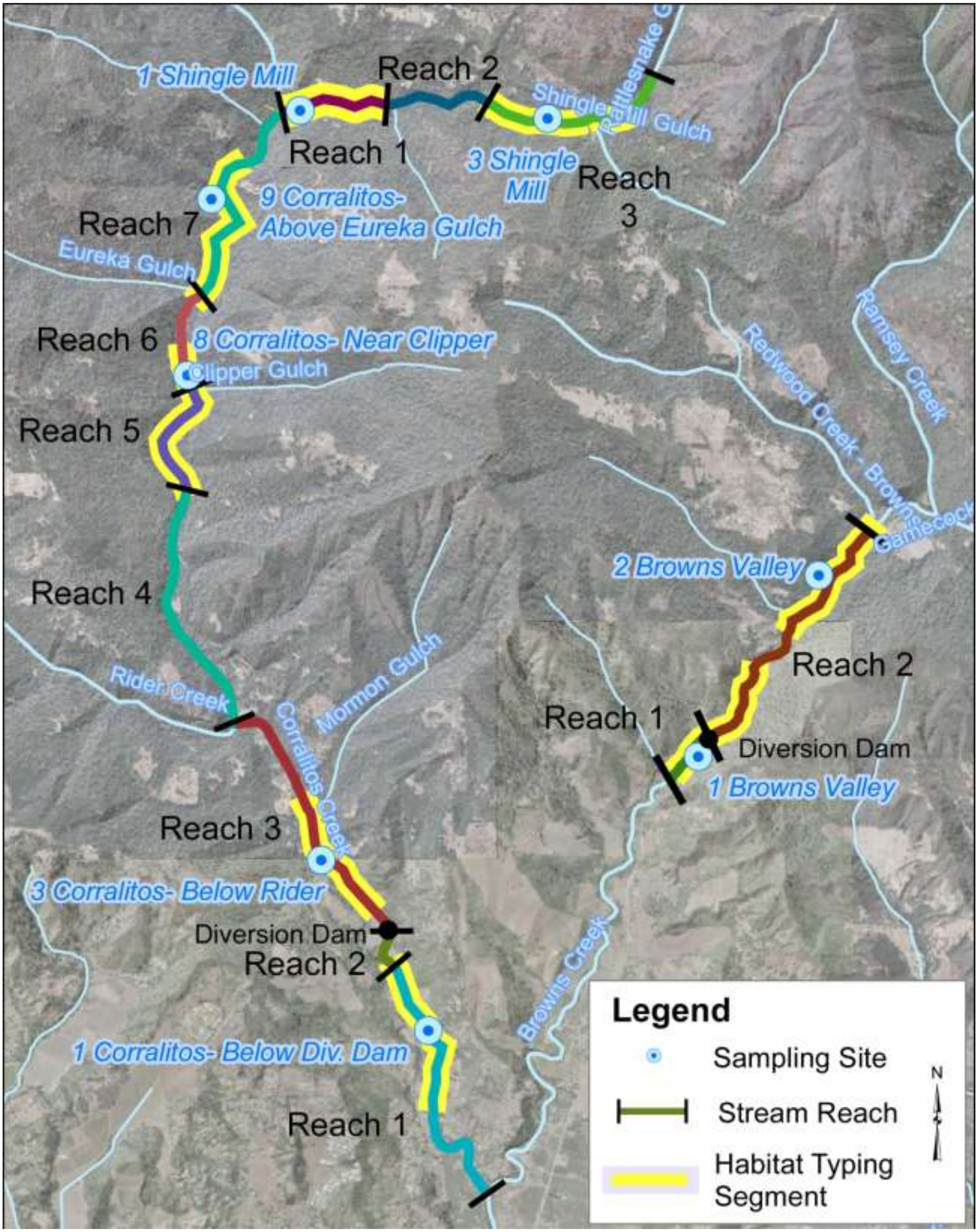


Figure 7. Upper Corralitos Creek Sub-Watershed of the Pajaro River Watershed

APPENDIX B. DETAILED ANALYSIS OF 2014 STEELHEAD MONITORING IN THE SAN LORENZO, SOQUEL, APTOS AND CORRALITOS WATERSHEDS

(Provided electronically in a separate PDF file.)

APPENDIX C. SUMMARY OF 2014 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.)