2016 SUMMARY REPORT− Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Pajaro Watersheds, Santa Cruz County, CA

Electrofishing in Fall Creek below Log Weir in a Pool with Large Instream Wood as Cover

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

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

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A. EXECUTIVE SUMMARY

Water Year 2016 streamflows in spring and early summer were below the median streamflow statistic, as was the case in 7 of the last 10 water years (***Appendix C***). Most rain and stormflows came in November, December, January and especially early March. Thus, adult spawning migration was not impeded to upper sampling sites of the San Lorenzo, Soquel, Aptos and Corralitos watersheds (except Bear Creek in the San Lorenzo drainage). But many spawning redds made before early March may have been destroyed by the 5-6 March stormflow that was at least 3 times bankfull. Based on the notable level of YOY in Casserly Creek, it is likely that adult steelhead migrated into this creek through College Lake to spawn.

Overall, rearing habitat improved from 2015 to 2016 in all but Aptos watershed due to increased baseflow above drought levels that provided more food and greater depth. However, escape cover declined in fastwater of the San Lorenzo mainstem and in tributary pools of Fall Creek, Bean Creek, Bear Creek, 1 of 2 sites in Boulder Creek, 2 of 4 sites/reaches in Zayante Creek; 3 of 8 sites/reaches in Soquel watershed and 3 of 4 sites/reaches in Aptos watershed. Site Bean 14c-1 was dry for the fifth consecutive year. Bean Reach 14c was habitat typed and sampled upstream in 2016. The Corralitos/Browns sub-watershed showed improvement in depth and escape cover.

Site densities of young-of-the-year (YOY), yearlings and Size Class II/III were mostly below average. YOY densities were higher at some upper watershed sites compared to lower ones. Densities of Size Class II/ III steelhead (soon-to-smolt) were generally rated below average in 2016 (***Table S-1*** *below*). Average YOY densities decreased in San Lorenzo mainstem and tributaries, Soquel Creek and Corralitos/Browns creeks compared to 2015. Average Size Class II/III site density increased slightly for mainstem San Lorenzo sites, Soquel sites, Aptos sites and Corralitos/Browns sites but was unchanged for San Lorenzo tributary sites. In comparison, the annual trend in average YOY density increased in Scott and Waddell creeks and decreased in Gazos Creeks in 2016 compared to 2015 (***Figure B-54; Smith 2016***). The annual trend in average yearling (Size Class II/III) site density decreased in Scott and Waddell creeks in 2016 while it increased slightly in Gazos Creek (***Figure B-55; Smith 2016***).

For the San Lorenzo watershed, the reach index for 18 reaches (not including the lagoon) was 21,000 (2010), 7,800 (2014), 7,500 (2015) and 9,900 (2016) Size Class II and III juveniles (***Figure B-31*** *below*). For the Soquel watershed, the reach index for 8 reaches (not including the lagoon) was 3,800 (2010), 880 (2014), 580 (2015) and 2,500 (2016) Size Class II and III juveniles (***Figure B-32*** *below*). The increase in 2016 was due to hydrologic continuity being maintained in the East Branch after being lost during drought in 2014 and 2015. For the Corralitos/Browns sub-watershed, the total reach index for 6 reaches excluding Shinglemill Gulch) for Size Class II and III was 3,000 (2010), 2,000 (2014), 1,000 (2015) and 1,400 (2016) (***Figure B-33*** *below*).

Two factors may explain the much below average YOY densities at most sites in all 4 watersheds sampled. As in 2015, the main factor in 2016 may have been low adult returns to all 4 watersheds. A second factor contributing to low YOY densities may have been poor egg survival in redds laid prior to the large March 2016 stormflows.

No steelhead were captured in the tidally influenced Pajaro River Estuary in fall 2016, as was the case in fall 2012−2015. Tidewater gobies were captured in reduced numbers, especially reduced at the upper site where they were previously abundant. No tidewater gobies were detected along the extensive beachfront where submerged aquatic vegetation was nearly absent and smelt were common.

B. INTRODUCTION

i. Scope of Work

In fall 2016, 4 Santa Cruz County watersheds were sampled for juvenile steelhead to primarily compare juvenile abundance with past years to assess trends and compare habitat conditions at sampling sites and in limited habitat typed segments with those in 2015 and past years in selected reaches of the San Lorenzo. Results from steelhead and habitat monitoring are used to guide watershed management and planning (including implementation of public works projects) and enhancement projects for species recovery. Refer to maps below that delineate reaches and sampling sites. Tables and figures referenced in this summary report and not included may be found in **Appendix B**, the detailed methods and analysis report. Hydrographs of all previous sampling years are included in **Appendix C**.

ii. Study Area

San Lorenzo River. The mainstem San Lorenzo River and 8 tributaries were sampled at 27 sites (10 mainstem and 17 tributary sites). Sampled tributaries included Branciforte, Carbonera, Zayante, Lompico, Bean, Fall, Newell, Boulder and Bear creeks. A new segment with sampling site was added to Bean Creek (14c-2) because the traditional site was dry again in 2016. The lower reach and sampling site in Carbonera Creek (20a) were added in 2016 after last being sampled in 2001. Nine half-mile segments were habitat typed in the San Lorenzo system to assess habitat conditions and select habitats of average quality to sample for fish density. For the remaining 18 sites, the 2015 sites were replicated for fish sampling, and depth and cover were measured at all sampling sites.

Soquel Creek. Soquel Creek and its branches were sampled at 8 sites (4 mainstem and 4 branch sites). Four half-mile segments were habitat typed to assess habitat conditions and select habitats of average quality to sample for fish density. For the remaining 4 sites, the 2015 sites were replicated for fish sampling, and depth and cover were measured at all sampling sites.

Aptos Creek. Aptos watershed was sampled at two Aptos and two Valencia creek sites in 2016. The upper Valencia 3 reach was habitat typed with a new site chosen. The other three 2015 sites were replicated for fish sampling. Depth and cover were measured at all sampling sites.

Pajaro River and Lagoon. In the Corralitos sub-watershed of the Pajaro River drainage, fish sampling included 4 sites in Corralitos Creek and 2 sites in Browns Creek. Two associated half-mile reach segments habitat typed, one each in Corralitos and Browns creeks, upstream of diversion dams. Depth and cover were measured at all sampling sites. A half-mile reach in Casserly Creek (tributary to Corralitos Creek), up and downstream of the Mt. Madonna Road Bridge, was habitat typed, and a representative site was sampled. The Pajaro River Lagoon was sampled in late September and early October for steelhead and tidewater goby, and water quality conditions were measured during sampling.

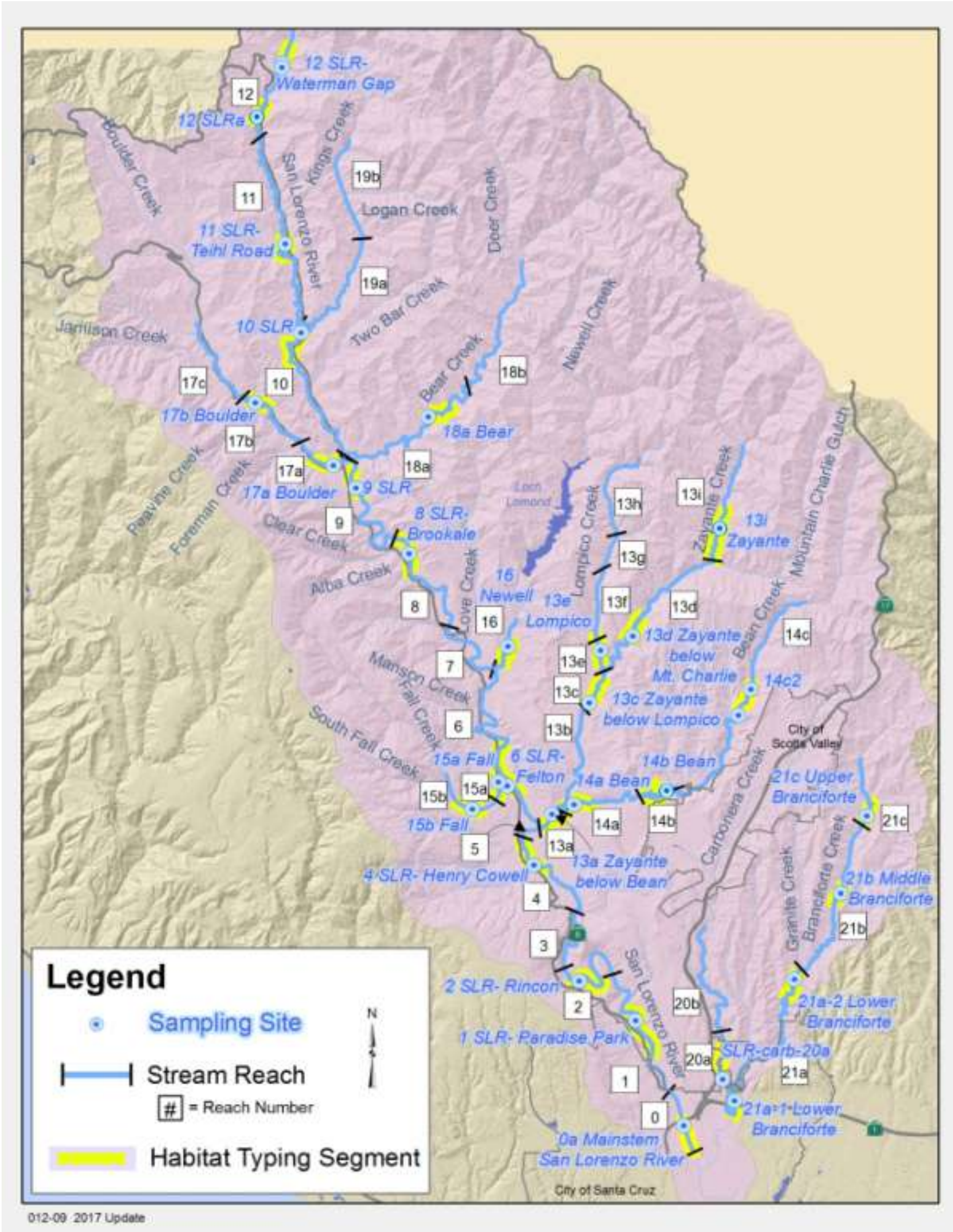

Figure A-2. San Lorenzo River Watershed− Sampling Sites and Reaches.

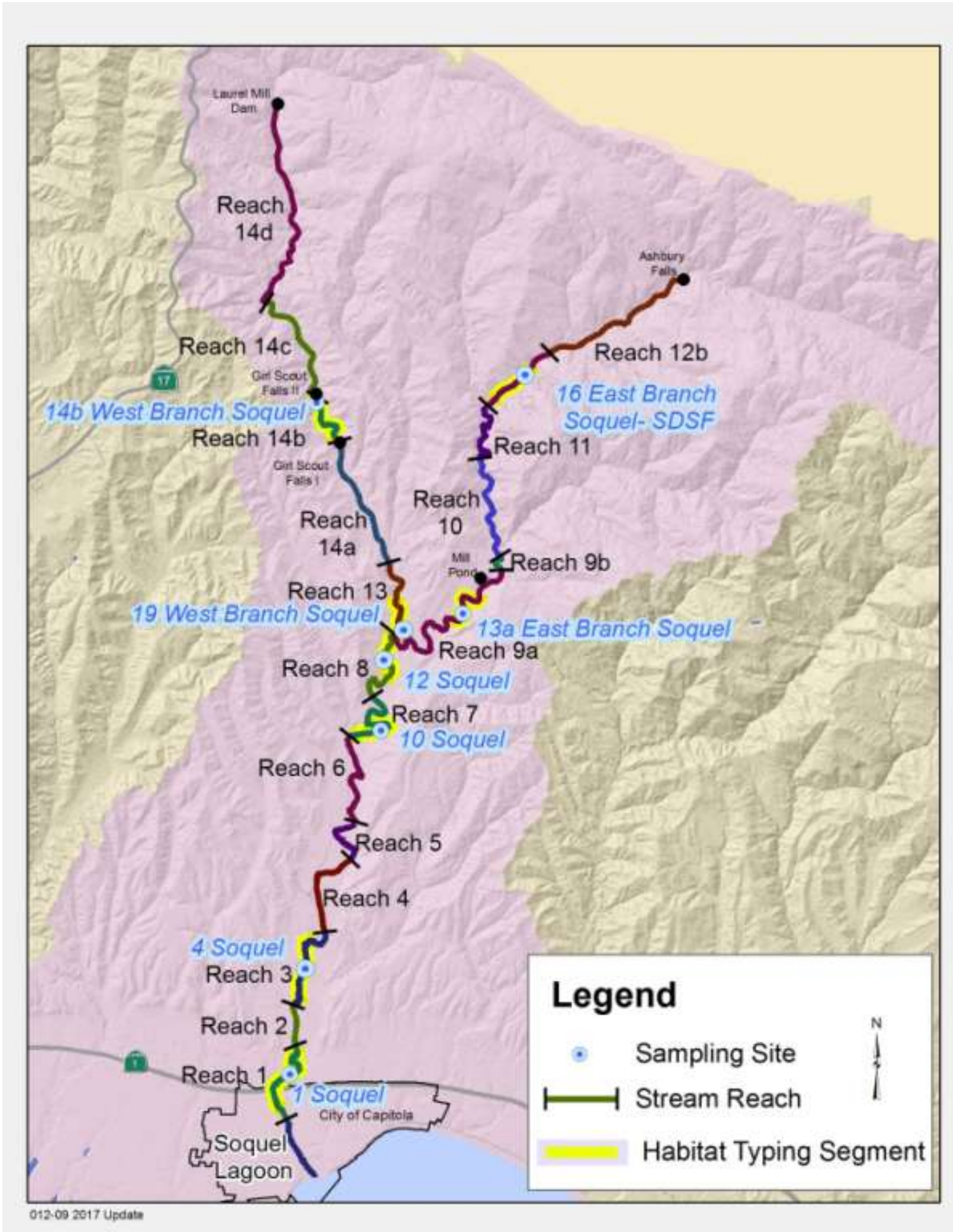

Figure A-3. Soquel Creek Watershed.

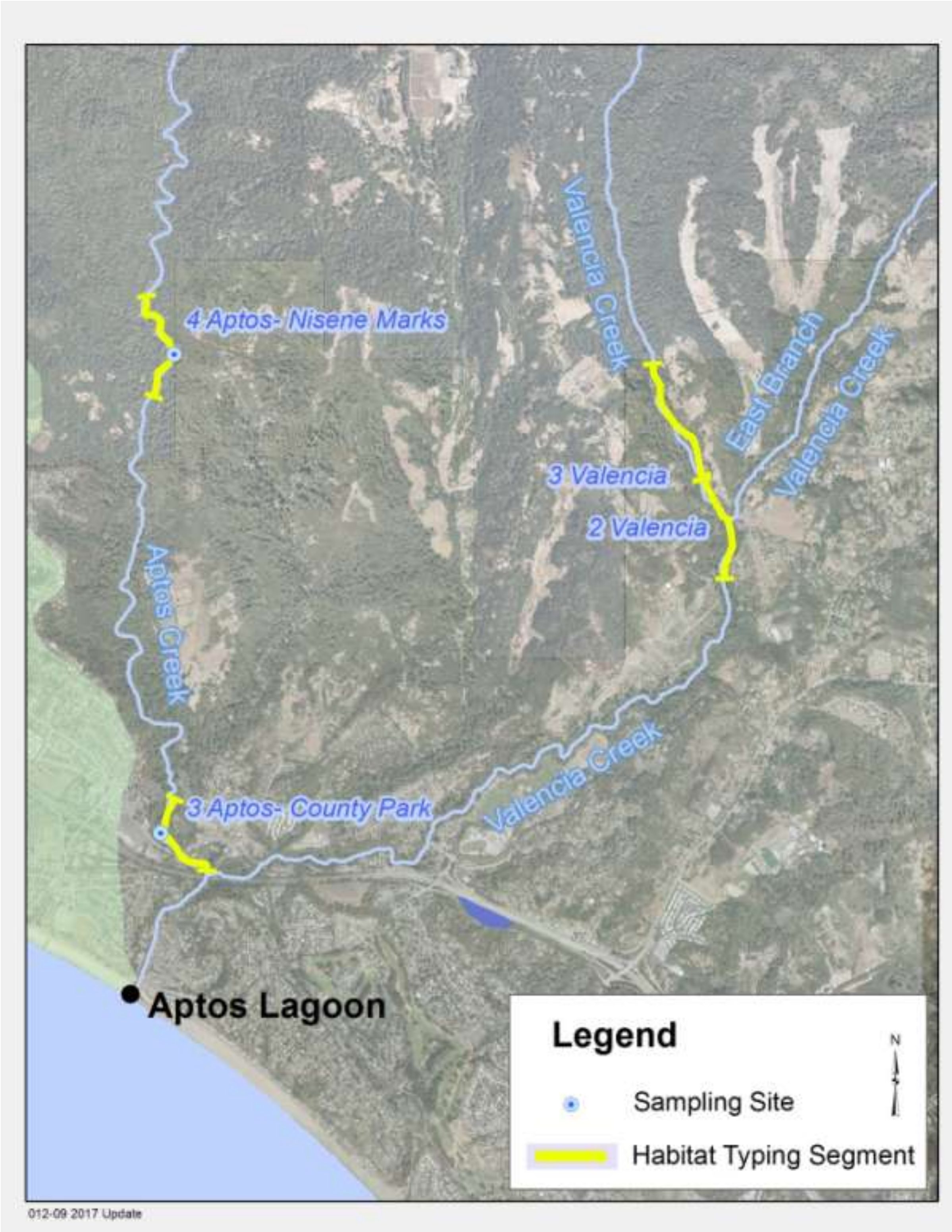

Figure A-6. Aptos Creek Watershed (Aptos Lagoon and Valencia not sampled in 2015).

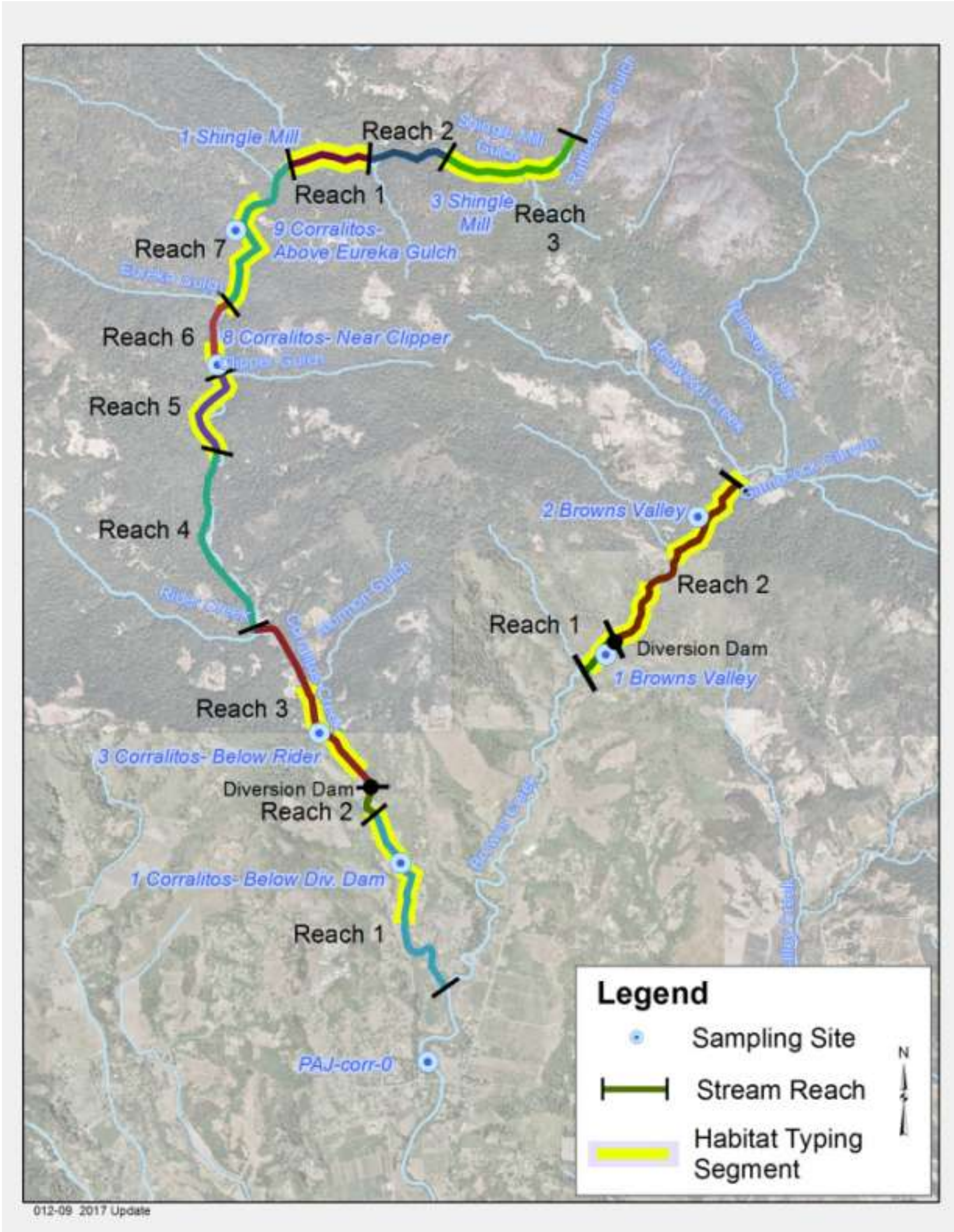

Figure A-7. Upper Corralitos Creek Sub-Watershed of the Pajaro River Watershed.

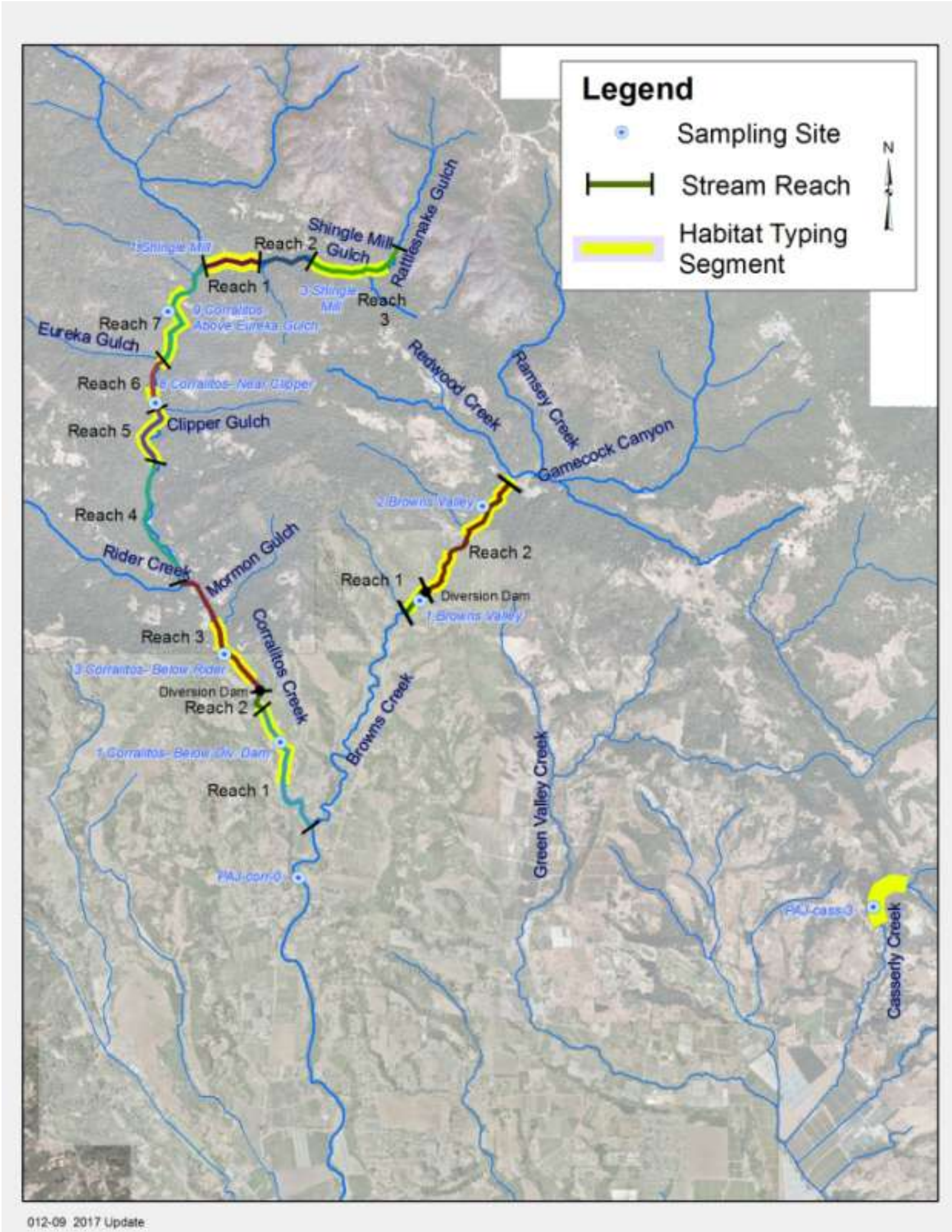

Figure A-8. Upper Corralitos Creek and Casserly Sub-Watersheds of the Pajaro River Watershed.

C. RESULTS

Figures and tables contained in this summary report were extracted from the detailed analysis found in **Appendix B**, including methods of sampling and life history descriptions of steelhead and coho salmon.

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

1. WY2016 streamflows in spring-summer-fall were below the median flow statistic, as they had been in 7 of the last 10 water years. Most rain and stormflows came in December, January and especially early March. Thus, adult spawning migration was not impeded to headwater reaches (except Bear Creek). But many spawning redds made before early March may have been destroyed by the 5-6 March stormflow that was at least 3 times bankfull (11,600 cfs at Big Trees gage). Baseflow steadily declined from April on (except for small stormflows in late April of slightly more than 100 cfs), down to a minimum of 11 cfs in September at Big Trees Gage (***Figure B-34*** *below*).

2. ***In the lower and middle mainstem in 2016***, rearing habitat quality improved from 2015 at all replicated sampling sites and habitat-typed Reach 2, primarily due to increased baseflow (more food) and greater depth during the dry season (***Figure B-53*** *below*) But escape cover declined in fastwater habitat throughout except for Site 8 (***Table S-1 below***). In Reach 2, the escape cover index declined from 0.132 in 2015 to 0.119 in 2016, which was consistent with increased embeddedness. In Reach 2 there was more than 4 times the escape cover in 1999 compared to that measured in 2016.

3. ***Upper mainstem and tributary steelhead sites/reaches*** in 2016 had improved habitat quality from 2015 primarily due to increased baseflow (more food) and increased pool depth in the dry season. About half of the sites had reduced pool escape cover perhaps due to sedimentation (Zayante 13a and 13d, Bean 14b, Fall 15a and 15b, Boulder 17b, Bear 18a and Branciforte 21c). In Zayante 13d, there was less than 1/3 the escape cover in 2016 (0.076) compared to the high reached in 2005 (0.269). Habitat quality declined in Bear 18a reach compared to 2012 conditions. (***Table S-3*** *above;* ***Table B-13b***). Pools in Lower Carbonera 20a widened since 1995 (avg. width = 16.8 ft (2016); avg. width = 10.9 ft (1995) (Alley 1997)). Upper Bean 14c-1 was dry for the fifth consecutive year.

4. ***YOY densities in the mainstem sites*** were below average at 9 of 10 sites and lower than 2015 at 6 of 10 sites (***Table 18 in Appendix B; Figures B-2a-b***). YOY recruitment into the mainstem from tributaries has apparently been minimal from 1999 onward, except for possibly at Site 4 in 2008 from lower Zayante Creek. ***Total densities*** mirrored YOY densities at mainstem sites (***Figure B-1***). No PIT tagged steelhead were captured at Sites 0, 1 and 2.

5. ***YOY densities in tributary sites*** were below average at 15 of 17 sites (***Table 23 in Appendix B; Figures B-2a-b***). Those sites in tributaries on the western side of the drainage had similar or

higher YOY densities in 2016, while those on the eastern side had similar or lower densities except for notable increases at Zayante 13d and Branciforte 21b (**Figure 2b**). Decline at Zayante 13c was substantial. Adult steelhead access to Bear 18a appeared restricted with more logs jamming on the flashboard dam abutment below Lanktree Bridge. All tributary sites were dominated by YOY in 2016. Most YOY reached Size Class II in the lower mainstem below Zayante Creek but not in the mainstem upstream.

6. Two factors may explain the much below average YOY densities at most sites in all 4 watersheds sampled. As in 2015, the main factor in 2016 may have been low adult returns to all 4 watersheds. A second factor contributing to low YOY densities may have been poor egg survival in redds laid prior to the large March 2016 stormflows.

7. The trend in average mainstem site ***total density*** declined from 2016 to 2015 (***Figure B-17***) to 8.9 juveniles/100 ft, and was one of the 4 lowest averages since 1997. The 2016 average total density at tributary sites remained similar to 2015 (***Figure B-19***) at 47.6 juveniles/ 100 ft.

8. ***Yearling densities*** were below average at 23 of 26 wetted sites after low recruitment from few YOY in 2015 and a high stormflow in early March that may have encouraged out-migration (***Figure B-3***). Sites with above average yearling density were Mainstem SLR 0a (still low), Fall 15a and Boulder 17a.

9. Twenty-two of 26 wetted sites had below average ***densities of Size Class II and III*** steelhead (***Figure B-4*** *below*). Zayante 13i had average density, while above average densities were found at Zayante 13c (slightly above), Fall 15a and Boulder 17a. All mainstem sites had below average densities of larger size classes, consistent with below average total, YOY and yearling densities. Regarding the trend in soon-to-smolt-densities, the 6-site mainstem average increased slightly from 2.7 in 2015 to 2.8 juveniles/ 100 ft in 2016 (***Figure B-21*** *below*). But the 8-site tributary average declining from 9.3 in 2015 to 8.2 juveniles/ 100 ft in 2016 (Zayante 13a included in the average). A positive correlation was evident between average site densities of these larger juveniles and the 5-month baseflow average. A similar positive correlation between average baseflow and average densities of larger juveniles was evident at 2 middle mainstem sites (***Figure B-22*** *below*). When baseflow average was higher, average site density tended to be higher in many years and vice versa. When baseflow was relatively high in the April to June growth period in tributaries, more YOY could reach Size Class II than with reduced baseflow. This was evident in middle and lower Zayante Creek and middle Bean Creek in wetter years. In drier years, reduced streamflow with associated reduced food supply hindered YOY from growing into the soon-to-smolt Size Class II.

10. The below average densities of larger juveniles at all sites in mainstem downstream of Kings Creek confluence resulted partially from retention of few yearlings being recruited from a small YOY age class in 2015, as had been the case the previous 2014 and 2015 drought years. Also, there may have been poor overwinter survival with the large 5 March stormflow. Low densities of Size Class II steelhead at many tributary sites, likely resulted a shortage of yearlings at most sites caused by 1) poor recruitment from the small YOY age class of 2015, 2) poor overwinter survival and 3) early out-migration due to good spring growth without turbid feeding conditions after mid-March.

11. ***For the San Lorenzo watershed, the total reach index*** for 18 reaches (not including the lagoon) was 21,000 (2010), 7,800 (2014), 7,500 (2015) and 9,900 (2016) for Size Class II and III juveniles (***Figure B-31*** *below*). In wetter years, the mainstem River contributes much more to the index than in drier years, when YOY densities and growth rate are curtailed with less streamflow. In 2016, Zayante 13d and Boulder 17a reaches provided higher indices than in the wet year of 2010. Bean 14c produced juveniles in 2016 because a portion of it was watered. Reach indices for Bean 14b, Newell 16 and Bear 18a increased little in 2016, despite higher baseflow.

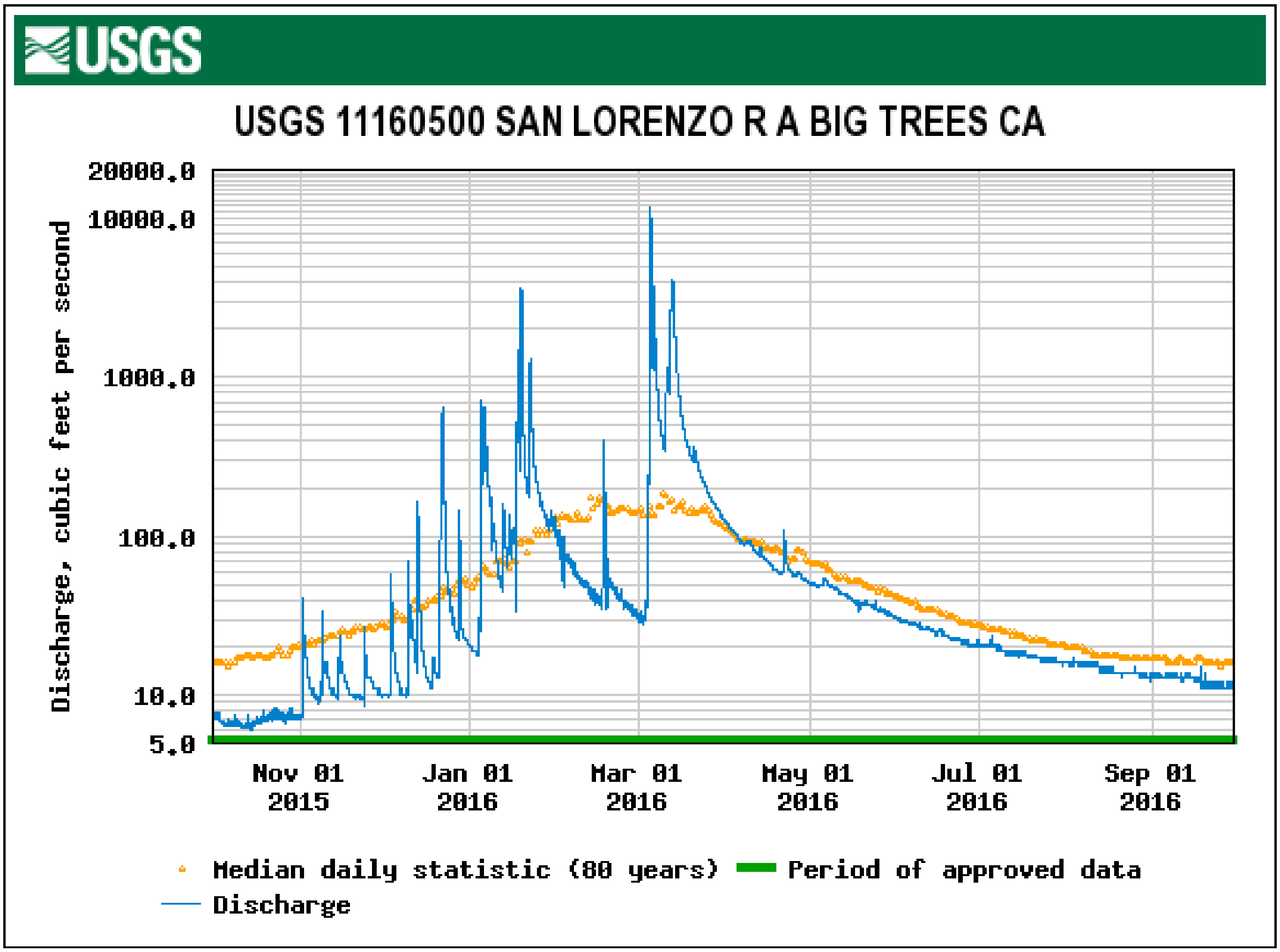

Figure B-34. The 2016 Discharge Flow of Record for the USGS Gage on the San Lorenzo River at Big Trees.

Table S-1. 2016 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Average Smolt Size, with Physical Habitat Change since 2015. (Red denotes ratings of 1−3 or negative habitat change; purple denotes ratings of 5−7. Methods for assessing habitat change in M-6 of **Appendix B**).

Site	Multi-Year Avg. Potential Smolt Density Per 100 ft	2016 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2016 Numeric Smolt Rating (With Size Factored In)	2016 Symbolic Rating (1 to 7)	Physical Habitat Change by Reach/Site Since 2015
Low. San Lorenzo #0a	8.6	5.6/ 120 mm	4 (Fair)	@@@@	Site Positive
Low. San Lorenzo #1	6.9	5.6/ 100 mm	3 (Below Avg)	@@@	Site Positive
Low. San Lorenzo #2	13.2	8.3/ 100 mm	4	@@@@	Reach Positive
Low. San Lorenzo #4	12.8	6.3/ 88 mm	2 (Poor)	@@	Site Positive
Mid. San Lorenzo #6	3.8	0.5/ 81 mm	1 (Very Poor)	@	Site Positive
Mid. San Lorenzo #8	5.3	1.3/ 81 mm	1	@	Site Positive
Mid. San Lorenzo #9	6.4	3.6/ 89 mm	2	@@	Site Positive
Up. San Lorenzo #10	5.0	3.5/ 86 mm	1	@	Site Positive
Up. San Lorenzo #11	5.9	4.6/ 117 mm	4	@@@@	Site Positive
Up.San Loren #12a (res.Rt)	7.2	2.4/ 122 mm	3	@@@	Site Positive
Zayante #13a	9.1	4.6/ 95 mm	3	@@@	Site Positive
Zayante #13c	15.3	15.9/ 91 mm	5 (Good)	@@@@@	Site Positive
Zayante #13d	16.2	14.0/ 100 mm	4	@@@@	Site Positive
Lompico #13e	6.6	3.5/ 112 mm	3	@@@	Site Negative
Zayante #13i	7.4	7.4/ 96 mm	3	@@@	Site Positive
Bean #14a	4.4	6.2/ 89 mm	3	@@@	Site Positive
Bean #14b	11.6	4.5/ 99 mm	3	@@@	Reach Positive
Bean #14c	7.8	Dry	Dry	Dry	Dry
Bean #14c-2	7.1	7.1/ 103 mm	4	@@@@	NA
Fall #15a	5.7	8.4/ 102 mm	4	@@@@	Site Positive
Fall #15b	11.6	4.8/ 116 mm	4	@@@@	Site Positive
Newell #16	12.4	4.3/ 87 mm	2	@@	Site Positive
Boulder #17a	10.5	17.1/ 99 mm	5	@@@@@	Reach Positive
Boulder #17b	10.4	7.2/ 88 mm	3	@@@	Site Positive
Bear #18a	9.0	2.2/ 102 mm	2	@@	Reach Negative
Carbonera #20a	5.2	1.6/ 102 mm	1	@	NA
Branciforte #21b	12.6	7.4/ 102 mm	3	@@@	Site Positive
Branciforte #21c (res. Rt)	8.9	6.1/ 106 mm	4	@@@@	Site Positive
Soquel #1	3.5	0.3/ 88 mm	1	@	Reach Positive
Soquel #4	8.0	1.0/ 89 mm	1	@	Site Positive
Soquel #10	8.0	3.7/ 98 mm	2	@@	Site Positive
Soquel #12	7.8	12.5/ 96 mm	4	@@@@	Reach Positive
East Branch Soquel #13a	10.4	6.8/ 98 mm	3	@@@	Reach Positive
East Branch Soquel #16	9.2	9.0/ 89 mm	4	@@@@	Reach Positive
West Branch Soquel #19	5.9	3.3/ 83 mm	1	@	Reach Negative
West Branch Soquel #21	9.2	5.1/ 98 mm	3	@@@	Site Positive
Aptos #3	8.5	0.7/ 148 mm	2	@@	Site Positive
Aptos #4	8.7	8.4/ 88 mm	3	@@@	Site Positive
Valencia #2	9.6	6.4/ 96 mm	3	@@@	Site Negative
Valencia #3	11.3	3.3/ 107 mm	3	@@@	Reach Negative
Corralitos #0	5.2	5.2/ 128 mm	4	@@@@	NA
Corralitos #1	8.6	3.7/ 125 mm	2	@@	Site Positive
Corralitos #3	10.2	7.3/ 129 mm	3	@@@	Site Positive
Corralitos #8	9.8	4.8/ 120 mm	4	@@@@	Site Positive

Site	Multi-Year Avg. Potential Smolt Density Per 100 ft	2016 Potential Smolt Density (per 100 ft)/ Avg Pot. Smolt Size SL	2016 Numeric Smolt Rating (With Size Factored In)	2016 Symbolic Rating (1 to 7)	Physical Habitat Change by Reach/Site Since 2015
Corralitos #9	15.3	8.5/ 110 mm	5	@@@@@	Reach Positive
Browns #1	14.0	9.4/ 106 mm	5	@@@@@	Site Positive
Browns #2	11.8	5.9/ 111 mm	4	@@@@	Reach Positive
Casserly #3	2.6	2.6/ 115 mm	3	@@@	NA

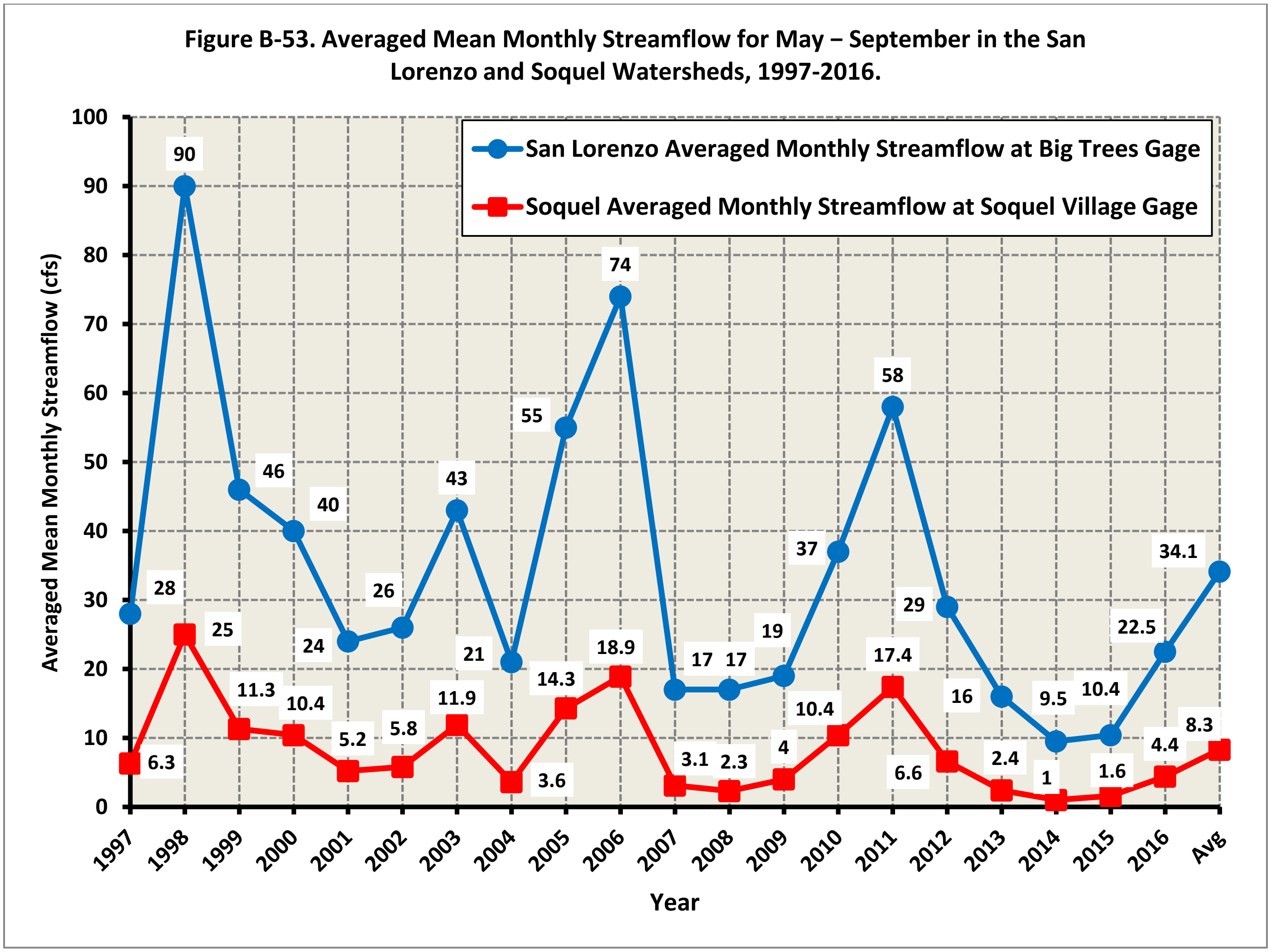

Figure B-53. Averaged Mean Monthly Streamflow for May−September in the San Lorenzo and Soquel Watersheds, 1997-2016.

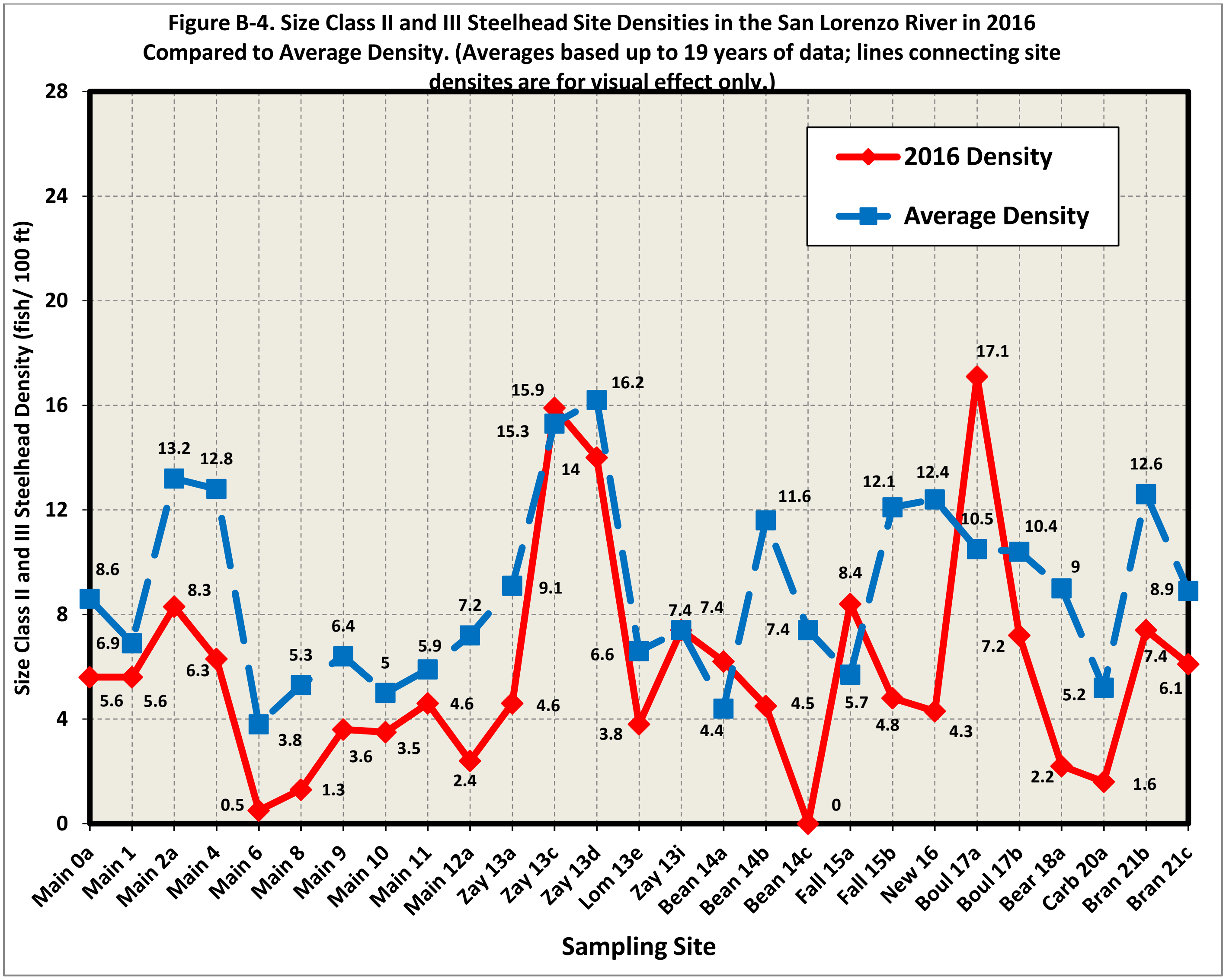

Figure B-4. Size Class II and III Steelhead Site Densities in the San Lorenzo River in 2016 Compared to Average Density. (Averages based on up to 19 years of data.)

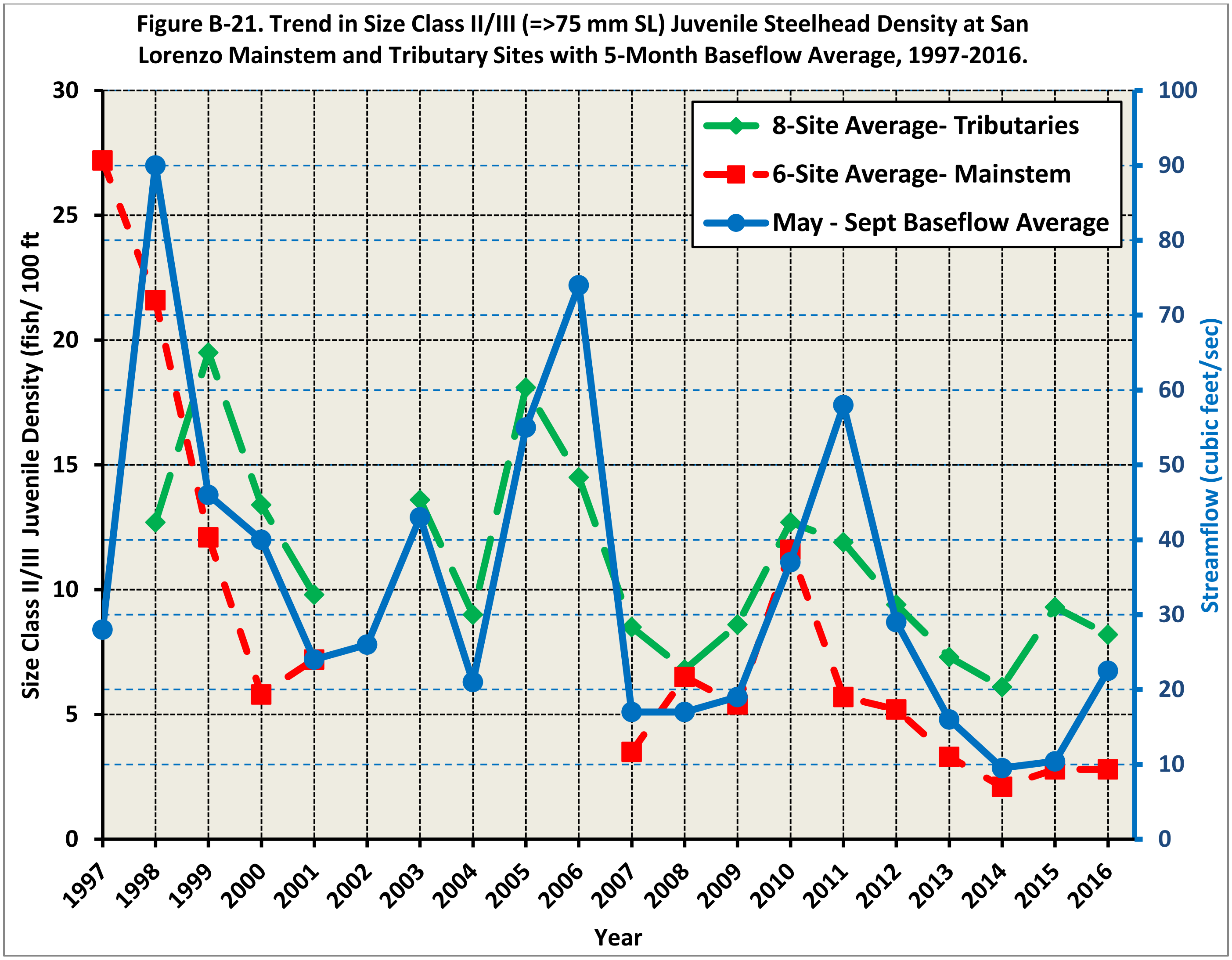

Figure B-21. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem and Tributary Sites with 5-Month Baseflow Average, 1997-2016.

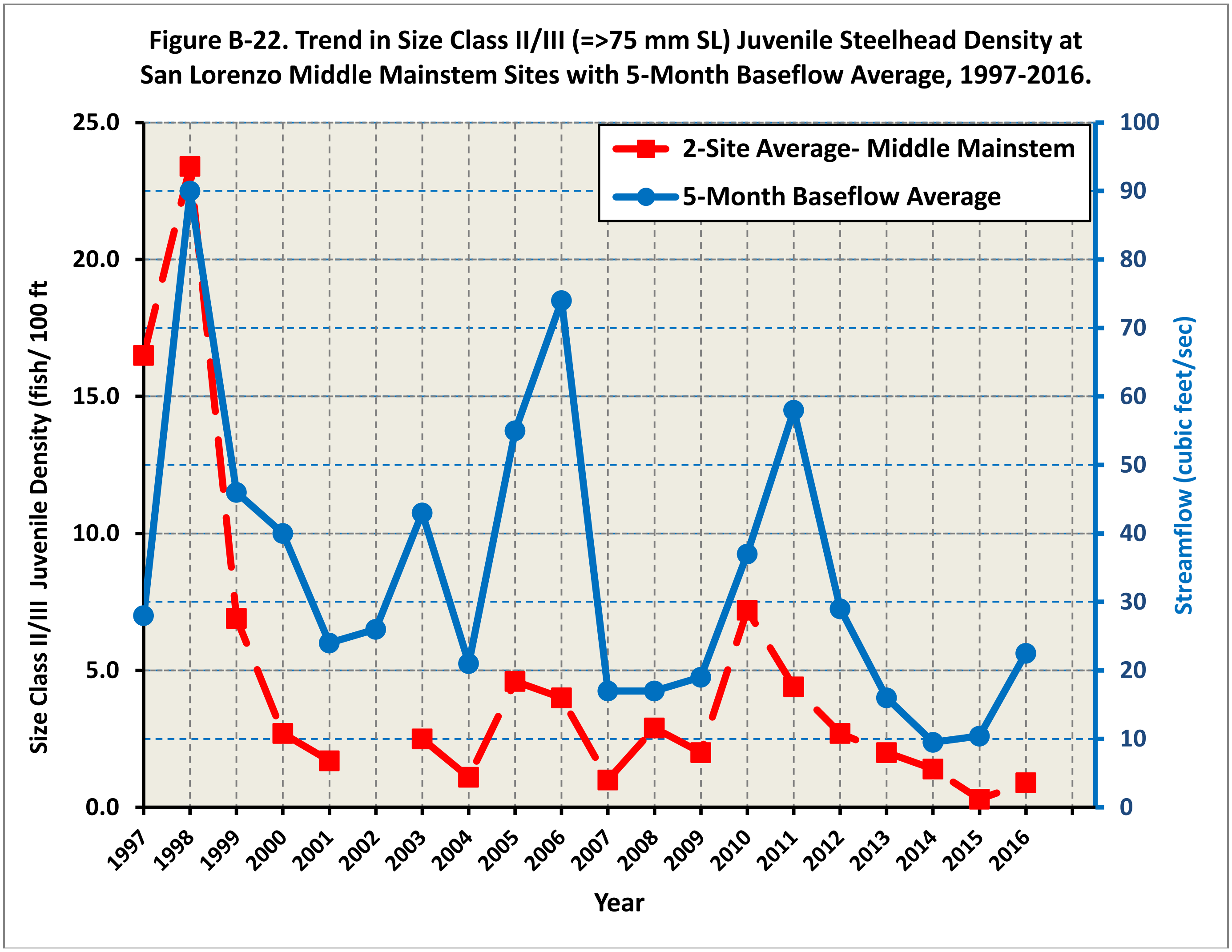

Figure B-22. Trend in Average Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Middle Mainstem Sites with 5-Month Baseflow Average, 1997-2016.

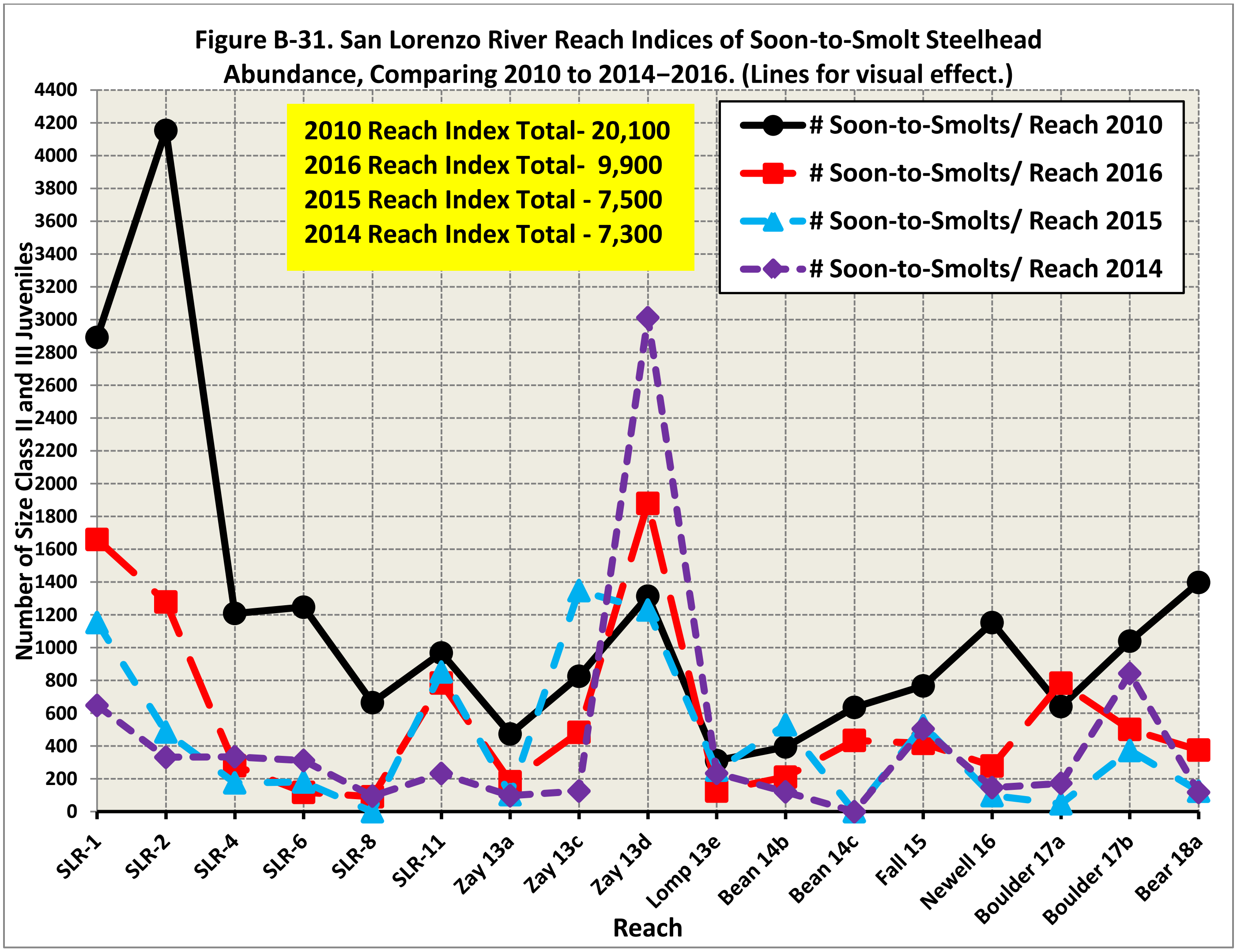

Figure B-31. San Lorenzo River Reach Indices of Soon-to-Smolt Steelhead Abundance (excluding Branciforte Reaches), Comparing 2010 to 2014−2016.

ii. Steelhead Abundance and Habitat in the Soquel Creek Watershed

1. WY2016 streamflows in spring-summer-fall were below the median flow statistic, as they had been in 7 of the last 10 water years. Most rain and stormflows came in December, January and especially early March. Thus, adult spawning migration was not impeded to headwater reaches on the East Branch into the Soquel Demonstration Forest and to Girl Scout Falls II on the West Branch. But many spawning redds made before early March may have been destroyed by the 5-6 March stormflow that was at least 3 times bankfull (7,240 cfs at Soquel Village gage). Baseflow steadily declined from April on (except for small stormflows in late April of slightly more than 100 cfs), down to a minimum of 0.4 cfs in late September at the Soquel Village gage (***Figure B-40*** *below*).

2. Habitat conditions improved in 2016 at all sites primarily due to increased baseflow compared to very low baseflow throughout and intermittency in the East Branch during severe drought in 2015 (***Table S-1*** *above*). (Site numbers do not necessarily correspond to reach numbers because in earlier sampling years, more than one site was sampled per reach.) Pool escape cover improved at 4 of 8 sites in 2016 and was similar to 2015 conditions at one site. However, it worsened at 3 sites. Sedimentation was evidenced in some reaches because pool depth decreased at 3 of 4 mainstem sites (especially in the Cherryvale reach) and at both West Branch sites. At least one habitat type in 6 of 8 sites/reaches had increased embeddedness.

3. ***Total and YOY juvenile steelhead densities*** increased from 2015 at only 1 of 7 repeated sampling sites (***Tables B-26b and B-27b***), and East Branch Site 16 had surface flow and steelhead in 2016 after being dry the 2 previous years. 2016 total and YOY site densities were below average at all 8 sampled sites (***Figures B-5 and B-6***). The trend in total densities (consisting of mostly YOY) for the watershed showed a decrease in 2016 to the lowest 6-site average since 1997 (19 years) (8.1 fish/ 100 ft).

4. ***Yearling densities*** in 2016 were slightly above average at 3 of 8 sites (upper mainstem Site 12, lower West Branch Site 19 and lower East Branch Site 13a) and similarly compared to 2015 throughout (avg density = 2.5 yearlings/ 100 ft) (***Table B-28; Figure B-7***). No yearlings were captured at the 2 lower mainstem sites.

5. ***Size Class II and III juvenile densities*** were below average at 7 of 8 sites except upper mainstem Site 12, but close to average at East Branch Site 16 (***Table B-30b; Figure B-8*** *below*). Six of eight sites were rated from "poor" to "below average" with 2 sites rated only "fair" in 2016, based on site densities of Size Class II and III (***Table S-1*** *above*). The juvenile steelhead population in Soquel Creek consisted primarily of YOY in Size Class II (where densities were low in mainstem sites and lower East Branch 13a) and of Size Class I in upper East Branch 16 and the 2 West Branch sites (19 and 21) (***Tables B-27b and B-29b***).

6. The below average densities of Size Class II and III juveniles in the Soquel drainage again in 2016 as in 2013−2015 were due to 1) typical poor survival/retention of yearlings either because they were flushed out or killed during the high 5 March stormflow or grew sufficiently in low turbidity water in spring to smolt early, and 2) very low densities of YOY to grow into Size Class II at all but the upper mainstem site 12 in mainstem and lower East Branch sites where a portion of YOY grew into the larger size classes in 2016.

7. The trend in Size Class II/III densities increased slightly in 2016 (5.6 juveniles/ 100 feet, on average) (***Figure B-24***) largely due to the higher density of larger YOY and above average yearling density at mainstem Site 12, East Branch 13a and West Branch 19 (***Table B-28b; Figure B-7***). When the trend in average soon-to-smolt site densities was plotted annually with the 5-month average baseflow (May through September), a positive correlation was indicated in many years (***Figure B-25*** *below*). Average density increased or remained relatively high during some average to wetter years (1998, 2005, 2010 and 2012). Average density decreased in some drier years (2000, 2004, 2008 and 2013−2015). But it remained relatively high in 2007 and 2009 despite relatively low baseflows. It was relatively low in 2003 and did not increase in 2011 when baseflow increased. The trend in site densities of Size Class II/III fish was affected by the proportion of YOY reaching Size Class II, it being higher in wet years and lower in dry years.

8. Soquel Lagoon is typically habitat for a sizeable juvenile steelhead population, as indicated by our long-term population censusing for the City of Capitola. It indicated a long-term average population size of 1,600 soon-to-smolt sized steelhead between 1993 and 2013 (**Alley 2016**). In 2016, the lagoon population estimate was 237 with more than half greater than 150 mm SL and yearlings. The relatively small lagoon population and low proportion of YOY captured, indicated limited spawning and/or poor spawning success in reaches near the lagoon.

9. For the Soquel watershed, the total reach index for 8 reaches (not including the lagoon) was 3,800 (2010), 880 (2014), 580 (2015) and 2,500 (2016) for Size Class II and III juveniles (***Figure B-32*** *below*). The 2016 total index increased substantially from the 2 previous drought years because East Branch Soquel 13a remained completely watered in 2016, and East Branch Soquel 12a also had surface flow after being dry in 2014 and 2015. However, the remainder of the mainstem and lower West Branch were still low in production, perhaps indicating patchy spawning and/or spawning success by a dwindling adult steelhead population. Also, upper mainstem Soquel 8 had a higher index in 2016 than in 2010 due to fast growth of high density YOY's present in fastwater habitat.

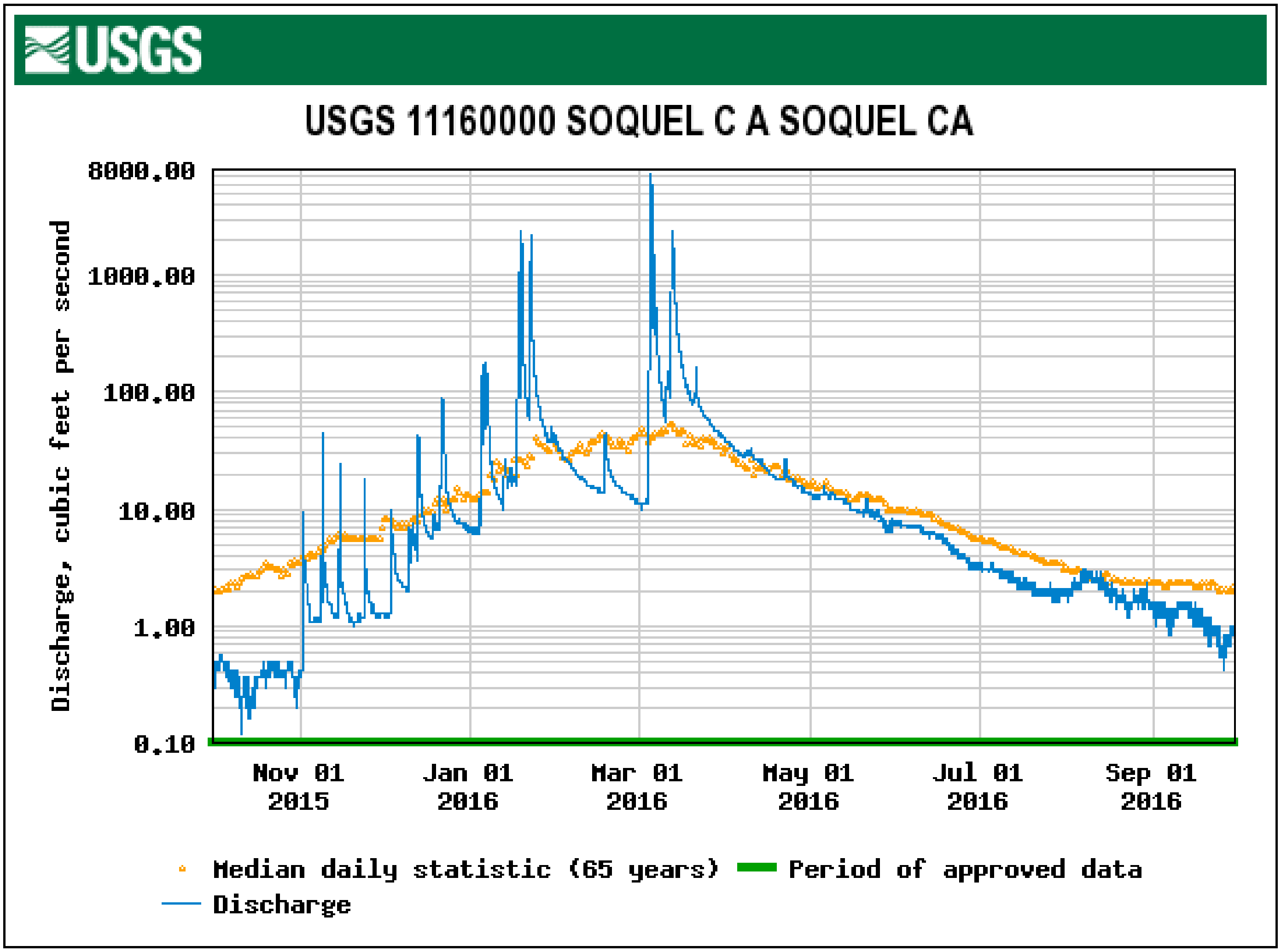

Figure B-40. The 2016 Discharge at the USGS Gage on Soquel Creek at Soquel Village.

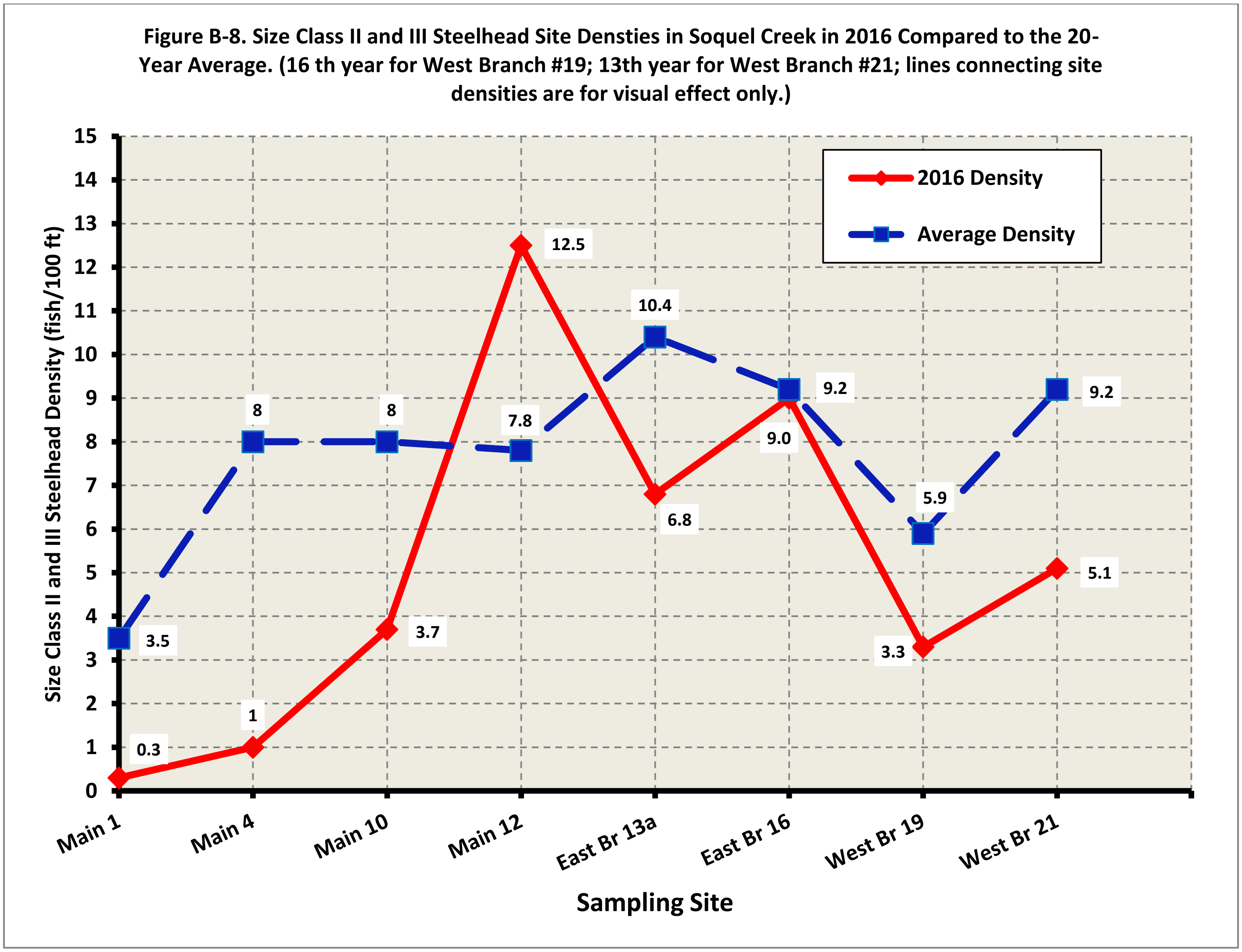

Figure B-8. Size Class II and III Steelhead Site Densities in Soquel Creek in 2016 Compared to the 20-Year Average (16th year for West Branch #19.)

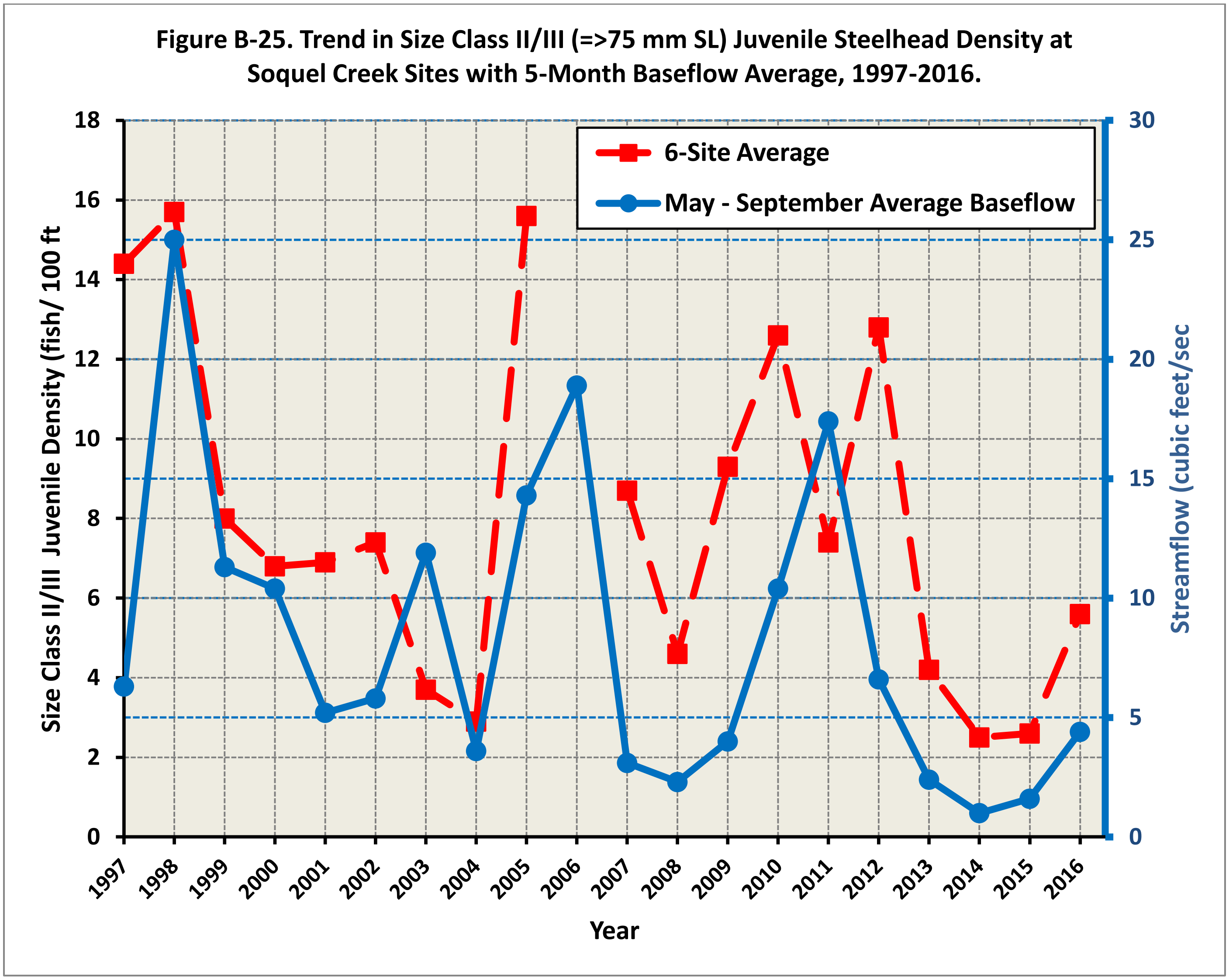

Figure B-25. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites with 5-Month Baseflow Average, 1997-2016.

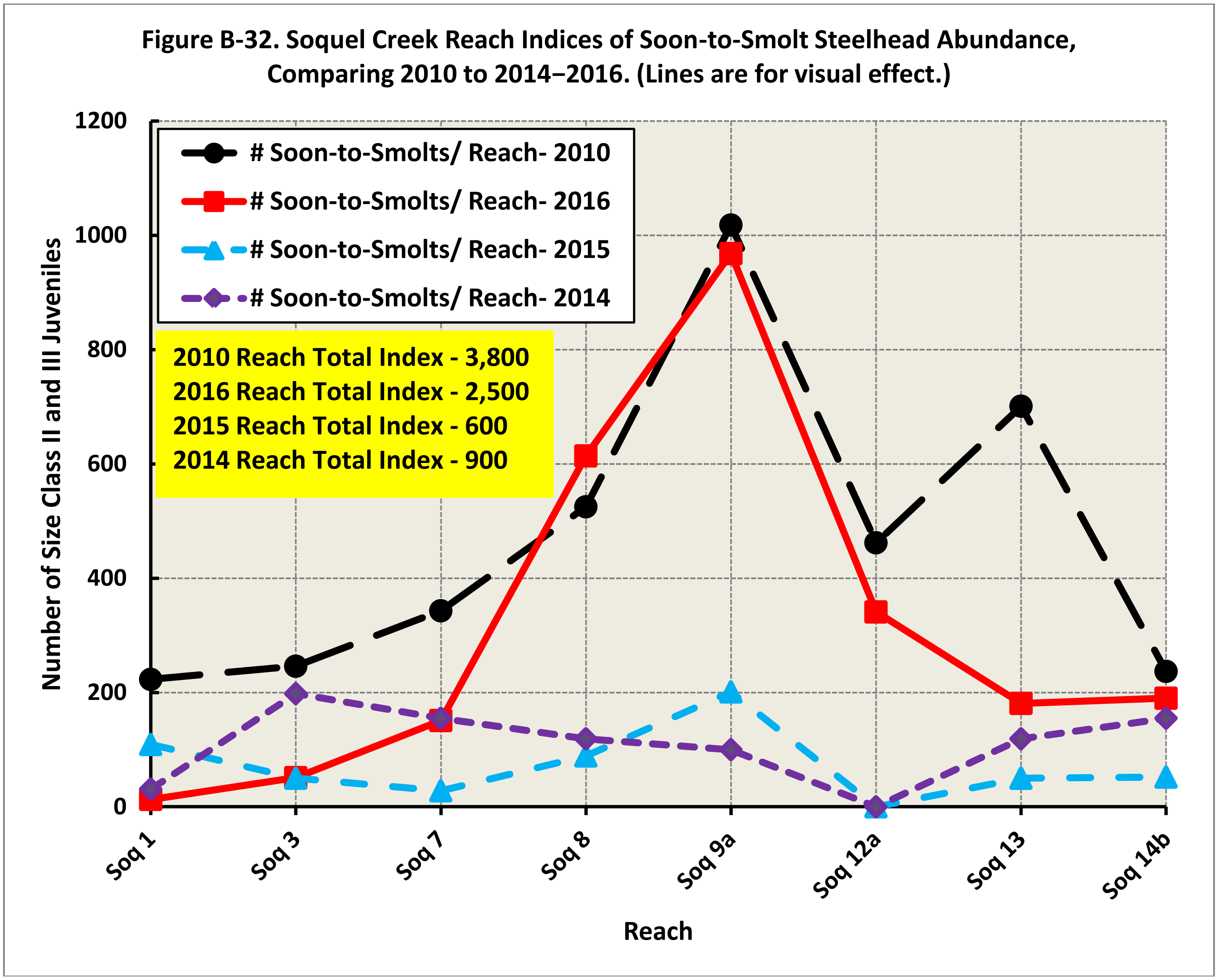

Figure B-32. Soquel Creek Reach Indices of Soon-to-Smolt Steelhead Abundance, Comparing 2010 to 2014–2016.

iii. Steelhead Abundance and Habitat in the Aptos Creek Watershed

1. Aptos Creek likely had a 2016 WY hydrograph similar to those in the San Lorenzo and Soquel drainages, with stormflows at the same frequency and intensity, resulting in below median baseflow in the dry season (***Figures 34-44 in Appendix B).*** These streamflow levels made access to headwater reaches possible for adult steelhead and provided more food than during previous drought years. However, steelhead were nearly absent in lower Aptos Creek and could not take advantage of improved habitat and food conditions there.

2. ***Habitat quality*** improved at lower Aptos Site 3 due to predicted increased baseflow and measured increased pool escape cover (**Table B-16c**). However, pool depth decreased. Habitat quality at Upper Aptos Site 4 worsened because, despite predicted higher baseflow than 2015, pool depth declined, as did pool escape cover substantially (**Table B-16b**). Thus, sedimentation deteriorated habitat at both Aptos sampling sites after bankfull stormflows during winter/spring. Habitat typed segment 3 in Valencia Creek (above Valencia Road crossing) declined in habitat quality compared to 2009 conditions. Despite likely similar baseflow between 2009 (the last previous habitat typing of the segment) and 2016, pool depth and escape cover declined, and fine sediment increased in 2016 (**Table B-16a**). Pools were absent at Site 2 (downstream of Valencia Road crossing) in 2014 and 2016 due to sedimentation, though pools were sparingly present in 2009. Thus, substantial sedimentation and habitat deterioration had occurred in Valencia Creek since 2009, after bankfull stormflows in 2010, 2011 and 2016.

3. ***All size classes and age classes of juvenile steelhead*** increased at upper Aptos Site 4 and declined at lower Aptos Site 3 in 2016, with only 1 juvenile steelhead captured at the lower site (***Tables B-31 through B-35***).

4. ***Densities of all size and age classes were below average*** at the Aptos and Valencia creek sites (***Figures B-9 – B-12*** *below*). The trend in average total density at the 4 sites (10.4 juveniles/ 100 ft in 2016) remained near the 2014 low (***Figure B-26a***). The trend in average YOY density was similarly low as in 2009 and 2014 at 7.0 YOY/ 100 ft in 2016, with no YOY captured at Aptos Site 3 (***Figure B-26b***). The trend in average Size Class II/III density showed the lowest 4-site average in 12 years at 4.7 fish/ 100 ft in 2016, (***Figure B-27*** *below*).

5. Low soon-to-smolt density in Aptos and Valencia creeks in 2016 was due to 1) few YOY present to grow into soon-to-smolt size in 2016 (likely few adult spawners), 2) poor growth of YOY fish into Size Class II with likely below median baseflow, and 3) poor overwinter recruitment or retention of yearlings (less than average YOY densities in 2015 to become yearlings and a large stormflow in early March to encourage early out-migration of yearlings).

6. The soon-to-smolt density ratings for Aptos #3 and Aptos #4 were "poor" and "below average," respectively (***Table S-1*** *above*). Both sites in Valencia Creek were rated "below average."

7. Yearling and older densities were higher in Valencia Creek than Aptos Creek, despite poor habitat conditions and less baseflow, because older resident rainbow trout likely contributed to the salmonid population in Valencia Creek. The ratings would have been lower in Aptos 3 and Valencia 3 except that the average size of the few larger fish present was greater than 102 mm SL at each site.

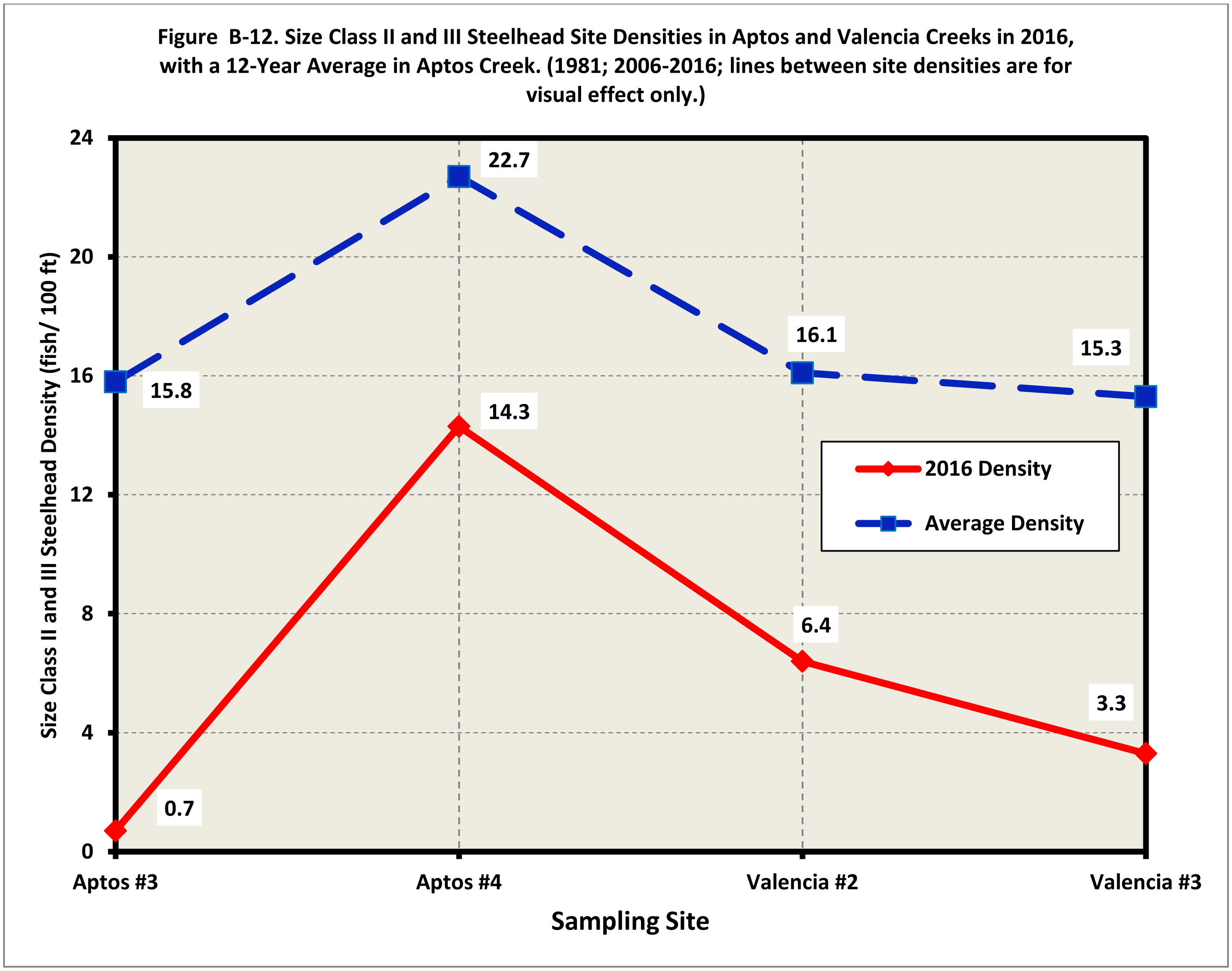

Figure B-12. Size Class II and III Steelhead Site Densities in Aptos Creek in 2016, with a 12-Year Average (1981; 2006-2016).

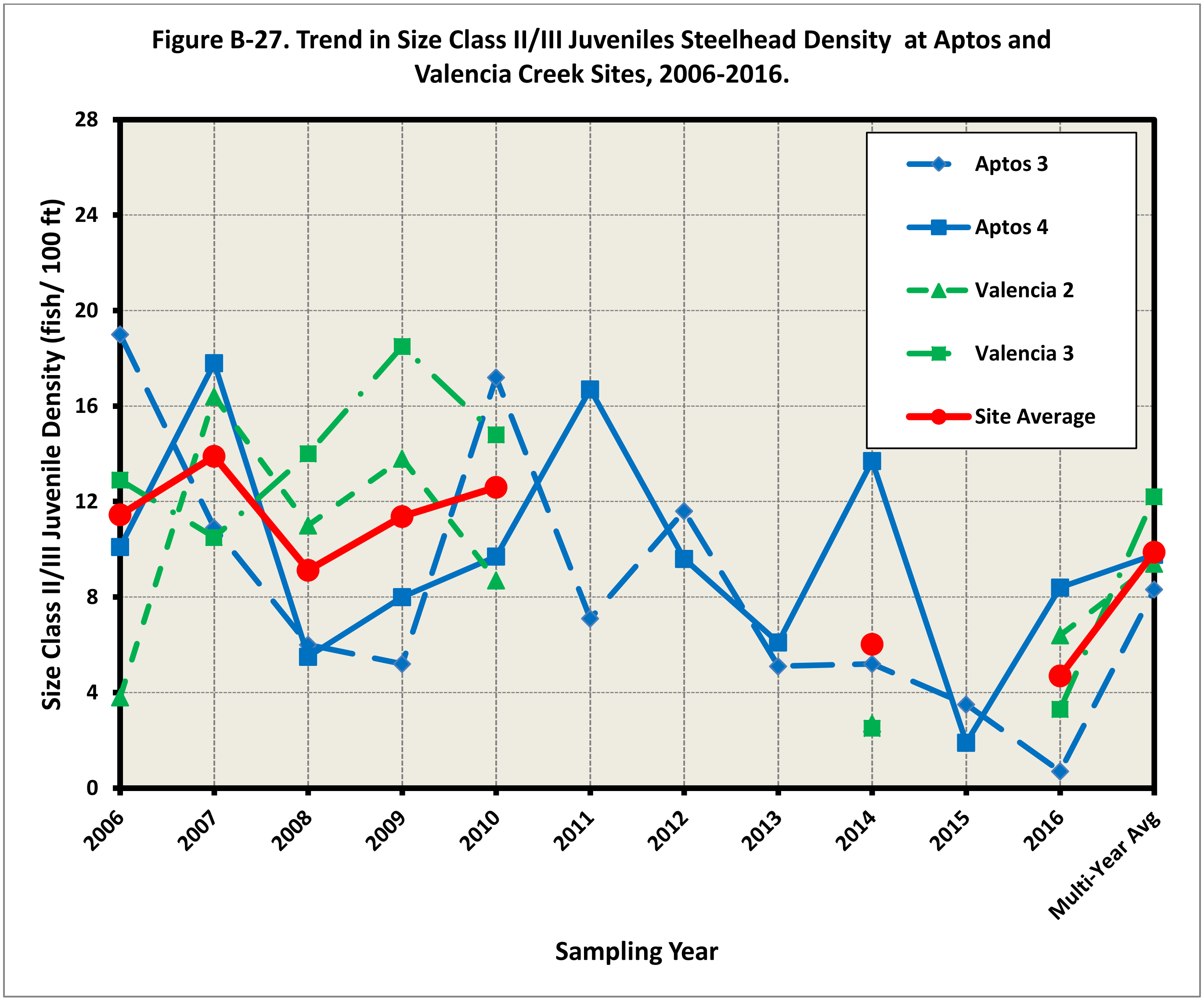

Figure B-27. Trend in Size Class II/III Juveniles Steelhead Density at Aptos and Valencia Creek Sites, 2006-2016.

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

1. Baseflow was higher in 2016 than 2013−2015 and above the median flow after the early March storm until the end of May, based on stream gage data from other watersheds and Corralitos Creek at Freedom gage (***Figure B-50***). The 4 main stormflows of the 2015-2016 winter were in January (≈1,750 cfs and 750 cfs) and March (≈3,300 cfs and ≈2,000 cfs). Three of the 4 likely exceeded bankfull discharge. Adult steelhead spawning access to Corralitos and Browns creeks also greatly improved in 2016. Adult steelhead successfully passed above diversion dams on Browns and Corralitos creeks in 2016.

2. Overall habitat quality improved in the Corralitos-Browns-Shingle Mill sub-watershed in 2016 primarily due to increased baseflow throughout and increased pool escape cover at 5 of 6 sites/ reaches (***Table S-1*** *above;* ***Tables B-16a-c***). (Site numbers do not necessarily correspond to reach numbers because in earlier sampling years, more than one site was sampled per reach.) Indication of sedimentation was detected with shallower pools at Sites 1 and 8 and increased embeddedness at Sites 1 and 3 in Corralitos Creek. Pools in the other 4 Sites/Reaches deepened. Most juvenile steelhead growth occurs in the spring-early summer when baseflow is higher and most important. With higher streamflow in 2016, there was undoubtedly more food and faster growth rate in all reaches in 2016 than in 2013−2015, especially when juvenile densities were low.

3. In 2016, ***total juvenile densities*** were lower than in 2015 except at Corralitos Site 8 and below average at all 6 repeated sites (***Table B-31; Figure B-13***). Total densities at sites ranged between 3.7 and 25.1 juveniles/ 100 ft in 2016. The trend in total densities for the 6 Corralitos and Browns creek sites decreased in 2016 from 2015 to the second lowest 6-site average (12.8 juveniles/ 100 ft) in the last 9 years of monitoring (***Figure B-28***).

4. In 2016, ***YOY juvenile densities*** were lower than in 2015 except at Corralitos Site 8 and below average at all 6 repeated sites (***Table B-32; Figure B-14***). This occurred despite better adult spawning access in 2016. YOY densities at sites ranged between 0 and 18 YOY/ 100 ft in 2016.

5. In 2016, ***yearling juvenile densities*** were slightly higher than in 2015 at 4 of 6 repeated sites (***Table B-33***) but below average at all sites (nearly average at Corralitos Site 3) (***Figure B-15***).

6. In 2016, ***Size Class II/III densities*** were higher than in 2015 at 5 of 6 sites (slightly higher at Browns 2 and less at Corralitos 1 than in 2015) (***Table B-35***). 2016 Size Class II densities were below average at all 6 sites (***B-Figure 16*** *below*), with a range of 3.7 at Corralitos 1 to 9.4 fish/ 100 ft at Browns 1. The trend in soon-to-smolt densities increased slightly in 2016, with the 6-site average of 6.6 fish/ 100 ft, after declining from 2012 to 2015 (***Figure B-29*** *below*). The same pattern occurred for the 4 sites in Corralitos Creek only (***Figure B-30***), with an average of 6.1 fish/ 100 ft in 2016. Increased densities were consistent with rearing habitat improvement at all sites.

7. In comparing sampling site ratings based on soon-to-smolt densities, 3 sites improved, 1 site declined and two remained the same (***Table S-1*** *above*). Of all of the sites sampled in the Corralitos sub-watershed, Corralitos 9 and Browns 1 were rated "good." Corralitos 0, Corralitos 3, Corralitos 8 and Browns 2 were rated fair. Casserly 3 was rated "below average." Corralitos 1 was rated "poor." Sites that obtained the "fair" and "good" ratings did so because their ratings were increased one increment due to the average sizes of these larger fish at the sites being greater than 102 mm SL and not because of high densities.

8. For the Corralitos sub-watershed, the total reach index for 6 reaches (excluding Shinglemill Gulch) for Size Class II and III juveniles was 3,000 (2010), 2,000 (2014), 1,000 (2015) and 1,400 (2016) (***Figure 33*** *below*). The reach index total in 2016 was an improvement over the 2015 total but was less than the 2014 total.

9. Habitat typed Casserly Creek Reach 3 was dominated by short, shallow pools (46% of stream length; average mean depth = 0.6 ft; average maximum depth = 1.0 ft; average length = 26 ft.) with moderate escape cover (10 ft/ 100 ft of stream) and highly embedded pool substrate (48%). YOY steelhead density in Casserly Creek was the highest of Corralitos/Casserly sub-watershed sites in 2016 (22 YOY/ 100 ft) (***Table B-32***). However, soon-to-smolt (yearling) density was relatively low (2.6 fish/ 100 ft) (***Figure B-16 below***) and likely included resident rainbow trout.

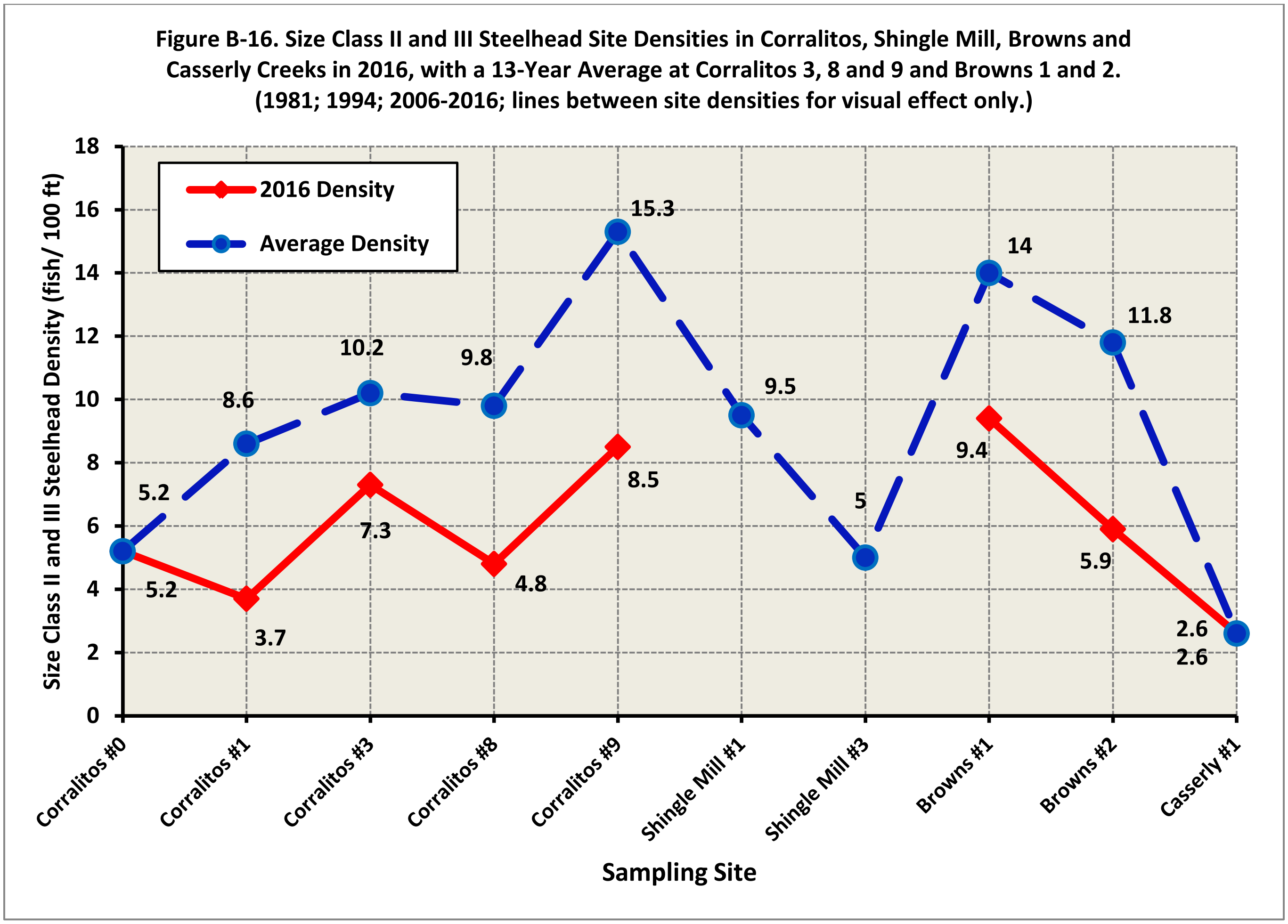

Figure B-16. Size Class II and III Steelhead Site Densities in Corralitos and Browns Creeks in 2016, with a 13-Year Average (1981; 1994; 2006-2016).

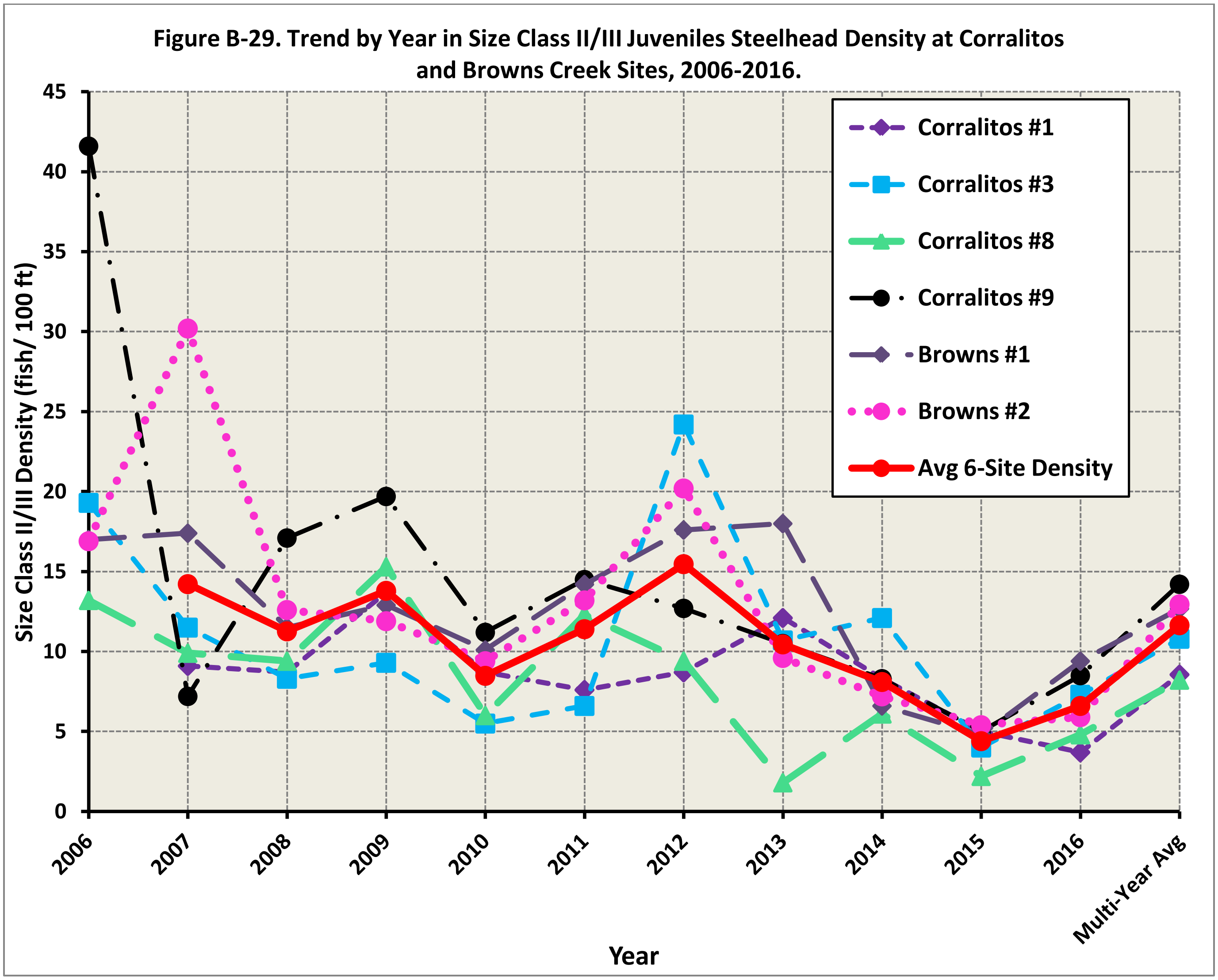

Figure B-29. Trend by Year in Size Class II/III Juveniles Steelhead Density at Corralitos and Browns Creek Sites, 2006-2016.

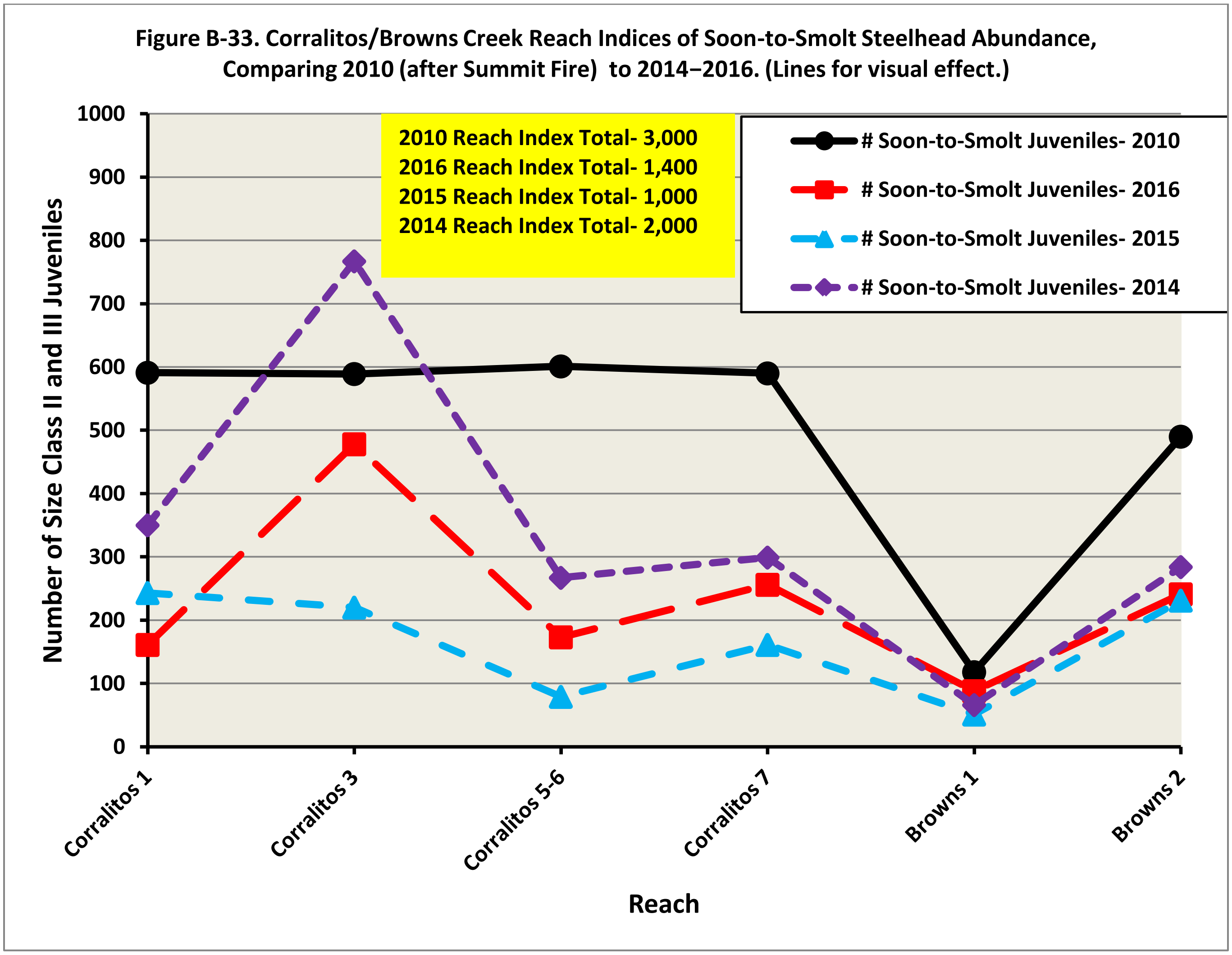

Figure B-33. Corralitos/Browns Creek Reach Indices of Soon-to-Smolt Steelhead Abundance, Comparing 2010 to 2014−2016.

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

No steelhead were detected in Pajaro Estuary despite the absence of temperature and oxygen stratification and good oxygen concentrations in the lower estuary along the beach. The sandbar was open during sampling and water quality measurements. The Pajaro Estuary, with its daily tidal influence was less favorable to juvenile steelhead for rearing and tidewater goby for spawning than a deeper freshwater lagoon without depth fluctuation and stratification would be. The estuary had high saline content throughout the water column and evidence of temporal oxygen fluctuations. Oxygen was adequate for steelhead during the sampling period, although it fluctuated considerably and may have been temporarily low at dawn on 30 September. Water temperature was cool during sampling due to the lack of saltwater stratification at most sites and the strong tidal influence. The low oxygen concentrations at midday on 30 September indicated that the biological oxygen demand was high and capable of depressing oxygen levels. While water quality data were not collected throughout the summer and during periods of sandbar closure, habitat conditions for steelhead can become difficult when the sandbar closes to form a lagoon with little stream inflow, and trapped saltwater creates a stratified water column with higher water temperatures throughout and lower oxygen levels at greater depth. Much of the Pajaro Estuary was less than 1 meter deep at water quality stations, with a narrow thalweg present nearby in the lower estuary that was somewhat deeper.

A small population of tidewater goby still existed in Pajaro Estuary, but again appeared absent in the lower estuary along the beach, as was the case in 2015. Algae and submerged vegetation appeared absent in the lower estuary in both years. The highest tidewater goby densities were in the upper estuary at Thurwachter Bridge. But they were much reduced from past years, particularly at the boat ramp. Water quality was adequate for tidewater goby survival during the dry season, though oxygen may have been low at times in some locations. They spawn along freshwater margins, which were absent at sampling sites in 2016. Freshwater habitat may have existed at the very top of the estuary where the River entered the estuary earlier in the dry season.

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

The annual trend in average YOY density increased in Scott and Waddell creeks and decreased in Gazos Creeks in 2016 compared to 2015 (***Figure B-54; Smith 2016***). Average YOY densities decreased in San Lorenzo mainstem or tributaries, Soquel Creek and Corralitos/Browns creeks. The average YOY density increased for the 2 sites in Aptos Creek. YOY densities were below average at 5 of 8 Gazos sites, above average at one sites and near average at 1 site (***Figure B-56; Smith 2016***). As mentioned before, the average YOY density for all sites combined in Waddell Creek increased in 2016 but we do not have the multi-year averages for each site. YOY site densities in Scott Creek were below average at 9 of 10 sites (***Figure B-58***), consistent with YOY site densities being below average in San Lorenzo, Soquel, Aptos and Corralitos/Browns creeks.

The annual trend in average yearling (Size Class II/III) site density decreased in Scott and Waddell creeks in 2016 while it increased slightly in Gazos Creek (**Figure B-55; Smith 2016**). Average Size Class II/III site density increased slightly for mainstem San Lorenzo sites, Soquel sites, Aptos sites and Corralitos/Browns sites but was unchanged for San Lorenzo tributary sites. In 2016, yearling (Size Class II/III) juvenile densities were below average at 5 of 7 sites in Gazos Creek and all 10 sites in Scott Creek (***Figures B-57 and B-59; Smith 2016***). This was consistent with the San Lorenzo (22 of 26 sites below average), Soquel (5 of 7 sites below average), Aptos (all 4 sites below average) and Corralitos/Browns (all 6 sites below average).

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