

2024 SUMMARY REPORT– Juvenile Steelhead Densities and Indices of Juvenile Production in the San Lorenzo, Soquel and Aptos Watersheds, Santa Cruz County, CA



Bean Creek through Mt. Hermon Reach 14a with, from left to right, Chad Steiner (Fishery Biologist), Ben Johnson (Big Creek Hatchery) and Jon Jankovitz (CDFW) taking steelhead genetic samples.

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Funding from the

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

(Sampling for Tidewater Goby under USFWS Endangered Species Recovery Permit TE-793645-5)

March 2025

Project # 200-22

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A. ABSTRACT

Baseflow in Water Year 2024 in the San Lorenzo (SLR), Soquel and Aptos watersheds was relatively high and above the median flow statistic after an even higher baseflow in 2023. The 3 more than bankfull flows in January and February provided good adult steelhead spawning access and nesting conditions. However, these high stormflows likely scoured out or smothered some spawning redds, leading to poor egg survival with significant sediment transport in these sandy watersheds. This likely led to reduced YOY densities in all three watersheds. Higher baseflow provides relatively good rearing habitat for juvenile steelhead. Relatively high baseflow above the median enhanced food supply (insect drift), as evidenced by a higher proportion of YOY reaching Size Class II than in lower baseflow years, because in fastwater habitat where most aquatic insects are produced, water velocity, surface area and depth are enhanced in higher baseflow years. The rate of insect drift would be higher with greater water velocity through riffles, runs and heads of pools to accelerate the conveyor belt of food to juvenile steelhead, resulting in larger juveniles. Juvenile densities at the heads of pools generally increase in the lower San Lorenzo River Mainstem during higher baseflow years with higher water velocity at their heads. Depth in pool and fastwater habitat generally increased for habitat enhancement. Increased baseflow brought relatively cooler summer water temperature to reduce metabolic energy costs and increase fish growthrate compared to lower baseflow years. A higher proportion of young-of-the-year (YOY) steelhead grew into Size Class II (\Rightarrow 75 mm Standard Length (SL)) than previous dry years, encouraging them to smolt the following spring instead of spending two growing seasons in freshwater and risk higher mortality before migrating to the Monterey Bay.

The multiple high stormflows during the previous wet season resulted in evidence in some SLR reaches of increased percent fine sediment and/or increased embeddedness of cobbles and boulders. Considerable sediment was still moving through Fall Creek after the 2020 CZU fire, leading to shallower pools, more fine sediment and embeddedness in fastwater habitat and reduced escape cover upstream of the fish ladder. Boulder Creek showed no further habitat degradation from fire-related sediment impacts. Both Fall and Boulder creeks benefitted from elevated baseflow since the fire. Less food as insect drift was available compared to 2023, which had higher baseflow. The reduced food factor in 2024 made overall habitat quality reduced compared to 2023 except in Branciforte Creek where baseflow was similar between years, leading to no overall habitat quality change in lower Branciforte and higher habitat quality in upper Branciforte Creek in 2024. Elsewhere in the SLR watershed, average pool depth was generally less than in 2023, consistent with reduced 2024 baseflow but deeper than previous drought years and sometimes with deeper maximum pool depth compared to 2023. Pool escape cover generally increased in SLR reaches and sites compared to 2023 and earlier drought years except at Mainstem 12b in Waterman Gap (high sedimentation), upper Fall 15b, Newell 16, Zayante 13d below Mt. Charlie Gulch (small decrease in a cover-rich reach) and lower Branciforte 21a-2.

Soquel Creek had a WY2024 hydrograph similar to the San Lorenzo drainage, with stormflows at the same frequency and with similar intensity except for higher intensity in early March. The 4 stormflows near or above bankfull were sufficient to scour redds or smother them to reduce egg survival, especially in this sand-laden watershed, particularly in the Mainstem downstream of Moores Gulch. All Soquel Creek reaches/sites had habitat degradation resulting from reduced baseflow and less food available compared to 2023. When three habitat typed reach segments were compared to 2023, all showed reduced habitat depth. Lower West Branch 13 had more pool cover and the two lowermost Mainstem reaches had similar pool cover. Upper Mainstem Reach 8 had less pool cover than in 2022, and Lower East Branch Reach 9a had more than in 2021. When habitat conditions at four 2024 sites were compared to 2023, Mainstem 10 had reduced average pool depth but much more cover. East Branch 16 had shallower pools but more escape cover. Mainstem 6 and Upper West Branch 21 had deeper maximum pool depth and more pool cover. Percent fine sediment and embeddedness were generally similar in 2024 to past conditions except notably in Reach 9a below Mill Pond, which showed degradation in both factors since 2021 measurements. A plant nursery and former surface water diverter from mainstem Soquel Creek closed downstream of Moores Gulch

in 2023. This continued to enhance summer baseflow in Soquel Creek in 2024.

Aptos Creek likely had a WY2024 hydrograph similar to that in the Soquel drainage, with stormflows at the same frequency and with similar intensity. These stormflows likely provided good adult steelhead spawning access and nesting conditions, though egg survival was likely low after the larger stormflows near or above bankfull due to redd scour and/or smothering with sand, especially in lower Aptos and all of sandy Valencia Creek. Habitat conditions declined in the Aptos Creek arm of the watershed primarily due to reduced baseflow (less food, increased fine sediment in lower Aptos and reduced average pool depth in upper Aptos. Habitat conditions generally improved in Valencia Creek from the recent past due to increased pool depth and pool escape cover, despite slightly lower baseflow compared to 2023 (site comparison) and much higher baseflow compared to 2021 (reach comparison).

Total and YOY steelhead densities were below average at most sites in the San Lorenzo, Soquel and Aptos watersheds in 2024. Densities of Size Class II/III juveniles, made up of faster growing YOY and yearlings were above average at the majority of sites as they were in the higher baseflow 2023, and differences in density between 2024 and 2023 were not statistically significant in any of the 3 watersheds. Unusually below average Size Class II/III densities for a high baseflow year occurred at the 3 lowermost mainstem sites in the SLR and Soquel Creek and the downstream site in Aptos Creek. Longterm density trends declined somewhat in 2024 for these soon-to-smolt juveniles in the SLR, remained the same in Soquel and increased in Aptos watershed compared to the higher baseflow 2023 and remained substantially higher than during drought years. The average length of juveniles captured at San Lorenzo sampling sites fit the higher baseflow year pattern of larger size compared to smaller size in low baseflow years. The trend in densities and production indices of Size Class II/III in selected reaches continued to track very positively with the average 5-month (May-September) baseflow metric in all three watersheds. In the San Lorenzo watershed, the production index increased from 17,741 in 2023 to 19,045 in 2024, which was typically relatively high for a high baseflow year and increased primarily due to retention of more yearlings in 2024 than 2023. In the Soquel watershed, the production index for larger juveniles decreased slightly from 4,194 in 2023 to 3,856 in 2024, both being relatively high and consistent with higher baseflow years. In Aptos Creek the production index continued to increase from 462 in 2023 to 582 in 2024 when densities of these larger juveniles were still below average.

The juvenile steelhead population estimate for the Aptos Estuary was relatively high at 312 (fourth highest in 12 years of censusing), with 78 steelhead captured the first day and 72 the second (a week later), with 18 recaptures. Tidewater gobies were not detected in the estuary, though low salinity and adequate oxygen were present in the shallow margins to provide habitat. The main body of the estuary to the west of the jetty had nearly achieved freshwater conversion by the second day of sampling, 4 October.

B. INTRODUCTION

i. Scope of Work

In fall 2024, three Santa Cruz County watersheds were sampled for juvenile steelhead to primarily compare juvenile abundance at multiple stratified sites to assess annual trends and compare habitat conditions with those in 2023 and past years in selected reaches. The three watersheds were the San Lorenzo, Soquel and Aptos drainages (**Figures 1–3**). Results of salmonid sampling and habitat monitoring guide watershed management and planning (including implementation of public works projects) and enhancement for species recovery. Refer to the Santa Cruz County Environmental Health website <http://scceh.com/steelhead.aspx> for the database and sampling site photos. Hydrographs of previous sampling years are also available at the website. Methods of data collection and tables of habitat conditions and steelhead density since 1997 are available upon request, and past reports that include the methods are available at the county website. Sampling sites represented average habitat conditions regarding escape cover and water depth within reaches, based on systematic and consistent habitat typing of ½-mile segments within designated reaches. Commonly used terms are defined in the glossary.

ii. Study Area

San Lorenzo River. The Mainstem San Lorenzo River and 8 tributaries were sampled at 26 sites (10 Mainstem and 16 tributary sites) (**Figure 1**). Tributaries included Branciforte, Zayante, Bean, Fall, Newell, Boulder and Bear creeks. Eight 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 18 sites, the 2023 site locations were replicated for fish sampling. Depth, cover, percent fines, embeddedness, percent tree canopy and water temperature were measured at sampling sites.

Soquel Creek. Soquel Creek and its branches were sampled at 9 sites (5 Mainstem and 4 branch sites), Site 6 in Reach 4 added in 2020 after a 15-year break. Five half-mile segments were habitat typed to assess habitat conditions and select habitats of average quality to sample for fish density (**Figure 2**). For the remaining 4 sites, the 2023 sites were replicated for fish sampling. Depth, cover, percent fines, embeddedness, percent tree canopy and water temperature were measured at sampling sites.

Aptos Creek and Lagoon/Estuary. Aptos watershed was sampled for steelhead at two Aptos and two Valencia creek sites, as well as at the estuary (**Figure 3**). After habitat typing of the lower Aptos Creek segment 3 and upper Valencia Creek segment 3, sites were chosen for sampling, and the other two sites were replicated at 2023 locations. Depth, cover, percent fines, embeddedness, percent tree canopy and water temperature were measured at all sampling sites. Water quality conditions were measured during estuary sampling. In the estuary, a steelhead population estimate was made with a mark and recapture effort on 2 days in late September and early October, using a beach seine with a central bag.

Pajaro River Lagoon/Estuary. Pajaro River Estuary was sampled in early October for steelhead and tidewater goby, using a large beach seine with a central bag for steelhead and a smaller, fine-meshed beach seine for tidewater goby. Water quality conditions were measured during sampling. Results are presented in a separate report to the Santa Cruz County flood control district and available upon request.

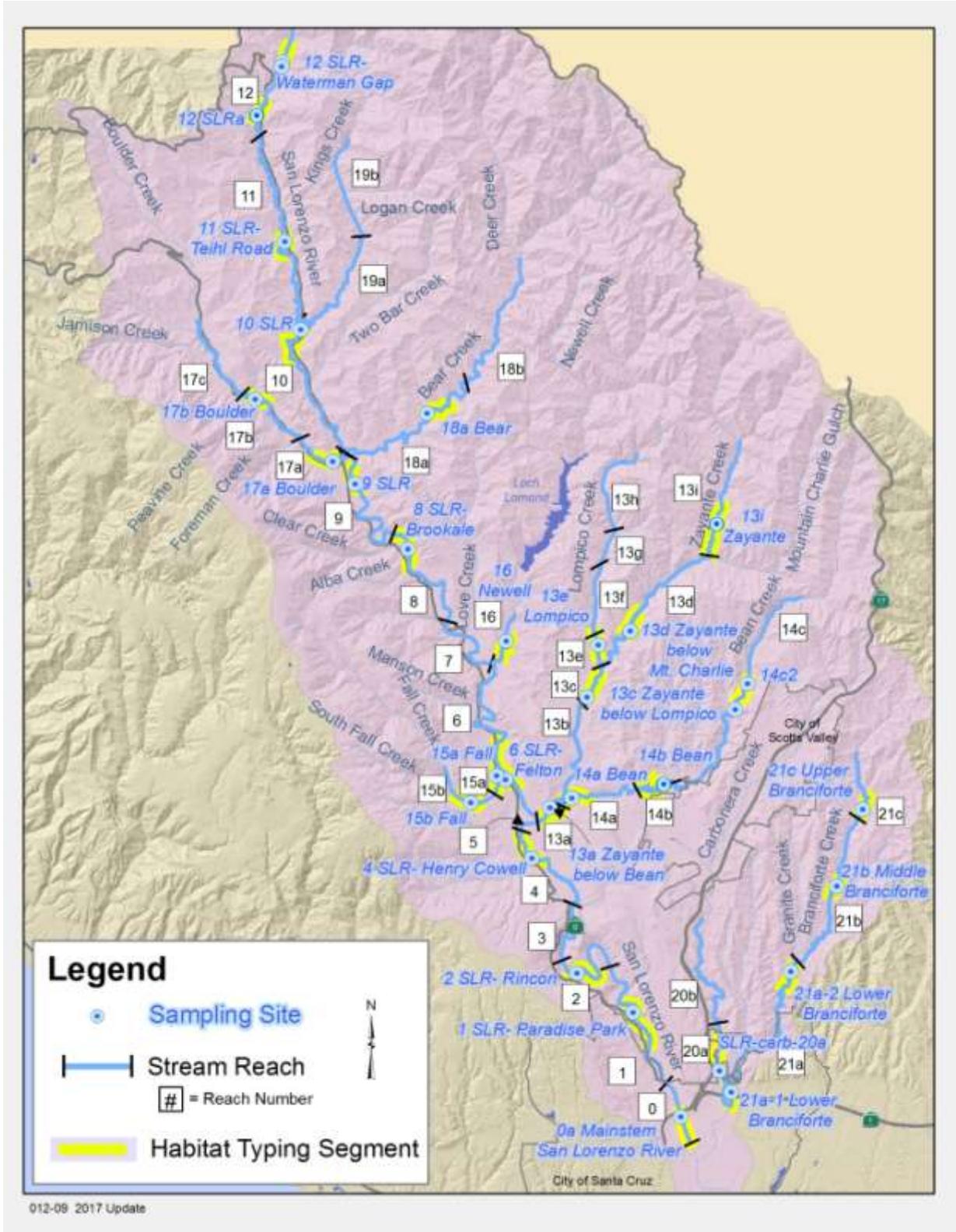


Figure 1. San Lorenzo River Watershed– Sampling Sites and Reaches.

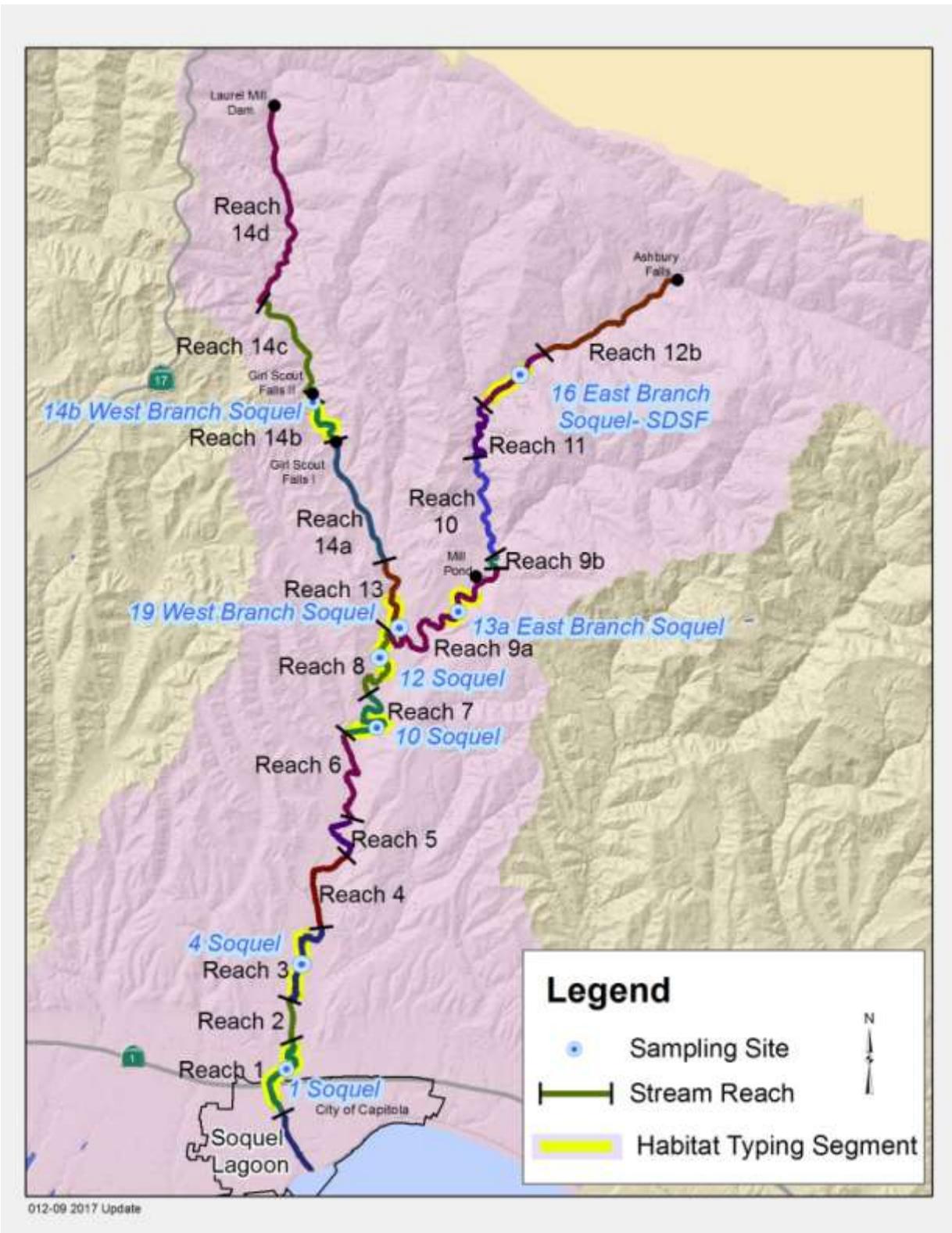


Figure 2. Soquel Creek Watershed.

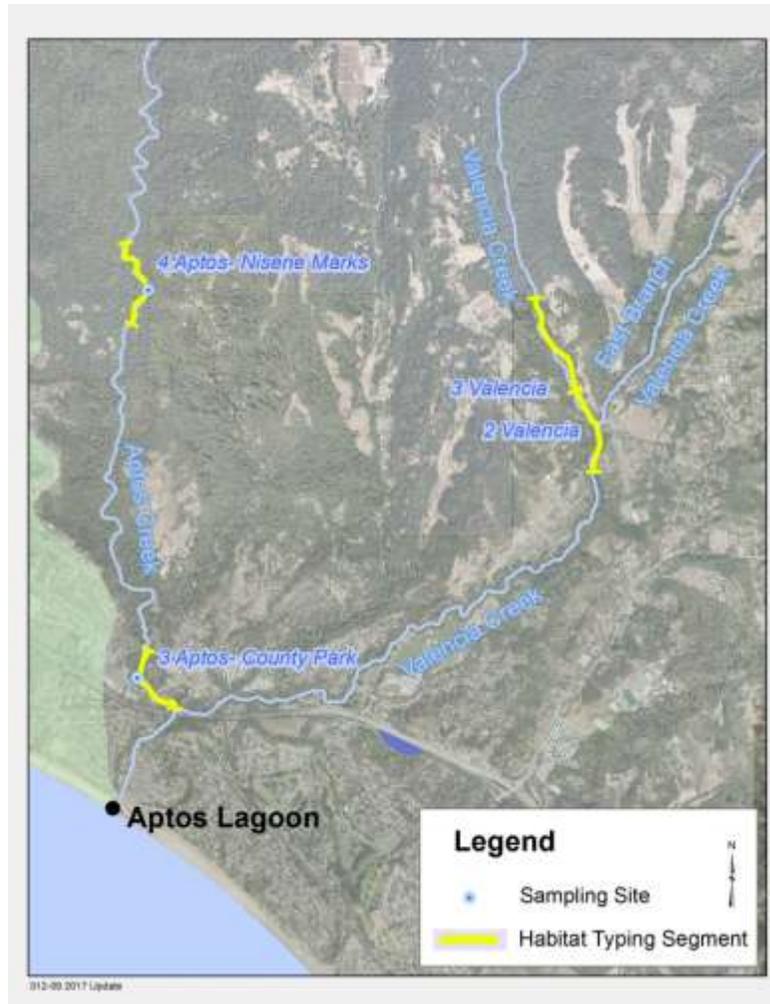


Figure 3. Aptos Creek Watershed.

C. RESULTS

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

1. Over the past winter, several stormflows of adequate size for steelhead adult passage occurred during the steelhead spawning period in December through mid-April. Two occurred in December in the 500-600 cfs range (**Figure 4**). Four occurred in January and February in the 2500-5000 cfs range. Two occurred in March and early April at approximately 1,000 cfs, with another in mid-April of approximately 450 cfs. One occurred in early May at approximately 300 cfs. Bankfull events (1.5 year recurrence interval) are capable of scouring or smothering spawning redds with sediment. Bankfull flow at Big Trees Gage was likely in the 3,000 cfs range (2,800 cfs had a 1.3 year recurrence interval in 1999). The adult salmonid trap on Scott Creek could not be maintained for 28 days during the 2023-2024 spawning season (7 days in January; 18 days in February; 2 days in March) due to high stormflows (**J. Kiernan, NOAA Fisheries, pers. comm.**). Kiernan's best estimate of steelhead escapement was 43 adult steelhead (95% confidence interval of 27–59 individuals), which was the lowest in the 21-year program (**Figure 11**). His estimate may have been somewhat low because the trap was inoperative during important passage flows. Low Scott Creek steelhead returns may indicate a relatively low number of adult spawners returning to the San Lorenzo drainage over the 2023-2024 spawning season, as well. Adult steelhead passage and spawning

conditions were good. But egg survival may have been reduced after the 3 greater than bankfull stormflows of more than 3,500 cfs in January and February but good otherwise. Smaller stormflows in April and early May encouraged yearlings to smolt to the Bay. Streamflow remained above 100 cfs at Big Trees Gage until early-May and stayed above 20 cfs and the median flow throughout the dry season, providing relatively good rearing habitat for juvenile steelhead that survived the winter. This was consistent with the previous 2023 baseflow which was even higher. Streamflow at the Big Trees Gage was 20.1 cfs on 10 October 2024 when other streamflow measurements were made in the watershed (**Table 1**). Tributary baseflows were also relatively high except for Branciforte Creek. Fish sampling in 2024 was completed prior to any fall stormflow.

2. **In the SLR Mainstem, rearing habitat declined across all replicated sites in 2024 due to reduced baseflow (less food) and generally decreased depth compared to the relatively higher baseflow year of 2023 (Tables 1 and 3).** Habitat conditions at sampling sites were rated between “poor” and “good,” based on densities of soon-to-smolt sized juvenile steelhead (**Tables 1–3; Figures 5 and 6b**). In the lower Mainstem in 2024, pool and run depth increased in Reach 2 (sediment moved out) and run depth increased at Site 4 (scour around instream wood), despite reduced baseflow. Percent fine sediment was generally similar or increased compared to 2023 except decreasing in riffles at Site 0a between the levees and Site 6 below Fall Creek confluence (**Table 3**). Embeddedness was either similar or increased in pools and fastwater habitat compared to 2023 except improving in riffles at Sites 0a, 4, 6 and 10 (**Table 3**). No habitat measurements were made in pools downstream of Boulder Creek except at Site 0a (increased pool sediment and embeddedness in 2024) and in the Rincon Reach 2 (similar to 2023 in 2024). Escape cover increased substantially at Site 0a between the levees due to increased overhanging willows. It increased in pools and runs in Reach 2, in fastwater habitat at middle Mainstem Sites 6 and 8 and in pools in upper Mainstem Sites 10 and 11 (**Table 3**). But it decreased at Site 12b in Waterman Gap, where sediment and embeddedness increased. Escape cover did not change in riffle habitat in the Mainstem Reach 2 (**Figure 6a**). Tables of habitat measurements are available in the detailed analysis report upon request.
3. **In SLR tributaries, overall habitat quality decreased in most reaches and sampling sites in 2024 due to reduced baseflow, generally decreased depth and similar or increased fine sediment and embeddedness (Table 1-3; Figures 5 and 7b).** Evidence of increased sediment in pools more so than reduced baseflow occurred in upper Zayante 13d and 13i, upper Fall 15b and upper Bean 14c-2 and Newell Creek. However, pool depth (either average or maximum) increased despite reduced baseflow in lower Zayante 13a and 13c, lower Boulder 17a and upper Branciforte 21b. Fine sediment increased in fastwater habitat of Zayante 13d, upper Fall 15b, Bear 18a and 18b and upper Branciforte 21b. Pool embeddedness increased in Bean 14c-2, Newell 16 and lower Bear 18a. Embeddedness in fastwater habitat occurred in upper Zayante 13i, upper Bean 14c-2 and Newell 16. **Escape cover increased at 7 of 9 replicated sites and three habitat typed reach segment** (lower Fall 15a, lower Boulder 17a and upper Bear 18b) (**Table 3**). Newell 16 had less pool escape cover and upper Bean Site 14c-2 had the same in 2023 and 2024. Three habitat typed segments had lower escape cover indices (upper Zayante 13d, upper Fall 15b and lower Branciforte 21a-2) (**Table 3; Figures 6a and 7a**). Nine of 16 tributary sites were rated between “good” and “very good” in 2024 with regard to habitat quality based on soon-to-smolt densities and fish size (**Table 2**). Five sites were rated “fair.” Lower Branciforte 21a-2 was rated “below average” and lower Bean 14a was rated “poor.”
4. **With respect to Fall Creek reaches that were impacted by the August 2020 CZU fire, there have been 2 dry winters followed by 2 wet winters since the fire.** Pools in lower Fall Reach 15a deepened from 2021 to 2023 and remained similar depth in 2024. Compared to 2021, 2024 percent sediment in lower Reach 15a was the same or similar in pools, riffles and step-runs. Pool escape cover has steadily increased annually since 2021 in this reach, it being substantially higher by 2024 due to increased instream wood. Escape cover in runs and step-runs in Reach 15a was similar in 2021 and 2024. **The conclusion is that habitat conditions have improved in lower Fall Reach 15a since the fire due to deeper pools and**

more pool escape cover, besides the increase in baseflow. Upper Fall Creek Reach 15b above the fish ladder showed progressively deeper pools since 2022. But percent fine sediment has increased to the highest since 2022 in pools (72%) and riffles (55%) and runs (70%). Pool escape cover has increased since 2022 due to increased instream wood. **The conclusion is that habitat conditions have improved in lower Reach 15b since the fire due to deeper pools and more pool escape cover, besides the increase in baseflow.** The riffle at Mainstem Site 6 below Fall Creek that had increased percent fine sediment in 2023 (50%) possibly due to sediment input from Fall Creek had a reduction in 2024 (40%).

5. **With respect to Boulder Creek reaches that were impacted by the August 2020 CZU fire,** there have been 2 dry winters followed by 2 wet winters since the fire. As indicated from habitat typing, Boulder Creek Reaches 17a since 2021 and 17b since 2022 have deeper pools in 2024. Lower Reach 17a has increased percent fine sediment in pools (8% more), riffles (16% more) and runs/step-runs (14% more) since 2021. Upper Boulder Creek Reach 17b has similar percent sediment in pools runs/step-runs since 2022 but reduced percent fine sediment in riffle habitat (9% less). Pool escape cover has increased in Reach 17a since 2021 and in Reach 17b since 2022. Baseflow has been atypically high in fall 2022-2024, indicative of a combination of higher groundwater after wet winters, less plant transpiration and reduced stream diversion. **In conclusion, despite increased fine sediment in the lower reach, habitat conditions have improved in Boulder Creek since 2021 due to deeper pools with more escape cover, besides the significant increase in baseflow.**
6. Spawning success was evident at all Mainstem and tributary sites in 2024. **SLR total and YOY juvenile densities at Mainstem sites were below average at most sites,** but close to average at 4 sites, while averaging 16.5 total juveniles/100 ft in 2024 (**Figures 8 and 9**). The 2024 average Mainstem YOY density was 13.5/100 ft (14.4 in 2023). Year classes and size classes are defined in the glossary. Upper Site 12b in Waterman Gap (above the problematic adult passage impediment at the Highway 9 culvert) had near average total and YOY densities. **At tributary sites, total and YOY juvenile densities were below average** at most sites in 2024, averaging 34 total juveniles/100 ft and 29 YOY juveniles/100 ft. The 26-site average total juvenile density in 2024 was 27/100 ft (38/100 ft in 2023). The 26-site average YOY density in 2024 was 21/100 ft (21/100 ft in 2023). YOY densities were very much below average at sites in lower and middle Zayante, all sites in Bean, Bear and Boulder, and lower Branciforte. Generally in 2024, YOY densities were higher at upper Mainstem and upper tributary sites than at downstream sites on the lower gradient east side of the watershed, indicating good spawning access to more headwater sites, which was true in 2023 with even higher upstream YOY densities (**Figure 10**). YOY densities were higher in the lower tributary sites than upstream sites on the higher gradient west side, indicating less spawning activity at more headwater sites. In 2023, this was the case in Fall Creek but not Boulder Creek. Tables of fish densities are available in the detailed analysis report upon request.
7. **The differences between YOY site densities in 2023 (wetter year) and 2024 (wet year) were not statistically significant (Table 8).** Compared to 2023 YOY densities, 2024 YOY densities were similar at Mainstem sites downstream of Boulder Creek confluence (**Figure 10**). In the upper Mainstem, YOY density was higher at Site 10 in 2024 but less at upstream Sites 11 and 12b. 2024 YOY densities were higher at all 4 Zayante sites and lower Bean. YOY densities were less in 2024 at uppermost sites in Bean, Fall, Boulder and Bear, as well as lower Fall. Newell had higher YOY densities compared to 2023. Smith (2024) found in Gazos Creek that despite only apparent modest improvements in channel habitat, mean steelhead YOY density (33.2 /100 ft) nearly tripled compared to 2023 and was the second highest since 2009. Smith found in 2024 in Waddell Creek that average YOY steelhead density was 4.8 /100 ft and not much different from the dismal results in 2022 and 2023 (3.2/100 ft), despite improved habitat conditions since the CZU fire at the three downstream sites and less severe winter streamflows than in 2023 that reduced redd survival that year.
8. **Yearling densities were small and near average at the lower 8 Mainstem sites** in 2024, with above

average densities at the two uppermost sites where YOY densities had been good in 2023 (**Figures 10 and 12**). Notable retention of yearlings with above average densities at other sites where YOY densities had been mostly good in 2023 included those in uppermost Bean, both sites in Fall, both sites in Boulder and upper Bear Creek. Upper Branciforte was near average. Notable low densities occurred in lower sites in Bean, Bear and Branciforte, as well as Newell Creek. Smith (**2024**) found average yearling density in Gazos Creek in 2024 (7/100 ft) to be similar to 2023 (7.5/100 ft). He found that average yearling density remained low in Waddell Creek in 2024 (1.1/100 ft) compared to 2023 (1.4/100 ft). He did not sample Scott Creek in 2024.

9. **Size Class II/III (=> 75 mm SL) densities were near average at most Mainstem SLR sites and above average at 2/3 of tributary sites in 2024 (Figure 13)** compared to being below average in 2021 and 2022 during drought at most sites. Some YOY reached Size Class II where food was more abundant, especially in the Mainstem River, downstream of Zayante Creek as they did in 2023. The portion of YOY reaching Size Class II increases in wetter years, and the average size of captured fish at each site is greater in wetter years unless most storms come late, as in 2019 (**Figure 21**). Therefore, at many sites in 2024, the Size Class II/III group included YOY and yearlings. Food supply (insect drift) increases in wetter years because the higher baseflow creates more fastwater area where most aquatic insects are produced (wider channels) and faster water velocity at heads of pools as insects drift at faster water velocity through riffles, runs and heads of pools than in drier years. The 26-site average Size Class II/III density doubled in 2023 to 10.9 fish/100 ft and remained at 10.9 fish/100 in 2024 (5.0 fish/100 ft in 2022). It ranged between 3.4 at Mainstem 9 and 22.7 fish/100 ft at Zayante 13a. The 2024 Mainstem average was 8.1 fish/100 ft while the tributary average was 12.7 fish/100 ft. The highest densities resulting from high baseflow and fast growing YOY were at Mainstem Site 4 below Zayante Creek, Zayante lower (13a), middle (13c) and middle/upper 13d and Newell 16. Other relatively high densities resulting from retained yearlings from good YOY densities in 2023 were upper Zayante 13i, upper Bean 14c-2 and upper Branciforte 21b.
10. **The differences between Size Class II/III site densities in 2024 (wet year) and 2023 (wetter year) were not statistically significant (Table 8)**. Compared to 2023 densities, 2024 soon-to-smolt densities at Sites 0a, 1, 2 and 4 were similar. 2024 soon-to-smolt densities were less at Sites 6, 8, 9 and 10 and more at Sites 11 and 12b compared to 2023 (**Table 2; Figure 14**). Densities increased at only 3 of 10 Mainstem sites and notably at only upper Mainstem 11 (few yearlings and moderate YOY density in 2023 and more cover in 2024) and upper Mainstem 12b (good yearlings retention after high YOY density in 2023 and despite habitat quality decline in 2024). Densities increased at 7 of 16 tributary sites, with notable increases at lower Zayante 13a (sampled pool with much more cover due to geomorphic changes and no large wood management in 2024 as had occurred in 2023), upper Zayante 13i (more cover and high YOY densities in 2023), upper Fall 15b (very few yearlings in 2023; deeper pools and more pool cover in 2024) and Boulder 17b (very few yearlings in 2023, deeper pools and more cover in 2024) (**Figure 14**). Notable declines in tributary site densities from 2023 to 2024 resulted from a smaller YOY and a smaller proportion of YOY reaching Size Class II due to slower growthrate, along with lower habitat quality at the following sites; Zayante 13d (shallower pools and less pool cover), Newell 16 (less pool cover), Boulder 17a (less pool cover) and Bear 18b (shallower pools).
11. **The average 5-site Mainstem trend in total density and soon-to-smolt (=> 75 mm SL; Size Class II/III) density decreased slightly in 2024 (wet year) from 2023 (another wetter year) (Figures 15 and 17)** (15 total fish/100 ft; 27-year average of 22) (9 Class II/III fish/100 ft; 27-year average of 7). **The average 7-site tributary trend in average total density increased in 2024 (Figure 16)** (34 fish/100 ft; 27 year average of 55). **The tributary trend in average Size Class II/III density decreased in 2024 but remained above average (Figure 18a)** (13 fish/100 ft; 27-year average of 11). Trends in densities of these larger juveniles follow similar upward fluctuations through the wet years and downward fluctuations through dry years in the SLR and Soquel watersheds (**Figure 18b**), and somewhat less so for the Aptos/Valencia watershed where annual summer baseflow fluctuates less. Densities of Size Class

II/III steelhead typically increase in wetter years with faster YOY growth rate and decrease in drier years with slower growth rate. The density of these larger fish that will soon smolt is more important than the total juvenile steelhead density. Relevant here is that Smith (**pers. comm.**) found from scale analysis of returning adult steelhead that YOY that could not reach at least 60 mm SL their first year did not survive to return as adults to the San Lorenzo River. Therefore, high densities of very small YOY found in the upper tributaries may contribute little to the returning adult population.

12. **For Size Class II/III juveniles, annual average site densities positively tracked with the 5-month (May-September) baseflow average at the Big Trees USGS gage for 1997-2024 (Figures 19a-b). Importantly, production indices for these larger juveniles also track well with the 5-month baseflow average for 2010-2024 (Figure 20a), with the 2024 index (19,045) more than double the 2022 index (8,417).** The same positive tracking of fluctuating production index and fluctuating baseflow is evident for Mainstem reaches, specifically, with production in 6 Mainstem reaches (**Figure 20b**) sometimes contributing more than half of the index that includes 6 Mainstem and 11 tributary reaches. Therefore, although total and YOY densities were below average in 2024, densities and production estimates of important Size Class II/III fish were relatively high and consistent with high baseflow.
13. **Two factors may explain the below average YOY densities at most sites in 2024.** One factor may have been **low adult returns**, which we have evidence of in Scott Creek in 2024 from which to extrapolate (**Figure 11**). A second factor was likely **poor egg survival during a wet winter having 3 above bankfull stormflows that could either scour out redds or smother them with sediment**. Similar to our below average YOY densities in Soquel Creek and the San Lorenzo drainage, Smith (**2024**) found continued low YOY densities in Waddell Creek, which was significantly damaged by the 2020 CZU fire. However, YOY densities in the smaller Gazos Creek increased 3- fold after less severe stormflows in 2024.
14. **YOY that survived as of swim-up fry living in the gravel and avoided mortality during high stormflows experienced more food and faster growth in 2024 compared to most years.** This was because YOY production was likely low but baseflows were relatively high and much above the median. These relatively high baseflows provided a better than average food supply with less competition, especially in the late spring and early summer when baseflow was high and water clarity was good. The average fish length at selected sites (mostly YOY's) in 2024 was typical of other higher baseflow years and greater than in dry years (**Figure 21**). Only 2019 did not fit the pattern of larger juveniles in higher baseflow years. This was likely because storms were late that year and successful steelhead spawning may have been delayed, giving YOY less growing time before sampling. There were high densities of small YOY that year.



USGS 11160500 SAN LORENZO R A BIG TREES CA

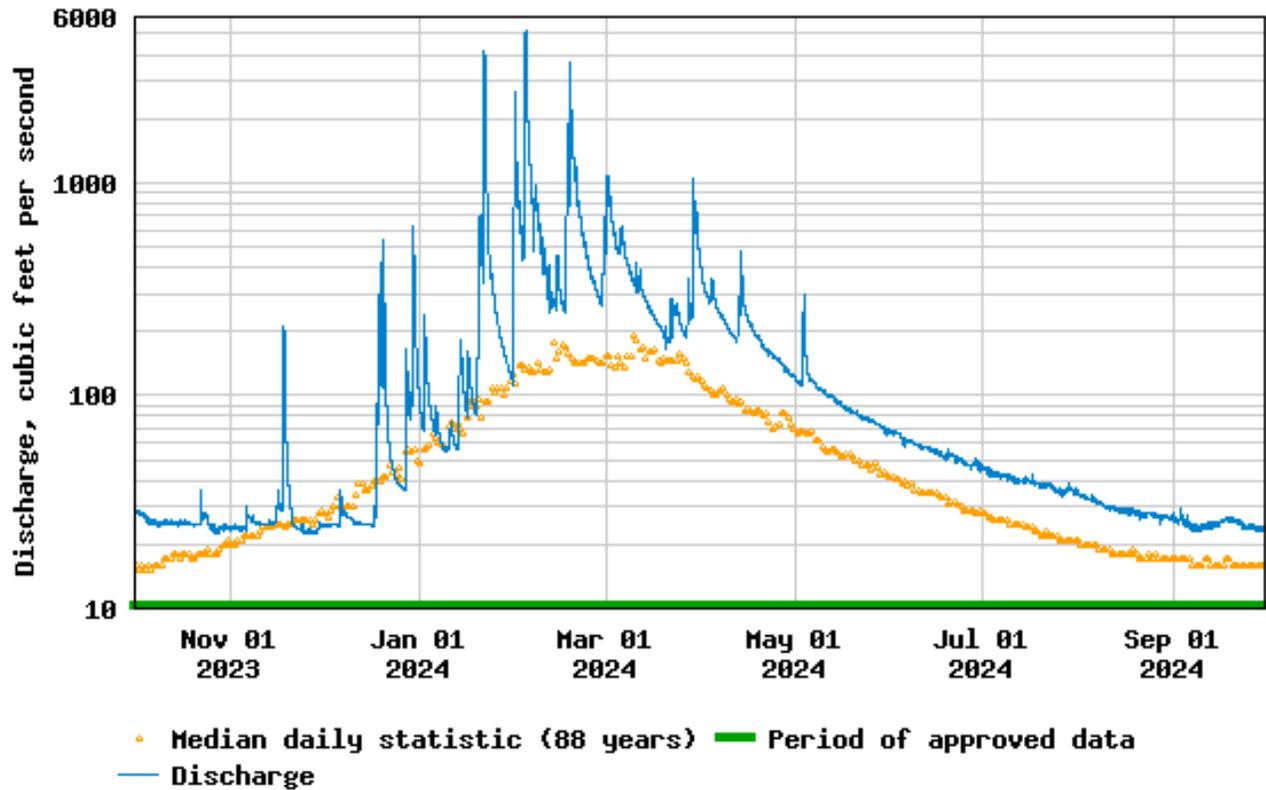


Figure 4. The WY2024 Streamflow for the USGS Big Trees Gage on the San Lorenzo River at Felton, CA.

Figure 5. Averaged Mean Monthly Streamflow for May – September in the San Lorenzo and Soquel Watersheds, 1997-2024.

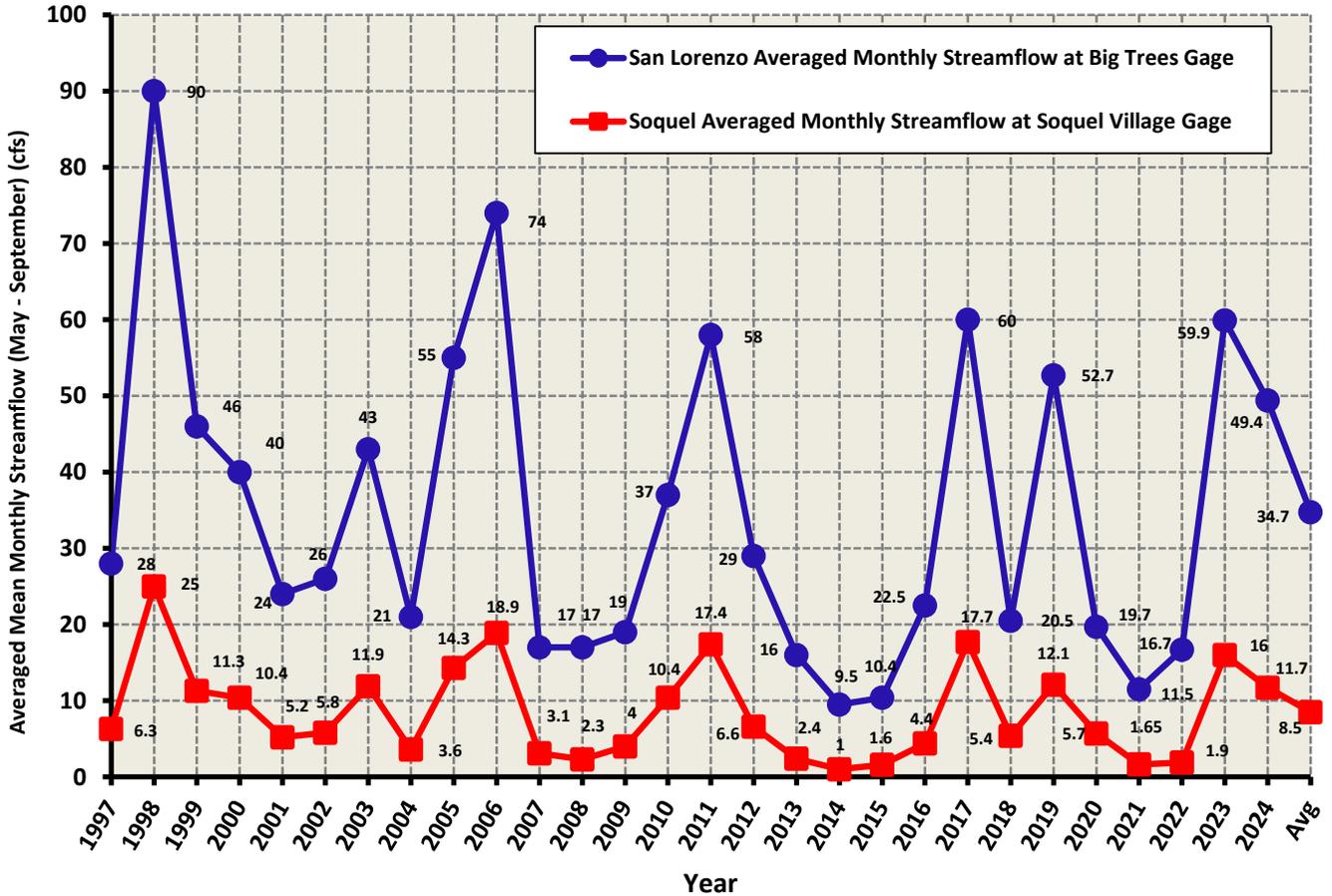


Figure 5. Average Mean Monthly Streamflow, May – September, San Lorenzo and Soquel Watersheds, 1997-2024.

Table 1. Fall STREAMFLOW (cubic feet/ sec) measured by D.W. ALLEY & Associates at SAN LORENZO sampling sites before fall storms (or in 2011 and 2022 when baseflow had resumed after an early storm) and at the USGS Gages at Big Trees (Felton) and Santa Cruz..

Site # / Location	1998/1999	2000	2001	2005	2006	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022**	2023	2024
0a- Santa Cruz						5.5 2 Oct	12 23 Sep	5.2 19 Oct	5.6 23 Oct	1.2 19 Oct	2.48 16 Oct	8.8 6 Oct	14 12 Oct	8.7 12 Oct	15. 2 12 Oct	8.9 12 Oct	3.8 16 Oct	8.8 16 Oct	17.4 10 Oct	12.6 10 Oct
1- SLR/ Paradise Park	34.3/ 26.2	21.7	19.6		26.2	18.7	27. 6	17.2	12.9	8.0	7.81		22.6	13.5	22. 8	13.1	9.65	13.7	27.3	19.8
2- SLR/ Rincon	/ 24.0	21.1	17.2																	
3-SLR Gorge																				
4-SLR/ Henry Cowell	32.7/ 23.3	21.8	15.5		24.1															
5-SLR Big Trees Gage	27.0/ 21.0	22.0	13.0	21.0	27.0	15.1	24. 8	15.9	11.2	6.41	6.19	12.2 6 Oct	21.4	12.1	18. 1	11.8	9.8	13.4 14 Oct	25.6 10 Oct	20.1 10 Oct
6- SLR/ Below Fall	23.4/ 12.8	11.6	9.4	18.9	14.3					3.7	3.25	6.99	12.9	6.68						
8- SLR/ Below Clear	10.3/ 4.9	4.2	3.1	7.1	6.4	4.0		2.8	1.7	0.95	1.11	2.35	4.71	2.61	4.5 3	2.41	1.54	3.85	7.04	4.67
9- SLR/ Below Boulder	7.2/ 3.5		3.0	5.8						0.80	0.88	1.82	4.02	1.43	4.3 6					
10- SLR/ Below Kings	/ 3.0	1.1	1.3	1.4																
11- SLR/ Teihl Rd	1.7/ 0.8	0.8	0.4	1.5		0.94	1.1 0	0.40	0.38	0.13	0.21		1.07	0.35	0.8 7	0.24	0.17	0.28	1.00	0.64
12a-b SLR/ Lower Waterman	1.0/ 0.7								0.33	0.10	0.22		0.85	0.39	0.7 8	0.32	0.17	0.20	0.93	0.71
13a/ Zayante below Bean	8.5 6.3	5.2	4.7	7.4	7.8*	4.9	7.2	4.4	3.9	3.2	2.9		8.27	4.04	5.9 6	4.64	3.05	3.95	8.21	5.44
14b/Bean below Lockhart G	1.1/ 1.1	1.0	1.1	1.0	1.1						0.62									
14c/Bean above MacKenzie						0.03	0.1 1	Dry	Dry	Dry	Dry	Dry	0.07	Dry	We t	Dry	Dry	Dry	Trickl e	Trickl e
14c-2/Bean above MacKenzie														0.02	0.0 6	0.02	Part Dry	Part Dry	0.13	0.08
15a-b/ Fall	3.4/ 2.2 Above Div.	1.7 Above Div	1.7 Above Div							1.0 below div. Bal	0.32 Bel div Bal	1.39 Belo div.	2.80 Bel div.	1.00 Bel div.		1.01 Belo w div	0.61 Belo w div	1.33 Belo w Div	2.80 Belo w Div	2.22 Belo w Div
16/ Newell		0.51				1.2	0.9 2	0.78	0.78	0.08	0.04		1.05	0.87		1.07 SCW D	0.29 (SCW D)	0.96 (SCW D)	1.18 (SCW D)	1.01 (SCW D)
17a/ Boulder	2.2 1.1	1.1	1.0	1.6	1.7	1.6	2.2	1.1	1.1	0.76 Bal	0.66 Bal	1.39 Bal	1.76	0.94	1.4 5	1.24	1.00	1.81	2.82	1.89
18a/ Bear above Hopkins G	/ 0.45	0.61	0.34	0.90	1.1	0.68	1.3	0.23	0.16	0.03	0.02		0.90	0.21	0.7 0	0.10	0.06	0.175	1.32	0.84
21a-2/ Branciforte	0.80					0.44	0.8 1	0.32	0.29		0.13			0.37	0.3 8	0.29	0.18	0.44	0.38	0.42

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

**Streamflow was measured in mid-October 2022 after a mid-September stormflow, which partially elevated the baseflow.

Table 2. 2024 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (\Rightarrow 75 mm SL) and Average Smolt Size, with Physical Habitat Change in 2024 since Previous Reach or Site Measurements. (Number of @ symbols refers to Smith ratings 1-7 listed after this table. Red denotes ratings of 1-3 below average or negative habitat change; purple denotes ratings of 5-7. Methods for assessing habitat change are in previous years' reports and available upon request. Average size affects rating.)

Site	Multi-Year Avg. Potential Smolt Density Per 100 ft/ Avg Pot. Smolt Length SL (since 2006 for SL)	2024 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2024 Symbolic Rating* (1 to 7)	2023 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	Physical Habitat Change by Reach/Site (Since 2023 unless Specified)
Low. San Lorenzo #0a	7.2/ 122 mm	7.1/ 146 mm	@@@@ Fair	6.5/ 152 mm	Site -
Low. San Lorenzo #1	7.5/ 109 mm	5.4/ 122 mm	@@@@ Fair	5.8/ 109 mm	Site -
Low. San Lorenzo #2	12.7/ 103 mm	9.2/ 115 mm	@@@@@ Good	11.9/ 131 mm	Reach -
Low. San Lorenzo #4	12.9/ 90 mm	17.3/ 94 mm	@@@@@ Good	18.4/ 107 mm	Site -
Mid. San Lorenzo #6	3.5/ 95 mm	3.8/ 102 mm	@@ Poor	5.9/ 95 mm	Site -
Mid. San Lorenzo #8	4.7/ 93 mm	5.8/ 87 mm	@@ Poor	8.6/ 90 mm	Site -
Mid. San Lorenzo #9	5/ 93 mm	3.4/ 102 mm	@@ Poor	9.2/ 96 mm	Site -
Up. San Lorenzo #10	5.2/ 102 mm	5.7/ 101 mm	@@@ Below Average	9.3/ 107 mm	Site -
Up. San Lorenzo #11	5.8/ 108 mm	11.3/ 100 mm	@@@@ Fair	3.3/ 116 mm	Site -
Up. San Loren #12b	11.9/ 106 mm	12.1/ 100 mm	@@@@ Fair	5.8/ 116 mm	Site -
Zayante #13a	8.5/ 101 mm	22.7/ 100 mm	@@@@@ Good	5.6/ 109 mm	Site -
Zayante #13c	14.8/ 92 mm	19/ 87 mm	@@@@ Fair	18.8/ 88 mm	Site -
Zayante #13d	15.9/ 100 mm	16.5/ 103 mm	@@@@@@ Very Good	32.4/ 89 mm	Reach -
Zayante #13i	9.3/ 103 mm	20.4/ 93 mm	@@@@@ Good	4.3/ 107 mm	Site -
Bean #14a	4.3/ 94 mm	4.5/ 82 mm	@@ Poor	6.7/ 105 mm	Site -
Bean #14b	10.3/ 105 mm	5.9/ 114 mm	@@@@ Fair	7.8/ 115 mm	Reach -
Bean #14c-2	9/ 109 mm	15.2/ 105 mm	@@@@@ Good	12.4/ 93 mm	Site -
Fall #15a	9.2/ 96 mm	14.1/ 104 mm	@@@@@ Good	16.7/ 113 mm	Reach -
Fall #15b	10.9/ 105 mm	11.5/ 99 mm	@@@@ Fair	4.8/ 106 mm	Reach -
Newell #16	12.1/ 99 mm	15/ 108 mm	@@@@@ Good	22.1/ 118 mm	Site -
Boulder #17a	10.5/ 105 mm	11.8/ 104 mm	@@@@@ Good	24.2/ 103 mm	Reach + Compared to 2022
Boulder #17b	9.6/ 98 mm	10.7/ 115 mm	@@@@@ Good	1.8/ 107 mm	Site -
Bear #18a	8.2/ 100 mm	10.4/ 90 mm	@@@@ Fair	7.9/ 85 mm	Site -

Site	Multi-Year Avg. Potential Smolt Density Per 100 ft/ Avg Pot. Smolt Size Since 2006	2024 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2024 Symbolic Rating (1 to 7)	2023 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	Physical Habitat Change by Reach/Site (Since 2023 unless Specified)
Bear #18b	10.4/ 102 mm	9.65/ 107 mm	@@@@@ Good	17.2/ 95 mm	Reach - Since 2017
Branciforte #21a-2	8/ 102 mm	3.4/ 116 mm	@@@ Below Average	5.2/ 103 mm	Reach Similar Since 2022
Branciforte 21b	11.4/ 100 mm	12/ 100 mm	@@@@ Fair	5.4/ 103 mm	Site +
Soquel #1	3.7/ 105 mm	3.9/ 130 mm	@@@ Below Average	7.3/ 115 mm	Reach - (Since 2021)
Soquel #4	6.5/ 104 mm	0.6/ 117 mm	@@ Poor	6.6/ 109 mm	Reach -
Soquel #6	4.9/ 102 mm	2.5/ 103 mm	@@@ Below Average	3.6/ 120 mm	Site -
Soquel #10	9/ 92 mm	5.2/ 117 mm	@@@@ Fair	12.5/ 105 mm	Site -
Soquel #12	8.3/ 93 mm	18.4/ 98 mm	@@@@@ Good	14.4/ 97 mm	Reach + Compared to 2022
East Branch Soquel #13a	8.8/ 98 mm	8.6/ 86 mm	@@@ Below Average	8.2/ 100 mm	Reach + Compared to 2021
East Branch Soquel #16	9.4/ 99 mm	17.6/ 93 mm	@@@@@ Good	5.6/ 91 mm	Site -
West Branch Soquel #19	6.1/ 99 mm	6.9/ 98 mm	@@@ Below Average	21.1/ 80 mm	Reach -
West Branch Soquel #21	9.2/ 97 mm	8.3/ 97 mm	@@@@ Fair	5.5/ 89 mm	Site -
Aptos #3	7.4/ 109 mm	3.8/ 127 mm	@@@ Below Average	3.4/ 150 mm	Reach -
Aptos #4	8.4/ 106 mm	8.2/ 99 mm	@@@@ Fair	7.1/ 103 mm	Site -
Valencia #2	7/ 98 mm	5.4/ 107 mm	@@@@ Fair	3.8/ 94 mm	Site -
Valencia #3	9.7/ 103 mm	8.6/ 100 mm	@@@@ Fair	4.8/ 96 mm	Reach + Compared to 2021

*Rating Assumes that habitat was saturated, which was doubtful.

Ratings of Steelhead Rearing Habitat For Small, Central Coast Streams. (Assumes saturated habitat; From Smith 1982.)

1. Very Poor- less than 2 smolt-sized (<=75 mm SL) fish per 100 feet 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 " " " "

Average Length less than 89 mm SL- reduces rating one category;
Average Length greater than 102 mm SL- increases rating one category

Table 3. Habitat Change in the SAN LORENZO MAINSTEM AND TRIBUTARIES from most recent years' reach averages compared to 2024 reach averages, or site comparisons when reach averages were unavailable. (Green highlight indicates Reach Comparisons. Yellow highlight indicates Site Comparisons.)

Reach or (Site Only) Comparison To Previous Years	2024 Baseflow Comparison (Most Important Factor May- September)	Pool Depth / Fastwater Habitat Depth	Fine Sediment Pool/ Fastwater	Embed-dedness Pool/ Fastwater	Pool Escape Cover/ Fastwater Habitat Cover	Overall Habitat Change & (Improvement/ Deterioration)
(Mainstem Site 0a) (Since higher baseflow in 2023)	-	- pool / - riffle	Very - pool / + riffle	- pool / + riffle	+ / +	- (less food, shallower, less riffle sediment, less embedded in riffle, more cover)
(Mainstem Site 1) (Since higher baseflow in 2023)	-	/ Sim	/ - riffle - run	/ Sim	/ -	- (less food, more sediment, less fastwater cover)
Mainstem Rch 2 (Since higher baseflow in 2023)	-	+ / - riffle + run	Sim / Sim riffle - run	Sim / Sim	+ / Same riffle + run	- (less food, deeper pools and runs, more cover in pools and runs)
(Mainstem Site 4) (Since higher baseflow in 2023)	-	/ Sim riffle + run	/ Sim riffle - run	/ +	/ -	- (less food, deeper run, more riffle sediment, less fastwater cover)
(Mainstem Site 6) (Since higher baseflow in 2023)	-	/ -	/ + riffle - run	/ +	/ Very +	- (less food, shallower fastwater habitat, more fastwater cover)
(Mainstem Site 8) (Since higher baseflow in 2023)	-	/ -	/ - riffle Same run	/ -	/ Very +	- (less food, shallower, more sediment and embeddedness, more fastwater cover)
(Mainstem Site 9) (Since higher baseflow in 2023)	-	/ -	/ Sim	/ Sim	/ -	- (less food, shallower with less cover)
(Mainstem Site 10) (Since higher baseflow in 2023)	-	- / + riffle - run	Sim / Sim	- / Same riffle + run	Very + / Sim	- (less food, shallower, more pool sediment, much more pool cover)
(Mainstem Site 11) (Since higher baseflow in 2023)	-	- / Same riffle Same avg run - max run	- / -	Sim / Sim	+ / -	- (less food, shallower, more sediment, more pool cover)
(Mainstem Site 12b) (Since higher baseflow in 2023)	-	- / + avg riffle & run - max riffle & run	- / -	- / Same riffle - run	Very - / +	- (less food, shallower pools, more sediment/embeddedness, much less pool cover)

Reach or (Site Only) Comparison To Previous Years	2023 Baseflow Comparison (Most Important Factor May-September)	Pool Depth / Fastwater Habitat Depth	Fine Sediment Pool/ Fastwater	Embed-dedness Pool/ Fastwater	Pool Escape Cover/ Fastwater Habitat Cover	Overall Habitat Change
(Zayante Site 13a) (Since higher baseflow in 2023)	-	+ / +	- / Sim riffle + run	+ / + run Sim riffle	Very + /	- (less food, deeper, less embedded, more cover in new pool)
(Zayante Site 13c) (Since higher baseflow in 2023)	-	+ / -	- / + riffle	+ / +	+ /	- (less food, deeper pools, more pool sediment, less embedded and more pool cover)
Zayante Reach 13d (Since higher baseflow in 2023)	-	- / -	Sim / - riffle Sim run	Same / Sim riffle Same run	- / Sim	- (less food, shallower, less pool escape cover)
(Zayante Site 13i) (Since higher baseflow in 2023)	-	- / - riffle + run	Same / Sim riffle + run	Sim / Sim riffle - run	+ /	- (less food, shallower, more pool cover)
(Bean Site 14a) (Since higher baseflow in 2023)	-	+ avg - max / + riffle - run	Sim / Sim riffle + run	+ / -Sim riffle + run	+ /	- (less food, deeper avg pool depth, less run sediment, less embedded runs and pool)
Bean Reach 14b (Since higher baseflow in 2023)	-	- avg + max / + max riffle + max run	Sim / Sim	Sim / Sim	Sim / Very -	- (less food, deeper maximum habitat depth, less fastwater cover)
(Bean Site 14c-2) (Since higher baseflow in 2023)	Similarly low	- / Same riffle - avg run	Sim / Sim riffle Same run	- / -	Same /	- (shallower, more embedded)
Fall Reach 15a (Since higher baseflow in 2023)	-	- max / - riffle + avg run	+ / Sim	Sim / Sim	+ / Sim	- (less food, shallower max pools and riffles, deeper runs, less pool sediment)
Fall Reach 15b (Since higher baseflow in 2023)	-	- / -	Sim / - riffle Sim run	Sim / Sim riffle - run	- / -	- (less food, shallower, more riffle sediment, more run embed., less cover)
(Newell Site 16) (Since higher baseflow in 2023)	-	- / -	- / Sim riffle Same run	- / -	- /	- (less food, shallower, more pool sediment, more embeddedness, less cover)
(Boulder Site 17a) (Since lower baseflow in 2022)	+	+ / +	+ / Sim	Sim / Sim riffle + run	+ / +	+ (more food, deeper habitat, less pool sediment, more cover)

Reach or (Site Only) Comparison To Previous Years	2024 Baseflow Comparison (Most Important Factor May-September)	Pool Depth / Fastwater Habitat Depth in Mainstem below Boulder Creek	Fine Sediment Pool/ Fastwater	Embed-dedness Pool/ Fastwater	Pool Escape Cover/ Fastwater Habitat Cover	Overall Habitat Change
Boulder Reach 17b (Since higher baseflow in 2023)	-	+ max / + riffle + avg run - max run	Sim / Sim riffle + run	Same / Same riffle + run	+ /	- (less food, deeper max pool, riffle and avg run, less run sediment and embed., more cover)
Bear Reach 18a (Since higher baseflow in 2023)	-	- / -	Sim/ - riffle Sim run	- / Same run Sim riffle	Very + /	- (less food, shallower, more riffle sediment, more pool embed., more pool cover)
Bear Reach 18b (Since Higher baseflow in 2017)	-	- / -	Sim / - riffle Sim run	Sim / Sim	+ / +	- (less food, shallower, more riffle sediment, more cover)
(Branciforte Site 21a-2) (Since Similar baseflow 2022)	Similar	+ / +	Sim / Sim	+ / Sim	- / +	Similarly Poor (deeper habitat, less pool embed. and less cover)
Branciforte Reach 21b (Since similar baseflow 2023)	Similar	+ avg - max / + avg - max	Sim / + riffle - run	Sim / Sim riffle Same run	+ /	+ (deeper avg habitat with more pool cover)

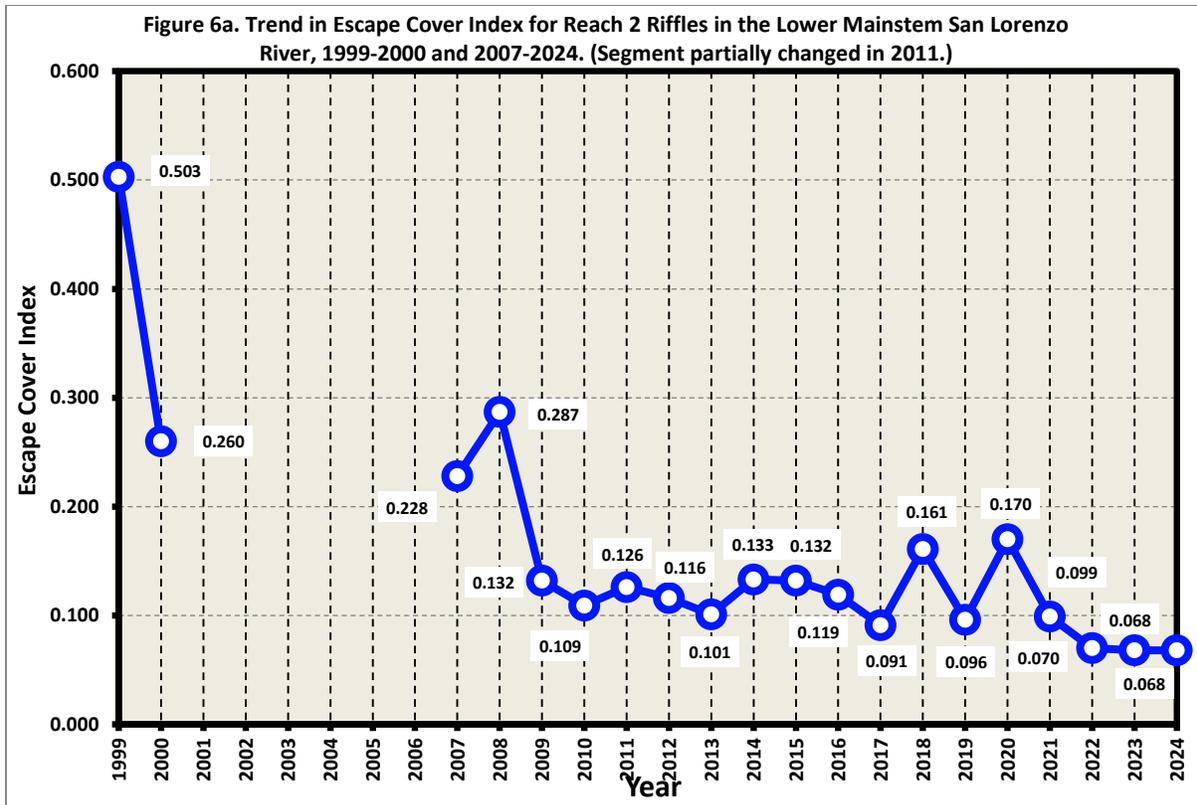


Figure 6a. Trend in the Escape Cover Index for Reach 2 Riffles in the Lower San Lorenzo River.

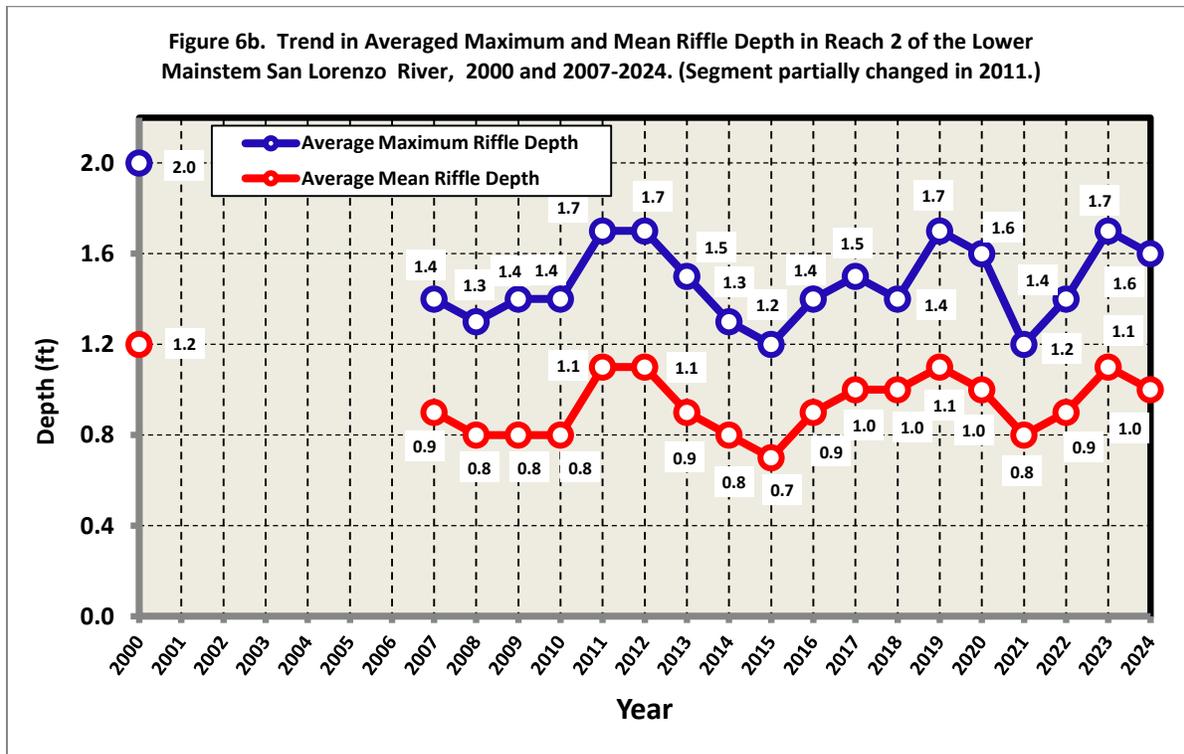


Figure 6b. Trend in Riffle Depth for Reach 2 in the Lower San Lorenzo River.

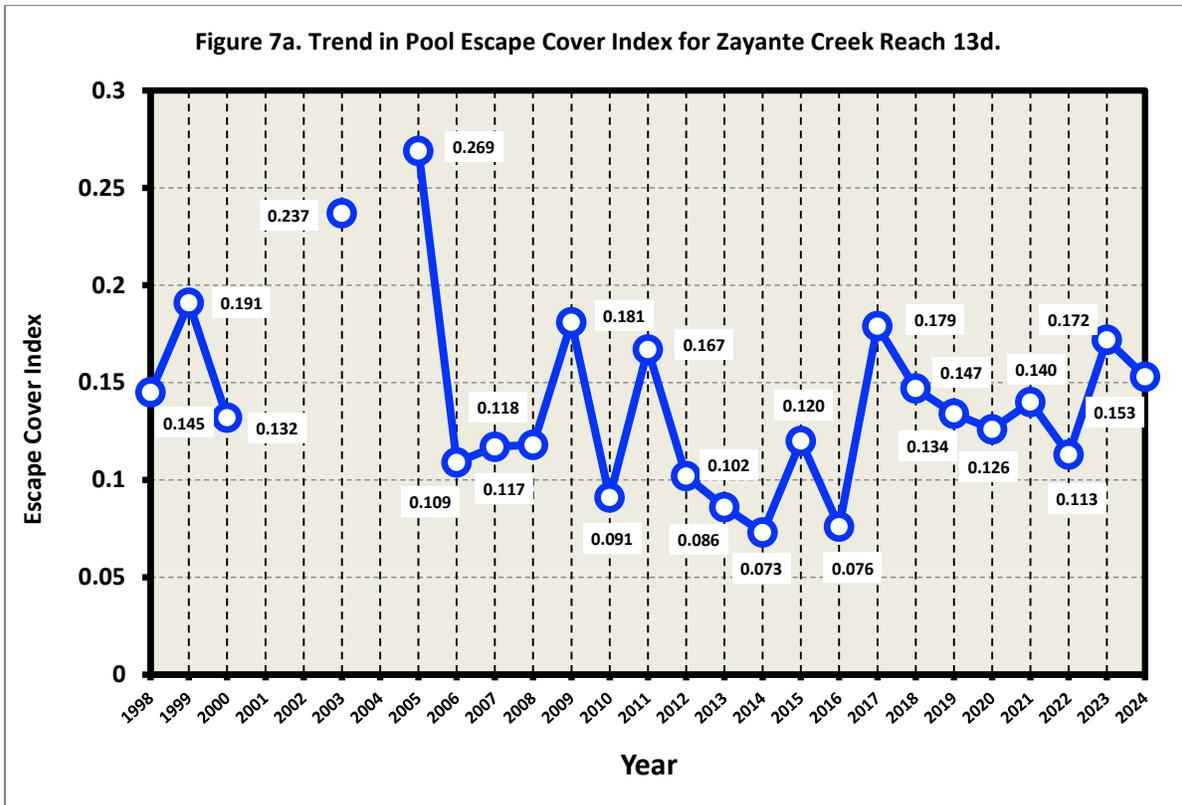


Figure 7a. Trend in Pool Escape Cover Index for Zayante Creek, Reach Segment 13d.

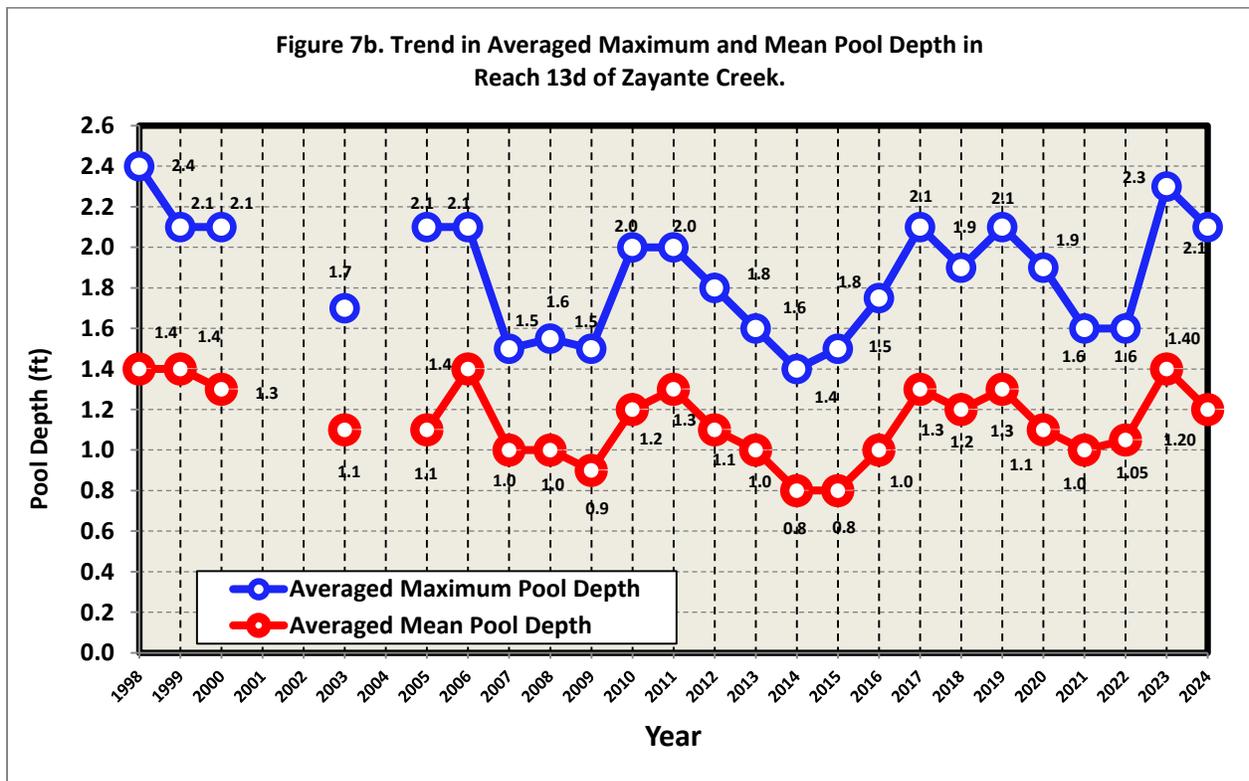


Figure 7b. Trend in Averaged Maximum and Mean Pool Depth in Reach 13d, Zayante Creek.

Figure 8. TOTAL JUVENILE STEELHEAD SITE DENSITIES IN THE SAN LORENZO RIVER WATERSHED in 2024 Compared to the Average Density. (Averages based on up to 28 years of data since 1997; lines connecting site densities for visual effect only).

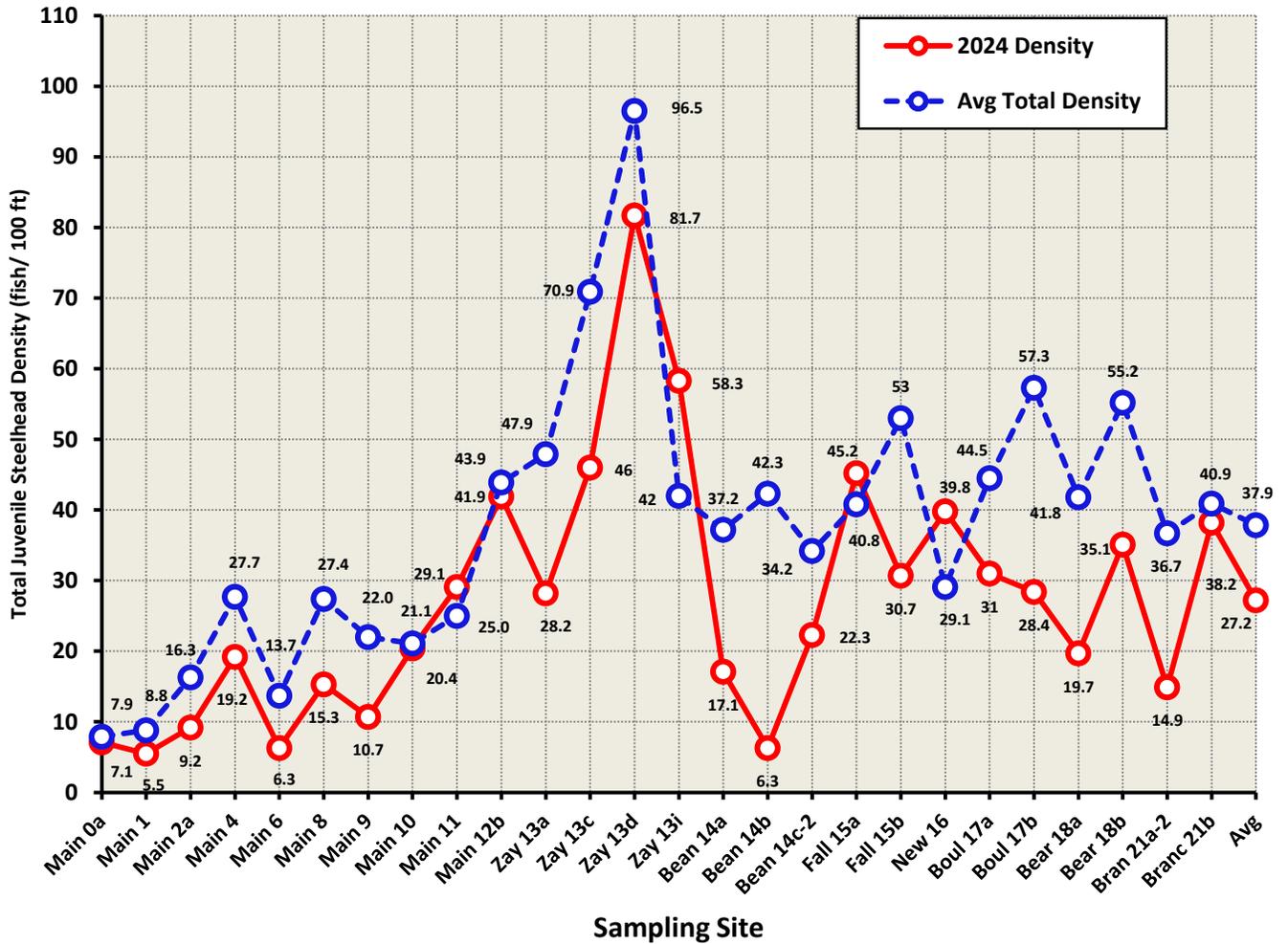


Figure 8. Total Juvenile Steelhead Site Densities in the San Lorenzo River in 2024 Compared to Average Density. (Averages based on up to 28 years of data.)

Figure 9. YOUNG-OF-THE-YEAR STEELHEAD SITE DENSITIES in the San Lorenzo River in 2024.
 (Averages based on up to 28 years of data; lines connecting site densities are for visual effect only.)

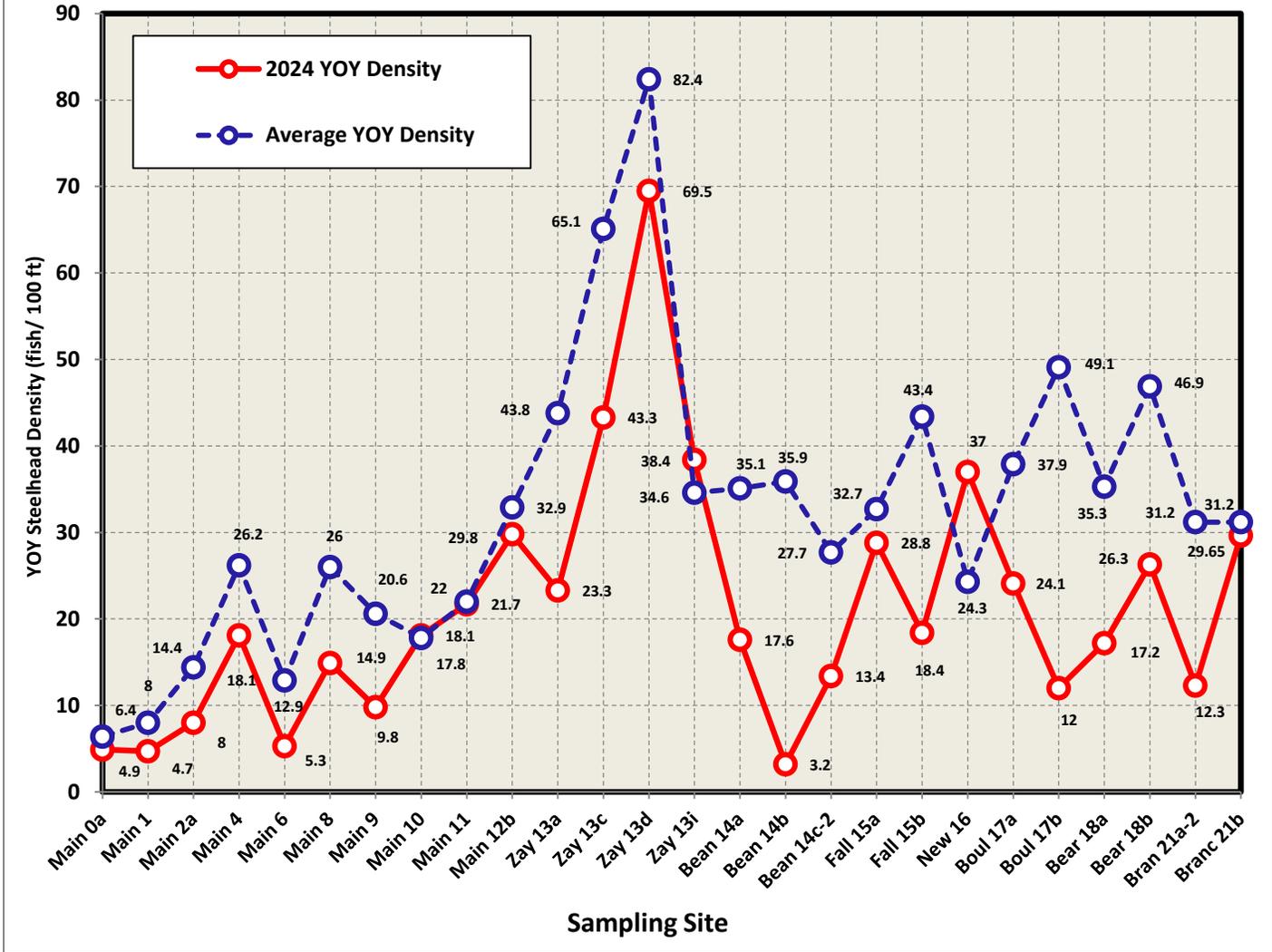


Figure 9. Young-of-the-Year Steelhead Site Densities in the San Lorenzo River in 2024 Compared to Average Density. (Averages based on up to 28 years of data.)

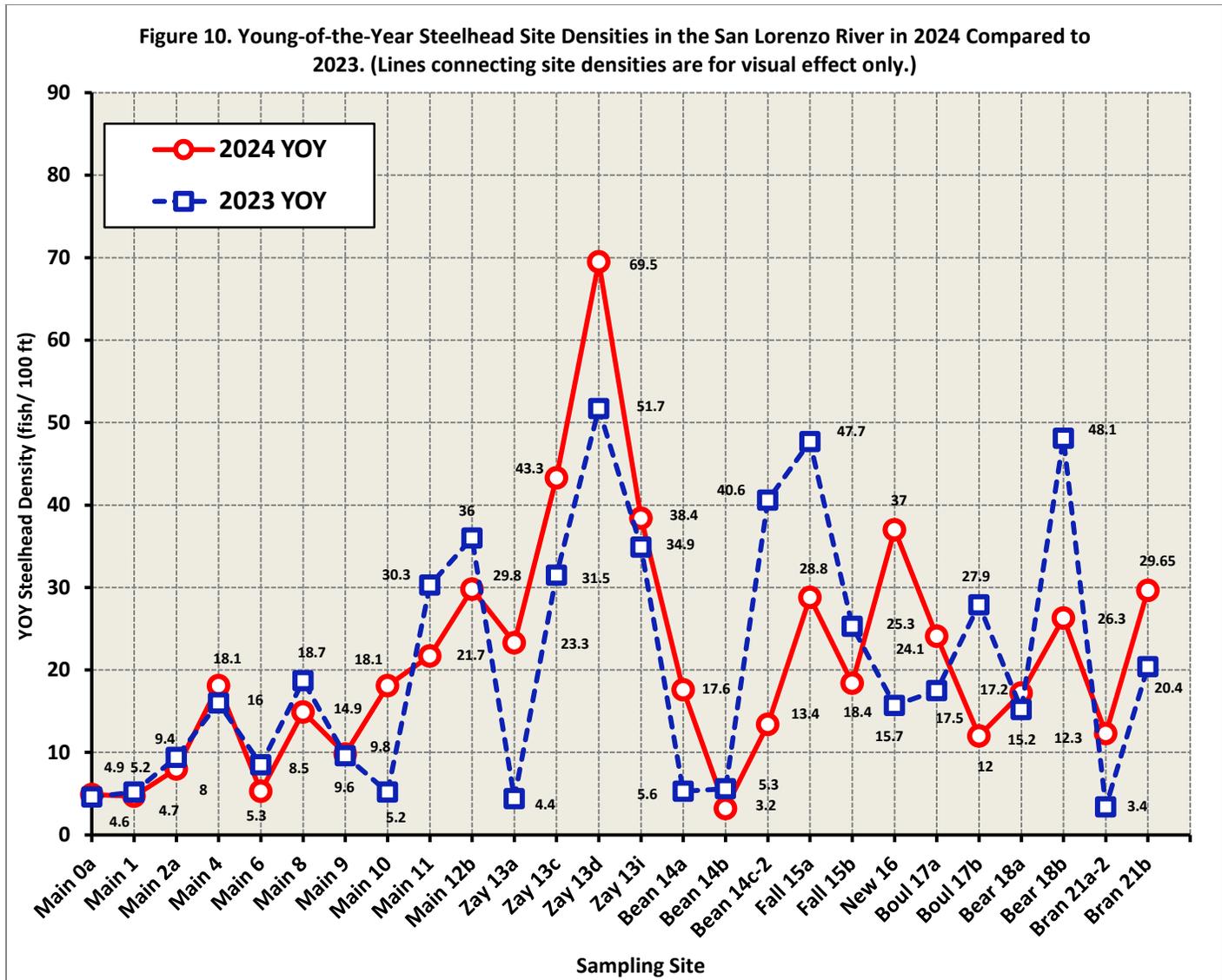


Figure 10. Young-of-the-Year Site Densities in the San Lorenzo Watershed Comparing 2024 to 2023.

Figure 11. Estimated Adult Steelhead Returns to Scott Creek and San Clemente Dam on the Carmel River.

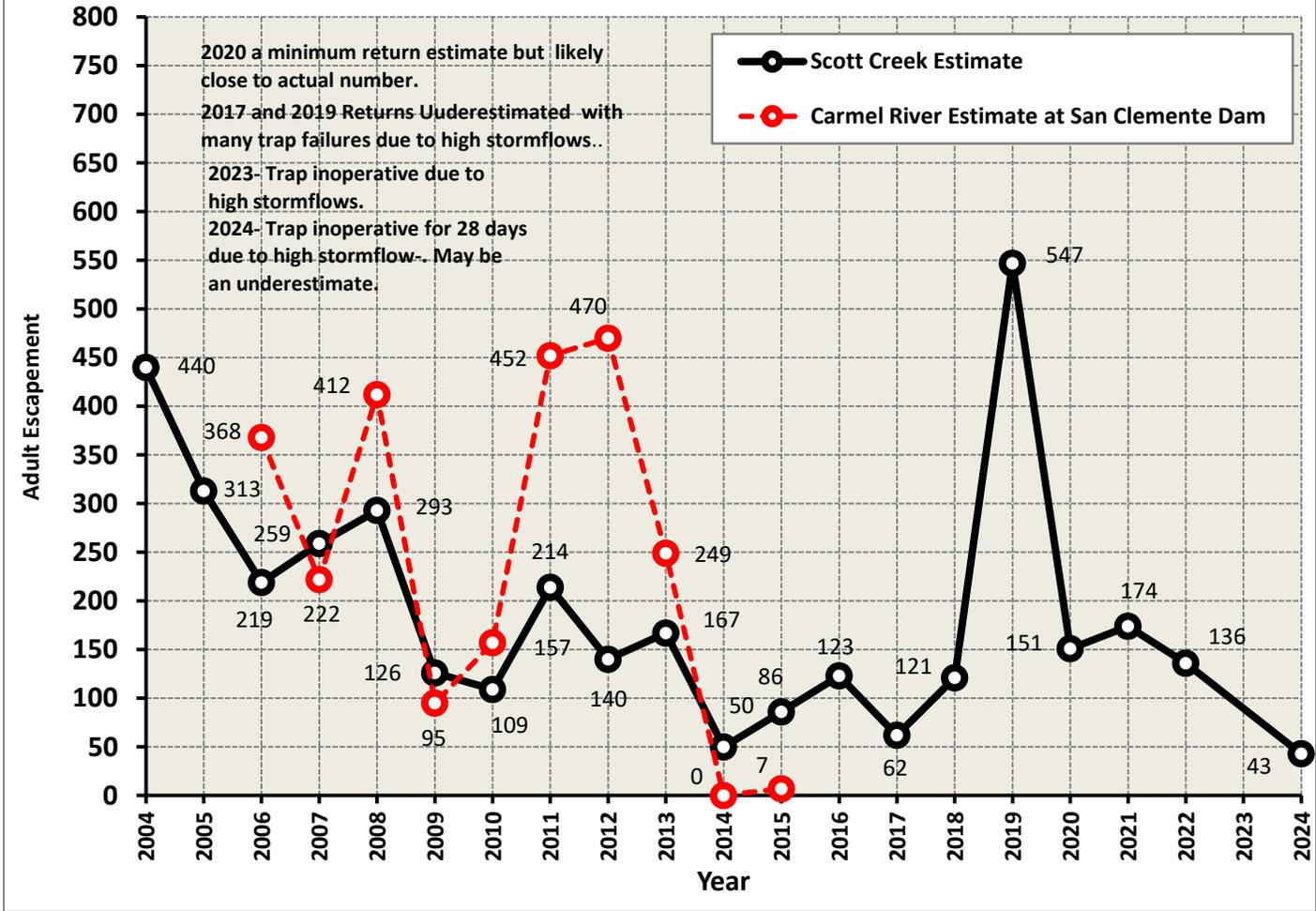


Figure 11. Estimated Adult Steelhead Returns to Scott Creek and San Clemente Dam on the Carmel River.

Figure 12. Yearling and Older Steelhead Site Densities in the San Lorenzo River in 2024 Compared to Average Density. (Averages based on up to 28 years of data; lines connecting site densities are for visual effect only.)

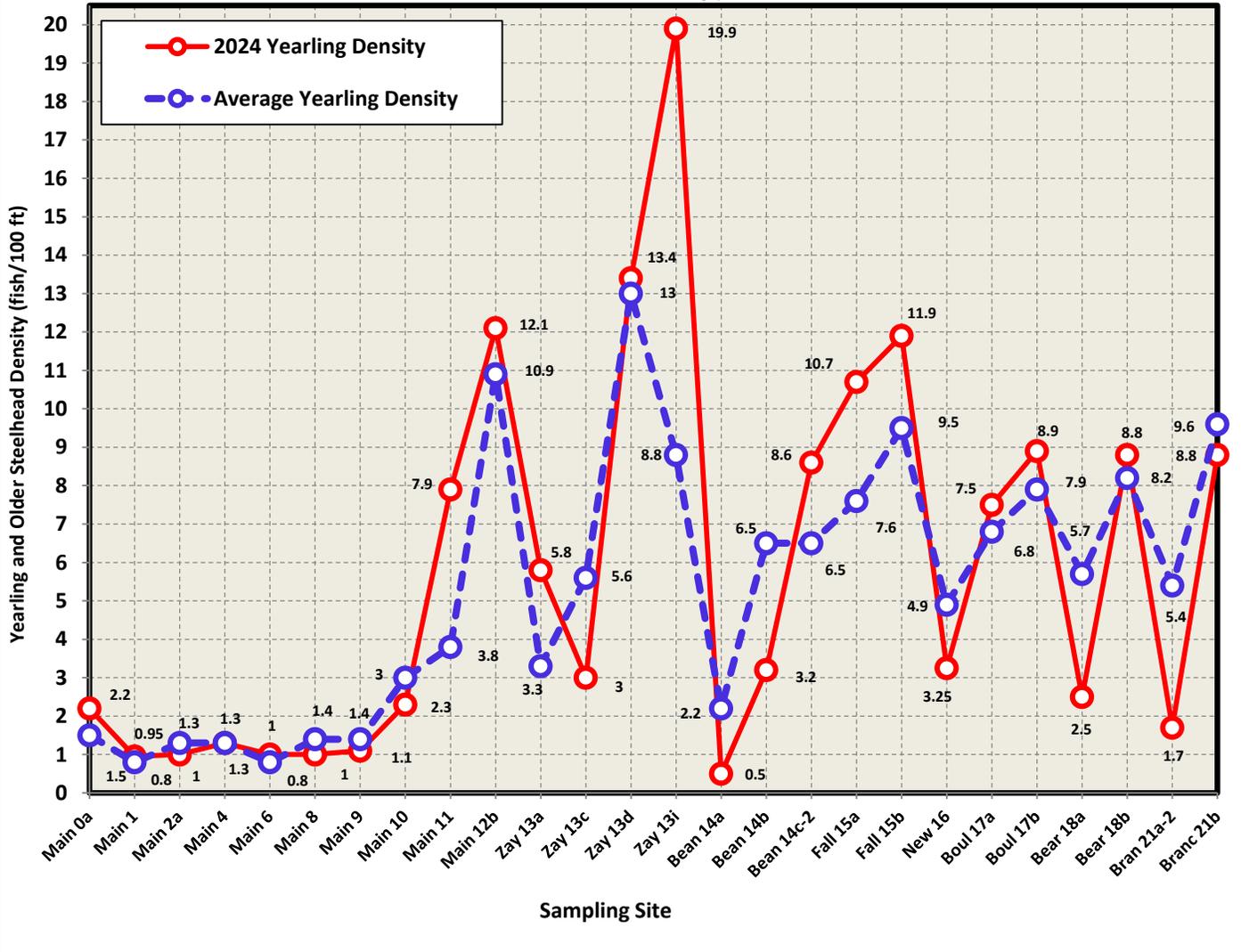


Figure 12. Yearling Steelhead Site Densities in the San Lorenzo River in 2024 Compared to Average Density. (Averages based on up to 28 years of data.)

Figure 13. SIZE CLASS II AND III STEELHEAD SITE DENSITIES in the San Lorenzo River in 2024 Compared to Average Density. (Based on up to 28 years of data; lines connecting site densities are for visual effect.)

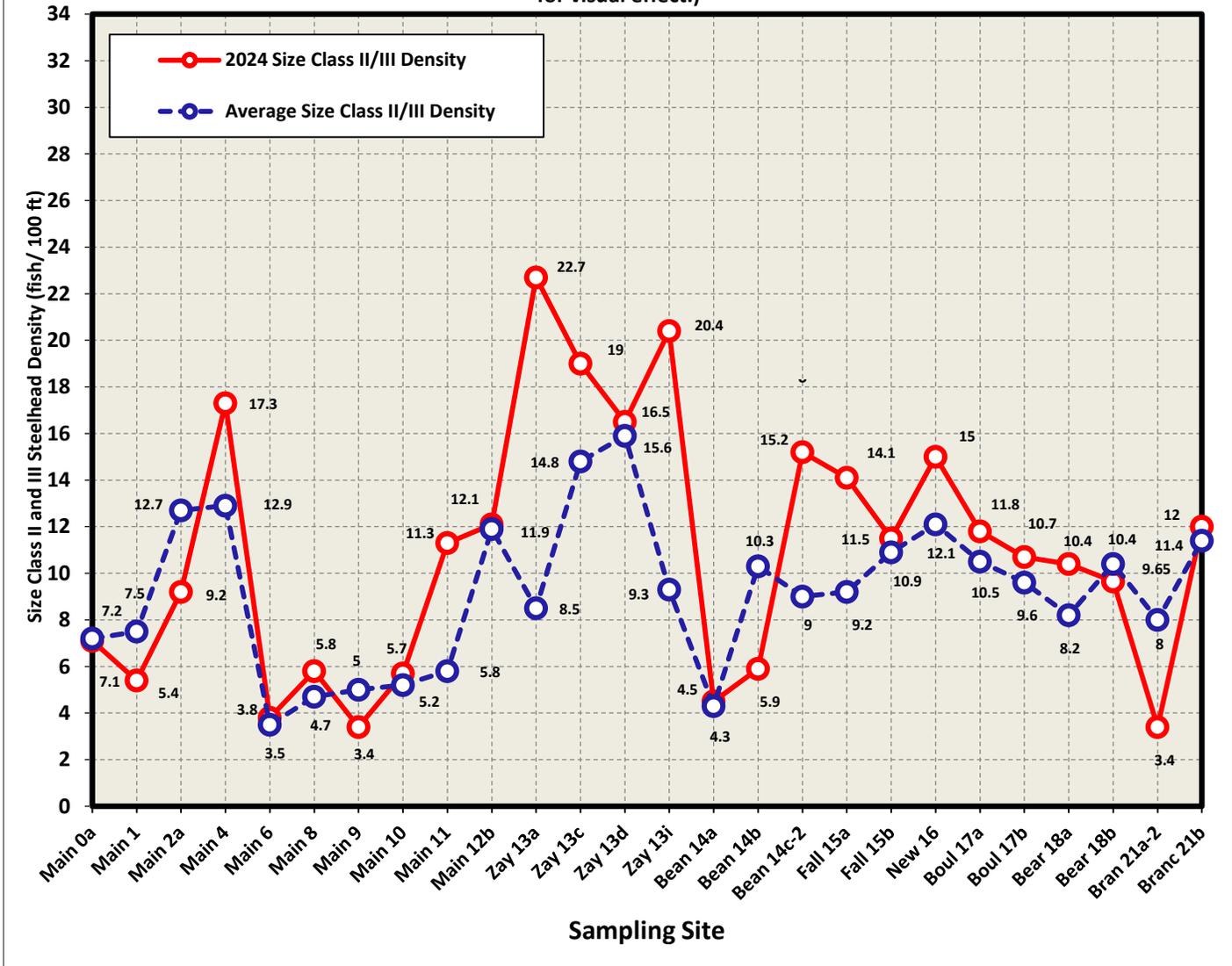


Figure 13. Size Class II/III Steelhead Site Densities in the San Lorenzo River in 2024 Compared to Average Density. (Averages based on up to 28 years of data.)

Figure 14. SIZE CLASS II AND III STEELHEAD SITE DENSITIES in the San Lorenzo River in 2024 Compared to 2023.
(Lines connecting site densities are for visual effect.)

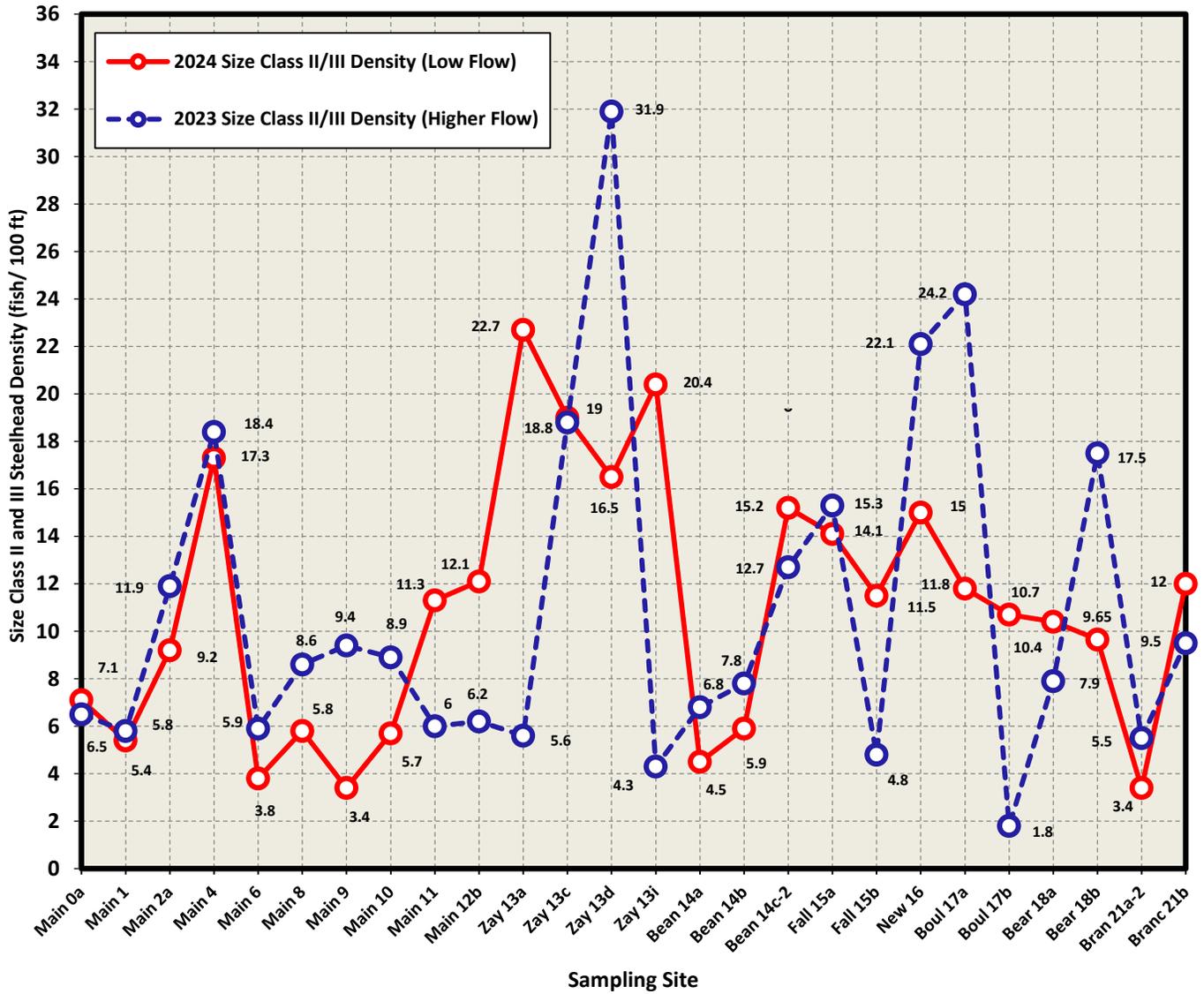


Figure 14. Size Class II/III Steelhead Site Densities in the San Lorenzo Watershed
Comparing 2024 to 2023.

Figure 15. Trend in Total Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2024.

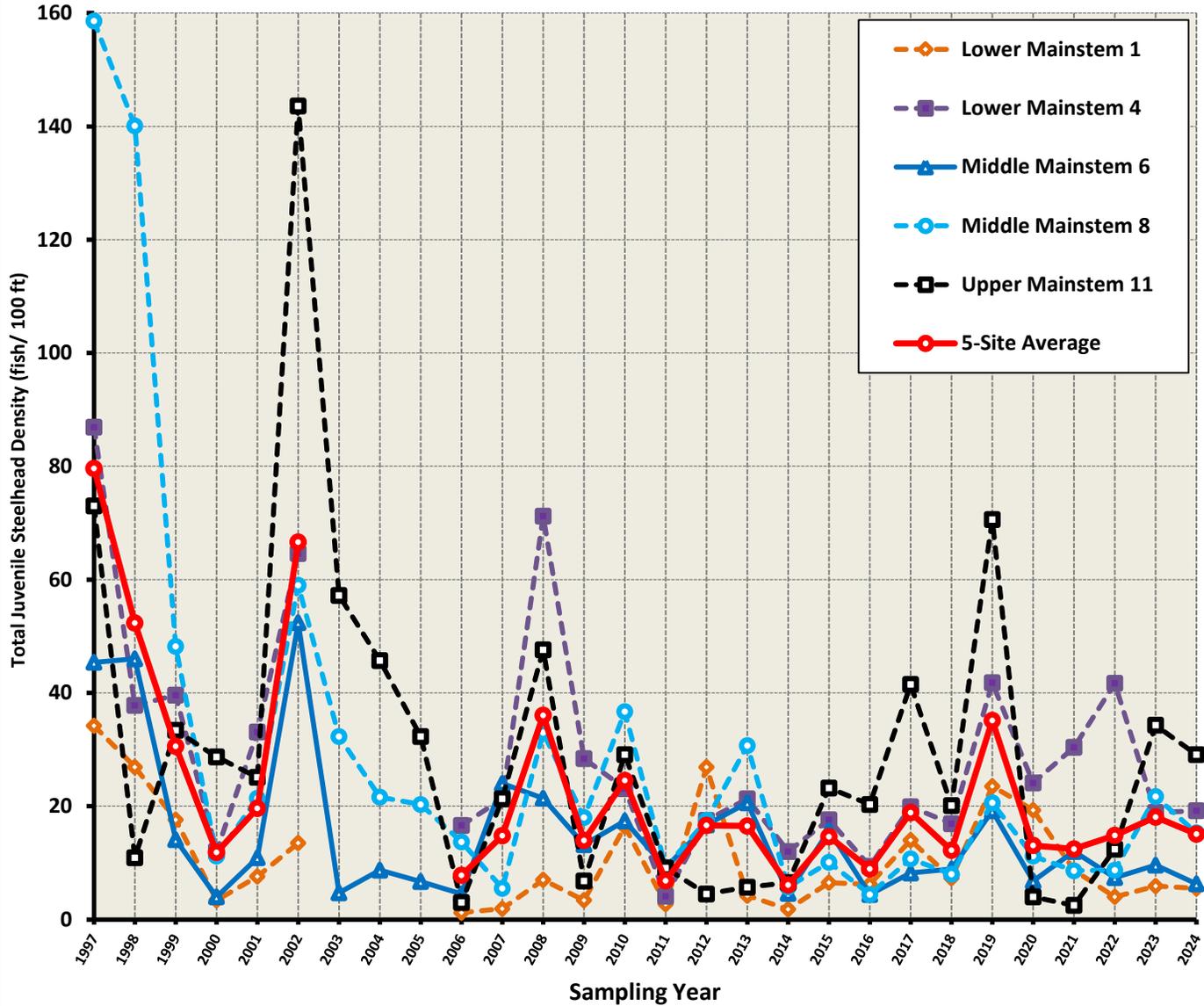


Figure 15. Trend in Total Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2024.

Figure 16. Trend in Total Juvenile Steelhead Density at 7 San Lorenzo Tributary Sites, 1997-2024. (Bean Creek Segment 14c was moved upstream in 2016 because it then became frequently dewatered.)

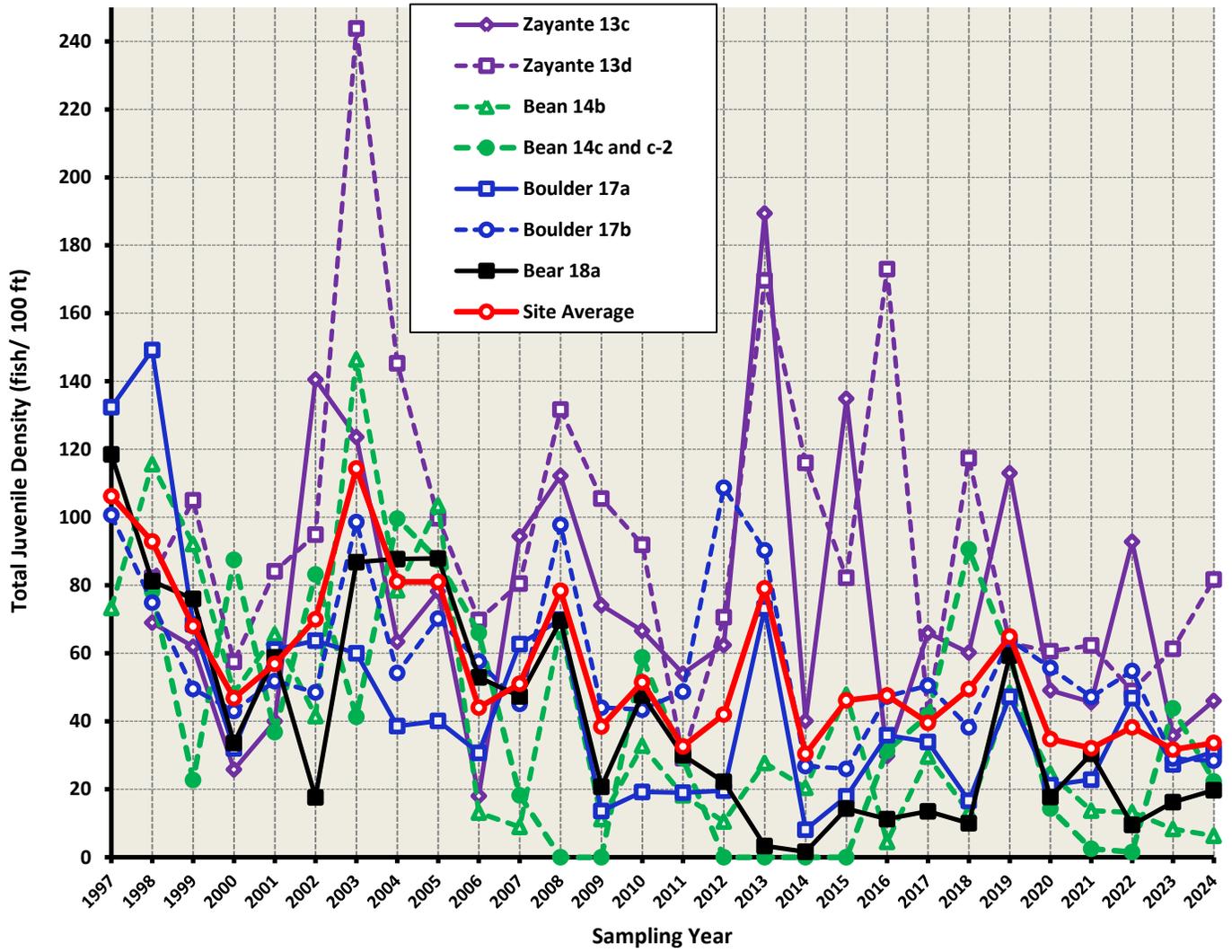


Figure 16. Trend in Total Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2024.

Figure 17. Trend in Size Class II/III ($\Rightarrow 75$ mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2024.

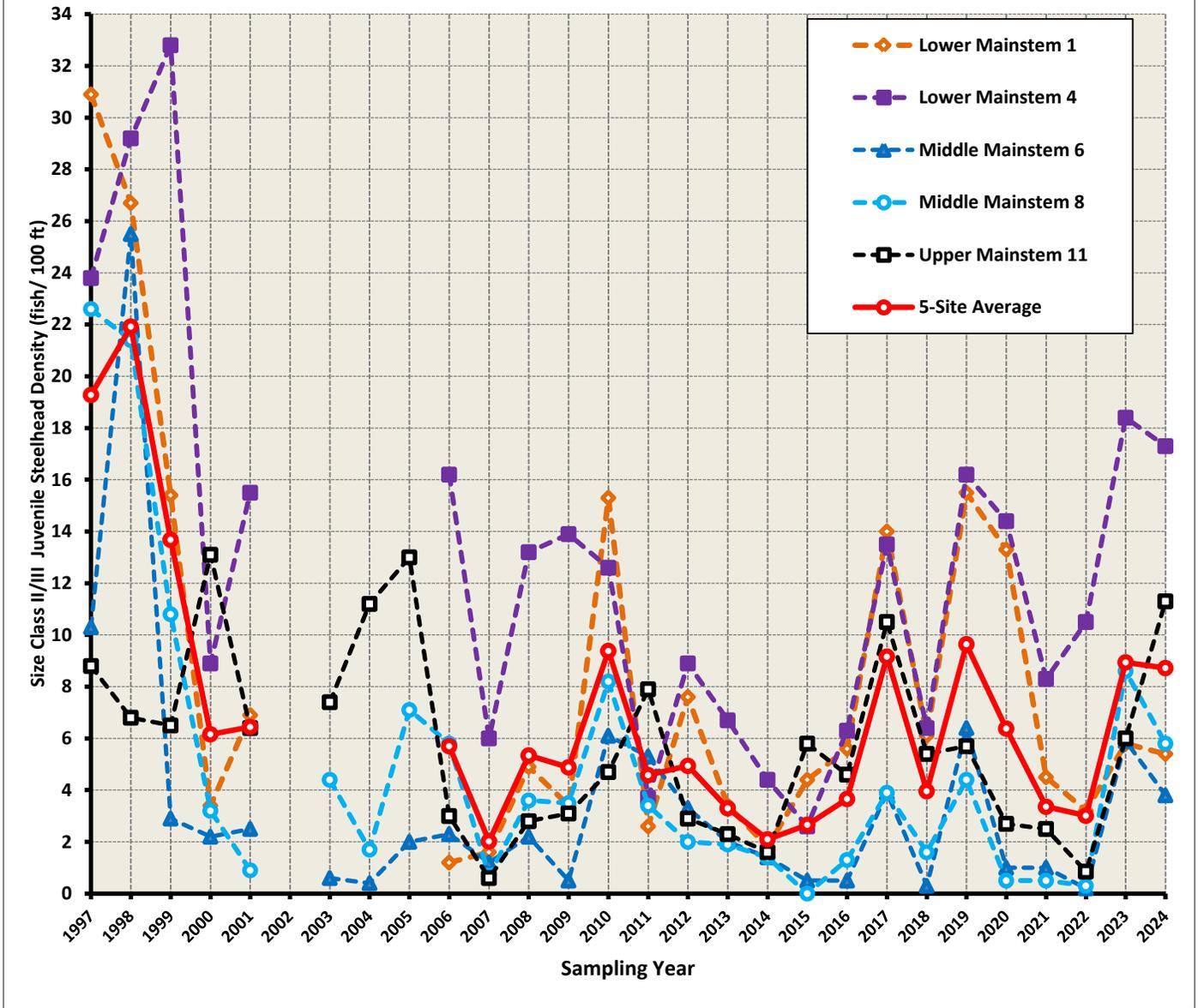


Figure 17. Trend in Size Class II/III Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2024.

Figure 18b. Trend in Size Class II/III (≥ 75 mm SL) Juvenile Steelhead Density at 7 San Lorenzo Tributary Sites, 1997-2024. (Bean Creek Segment 14c was moved upstream in 2016 because it became dewatered.)

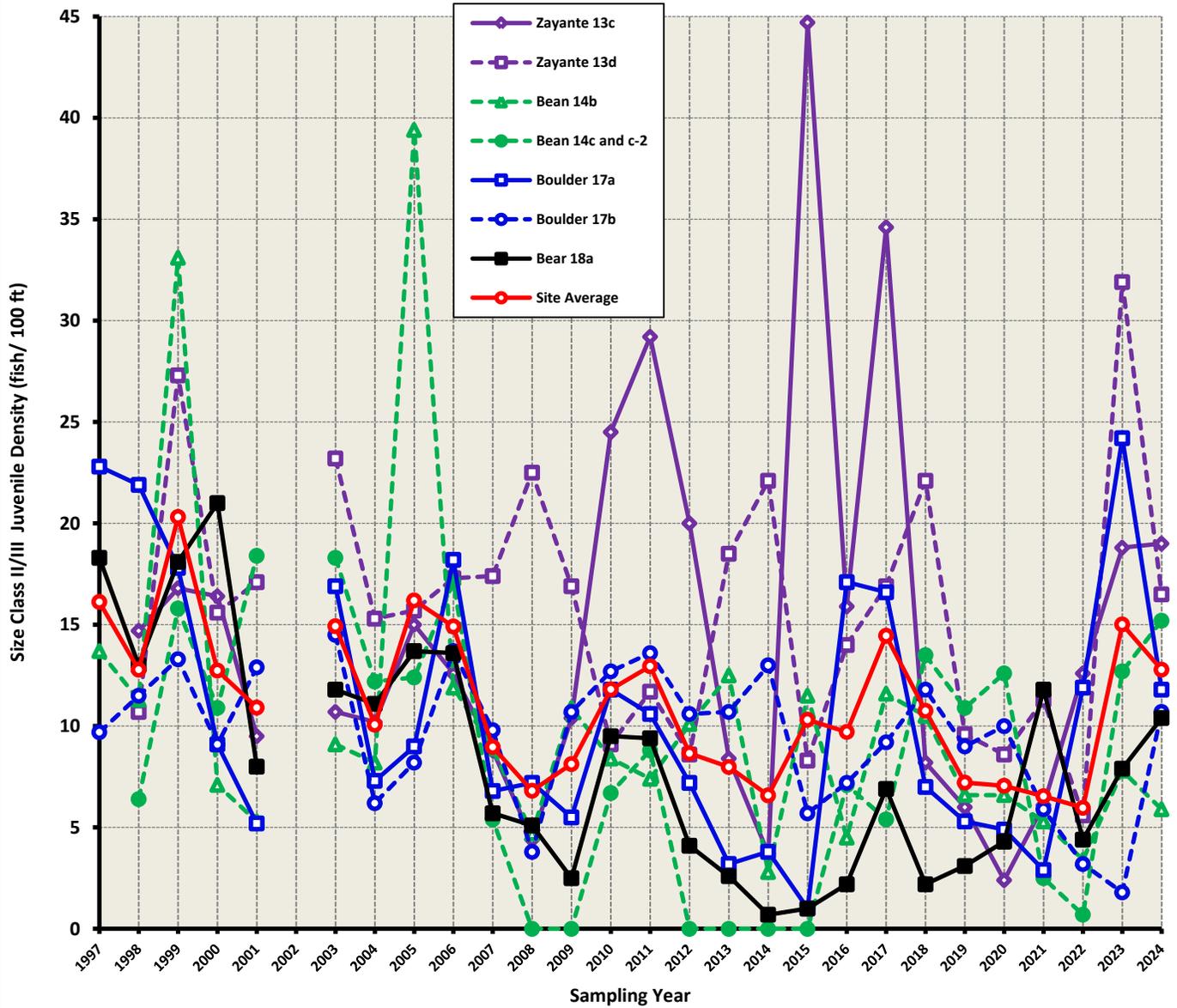


Figure 18a. Trend in Size Class II/III Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2024.

Figure 18b. Trends in Size Class II/III (≥ 75 mm SL) Juvenile Steelhead Density in the San Lorenzo, Soquel and Aptos/Valencia Watersheds, 1997 –2024.

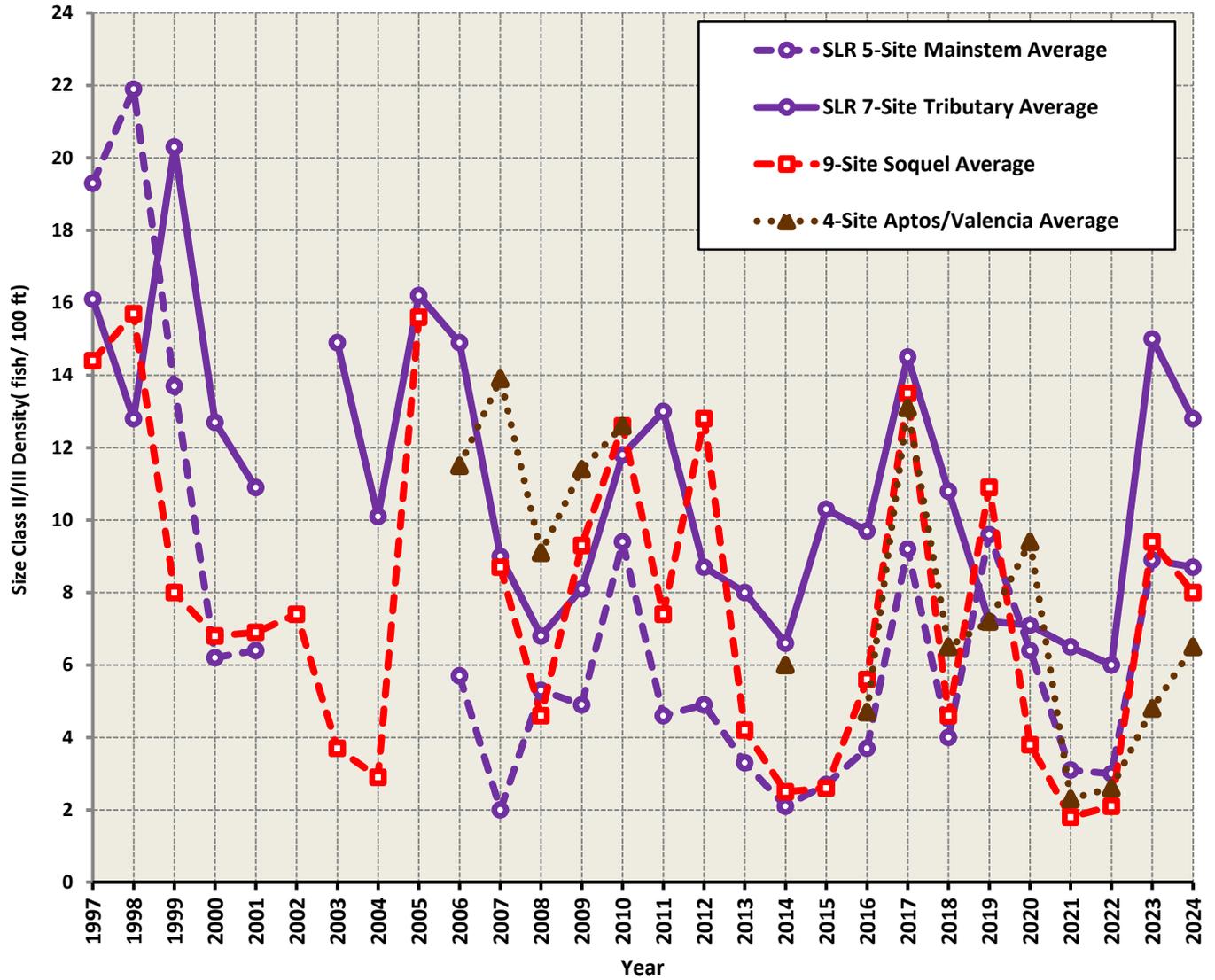


Figure 18b. Trend in Size Class II/III Juvenile Steelhead Density in San Lorenzo, Soquel and Aptos/Valencia Sites, 1997-2024.

Figure 19a. Trend in Size Class II/III (\Rightarrow 75 mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem and Tributary Sites with 5-Month Baseflow Average, 1997-2024.

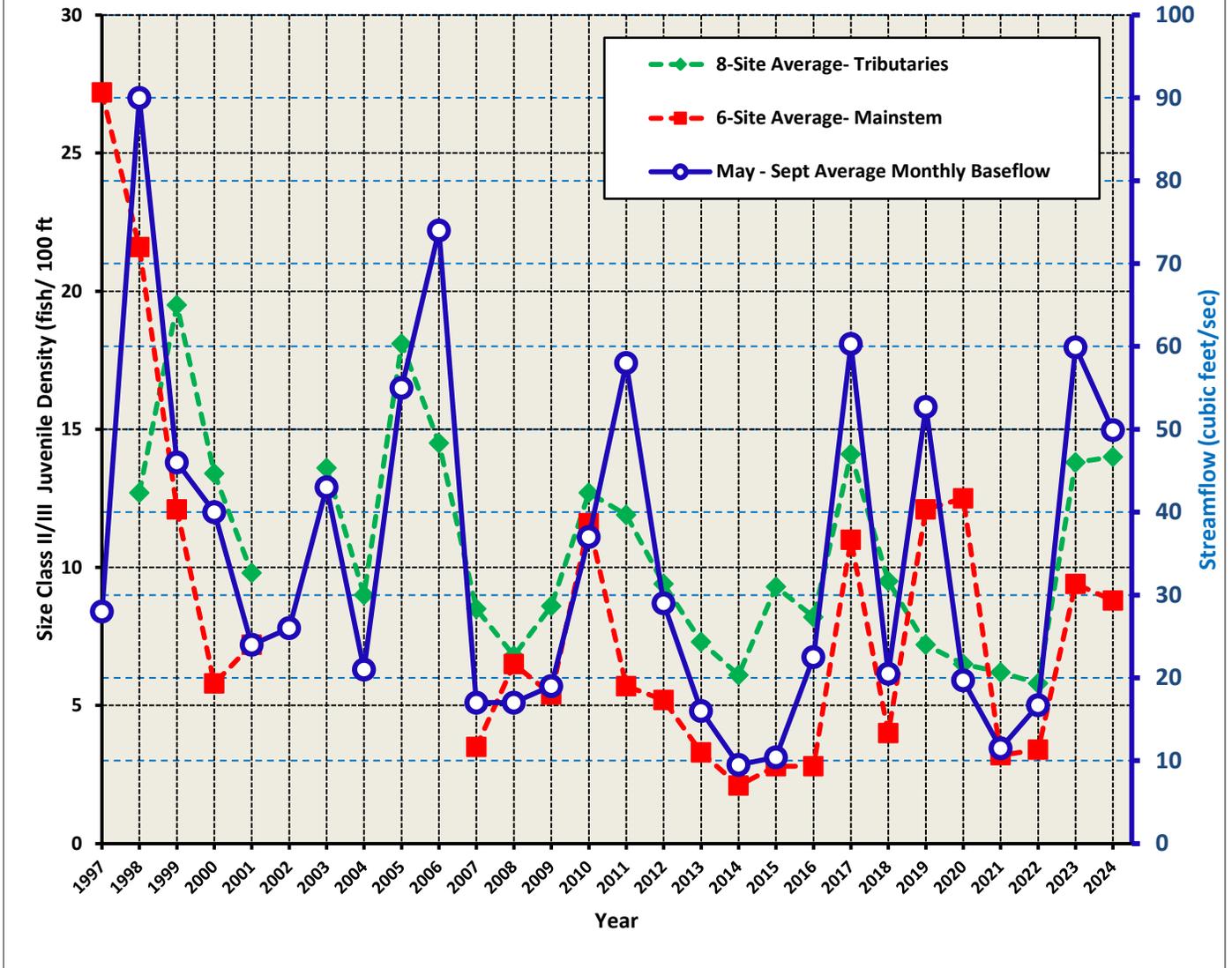


Figure 19a. Trend in Size Class II/III (\Rightarrow 75 mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem and Tributary Sites with 5-Month Baseflow Average, 1997-2024.

Figure 19b. Trend in Size Class II/III (\Rightarrow 75 mm SL) Steelhead Density at Middle Mainstem San Lorenzo Sites with 5-Month Baseflow Average, 1997-2024.

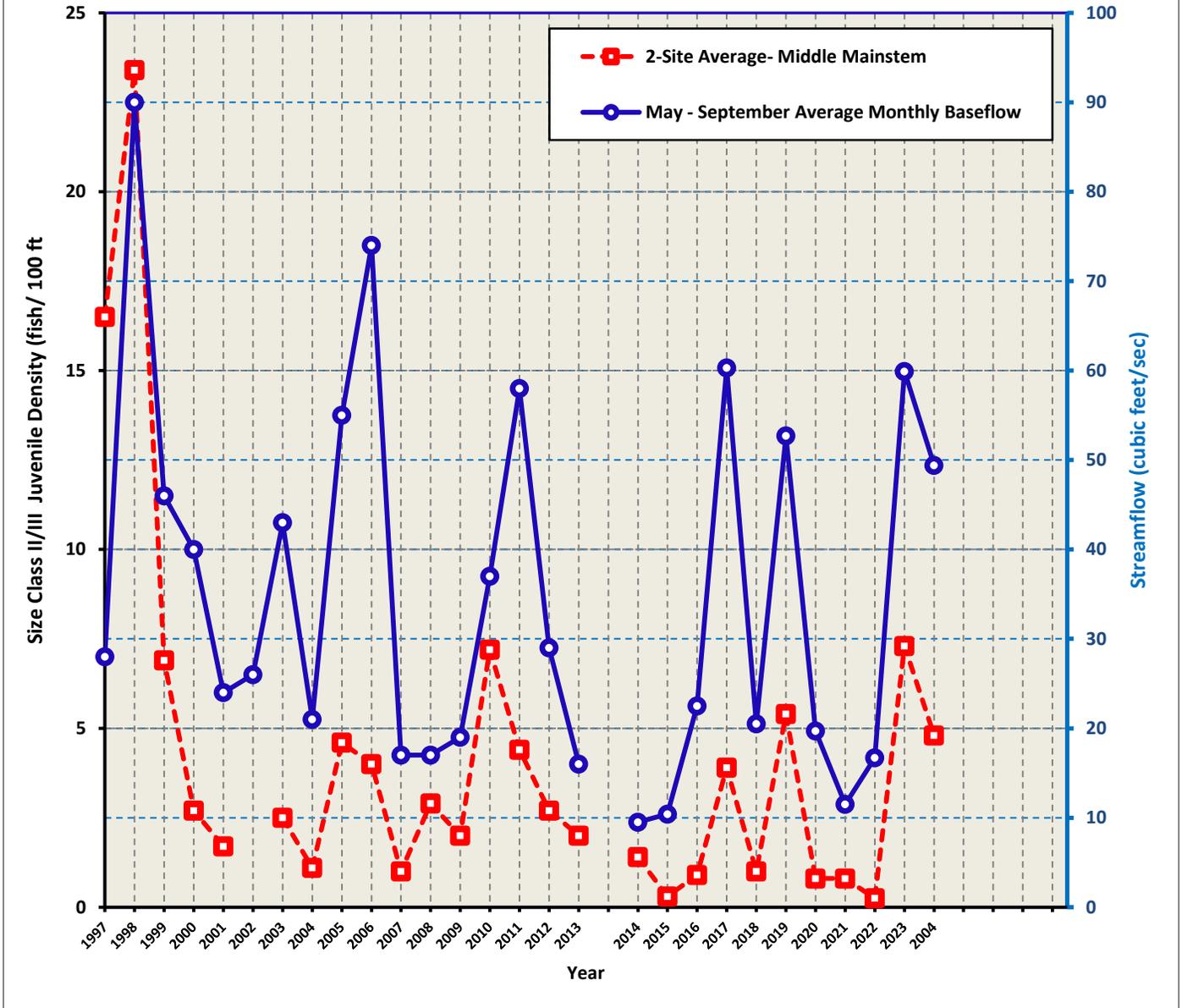


Figure 19b. Trend in Average Size Class II/III (\Rightarrow 75 mm SL) Juvenile Steelhead Density at San Lorenzo Middle Mainstem Sites with 5-Month Baseflow Average, 1997-2024.

Figure 20a. Trend in Index of Size Class II/III (≥ 75 mm SL) Juvenile Production in 6 Mainstem and 11 Tributary San Lorenzo River Reaches with 5-Month Baseflow Average, 2010-2024.

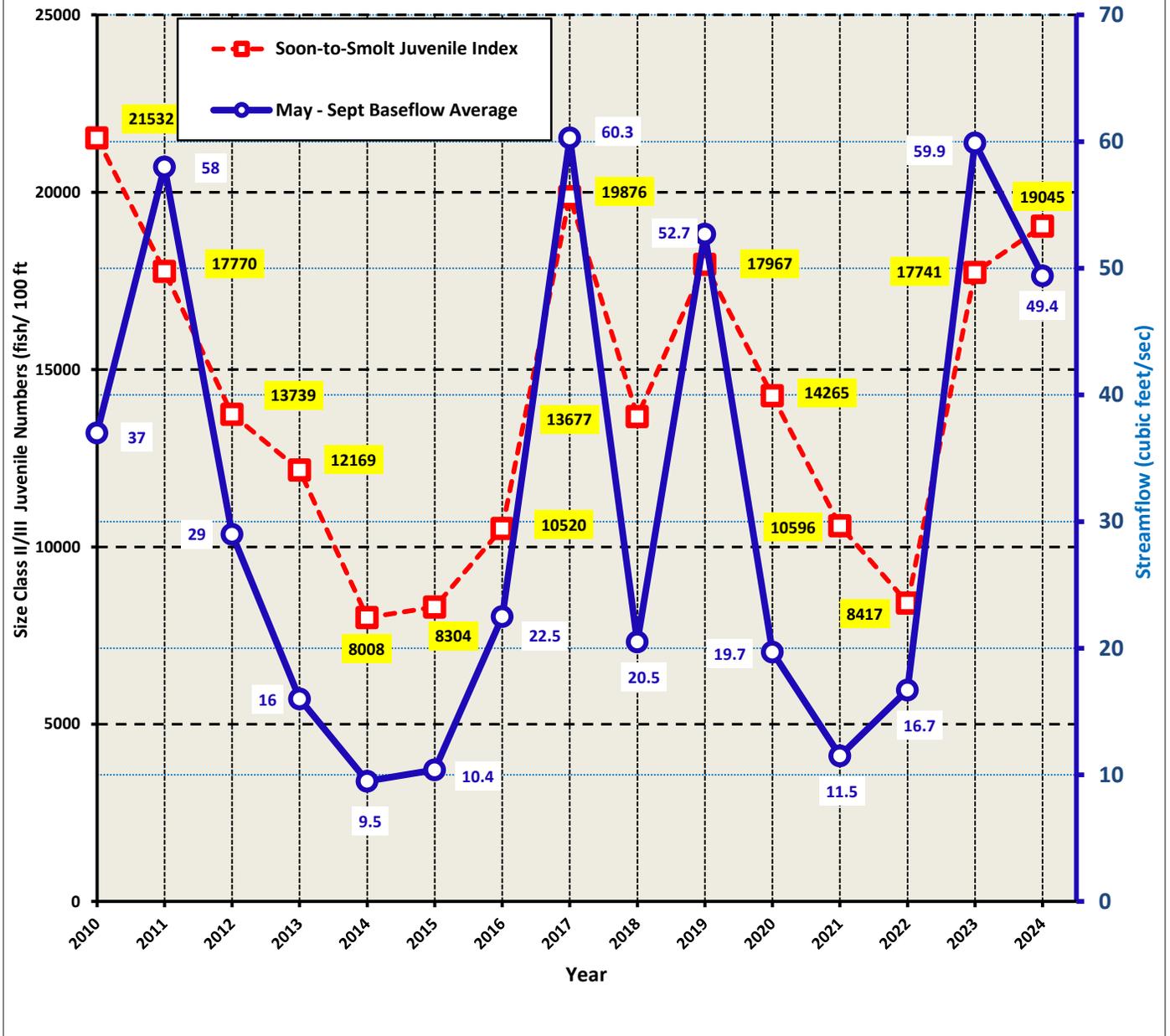


Figure 20a. Trend in Index of Size Class II/III (≥ 75 mm SL) Juvenile Steelhead Production in 6 Mainstem and 11 Tributary San Lorenzo River Reaches with 5-Month Baseflow Average, 2010-2024.

Figure 20b. Soon-to-Smolt Juvenile Steelhead Indices of Production for 6 Mainstem San Lorenzo River Reaches (1, 2, 4, 6, 8 and 11).

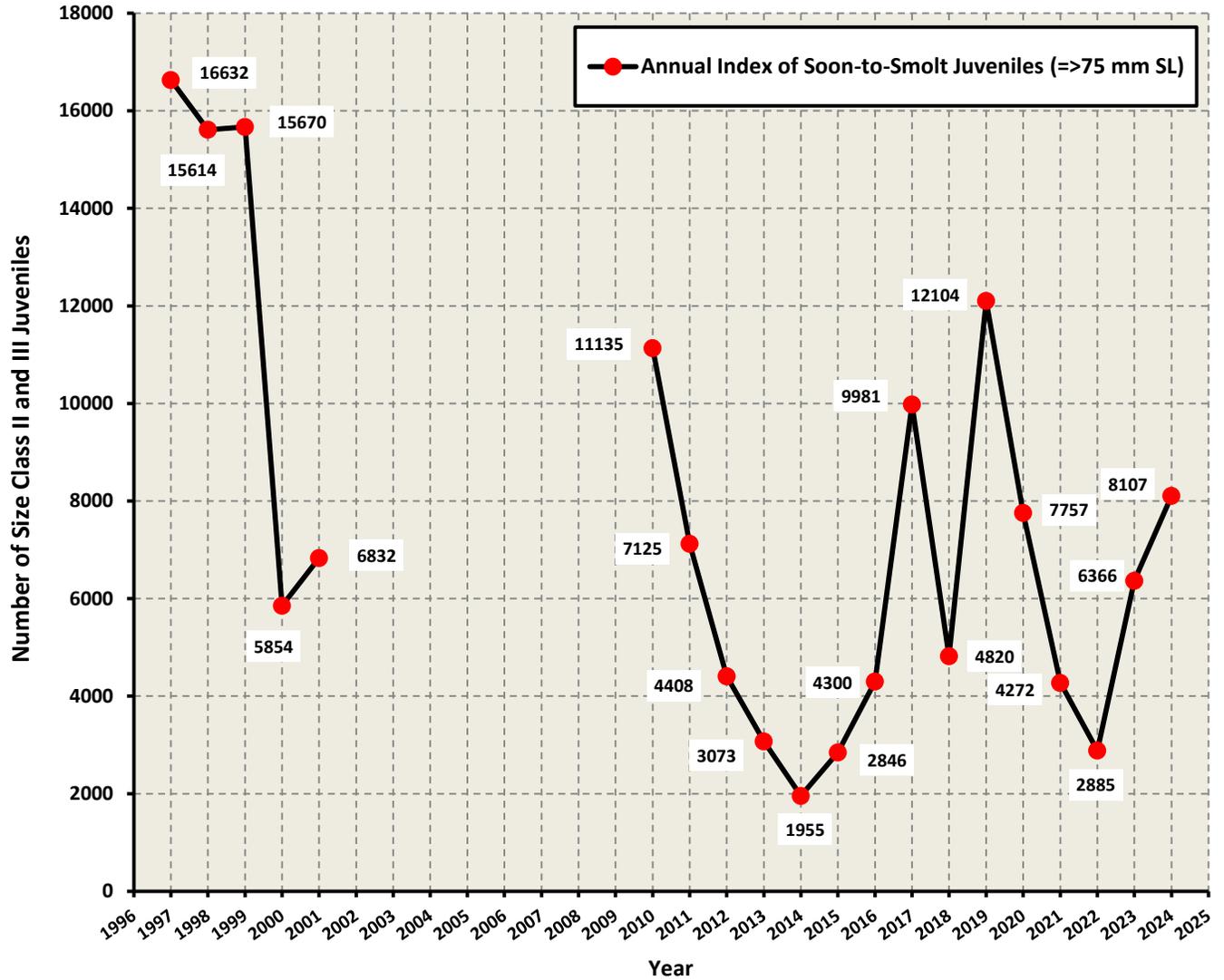


Figure 20b. Trend in Index of Size Class II/III Juvenile Steelhead Production in 6 Mainstem San Lorenzo River Reaches Since 1997.

Figure 21. Average Standard Length of Juvenile Steelhead at San Lorenzo Sampling Sites after Relatively Wet and Dry Rainfall Seasons with Associated Higher and Lower 5-Month Average Baseflows.

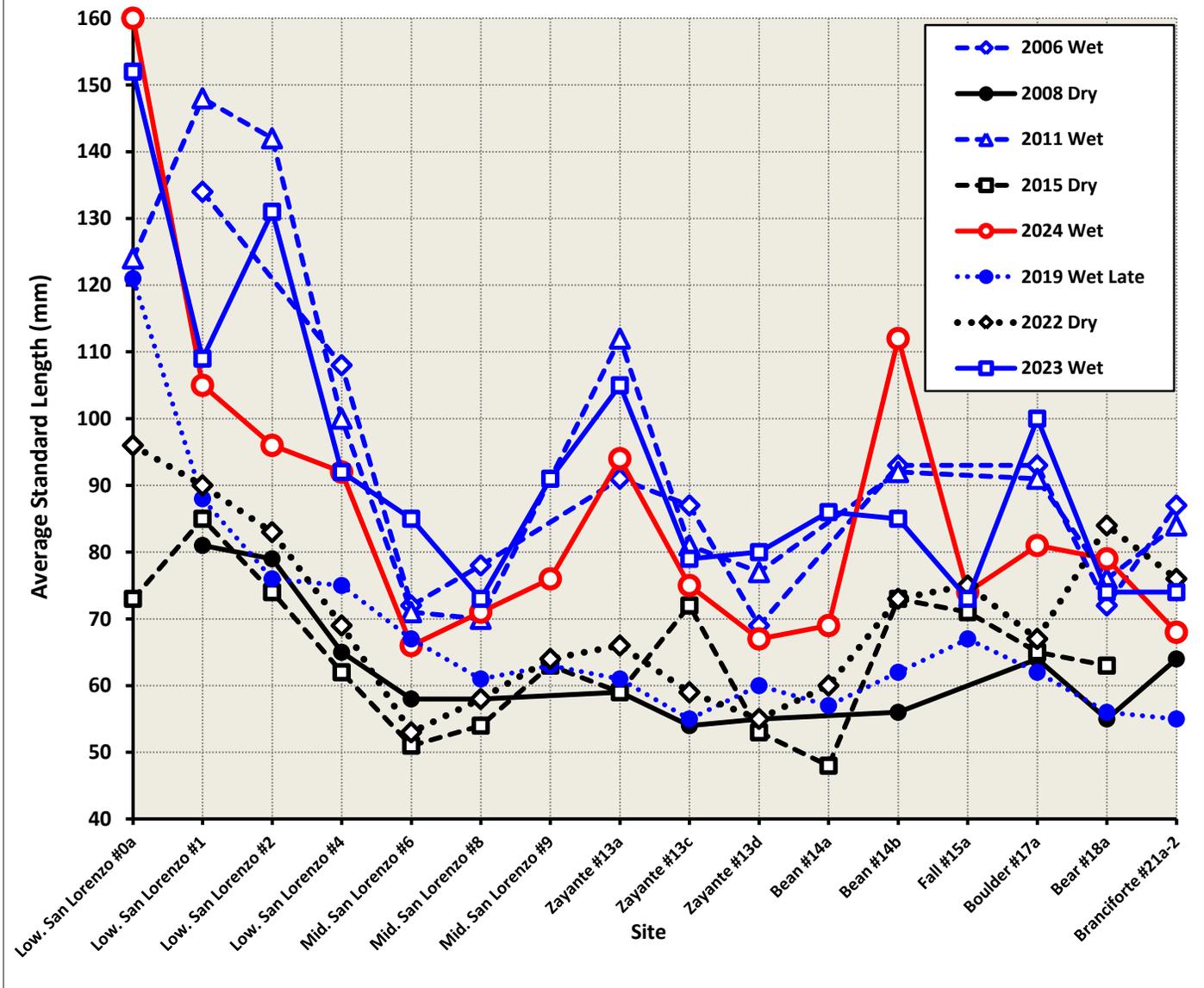


Figure 21. Average Standard Length of Juvenile Steelhead at San Lorenzo Sampling Sites after Relatively Wet and Dry Rainfall Seasons, with Associated High and Low Annual Baseflows.

ii. Steelhead Abundance and Habitat in the Soquel Creek Watershed

1. In Soquel Creek, adult steelhead passage and redd-building flows in winter and spring were good and followed the same pattern as in the SLR, with 8 significant stormflows greater than 200 cfs between December and early April that provided good headwater spawning access. Between January and early March, two stormflows produced peak flows in excess of bankfull at the Soquel Village USGS (1,300-1,800 cfs) and two others were in the 1,000-1,200 cfs range (**Figure 22**). These stormflows were sufficient to scour redds or smother them to reduce egg survival, especially in this sand-laden watershed, particularly in the Mainstem downstream of Moores Gulch. Stormflows between 100 and 500 cfs in April and May encouraged out-migration of smolts. Baseflow steadily declined from early May at well above median baseflow, with it remaining above 10 cfs until July. Our measured baseflows on 16 October 2024 were relatively high and second highest since 2010 in lower Soquel Creek at Walnut Street (4.13 cfs; 4.33 cfs in 2023; 1.40 in 2022) and lower East Branch (1.31 cfs; 1.85 cfs in 2023; 0.24 in 2022) (**Table 4**). It was the second highest since 2017 in the middle Mainstem above Moores Gulch (3.15 cfs; 3.50 cfs in 2023; 1.35 in 2022). A plant nursery and former surface water diverter from Soquel Creek closed downstream of Moores Gulch and Reach 7 in 2023. This enhanced summer baseflow in Soquel Creek. Fish sampling occurred prior to any fall stormflow in 2024.
2. **Overall 2024 habitat quality declined in all site/reaches when compared to 2023 conditions (Table 5; Map in Figure 2).** Where only site data were collected in 2024, sites were compared to 2023 site conditions. Habitat declined somewhat at all of these sites due to **somewhat decreased baseflow (Table 4), decreased insect drift rate and decreased fastwater area (less food), although streamflow was well above the median (Figure 22).** But escape cover in pools increased at these sites, and maximum pool depth increased at 3 of 4 sites. When habitat typed reach segments in 2024 were compared to 2023, habitat declined due to reduced food and shallower habitat in the lower Mainstem and lower West Branch, with similar pool escape cover in 2 of 3 segments and improvement in lower West Branch Reach 13. **When habitat typed reach segments in 2024 were compared to the drier years of 2021 and 2022, habitat improved** with more food, deeper habitat and more pool cover in Reaches 8 and East Branch 9a. Also, increased fastwater habitat depth and increased pool depth where sedimentation had not caused pool filling **Percent fine sediment** had increased in pools and fastwater habitat at all sites and reaches in 2023 except for pool habitat at uppermost West Branch Site 21. In 2024 it remained similar to 2023 except worsening in fastwater habitat from the middle Mainstem through the East Branch and in lower West Branch. Percent fines increased in pools only in upper West Branch 21 compared to 2023. However, percent fines in pools increased Reaches 8 and East Branch 13 when compared to 2021 and 2022. **Percent embeddedness** of larger substrate remained mostly similar to 2023 conditions except lessened in the upper East Branch. It had increased in the lower East Branch Reach 9a since 2021, consistent with increased percent fines. **Pool escape cover** increased in 6 of 9 reaches/sites compared to previous years and after improving in 5 of 9 in 2023. It was similar to 2023 levels in the two lower Mainstem reaches and declined in upper Mainstem Reach 8 compared to 2022. Escape cover was provided mostly by undercut banks, instream wood, overhanging vegetation and unembedded boulders (especially in headwater sites).
3. **Total and YOY juvenile steelhead densities** in 2024 were well below average at all sampling sites except approaching average at the upper West Branch 21 (**Figures 23 and 24**). In 2024 the 9 sites averaged 16 total juveniles/100 ft compared to the long term average of 33 juveniles and 14 YOY/100 ft compared to the long term average of 30 YOY). The highest YOY densities were at the uppermost East Branch Site 16 in the SDSF and at the uppermost West Branch 21, indicating adequate spawning access. The decreases in total and YOY juvenile densities from 2023 to 2024 were not statistically significant (**Table 9; Figure 25**). Smith (2024) found in Gazos Creek that despite only apparent modest improvements in channel habitat, mean steelhead YOY density (33.2/100 ft) nearly tripled compared to 2023 and was the second highest since 2009. Smith found in 2024 in Waddell Creek that average YOY steelhead density was

4.8/100 ft and not much different from the dismal results in 2022 and 2023 (3.2/100 ft), despite improved habitat conditions since the CZU fire at the three downstream sites and less severe winter streamflows than in 2023 that reduced redd survival that year.

4. **Yearling densities** were above average at 7 of 9 sites in 2024 and higher than in 2023 at 3 sites, with differences between 2024 and 2023 yearling densities not being statistically significant (**Table 9; Figure 26**). Smith (**2023**) also found that average yearling and older steelhead density increased in Gazos Creek in 2023 (7.5/100 ft; 5.1 in 2022), it being attributed to the high 2022 YOY density. Smith (**2024**) found average yearling density in Gazos Creek in 2024 (7/100 ft) to be similar to 2023 (7.5/100 ft). He found that average yearling density remained low in Waddell Creek in 2024 (1.1/100 ft) compared to 2023 (1.4/100 ft). He did not sample Scott Creek in 2024.
5. **Size Class II and III densities** were well above average at 2 of 9 sites in 2024 (upper Mainstem 12 with mostly larger YOY and upper East Branch 16 with yearling retention after good YOY densities in 2023) and greater than in 2023 at 4 sites (**Figures 27 and 28**). But with the shortage of YOY and yearlings at lower Mainstem sites, Size Class II and III densities were low in 4 of 5 Mainstem sites. The differences between 2024 (wet year) and 2023 (wetter year) densities were not statistically significant (**Table 9**). Some YOY reach Size Class II where food is more abundant. Therefore, at some sites the Size Class II/III group includes YOY and yearlings, especially in the higher baseflow year of 2024. The density of these larger fish that will soon smolt is more important than the total or YOY density of juvenile steelhead. Relevant here is that Smith (**pers. comm.**) found from scale analysis of returning adult steelhead that **YOY that could not reach at least 60 mm SL their first year did not survive to return as adults** to the San Lorenzo River. Therefore, high densities of very small YOY at upper tributary sites may contribute little to the returning adult population.
6. In 2024, the 6-site long-term **trend in Size Class II/ III densities** remained the same as in 2023 (9.1/100 ft) after it had more than doubled from 2022 to 2023 (**Figure 30**). The 9-site average Size Class II/III density was less in 2024 (8/100 ft) than in 2023 9.1/ 100 ft after it had increased from the three previous drought years when it ranged between 1.8 and 3.8 fish. The 27-year average of 7.3 fish.
7. This annual **trends in density and production indices of Size Class II/III numbers positively tracked with averaged 5-month baseflow (Figure 31a-b)**. The production index from 8 Soquel Creek reaches decreased from 2023 (4,194) to 2024 (3,856), which was the third highest index since 2010, with 2017 having the highest production index (5,039; another wetter year). The increased production index in high baseflow years comes from fast growing YOY at all Mainstem sites and lower East and West Branch sites. Therefore, although total and YOY densities in 2024 were relatively low, the densities and production estimate of the more important Size Class II/III fish were relatively high, as was baseflow. Trends in these larger juveniles in Soquel Creek follow similar fluctuations through the wet and dry years in the SLR watershed (**Figures 20a-b**), and to a degree in the Aptos/Valencia watershed (**Figure 38b**). **Therefore, although total and YOY densities in 2024 were below average at all sampled sites, densities and production estimates of the important Size Class II/III fish were relatively high in the upper Mainstem and Branches and consistent with higher baseflow.**
8. No steelhead population estimate for Soquel Lagoon was possible in 2024 because only 2 steelhead were captured on two days of sampling with no recaptures. This was the fewest steelhead captured in the 34 years of annual lagoon sampling. Only the lower lagoon is accessible to sampling, and more juveniles were likely present further upstream in the lagoon. The apparent low density of steelhead inhabiting the lagoon in 2024 may have occurred because, with the many significant stormflows over the winter/spring, most adult steelhead likely spawned far up in the watershed, some distance from the lagoon. YOY densities were very low at stream sites in the lower and middle Mainstem, indicating low spawning effort and/or scour of redds constructed there. Also, the adult spawning population may have been relatively small over the 2023-2024 winter/spring.

9. Habitat conditions based on soon-to-smolt densities ranged from “poor” to “good” in 2024, which were diminished from 2023 ratings in 4 of 5 Mainstem sites and lower West Branch 19 (**Table 2**). These ratings incorporate fish density and fish length. Mainstem Site 4 just upstream of the flower fields was rated “poor” when only 2 juvenile steelhead (both Size Class II) were captured at the site despite good streamflow and escape cover. “Below average” ratings occurred at Mainstem Sites 1 and 6, lower East Branch 13a and lower West Branch 19. Site 19 in lower West Branch had the highest soon-to-smolt density in 2023 of mostly fast growing YOY. Upper West Branch 21 had a “fair” rating in 2024. Upper Mainstem 12 and upper East Branch 16 had “good” ratings.
10. The average 6-site *trend in total site densities* (consisting mostly of YOY) declined in 2024 and was the fifth lowest average in 27 years at 14 fish/100 ft (18 in 2023; 10 in 2022; 16 in 2021; 13 in 2020; 57 in 2019 (wet spring); 27-year average of 34 juveniles/100 ft) (**Figure 29**). The downward trend in total and YOY juvenile steelhead densities in Soquel Creek over the years, excepting 2019, was likely due to a steady decline in returning adults that made spawning patchy and egg survival low during a preponderance of dry winters.
11. As stated for the San Lorenzo River YOY population in 2024, two factors may explain the relatively low YOY densities at most sites in Soquel Creek. One factor may have been low adult returns as indicated from adult returns estimated for Scott Creek mentioned earlier for the San Lorenzo adult returns (**Figure 11**). A second factor may have been poor egg survival during a wet winter in which 4 large stormflows occurred that could either scour out redds or smother them with fine sediment that was abundant throughout Soquel Creek. Even the 500 cfs stormflow registered at the Soquel Village gage may have been sufficient to smother some redds. YOY survival of swim-up fry that avoided mortality in the gravel during high stormflows experienced more food available and faster growth in 2024 compared to most years. This was because YOY production was likely low but baseflows were relatively high and much above the median. These relatively high baseflows provided more food with less competition, especially in late spring and early summer when baseflow was the highest with good water clarity. Tables of fish densities in Soquel Creek are in the detailed analysis report available upon request.



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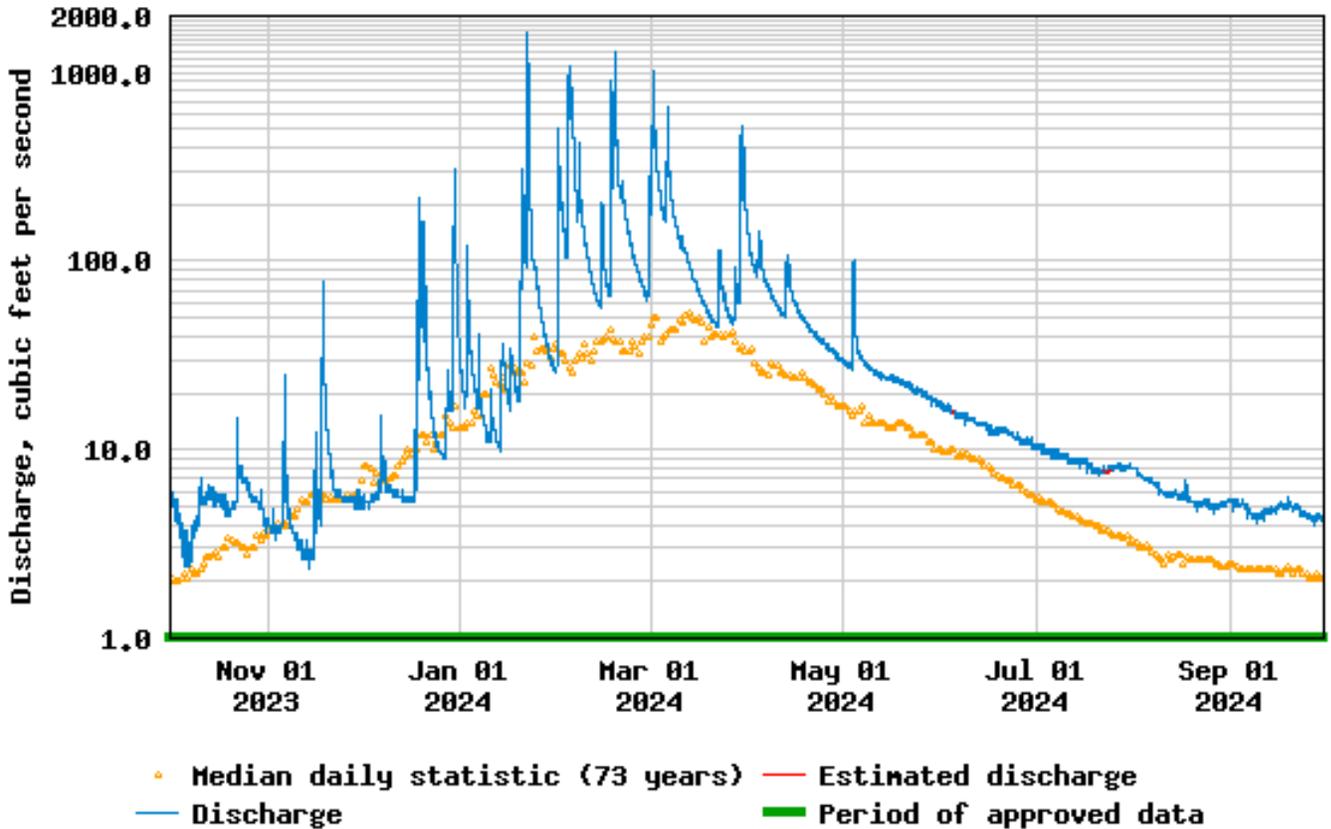


Figure 22. The WY2024 Discharge at the USGS Gage on Soquel Creek at Soquel Village.

Table 4. Fall/Late Summer STREAMFLOW (cubic feet/ sec) Measured by Santa Cruz County Staff in 2007–2017 (where dates are specified), from the USGS Stream Gage and by D.W. ALLEY & Associates; 2010 (September), 2011–2015, 2018– 2024 (October) at fall baseflow conditions.

Location	2007/ 2008	2009	2010	2011	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022*	2023	2024
Branciforte @ Isabel Lane	/ 0.3	0.25	0.42 (8/26)		0.57 (8/22)	0.59 (6/20)	0.31 (8/7)									
Soquel Creek above Lagoon in Reach 1			2.3 (DWA)	4.9 (DWA)	1.8 (DWA)	0.33 (DWA)	0.19 (DWA) (Walnut St.)	0.18 (DWA) (Walnut St.)	3.98 (DWA) (Walnut St.)	1.59 (DWA) (Walnut St.)	2.84 (DWA) (Walnut St.)	1.50 (DWA) (Walnut St.)	0.29 (DWA) (Walnut St.)	1.40 (DWA) (Walnut St.)	4.33 (DWA) (Walnut St.)	4.13 (DWA) (Walnut St.)
Soquel Cr @ USGS Gage in Reach 2	1.4/ 0.65	1.2	3.4	5.8	1.8	0.36	0.35	0.36 0.10 (9/9)	5.0 (12 Oct)	2.18 (12 Oct)	2.93 (12 Oct)	1.79 (12 Oct)	0.25 (15 Oct)	1.76 (18 Oct)	5.06- 5.96 (12 Oct) ???	3.96- 4.19 (16 Oct)
Soquel Cr @ Bates Cr	-/ 1.08		4.2 (9/1)	7.3 (8/31)	2.0 (9/19)	0.95 (9/11)	0.22 (9/17)	0.35 (9/9)								
Soquel Cr above Moores Gulch in Reach 7			2.16 (DWA)	4.3 (DWA)	2.0 (DWA)	1.26 (DWA)	0.72 (7/16) 0.80 (DWA)	0.54 (7/28) 0.56 (DWA)	4.46 (DWA)	1.51 (DWA)	3.30 (DWA)	1.57 (DWA)	0.72 (DWA)	1.35 (DWA)	3.50 (DWA)	3.15 (DWA)
W. Branch Soquel Cr below Old S.J. Road Olive Springs Bridge	1.75 After rain	–	1.2 @ Mouth (DWA)	2.2 @ Mouth (DWA); 3.0 (8/31)	1.1 @ Mouth (DWA); 1.21 (9/05)	0.91 @ Mouth (DWA); 1.73 (5/14)	0.80 (9/16) 0.74 @ Mouth (DWA)	0.58 (9/14) 0.59 @ Mouth (DWA)	1.85 @ Mouth (DWA)	1.16 @ Mouth (DWA)	1.59 @ Mouth (DWA)	0.93 @ Mouth (DWA)	0.79 @ Mouth (DWA)	0.96 @ Mouth (DWA)	2.16 Mouth (DWA)	1.76 Mouth (DWA)
E. Branch Soquel Cr @ 152 Olive Springs Rd.	1.0 After rain	–	0.77 @ Mouth (DWA)	2.1 @ Mouth (DWA); 2.7 (8/31)	0.54 @ Mouth (DWA); 0.43 (9/05)	0.16 @ Mouth (DWA); 2.0 (5/14)	0.0 (7/16) Trickle @ Mouth; Dry above (DWA)	Dry (DWA)	1.44 @ Mouth (DWA)	0.45 @ Mouth (DWA)	1.06 @ Mouth (DWA)	0.44 @ Mouth (DWA)	Trickle Immeasurable (DWA)	0.24 @ Mouth (DWA)	1.85 Mouth (DWA)	1.31 Mouth (DWA)
E. Branch Soquel Cr above Amaya Creek in Reach 12a		Trickle (DWA)	0.44 (DWA)			0.03 (DWA)	Dry (DWA)	Dry (DWA)	0.71 (DWA)	0.15 (DWA)	0.46 (DWA)	0.10 (DWA)	Dry (DWA)	0.12 (DWA)	0.66 (DWA)	0.23 (DWA)
Aptos Cr below Valencia Creek confluence	1.2 After Rain/ 0.77	0.53	0.85 (9/1)		0.87 (DWA); 1.10 (9/05)	0.75 (DWA) 0.84 (9/11) (Valencia Cr. dry)	0.47 (9/16)		2.52 (DWA)	1.08 (DWA)	1.65 (DWA)	1.12 (DWA)	0.72 (DWA)	0.96 (DWA)	2.34 (DWA)	2.05 (DWA)
Aptos Cr above Valencia Creek			0.97 (DWA)	1.6 (DWA)			0.63 (DWA)	0.44 (DWA)								
Valencia Cr @ Aptos Cr	-/ 0.007	0.34 (May)	0.09 Adj. School (DWA)	0.8 Adj. School (7/27)	0.20 (9/05)	0.105 (9/11)										
Valencia Creek below Valencia Rd			0.22 (DWA)													

*Streamflow was measured in 2022 a month after mid-September stormflow that partially elevated baseflow.

Table 5. Habitat change in SOQUEL CREEK WATERSHED Reaches and Sites from the Most Recent, Previous Year Having Data. (Green highlight indicates Reach Comparisons. Yellow highlight indicates Site Comparisons.)

Reach or (Site Only) Comparison To Previous Years	2024 Baseflow Comparison (Most Important Habitat Factor May-September)	Depth - Pool / Fast-water Habitat	Fine Sediment- Pool / Fastwater Habitat	Embeddedness - Pool / Fastwater Habitat	Pool Escape Cover	Overall Habitat Change and (Any Improvement)
Site 1 Reach 1 (Since higher baseflow 2023)	-	Sim / -	Sim / Sim	Same / Same riffle Sim run	Sim	- (less food, shallower fastwater habitat)
Site 4 Reach 3a (Since higher baseflow 2023)	-	- / -	Sim / Sim	Same / Sim	Sim	- (less food, shallower habitat)
Site 6 Reach 4 (Since higher baseflow 2023)	-	Same avg + max / - avg riffle and run + max run	Sim / Sim riffle - run	Sim / - riffle run	+	- (less food, deeper max depth in pool and run, more sediment run, more embed. riffle, more pool cover)
Site 10 Reach (Since higher baseflow 2023)	-	- avg + max / - avg riffle and run Same max riffle	Sim/ Sim riffle - run	+ / Sim	Very +	- (less food, deeper max pool, shallower avg pool, more pool cover)
(Site 12) Reach 8 (Since lower baseflow 2022)	Very +	Same avg + max / +	- / Sim	Sim / Sim	-	+ (more food, deeper max pool and fastwater habitat, more pool sediment, less pool cover)
East Branch (Site 13a) Reach 9a (Since lower baseflow 2021)	Very +	+ / +	- / -	-/ Sim riffle - run	+	+ (more food, deeper fastwater habitat, less pool fine sediment, more pool cover)
East Branch (Site 16) Reach 12a (Since higher baseflow 2023)	-	- / - except Same avg riffle	+ / -	+ / - riffle + run	+	- (less food, shallower except same in riffles, more pool cover with less sediment and embeddedness)
West Branch Site 19 Reach 13 (Since higher baseflow 2023)	-	- / -	Sim / - riffle + run	Sim / Sim riffle + run	+	- (less food, shallower, more riffle sediment, less run sediment and embeddedness, more pool cover)
West Branch (Site 21) Reach 14b (Since higher baseflow 2023)	-	Same avg + max / - except + avg run	- / + riffle Same run	Sim / Sim riff - run	+	- (less food, deeper max pool, more pool sediment, more run embed., more pool cover)

Figure 23. TOTAL JUVENILE STEELHEAD DENSITIES IN SOQUEL CREEK in 2024 Compared to up to the 28-Year Average. (Lines between site densities are for visual effect only).

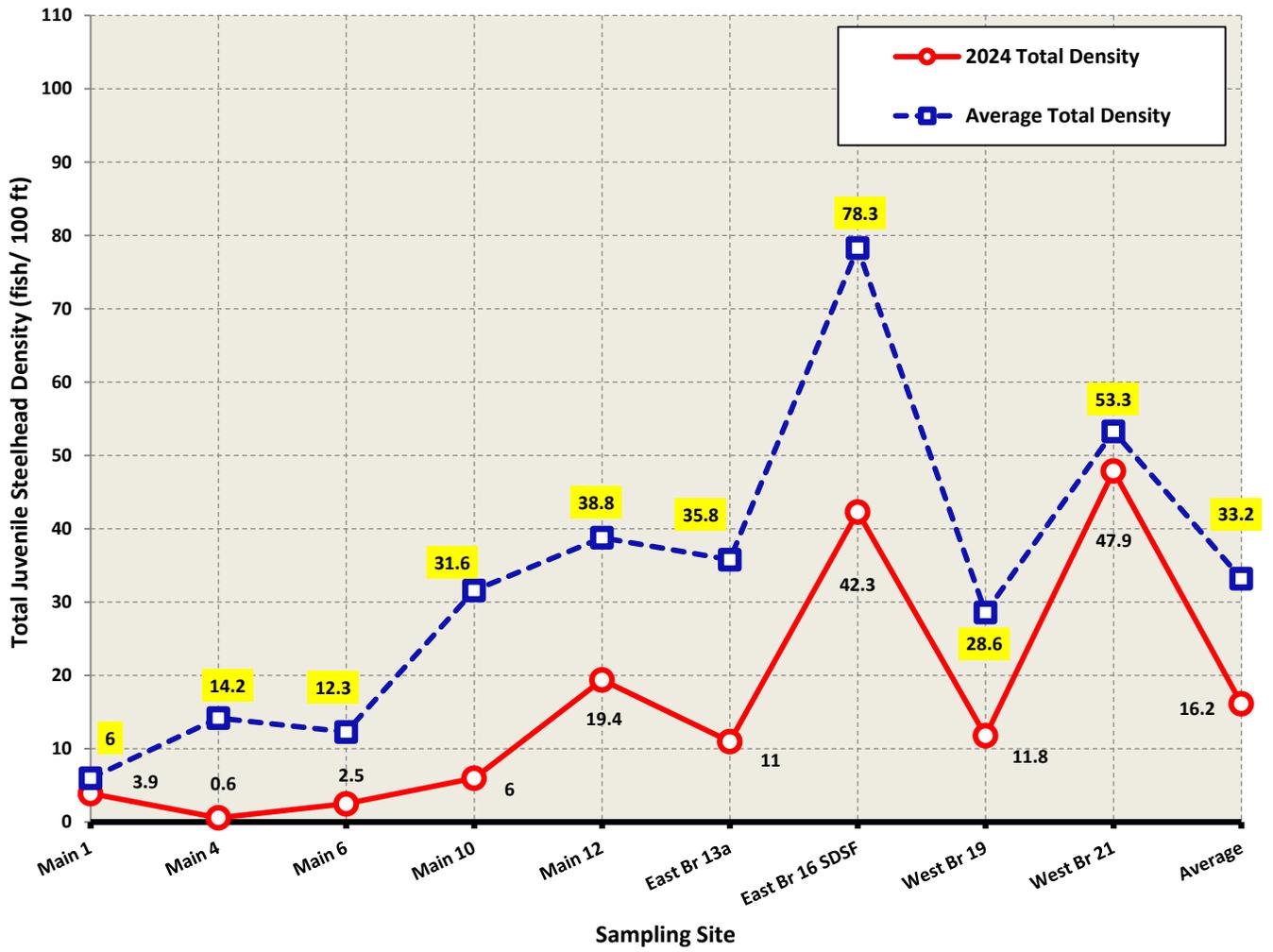


Figure 23. Total Juvenile Steelhead Site Densities in Soquel Creek in 2024 Compared to up to the 28-Year Average (14-year average for Mainstem Site #6.)

Figure 24. YOUNG-OF-THE-YEAR JUVENILE STEELHEAD SITE DENSITIES IN SOQUEL CREEK 2024 Compared to up to 28-Year Average (Lines between site densities are for visual effect only.)

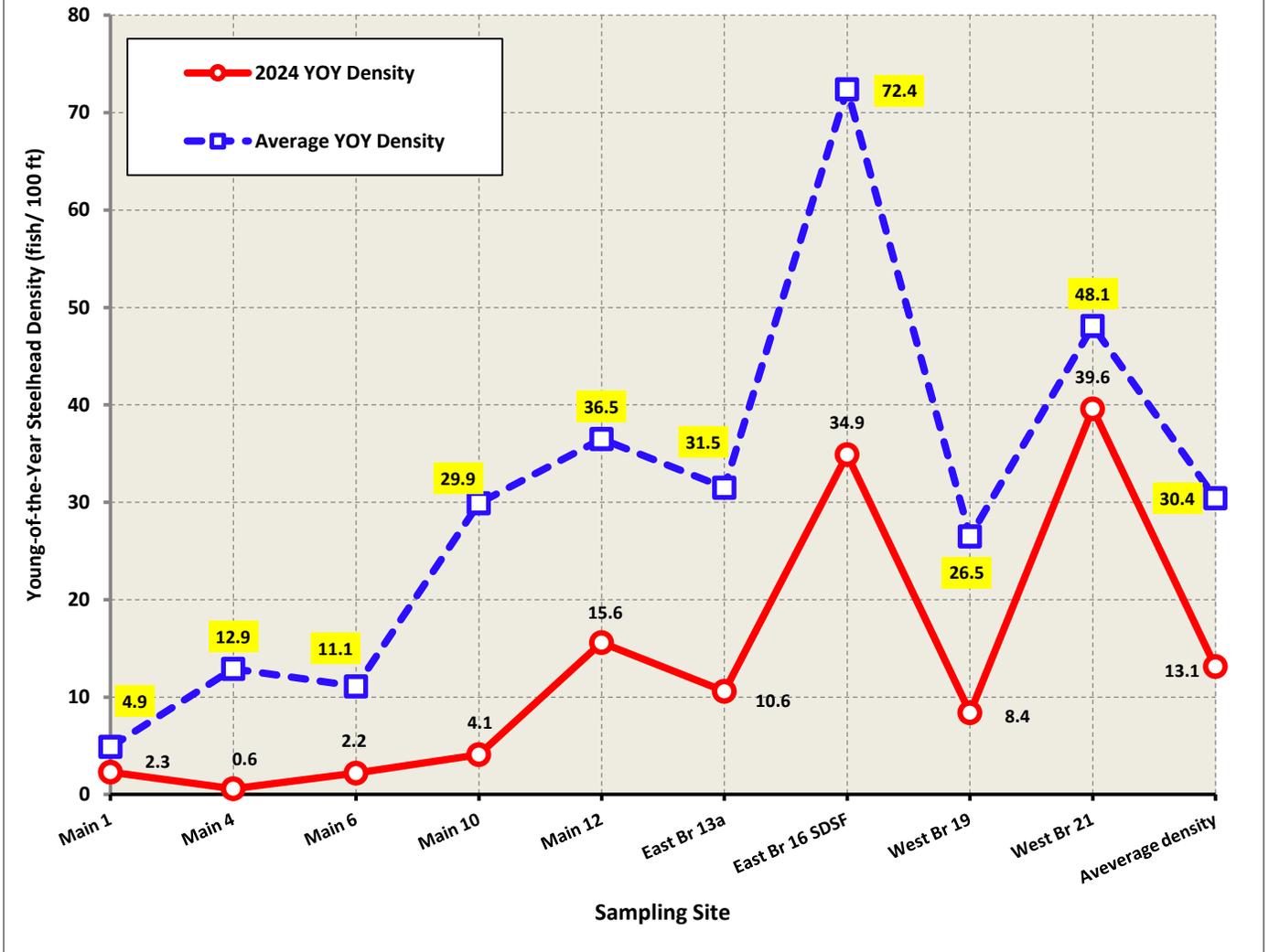


Figure 24. Young-of-the-Year Steelhead Site Densities in Soquel Creek in 2024 Compared to up to the 28-Year Average (14-year average for Mainstem Site #6.)

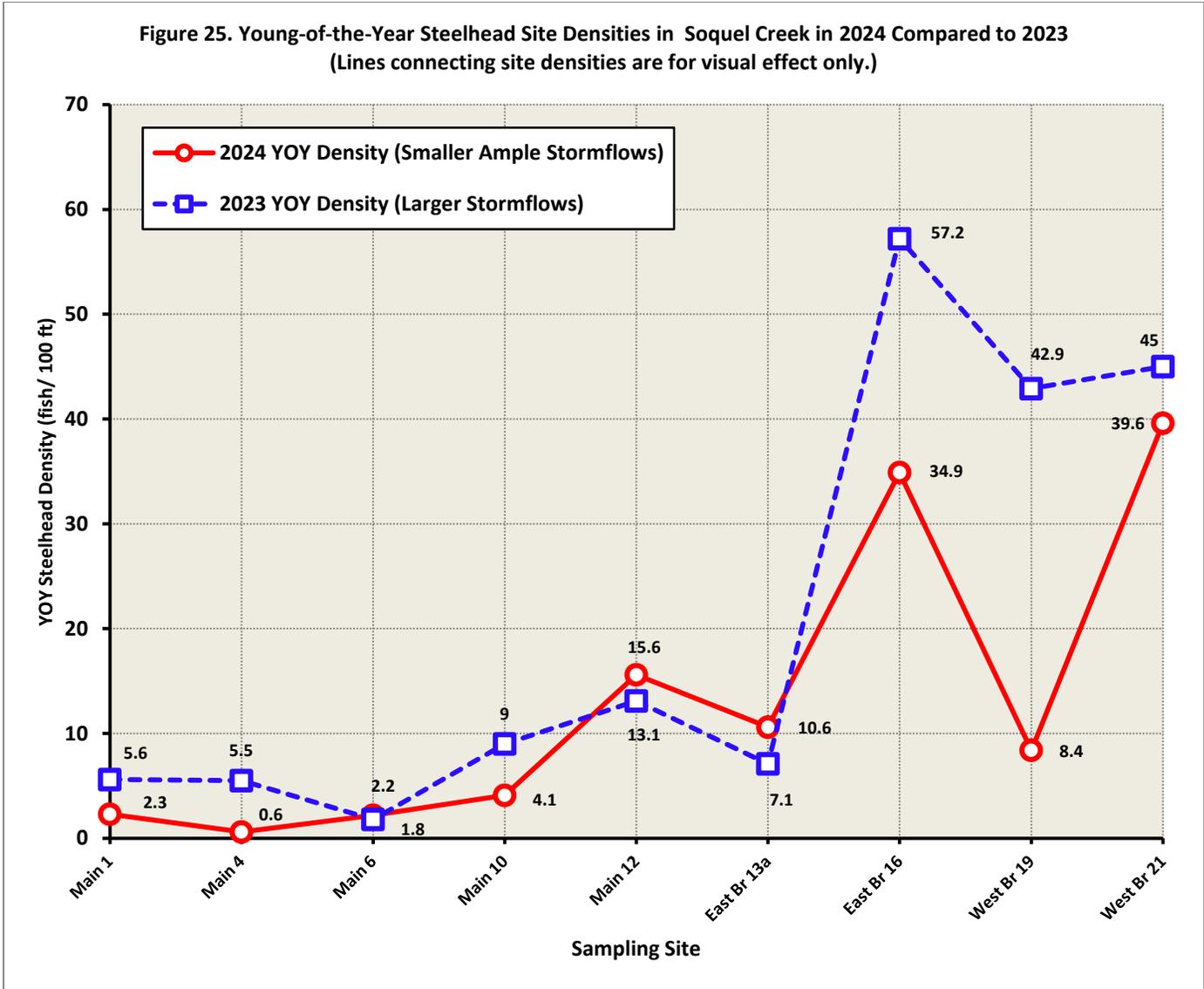


Figure 25. Young-of-the-Year Site Densities in Soquel Creek, Comparing 2024 to 2023.

Figure 26. YEARLING STEELHEAD SITE DENSITIES IN SOQUEL CREEK in 2024 Compared to up to the 28-Year Average. (Lines connecting site densities are for visual effect only.)

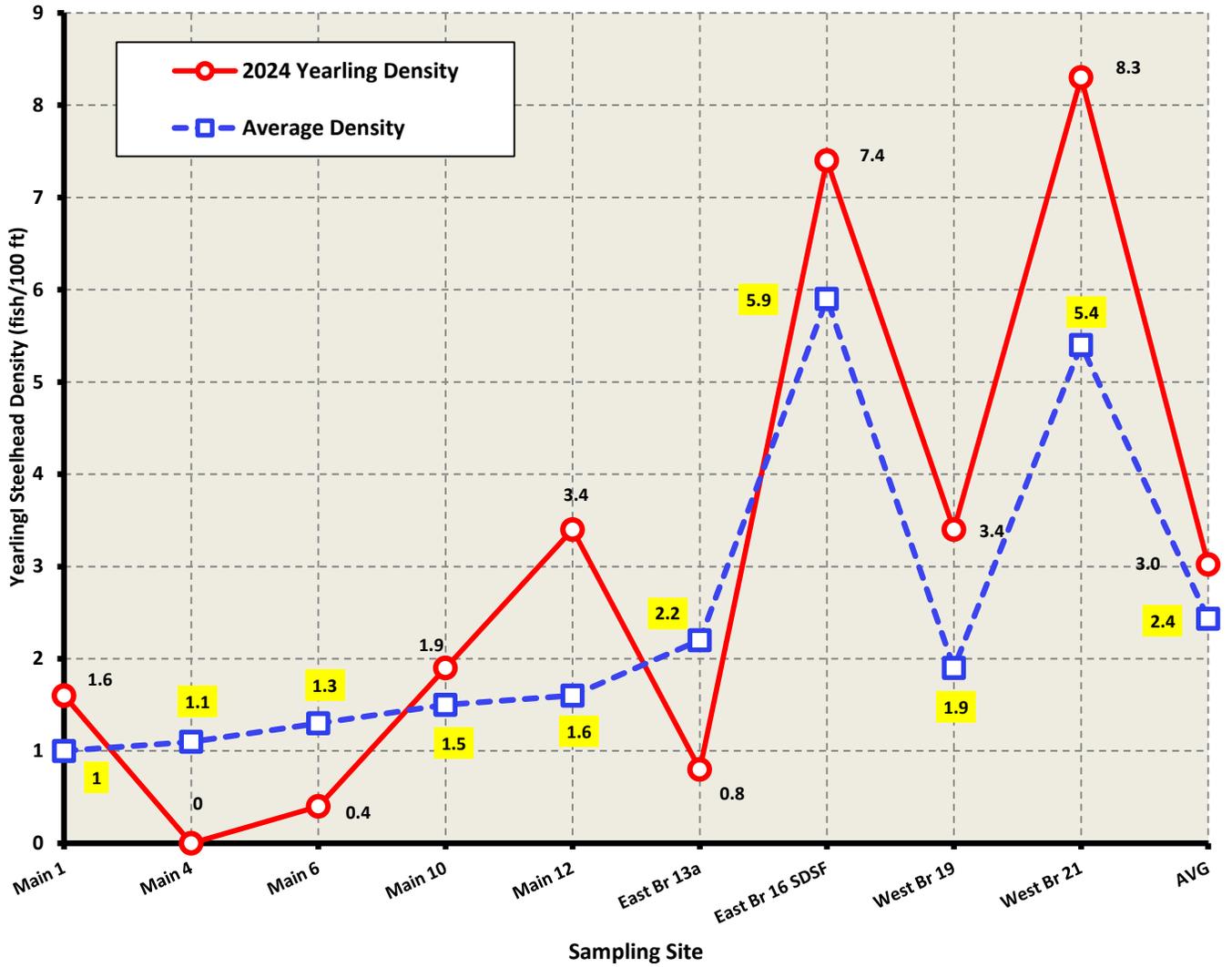


Figure 26. Yearling Steelhead Site Densities in Soquel Creek in 2024 Compared with up to the 28-year Average.

Figure 27. SIZE CLASS II AND III STEELHEAD SITE DENSITIES IN SOQUEL CREEK in 2024 Compared to up to the 28-Year Average. (Lines between site densities are for visual effect only.)

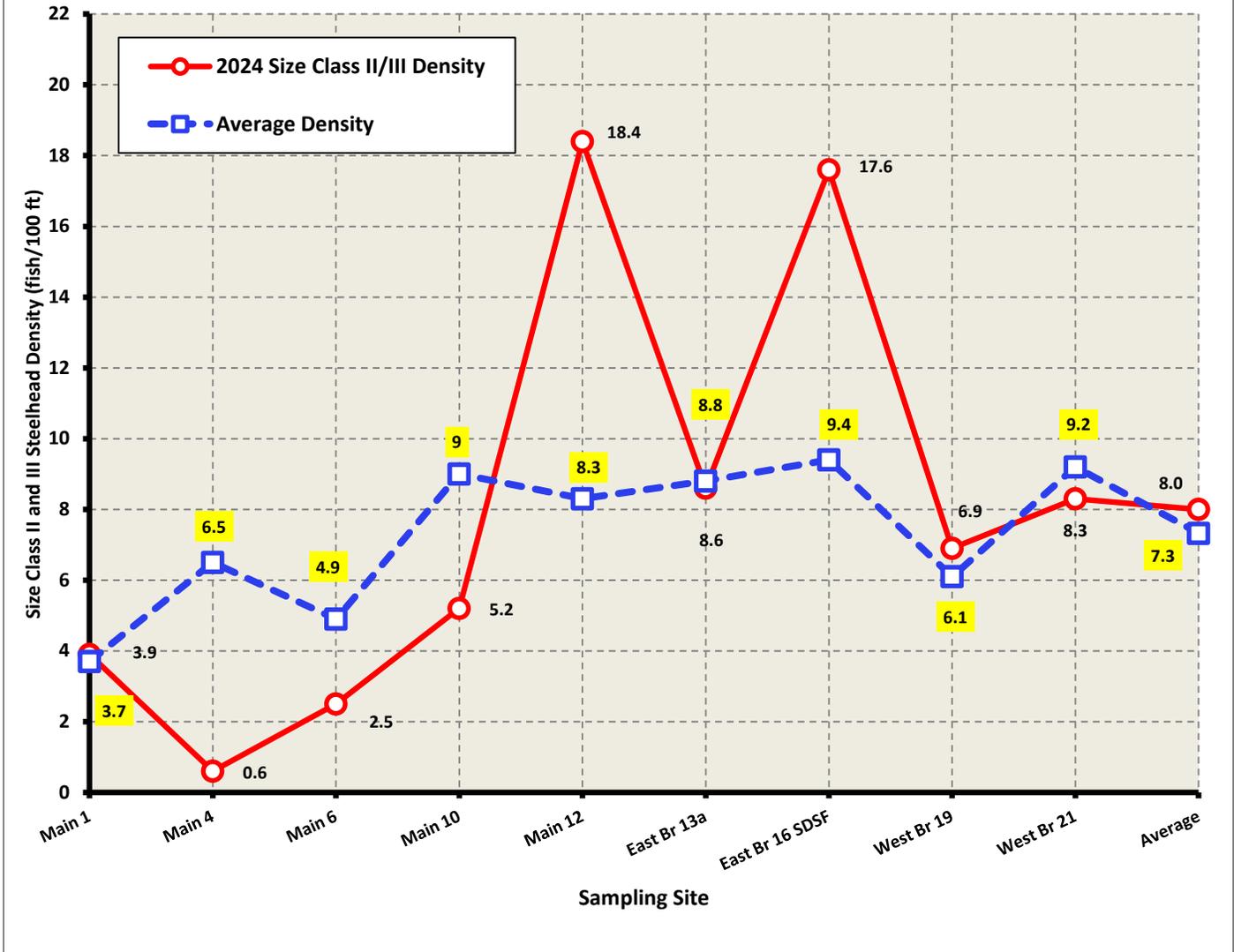


Figure 27. Size Class II and III Steelhead Site Densities in Soquel Creek in 2024 Compared with up to the 28-Year Average.

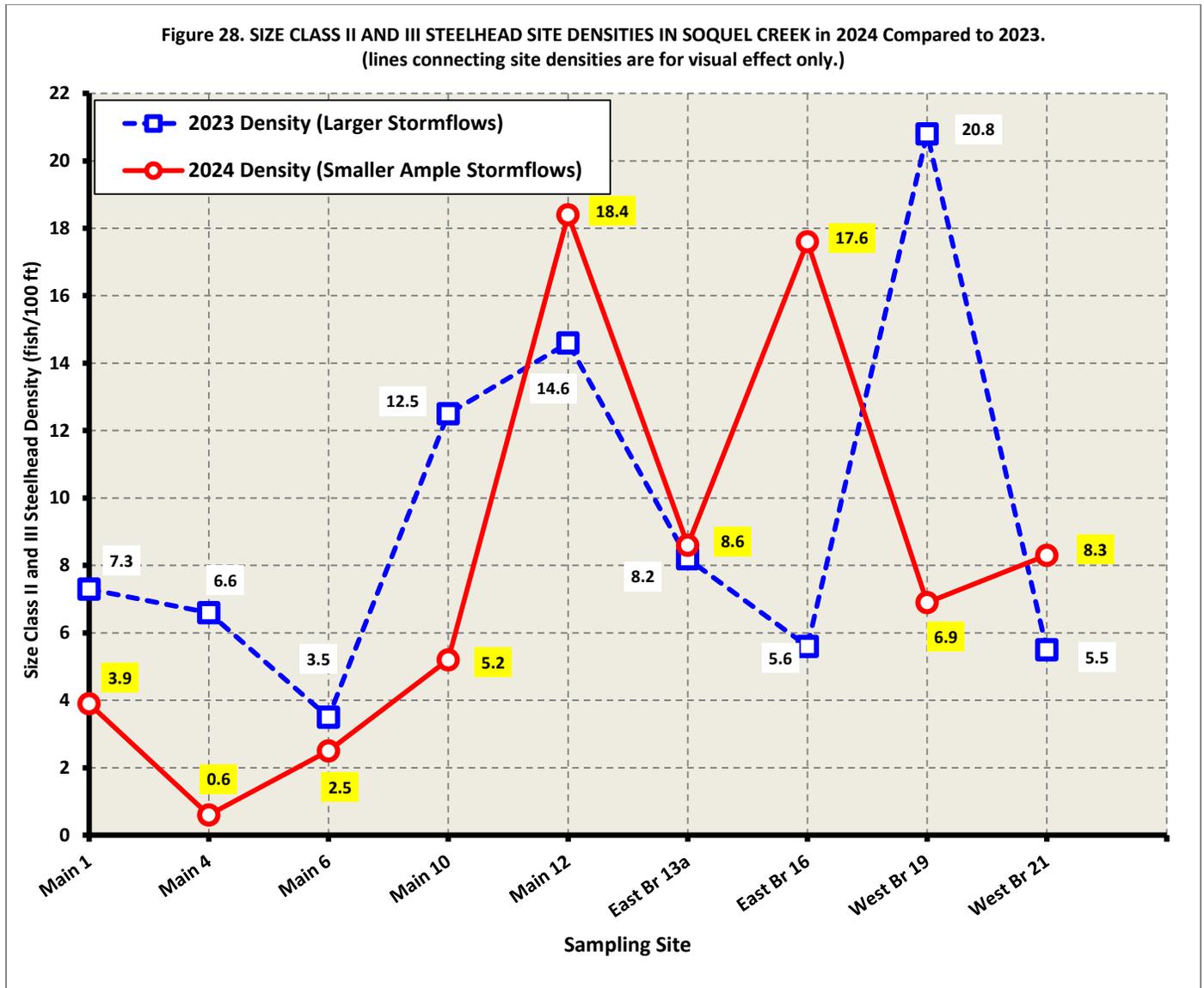


Figure 28. Size Class II/III Steelhead Site Densities in Soquel Creek Comparing 2024 to 2023.

Figure 29. Trend in Total Juvenile Steelhead Density (Mostly YOY) at Soquel Creek Sites, 1997-2024.
(East Branch 16 was dry in 2014, 2015 and 2021.)

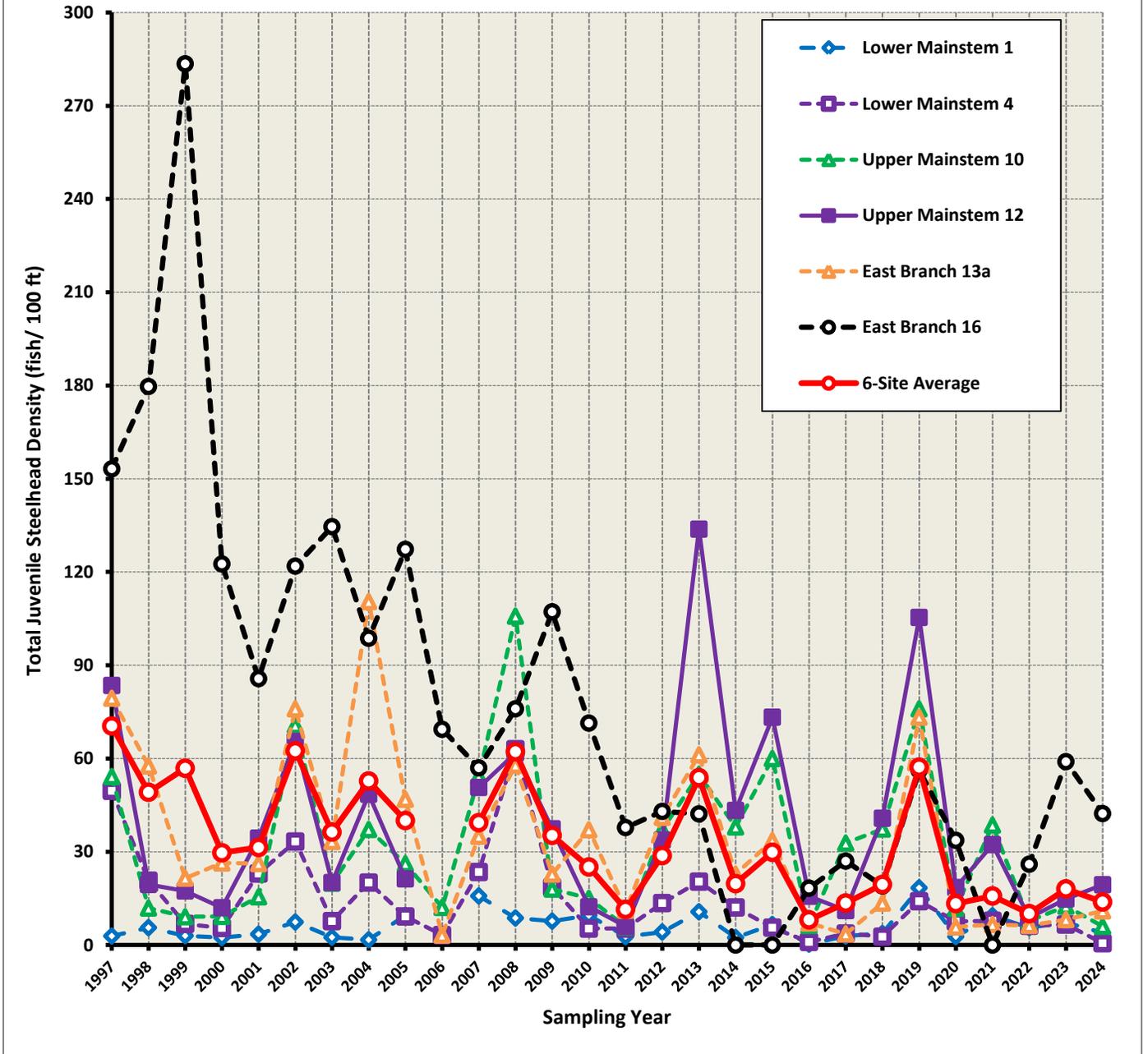


Figure 29. Trend in Total Juvenile Steelhead Density (Mostly YOY) at Soquel Creek Sites, 1997-2024.

Figure 30. Trend in Size Class II/III (≥ 75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites, 1997-2024 (Site #16 dry in 2014, 2015 and 2021).

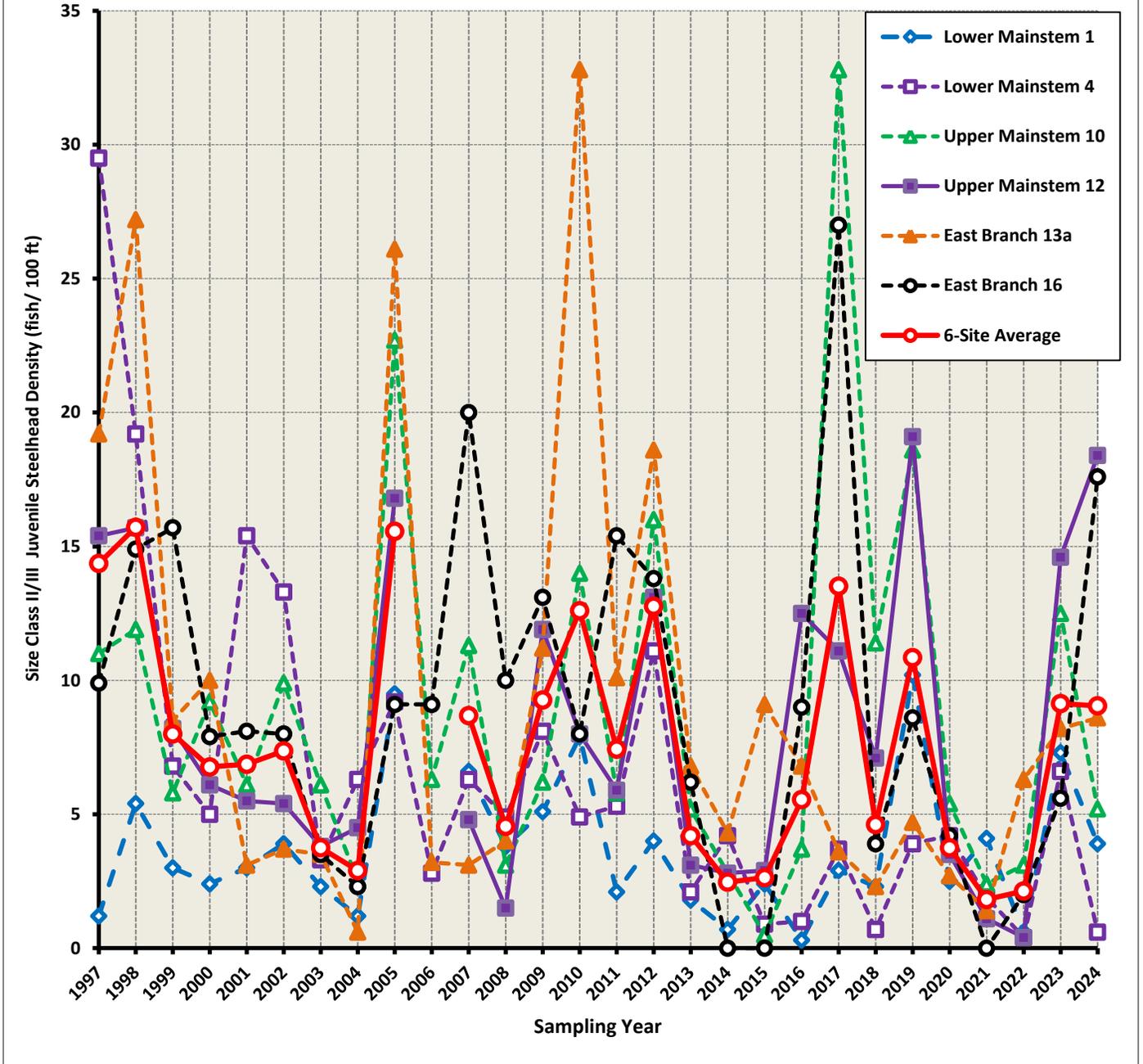


Figure 30. Trend in Size Class II/III Juvenile Steelhead Density at Soquel Creek Sites, 1997-2024.

Figure 31a. Trend in Size Class II/III (\Rightarrow 75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites with 5-Month Baseflow Average, 1997-2024.

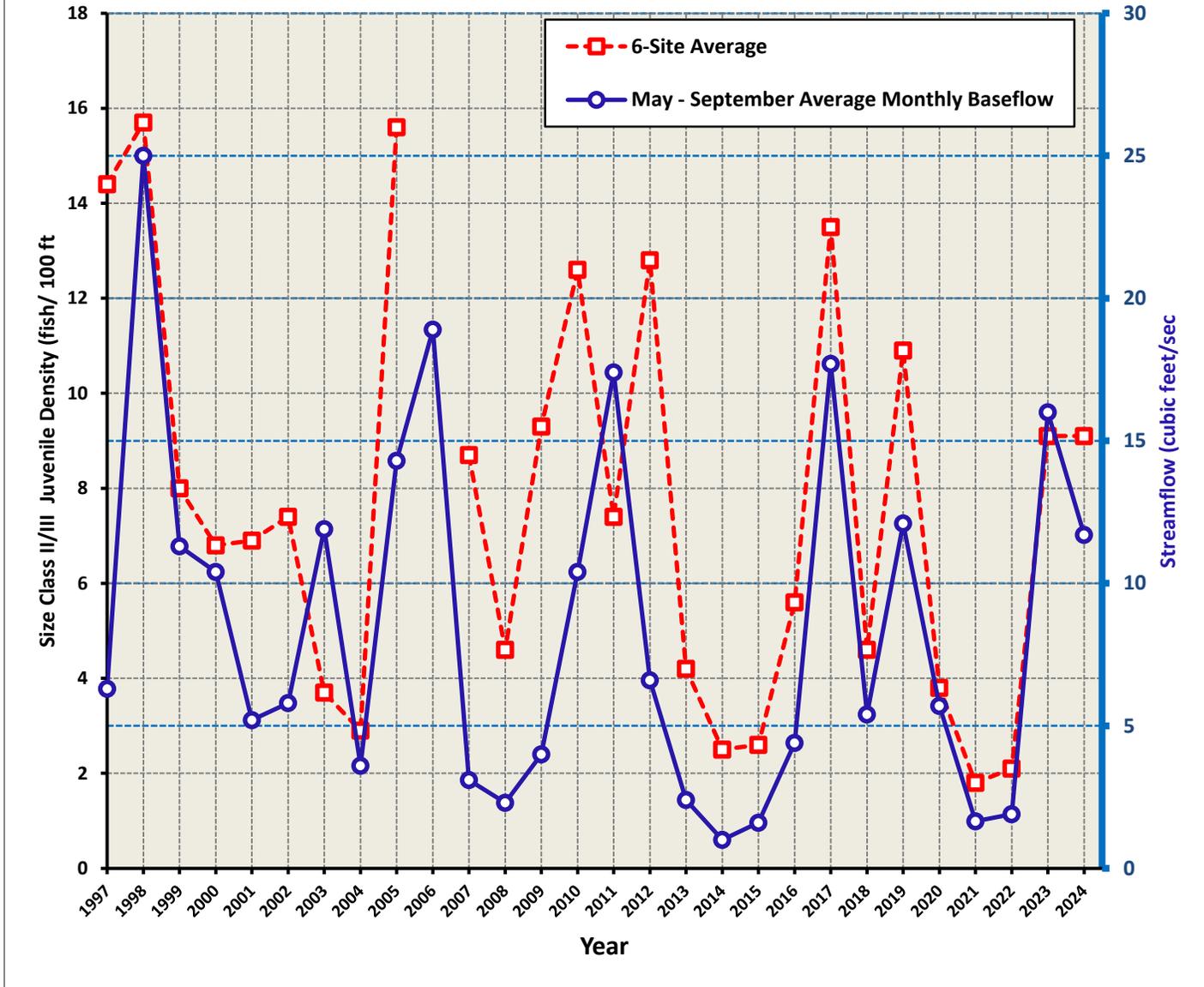


Figure 31a. Trend in Size Class II/III (\Rightarrow 75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites with 5-Month Baseflow Average, 1997-2024.

Figure 31b. Trend in Index of Size Class II/III (≥ 75 mm SL) Juvenile Steelhead Production in 8 Soquel Creek Reaches with 5-Month Baseflow Average, 2010-2024.

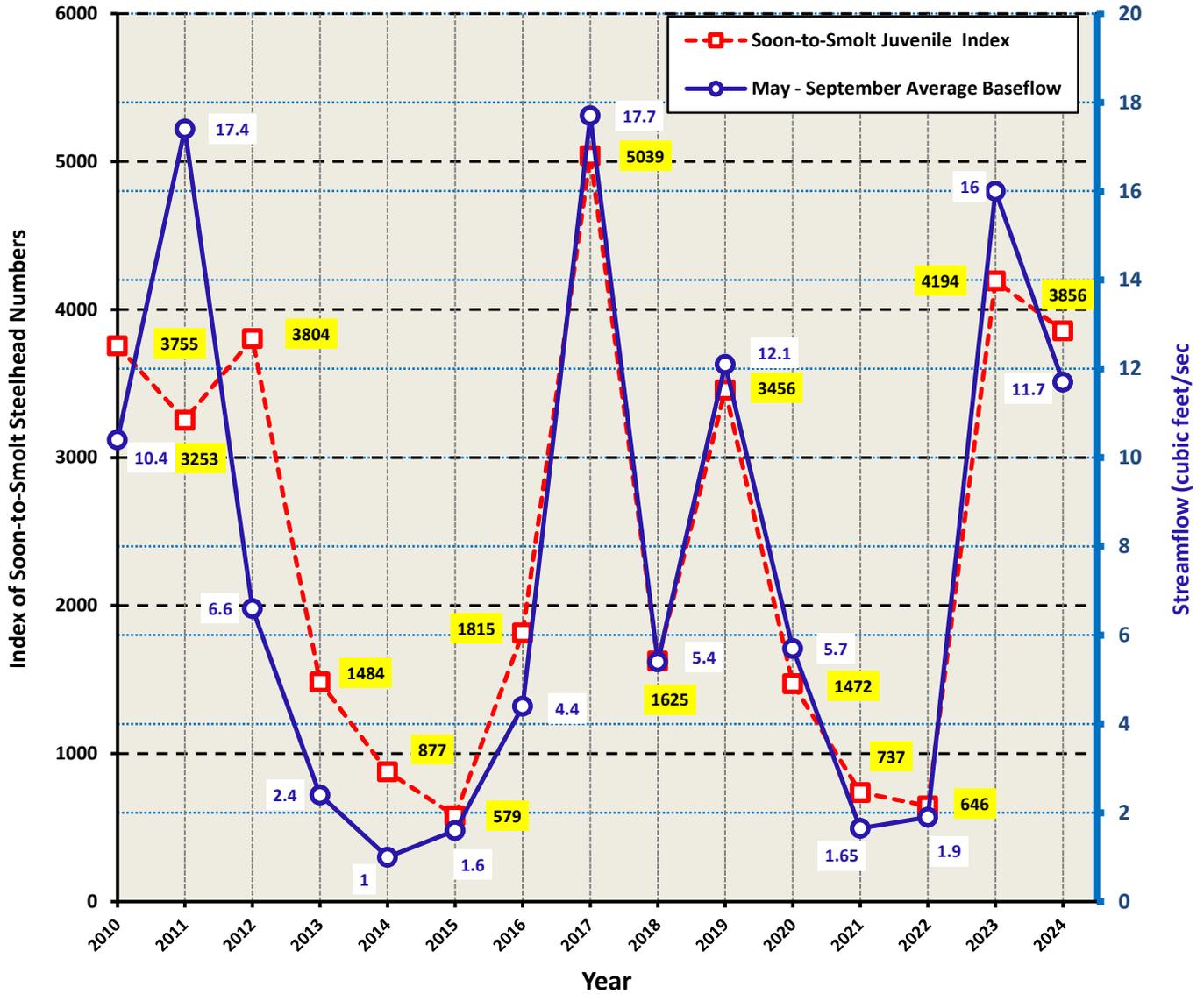


Figure 31b. Trend in Index of Size Class II/III (≥ 75 mm SL) Juvenile Steelhead Numbers in 8 Soquel Creek Reaches with 5-Month Baseflow Average, 2010 – 2024.

iii. Steelhead Abundance and Habitat in the Aptos Creek Watershed

1. Aptos Creek likely had a WY2024 hydrograph similar to those in the San Lorenzo and Soquel drainages, with stormflows at the same frequency and with similar intensity. This resulted in similar high stormflow patterns for WY2024, with 2 above bankfull stormflows and 2 near bankfull stormflows occurring in January through early March and a moderate stormflow in mid-March (**Figure 22**). These stormflows likely provided good adult steelhead spawning access and nesting conditions, though egg survival was possibly low after the large stormflows due to redd scour and/or smothering with sand, especially in lower Aptos and all of sandy Valencia Creek. Baseflow likely declined steadily from May onward with above median baseflow down to 2.05 cfs in mid-October at our streamflow measuring location just downstream of the Valencia Creek confluence (**Table 4**). Fish sampling in the Aptos watershed occurred prior to any fall stormflow.
2. **Habitat conditions** in 2024 were compared to 2023, based partially on habitat typing results from half-mile stream segments in lower Aptos Reach 3 and upper Valencia Reach 3. They were also based on habitat typing results at the upper Aptos Creek Site 4 and the lower Valencia Creek Site 2. Habitat quality declined in lower Aptos Segment 3 near the County Park due reduced streamflow (less food) and increased sedimentation compared to 2023, although pool depth increased and pool escape cover was similar with less embeddedness (**Table 6**). Sedimentation had increased in 2023 and continued to increase in 2024. Densities of YOY and Size Class II/III steelhead at Aptos 3 were similarly low between the two years (**Figures 34 and 37**). Overall habitat quality declined in 2024 at upper Aptos Site 4 above the metal bridge with decreased baseflow (less food) and shallower average pool depth. However, maximum depth and escape cover in pools increased while percent fine sediment and embeddedness in pools were similar from 2023 to 2024. Consistent with these habitat improvements, YOY densities nearly doubled at Aptos Site 4, and Size Class II/III density increased in 2024. Egg survival may have improved in 2024 due to reduced stormflow sizes.
3. **In Valencia Creek, habitat conditions improved at lower Site 2** despite decreased baseflow because pools were deeper and pool escape cover greatly increased as undercut bank while percent fine sediment and embeddedness remained high (**Table 6**). Habitat conditions improved in Valencia Reach 3 above Valencia Road compared to the drought year of 2021. Baseflow was greater (more food). Pool depth and pool escape cover increased while percent fine sediment and embeddedness remained the same. Tables of habitat measurements are available in the detailed analysis report upon request.
4. **Total and YOY steelhead densities were again much below average at Aptos sites but above average at Valencia sites** (4-site average of 16.8 total juveniles/100 ft in 2024; 7.9 in 2023; 7.8 in 2022; 4.4 in 2021) and 12.4 YOY/100 ft in 2024 (5.8 in 2023, 5.2 in 2022; 2.0 in 2021)) (**Figures 32 and 33**). The trend in total steelhead site densities increased in 2024 (**Figure 38**). But the 2024 averages were below the longterm, multiple-year averages of 22.6 total juveniles/100 ft and 16.7 YOY/100 ft. With only two degrees of freedom, the differences in 2024 and 2023 total and YOY densities were not statistically significant when upper Valencia 3 densities was not compared between years because the sampling location had changed (**Table 10**). The multiple bankfull events the previous rainy season apparently afforded adult fish passage above the wood cluster examined in Aptos Creek in 2022 between Sites 3 and 4. 2023 and 2024 YOY densities at Aptos Site 4 were greater than in 2022. YOY were not detected there in 2021.
5. **Yearling and older densities were below average at all 4 sites in 2024 (Figure 35)**. Densities increased at 3 of 4 sites, excepting lower Aptos 3, and the 4-site average was 4.4 fish/100 ft (2.1 in 2023; 2.6 in 2022); longterm, multi-year average of 5.8 fish/100 ft with 2024 included.

6. ***Size Class II/III densities were below average in 2024 at the all 4 sites and increased from 2023 densities***, averaging 6.5 fish/100 ft (4.8 in 2023; 2.6 in 2022; 2.3 in 2021) (**Figures 36 and 37**). With only 2 degrees of freedom, the increase at all 4 sites from 2023 to 2024 was not statistically significant (**Table 10**). Some YOY may reach Size Class II where food is more abundant. Therefore, at some sites in Aptos Creek the Size Class II/III group included YOY and yearlings. In Valencia Creek, growthrate is slower, especially at the lower site, and past scale analysis indicated that some soon-to-smolt size fish are two-year olds. The trend in average site density of Size Class II/III juveniles increased in 2024 but the average density was still below average and the sixth lowest of 15 annual measurements beginning in 2006 (**Figure 39a**).
7. Trends in the SLR and Soquel watersheds of densities and index production numbers of larger juveniles track positively with 5-month average baseflow through the wet and dry years, and to a degree in the Aptos/Valencia watershed (**Figures 19a-b, 20a-b, 31a-b and 39b**). The production index in 2019 was an exception in that it did not increase with baseflow. The production index in 2024 increased to 582 from 462 in 2023 despite a lower baseflow average in 2024. The positive tracking may not occur in every year in the Aptos watershed because the Aptos adult steelhead population has likely declined to the point where the juvenile offspring are in such low densities that density dependent competition that would typically reduce juvenile densities in dry years with low baseflows does not intensify in Aptos Creek. This would be the case because the few juveniles produced from few adults spawning do not come close to saturating the rearing habitat in the Aptos Creek branch of the watershed or the upper Reach 3 in Valencia Creek even in dry years. In the SLR and Soquel watersheds, an increase in these larger juveniles occurs in higher baseflow years partially because more YOY grow into Size Class II their first summer. But in Aptos Creek, total juvenile density may be low enough to allow faster YOY growth even in low baseflow years. Because a significant portion of YOY at Aptos Creek sites may reach Size Class II the first year, egg survival plays an important part in determining Size Class II densities, and egg survival may be much less in lower Aptos Creek in wetter years. This will reduce the degree of positive tracking between baseflow and Size Class II/III production when YOY production has reached its present low level. The 2019 higher baseflow year showed no positive tracking without faster YOY growth. The YOY fish remained small due to high YOY densities of small YOY probably produced from late spawning during late stormflows, with ensuing high competition and slow growthrate. With few YOY reaching Size Class II in 2019 and few yearlings present in 2019 from the previous year's small YOY population, numbers of these larger juveniles did not increase in 2019 in the Aptos watershed as they did in the San Lorenzo and Soquel watersheds.
8. ***The Aptos Estuary steelhead population estimate of 312 was relatively high in 2024 (Figure 40)***. A total of 78 juveniles were captured and marked the first day, with 72 captured the second day. There were 18 recaptures. All captured juveniles were in Size Class II/III (mostly Size Class III) and had a median length between 155 mm and 164 mm SL (**Figure 41**). A negative dip in steelhead numbers at 160-164 mm SL with greater numbers of smaller and larger juveniles on either side of the size histogram may indicate that juveniles larger than that were dominated by yearlings. The two large outliers longer than 255 mm SL may have been 2-year olds. The 2024 population estimate was nearly 4 times the 2023 estimate of 78 when the median length was larger (170-174 mm SL; less competition than in 2024). In 2024, the estuary was shallower than usual upstream, allowing seining further upstream than usual, with a dry margin beyond the walk bridge for beaching the seine. Most of the steelhead were captured from hauls furthest upstream near large instream wood (including a rootwad) that had created a relatively deep pocket around it. We suspected in 2023 that juveniles had moved upstream between sampling days when we had captured 78 the first day in the lower estuary and only 2 steelhead a week later with worsened water quality in the lower estuary. Our 2024 sampling confirmed that juveniles would distribute upstream if water quality and depth

were adequate. By comparison, the population size in Soquel Lagoon could not be estimated because, atypically, only 2 steelhead were captured during 2 days of fall sampling in the lower lagoon, which was more shallow than usual due to substantial sediment deposit in the lower lagoon (Alley 2025).

9. **In 2024, the morning water quality at the Rio Del Mar walk bridge over Aptos Estuary was relatively cool** on both sampling days (16-18°C to near the bottom); with freshwater down to 0.75 m from the surface the first day and a week later down to 1.00 m, detecting reduced salinity near the bottom to nearly freshwater from 27 September to 4 October (Table 7). Oxygen concentration was very good to near the bottom the first day (> 7 mg/L) and to the bottom on the second day (>8 mg/L). A debris jam that collected sand at the end of the rock jetty likely restricted saltwater from entering the estuary at high tide. See the photos that follow. Just east beyond the jetty, the estuary formed a shallow neck with a deeper basin further east to collect heavier saltwater at high tide. The exit to the Monterey Bay was shallow. The main body of the Aptos Estuary, west of the jetty had nearly achieved freshwater conversion by the second day of sampling, 4 October.
10. **No tidewater gobies (*Eucyclogobius newberryi*) were captured in Aptos Estuary with the large seine (5/16-inch mesh) on either day, 27 September or 4 October.** Conditions along the shallow margins were freshwater (0.4 ppt) and conducive to tidewater goby nesting and reproduction. Tidewater goby sampling was unbudgeted and not done with the finer, 1/8-inch meshed goby seine. Besides steelhead, other species captured on both days, combined, were 5 starry flounder (*Platichthys stellatus*), 2 staghorn sculpin (*Leptocottus armatus*) and hundreds threespine stickleback (*Gasterosteus aculeatus*). The reason that tidewater goby was not detected could be low survival over the previous winter/spring with multiple bankfull stormflows. Also, the east side cove beside the rock jetty that often serves as overwinter shelter was filled in with sand over the previous winter. In 2024, we did not detect tidewater goby at Soquel Lagoon or Pajaro Estuary, where the finer meshed seine was used.



Looking southeast with the main Aptos Estuary on the right, the shallow neck toward the end of the rock jetty and a deeper basin to the east on the right. 10-04-2024



Constriction at the end of the rock jetty with the deeper Aptos Estuary to the right of the rock jetty and the shallow constriction just to the left of the jetty. 10-04-2024



Looking south at the shallow Aptos Estuary exit to the Monterey Bay. 10-04-2024

Table 6. Habitat Change in Reaches and Sites in the APTOS WATERSHED from most recent previous years. (Green highlight indicates reach comparisons. Yellow highlight indicates site comparisons.)

Reach or (Site Only) Comparison To Previous Years	2024 Baseflow Comparison (Most Important Factor May-September)	Pool Depth	Pool Fine Sediment	Pool Embeddedness	Pool Escape Cover	Overall Habitat Change (Any Improvement)
Aptos Reach 3 Aptos Reach 3 (Since lower baseflow 2023)	-	+	-	+	Similar	- (less food, deeper, more sediment, less embed.)
(Aptos Reach 4) Aptos Site 4 (Since lower baseflow 2023)	-	- avg + max	Similar	Similar	Very +	- (less food, deeper maximum pool, shallower avg pool, more escape cover)
Valencia Reach 2 Valencia Site 2 (Since lower baseflow 2023)	Slightly -	+	Similarly High	Similarly High	Very +	+ (slightly less food in a food-deprived reach, deeper, more pool escape cover)
Valencia Reach 3 Valencia Site 3 (Since lower baseflow 2021)	+	+	Same	Same	+	+ (more food, deeper, more pool escape cover)

Figure 32. TOTAL JUVENILE STEELHEAD SITE DENSITIES IN APTOS CREEK WATERSHED in 2024 (Valencia Creek with resident fish), with up to a 20-Year Average in Aptos Creek and up to a 16-Year Average in Valencia Creek (1981; 2006-2024; lines connecting site densities are for visual effect only.).

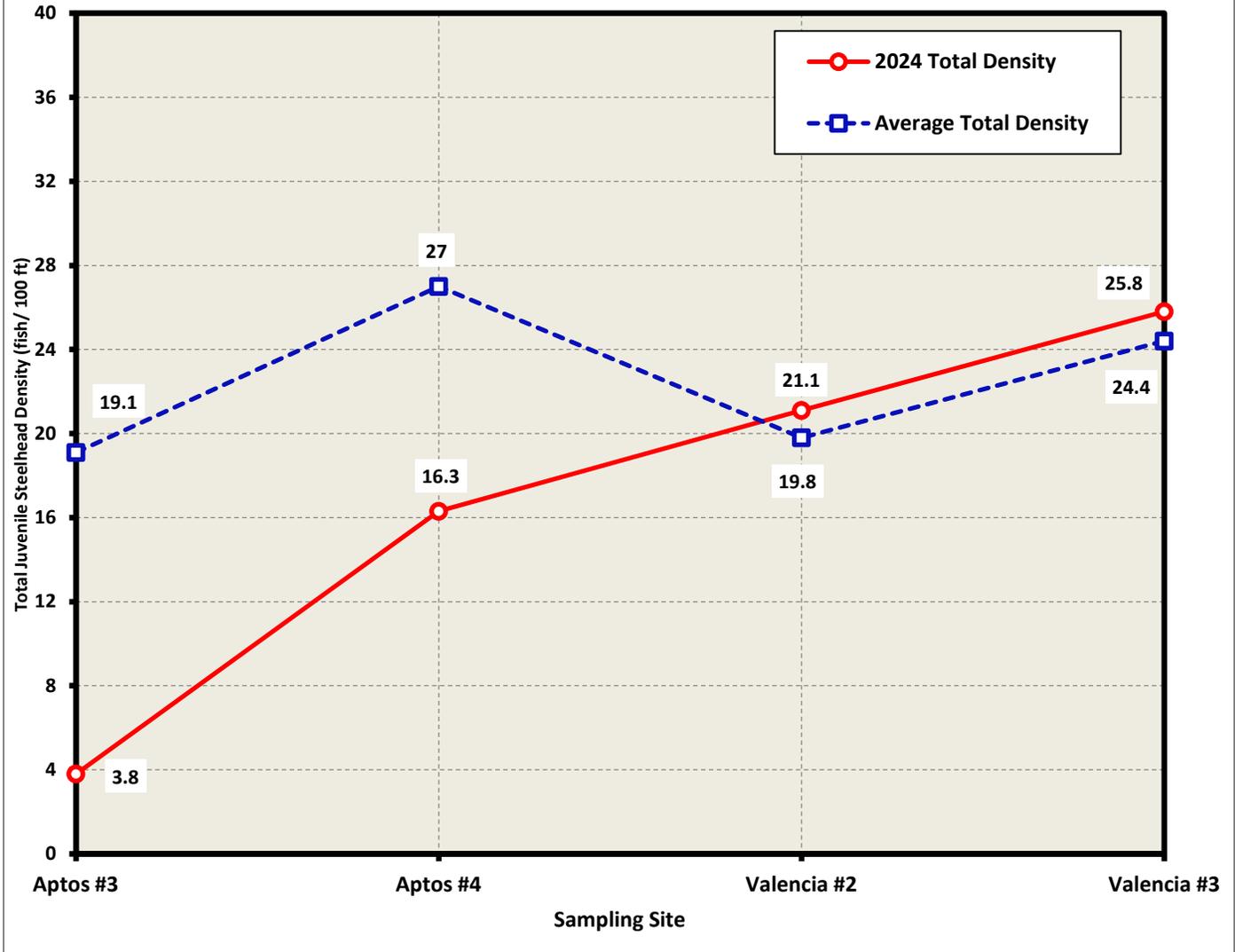


Figure 32. Total Juvenile Steelhead Site Densities in Aptos Watershed in 2024, Compared to up to a 20-Year Average (1981; 2006-2024).

Figure 33. YOUNG-OF-THE-YEAR JUVENILE STEELHEAD SITE DENSITIES IN THE APTOS CREEK WATERSHED in 2024 (Valencia Creek with Resident fish), with a 20-Year Average in Aptos Creek and 16-Year Average in Valencia Creek (1981; 2006-2024; lines connecting site densities are for visual effect only).

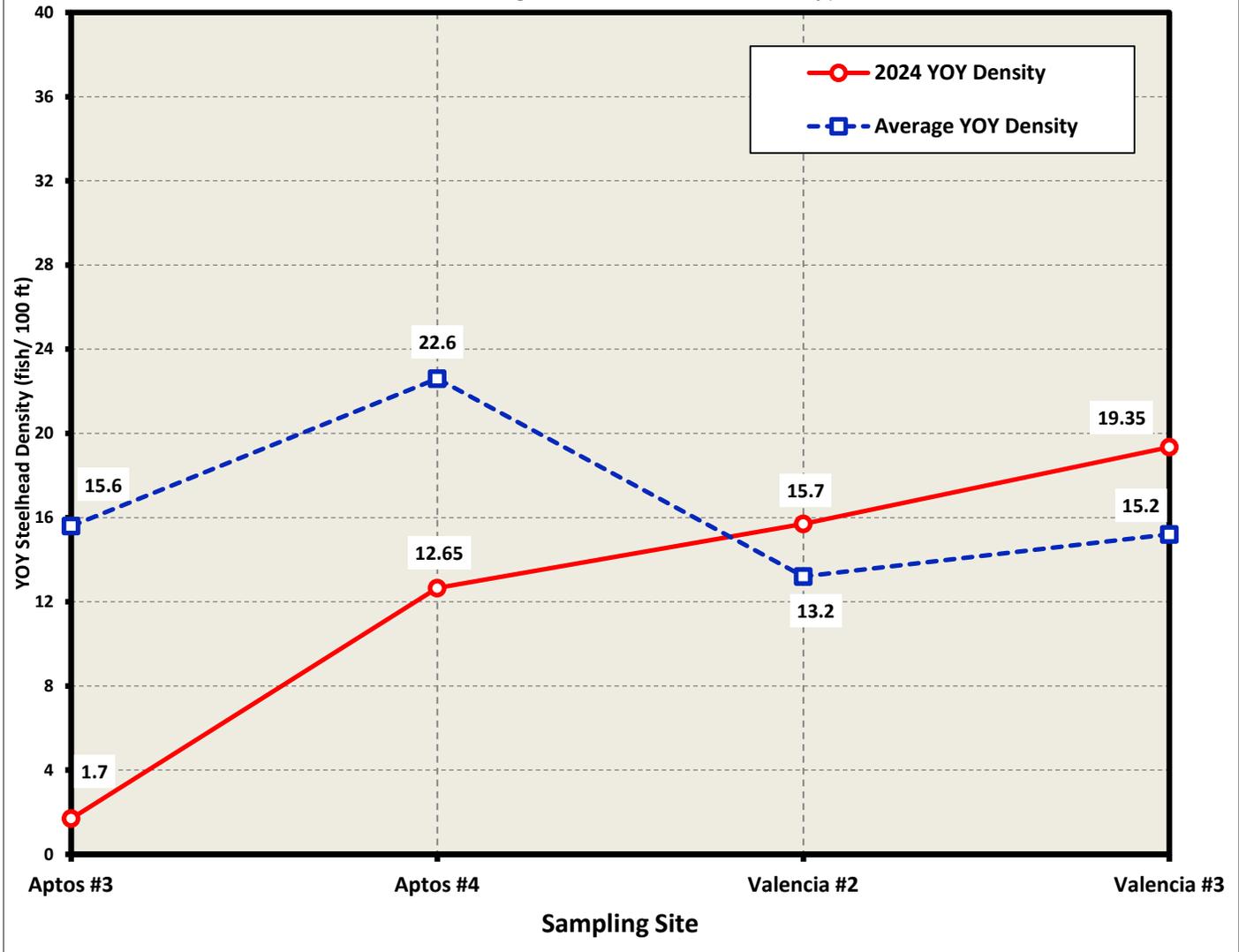


Figure 33. Young-of-the-Year Steelhead Site Densities in the Aptos Watershed in 2024, Compared with up to a 20-Year Average (1981; 2006-2024).

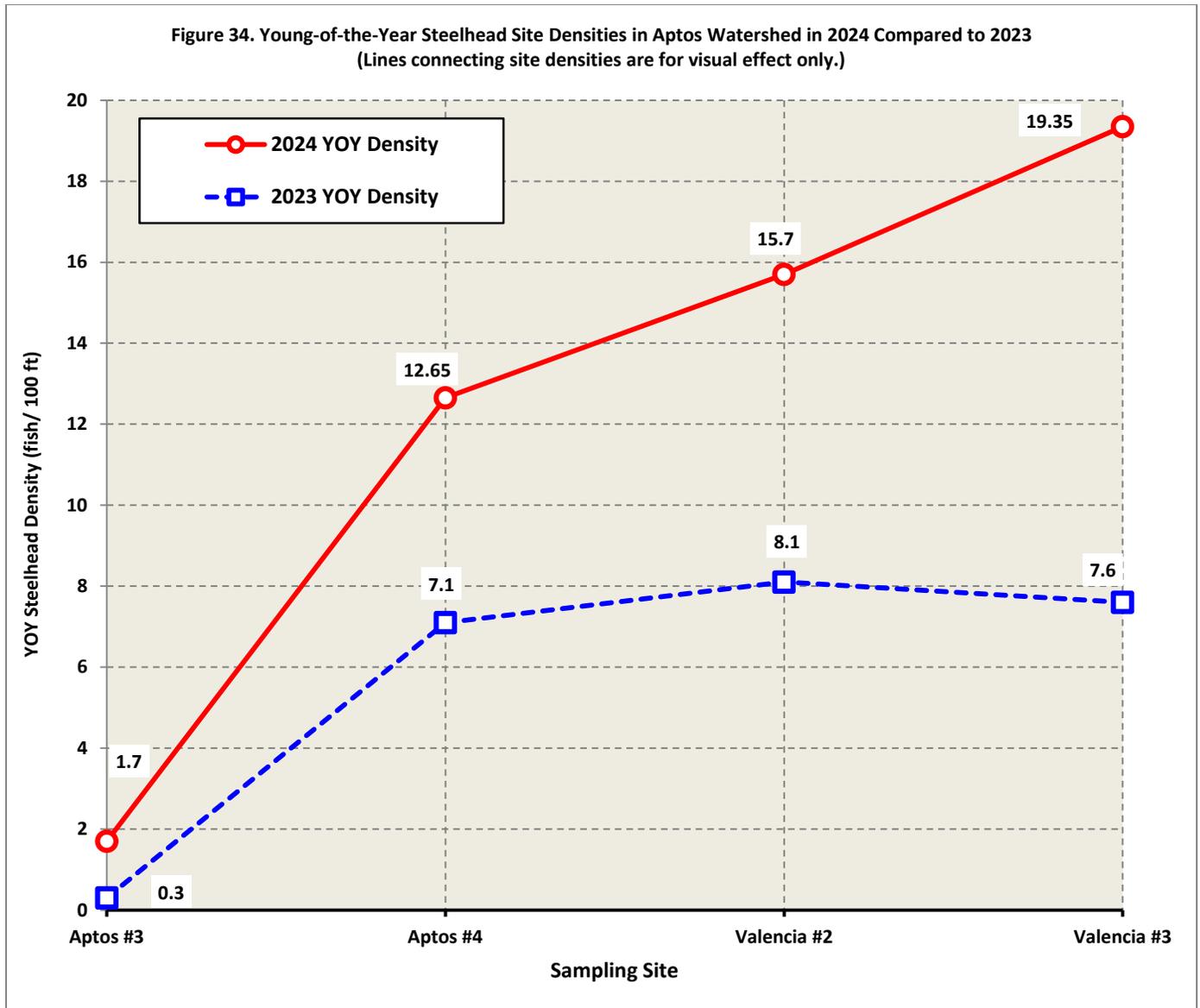


Figure 34. Young-of-the-Year Site Densities in Aptos Creek, Comparing 2024 to 2023.

Figure 35. YEARLING AND OLDER SITE DENSITIES IN THE APTOS CREEK WATERSHED in 2024, with up to a 20-Year Average in Aptos Creek and 16-Year Average in Valencia Creek. (1981; 2006-2024; lines between site densities are for visual effect.).

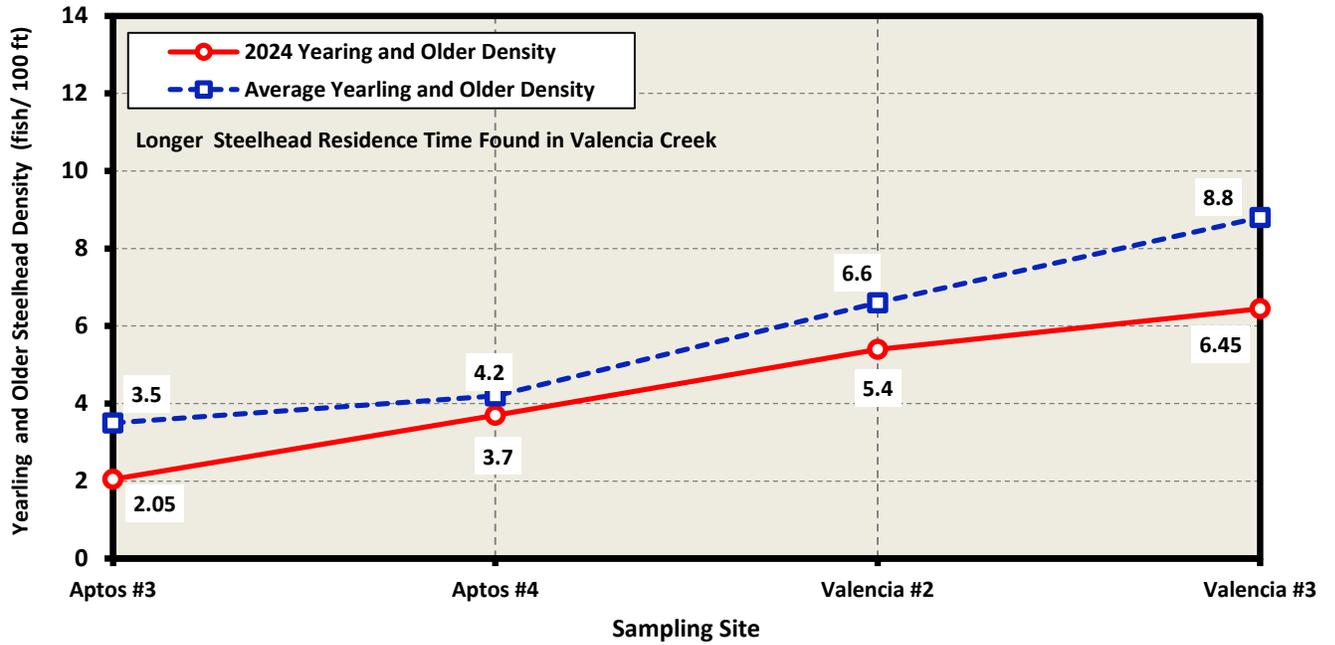


Figure 35. Yearling and Older Steelhead Site Densities in Aptos Watershed in 2024, Compared with up to a 20-Year Average (1981; 2006-2024).

Figure 36. SIZE CLASS II AND III STEELHEAD SITE DENSITIES IN THE APTOS CREEK WATERSHED in 2024, with up to a 20-Year Average in Aptos Creek and 16-Year Average in Valencia Creek. (1981; 2006-2024; lines between site densities are for visual effect.).

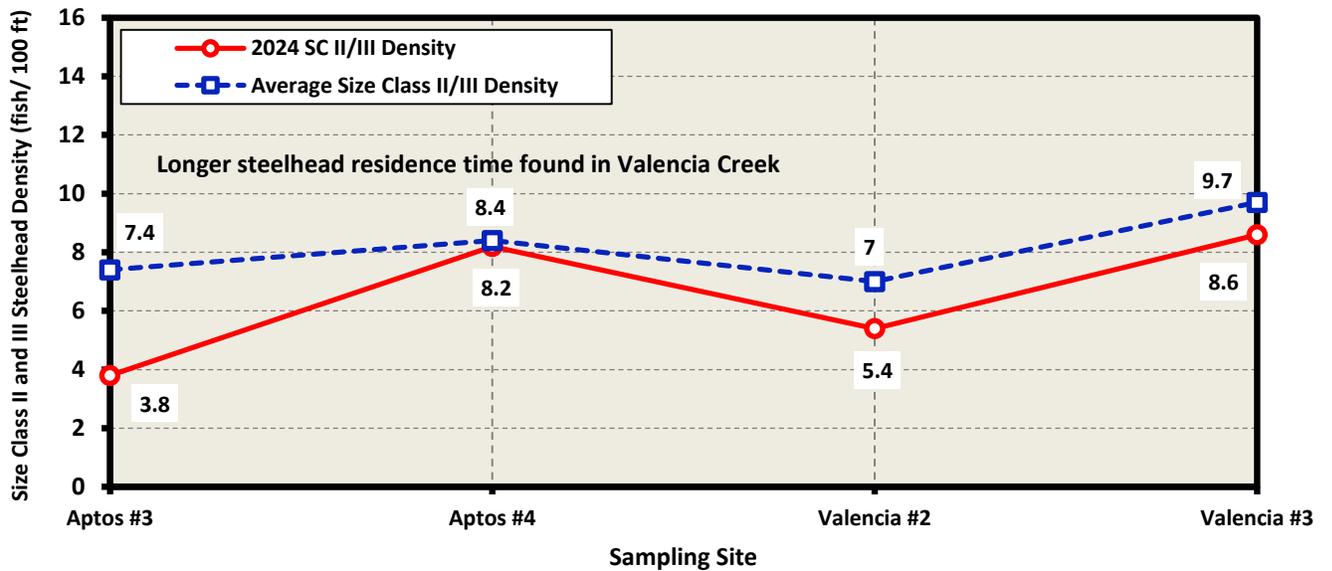


Figure 36. Size Class II and III Steelhead Site Densities in Aptos Watershed in 2024, Compared with up to a 20-Year Average (1981; 2006-2024).

Figure 37. SIZE CLASS II AND III STEELHEAD SITE DENSITIES IN THE APTOS CREEK WATERSHED in 2024 Compared to 2023.
(Lines connecting data points are for visual effect only.)

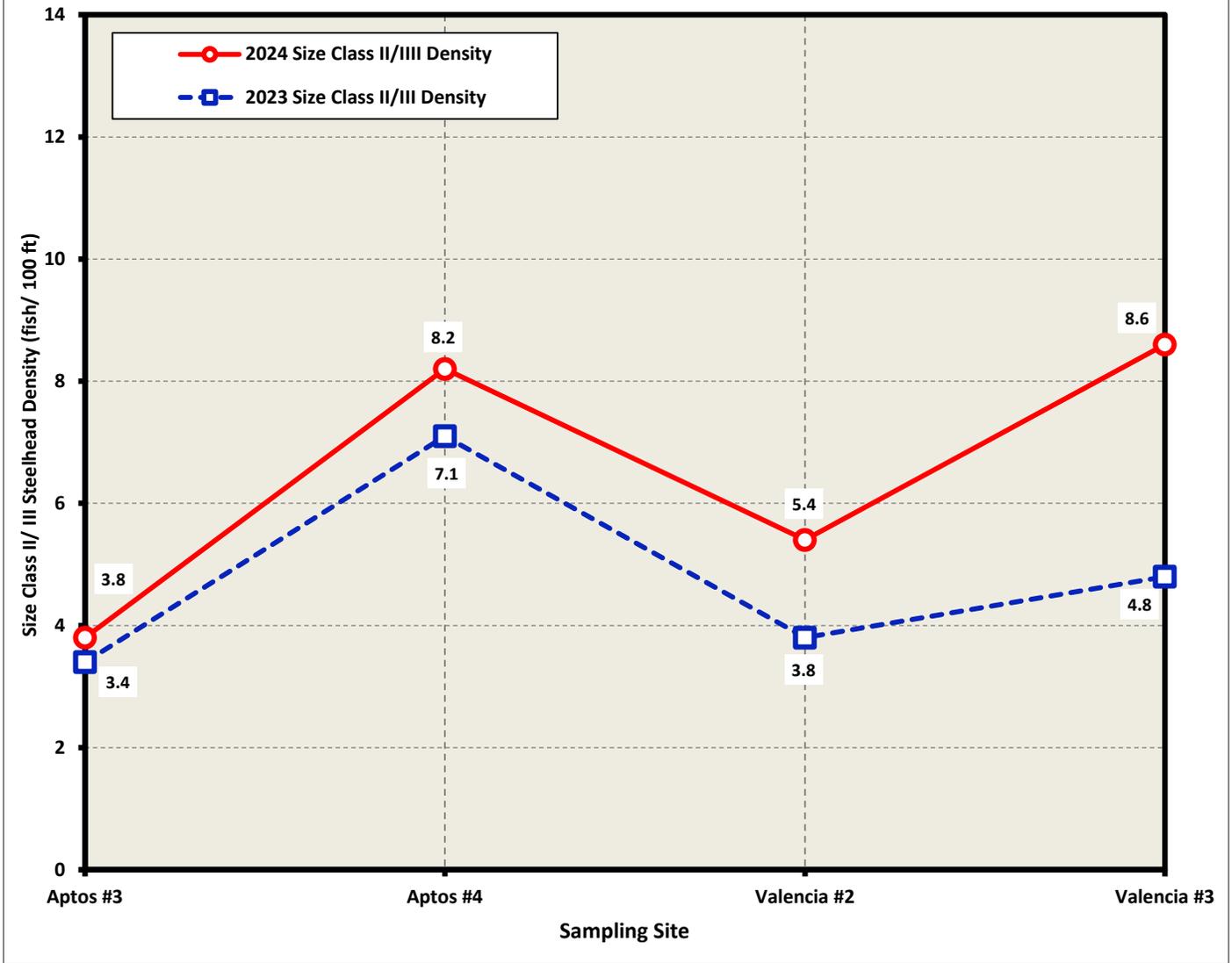


Figure 37. Size Class II/III Steelhead Site Densities in Aptos Creek Comparing 2024 to 2023.

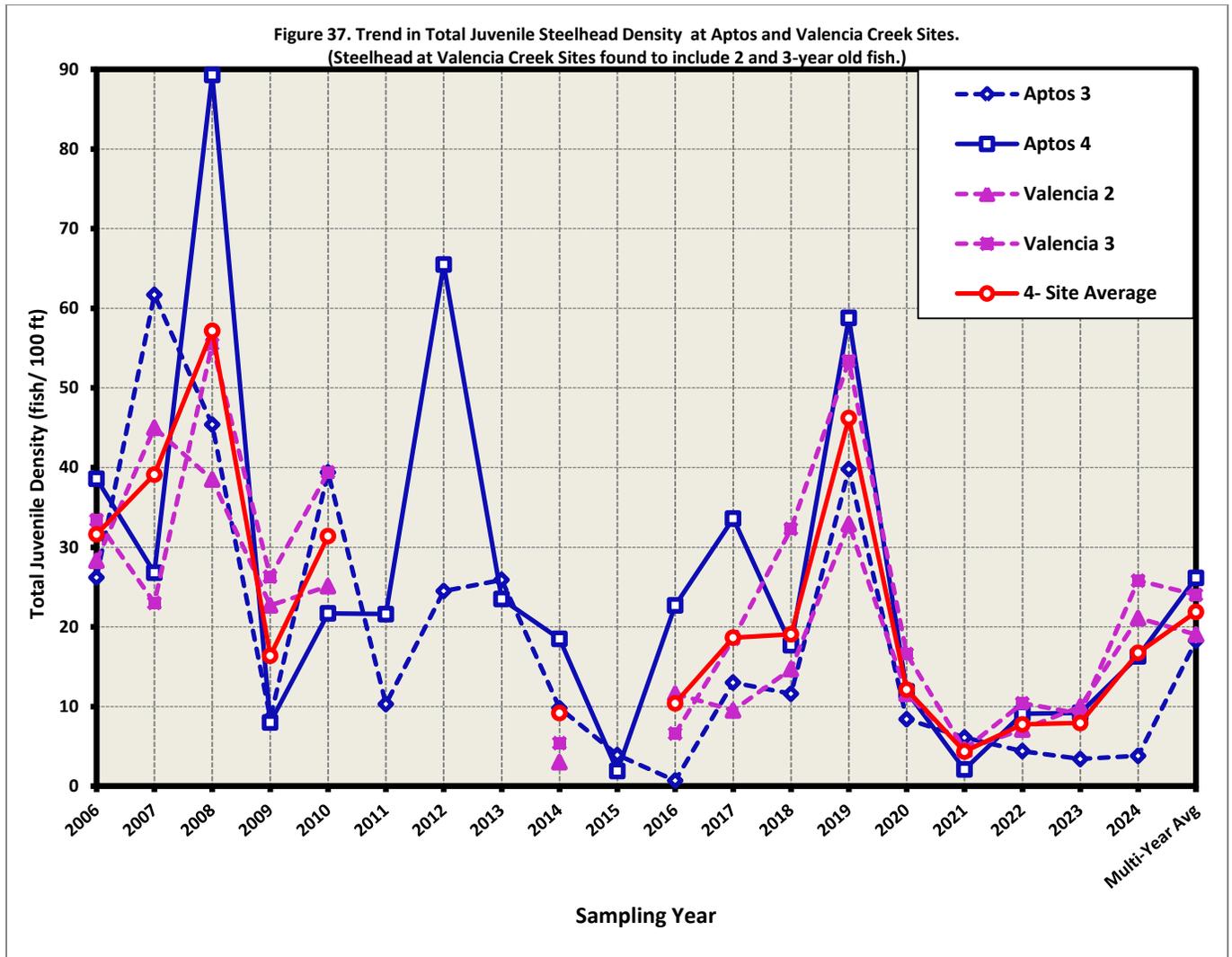


Figure 38. Trend in Total Juvenile Steelhead Site Densities in Aptos Watershed for 2006–2024.

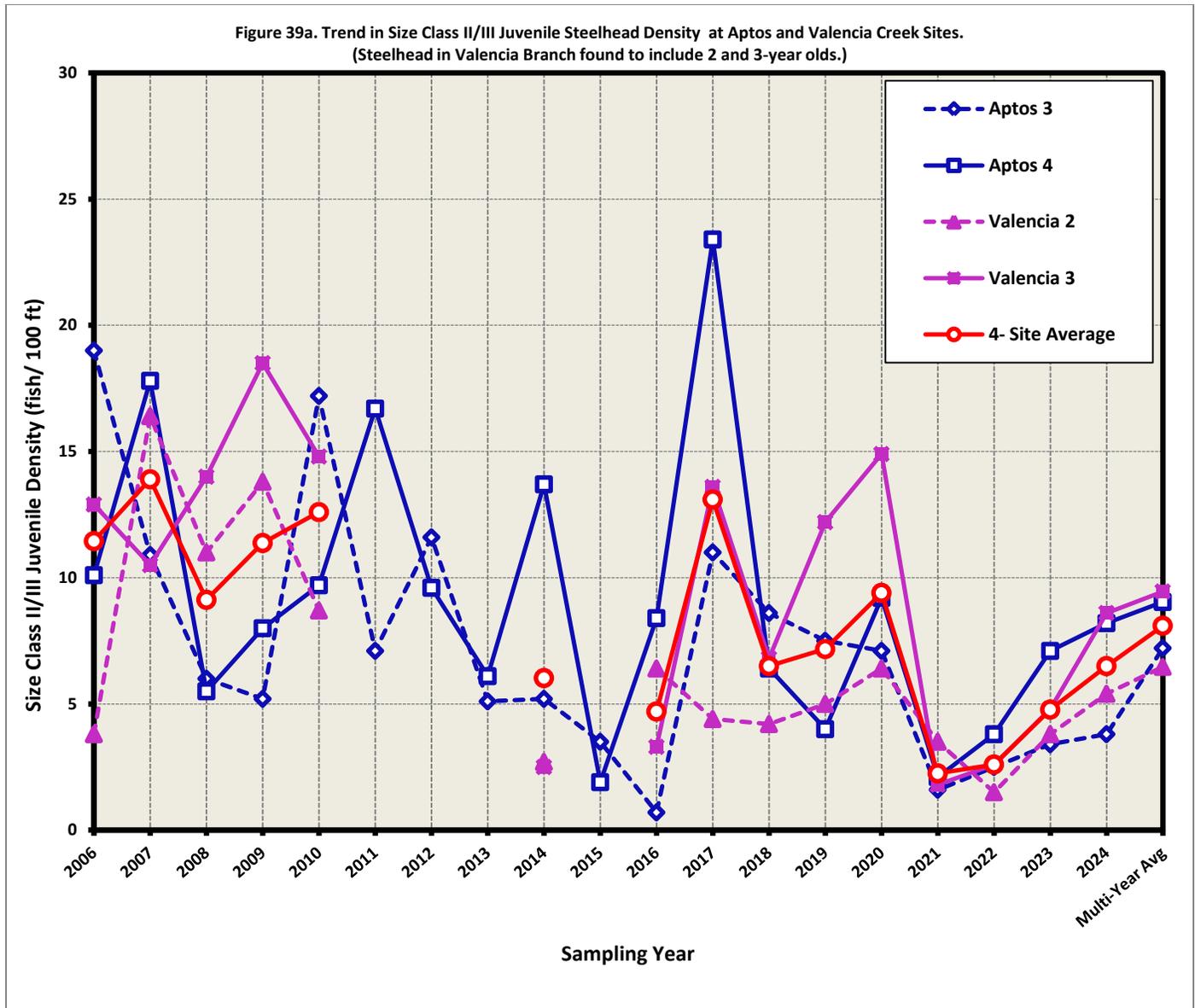


Figure 39a. Trend in Size Class II/III Steelhead Site Densities in Aptos Watershed for 2006 – 2024.

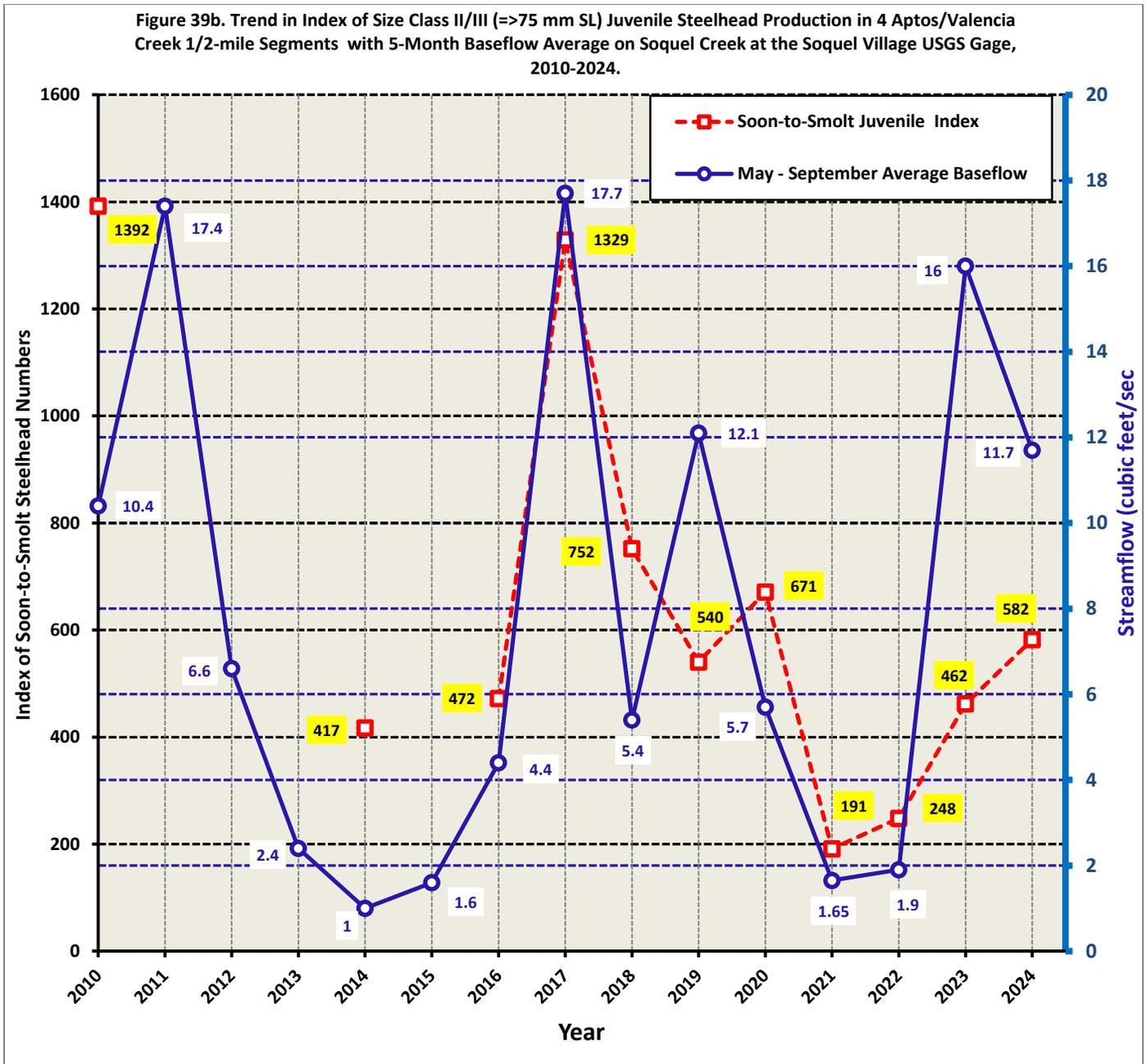


Figure 39b. Trend in Index of Size Class II/III (\Rightarrow 75 mm SL) Juvenile Steelhead Numbers in 4 Aptos/Valencia Creek Segments Graphed with 5-Month Baseflow Average in Soquel Creek, 2010 – 2024.

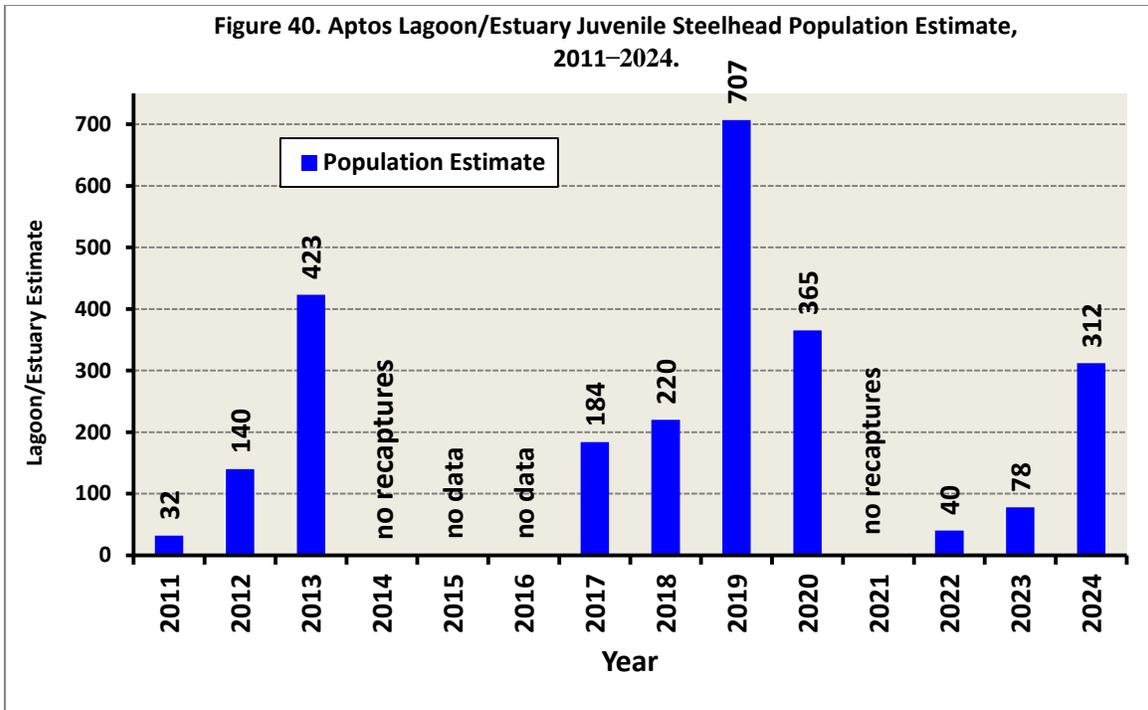


Figure 40. Aptos Lagoon/Estuary Juvenile Steelhead Population Estimate, 2011–2024.

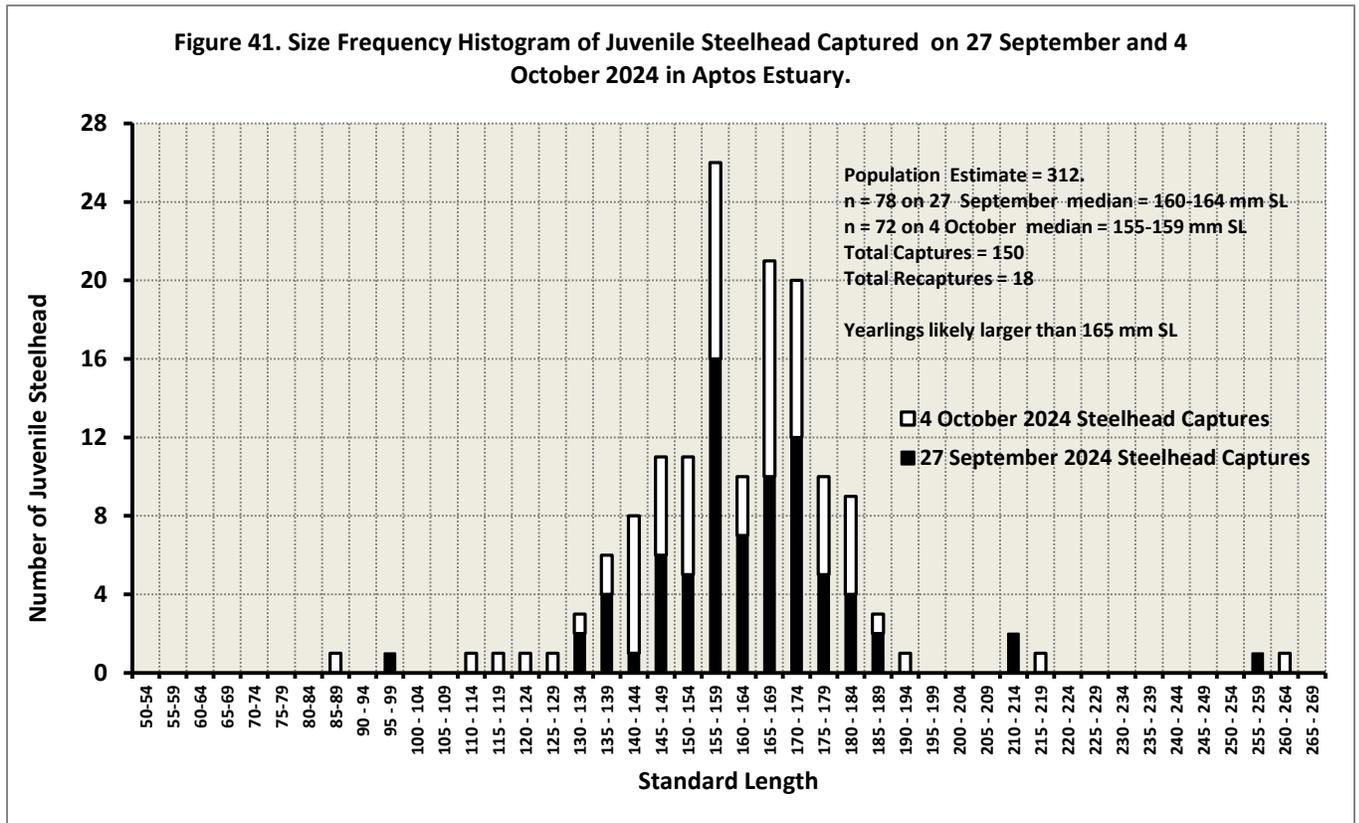


Figure 41. Size Frequency Histogram of Steelhead Captured in Aptos Lagoon, October 2024.

Table 7. Water quality measurements in Aptos Lagoon (sandbar slightly open) during steelhead sampling, 27 September and 4 October 2024.

27 September 2024					4-Oct-2024				
Walk-bridge (thalweg) Air temp. 15.5°C Gage Height = 4.53					0845 hr	Walk-bridge (thalweg) Air temp. 17.2°C; Gage Height = 4.50			0832 hr
Depth	Temp	Salin	Oxygen	Cond	Temp	Salin	Oxygen	Cond	
(m)	(C)	(ppt)	(mg/l)	micro-mhos	(C)	(ppt)	(mg/l)	micro-mhos	
0 (surface)	16.7	0.4	9.94	619	17.6	0.4	9.92	732	
0.25	16.7	0.4	9.94	619	17.6	0.4	10.04	724	
0.5	16.7	0.4	9.92	617	17.6	0.4	10.02	723	
0.75	17.1	0.4	10.52	651	17.6	0.4	10.02	721	
1.00	18.1	17.4	7.30	17737	17.6	0.4	10.03	720	
1.25b	18.0	18.2	3.10	25401	19.3	2.8	8.78	4599	

* “b” indicates the lagoon/estuary bottom where measurements were taken through the water column.

iv. Statistical Analysis of Annual Difference in Juvenile Steelhead Densities

Table 8. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Replicated Sampling Sites in the SAN LORENZO Watershed (2024 to 2023; n=23).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	-0.13	0.50	1.47	2.30
Df	22	22	22	22
Std Error	1.60	2.70	0.97	2.54
t Stat	-0.08	0.18	1.51	0.91
P-value (2-tail)	0.9367	0.8555	0.1453	0.3751
95% CL (lower)	-3.44	-5.11	-0.55	-2.96
95% CL (upper)	3.18	6.10	3.50	7.55

Table 9. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Replicated Sampling Sites in the SOQUEL Watershed (2024 to 2023; n=7).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	0.13	-5.41	1.47	-3.89
Df	6	6	6	6
Std Error	2.53	3.03	1.36	2.62
t Stat	0.05	-1.78	1.08	-1.46
P-value (2-tail)	0.9611	0.1246	0.3213	0.1890
95% CL (lower)	-6.05	-12.84	-1.86	-10.30
95% CL (upper)	6.31	2.01	4.80	2.53

Table 10. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Repeated Sampling Sites in the APTOS Watershed (2024 to 2023; n=3).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	1.03	4.85	1.35	6.20
Df	2	2	2	2
Std Error	0.35	1.82	1.32	3.12
t Stat	2.97	2.66	1.02	1.99
P-value (2-tail)	0.0972	0.1171	0.4138	0.1854
95% CL (lower)	-0.46	-3.00	-4.33	-7.23
95% CL (upper)	2.53	12.70	7.03	19.63

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D. GLOSSARY

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

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

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

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

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

Fork Length (FL): Fish length from snout to mid point in the tail's edge.

Hydraulic control point: The top of an obstruction in the stream channel in which streamflow must rise before passing over, or a point in the stream where the flow is constricted. The hydraulic control point determines the water surface elevation upstream to the next riffle or run. It is typically at the tail of a pool. Riffles and runs have no hydraulic controls except for very short distances at most.

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

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

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

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

Mainstem: The principal or dominating stream channel in a drainage system. Tributaries flow into it.

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

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

Percent fines: The percent of the streambed area covered with silt and sand in a habitat type.

Pool: A deeper stream habitat with little surface turbulence except at the head and that has places where downstream water velocity is near zero or water is backwatered with upstream eddies. Pools are formed by scour objects, such as large instream wood, large boulders, streambank tree roots or bedrock faces. Pools are the primary habitat for coho salmon and for larger juvenile steelhead in Santa Cruz Mountain tributaries and Mainstem headwater sites.

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

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

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

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

Run: Deeper than a riffle, fastwater habitat without surface turbulence, but is moving.

Scour: The localized removal of material from the streambed by flowing water. It causes the stream channel to deepen and is the opposite of fill.

Shade: The percent canopy closure over the stream as estimated by a spherical densiometer.

Size Class I steelhead/ coho salmon: Juvenile steelhead or coho salmon captured in the fall that are less than 75 mm Standard Length.

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

Size Class III steelhead: Juvenile steelhead captured in the fall that are at least 150 mm Standard Length and include yearling and older juveniles.

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

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

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

Steelhead/ coho salmon adult migration: Adult steelhead are sexually mature and typically migrate upstream from the ocean through an open sandbar after several prolonged storms; the migration seldom begins earlier than December and may extend into May if late spring storms develop. Many of the earliest migrants tend to be smaller than those entering later in the season. Adult fish may be blocked by barriers such as bedrock falls, wide and shallow riffles and occasionally logjams. Man-made objects, such as culverts, bridge abutments, dams and remnant dam abutments are often significant barriers. Some barriers may completely block upstream migration, but many barriers in coastal streams are passable at higher streamflows. If the barrier is not absolute, some adult steelhead are usually able to pass in most years, since

they can time their upstream movements to match optimal stormflow conditions. However, in drought years and years when storms are delayed, some obstructions can be serious barriers to steelhead and especially coho salmon spawning migration. Sexually mature adult coho salmon often have more severe migrational challenges because much of their migration period, November through early February, may be prior to stormflows needed to pass bridge abutments, shallow riffles, boulder falls and partial logjam barriers. Access is also a greater problem for coho salmon because they die at maturity and cannot wait in the ocean an extra year if access is poor due to failure of sandbar breaching during drought or delayed stormflow.

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

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

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

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

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

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

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

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

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

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

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

Young-of-the-year steelhead and coho salmon (YOY): Juvenile steelhead and coho captured in the fall and hatched earlier in the spring. Most are <75 mm Standard Length but many may be => 75 mm Standard Length and in the Size Class II if food is more abundant where they rear, such as in the lower San Lorenzo River downstream of the Zayante Creek confluence and in lagoons in most years.