APPENDIX B. DETAILED ANALYSIS OF 2011 STEELHEAD MONITORING IN THE SAN LORENZO, SOQUEL, APTOS AND CORRALITOS WATERSHEDS.

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SCOPE OF WORK

In fall 2011, 4 Santa Cruz County watersheds were evaluated for habitat quality and sampled for juvenile steelhead to compare with past results. Refer to maps in **Appendix A** that delineate reaches and sampling sites. The mainstem San Lorenzo River and 7 tributaries were sampled with a total of 19 sites. Seven half-mile segments were habitat typed to assess habitat conditions and select habitats of average quality to sample. In reaches that were not habitat typed, the same habitats were sampled in 2010 and 2011. Tributaries included Branciforte, Zayante, Lompico, Bean, Fall, Newell, Boulder and Bear creeks. Eight steelhead sites were sampled below anadromy barriers in Soquel Creek and its branches, and 4 half-mile reach segments were habitat typed. In the Aptos Creek watershed, 2 sites in Aptos Creek and Aptos Lagoon/Estuary were sampled. The upper ½-mile segment of Aptos Creek was habitat typed. In the Corralitos sub-watershed of the Pajaro River drainage, 4 sites were sampled in Corralitos Creek with 3 half-mile reach segments habitat typed, 2 sites were sampled in Shingle Mill Gulch and 2 sites were sampled in Browns Valley Creek.

Annual monitoring of juvenile steelhead began in 1994 in the San Lorenzo and 1997 in Soquel Creek. The Corralitos sub-watershed was previously sampled in 1981, 1994, 2006─2010. Aptos Creek was previously sampled in 1981, 2006─2010. Fall streamflow was measured at 16 locations in the 4 sampled watersheds.

For annual comparisons, fish were divided into two age classes and three size classes. Age classes were young-of-the-year (YOY) and yearlings and older. The size classes were Size Class I (<75 mm Standard Length (SL)), Size Class II (between 75 and 150 mm SL) and Size Class III (>=150 mm SL). Juveniles in Size Classes II and III were considered to be "smolt-sized," based on scale analysis of out-migrating smolts by Smith (**2005**), because most fish of that size would grow sufficiently in the following spring to smolt. Fish below that size very rarely smolt the following spring.

I-1. Steelhead and Coho Salmon Ecology

Migration. Adult steelhead in small coastal streams tend to 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 the stream later in the season. Adult fish may be blocked in their upstream migration by barriers such as bedrock falls, wide and shallow riffles and occasionally log-jams. Man-made objects, such as culverts, bridge abutments and dams 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. We located partial migrational barriers in the San Lorenzo River Gorge caused by a wide riffle that developed below a bend in 1998 (Rincon riffle) and a large boulder field discovered in 1992 that created a falls (above Four Rock). Both of these impediments were probably passable at flows above approximately 50-70 cubic feet per second (cfs) as they were observed in 2002. A split channel had developed at the Rincon riffle by 2002 and in 2007 there existed a steep cascade where the channels rejoined, making adult steelhead passage up the main channel difficult. In 2008, the steep cascade was gone, offering much easier fish passage up the main channel. The boulder field at Four Rock was partially modified in 2008, though we have not examined the results. In most years these are not passage problems. However, in drought years and years when storms are delayed, they can be serious barriers to steelhead and especially coho salmon spawning migration. In the West Branch of Soquel Creek, there are Girl Scout Falls I and II that impede adult passage. Based on juvenile sampling, adult steelhead pass Girl Scout Falls I in most years but seldom pass Girl Scout Falls II.

Coho salmon often have more severe migrational problems because their migration period, November through early February, is often prior to the stormflows needed to pass shallow riffles, boulder falls and partial logjam barriers. Access is also a greater problem for coho salmon because they die at maturity and cannot wait in the ocean an extra year if access is poor due to failure of sandbar breaching during drought or delayed stormflow. In recent years until 2008, the rainfall pattern has generally brought early winter storms to allow for good coho access to the San Lorenzo system, though only a small number of apparent strays have been detected at the Felton fish ladder and trap.

Smolts (young steelhead and coho salmon which have physiologically transformed in preparation for ocean life) in local coastal streams tend to migrate downstream to the lagoon and ocean in March through early June. In streams with lagoons, young-of-the-year (YOY) and yearling fish may spend several months in this highly productive lagoon habitat and grow rapidly. In some small coastal streams, downstream migration can occasionally be blocked or restricted by low flows due primarily to heavy streambed percolation or early season stream diversions. Flashboard dams or sandbar closure of the stream mouth or lagoon are additional factors that adversely affect downstream migration. However, for most local streams, downstream migration is not a major problem except under drought conditions.

Spawning. Steelhead and coho salmon require spawning sites with gravels (from 1/4" to 3 1/2" diameter) having a minimum of fine material (sand and silt) and with good flows of clean water moving over and through them. Flow of oxygenated water through the redd (nest) to the fertilized eggs is restricted by increased fine materials from sedimentation and cementing of the gravels with fine materials. Flushing of metabolic wastes is also hindered. These restrictions reduce hatching success. In many local streams, steelhead appear to successfully utilize spawning substrates with high percentages of coarse sand, which probably reduces hatching success. Steelhead spawning success may be limited by scour from winter storms in some Santa Cruz County streams. Steelhead that spawn earlier in the winter are more likely to have their redds washed out or buried by the greater number of winter and spring storms that will follow. However, unless hatching success has been severely reduced, survival of eggs and alevins is usually sufficient to saturate the limited available rearing habitat in most small coastal streams and San Lorenzo tributaries. However, in the mainstem San Lorenzo River downstream of the Boulder Creek confluence, spawning success in the river may be an important limiting factor. YOY fish production is related to spawning success, which is a function of the spawning habitat quality, the pattern of storm events and ease of spawning access to upper reaches of tributaries, where spawning conditions are generally better.

Rearing Habitat. In the mainstem San Lorenzo River, downstream of the Boulder Creek confluence, many steelhead require only one summer of residence before reaching smolt size. This is also the case in the Soquel Creek mainstem and lagoon. Except in streams with high summer baseflows (greater than about 0.2 to 0.4 cubic feet per second (cfs) per foot of stream width), steelhead require two summers of residence before reaching smolt size. This is the case for most juveniles inhabiting San Lorenzo River tributaries and the mainstem upstream of the Boulder Creek confluence. This is also the case for most juveniles in the East and West Branches of Soquel Creek, the Aptos watershed (except its lagoon) and the Corralitos sub-watershed except in wetter years such as 2006. Juvenile steelhead are generally identified as YOY (first year) and yearlings (second year). The slow growth and often two-year residence time of most local juvenile steelhead indicate that the year class can be adversely affected by low streamflows or other problems (including over-wintering survival) during either of the two years of residence. Nearly all coho salmon, however, smolt after one year under most conditions, despite their smaller size.

Growth of YOY steelhead and coho salmon appears to be regulated by available insect food (determined by substrate conditions in fastwater habitat and insect drift rate), although escape cover (hiding areas, provided by undercut banks, large rocks which are not buried or "embedded" in finer substrate, surface turbulence, etc.) and water depth in pools, runs and riffles are also important in regulating juvenile numbers, especially for larger fish. Densities of yearling and smolt-sized steelhead in small streams, the upper San Lorenzo (upstream of the Boulder Creek confluence) and San Lorenzo tributaries, are usually regulated by water depth and the amount of escape cover during low-flow periods (July−October) and by over-winter survival in deep and/or complex pools. In most small coastal streams, availability of this "maintenance habitat" provided by depth and cover appears to determine the number of smolts produced (**Alley 2006a; 2006b; 2007; Smith 1982**). Abundance of food (aquatic insects and terrestrial insects that fall into the stream) and fast-water feeding positions for capture of drifting insects in "growth habitat" (provided mostly in spring and early summer) determine the size of these smolts. Study of steelhead growth in Soquel Creek has noted that growth is higher in winter-spring compared to summer-fall (**Sogard et al. 2009**). It was determined that in portions of a watershed that are capable of growing YOY juvenile steelhead to smolt size their first growing season (Size Class II =>75 mm Standard Length in fall), the density of YOY that obtain this size was positively associated with the mean monthly streamflow for May–September (**Alley et al. 2004**). Furthermore, it has been shown that the density of slower growing YOY in tributaries was positively associated with the annual minimum annual streamflow (**Alley et al. 2004**). Aquatic insect production is maximized in unshaded, high gradient riffles dominated by relatively unembedded substrate larger than about 4 inches in diameter.

Yearling steelhead growth usually shows a large increase during the period of March through June. Larger steelhead then may smolt as yearlings. For steelhead that stay a second summer, mid to late summer growth is very slight in many tributaries (or even negative in terms of weight) as flow reductions eliminate fast-water feeding areas and reduce insect production. A short growth period may occur in fall and early winter after leaf-drop of riparian trees, after increased streamflow from early storms, and before water temperatures decline below about 48ºF or water clarity becomes too turbid for feeding. The "growth habitat" provided by higher flows in spring and fall (or in summer for the mainstem San Lorenzo River) is very important, since ocean survival to adulthood increases exponentially with smolt size.

During summer in the mainstem San Lorenzo River downstream of the Boulder Creek confluence, steelhead use primarily fast-water habitat where insect drift is the greatest. This habitat is found in deeper riffles, heads of pools and faster runs. YOY and small yearling steelhead that have moved down from tributaries can grow very fast in this habitat if streamflows are high and sustained throughout the summer. The shallow riffle habitat in the upper mainstem is used almost exclusively by small YOY, although most YOY are in pools. In the warm mainstem Soquel Creek, downstream of Moores Gulch, juvenile steelhead utilize primarily heads of pools in all but the highest flow years, with some YOY using shallower runs and riffles. Upstream of Moores Gulch in summer on the mainstem and in the two branches (East and West), juvenile steelhead use primarily pool habitat where cover is available and deeper step-runs. Riffles are used primarily by YOY and more so in the upper mainstem than the branches where they shallow.

Pools and step-runs are the primary habitat for steelhead in summer in San Lorenzo tributaries, the upper San Lorenzo River above the Boulder Creek confluence, the Aptos watershed and the Corralitos sub-watershed because riffles and runs are very shallow, offering limited escape cover. Primary feeding habitat is at the heads of pools and in deeper pocket water of step-runs. The deeper the pools, the more value they have. Higher streamflow enhances food availability, surface turbulence (as overhead cover) and habitat depth, all factors that increase steelhead densities and growth rates. Where found together, young steelhead use pools and fastwater in riffles and runs/step-runs, while coho salmon use primarily pools, being poorer swimmers.

Juvenile steelhead captured during fall sampling included a smaller size class of juveniles less than (<) 75 mm (3 inches) Standard Length (SL); these fish would almost always require another growing season before smolting. The larger size class included juveniles 75 mm SL or greater (=>) and constituted fish that are called "smolt size" because a majority will likely out-migrate the following spring and because fish smaller than this very rarely smolt the following spring. Smolt size was based on scale analysis of out-migrant smolts captured in 1987-89 in the lower San Lorenzo River. This size class in fall may include fast growing YOY steelhead inhabiting the mainstems of the San Lorenzo River and Soquel Creek, lower reaches of larger San Lorenzo tributaries, and lower reaches of Corralitos and Aptos creeks. It also includes slower growing yearlings and older fish inhabiting all watershed reaches.

The lower San Lorenzo mainstem below Zayante Creek typically has sufficient baseflow every year to grow a high proportion of YOY to smolt size in one year, as does lower Soquel Creek below Moores Gulch. In these lower reaches with high growth potential, factors that determine YOY densities are important in determining soon-to-smolt densities, such as number of adult spawners, spawning success and/or recruitment of YOY from nearby tributaries.

There is a group of sites with intermediate YOY growth potential which may produce a higher proportion of YOY that reach potential smolt size by fall in addition to yearlings if streamflow is high and/or YOY densities are low. These reaches include the middle mainstem San Lorenzo between Boulder and Zayante creek confluences, upper Soquel mainstem above the Moores Gulch confluence, lower East Branch Soquel, Aptos Creek mainstem and lower Corralitos below Rider Creek confluence. In above average baseflow years, these reaches are relatively productive for soon-to-smolt-sized YOY unless large, late stormflows reduce YOY survival or insufficient adults spawn after the late storms to saturate habitat with YOY.

A basic assumption in relating juvenile densities to habitat conditions where they are captured is that juveniles do not move substantially from where they are captured during the growing season. This assumption is reasonable because at sites in close proximity, such as adjacent larger mainstem and smaller tributary sites, there are consistent differences in fish size, such as juveniles that are consistently larger in the mainstem sites where streamflow is greater and there is more food (**D. Alley pers. observation)**. In other cases, there are differences in fish size between sunny productive habitats and shady habitats where food is scarce. This indicates a lack of movement between sites. In addition, Davis (**1995**), during a study of growth rates in various habitat types, marked juvenile steelhead in June in Waddell Creek and recaptured the same fish in September in the same (or immediately adjacent) habitats where they had been marked. During the Sogard et al. (**2009**) work, many juveniles that had been PIT tagged early in the growing season were recaptured in the same habitats later in the fall, and we detected very few of their marked fish in other downstream sites through the years of tagging, with most being captured in close proximity of where they were originally tagged. Evidence is lacking that would indicate ecologically significant juvenile movement upstream during the dry season, and the concern that summer flashboard dams without ladders may impede upstream movements of juvenile salmonids appears unfounded. Shapovalov and Taft (**1954**), after 9 consecutive years of fish trapping on Waddell Creek, detected very limited upstream juvenile steelhead movements; most of the relatively limited movement was in the winter.

Overwintering Habitat. Shelter for fish against high winter flows is provided by deeper pools, undercut banks, side channels, large unembedded rocks and large wood clusters. Over-wintering survival is usually a major limiting factor, since yearling fish are usually less than 10-20% as abundant as YOY. Extreme floods (i.e. 1982 and 1998) may make overwintering habitat the most critical for steelhead production. In the majority of years when bankfull or greater stormflows occur, these refuges are critical, and it is unknown how much refuge is needed. The remaining coho streams, such as Gazos, Waddell and Scott creeks, have considerably more instream wood than others (**Leicester 2005**).

I-2. Project Purpose and General Study Approach

The 2011 fall fish sampling and habitat evaluation included comparison of 2011 juvenile steelhead densities at sampling sites and rearing habitat conditions with those in 1997–2001 and 2003–2010 for the San Lorenzo River mainstem and 8 tributaries and with those in 1997−2010 for the Soquel Creek mainstem and branches. 2011 site densities were compared to multi-year averages. Habitat conditions were assessed primarily from measured streamflow, escape cover, water depth and consistent visual estimates of streambed composition and embeddedness.

Fall steelhead densities and habitat conditions in 2011 in the Corralitos Creek sub-watershed were compared to those in 1981, 1994 and 2006−2010. Fall 2011 steelhead densities and habitat conditions in the Aptos Creek watershed were compared to those in 1981 and 2006−2010, and the Aptos Lagoon/estuary was sampled inventoried for the first time. 2011 site densities were compared to multi-year averages.

In 2011, instream wood was inventoried in Bean Creek Reach 14c, l Bear Creek Reach 18a and upper mainstem Soquel Creek Reach 8 to guide the County in choosing potential habitat enhancement projects.

DETAILED METHODS

M-1. Choice of Reaches and Vicinity of Sample Sites

Prior to 2006, juvenile steelhead densities were estimated by reach, an index of juvenile steelhead production was estimated by reach to obtain an index of juvenile population size for each watershed. Indices of adult steelhead population size were also calculated from juvenile population indices. Since 2006, fish densities at average habitat quality sampling sites in previously determined reach segments have been compared to past years' fish densities. The proportion of habitat types sampled at each site within a reach was kept similar between years so that site densities could be compared between years for each reach. However, site density did not necessarily reflect fish densities for an entire reach because the habitat proportions sampled were not exactly similar to the habitat proportions of the reach. In most cases, habitat proportions at sites were somewhat similar to habitat proportions in the reach because sampling sites were more or less continuous and lengths of each habitat type were somewhat similar. However, in reaches where pools are less common, such as Reach 12a on the East Branch of Soquel Creek and Reach 2 in lower Valencia Creek, a higher proportion of pool habitat was sampled than exists in the respective reaches. More pool habitat was sampled because larger yearlings utilize, almost exclusively, pool habitat in small streams, and changes in yearling densities in pools are most important to monitor. In these two cases, site densities of yearlings were higher than reach densities. Prior to 2006, actual reach density and fish production could be compared between years and between reaches because fish densities by habitat type were extrapolated to reach density and an index of reach production with reach proportions of habitat types factored in.

The mainstem San Lorenzo was divided into 13 reaches, based on past survey work (**Table 1a; Appendix A map, Figure 2**). Much of the San Lorenzo River was surveyed during a past water development feasibility study in which general geomorphic differences were observed (**Alley 1993**). This work involved survey and determination of reach boundaries in the mainstem and certain tributaries, including Kings and Newell creeks (**Tables 1a-b; Appendix A map, Figure 2**). In past work for the San Lorenzo Valley Water District, Zayante and Bean creeks were surveyed and divided into reaches. Previous work for the Scotts Valley Water District required survey of Carbonera Creek and reach determination, although it has not been sampled since 2001. Considerations for reach boundaries in Lompico Creek were similar to those for other tributaries, including summer baseflows, past road impacts and bridge crossings, water diversion impacts and extent of perennial channel. The half-mile segment surveyed and sampled in Lompico Creek was mostly in the lowermost Reach 13e and included some of Reach 13f with two bridge crossings.

In each tributary and the upper mainstem of the San Lorenzo, the uppermost extent of steelhead use was approximated in past years to make watershed population estimates. For the upper San Lorenzo River, topographic maps were used with attention to change in gradient and tributary confluences to designate reach boundaries (**Table 1b; Appendix A map, Figure 2**). The uppermost reach boundaries for Bean and Bear creeks were based on a steep gradient change seen on the topographic map, indicative of passage problems. The Deer Creek confluence was used on Bear Creek, although steelhead access continues somewhat further. Known barriers were upper reach boundaries in Carbonera, Fall, Newell, Boulder and Kings creeks. The extent of perennial stream channel in most years was used for setting boundaries on Branciforte, Zayante and Lompico creeks. Steelhead estimates in Zayante Creek stopped at the Mt. Charlie Gulch confluence in past years, although steelhead habitat exists above in Zayante Creek and Mt. Charlie Gulch in many years. Steelhead habitat in Lompico Creek was first sampled in 2006.

In 2011, sampled tributaries of the San Lorenzo included Zayante, Lompico, Bean, Fall, Newell, Boulder, lower Bear and lower Branciforte creeks. Refer to **Table 1c, Appendix A, Figure 2** and page 2 for a list of sampling sites and locations in 2011. Half-mile segments in the vicinity of sampling sites were habitat typed to select sampling sites with average habitat conditions. For reaches not habitat typed in 2011, the previous year's sampling site was replicated. Steelhead inhabit other tributaries, and in the past, 9 major tributaries were sampled, including Carbonera. Other tributaries known to contain steelhead from past sampling and observation include (from lower to upper watershed) Eagle Creek in Henry Cowell State Park, Lockhart Gulch, Mountain Charlie Gulch in the upper Zayante Creek drainage, Love Creek, Clear Creek, Two Bar Creek, Logan Creek tributary to Kings Creek and Jamison Creek (a Boulder Creek tributary). Other creeks likely to provide limited steelhead access and perennial habitat in some years for relatively low densities of steelhead include Glen Canyon and Granite creeks in the Branciforte system; Powder Mill Creek, Gold Gulch (lower mainstem San Lorenzo tributaries); and Ruins and Mackenzie creeks (2 small Bean Creek tributaries). This list is not exhaustive for steelhead. Resident rainbow trout undoubtedly exist upstream of steelhead migrational barriers in some creeks and especially upper Boulder Creek above the bedrock chute near the Boulder Creek Country Club.

In Soquel Creek, reach boundaries downstream of the East and West Branch confluence were determined from our habitat typing and stream survey work in September 1997. For reaches on the East and West Branches, boundaries were based on observations made while hiking to sampling sites, observations made during previous survey work, and reach designations made by Dettman during earlier work (**Dettman and Kelley 1984**). Changes in habitat characteristics that necessitated reach boundary designation often occurred when stream gradient changed. Stream gradient often affects habitat type proportions, pool depth, substrate size distribution and channel type. Other important factors separating reaches are a change in tree canopy closure or significant tributary confluences that increase summer baseflow and/or may be locations of sediment input from tributaries in winter.

The 7.1 miles of Soquel Creek (excluding the lagoon) downstream of the East and West Branches were divided into 8 reaches (**Table 2a; Appendix A of watershed maps**). The lagoon was designated Reach 0. The 7 miles of the East Branch channel between the West Branch confluence and Ashbury Gulch were divided into 4 reaches. The upstream limit of steelhead in this analysis was considered Ashbury Gulch due to the presence of a bedrock falls and several boulder drops constituting Ashbury Falls immediately downstream. These impediments likely prevent adult access to areas above the falls in most years. Furthermore, the salmonid size distribution of previous years at Site 18 above Ashbury Falls (delineated in **Table 2b**) indicated that a higher proportion of larger resident rainbow trout was present in the population upstream of Reach 12b. The West Branch had 2 reliable steelhead reaches (13 and 14a). The upper West Branch reach was shortened in 2000 when a bedrock chute (Girl Scout Falls I) was observed upstream of Olson Road (formerly Olsen Road) near the Girl Scout camp. This chute is likely impassable during many stormflows. Therefore, juvenile steelhead population estimates for previous years were reduced to exclude potential juvenile production above this passage impediment. Sampling in 2003 and 2005 indicated that steelhead likely passed Girl Scout Falls I but not Girl Scout Falls II. Sampling in 2004 indicated that some steelhead might have passed Girl Scout Falls II, although young-of-the-year production above Girl Scout Falls II was approximately half what it was downstream. Sampling in 2005 and 2006 indicated that adult steelhead did not pass Girl Scout Falls II. After 2006, the sampling site upstream of Girl Scout Falls II was dropped from the scope.

In 2002, the upper West Branch was surveyed. Significant impediments to salmonid migration were found and used as reach boundaries. Reach 14b was designated between Girl Scout Falls I and Girl Scout Falls II. Reach 14c was designated between Girl Scout Falls II and Tucker Road (formerly Tilly's Ford). Reach 14d was designated between Tucker Road and Laurel Mills Dam.

Soquel Creek sites included 4 mainstem sites with one in Reach 1 (Site 1) upstream of the lagoon (downstream of Bates Creek), one in the lower mainstem below Moores Gulch in Reach 3 (Site 4), one in the upper mainstem in Reach 7 (Site 10) and one in the upper mainstem in Reach 8 (Site 12) (**Table 2b**). Half-mile segments encompassing these sites were habitat typed to determine sampling sites with average habitat quality, except 0.8 miles were habitat typed in Reach 1. Sampling sites were chosen to represent the lower East Branch Reach 9 (Site 13a) and the upper East Branch Reach 12a (Site 16) (**Table 2b**) in the upper Soquel Creek watershed where most of the spawning usually occurs. On the West Branch, one sampling site was chosen downstream of Girl Scout Falls I and Hester Creek in Reach 13 (Site 19). The reach between Girl Scout Falls I and II was habitat typed (Reach 14b) and sampled (Site 21) in 2009. Landowner objection in 2006 prevented our surveying and sampling of Reach 14a in the future.

In the Aptos Creek watershed, 2 sites were sampled in Aptos Creek, representing the low-gradient Reach 2 above the Valencia Creek confluence and the higher gradient Reach 3 in Nisene Marks State Park (**Appendix A map**). Two sites on Valencia Creek were sampled in the vicinity of historical sites previously sampled in 1981 (**Table 3**). Reach 2 was above passage impediments near Highway 1 where a new fish ladder was constructed. Reach 3 was above the passage impediment that has been retrofitted at the Valencia Road culvert crossing. Half-mile segments in the vicinity of historical sampling sites were habitat typed so that pools with average habitat quality could be chosen for sampling, along with adjacent fastwater habitat. Site numbers were consistent with 1981 numbering.

In the Corralitos Creek sub-watershed of the Pajaro River Watershed, sampling sites were chosen based on historical sampling locations (**Smith 1982; Alley 1995a**) and historical reach designations determined in 1994 (**Alley 1995a**). Reach delineations were based on previous stream survey work of streambed conditions, streamflow and habitat proportions by Alley of the extent of steelhead distribution in sub-watershed in 1981 and past knowledge of streamflow and sediment inputs from tributaries by Smith and Alley during drought and flood (**Table 4a; Appendix A**). Half-mile segments were habitat typed in the vicinity of the historical sampling sites to identify pools with average habitat quality and their adjacent fastwater habitat to sample. Site numbers were kept consistent with the original 1981 designations to prevent confusion.

In Corralitos Creek, 4 reaches were chosen: Reach 1 downstream of the water diversion dam (Site 1), Reach 3 downstream of Rider Creek as streamflow steadily increased toward the diversion dam (Site 3), Reach 6 upstream of Rider Creek (a historical sediment source) and the Eureka Canyon Road crossing at RM 2.95 (box culvert baffled in 2008) that is a partial passage impediment (Site 8) and Reach 7 upstream of Eureka Gulch, a historical sediment source (Site 9) (**Tables 4a and 4b; Appendix A map**).

In Shingle Mill Gulch, Reach 1 was chosen below the partial passage impediment at the second road crossing (Site 1) and Reach 3 above the second (approach modified in 2008 and reworked in 2011) and third road crossings and the steep Reach 2. Reach 3 is a lower gradient, low flow reach downstream of Grizzly Flat (Site 3) (**Tables 4a and 4b; Appendix A map**).

In Browns Valley Creek, Sites 1 and 2 were chosen to represent the 2 reaches previously delineated there (**Tables 4a and 4b; Appendix A map**). The diversion dam demarcated the reach boundaries because of its potential effect on surface flow and a change in channel type. Other valuable steelhead habitat exists in Ramsey Gulch and Gamecock Canyon Creek (**Smith 1982**).

M-2. Classification of Habitat Types and Measurement of Habitat Conditions

In each watershed, ½-mile stream segments were habitat-typed using a modified CDFG Level IV habitat inventory method; with fish sampling sites chosen within each segment based on average habitat conditions. See sampling methods for more details. Habitat types were classified according to the categories outlined in the <u>California Salmonid Stream Habitat Restoration Manual</u> (**Flosi et al. 1998**). Some habitat characteristics were estimated according to the manual's guidelines, including length, width, mean depth, maximum depth, shelter rating and tree canopy (tributaries only in 1998). More detailed data were collected for escape cover than required by the manual to obtain biologically relevant information.

M-3. Measurement of Habitat Conditions

During habitat typing in 2011, as in past years, visual estimates of substrate composition and embeddedness were made. The observer looked at the habitat and made mental estimates based on what he saw with his trained eye. Therefore, these estimates are somewhat subjective, with consistency between data collectors requiring calibration from one to the other. An assumption is that the same data collector will be consistent in visual estimates. If more than one data collector contributed to the same study, the original observer trained the others to be consistent ("calibrated") on visual estimates. Changes in visual estimates of substrate abundance or embeddedness of about 10% or more between sites and years probably represent real changes in habitat quality. The previous years' data was not reviewed prior to data collection so as not to bias current data.

Fine Sediment. Fine sediment was visually estimated as particles smaller than approximately 0.08 inches. In the Santa Cruz Mountains, there is little gradual gradation in particle size between sand and larger substrate, making visual estimates of fines relatively easy. Annual consistency in data collecting personnel during habitat typing is important, however. Gravel-sized substrate is generally in short supply. The comparability of these visual estimates to data collection via pebble counts would depend on the skill of the visual estimator and the skill of the pebble count collectors. Untrained volunteers tend to select larger substrate to pick up and measure during pebble counts, resulting in an overestimate of particle size composition. The accuracy of pebble counts is also dependent on sample size. Neither the pebble count nor the visual estimate will provide data for substrate below the streambed surface. The McNeil Sampler may be used for core samples, and results from this method may not be comparable to the other methods. The substrate sampled with coring devices is restricted by the diameter of the sampler. Both pebble counting and core sampling are too labor intensive for habitat typing. We do not believe more in-depth estimates than those taken for percent fines are necessary for this fishery study.

Embeddedness. Embeddedness was visually estimated as the percent that cobbles and boulders larger than 150 mm (6 inches) in diameter were buried in finer substrate. Previous to 1999, the cobble range included substrate larger than 100 mm (4 inches). The change in cobble size likely had little effect on embeddedness estimates. The reason the cobble size was increased to 150 mm was because substrate smaller than that probably offered little benefit for fish escape cover, and embeddedness of smaller substrate was not a good indicator of habitat quality for fish.

Cobbles and boulders larger than approximately 150 mm in diameter provided good, heterogeneous habitat for aquatic insects in riffles and runs and some fish cover if embedded less than 25%. Cobbles and boulders larger than 225 mm provided the best potential fish cover if embedded less than 25%.

Tree Canopy Closure. Tree canopy closure was measured with a densiometer. Included in the tree canopy closure measurement were trees growing on slopes considerable distance from the stream. The percent deciduous value was based on visual estimates of the relative proportion of deciduous canopy closure provided to the stream channel. Tree canopy closure directly determines the amount of solar radiation that reaches the stream on any date of the year, but the relationship changes as the sun angle changes through the seasons and with stream orientation. Our measure of canopy closure estimated the percent of blue sky blocked by the vegetative canopy and was not affected by the sun angle.

Greater tree canopy inhibits warming of the water and is critically important in small tributaries. Increased water temperature increases the metabolic rate and food requirements of steelhead. Tree canopy in the range of 75-90% is optimal in the upper mainstem San Lorenzo River (Reaches 10-12) and tributaries because water temperatures are well within the tolerance range of juvenile steelhead and coho salmon. If reaches with low summer baseflow become unshaded, water temperature rapidly increases. Limited openings (10-15%) in the canopy provide some sunlight during the day for algal growth and visual feeding by fish. In the San Lorenzo River system, it is important that the tributaries remain well shaded so that tributary inflows to the mainstem are sufficiently cool to prevent excessively high water temperatures in the lower mainstem river (Reaches 1-5), where tree canopy is often in the 30-75% range. There is an inverse relationship between tree canopy and insect production in riffles, which allows faster steelhead growth in larger, mainstem reaches, especially downstream of the Zayante Creek confluence, having deeper, fastwater feeding areas, despite the elevated temperatures and steelhead metabolic rate (and associated food requirements.) In addition, very dense shading reduces visibility of drifting insect prey and reduces fish feeding efficiency. However, as fast-water feeding areas diminish in smaller stream channels with less streamflow further up the watershed, high water temperatures may increase steelhead food demands beyond the benefits of greater food production in habitat lacking in fast-water feeding areas. Here is where shade canopy must increase to maintain cooler water temperature and lowered metabolic rate and food requirements of juvenile steelhead.

Escape Cover– Sampling Sites. The escape cover index for each habitat type within sampled sites was quantitatively determined in the same manner in 1994-2001 and in 2003-2011. The importance of escape cover is that the more there is in a habitat, the higher the production of steelhead, particularly for steelhead => 75 mm SL. Water depth itself provides some escape cover when 2 feet deep and good escape cover when it is 3 feet deep (1 meter) or greater. Escape cover was measured as the ratio of the linear distance under submerged objects and undercut banks within the habitat type that fish at least 75 mm (3 inches) Standard Length (SL) could hide under, divided by the length of the habitat type. The summer escape cover (as unembedded cobbles, undercut banks and instream wood) also provides overwintering habitat in the tributaries. This allowed annual comparisons for the habitats at historical sites.

Escape Cover– Habitat Typing Method by Reach. Reach segment averages in 1997–2000, 2003, 2005–2011 for escape cover by habitat type were determined from habitat typed segments. Reach cover indices were determined for habitat types in reach segments for purposes of annual comparisons. The escape cover index for each habitat type in a half-mile segment was measured as the ratio of linear feet of cover under submerged objects that Size Class II and III juveniles could hide under for all of that habitat type in the segment divided by total feet of stream channel as that habitat type in the reach segment. Objects of cover included unembedded boulders, submerged woody debris, undercut banks, bubble curtains and overhanging tree branches and vines that entered the water. Man-made objects, such as boulder rip-rap, concrete debris and plywood also provided cover. Escape cover constituted areas where fish could be completely hidden from view. This was not a measure of the less effective overhead cover that may be caused by surface turbulence or vegetation hanging over the water but not touching. Steelhead habitat is illustrated in the following drawings.

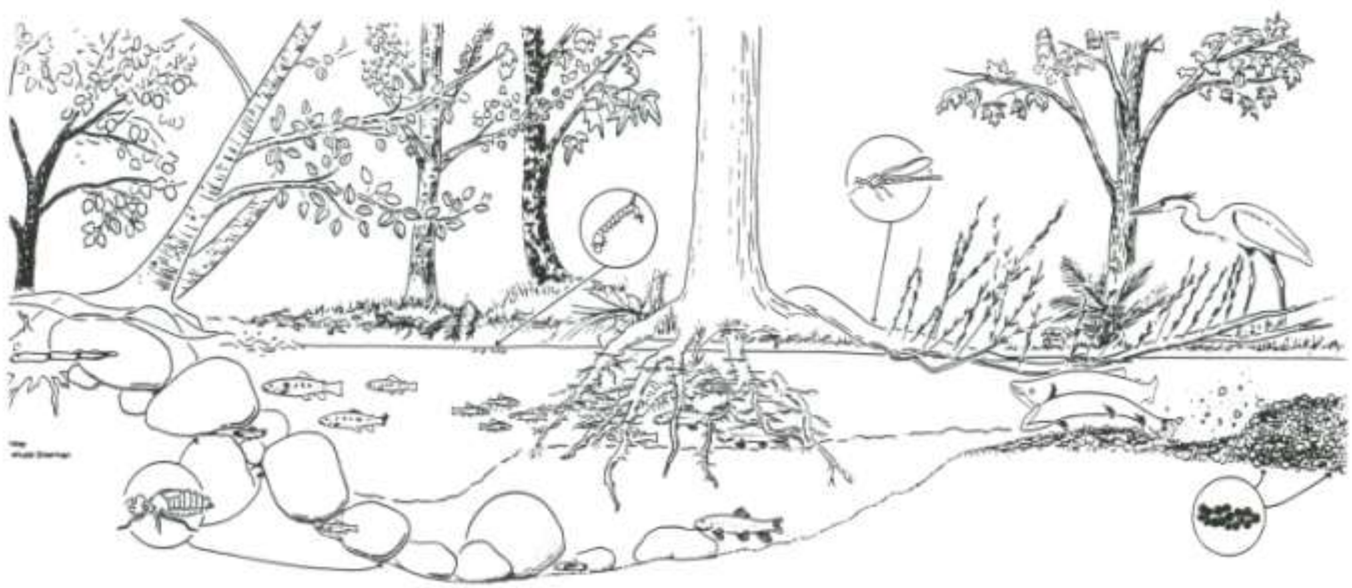


Illustration of pool habitat (stream flowing from left to right) showing escape cover under boulders and undercut bank with tree roots. Juvenile steelhead are feeding at the head of the pool. (Female steelhead covering her redd of eggs after spawning at the tail of the pool.)

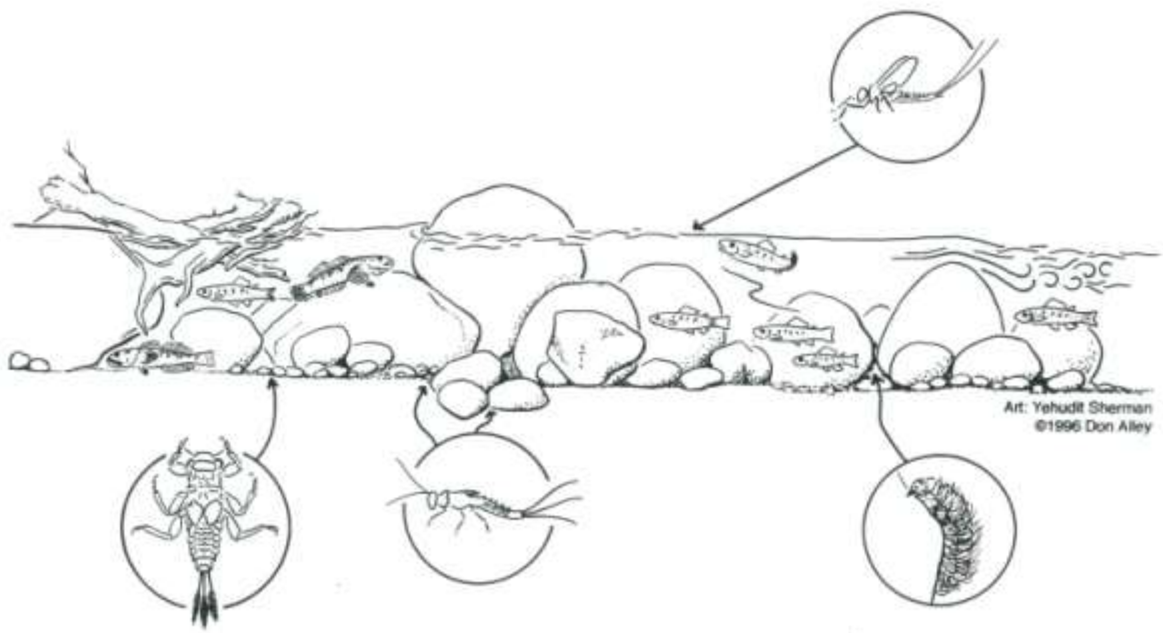


Illustration of riffle habitat (stream flowing from left to right) showing escape cover under rootwad and boulders. (Juvenile steelhead are holding feeding positions, facing upstream.)

Water Depth, Channel Length and Width. Water depth is important because deeper habitat is utilized more heavily by steelhead, especially by larger fish. Deeper pools are associated with scour objects that often provided escape cover. Mean depth and maximum depth were determined with a dip net handle, graduated in half-foot increments. Soundings throughout the habitat type were made to estimate mean and maximum depth. Annual comparisons of habitat depth were possible because measurements were taken in the fall of each year. Minimum depth was determined approximately one foot from the stream margin in earlier years. Stream length was measured with a hip chain. Width in each year was measured with the graduated dip net except in wider habitats of the mainstem. In wider habitats (greater than approximately 20 feet), a range finder was used to measure width.

Streamflow. Streamflow is an important aspect of habitat because it contributes to habitat depth and water velocity. Greater depth offers better rearing habitat. Faster water velocity offers better feeding habitat and higher growth rate. Assessment of streamflow at only established gages is insufficient to compare annual differences in streamflow throughout a watershed because streamflow decline in each tributary is not necessarily proportional to decline at a downstream gage, especially when specific aquifers are drawn down at variable municipal pumpage rates or specific tributary surface water is diverted at variable rates, which impact summer baseflow differently in wet versus dry years.

For 1995 and 1998 onward, the Marsh McBirney Model 2000 flowmeter was more extensively used at most sampling sites. Streamflow measurement was beyond the project scope and budget in 2006−2009 but was added back in 2010 and 2011. Even so, streamflow was measured in 2006 at historical sites in the San Lorenzo watershed in fall before any fall storms, as in past years. Mean column velocity was measured at 20 or more verticals at each cross-section. For 2007−2009, streamflow measurements made by Santa Cruz County staff were used for annual comparisons.

M-4. Choice of Specific Habitats to be Sampled Within Reaches

Based on the habitat typing conducted in each reach prior to fish sampling, representative habitat units were selected with average habitat quality values in terms of water depth and escape cover to determine fish densities by habitat type. In mainstem reaches of the lower and middle San Lorenzo River (Sites 1, 2, 4, 6 and 8), riffles and runs that were close to the average width and depth for the reach were sampled by electrofishing. Pools in these reaches were divided into long pools (greater than 200 feet long) and short pools (less than 200 feet) and at least one pool of each size class was either snorkel censused or electrofished. The exception was Reach 1, which had only one pool less than 200 ft long, which was not censused. Only a long pool was censused in Reach 1 (which historically consisted of a long pool and a short pool). In these mainstem reaches, most fish were in the fastwater habitat of riffles, runs and the heads of pools and fish were not using most of the pool habitat. Some of the pools are hundreds of feet long with very few juveniles, except for those at the heads of pools. The sampling site in Reach 0a between the levees was chosen in 2009 because it was the only location downstream of Highway 1 where a pool and adjacent fastwater habitat could be sampled by electrofishing. Much of the reach was lagoon habitat due to a closed sandbar that summer.

For all other reaches, including the upper San Lorenzo River above the Boulder Creek confluence, all San Lorenzo tributaries and in the Aptos and Corralitos watersheds, representative pools with average habitat quality in terms of water depth and escape cover were sampled. Pools were deemed representative if they had escape cover ratios and water depths similar to the average values for all pools in the half-mile segment that was habitat typed within the reach. Therefore, pools that were much deeper or much shallower than average or had much less or much more escape cover than average were not sampled. Once the pools were chosen for electrofishing, adjacent riffles, step-runs, runs and glides were sampled, as well. In these smaller channel situations, these latter habitat types showed great similarity to most other habitats of the same type. Namely, all riffles, runs and glides had similar depth and escape cover within their own habitat type designations.

Sampled units may change from year to year since habitat conditions change, and locations of individual habitat units may shift depending on winter storm conditions. Our assumption is that fish sampling of mean habitat quality will reflect representative habitat for the reach and provide typical, average fish densities for each habitat type in the reach. The assumption is that there is a correlation between fish density and habitat quality in that better habitat has more fish. Past modeling has indicated that increased densities of smolt-sized juveniles are positively associated with greater water depth and escape cover in small, low summer flow streams (**Smith 1984**). Site densities were determined by calculating the number of juveniles present in each sampled habitat from electrofishing and/or snorkel censusing and adding those to numbers of juveniles from other habitats. The total number of fish was divided by the total lineal feet sampled at the site.

The proportion of habitat types sampled at each site within a reach were kept similar between years so that site densities could be compared for each reach. However, site density did not necessarily reflect fish densities for the entire reach because the habitat proportions sampled were not necessarily similar to the habitat proportions of the reach. In most cases, habitat proportions at sites were similar to habitat proportions in the reach because sampling sites were more or less continuous. However, in reaches where pools were less common, such as Reach 12a on the East Branch of Soquel Creek and in Reach 2 of Valencia Creek, a higher proportion of pool habitat was sampled than existed in the respective reaches. In these two cases, site densities were higher than reach densities. Prior to 2006, actual reach density and fish production could be compared between years and between reaches because fish densities by habitat type were extrapolated to reach density and an index of reach production according to reach proportions of habitat types.

M-5. Consistency of Data Collection Techniques in 1994-2001 and 2003-2011

Habitat conditions of depth and escape cover were measured at the monitoring sites in 2011 consistent with methods used in 1981 and 1994-2001 and 2003−2010 in the San Lorenzo River and Soquel Creek watersheds. Donald Alley, the principal investigator and data collector in 1994−2001 and 2003−2011, had also collected the fish and habitat data at approximately half or more of the sites in the 1981 study for the County Water Master Plan that included the 4 watersheds in the current study, except for Aptos Creek (**Smith 1982**). His previous qualitative estimates of embeddedness, streambed composition and habitat types were calibrated to be consistent with those of Dr. Smith, the primary investigator for the 1981 sampling program. Mr. Alley's method of measuring escape cover for smolt-sized (=>75 mm SL) and larger steelhead was consistent through the years, although the escape cover index in 1981 was based upon linear cover per habitat perimeter and later escape cover indices were based on linear cover per habitat length. In 2006, Chad Steiner began assisting in habitat typing some reaches after being calibrated to be consistent with Mr. Alley’s methods. During electrofishing from 1996 onward, block nets were used to partition off habitats at all electrofishing sites. This prevented steelhead escapement. A multiple-pass method was used in each habitat with at least three passes.

From 1998 onward, underwater visual (snorkel) censusing was incorporated with electrofishing so that pool habitat in the mainstem San Lorenzo River, which had been electrofished in past years, could be effectively censused despite it being too deep in 1998 (a high-flow year) for backpack electrofishing.

Snorkel censusing was also used to obtain density estimates in deeper pools previously unsampled prior to 1998 at Sites 2, 3, 7, 8 and 9, in an effort to increase the accuracy of production estimates. A better juvenile production estimate and predictions of adult returns were made with snorkel-censusing of pool habitat in the mainstem San Lorenzo River for 1998–2005. In 2006−2011, deeper pools were snorkel-censused at Sites 1, 2, 4, 6 and 8 in the lower and middle mainstem San Lorenzo to determine site densities only. All other watersheds were sampled by electrofishing only.

The City of Santa Cruz funded a separate San Lorenzo watershed sampling effort in 2002 (**H.T. Harvey & Associates (HTH) 2003**). Much of their data were not included in this report their methods were different from ours. The method used for choosing nonrandom fish sampling sites was not stated in their report. Their size class divisions of juvenile steelhead differed from ours, thus preventing annual comparisons by size class. Therefore, only 2002 total densities were graphed in this report. HTH did not compute densities by age class. In 2002, random and nonrandom sites were sampled in the middle mainstem San Lorenzo and compared. HTH found good correlation for juvenile densities between random and nonrandom sampling sites, especially in riffles and runs. HTH found higher steelhead densities in some mainstem pools than earlier sampling. However, this may have been an artifact of eliminating about 20% of the pools for inventory because they were judged to be too deep or had too much cover for censusing, creating a bias toward short, shallow pools that misrepresented typical mainstem pool habitat that would yield higher densities. In mainstem pools, juvenile steelhead inhabit primarily the fastwater habitat at the heads of pools that typically span hundreds of feet in length, with the majority of the pool length unused. HTH's 2002 juvenile densities in the San Lorenzo system were generally above average, which was consistent with D.W. Alley & Associates findings in Soquel Creek in 2002. For a more detailed review of HTH findings, please refer to our 2003 censusing report (**Alley 2004**).

M-6. Assessing Change in Rearing Habitat Quality

Change in rearing habitat quality was based on changes in reach segment habitat conditions, if the reach was habitat typed in successive years. If it was not, then habitat conditions in replicated sampling sites were compared between years. Elements of habitat change in the lower San Lorenzo mainstem (downstream of the Zayante Creek confluence) were assessed in fastwater habitat (runs and riffles) where most juvenile steelhead inhabited. In all other sites, primarily habitat conditions in pools were considered. Increased escape cover, increased habitat depth, increased baseflow, reduced embeddedness and reduced percent fines constituted positive change, in order of decreasing importance, except in the lower San Lorenzo mainstem where increased baseflow was considered most important. Spring and summer/fall baseflow were considered. Change in linear escape cover of 1 foot per 100 feet of stream channel (0.010) constituted significant habitat change. Change in average maximum pool depth was more significant than change in average mean pool depth in sites beyond the lower San Lorenzo mainstem. A change in 0.1−0.2 ft or more in either pool depth constituted significant habitat change. A change in 0.1 ft or more in fastwater habitat constituted significant habitat change in the lower San Lorenzo mainstem. Embeddedness and percent fines must have changed at least 10 percent to constitute change because these factors are visually estimated and less than 10%

changes are difficult to detect visually. Decreased escape cover, habitat depth or baseflow indicated negative habitat change, along with increased embeddedness and increased fines. Assessment is more complex when some factors improve while others decline or remain similar between years. This is when order of importance plays a key role in judging overall habitat change.

Sometimes, habitat factors change together. Sometimes, pool depth will increase due to increased scour, which also may occur during a wet year with associated high baseflow. Greater scour may also reduce embeddedness and increase escape cover under boulders and instream wood. However, if high stormflows were associated with high erosion and sedimentation, pool depth and escape cover may diminish as embeddedness increases afterwards, despite higher baseflow. Sometimes during a mild winter, sedimentation is reduced and escape cover and pool depth may increase because sediment is removed from the streambed. Embeddedness and percent fines may be reduced in this scenario.

If YOY growth rate increased when YOY density was similar to or more than in the previous year, rearing habitat was assessed to have improved due to primarily increased baseflow (usually spring baseflow). However, if juvenile numbers =>75 mm SL were much less compared to the previous year, rearing habitat change could be negative if escape cover or pool depth decreased, even though YOY growth rate had increased. Rearing habitat quality was judged independent of juvenile steelhead densities.

Table 1a. Defined Reaches in the Mainstem San Lorenzo River.
Refer to Appendix A for map designations. Surveyed reach segments within reaches indicated by asterisk)

Reach #	Reach Boundaries	Reach Length (ft)
0	Water Street to Tait Street Diversion CM0.92 – CM1.92	5,277
1	Tait Street Diversion to Buckeye Trail Crossing CM1.92 - CM4.73	14,837
2*	Buckeye Trail Crossing to the Upper End of the Wide Channel Representation on the Felton USGS Quad Map CM4.73 - CM6.42	8,923
3	From Beginning of Narrow Channel Representation in the Gorge to the Beginning of the Gorge (below the Eagle Creek Confluence) CM6.42 - CM7.50	5,702
4	From the Beginning of the Gorge to Felton Diversion Dam CM7.50 - CM9.12	8,554
5	Felton Diversion Dam to Zayante Creek Confluence CM9.12 - CM9.50	2,026
6	Zayante Creek Confluence to Newell Creek Confluence CM9.50 - CM12.88	17,846
7	Newell Creek Confluence to Bend North of Ben Lomond CM12.88 - CM14.54	8,765
8	Bend North of Ben Lomond to Clear Creek Confluence in Brookdale CM14.54 - CM16.27	9,138
9	Clear Creek Confluence to Boulder Creek Confluence CM16.27 - CM18.38	11,137
10	Boulder Creek Confluence to Kings Creek Confluence CM18.38 - CM20.88	13,200
11	Kings Creek Confluence to San Lorenzo Park Bridge Crossing CM20.88 - CM24.23	17,688
12	San Lorenzo Park Bridge to Gradient Change, North of Waterman Gap CM24.23 - CM26.73	13,200
	TOTAL	136,293 (25.8 miles)

Table 1b. Defined Reaches in Major Tributaries of the San Lorenzo River.

Creek- Reach #	Reach Boundaries (Downstream to Upstream)	Reach Length (ft)
Zayante 13a	San Lorenzo River Confluence to Bean Creek Confluence CM0.0-CM0.61	3,221
13b	Bean Creek Confluence to Trib. Draining from S.Cruz Aggregate Quarry CM0.61-CM2.44	9,662
13c*	Santa Cruz Aggregate Tributary to Lompico Creek Confluence CM2.44-CM3.09	3,432
13d*	Lompico Creek Confluence to Mt. Charlie Gulch Confluence CM3.09-CM5.72	13,886
Lompico 13e	Lompico Creekmouth to 1st Culvert Crossing CM0.0-CM0.5	4,265
Lompico 13f	1st Culvert Crossing to Carol Road Bridge CM0.5-CM1.77	5,077
Lompico 13g	Carol Road Bridge to Mill Creek Confluence CM1.77-CM2.35	3,046
Lompico 13h	Mill Creek Confluence to End of Perennial Channel CM2.35-CM3.73	7,311
Bean 14a	Zayante Creek Confluence to Mt. Hermon Road Overpass CM0.0-CM1.27	6,706
14b*	Mt. Hermon Road Overpass to Ruins Creek Confluence CM1.27-CM2.15	4,646
14c*	Ruins Creek Confluence to Gradient Change Above the Second Glenwood Road Crossing CM2.15-CM5.45	17,424
Fall 15*	San Lorenzo River Confluence to Boulder Falls CM0.0-CM1.58	8,342
Newell 16*	San Lorenzo River Confluence to Bedrock Falls CM0.0-CM1.04	5,491
Boulder 17a	San Lorenzo River Confluence to Foreman Creek Confluence CM0.0-CM0.85	4,488
17b	Foreman Creek Confluence to Narrowing of Gorge Adjacent Forest Springs CM0.85-CM2.0	6,072
17c	Narrow Gorge to Bedrock Chute At Kings Highway Junction with Big Basin Way CM2.0-CM3.46	7,709

Creek-Reach #	Reach Boundaries (Downstream to Upstream)	Reach Length (ft)
Bear 18a	San Lorenzo River Confluence to Unnamed Tributary at Narrowing of the Canyon Above Bear Creek Country Club CM0.0-CM2.42	12,778
18b	Narrowing of the Canyon to the Deer Creek Confluence CM2.42-CM4.69	11,986
Kings 19a	San Lorenzo River Confluence to Unnamed Tributary at Former Fragmented Dam Abutment Location CM0.0-CM2.04	10,771
19b	Tributary to Bedrock-Boulder Cascade CM2.04-CM3.73	8,923
Carbonera 20a	Branciforte Creek Confluence to Old Road Crossing and Gradient Increase CM0.0-CM1.38	7,293
20b	Old Road Crossing to Moose Lodge Falls CM1.38-CM3.39	10,635
Branciforte 21a	Carbonera Creek Confluence to Granite Creek Confluence CM1.12-CM3.04	10,138
21b	Granite Creek Confluence to Tie Gulch Confluence CM3.04-CM5.73	14,203

	TOTAL	177,806 (33.7 miles)

Table 1c. Fish Sampling Sites in the San Lorenzo Watershed.
(2011 Sites Indicated by Asterisk.)

Reach #	Sampling Site # -Channel Mile	<u>MAINSTEM SITES</u> Location of Sampling Sites
0	*0a –CM1.6	Above Water Street Bridge
0	0b –CM2.3	Above Highway 1 Bridge
1	*1 -CM3.8	Paradise Park
2	*2 –CM6.0	Lower Gorge in Rincon Reach, Downstream of Old Dam Site
3	3 -CM7.4	Upper End of the Gorge
4	*4 –CM8.9	Downstream of the Cowell Park Entrance Bridge
5	5 -CM9.3	Downstream of Zayante Creek Confluence
6	*6 -CM10.4	Below Fall Creek Confluence
7	7 -CM13.8	Above Lower Highway 9 Crossing in Ben Lomond
8	*8 -CM15.9	Upstream of the Larkspur Road (Brookdale)
9	9 -CM18.0	Downstream of Boulder Creek Confluence
10	10 -CM20.7	Below Kings Creek Confluence
11	*11 -CM22.3	Upstream of Teilh Road, Riverside Grove
12	12a -CM24.7	Downstream of Waterman Gap and Highway 9
	12b -CM25.2	Waterman Gap Upstream of Highway 9

Table 1c. Fish Sampling Sites in the San Lorenzo Watershed (continued).

Reach #	Sampling Site # -Channel Mile	TRIBUTARY SITES Location of Sampling Sites
13a	*13a-CM0.3	Zayante Creek Upstream of Conference Drive Bridge
13b	13b-CM1.6	Zayante Creek Above First Zayante Rd crossing
13c	*13c-CM2.8	Zayante Creek downstream of Zayante School Road Intersection with E. Zayante Road
13d	*13d-CM4.1	Zayante Creek upstream of Third Bridge Crossing of East Zayante Road After Lompico Creek Confluence
13e	*13e-CM0.4	Lompico Creek upstream of the fish ladder and downstream of first bridge crossing.
14a	14a-CM0.1	Bean Creek Upstream of Zayante Creek Confluence
14b	*14b-CM1.8	Bean Creek Below Lockhart Gulch Road
14c	*14c-CM4.7	Bean Creek 1/2-mile Above Mackenzie Creek Confluence and Below Golpher Gulch Rd.
15	*15 -CM0.8	Fall Creek, Below Wooden Bridge
16	*16 -CM0.5	Newell Creek, Upstream of Glen Arbor Road Bridge
17a	*17a-CM0.2	Boulder Creek Just Upstream of Highway 9
17b	*17b-CM1.6	Boulder Creek Below Bracken Brae Creek Confluence
17c	17c-CM2.6	Boulder Creek, Downstream of Jamison Creek
18a	*18a-CM1.5	Bear Creek, Just Upstream of Hopkins Gulch
18b	18b-CM4.2	Bear Creek, Downstream of Bear Creek Road Bridge and Deer Creek Confluence
19a	19a-CM0.8	Kings Creek, Upstream of First Kings Creek Road Bridge
19b	19b-CM2.5	Kings Creek, 0.2 miles Above Boy Scout Camp and Upstream of the Second Kings Creek Road Bridge
20a	20a-CM0.7	Carbonera Creek, Upstream of Health Services Complex
20b	20b-CM1.9	Carbonera Creek, Downstream of Buelah Park Trail
21a	21a1-CM1.5	Branciforte Creek, Upstream of the Highway 1 Overpass
21a	*21a2-CM2.8	Branciforte Ck, Downstream of Granite Creek Confluence
21b	21b-CM4.6	Branciforte Ck, Upstream of Granite Crk Confl. and Happy Valley School

Table 2a. Defined Reaches on Soquel Creek.

(Refer to Appendix A for map designations. Surveyed reach segments indicated by asterisk.)

Reach #	Reach Boundaries (Downstream to Upstream)	Reach Length (ft)
0	Soquel Creek Lagoon	3,168
1	Upper Lagoon's Extent to Soquel Avenue CM0.6 - CM1.41	4,449
2	Soquel Avenue to First Bend Upstream CM1.41 - CM1.77	2,045
3*	First Bend Above Soquel Avenue to Above the Bend Closest to Cherryvale Avenue CM1.77 - CM2.70	4,827
4	Above the Bend Adj. Cherryvale Ave to Bend at End of Cherryvale Ave CM2.70 – CM3.54	4,720
5	Above Proposed Diversion Site to Sharp Bend Above Conference Center CM3.54 - CM4.06	3,041
6	Sharp Bend Above Conference Center to the Moores Gulch Confluence CM4.06-CM5.34	6,640
7	Moores Gulch Confluence to Above the Purling Brook Road Crossing CM5.34 - CM6.41	5,569
8*	Above Purling Brook Road Crossing to West Branch Confluence CM6.41 - CM7.34	5,123
	Subtotal	39,582 (7.5 miles)
9a*	West Branch Confluence to Mill Pond Diversion CM7.34 - CM9.28	10,243
9b	Mill Pond Diversion to Hinckley Creek Confluence CM9.28 - CM9.55	1,425
10	Hinckley Creek Confluence to Soquel Creek Water District Weir CM9.55 - CM10.66	5,856
11	Soquel Creek Water District Weir to Amaya Creek Confluence CM10.66 - CM11.79	5,932
12a*	Amaya Creek Confluence to Gradient Increase CM11.79 – 12.56	4,062
12b	Gradient Increase to Ashbury Gulch Confluence CM12.56 - CM14.38	9,647
	SUBTOTAL	76,747 (14.5 miles)

Table 2a. Defined Reaches on Soquel Creek (continued).

Reach #	Reach Boundaries (Downstream to Upstream)	Reach Length (ft)
13	West Branch Confluence to Hester Creek Confluence on West Branch CM0.0 - CM0.98	5,173
14a	Hester Creek Confluence to Girl Scout Falls I CM0.98- CM2.26	6,742
	SUBTOTAL	88,662 (16.8 miles)
14b	Girl Scout Falls I to Girl Scout Falls II CM2.26 – CM2.89	3,311
14c	Girl Scout Falls II to Tucker Road (Tilly's Ford) CM2.89 – CM4.07	6,216
14d	Tucker Road (Tilly's Ford) to Laurel Mill Dam- 1,465 ft Below Confluence of Laurel and Burns Creeks on West Branch CM4.07 - CM6.56	13,123
	TOTAL	111,312 (21.1 miles)

Table 2b. Locations of Sampling Sites by Reach on Soquel Creek.
(An asterisk indicates sampling in 2009.)

Reach #	Site # -Channel Mile	Location of Sampling Sites
1	*1 -CM1.2	Below Grange Hall
2	2 -CM1.6	Near the USGS Gaging Station
3	3 -CM2.1	Above Bates Creek Confluence
3	*4 -CM2.7	Upper Reach 3, Adjacent Cherryvale Ave Flower Fields
4	5 -CM2.9	Near Beach Shack (Corrugated sheet metal)
4	6 -CM3.4	Above Proposed Diversion Site
5	7 -CM3.9	Upstream to Proposed Reservoir Site, End of Cherryvale
6	8 -CM4.2	Adjacent to Rivervale Drive Access
6	9 -CM4.8	Below Moores Gulch Confluence, Adjacent Mountain School
7	*10 -CM5.5	Above Moores Gulch Confluence and Allred Bridge
7	11 -CM5.9	Below Purling Brook Road Ford
8	*12 -CM7.0	Below and Above Soquel Creek Road Bridge
9a	*13a-CM8.9	Below Mill Pond
9b	13b-CM9.2	Below Hinckley Creek Confluence
10	14 -CM9.7	Above Hinckley Creek Confluence
11	15 -CM10.8	Above Soquel Creek Water District Weir
12a	*16 -CM12.3	Above Amaya Creek Confluence
12b	17 -CM13.0	Above Fern Gulch Confluence
	18 -CM15.2	Above Ashbury Gulch Confluence One Mile
13	*19 -CM0.2	West Branch below Hester Creek Confluence
14a	20 -CM2.0	West Branch Near End of Olson Road
14b	*21 -CM2.4	Above Girl Scout Falls I (Added in 2002)
14c	22 -CM3.0	Above Girl Scout Falls II (Added in 2002)

Table 3. Locations of Sampling Sites by Reach in the Aptos Watershed.
(An asterisk indicates sampling in 2011.)

Reach #	Site # -Channel Mile	Location of Sampling Sites
Aptos Creek		
0	*0 –CM0.0	Lagoon/Estuary
1	1 –CM0.4	Below Mouth of Valencia Creek
2	2 –CM0.5	Just Upstream of Valencia Creek Confluence
2	*3 –CM0.9	Above Railroad Crossing in County Park near Center
3	*4 –CM2.9	In Nisene Marks State Park, 0.3 miles above First Bridge Crossing
Valencia Creek		
1	1 –CM0.9	0.9 miles Up from the Mouth
2	2 –CM2.85	Below Valencia Road Crossing and above East Branch
3	3 –CM3.26	Above Valencia Road Crossing

Table 4a. Defined Reaches in the Corralitos Sub-Watershed.

(Refer to Appendix A for map designations. Reach segments surveyed within reaches are indicated by asterisk.)

Reach #	Reach Boundaries (downstream to upstream)	Reach Length (ft)
Corralitos Creek		
1	Browns Creek Confluence to 0.25 miles Below Diversion Dam CM0.00 – CM10.25	4,171
2	0.25 miles below Diversion Dam to Diversion Dam CM10.25.6 - CM10.5	1,320
3*	Diversion Dam to Rider Creek Confluence CM10.5 – CM11.77	6,706
4	Rider Creek Confluence to Box Culvert Crossing above Rider Creek Confluence CM11.77 – CM12.87	3,643
5*	First Bridge Crossing Above Rider Creek to Clipper Gulch Confluence CM12.46 – CM12.87	2,165
6*	Clipper Gulch Confluence to Eureka Gulch Confluence CM12.87 – CM13.33	2,429
7*	Eureka Gulch Confluence to Shingle Mill Gulch Confluence CM13.33 –CM13.98	3,432
Shingle Mill Gulch		
1	From Corralitos Creek Confluence to Second Eureka Canyon Road Crossing on Shingle Mill Gulch CM0.0 – CM0.35	1,848
2	From 2nd Eureka Canyon Road Crossing of Shingle Gulch to 3rd Road Crossing CM0.35 – CM0.62	1,420
3	3rd Eureka Canyon Road Crossing of Shingle Mill Gulch to Beginning of Steep (Impassable) Gradient on Rattlesnake Gulch CM0.62 –CM1.35	3,858
	Total	30,992 (5.9 miles)
Browns Valley Creek *		
1	First Bridge Crossing on Browns Valley Road below the Diversion Dam to the Diversion Dam	1,015
2	From Diversion Dam to Redwood Canyon Creek Confl.	4,468
	Total	5,483 (1.04 miles)

* More steelhead habitat exists above Reach 2 in Browns Valley Creek and in Redwood Canyon Creek, Ramsey Gulch and Gamecock Canyon Creek. Varying amounts of perennial steelhead habitat exists downstream of Reach 1, depending on bypass flows from the diversion dam.

Table 4b. Locations of Sampling Sites by Reach in the Corralitos Sub-Watershed.
(An asterisk indicates sampling in 2011.)

Corralitos Creek

Reach #	Site # -Channel Mile	Location of Sampling Sites
1	*1 -CM10.1	Downstream of Diversion Pipe Crossing
2	2 -CM10.3	Below Diversion Dam to Around the Bend
3	3a-CM10.6	Just Upstream of Diversion Dam
	*3b-CM11.1	0.6 miles Upstream of Diversion Dam (above Las Colinas Drive)
	4 -CM11.3	Below Rider Creek Confluence below bridge crossing
	5 -CM11.4	Below Rider Creek confluence and upstream of bridge crossing
4	6 -CM11.4	Upstream of Rider Creek Confluence
5	7 -CM12.0	Upstream of First Bridge Crossing above Rider Creek Confluence
6	*8 -CM12.9	Downstream of Eureka Gulch near Clipper Gulch
7	*9 -CM13.6	0.4 miles Above Eureka Gulch Confluence

Shingle Mill Gulch

1	*1 -CM0.3	Below Second Bridge on Shingle Mill Gulch
2	2 -CM0.5	Above Second Bridge on Shingle Mill Gulch
3	* 3 -CM0.9	At and Above Washed Out Check Dams below Grizzly Flat on Shingle Mill Gulch

Browns Valley Creek

1	*1 -CM1.9	Between First Browns Valley Road Crossing and Diversion Dam Upstream
2	*2 -CM2.7	Above Diversion Dam but Below Redwood Canyon Creek Confluence

M-7. Juvenile Steelhead Densities at Sampling Sites - Methods

Electrofishing was used at sampling sites to determine steelhead densities according to two juvenile age classes and three size classes in all 4 watersheds. Block nets were used at all sites to separate habitats during electrofishing. A three-pass depletion process was used to estimate fish densities. If poor depletion occurred with 3 passes, a fourth pass was performed and the number of fish captured in 4 passes represented a total count for the habitat. Electrofishing mortality rate has been approximately 1% or less over the years. Snorkel-censusing was used in deeper pools that could not be electrofished at sites in the mainstem reaches of the San Lorenzo River, downstream of the Boulder Creek confluence. For the middle mainstem reaches included in Table 2 of Appendix C, underwater censusing of deeper pools was incorporated with electrofishing data from more shallow habitats to provide density estimates.

Visual censusing was judged inappropriate in habitats other than deep mainstem San Lorenzo pools because it would be inaccurate in heavily utilized fastwater habitat in the mainstem and in 80-90% of the habitat in tributaries. Shallow depth and poor visibility prevent most all habitats in tributary reaches and fastwater riffles of the mainstem reaches from being effectively censused by snorkeling. In Santa Cruz Mountain watersheds, tributaries to mainstems often flow through steep-walled canyons, consisting of densely shaded pools with undercut banks and other cover complexity, along with shallow fastwater habitat usually averaging 0.5 feet in depth or less. Mainstem riffles, where juvenile densities are especially high, usually average less than a foot in depth. Furthermore, our level of data analysis requires dividing juveniles into size and age classes to adequately evaluate the composition of juvenile populations with regard to potential smolt size and annual growth rates, which cannot be effectively accomplished by snorkeling unless juvenile densities are very low. However, as is typical, 24 of 26 sampled tributary pools in the San Lorenzo system (typically 50-100 feet long) had more than 20 juvenile steelhead in 2005. And densities are typically between 50 and 100 juveniles per 100 feet at sampling sites (**Figure 23**). Inventory by size class requires actual measurement of individuals with rulers.

In larger rivers of northern California, density estimates from electrofishing are commonly combined with those determined by underwater observation in habitats too deep for electrofishing. Ideally, underwater censusing would be calibrated to electrofishing data in habitat where capture approached 100%. Calibration was originally attempted by Hankin and Reeves (**1988**) for small trout streams. Their intent was to substitute snorkel censusing for electrofishing. However, attempts at calibration of the two methods of censusing in large, deep pools of the mainstem San Lorenzo River was judged impractical, beyond the scope of the study and probably inadequate.

Two divers were used in snorkel censusing. Visual censusing of deeper pools occurred prior to electrofishing of sites. In wide pools, divers divided the channel longitudinally into counting lanes, combining their totals after traversing the habitat in an upstream direction. Divers would warn each other of juveniles being displaced into the other's counting lane to prevent double- counting. For juveniles near the boundaries of adjacent counting lanes, divers would verbally agree to who would include them in their tallies. In narrower pools, divers would alternate passes through the pool to obtain replicates to be averaged. In most pools, three replicate passes were accomplished per pool. The relative proportions of steelhead in the three Size Classes obtained from electrofishing were considered in dividing visually censused steelhead into size and age classes. The average number of steelhead observed per pass in each age and size category became the density estimate. In Reaches 1−4, most juveniles were greater than 75 mm SL, and yearlings were considerably larger than YOY fish. It was relatively easy to separate fish into size and age classes. In Reaches 6−9, more juveniles are normally around 75 mm SL, leading to a small error in deciding division between Size Classes 1 and 2. Age classes were easily distinguished.

Steelhead were visually censused for two size classes of pools in the San Lorenzo. There were short pools less than approximately 200 feet in length and those more than approximately 200 feet. Juvenile densities in censused pools were extrapolated to other pools in their respective size categories. Steelhead were censused by size and age class, as in electrofishing. If less than 20 juveniles were observed in a pool, the maximum number observed on a pass was the estimate. When 20 or more fish were observed, the average of the three passes was the best estimate.

Visual censusing offered realistic density estimates of steelhead in deeper mainstem pools. It was the only practical way to inventory such pools, which were mostly bedrock- or boulder- scoured and had limited escape cover. Visibility was usually 10 feet or more, making the streambed and counting lanes observable. Relatively few steelhead used these pools in 1999-2001 and 2003-2011, compared to 1998 when mainstem baseflow was considerably higher (minimum of 30 cubic feet per second at the Big Trees Gage compared to approximately 20 cfs or less in later years).

M-7. Age and Size Class Divisions

With electrofishing data, the young-of-the-year (YOY) age class was separated from the yearling and older age class in each habitat, based on the site-specific break in the length-frequency distribution (histogram) of fish lengths combined into 5 mm groupings. Also, scale analysis was utilized in the past for fish captured at lower mainstem sites in the San Lorenzo River and Soquel Creek. Density estimates of age classes in each habitat type were determined by the standard depletion model used with multiple pass capture data. Densities were expressed in fish per 100 feet of channel and determined in the lowest baseflow period when juvenile salmonids remain in specific habitats without up or downstream movement. Density is typically provided per channel length by convention and convenience, and may be accurately measured quickly. Consistent density measurement allows valid annual comparisons.

Depletion estimates of juvenile steelhead density were applied separately to two size categories in each habitat at each site. The number of fish in Size Class 1 and combined Classes 2 and 3 were recorded for each pass. The size class boundary between Size Classes 1 and 2 was 75 mm Standard Length (SL) (3 inches) because smaller fish would almost always spend another growing season in freshwater before smolting and entering the ocean the following spring. Although some fish larger than 75 mm SL stayed a second year in the stream, the majority of fish captured during fall sampling that were larger than 75 mm SL were found to smolt the very next spring to enter the ocean. These assumptions are based on scale analysis, back-calculated annuli and standard length determinations by Smith of steelhead smolts captured in spring of 1987 and 1989 (**Smith unpublished**). He found that 97% of a random sample (n=248) of yearling smolts in spring were 76 mm SL or longer after their first growing season. In addition, about 75% of smolts that were 75 mm SL or larger at their first annulus (n=319) smolted as yearlings. All 2-year old smolts from a random sample (n=156) were larger than 75 mm SL after 2 growing seasons prior to smolting. Also, 95% of these 2-year olds were at least 60 mm SL after their first growing season, indicating that few YOY less than 60 mm SL after their first growing season survived to smolt.

The depletion method estimated the number of fish in each sampled habitat in two size categories; those less than (<) 75 mm SL (Class 1) and those equal to or greater than (=>) 75 mm SL (Classes 2 and 3). Then, the number of juveniles => 75 mm SL (Class 2) was estimated separately from the juveniles => 150 mm SL (Class 3). This was done by multiplying the proportion of each size class (Class 2 and 3 separately) in the group of captured fish by the estimate of fish density for all fish => 75 mm SL. A density estimate for each habitat type at each site was then determined for each size class. Densities in each habitat type were added together and divided by the total length of that habitat type at the sampling site to obtain a density estimate by habitat type.

The depletion method was also used to estimate the number of fish in each sampled habitat based on 2 age classes: young-of-the-year (YOY) and yearling and older (1+) age classes. Age classes in the mainstem San Lorenzo and mainstem Soquel Creek were determined by scale analysis of a spectrum of fish sizes in 2007. A total of 28 larger San Lorenzo juvenile steelhead and 10 larger Soquel Creek juveniles were aged by scale analysis, along with 20 juveniles from Soquel Lagoon. These limited results showed that the majority of fish => 75 mm SL in the mainstems and lagoon were YOY, but also included yearlings that moved into the mainstem after slow tributary growth in their first year. These data provided information for age class division for both watersheds. Scale analysis, along with past experience of growth rates, and breaks in fish length histograms were used to discern age classes at other sampling sites. Density estimates determined by size class and age class were not the same when YOY reached Size Class II by fall.

In 2011, as in previous years, the lower mainstems of the San Lorenzo River and Soquel Creek, a high proportion of YOY steelhead reached Size Class 2 size in one growing season, as did a few in the middle mainstem San Lorenzo and upper mainstem of Soquel Creek. In this monitoring report, sampling site densities were compared for 14 years in the San Lorenzo system by size and age (1997−2001 and 2003−2011) and for 15 years in Soquel Creek (1997−2011). At each sampling site, habitat types were sampled separately, with density estimates calculated for each habitat. Then these density estimates were combined and divided by the stream length of the entire site to calculate annual site density.

M-8. Sampling of Aptos Lagoon/Estuary

Initially on 26 September 2011, steelhead were sampled from 3 seine hauls with a 106-ft long bag seine (6 feet high by 3/8-inch mesh) in the main estuary (**refer to illustration and photos**). Steelhead were placed in a holding pin until all seine hauls were completed. Half of one pelvic fin was clipped on each steelhead as all steelhead were released back into the estuary. There were no mortalities.

In addition, the periphery of the estuary, including the two eastern fingers, was sampled for tidewater goby and other small fishes from 18 seine hauls with a 30-foot long beach seine (4 feet high by 1/8-inch mesh) (**refer to Figure 41**). The margin along the jetty, concrete walls and riprap could not be seined effectively because these areas lacked smooth, gradual shorelines where the seine could be adequately beached. Each seine haul was inspected for tidewater goby, and the fish species composition was determined for the seine hauls, combined.

On 3 October 2011, steelhead were again sampled with 5 seine hauls with a 106-ft long bag seine in the main estuary. Scale samples were taken from 25 steelhead greater than 150 mm Standard Length for purposes of determining their age (young-of-the-year or older).

DETAILED RESULTS

R-1. Capture and Mortality Statistics

For this study overall in 2011, 1774 juvenile steelhead were captured by electrofishing among all 38 sites, with 4 mortalities (0.23% mortality rate). 405 juvenile steelhead were captured on 2 days at Aptos Lagoon/Estuary with no mortalities. A total of only 79 juvenile steelhead were visually censused in pools at 5 San Lorenzo mainstem sites. Seven mainstem sites and 12 tributary sites were sampled in the San Lorenzo watershed in 2011, with a total of 950 juvenile steelhead captured and 1 mortality (0.11%). A total of 285 juvenile steelhead were captured at 8 sites in the Soquel watershed in 2011 with 1 mortality (0.35%). A total of 88 juveniles steelhead were captured in the Aptos Watershed at 2 Aptos sites with no mortality. A total of 451 juveniles were captured in the Corralitos watershed at 8 sites with 2 mortalities (0.44%).

R-2. Habitat Change in the San Lorenzo River Mainstem and Tributaries, 2010 to 2011

Refer to **Appendix A** for maps of reach locations. Summary tables of habitat change for all reaches are provided in **Tables 13b and 37**. Weighing the relative importance of streamflow as an aspect of habitat quality with other habitat parameters in the fall is not clear cut, especially when exact fall streamflow measurements are limited and spring streamflows were not measured. Most juvenile steelhead growth occurs in the spring when baseflow is most important. All reaches had high baseflow in 2010 and 2011, especially during the important spring growth period, due to late storms in both years. Summer baseflow was higher in 2011 than 2010 because aquifers had recovered somewhat from the dry years of 2007-2009 (**Table 5a**). Higher baseflow provided high levels of food (higher insect drift velocity and more fastwater habitat) and high growth rate in all reaches in 2011, especially with the lower fish densities in 2011 than 2010 (**Figures 22, 23, 27 and 28;** size histograms in **Appendix D**). In 2010 and 2011, only Reach 2 was habitat typed in the mainstem. Therefore, evaluation of habitat quality in other reaches was based on changes at sampling sites. The 2010 contract did not include estimate of substrate conditions at sampling sites, preventing comparisons.

Overall habitat quality improved in Reach 2 primarily due to higher summer baseflow, reduced fine sediment, greater pool and riffle depth and slightly more escape cover in fastwater habitat (**Tables 5a, 6a, 7, 8 and 9a**). Comparisons were imprecise, however, because the habitat typed segment was shifted in 2011 to include the wider northern channel around the island that received most of the streamflow instead of the smaller, historical southern channel. Juvenile steelhead were observed during snorkel censusing in faster glides that developed at pool tails in 2011 (also 2010), which were absent in 2009. Despite better habitat, YOY and Size Class II densities at Site 2a were lower in 2011 (**Tables 18 and 21**) and below average (**Figures 2 and 4**).

Overall rearing habitat conditions improved in the mainstem below the Boulder Creek confluence, based on habitat improvement that occurred at all replicated sampling sites. All sites had higher summer baseflow (more food) and deeper fastwater habitat, (**Tables 5a and 6b**). However, escape cover in fastwater habitat was less in 2011at all replicated sites, indicating habitat degradation in that regard (**Table 9b**). The mainstem site near Teihl Road (upstream of Kings Creek) had overall negative habitat change (slightly shallower pools with less escape cover) (**Table 13b**).

In San Lorenzo River tributaries, of the 5 reaches monitored and compared between 2010 and 2011 (and for the Fall Reach 15 between 2009 and 2011), Zayante 13c, Zayante 13d, Bean 14b, Bean 14c and Fall 15 had overall positive habitat improvement in 2011 (**Table 13b summarized from Tables 5a, 6a, 7, 8 and 12a**). Newell 16 had overall habitat degradation (similar baseflow, shallower, similar sediment, more embeddedness, reduced pool escape cover).

For tributary reaches where habitat conditions were measured at sampling sites only, it is sometimes problematic to extrapolate from site conditions to reach conditions, especially when embeddedness and percent fines were not measured. Sometimes the type of escape cover is site specific. Only if we see consistent habitat changes between sites and reaches in the same tributary can we assume site conditions mirror reach conditions. We know that baseflow was consistently greater in 2011, giving a positive effect on habitat, in general. Sites that improved in 2011 were Zayante 13a, Lompico 13e, Boulder 17a and Bear 18a (**Table 13b summarized from Tables 5a, 6b, 9b, and 12b and raw data in Appendix D**). Sites in Boulder 17b and Branciforte 21a-2 became degraded in 2011.

Table 5a. Fall STREAMFLOW (cubic feet/ sec) Measured by Flowmeter at SAN LORENZO Sampling Sites Before Fall Storms (or in 2011 after summer baseflow has resumed after early storm) by D.W. ALLEY & Associates.

Site # / Location	1995	1996	1998	1999	2000	2001	2003	2004	2005	2006	2010	2011
1- SLR/ Paradise Pk	22.9	25.5	34.3	26.2	21.7	19.6				26.2	18.7	27.6
2- SLR/ Rincon				24.0	21.1	17.2						
3-SLR Gorge	23.3	20.5										
4-SLR/Henry Cowell	18.7		32.7	23.3	21.8	15.5				24.1		
5- SLR/ Below Zayante			31.9									
6- SLR/ Below Fall	14.6		23.4	12.8	11.6	9.4	10.6	8.8	18.9	14.3		
7- SLR/ Ben Lomond	5.8				5.4	3.7	5.4	3.7	8.1			
8- SLR/ Below Clear	4.2		10.3	4.9	4.2	3.1	4.2	2.7	7.1	6.4	4.0	
9- SLR/ Below Boulder	4.6		7.2	3.5		3.0	3.7	2.1	5.8			
10- SLR/ Below Kings				3.0	1.1	1.3	0.6	0.52	1.4			
11- SLR/ Teihl Rd			1.7	0.8	0.8	0.4	0.9	0.63	1.5		0.94	1.10
12a- SLR/Lower Waterman G			1.0	0.7								
13a/ Zayante below Bean			8.5	6.3	5.2	4.7	5.4	5.1	7.4	7.8*	4.9	7.2
13b/ Zayante above Bean			3.9	2.9	2.8	1.9	2.1	1.7	3.2	2.8		
14b/ Bean be Lockhart G	1.5		1.1	1.1	1.0	1.1	1.1	0.77	1.0	1.1		
14c/ Bean ab MacKenzie											0.03	0.11
15/ Fall	2.0		3.4	2.2	1.7	1.7						
16/ Newell	1.6				0.51						1.17	0.92
17a/ Boulder	2.0		2.2		1.1	1.0	1.25	0.9	1.6	1.7	1.58	2.22
18a/ Bear				0.45	0.61	0.34	0.6	0.51	0.90	1.1	0.68	1.30
19a/ Lower Kings			1.1	0.11	0.17	0.02						
20a/ Lower Carbonera	0.33	0.36										
21a-2/ Branciforte			0.80								0.44	0.81

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

Table 5b. Fall/Late Summer STREAMFLOW (cubic feet/ sec) Measured by Santa Cruz County Staff in 2006−2011 and from Stream Gages; Measurements by D.W. ALLEY & Associates; 2010 (September) − 2011 (October at summer baseflow conditions), County Staff (Date stipulated) and from Stream Gages.

Location	2006	2007	2008	2009	2010	2011
SLR at Sycamore Grove	34.8	14.6	14.2	−	18.7 Paradise P. (DWA)	27.6 Paradise P. (DWA)
SLR at Big Trees Gage	28 (1 Oct)	11 (1 Oct)	11 (1 Oct)	11 (1 Oct)	17 (15 Sep); 15 (1 Oct)	26 (15 Sep); 22 (1 Oct)
SLR above Love Cr	13.14	5.42 After*	3.8	−	6.97 (9/7)	
SLR below Boulder Cr	7.49	2.87 After	3.1	−	5.93 (9/7)	
SLR @ Two Bar Cr	1.81	0.78	0.39	−	2.02 (8/4)	2.4 (8/16)
SLR @ Teihl Rd					0.97 (DWA)	1.10 (DWA)
Zayante @ SLR	6.51	3.80	−	−	4.9 Below Bean (DWA)	7.2 Below Bean (DWA); 9.1 (8/3)
Zayante below Lompico Cr	1.21	0.96	0.41	0.43	1.51 (8/24)	
Lompico Creek @ Carrol Ave						0.3 (8/10)
Bean adjacent Mt. Hermon	2.6	1.9	2.1	2.2	3.1 (9/2)	3.5 (8/25)
Bean Below Lockhart Gulch	1.37	0.72	0.79	0.89	0.68 (9/2)	
Newell Cr @ Rancho Rio	1.18	1.16	1.11	−	1.17 (DWA)	0.92 (DWA); 1.6 (8/17)
Boulder Cr @ SLR	2.09	0.84	1.04	0.97	1.58 (DWA)	2.22 (DWA); 2.6 (8/17)
Bear Cr above Hopkins Gu					0.68 (DWA)	1.30 (DWA)
Bear Cr @ SLR	1.87	0.37	0.27	−	1.64 (8/4)	2.0 (8/16)
Branciforte @ Isabel Lane			0.3	0.25	0.42 (8/26)	
Soquel above Lagoon					2.31(DWA)	4.92 (DWA)
Soquel Cr at USGS Gage	6.6**	1.4**	0.65**	1.2**	3.4**	
Soquel Cr @ Bates Cr	5.73	-	1.08		4.19 (9/1)	7.3 (8/31)
Soquel above Moores Gulch					2.06 (DWA)	4.32 (DWA)
W. Branch Soquel @ Old S.J. Road Olive Springs Bridge	2.17	1.75 After	−	−	1.21 @ Mouth (DWA)	2.16 @ Mouth (DWA); 3.0 (8/31)
W. Branch above Hester Creek (SCWD Weir/ Kraeger-prelim.)	1.48 (15 Sep)	1.04 (15 Sep)	−	−	−	−
E. Branch Soquel @ 152 Olive Springs Rd.	-	1.01 After	−	−	0.77 @ Mouth (DWA)	2.10 @ Mouth (DWA); 2.7 (8/31)
E. Branch below Amaya and above Olive Springs Quarry (SCWD Weir/ Kraeger-prelim.)	1.53 (15 Sep)	0.43 (15 Sep)	−	−	−	−
E. Branch Soquel above Amaya Creek				Trickle (DWA)	0.44 (DWA)	
Aptos @ Valencia Cr	2.48	1.21 After	0.77	0.53	0.85 (9/1)	
Aptos above Valencia Cr					0.97 (DWA)	1.64 (DWA)
Valencia Cr @ Aptos Cr			0.007	0.34 (May)	0.09 Adj. School (DWA)	0.8 Adj. School (7/27)
Valencia below Valencia Rd					0.22 (DWA)	
Corralitos Cr below Browns Valley Road Bridge	15.94 (May)	0.49 (May)	dry	1.71 (May)	0.47 (9/2)	0.2 (9/8)
Corralitos above Los Casinos Road Bridge					2.01 (DWA)	2.62 (DWA)
Corralitos Cr @ Rider Cr	3.35	2.50 After	1.44	−	2.41 (9/2)	
Corralitos above Eureka Gu					0.63 (DWA)	0.71 (DWA)
Browns @ 621 Browns Valley Rd	0.96	0.30 After	0.32	−	0.41 (DWA)	0.79 (DWA); 0.5 (9/8)

* After 2 early October storms that increased baseflow.

** Estimated from USGS Hydrographs for September 1.

Table 5c. Habitat Proportions of Pools, Riffles and Run/Step-runs in Habitat-Typed Reaches of the San Lorenzo, Soquel, Aptos and Corralitos Watersheds in 2010 and 2011.

Reach	2010 Pool Habitat In Feet/ Percent / # Habitats	2011 Pool Habitat In Feet/ Percent / # Habitats	2010 Riffle Habitat Feet/ Percent / # Habitats/ Riffle Width (ft)	2011 Riffle Habitat Feet/ Percent / # Habitats/ Riffle Width (ft)	2010 Run/Step-run/ Glide Habitat Feet/ Percent / # Habitats/ Width (ft)	2011 Run/ Step-run Habitat Feet/ Percent / #Habitats/ Width (ft)
Low. San Lorenzo #2 (Segment Shifted)	2006/61%/ 9	1711/52%/ 9	787/ 24%/ 10/ 26 ft	773/ 24%/ 13/ 39 ft	474/ 15%/ 10/ 30 ft	781/ 24%/ 7/ 31 ft
Zayante #13c	2038/69%/ 19	1930/66%/ 21	550/ 19%/ 16/10 ft	579/20%/ 16/13 ft	370/ 12%/ 10/10 ft	419/14%/ 11/ 13 ft
Zayante #13d	1517/57%/ 30	1553/61%/ 30	143/ 6%/ 7/ 8 ft	232/ 9%/ 7/ 10 ft	987/ 37%/ 24/ 15 ft	776/ 30%/ 21/ 16 ft
Bean #14b	2040/67%/ 28	1743/64%/ 26	560/ 18%/ 18/ 11 ft	511/15%/ 18/ 10 ft	445/ 15%/ 15/ 13 ft	666/21%/ 14/ 12 ft
Bean #14c	1765/ 66%/ 31	1700/64%/ 29	323/ 12% 15/ 6 ft	482/18%/ 19/ 7 ft	594/ 22%/ 16/ 7 ft	460/17%/ 14/ 8 ft
Fall #15		523/20%/ 21		1821/71%/ 25/ 16 ft		237/9%/ 9/ 16 ft
Newell #16	1431/59%/ 17	1438/60%/ 16	638/20%/ 15/ 12 ft	449/19%/ 15/ 14 ft	412/21%/ 9/ 14 ft	432/18%/ 10/ 14 ft
Bear #18a	2327/ 70%/ 19		427/ 13%/ 11/14 ft		581/ 17%/ 11/ 15 ft	
Branciforte #21a-2	2075/ 75% 23		312/ 11%/ 18/ 9 ft		380/ 14%/ 13/ 9 ft	
Soquel #3		2407/66%/ 14		480/13%/ 12/ 18 ft		783/21%/ 8/ 19 ft
Soquel #8		1729/61%/ 9		576/20%/ 14/ 19 ft		507/18%/ 6/ 15 ft
Soquel #9a		1575/55%/ 14		774/27%/ 15/ 16 ft		487/17%/ 9/ 18 ft
Soquel #12a		882/34%/ 17		297/12%/ 9/ 11 ft		1402/54%/ 20/ 12 ft
Aptos #4		1854/70%/ 21		322/12%/ 16/ 13 ft		485/18%/ 11/ 12 ft
Corralitos #3		1040/39%/ 20		907/34%/ 22/ 14 ft		752/28%/ 18/ 14 ft
Corralitos #5/6		1181/41%/ 20		800/27%/20/ 12 ft		935/32%/ 17/ 12 ft
Corralitos #7		1044/39%/ 29		329/12%/ 14/ 7 ft		1313/49%/ 27/ 11 ft

Table 6a. Averaged Mean and Maximum WATER DEPTH in SAN LORENZO Reaches Since 2005.

Reach	Pool 2005	Pool 2006	Pool 2007	Pool 2008	Pool 2009	Pool 2010	Pool 2011	Riffle 2005	Riffle 2006	Riffle 2007	Riffle 2008	Riffle 2009	Riffle 2010	Riffle 2011	Run/Step Run 2005	Run/Step Run 2006	Run/Step Run 2007	Run/Step Run 2008	Run/Step Run 2009	Run/Step Run 2010	Run/Step Run 2011
1-L. Main		2.5/4.4	1.8/3.0	1.85/3.4					1.1/1.5	0.8/1.2	0.7/1.2					2.4/3.1	1.0/1.5	0.9/1.35			
2-L. Main			2.5/4.1	2.6/5.1	2.5/4.4	2.7/4.9	**2.9/5.4 Seg. Δ**			0.9/1.4	0.8/1.3	0.8/1.4	0.8/1.4	**1.1/1.7 Seg. Δ**			1.4/2.2	1.3/1.9	1.3/2.3	1.7/2.7	**1.6/2.5 Seg. Δ**
3-L. Main																					
4-L. Main		2.6/4.4	1.9/3.8	2.0/3.6					0.9/1.5	0.7/1.2	0.5/1.0					1.6/2.2	1.4/2.1	0.9/1.5			
5-L. Main																					
6-M. Main	1.9/3.4	2.2/4.3	1.7/3.4	1.6/3.1				0.9/1.4	0.8/1.3	0.6/1.0	0.55/0.9				1.1/2.1	1.3/1.85	0.9/1.3	0.8/1.1			
7-M. Main	2.0/3.5							0.7/1.1							1.1/1.4						
8-M. Main	2.6/5.8	2.7/5.5	2.3/4.3	2.3/4.7	2.8/5.1			1.0/1.5	1.1/1.6	0.6/1.0	0.45/0.7	0.65/1.0			1.3/2.1	1.3/2.25	0.8/1.2	0.8/1.2	0.7/1.0		
9-M. Main	1.9/3.5							0.7/1.1							1.0/1.4						
10-U. Main	1.4/2.8							0.4/0.7							0.7/1.0						
11-U. Main	1.1/2.0	1.1/2.1	1.0/1.9	0.9/1.8	1.05/1.8			0.4/0.7	0.5/0.8	0.2/0.4	0.25/0.5	0.25/0.4			0.5/1.0	0.6/1.1	0.4/0.6	0.4/0.7	0.4/0.75		
12b-U. Main	1.3/2.2							0.3/0.6							0.5/0.8						
Zayante 13a	1.5/2.5	1.6/2.6	1.4/2.2	1.5/2.5				0.6/0.9	0.6/0.9	0.5/0.8	0.4/0.8				0.8/1.1	0.85/1.2	0.6/1.0	0.6/0.9			
Zayante 13b	1.7/2.9							0.5/0.9							0.7/1.2						
Zayante 13c	1.35/2.4		1.2/2.2	1.2/2.2		1.3/2.2	**1.5/2.4**	0.5/0.8		0.2/0.5	0.2/0.6		0.4/0.7	**0.5/0.8**	0.7/1.0		0.5/0.9	0.4/0.8		0.6/1.0	**0.7/1.1**
Zayante 13d	1.1/2.1	1.35/	1.0/	1.0/1.55	0.9/1.5	1.2/2.0	**1.3/2.0**	0.5/0.7	0.45/	0.3/0.5	0.2/0.5	0.25/0.5	0.4/0.6	**0.45/0.8**	0.8/1.4	0.9/1.4	0.6/1.0	0.5/0.9	0.55/0.9	0.7/1.1	**0.8/1.2**

		2.1	1.5						0.8												
Lompico 13e		1.1/ 1.8	0.8/ 1.5	1.0/ 1.7					0.3/ 0.6	0.15/0.4	0.1/ 0.3					0.45/ 0.8	0.35/ 0.65	0.3/ 0.5			
Bean 14a	1.0/ 1.9							0.4/ 0.7							0.7/ 1.1						
Reach	**Pool 2005**	**Pool 2006**	**Pool 2007**	**Pool 2008**	**Pool 2009**	**Pool 2010**	**Pool 2011**	**Rif-fle 2005**	**Rif-fle 2006**	**Rif-fle 2007**	**Rif-fle 2008**	**Rif-fle 2009**	**Rif-fle 2010**	**Rif-fle 2011**	**Run/Step Run 2005**	**Run/Step Run 2006**	**Run/Step Run 2007**	**Run/ Step Run 2008**	**Run/ Step Run 2009**	**Run/ Step Run 2010**	**Run/ Step Run 2011**
Bean 14b	1.0/ 1.9		1.1/ 1.8	1.0/ 1.8	1.2/ 1.9	1.15/ 2.0	**1.2/ 2.0**	0.3/ 0.5		0.2/ 0.4	0.2/ 0.4	0.2/ 0.4	0.2/ 0.4	**0.3/ 0.6**	0.6/ 0.8		0.4/ 0.8	0.4/ 0.65	0.4/ 0.6	0.4/ 0.6	**0.5/ 0.8**
Bean 14c	1.0/ 1.7	1.0/ 1.8	0.8/ 1.5	0.9/ 1.7		0.9/ 1.6	**1.0/ 1.8**	0.1/ 0.3	0.2/ 0.3	0.03/0.1	0.03/ 0.1		0.1/ 0.2	**0.2/ 0.4**	0.2/ 0.5	0.35/ 0.5	0.1/ 0.2	0.06/ 0.1		0.2/ 0.4	**0.3/ 0.5**
Fall 15				0.9/ 1.4	0.9/ 1.4		**1.3/ 1.9**				0.4/ 0.8	0.35/ 0.75		**0.6/ 1.05**				0.6/ 0.9	0.5/ 1.0		**0.8/ 1.25**
Newell 16		1.6/ 2.8			1.3/ 2.4	1.5/ 2.5	**1.4/ 2.3**		0.3/ 0.5			0.25/ 0.45	0.3/ 0.5	**0.3/ 0.5**		0.6/ 0.9			0.4/ 0.7	0.4/ 0.8	**0.5/ 0.8**
Boulder 17a	1.8/ 2.9	2.0/ 3.1	1.7/ 2.7	1.6/ 2.6	1.8/ 2.9			0.5/ 0.9	0.6/ 1.0	0.4/ 0.7	0.4/ 0.7	0.35/ 0.7			0.7/ 1.2	0.9/ 1.4	0.6/ 1.0	0.6/ 0.95	0.65/ 1.05		
Boulder 17b	1.7/ 2.8	1.7/ 2.8	1.6/ 2.7	1.5/ 2.7				0.4/ 1.0	0.6/ 1.0	0.4/ 0.75	0.3/ 0.6				0.7/ 1.2	0.8/ 1.4	0.6/ 1.1	0.55/ 0.95			
Boulder 17c	1.9/ 2.9							0.4/ 0.8							0.9/ 1.5						
Bear 18a	2.0/ 3.4	2.0/ 3.35	1.4/ 2.4	1.3/ 2.55				0.4/ 0.7	0.6/ 0.9	0.2/ 0.4	0.2/ 0.4				0.7/ 1.1	0.8/ 1.25	0.4/ 0.7	0.35/ 0.7			
Bear 18b																					
Branciforte 21a-1			1.2/ 2.2	1.35/ 2.3						0.15/0.3	0.2/ 0.3						0.3/ 0.5	0.3/ 0.6			
Branciforte 21a-2		1.1/ 1.9	1.0/ 1.7	0.9/ 1.7	1.0/ 1.8	1.0/ 1.9			0.3/ 0.5	0.2/ 0.4	0.2/ 0.35	0.2/ 0.35	0.2/ 0.4			0.5/ 1.0	0.4/ 0.7	0.45/ 0.65	0.45/ 0.65	0.5/ 0.8	
Branciforte 21b	1.1/ 1.7							0.4/ 0.7							0.3/ 0.6						

Table 6b. Averaged Mean and Maximum WATER DEPTH (ft) at REPLICATED San Lorenzo Sampling Sites in 2009−2011.

Site	Pool 2009	Pool 2010	Pool 2011	Riffle 2009	Riffle 2010	Riffle 2011	Run/Step Run 2009	Run/Step Run 2010	Run/Step Run 2011
0a	1.8/ 3.2	1.2/ 2.2	**1.6/ 2.0**	0.15/ 0.2	0.75/ 0.9	**1.1/ 1.8**	0.4/ 0.8	0.95/ 1.8	**1.0/ 1.8**
1				0.8/ 1.1	0.9/ 1.45	**1.15/ 1.6**	1.2/ 1.7	1.3/ 1.9	**1.6/ 2.1**
2						**1.3/ 1.5**			**1.7/ 2.95**
4				0.55/ 0.9	0.55/ 0.9	**0.85/ 1.1**	0.8/ 1.35	1.1/ 2.2	**1.55/ 2.0**
6				0.5/ 0.7	0.65/ 0.8	**0.65/ 1.0**	0.6/ 1.1	0.6/ 1.2	**0.7/ 1.2**
8				0.65/ 0.9	0.8/ 1.0	**0.9/ 1.2**	0.85/ 1.0	0.95/ 1.2	**1.0/ 1.3**
11	0.95/ 1.75	1.0/ 1.6	**0.9/ 1.5**	0.1/ 0.2	0.2/ 0.35	**0.3/ 0.45**	0.4/ 0.8	0.6/ 0.8	**0.6/ 1.1**
Zayante 13a	1.8/ 2.9	2.1/ 3.4	**1.8/ 3.8**	0.15/ 0.4	0.2/ 0.5	**0.5/ 0.8**	0.65/ 1.0	0.75/ 1.3	**0.9/ 1.5**
Zayante 13c			**1.1/ 1.85**			**0.6/ 0.9**			**0.7/ 0.95**
Zayante 13d			**1.1/ 1.9**						**0.8/ 1.15**
Lompico 13e	0.85/ 1.75	1.2/ 1.6	**1.25/ 1.75**	0.1/ 0.15	0.1/ 0.3	**0.2/ 0.4**	0.3/ 0.5	0.45/ 0.75	**0.5/0.8**
Bean 14b	1.0/ 2.0	0.9/ 2.0	**1.4/ 2.4**	0.2/ 0.4	0.25/ 0.4	**0.25/ 0.8**	0.2/ 0.4	0.5/ 0.6	**0.5/ 0.7**
Bean 14c			**0.8/ 1.65**			**0.2/ 0.3**			**0.3/ 0.5**
Fall 15			**1.1/ 1.85**			**0.7/ 1.4**			**0.9/ 1.4**
Newell 16	1.15/ 1.95	1.25/ 1.9	**1.15/ 1.85**	0.2. 0.5	.25/ .55	**0.4/ 0.5**	0.3/ 0.5	0.5/ 0.9	**0.4/ 0.6**
Boulder 17a	1.05/ 1.8	1.2/ 1.75	**1.35/ 1.95**	0.4/ 0.8	0.7/ 1.1		0.7/ 1.1	0.9/ 1.2	**1.1/ 1.4**
Boulder 17b	1.4/ 2.4	1.45/ 2.2	**1.2/ 1.85**	0.5/ 1.0	0.6/ 1.1	**0.7/ 1.2**	0.5/ 0.9	0.7/ 0.9	**0.8/ 1.4**
Bear 18a		1.35/ 2.6	**1.3/ 2.7**		0.3/ 0.6	**0.3/ 0.6**		0.7/ 0.9	**0.65/ 1.0**
Branciforte 21a-2	1.15/ 1.9	1.25/ 2.05	**1.0/ 2.0**	0.1/ 0.2	0.1/ 0.2	**0.25/ 0.5**	0.4/ 0.6	0.5/ 1.2	**0.35/ 0.6**

Table 7. Average PERCENT FINE SEDIMENT* IN SAN LORENZO Reaches Since 2005.

Reach	Pool 2005	Pool 2006	Pool 2007	Pool 2008	Pool 2009	Pool 2010	Pool 2011	Riffle 2005	Riffle 2006	Riffle 2007	Riffle 2008	Riffle 2009	Riffle 2010	Riffle 2011	Run / Step Run 2005	Run / Step Run 2006	Run / Step Run 2007	Run / Step Run 2008	Run / Step Run 2009	Run / Step Run 2010	Run / Step Run 2011
1		80	65	77					20	15	20					40	46	46			
2			42	54	48	48	**47**			10	13	13	10	**8**			26	23	26	40	**13**
4		75	46	47					20	13	10					50	42	37			
6	70	75	61	68				20	25	17	12				40	38	18	23			
7	70							20							40						
8	65	60	41	47	44			20	20	7	6	12			25	25	11	16	25		
9	60							15							30						
10	70							15							35						
11	35	40	32	52	40			15	25	10	9	12			25	15	24	14	14		
12b	35							35							10						
Zayante 13a	65	65	59	62				25	35	22	19				50	40	36	31			
Zayante 13b	65							30							30						
Zayante 13c	45		45	47		41	**43**	10		9	12		10	**14**	20		27	34		19	**19**
Zayante 13d	40	50	38	44	46	42	**40**	25	15	13	13	12	19	**14**	25	40	21	29	28	27	**28**
Lompico 13e		50	49	54					20	15	20					30	24	29			
Bean 14a	70							25							35						
Bean 14b	80		67	66	67	55	**61**	15		18	9	13	13	**32**	45		58	34	34	28	**72**
Bean 14c	60	65	42	37		54	**51**	5	15	6	6		14	**9**	30	40	28	10		26	**19**
Fall 15				64	69		**57**				30	34		**19**				48	50		**37**
Newell 16		25			46	22	**22**		5			11	6	**3**		20			19	12	**4**
Boulder 17a	30	35	31	27	28			20	5	12	9	11			15	20	17	13	11		
Boulder 17b	30	35	31	32				5	10	5	5				15	15	12	14			
Boulder 17c	25							5							5						
Bear 18a	50	60	41	46		41		15	15	7	11		13		20	25	13	13		19	
Branciforte 21a-1			65	62						7	10						30	16			
Branciforte 21a-2		75	50	42	38	43			40	12	8	8	9			55	35	21	13	22	
Branciforte 21b	55							15							65						

* Fine sediment was visually estimated as particles less than approximately 2 mm (0.08 inches).

Table 8. Average EMBEDDEDNESS IN SAN LORENZO Reaches Since 2005.

Reach	Pool 2005	Pool 2006	Pool 2007	Pool 2008	Pool 2009	Pool 2010	Pool 2011	Riffle 2005	Riffle \2006	Riffle 2007	Riffle 2008	Riffle 2009	Riffle 2010	Riffle 2011	Run/ Step Run 2005	Run / Step Run 2006	Run / Step Run 2007	Run / Step Run 2008	Run / Step Run 2009	Run / Step Run 2010	Run / Step Run 2011
1		59	50	52					31	23	26					49	48	48			
2			26	38	36	37	**49**			13	18	16	25	**20**			23	25	32	27	**28**
3																					
4		64	43	45					37	19	33					47	37	42			
5																					
6	49	56	45	51				31	31	18	21				46	41	34	39			
7	54							27							40						
8	53	56	40	46	33			25	28	18	30	19			29	35	28	26	32		
9	39							25							31						
10	39							27							34						
11	58	48	34	47	48			30	33	22	30	22			45	27	31	43	33		
12b	58							27							45						
Zayan-te 13a	45	54	44	51				29	23	25	30				44	50	36	47			
Zayan-te 13b	46							25							39						
Zayan-te 13c	48		36	49		49	**48**	25		19	28		29	**31**	38		31	44		36	**56**
Zayan-te 13d	47	51	55	49	49	57	**53**	48	37	30	33	43	39	**45**	43	42	39	37	41	51	**40**
Lompi-co 13e		55	52	47					42	16	19					46	37	32			
Bean 14a	45							21							37						
Bean 14b	41		45	44	44	53	**51**	20		22	14	16	25	**32**	29		36	22	35	30	**55**
Bean 14c	50	62	39	42		60	**53**	27	36	8	15		42	**31**	46	52	25	29		43	**46**
Fall 15				48	52		**46**				25	28		**18**				40	41		**42**
Newell 16		36			42	39	**53**		12			20	24	**31**		33			31	34	**43**
Boul-der 17a	34	48	37	37	38			24	29	18	21	18			30	33	27	31	27		
Boul-der 17b	36	43	33	35				14	24	22	17				29	34	33	34			
Boulder 17c	31							18							13						
Bear 18a	42	54	33	48		49		22	35	28	34		25		30	41	36	43		34	
Branc2 1a-1			60	58						31	24						55	41			
Branc-21a-2		68	62	46	49	53			41	30	28	28	30			59	36	33	28	41	
Branc-21b	41							28							32						

Table 9a. ESCAPE COVER Indices (Habitat Typing Method*) in RIFFLE HABITAT in MAINSTEM Reaches of the SAN LORENZO, Based on Habitat Typed Segments.

Reach	1998	1999	2000	2003	2005	2006	2007	2008	2009	2010	2011
1	0.187	0.244	0.084	-	-	0.270	0.257	0.200			
2	-	0.503	0.260	-	-		0.228	0.287	0.132	0.109	0.126 Seg. Δ
3	0.250	0.216	0.257	-	-						
4	0.125	0.078	0.109	-	-	0.183	0.354	0.141			
5	0.032	0.001	0.222	-	-						
6	**0.099**	**0.093**	**0.042**	**0.027**	**0.152**	**0.101**	**0.072**	**0.082**			
7	**0.148**	**0.146**	**0.050**	**0.130**	**0.187**						
8	**0.335**	**0.173**	**0.124**	**0.080**	**0.320**	**0.241**	**0.123**	**0.036**	**0.156**		
9	**0.038**	**0.080**	**0.043**	**0.066**	**0.161**						
10	0.011	0.039	0.012	0.018	0.040						
11	0.025	0.020	0.017	-	0.056	0.014	0.005	0.010	0.027		
12	0.086	0.022	0.036	-	0.044						

*Habitat Typing Method = linear feet of escape cover divided by habitat typed channel length as riffle habitat.

Table 9b. ESCAPE COVER Indices (Habitat Typing Method*) in RIFFLE AND RUN HABITAT at Replicated MAINSTEM SAN LORENZO SAMPLING SITES in 2009–2011.

Sampling Site	2009	2010	2011
Santa Cruz Levees 0a	0.211	0.298	0.205
Paradise Park 1	0.155	0.183	0.128
Rincon 2			0.129
Henry Cowell 4	0.537	0.479	0.374
Below Fall Creek 6	0.113	0.230	0.109
Below Clear Creek 8	0.082	0.194	0.154
Above Kings Creek Near Teihl Rd 11	0.0	0.024	0.036

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

Table 10. ESCAPE COVER Indices (Habitat Typing Method*) in RUN HABITAT in MAINSTEM Reaches of the SAN LORENZO, Based on Habitat Typed Segments.

Reach	1998	1999	2000	2003	2005	2006	2007	2008	2009	2010	2011
1	0.273	0.130	0.064	-	-	0.131	0.120	0.151			
2	0.228	0.136	0.100	-	-		0.282	0.226	0.196	0.252	0.158 Seg. Δ
3	0.186	0.113	0.144	-	-						
4	0.234	0.159	0.091	-	-	0.125	0.204	0.221			
5	0.071	0.249	0.261	-	-						
6	**0.145**	**0.107**	**0.044**	**0.068**	**0.098**	**0.101**	**0.049**	**0.044**			
7	**0.038**	**0.030**	**0.023**	**0.165**	**0.074**						
8	**0.129**	**0.152**	**0.131**	**0.154**	**0.164**	**0.103**	**0.168**	**0.087**	**0.079**		
9	**0.138**	**0.051**	**0.036**	**0.046**	**0.098**						
10	0.072	0.041	0.081	0.062	0.057						
11	0.026	0.016	0.022	-	0.021	0.0084	0.0068	0.014	0.032		
12	0.031	0.069	0.126	-	0.048						

*Habitat Typing Method = linear feet of escape cover divided by habitat typed channel length as run habitat.

Table 11. ESCAPE COVER Indices (Habitat Typing Method*) in POOL HABITAT in MAINSTEM Reaches of the SAN LORENZO, Based on Habitat Typed Segments.

Reach	2003	2005	2006	2007	2008	2009	2010	2011
1	-	-	0.271	0.186	0.205			
2	-	-		0.076	0.058	0.046	0.049	0.124 Seg. Δ
3	-	-						
4	-	-	0.203	0.275	0.290			
5	-	-						
6	**0.077**	**0.077**	**0.044**	**0.083**	**0.088**			
7	**0.134**	**0.105**						
8	**0.026**	**0.027**	**0.039**	**0.057**	**0.030**	0.049		
9	**0.037**	**0.070**						
10	0.054	0.051						
11	0.054 (2000)	0.059	0.031	0.034	0.035	0.042		
12	-	0.178						

*Habitat Typing Method = linear feet of escape cover divided by habitat typed channel length as pool habitat.

Table 12a. ESCAPE COVER Indices (Habitat Typing Method*) for POOL HABITAT in TRIBUTARY Reaches of the SAN LORENZO.

Reach	1998	1999	2000	2003	2005	2006	2007	2008	2009	2010	2011
Zayante 13a	0.320	0.069	0.056	0.169	0.081	0.074	0.071	0.086			
Zayante 13b	0.150	0.093	0.072	0.130	0.087						
Zayante 13c	0.114	0.110	0.095	0.110	0.109		0.102	0.099		0.073	**0.075**
Zayante 13d	0.145	0.191	0.132	0.237	0.269	0.126	0.117	0.118	0.181	0.091	**0.167**
Lompico 13e						0.089	0.082	0.095			
Bean 14a	0.248	0.143	0.186	0.124	0.155						
Bean 14b	0.378	0.280	0.205	0.288	0.212		0.231	0.171	0.179	0.207	**0.225**
Bean 14c	0.259	0.093	0.100	0.142	0.141	0.131	0.142	0.131		0.135	**0.115**
Fall 15	0.380		0.330					0.375	0.295		**0.429**
Newell 16	0.285		0.325			0.120			0.125	0.111	**0.083**
Boulder 17a	0.131	0.051	0.061	-	0.108	0.064	0.076	0.058	0.047		
Boulder 17b	0.129	0.141	0.164	-	0.232	0.100	0.140	0.155			
Boulder 17c	0.250	0.072	0.057	-	0.143						
Bear 18a	0.069	-	0.103	0.119	0.114	0.074	0.088	0.087		0.104	
Branciforte 21a-1							0.140	0.136			
Branciforte 21a-2						0.121	0.134	0.151	0.164	0.188	
Branciforte 21b	0.147	0.083	0.102	-	0.189						

*Habitat Typing Method = linear feet of escape cover divided by habitat typed channel length as pool habitat.

Table 12b. POOL ESCAPE COVER Indices (Habitat Typing Method*) at Replicated San Lorenzo Tributary Sites and the Mainstem Teihl Site in 2009−2011.

Site (Reach)	Pool Escape Cover 2009	Pool Escape Cover 2010	Pool Escape Cover 2011
Mainstem @ Teihl 11	0.058*	0.094	**0.033**
Zayante 13a	0.140	0.103	**0.167**
Zayante 13c			**0.120**
Zayante 13d	0.285	0.113	**0.168**
Lompico 13e	0.154	0.092	**0.061**
Bean 14b	0.145	0.120	**0.165**
Bean 14c			**0.098**
Fall 15	0.302	0.571	**0.429**
Newell 16	0.150	0.118	**0.101**
Boulder 17a	0.066	0.094	**0.110**
Boulder 17b	0.356	0.266	**0.258**
Bear 18a		0.138	**0.101**
Branciforte 21a-2	0.051	0.068	**0.040**

*Habitat Typing Method = linear feet of escape cover divided by habitat typed channel length as pool habitat.

Table 13a. ESCAPE COVER Indices (Habitat Typing Method*) for RUN/STEP-RUN HABITAT in TRIBUTARY Reaches of the SAN LORENZO.

Reach	1998	1999	2000	2003	2005	2006	2007	2008	2009	2010	2011
Zayante 13a	0.127	0.059	0.059	0.065	0.031	0.038	0.027	0.009			
Zayante 13b	0.060	0.127	0.087	0.152	0.103						
Zayante 13c	0.116	0.095	0.070	0.016	0.070		0.051	0.074		0.124	**0.007**
Zayante 13d	0.050	0.098	0.143	0.223	0.297	0.071	0.101	0.130	0.136	0.103	**0.134**
Lompico 13e						0.001	0.042	0.020			
Bean 14a	0.060	0.058	0.092	0.051	0.086						
Bean 14b	0.045	0.048	0.041	0.107	0.050		0.138	0.141	0.056	0.080	**0.084**
Bean 14c	-	0.018	0.023	0.015	0.012	0.009	0.0	0.0		0.0	**0.018**
Fall 15								0.110	0.092		**0.045**
Newell 16	0.072		0.129			0.020			0.065	0.018	**0.040**
Boulder 17a	0.188	0.093	0.170	-	0.135	0.169	0.138	0.113	0.100		
Boulder 17b	0.116	0.156	0.137	-	0.194	0.102	0.114	0.105			
Boulder 17c	0.019	0.122	0.107	-	0.114						
Bear 18a	0.073	-	0.177	0.063	0.088	0.063	0.027	0.030			
Branciforte 21a-1							0.087	0.040			
Branciforte 21a-2						0.028	0.045	0.037	0.045	0.101	
Branciforte 21b	0.138	0.014	0.087	-	0.133						

*Habitat Typing Method = linear feet of escape cover divided by habitat typed channel length as run habitat.

Table 13b. Habitat Change in the SAN LORENZO MAINSTEM AND TRIBUTARIES.

Reach Comparison or (Site Only)	Baseflow	Pool Depth/ Fastwater Habitat Depth in Mainstem below Boulder Creek	Fine Sediment	Embeddedness	Pool Escape Cover/ Fastwater Habitat Cover in Mainstem below Boulder Creek	Overall Habitat Change
(Mainstem 0a)	+	+ / +	NA*	NA	/−	+
(Mainstem 1)	+	/ +	NA	NA	/−	+
Mainstem 2	+	+ / +	+ (Run)	− (Pool)	+ / + Riffle; − Run (Segment Δ)	+
(Mainstem 4)	+	/ +	NA	NA	/−	+
(Mainstem 6)	+	/ +	NA	NA	/−	+
(Mainstem 8)	+	/ +	NA	NA	/−	+
(Mainstem Near Teihl 11)	Slightly +	Slightly −	NA	NA	−	−
(Zayante 13a)	+	+	+	NA	+	+
Zayante 13c	+	+	Similar	− (run)	Similar	+
Zayante 13d	+	+	Similar	+ (run)	+ (and step-run)	+
(Lompico 13e)	+	+	NA	NA	−	+
Bean 14b	+	+	−	− (run)	+	+
Bean 14c	+	+	Similar	+ (riffle)	−	+
Fall 15 (2009 to 2011)	+	+	+	+ (riffle)	+	+
Newell 16	Similar	−	Similar	−	−	−
(Boulder 17a)	+	+	NA	NA	Similar	+
(Boulder 17b)	+	−	NA	NA	Similar	−
(Bear 18a)	+	Similar	+ (riffle)	Similar	−	+
(Branciforte 21a-2)	+	−	−	− (run)	−	−

***NA = Not available.**

R-3. Habitat Change in Soquel Creek and Its Branches, 2010 to 2011

Refer to **Appendix A** for maps of reach locations. Summary tables of habitat change for all sites are provided in **Tables 15e and 37**. Weighing the relative importance of streamflow as an aspect of fall habitat quality with other habitat parameters is not clear cut. Most steelhead growth occurs in spring when baseflow is most important. All reaches had higher baseflow in summer/fall 2011 than 2010, but likely similar flows in the spring due to late storms in both 2010 and 2011 (Table 5b; **Figures 30 and 31**). This provided more food and good growth rates in all reaches (**Figure 18;** size histograms in **Appendix D**), especially when YOY abundance was below average (**Figure 6**). Changes in habitat conditions were based on comparisons of habitat typed segments or sampling sites where only sites conditions were assessed. Of the 4 reach segments and 4 sampling sites examined, all had overall positive habitat change based on more streamflow and greater pool depth at in 7 of 8 comparisons and more pool escape cover (6 of 8 comparisons) (**Table 15e summarized from Tables 5b, 14a, 14b, 15a−d**).

Table 14a. Averaged Mean and Maximum WATER DEPTH (ft) of Habitat in SQOUEL CREEK Reaches Since 2005 with Pool Depths Since 2003.

Reach	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Pool 2008	Pool 2009	Pool 2011	Riffle 2005	Riffle 2006	Riffle 2007	Riffle 2008	Riffle 2009	Riffle 2011	Run/ Step Run 2005	Run/ Step Run 2006	Run/ Step Run 2007	Run/ Step Run 2008	Run/ Step Run 2009	Run/ Step Run 2011
1	1.4/ 2.7	1.1/ 2.8		1.2/ 2.7	1.2/ 2.8	1.15 / 2.7		-/ 0.7		0.3/ 0.4	0.2/ 0.4*	0.25 / 0.45		-/ 0.8		0.4/ 0.5	0.3/ 0.5	0.35/ 0.5	
2	1.0/ 1.6	1.0/ 1.7						-/ 0.6						-/ 1.1					
3	1.35/ 2.5	1.3/ 2.3	1.4/ 2.5 *	1.4/ 2.3 *	1.2/ 2.3 *	1.4/ 2.35	**1.6/ 3.0**	-/ 0.7	0.5/ 0.8 *	0.3/ 0.5 *	0.2/ 0.4 *	0.25/ 0.4	**0.45/ 0.75**	-/ 1.0	0.7/ 1.0 *	0.4/ 0.6 *	0.3/ 0.6 *	0.45/ 0.7	**0.7/ 1.1**
4	1.2/ 2.6	1.1/ 2.6						-/ 0.8						-/ 0.9					
5	1.2/ 2.2	1.2/ 2.3						-/ 0.7						-/ 0.9					
6	1.45/ 2.5	1.25 / 2.2						-/ 0.7						-/ 0.9					
7	1.6/ 2.9	1.2/ 2.2	1.3/ 2.3 *	1.2/ 2.1 *	1.2/ 2.2 *	1.35 /2.4		-/ 0.8	0.5/ 0.8 *	0.3/ 0.6 *	0.3/ 0.5 *	0.35 /0.55		-/ 0.9	0.8/ 1.2 *	0.3/ 0.6 *	0.4/ 0.7 *	0.5/ 0.8	
8	1.6/ 2.9	1.4/ 2.7		1.5/ 2.9 *	1.4/ 2.5 *	1.6/ 2.8	**1.9/ 3.5**	-/ 0.8		0.4/ 0.6 *	0.2/ 0.4 *	0.3/ 0.45	**0.6/ 0.9**	-/ 0.9		0.5/ 0.9 *	0.4/ 0.7 *	0.5/ 0.75	**0.9/ 1.3**
9		1.3/ 2.1	1.5/ 2.5	1.3/ 2.2	1.2/ 2.3	1.45 /2.3	**1.6/ 2.7**	-/ 0.6	0.4/ 0.6	0.2/ 0.4	0.2/ 0.4	0.2/ 0.45	**0.5/ 0.7**	-/ 0.9	0.6/ 1.0	0.4/ 0.6	0.4/ 0.6	0.5/ 0.75	**0.6/ 0.85**
10																			
11																			
12a		1.1/ 1.7	1.3/ 2.05	0.8/ 1.4	0.6/ 1.1	1.0/ 1.5	**1.0/ 1.7**	-/ 0.6	0.45 / 0.8	0.1/ 0.2	0.02 /0.1	0.25 / 0.45	**0.4/ 0.7**	-/ 1.1 S.run	0.7/ 1.2	0.3/ 0.7	0.2/ 0.5	0.45/ 0.8	**0.6/ 1.05**
12b		1.1/ 1.6						-/ 0.5						-/ 1.0 S.run					
13				1.1/ 2.2 *	1.1/ 2.3 *	1.25 /2.3				0.3/ 0.5 *	0.3/ 0.5 *	0.3/ 0.5				0.5/ 0.8 *	0.4/ 0.7 *	0.5/ 0.8	
14a		1.0/ 1.8	1.4/ 2.4					-/ 0.5	0.5/ 0.8					-/ 0.7	0.6/ 1.0				
14b	1.5/ 2.6 2002		1.6/ 2.9	1.4/ 2.4	1.3/ 2.4	1.35 / 2.5			0.4/ 0.6	0.2/ 0.4	0.2/ 0.4	0.25 / 0.5			0.7/ 1.0	0.5/ 0.8	0.4/ 0.7	0.5/ 0.8	
14c	1.4/ 2.4 2002																		

*Partial, ½-mile segments habitat typed in 2006–2009 and 2011. Previously, the entire reach was habitat typed.

Table 14b. Averaged Mean and Maximum WATER DEPTH (ft) of Habitat at Replicated SQOUEL CREEK Sampling Sites in 2009− 2011.

Site (Reach)	Pool 2009	Pool 2010	Pool 2011	Riffle 2009	Riffle 2010	Riffle 2011	Run/Step Run 2009	Run/Step Run 2010	Run/Step Run 2011
1 (1)	1.0/ 2.8	1.0/ 2.8	**0.9/ 3.2**	0.4/ 0.5	0.5/ 0.75	**0.5/ 0.8**	0.2/ 0.3	0.35/ 0.8	**0.8/ 1.1**
4 (3)	1.6/ 2.9	2.0/ 4.3	**1.2/ 2.5**	0.4/ 0.6	0.55/ 0.8	**0.6/ 0.9**	0.5/ 0.8	0.7/ 1.0	**0.7/ 1.0**
10 (7)		1.4/ 2.8	**1.4/ 3.0**	0.55/ 0.9	0.6/ 1.2	**0.65/ 0.9**	0.5/ 0.9	0.6/ 1.2	**0.9/ 1.2**
12 (8)			**2.2/ 2.8**			**0.9/ 1.2**			**1.0/ 1.5**
13a (9a)			**1.65/ 2.4**			**0.5/ 0.7**			**0.7/ 0.9**
16 (12a)			**1.2/ 1.85**						**0.55/ 0.95**
19 (13)	1.0/ 2.0	1.1/ 2.1	**0.9/ 2.9**	0.5/ 0.7	0.5/ 0.9	**0.45/ 0.6**	0.5/ 0.9	0.6/ 1.1	**0.7/ 1.1**
21 (14b)	1.5/ 3.55	1.8/ 3.85	**1.9/ 3.75**	0.3/ 0.5	0.4/ 0.55	**0.3/ 0.7**	0.7/ 1.8	0.6/ 1.3	**0.4/ 1.3**

Table 15a. Average PERCENT FINE SEDIMENT in Habitat-typed Reaches in SOQUEL CREEK Since 2003.

Reach	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Pool 2008	Pool 2009	Pool 2011	Riffle 2005	Riffle 2006	Riffle 2007	Riffle 2008	Riffle 2009	Riffle 2011	Run/ Step Run 2005	Run/ Step Run 2006	Run/ Step Run 2007	Run / Step Run 2008	Run/ Step Run 2009	Run/ Step Run 2011
1	73	84		59	64	59		25		18	13	14		36		29	16	16	
2	69	80						24						34					
3	70	75	62	55	57	58	**59***	17	14	17	15*	8	**11***	43	29	29	20	19	**14***
4	72	61						21						29					
5	66	69						21						27					
6	59	63						14						26					
7	66	69	69	52	59	70*		17	21*	20	23	16*		35	33	25	25	20*	
8	59	64		46	56	58	**63***	16		14	15	5	**11***	24		25	64	28	**23***
9		56	62	47	49	42	**58**	17	12	13	10	6	**6**	25	30	24	26	19	**24**
10																			
11																			
12a		33	40	29	34	35	**42***	9	12	6	10	12	**8***	15 (S.run)	21 (S.run)	20 (S.run)	21 (S.run)	19 (S.run)	**15***
12b		36						5						18					
13				64	75	58*				26	18	11*				29	26	20*	
14a		55	66					15	14					31 (run)	28 (run)				
14b			51	40	55	52			15	9	10	8			35 (run)	26 (run)	20 (run	20 (run)	
14c																			

*Partial, ½-mile segments habitat typed in 2006–2009 and 2011 where previously, the entire reach was habitat typed.

Table 15b. Average EMBEDDEDNESS in Pool and Fastwater (Riffle and Run) Habitat of SOQUEL CREEK Reaches Since 2003 .

Reach	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Pool 2008	Pool 2009	Pool 2011	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Riffle 2008	Riffle 2009	Riffle 2011	Run / Step Run 2003	Run / Step Run 2005	Run / Step Run 2006	Run / Step Run 2007	Run / Step Run 2008	Run / Step Run 2009	Run / Step Run 2011
1	55	57		48	35	37		33	25		22	18	19		55	35		29	29	23	
2	60	56						39	34						69	46					
3	59	58	55*	40*	39*	37*	**40***	30	27	27*	17*	22*	19*	**13***	46	42	46*	28*	33*	23*	**24***
4	58	61						40	31						54	48					
5	52	55						36	27						48	42					
6	50	53						31	28						43	40					
7	53	53	56*	42*	44*	41*		33	30	25*	25*	23*	23*		43	43	39*	35*	39*	38*	
8	49	60		44*	43*	45*	**60***	38	29		25*	17*	17*	**28***	46	45		35*	48*	33*	**50***
9		59	54	47	44	50	**59**		34	26	18	22	26	**28**		45	50	37	47	42	**50**
10																					
11																					
12a		53	53	55	54	59	**57**		29	30	41	45	34	**28**		37 (S.run)	38 (S.run)	47 (S.run)	39 (S.run)	46 (S.run)	**38 (S.run)**
12b		59							30							47					
13				50*	42*	53*					26*	23*	22*					39*	29*	37*	
14a		58	57						47	18						59 (run)	34 (run)				
14b	55 2002		57	47	44	44		33 2002		32	17	19	16		47 (run) 2002		46 (run)	25 (run)	27 (run)	38 (run)	
14c	61 2002							30 2002							45 2002						

*Partial, ½-mile segments habitat typed in 2006–2009 and 2011where previously, the entire reach was habitat typed.

Table 15c. POOL ESCAPE COVER Index (Habitat Typing Method*) in SOQUEL CREEK, Based on Habitat Typed Segments.

Reach	Pool 2000	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Pool 2008	Pool 2009	Pool 2011
1	0.091	0.103	0.107		0.147	0.134	0.116	
2	0.086	0.055	0.106					
3	0.085	0.092	0.141	0.178 * **	0.177 **	0.131 **	0.112 **	**0.069 ****
4	0.041	0.071	0.086					
5	0.061	0.023	0.075					
6	0.082	0.102	0.099					
7	0.089	0.101	0.129	0.141 **	0.164 **	0.170 **	0.089 **	
8	0.047	0.036	0.060		0.070 **	0.071 **	0.037 **	**0.052 ****
9	0.146		0.101	0.086	0.117	0.147	0.100	**0.128**
10	0.100							
11	0.068							
12a	0.113		0.222	0.175	0.121	0.097	0.143	**0.169**
12b	0.129		0.158					
13	0.077				0.081 **	0.069 **	0.060 **	
14a	0.064			0.048				
14b		0.051 (2002)		0.058	0.076	0.080	0.069	
14c		0.068 (2002)						

* Habitat Typing Method = linear feet of escape cover divided by reach length as pool habitat.

** Partial, ½-mile segments habitat typed in 2006–2009 and 2011 where previously, the entire reach was habitat typed.

Table 15d. POOL ESCAPE COVER Indices (Habitat Typing Method*) in SOQUEL CREEK, at Replicated Sampling Sites in 2009− 2011.

Site (Reach)	Pool Escape Cover 2009	Pool Escape Cover 2010	Pool Escape Cover 2011
1 (1)	0.101	0.132	**0.104**
4 (3)	0.102	0.067	**0.085**
10 (7)		0.124	**0.254**
12 (8)			**0.092**
13a (9a)			**0.101**
16 (12a)			**0.079**
19 (13)	0.041	0.080	**0.131**
21 (14b)	0.029	0.017	**0.021**

Table 15e. Habitat Change in SOQUEL CREEK WATERSHED Reaches (2009 to 2011) and Replicated Sites (2010 to 2011).

Reach Comparison or (Site Only)	Baseflow	Pool Depth	Fine Sediment	Embeddedness	Pool Escape Cover	Overall Habitat Change
(Soquel Site-1)	+	+	NA*	NA	−	+
Soquel Reach-3a	+	+	Similar	Similar	−	+
(Soquel Site-10)	+	+	NA	NA	+	+
Soquel Reach-8	+	+	Similar	−	+	+
Soquel Reach-9a	+	+	Similar	Similar	+	+
Soquel Reach-12a	+	+	Similar	Similar	+	+
(Soquel Site-19)	+	+	NA	NA	+	+
(Soquel Site-21)	+	Similar	NA	NA	+	+

*** NA = Not available.**

R-4. Habitat Change in Aptos Creek, 2010 to 2011

Refer to **Appendix A** for maps of reach locations. Summary tables of habitat change for all sites are provided in **Tables 16c and 37**. The January 1982 storm caused severe streambank erosion and landsliding throughout the Santa Cruz Mountains, and streams have been recovering since. The 1997-98 winter also brought significant stormflow and sedimentation into some watersheds by 1999, such as the San Lorenzo River (**Alley 2000**). Weighing the relative importance of streamflow as an aspect of habitat quality with other habitat parameters is not clear cut, especially when no stream gage exists on Aptos Creek and exact streamflow measurements are very limited. In 2010, we began measuring fall baseflow in this watershed. Most juvenile steelhead growth occurs in the spring-early summer when baseflow is most important. Based on hydrographs from stream gages in other watersheds (**Figures 27-35**), it is likely that this watershed also had similarly high baseflow in 2010 and 2011, especially in the spring due to late storms in both years. This provided more food and better growth rate in all reaches in 2010 and 2011 compared to the 3 previous dry years. Measured streamflow in fall in Aptos Creek confirmed significantly higher baseflow in 2011 than 2010 (**Table 5b**). Habitat conditions at the lower Site 3 in Aptos Creek deteriorated from 2010 conditions despite higher baseflow, with reduced pool depth and escape cover (**Table 16c summarized from Tables 5b, 16a−b**). The upper Aptos Reach 3 in Nisene Marks was similar in 2010 and 2011, with higher baseflow, similar pool depth and substrate conditions and less pool escape cover (**Table 16c**). Habitat conditions in Aptos Creek did not improve in 2011 as they did in the other 3 watersheds being monitored.

Table 16a. Average POOL HABITAT CONDITIONS and Escape Cover Indices for Reaches in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS Creeks in 2006–2009 and 2011.

Reach #/ Sampling Site #	Mean Depth/ Maximum Depth					Escape Cover*					Embeddedness					Percent Fines				
	2006	2007	2008	2009	2011	2006	2007	2008	2009	2011	2006	2007	2008	2009	2011	2006	2007	2008	2009	2011
Aptos #2/#3- in County Park	1.4/3.0	1.1/2.3	1.1/2.1	1.0/2.1		0.123	0.133	0.172	0.155		82	49	47	48		85	76	60	53	
Aptos #3/#4- Above Steel Bridge Xing (Nis. Marks)	1.3/2.4	1.2/2.2	1.1/2.2	1.2/2.3	1.2/2.3	0.059	0.102	0.132	0.127	0.107	80	59	57	56	54	78	62	63	57	66
Valencia #2/#2- Below Valencia Road Xing	0.7/1.2	0.8/1.4	0.6/1.3	0.6/1.2		0.115	0.148	0.131	0.143		88	70	45	51		93	98	88	79	
Valencia #3/#3- Above Valencia Road Xing	1.0/1.7	0.9/1.6	0.7/1.4	0.8/1.5		0.119	0.154	0.210	0.217		82	56	55	53		83	78	79	76	
Corralitos #1/#1- Below Dam		1.25/1.95	1.3/2.0	1.5/2.1			0.106	0.152	0.123			35	44	49			37	50	54	
Corralitos #3/#3- Above Colinas Drive	1.5/2.6	1.3/2.3	1.1/2.0	1.2/2.0	1.3/2.0	0.138	0.191	0.172	0.121	0.175	52	41	46	52	50	47	38	50	53	32
Corralitos #6/#8- Below Eureka Gulch	1.3/2.2	1.1/1.9	1.0/1.8	1.1/1.9	1.2/2.0	0.061	0.084	0.090	0.093	0.052	54	42	45	58	58	45	35	48	56	29
Corralitos #7/#9- Above Eureka Gulch	1.2/1.8	1.0/1.6	0.9/1.5	1.0/1.5	1.0/1.5	0.160	0.185	0.171	0.125	0.119	47	37	40	45	54	33	30	29	41	20
Shingle Mill #1/#1- Below 2nd Road Xing	1.15/1.8	0.8/1.3	0.8/1.3			0.180	0.198	0.214			71	58	58			49	33	26		
Shingle Mill #3/#3- Above 3rd Road Xing	1.15/1.8	0.9/1.4	0.8/1.3	0.9/1.5		0.190	0.196	0.223	0.264		71	62	62	59		55	38	34	45	
Browns Valley #1/#2- Below Dam	1.4/2.4	1.1/1.8	1.2/1.9	1.2/1.9		0.051	0.127	0.156	0.185		71	60	56	57		61	40	35	38	
Browns Valley #2/#2- Above Dam	1.45/2.35	1.0/1.7	1.0/1.6	1.0/1.6		0.120	0.161	0.155	0.198		69	59	56	54		53	36	32	35	

* Habitat typing method = total feet of linear pool cover divided by total habitat typed channel length as pool habitat.

Table 16b. POOL HABITAT CONDITIONS and ESCAPE COVER INDICES for Replicated Sampling Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS Creeks in 2009–2011.

Reach #/ Sampling Site #	Avg Mean/ Maximum Pool Depth- 2009	Avg Mean/ Maximum Pool Depth- 2010	Avg Mean/ Maximum Pool Depth- 2011	Pool Escape Cover Index- 2009	Pool Escape Cover Index- 2010	Pool Escape Cover Index- 2011
Aptos #2/#3- in County Park	1.2/ 2.5	1.25/ 2.6	**1.0/ 2.4**	0.164	0.183	**0.055**
Aptos #3/#4- Above Steel Bridge Xing (Nisene Marks)			**1.35/ 3.25**			**0.156**
Valencia #2/#2- Below Valencia Road Xing	0.6/ 1.5	0.45/ 1.05	–	0.138	0.156	–
Valencia #3/#3- Above Valencia Road Xing	1.0/ 1.8	0.9/ 1.45	–	0.200	0.250	–
Corralitos #1/#1- Below Dam	1.05/ 1.65	0.85/ 1.5	**0.9/ 1.25**	0.106	0.087	**0.120**
Corralitos #3/#3- Above Colinas Drive	1.1/ 2.0	0.7/ 1.6	**0.95/ 1.95**	0.186	0.173	**0.231**
Corralitos #6/#8- Below Eureka Gulch	1.35/ 1.95	0.55/ 0.9	**1.0/ 1.85**	0.120	0.048	**0.033**
Corralitos #7/#9- Above Eureka Gulch			**1.0/ 1.8**			**0.112**
Shingle Mill #1/#1- Below 2nd Road Xing		0.9/ 1.3	**0.9/ 1.4**		0.296	**0.310**
Shingle Mill #3/#3- Above 3rd Road Xing	0.8/ 1.2	0.6/ 0.9	**1.0/ 1.5**	0.151	0.139	**0.173**
Browns Valley #1/#2- Below Dam	1.0/ 1.55	1.25/ 2.0	**1.3/ 2.05**	0.160	0.125	**0.187**
Browns Valley #2/#2- Above Dam	1.05/ 1.7	1.15/ 1.85	**1.35/ 1.85**	0.130	0.243	**0.203**

* Habitat typing method = total feet of linear pool cover divided by total habitat typed channel length as pool habitat.

Table 16c. Habitat Change in APTOS AND CORRALITOS WATERSHED Reaches (2009 to 2011) and Replicated Sites (2010 to 2011).

Reach Comparison or (Site Only)	Baseflow	Pool Depth	Fine Sediment	Embeddedness	Pool Escape Cover	Overall Habitat Change
(Aptos 3)	+	−	NA*	NA	−	−
Aptos 4	+	Similar	Similar	Similar	−	**Similar**
(Corralitos 1)	+	−	NA	NA	+	+
Corralitos 3	+	Similar	+	Similar	+	+
Corralitos 5/6	+	+	+	Similar	−	+
Corralitos 7	+	Similar	+	Similar	Similar	+
(Shingle Mill 1)	+	Similar	NA	NA	Similar	+
(Shingle Mill 3)	+	+	NA	NA	+	+
(Browns 1)	+	Similar	NA	NA	+	+
(Browns 2)	+	+	NA	NA	−	+

*** NA = Not Available.**

R-5. Habitat Change in Corralitos, Shingle Mill and Browns Valley Creeks, 2010 to 2011

Refer to **Appendix A** for maps of reach locations. Summary tables of habitat change for all reaches are provided in **Tables 16c and 37**. Weighing the relative importance of streamflow with other habitat parameters is not clear cut, especially when exact streamflow measurements are limited. Most juvenile steelhead growth occurs in the spring-early summer when baseflow is most important. All reaches had higher spring and summer/fall baseflow in 2011, especially in the spring due to later storms in 2011 of higher magnitude than in 2010 (**Table 5b; Figures 33−35**). Higher baseflow provided more food and better growth rate in all reaches, especially with the below average density of steelhead in Corralitos Creek (**Figure 13)**. Faster growth was exemplified by the higher percent of YOY reaching Size Class II in 2011 compared to the dry year of 2009 at most sites (**Figure 20**). Based on habitat typing data in 3 Corralitos reaches and site conditions at the remaining 5 sampling sites, habitat conditions improved overall in the entire Corralitos/ Browns sub-watershed in 2011 (**Table 16c**). Baseflow increased and pool depth was either similar or deepened except at Corralitos Site 1 below the dam. Pool escape cover was similar or increased except in the Corralitos 5/6 segment and at the upper Browns 2 site. Fine sediment was reduced in all 3 habitat typed segments in Corralitos Creek, indicating improvement 2 winters after the highly sedimented conditions observed after the first winter following the fire. Pool depths greatly increased in the Corralitos reaches above the dam in 2011 and at upper Shingle Mill Site 3, indicating reduced sedimentation and good scour over the winter of 2010-2011 (**Table 16b**). Much sediment had moved through the system but not past the reach below the dam yet. Corralitos pools had not recovered yet to pre-fire conditions, however. Unlike in Corralitos Creek, summer rearing habitat conditions in Browns Creek had not deteriorated after the fire, and pool depths at sampling sites were similar in 2011to those in 2010 (**Table 16b**). Pool escape cover increased at the lower site below the dam and decreased at the upper site in 2011.

ANNUAL COMPARISON OF JUVENILE STEELHEAD ABUNDANCE

R-7. 2011 Densities in the San Lorenzo Drainage Compared with Those Since 1997

All figures presented within the text may be found in color in the FIGURES section after the REFERENCES AND COMMUNICATIONS. In the mainstem San Lorenzo River, densities of all size and age classes (except yearling and older) were mostly lower in 2011 than 2010 and statistically significantly lower for total, YOY and Size Class II and III (**Table 40**). This was due low YOY densities in 2011. Site densities for all 3 categories were below average except for Size Class II and III at Mainstem 6 and 11 (**Tables 17, 18 and 22; Figures 1, 2 and 4**). Yearling densities between years were similarly low both years and below average in 2011 except at Mainstem 2a and 6 (**Table 19; Figure 3**). Juvenile steelhead densities in the mainstem were the lowest measured from 1997 onward, as indicated in a 5-site trend (**Figure 21**). High spring stormflows and baseflows may have encouraged yearlings to immigrate early and may have caused poor YOY survival (**Figures 28 and 29**). Peak flows on March 23, 24 and 26 at the Big Trees Gage were approximately 2,500, 11,500 and 3,800 cfs, respectively.

Densities of the larger Size Class II and III juveniles declined in 2011 but were similar low, on average, to 4 of the last 9 years of trend data and higher than in 2007 (**Figure 22**), though site variability in density was very restricted in 2011. Especially high spring streamflows and continued high summer/fall baseflows allowed fast YOY growth rates of those that survived, with minimal competition at mainstem sites. High proportions of YOY reached the Size Class II size category at all mainstem sites compared to a dry year (2009) to boost densities of larger juveniles in 2011 (**Figure 17**). However, with so few YOY present in the mainstem, smolt density ratings ranged between “Very Poor” and “Below Average” at all mainstem sites except a “Good” rating at Mainstem 2a in the Rincon (**Table 37**).

Site densities of YOY in the mainstem below the Boulder Creek have been low from 1999 onward (**Table 18**). However, Sites 1, 2 and 8 showed a modest rebound in 2010 only to decline in 2011. YOY densities also rebounded in 2008 at Site 4 in Henry Cowell Park. The year 1997 was unusual with considerable rain prior to 1 March with little afterwards, resulting in very stable spawning conditions after March 1 and baseflows near the average median flow. 1998 was a very wet year with so much baseflow that steelhead were in high densities at the heads of pools and even further back where water velocity was still high, unlike other years when they primarily reared in runs and riffles. 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. The mainstem will need more YOY recruitment from tributaries, improved spawning gravel and higher baseflow to greatly increase the smolt ratings there.

It was the winter of 1999 when substantial sediment entered the middle mainstem from erosion in upstream tributaries that occurred from the 1998 high peak-flow event (19,400 cfs at Big Trees), followed by the 1999 water year that had a relatively low peak flow (3,200 cfs at Big Trees) that apparently could not transport the sediment out of the system. Despite the fact that substrate conditions have improved in riffles and runs in terms of reduced fine sediment and embeddedness since then, substrate in glides where spawning occurs apparently has not, and spawning habitat in the mainstem remains poor in quality and primarily sand and fine gravel.

Table 17. Density of Juvenile Steelhead for ALL SIZES at MAINSTEM SAN LORENZO RIVER Monitoring Sites (Excluding Lagoon) in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
0a				5.4								2.4	20.4	2.1	7.6
0b				4.3	5.2										4.8
1	34.2*	26.9	17.6	3.4	7.6				1.2	1.9	7.0	3.4	16.4	2.7	11.1
2a	74.9	21.4	4.6	3.9	13.5					14.8	20.6	9.2	28.4	11.2	20.3
2b				24.8	15.4										20.1
3	83.9	73.5	29.0	33.0	36.0										51.1
4	86.9	37.8	39.6	12.0	33.1				16.6	21.3	71.2	28.4	23.1	4.1	34.0
5		133.8	46.2	4.5	23.6										52.0
6	45.4	46.0	14.1	4.0	10.9	4.7	8.7	6.7	4.5	24.0	21.4	13.2	17.4	9.1	16.4
7	149.3	21.7	11.8	7.6	15.5	29.4	38.9	11.0							35.7
8	158.6	140.1	48.2	11.2	21.4	32.3	21.6	20.3	13.7	5.5	33.0	18.0	36.7	9.2	40.7
9	126.8	77.3	27.6	12.0	29.6	17.4	10.9	17.1							39.8
10	69.1	17.9	10.9	18.4	19.7	51.9	44.6	21.9							31.8
11	73.0	10.9	33.4	28.7	5.1	57.2	45.7	32.3	3.0	21.3	47.6	6.8	29.1	9.1	28.8
12a	56.8	30.8	21.1	39.9	49.8										39.7
12b		32.2	25.9	43.5	30.4	51.9	48.4	98.2							47.2

*** Density in number of fish per 100 feet of stream.**

Table 18. Density of Juvenile Steelhead for the YOUNG-OF-THE-YEAR Age Class at MAINSTEM SAN LORENZO RIVER Monitoring Sites (Stream Habitat) in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
0a				2.2								1.2	19.0	2.1	6.1
0b				3.3	2.3										2.8
1	32.3*	25.6	12.6	1.8	6.8				1.2	1.6	7.0	2.7	16.0	1.9	10.0
2a	66.3	19.2	3.2	2.7	11.0					13.7	19.0	8.1	27.6	8.6	17.9
2b				21.2	12.1										16.7
3	84.3	68.2	24.7	29.4	29.6										47.2
4	86.2	32.9	34.2	10.5	30.5				13.9	20.7	69.8	26.5	22.5	3.5	31.9
5		132.4	38.5	3.5	22.8										49.3
6	42.0	44.4	13.2	3.3	10.6	4.4	8.5	5.9	4.2	23.4	20.6	11.1	16.7	8.1	15.5
7	143.5	19.8	5.7	3.6	12.0	9.7	38.0	11.2							32.9
8	152.0	135.3	44.2	10.9	21.0	30.5	20.9	18.7	11.6	5.5	31.2	16.3	35.4	5.8	38.5
9	119.9	69.7	23.4	11.0	28.9	17.6	10.0	15.4							37.0
10	65.8	11.7	6.5	13.4	5.9	45.1	40.5	18.4							27.2
11	64.2	6.8	27.6	16.4	21.8	49.8	34.5	29.6	1.5	20.8	46.1	4.4	26.8	8.4	25.6
12a	50.9	27.9	5.4	34.4	37.3										31.2
12b		24.2	14.3	37.9	15.8	44.4	39.3	89.1							37.9

***Density in Number of Juveniles per 100 feet of Stream.**

Table 19. Density of Juvenile Steelhead for YEARLINGS AND OLDER at MAINSTEM SAN LORENZO RIVER Monitoring Sites in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
0a				2.2								1.2	1.7	0	1.3
0b				1.0	2.9										2.0
1	1.6*	1.4	2.9	1.9	0.5				0	0.3	0	0.7	0.4	0.5	0.9
2a	7.9	1.5	0.9	1.2	1.5					0.9	0.4	1.0	0.5	2.2	1.8
2b				2.4	2.0										2.2
3	5.2	5.3	3.9	4.4	6.6										5.1
4	7.6	4.7	2.2	1.2	0.5				2.4	0.2	0.3	0.4	0.6	0.6	2.0
5		2.9	5.4	1.0	0.8										2.5
6	4.6	2.2	0.8	0.7	0.5	0.3	0.2	0.8	0.3	0.7	0.03	0	0.5	1.2	0.9
7	6.0	2.5	6.3	4.8	3.6	0.4	0.3	3.0							3.0
8	5.4	4.2	4.1	0.3	0.4	2.0	2.6	2.4	1.6	0	2.0	1.5	1.0	0.2	2.0
9	4.3	8.1	2.5	1.0	0.6	0.8	1.9	2.5							2.5
10	3.3	6.4	4.6	5.5	4.1	6.8	2.7	4.7							4.7
11	8.8	3.9	6.5	11.2	4.7	7.4	3.0	7.1	1.5	0.6	1.1	2.5	2.4	0.6	4.4
12a	5.9	3.2	15.7	5.5	12.9										8.6
12b		6.8	12.6	5.5	14.3	7.5	9.1	9.3							9.3

***Density in Number of Juveniles per 100 feet of Stream.**

Table 20. Density of Juvenile Steelhead for SIZE CLASS I (<75 mm SL) at MAINSTEM SAN L`ORENZO RIVER Monitoring Sites (Stream Habitat) in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
0a				0								0	0.6	0	0.15
0b				0	0										0
1	3.3*	0.2	2.2	0	0.7				0	0.3	2.1	0	1.1	0.1	0.9
2a	7.9	1.3	0.4	0.2	2.5					3.7	8.4	1.2	6.0	0	3.2
2b				1.2	6.7										4.0
3	47.7	9.4	3.7	5.9	18.1										17.0
4	63.0	8.6	6.8	3.1	17.6				0.5	15.4	58.1	14.5	10.5	0.4	18.0
5		19.1	5.2	0	8.1										8.1
6	35.1	20.5	11.2	1.8	8.4	4.1	8.3	4.7	2.2	22.8	19.2	10.7	11.3	3.4	11.7
7	126.7	11.7	2.9	1.5	8.6	23.6	35.0	4.9							26.9
8	138.6	118.7	37.4	8.0	20.5	27.9	19.9	13.2	7.9	4.8	29.4	14.5	28.5	5.8	33.9
9	102.2	57.5	18.5	6.2	28.4	15.4	9.6	12.2							31.3
10	65.8	9.6	4.4	10.1	12.2	45.1	39.8	17.6							25.6
11	64.2	4.1	26.9	15.6	18.7	49.8	34.5	19.3	0	20.8	44.9	3.7	24.4	1.3	23.4
12a	50.9	26.2	5.4	34.4	40.3										31.4
12b		19.5	4.1	37.0	17.4	44.4	39.3	87.6							35.6

*** Density in number of fish per 100 feet of stream.**

Table 21. Density of Juvenile Steelhead for SIZE CLASS II/ III (=>75 mm SL) at MAINSTEM SAN LORENZO RIVER Monitoring Sites (Stream Habitat) in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
0a				5.4								2.4	19.8	2.1	7.4
0b				4.3	5.2										4.8
1	30.9*	26.7	15.4	3.4	6.9				1.2	1.6	4.9	3.4	15.3	2.6	10.2
2a	67.0	20.1	4.2	3.7	11.0					11.1	12.2	8.0	22.4	11.2	17.1
2b				23.6	8.7										16.2
3	36.2	64.1	25.3	27.1	17.9										34.1
4	23.8	29.2	32.8	8.9	15.5				16.2	6.0	13.2	13.9	12.6	3.7	16.0
5		114.7	41.0	4.5	15.5										43.9
6	10.3	25.5	2.9	2.2	2.5	0.6	0.4	2.0	2.3	1.2	2.2	0.5	6.1	5.3	4.6
7	22.6	10.0	8.9	6.1	6.9	5.8	3.9	6.1							8.8
8	20.0	21.4	10.8	3.2	0.9	4.4	1.7	7.1	5.8	0.7	3.6	3.5	8.2	3.4	6.8
9	24.6	19.8	9.1	5.8	1.2	2.0	1.3	4.9							8.6
10	3.3	8.3	6.5	8.3	7.5	6.8	4.8	4.3							6.2
11	8.8	6.8	6.5	13.1	6.4	7.4	11.2	13.0	3.0	0.6	2.8	3.1	4.7	7.9	6.8
12a	5.9	4.6	15.7	5.5	9.5										8.2
12b		12.7	21.8	6.5	13.0	7.5	9.1	10.6							11.6

*** Density in number of fish per 100 feet of stream.**

In tributaries of the San Lorenzo River, an overall decreasing trend occurred between 2010 and 2011 regarding total and YOY juvenile steelhead densities. Total density decreased at 9 of 12 tributary sites and YOY decreased at 7 of 12 sites (**Tables 22 and 23**). Total and YOY densities in tributaries were below average in 2011 except for Fall 15 (**Figures 1 and 2**). Yearling densities decreased at 9 of 12 tributary sites, especially at Zayante 13d, Lompico 13e and Zayante 15, but were similarly low in 2010 and 2011 at other sites (**Table 24**). Yearling tributary densities were all below average except at Zayante 13c (**Figure 3**). High spring stormflows and baseflows may have encouraged yearlings to immigrate early and likely caused poor YOY survival (**Figures 28 and 29**). Peak flows on March 23, 24 and 26 at the Big Trees Gage were approximately 2,500, 11,500 and 3,800 cfs, respectively. The 24 March flow was 3 times the bankfull event, and the 26 March flow was close to a bankfull event. From previous calculations, bankfull at the Big Trees gage was between 2,800 and 4,300 cfs, corresponding to the 1.3 and 1.5 year recurrence intervals, respectively (**Alley 1999**).

Despite the overall fewer juvenile steelhead in tributaries in 2011 and the lowest since 1997 onward (**Figure 23**), Size Class II and III densities were only less than in 2010 at 6 of 12 sites (**Table 25**), with substantial downturns in lower Zayante 13a Newell 16. Especially high spring streamflows and continued high summer/fall baseflows allowed fast YOY growth rates of those that survived, with minimal competition at tributary sites. High proportions of YOY reached the Size Class II size category at many sites compared to a dry year (2009) to boost densities of larger juveniles in 2011 (**Figure 17**). The trend in Size Class II and III densities at key tributary sites actually increased, on average, from 2007 to 2011 (**Figure 24**), especially at middle Zayante 13c. However, Size Class II and III densities were still below average at 7 of 12 sites (**Figure 4**). Smolt ratings were similar in 2011 compared to 2010 at tributary sites with only 2 of 12 sites declining (Lompico 13e and Branciforte 21a-2) (**Table 37**). Two sites improved due to high YOY growth rates (Bean 14b and Boulder 17b). Tributary smolt ratings were "Fair" or "Good" at all sites except "Below Average" at Lompico 13e.

Table 22. TOTAL DENSITY of Juvenile Steelhead at SAN LORENZO TRIBUTARY Monitoring Sites in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
Zayante 13a		83.0	104.0	46.6	54.8	68.3	69.9	53.6	17.0	66.9	84.8	29.9	61.4	5.2	57.3
Zayante 13b	74.9*	50.7	74.9	24.9	38.0	70.0	65.1	53.3							
Zayante 13c		69.0	61.9	25.8	40.0	123.6	63.4	78.2	18.0	94.4	112.2	74.1	66.6	54.0	67.8
Zayante 13d		82.2	105.0	57.5	84.1	243.8	145.3	99.7	69.8	80.5	131.7	105.5	91.9	29.1	102.0
Lompico 13e									26.2	108.3	27.8	123.3	23.1	16.6	54.2
Bean 14a		44.2	45.9	17.0	38.0	50.9	31.9	54.0							
Bean 14b	73.0	115.6	92.1	48.3	65.5	146.4	78.5	103.5	13.1	8.9	67.6	11.2	32.8	18.2	62.5
Bean 14c		78.2	22.7	87.5	36.8	41.3	99.6	87.4	66.0	18.2	Dry		58.8	29.1	52.1
Fall 15	84.5	82.7	85.0	55.0	59.8						84.0	48.7	46.1	78.5	69.4
Newell 16	94.9	76.3	40.5	28.8	40.3				26.0			18.6	32.5	13.4	41.3
Boulder 17a	134.2	149.2	68.5	32.0	61.1	60.0	38.6	40.1	30.7	62.7	69.9	13.6	19.2	19.0	57.1
Boulder 17b	100.7	74.9	49.5	43.0	51.8	98.6	54.2	70.2	57.6	45.1	97.8	44.0	43.4	48.7	62.8
Boulder 17c		42.8	33.9	36.0	39.4	75.8	81.5	67.4							
Bear 18a	118.5	81.2	76.0	33.6	58.8	86.8	87.7	87.9	52.9	47.3	69.6	20.7	47.6	30.0	64.2
Bear 18b		69.5	116.1	67.6	63.5										
Kings 19a		10.8	0.5	8.4	7.6										
Kings 19b	52.7	22.9	44.9	37.5	41.6										
Carbonera 20a	13.4	21.0	18.9	9.7	19.6										
Carbonera 20b		53.4	51.7	45.2	45.2										
Branciforte 21a-1										6.6	3.3				
Branciforte 21a-2	70.0	60.2	47.1	65.2	45.2				29.5	49.1	33.0	20.0	15.7	25.0	41.8
Branciforte 21b		67.8	57.6	59.6	57.5			20.4							

*** Density in number of fish per 100 feet of stream.**

Table 23. Density of Juvenile Steelhead for YOUNG-OF-THE-YEAR Fish (and Size Class I Juveniles in Most Years) at SAN LORENZO TRIBUTARY Monitoring Sites in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
Zayante 13a		80.0	96.4	29.0	52.9	64.4	68.3	50.1	14.6	62.1	82.3	26.1	58.3	2.6	52.9
Zayante 13b	64.9*	43.5	60.6	7.7	31.2	60.4	58.7	48.1							
Zayante 13c		66.9	50.2	9.4	30.9	112.9	53.2	74.2	17.1	85.1	109.4	65.0	59.4	43.4	59.8
Zayante 13d		77.4	77.7	41.9	67.0	220.6	130.0	88.5	68.0	63.1	107.0	88.6	83.3	25.6	87.6
Lompico 13e									24.2	96.9	21.4	118.4	14.4	14.2	48.3
Bean 14a		43.4	42.0	11.1	36.0	46.4	30.0	50.9							
Bean 14b	60.7	104.3	59.0	41.3	60.2	137.3	70.3	84.7	10.9	0	63.0	4.9	31.7	14.3	53.0
Bean 14c		71.8	6.9	76.6	18.1	23.0	87.4	81.5	61.1	5.6	0 (Dry)		55.7	27.2	42.9
Fall 15	79.6	74.8	68.1	45.1	45.4						68.2	30.6	33.5	71.7	57.4
Newell 16	77.1	67.6	17.7	19.9	35.6				20.1			15.0	31.2	13.1	33.0
Boulder 17a	119.2	141.5	50.7	22.9	55.9	45.6	31.3	36.5	25.3	55.9	64.9	9.3	16.3	17.0	49.5
Boulder 17b	91.8	68.0	36.2	33.9	38.9	84.1	48.0	62.0	56.1	35.1	94.1	33.3	39.6	46.4	54.8
Boulder 17c		37.6	15.3	27.5	30.7	64.0	69.7	61.3							
Bear 18a	100.2	72.4	57.9	12.6	50.8	75.0	76.6	75.2	51.0	41.7	64.5	19.1	24.2	29.0	53.6
Bear 18b		66.6	89.2	58.3	48.1										
Kings 19a		9.8	0	6.6	6.0										
Kings 19b	48.2	20.8	32.1	31.5	28.5										
Carbonera 20a	9.1	17.2	13.2	5.6	16.5										
Carbonera 20b		50.9	40.3	29.7	33.4										
Branciforte 21a-1										2.8	2.7				
Branciforte 21a-2	64.6	54.1	35.5	47.2	34.2				30.6	47.6	27.3	12.5	11.2	21.5	35.1
Branciforte 21b		60.1	44.2	45.8	49.4			9.1							

*** Density in number of fish per 100 feet of stream.**

Table 24. Density of Juvenile Steelhead for YEARLING and OLDER Fish at SAN LORENZO TRIBUTARY Monitoring Sites in 1997-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
Zayante 13a		3.0	7.6	17.7	1.9	3.9	1.6	3.5	3.2	4.9	2.1	2.6	2.9	1.4	4.3
Zayante 13b	10.0*	7.2	14.3	17.2	6.8	9.6	6.4	5.2							
Zayante 13c		2.1	11.7	16.4	9.1	10.7	10.2	4.0	1.0	8.8	2.9	9.1	7.6	10.1	8.0
Zayante 13d		4.7	27.3	15.6	17.1	23.2	15.3	11.2	1.7	17.4	24.0	16.9	8.6	1.5	14.2
Lompico 13e									1.9	11.3	6.4	4.9	8.7	3.3	6.1
Bean 14a		0.8	3.9	5.9	2.0	4.5	1.9	3.1							
Bean 14b	12.3	11.3	33.1	7.0	5.3	9.1	8.2	18.8	2.0	8.9	3.7	5.6	0.8	3.9	9.3
Bean 14c		6.4	15.8	10.9	18.7	18.3	12.2	5.9	4.1	5.4	0 Dry		3.1	1.8	8.6
Fall 15	4.9	7.9	16.9	9.9	14.4						15.8	18.0	12.3	6.5	11.8
Newell 16	17.8	8.7	22.8	8.9	4.7				5.4			3.9	1.5	0.6	8.3
Boulder 17a	15.0	7.7	17.8	9.1	5.2	14.4	7.3	3.6	5.9	6.8	5.8	4.1	2.8	2.9	7.7
Boulder 17b	8.9	6.9	13.3	9.1	12.9	14.5	6.2	8.2	1.1	9.8	3.8	10.7	3.6	1.8	7.9
Boulder 17c		5.2	18.6	8.5	8.7	11.8	11.8	6.1							
Bear 18a	18.3	7.8	18.1	21.0	8.0	11.8	11.1	12.7	1.6	5.7	5.1	2.0	3.5	0.7	9.1
Bear 18b		2.9	26.9	9.3	15.4										
Kings 19a		1.0	0.5	1.8	1.6										
Kings 19b	4.5	2.1	12.8	6.0	13.1										
Carbonera 20a	4.3	3.8	5.7	4.1	3.1										
Carbonera 20b		2.5	11.4	15.5	11.8										
Branciforte 21a-1										3.9	0.5				
Branciforte 21a-2	5.4	6.1	11.6	18.0	11.0				0	1.5	5.7	7.5	4.4	3.4	6.8
Branciforte 21b		7.6	13.4	11.1	8.1			11.3							

*** Density in number of fish per 100 feet of stream.**

Table 25. Density of Juvenile Steelhead for SIZE CLASS II/III (=>75 mm SL) Fish at SAN LORENZO TRIBUTARY Monitoring Sites in 1998-2001 and 2003-2011.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
Zayante 13a		12.3*	13.5	17.7	1.9	3.9	1.6	31.4	11.7	4.9	6.3	12.1	18.8	4.8	10.8
Zayante 13b	11.7	14.9	19.9	17.2	7.1	9.6	6.4	17.3							
Zayante 13c		14.7	16.8	16.4	9.5	10.7	10.2	15.0	12.6	8.8	4.4	10.4	24.5	29.2	14.1
Zayante 13d		10.7	27.3	15.6	17.1	23.2	5.3	15.7	17.3	17.4	22.5	16.9	9.1	11.7	16.1
Lompico 13e									5.7	11.3	6.4	4.9	8.7	7.8	7.5
Bean 14a		2.1	3.9	5.9	2.0	4.5	1.9	12.0							
Bean 14b	13.7	11.3	33.1	7.1	5.3	9.1	8.2	39.4	11.9	8.9	4.7	10.9	8.4	7.4	12.8
Bean 14c		6.4	15.8	10.9	18.4	18.3	12.2	12.4	17.1	5.4	0 Dry		6.7	8.8	11.0
Fall 15	8.2	13.3	16.9	9.9	13.0						15.8	18.7	14.3	14.7	13.9
Newell 16	23.6	14.9	22.8	8.9	4.7				16.2			4.4	24.7	13.1	14.8
Boulder 17a	22.8	21.9	17.8	9.1	5.2	16.9	7.3	9.0	18.2	6.8	7.2	5.5	11.8	10.6	12.2
Boulder 17b	9.7	11.5	13.3	9.1	12.9	14.5	6.2	8.2	13.7	9.8	3.8	10.7	12.7	13.6	10.7
Boulder 17c		5.2	18.6	8.5	8.7	11.8	11.8	8.4							
Bear 18a	18.3	13.0	18.1	21.0	8.0	11.8	11.1	13.7	13.6	5.7	5.1	2.5	9.5	9.4	11.5
Bear 18b		6.2	26.9	9.3	13.2										
Kings 19a		6.2	0.5	1.8	1.6										
Kings 19b	4.5	6.2	12.8	6.0	10.0										
Carbonera 20a		11.5	5.7	4.1	3.1										
Carbonera 20b		11.4	11.4	15.5	11.8										
Branciforte 21a-1										3.9	0.5				
Branciforte 21a-2	4.3	8.5	11.6	18.0	10.8				10.8	1.5	5.7	7.5	12.6	13.6	9.5
Branciforte 21b		14.8	13.4	11.1	8.1			16.0							

*** Density in number of fish per 100 feet of stream.**

R-8. 2011 Densities in Soquel Creek Compared with Those Since 1997

The pattern of 2011 juvenile densities compared to average densities in Soquel Creek was similar to the pattern in the San Lorenzo watershed. Total and YOY densities were below average, as they generally were in 2009 and 2010 (**Tables 26 and 27; Figures 5 and 6; Alley 2010**). Four of the 8 sites had below average yearling densities but 5 were near typically low averages (**Figure 7**). Four of 8 sites had lower yearling densities than in 2010 but all were typically low (**Table 28**). 2011 juvenile steelhead densities were the lowest since 1997 onward in the Soquel watershed (**Figure 25**). High spring stormflows and baseflows may have encouraged yearlings to immigrate early and likely caused poor YOY survival (**Figures 31 and 32**). Peak flows on March 23, 24 and 26 at the Soquel Village Gage were approximately 850, 5,700 and 1,800 cfs, respectively. The 24 March storm was likely at least twice bankfull, and the 26 storm was likely near bankfull.

All of the 4 mainstem sites had below average Size Class II and III densities (**Figure 8**) attributed to their low YOY densities. Two of the tributary sites had near average densities while two were above average. Five of 8 sites had reduced Size Class II and III densities from 2010 (**Table 30**). Especially high spring streamflows and continued high summer/fall baseflows allowed fast YOY growth rates of those that survived, with minimal competition at all sites. High proportions of YOY reached the Size Class II size category at all sites compared to a dry year (2009) to boost densities of larger juveniles in 2011 (**Figure 18**). Although total juvenile densities in the watershed were especially low in 2011 (**Figure 25**), rapid YOY growth rates allowed Size Class II and III densities to be similar, on average, to 7 of the last 15 years of record and higher than 4 of the years (**Figure 26**). However, with so few YOY present in 2011, only East Branch 13a had a “Good” smolt density rating, with 6 other sites having a “Fair” rating and lower Soquel 1 registering at “Below Average” (**Table 37**). In 2010, with its high spring and above average summer streamflows and associated high food levels, Soquel Creek had 3 of the 4 branch sites in the “Good” range, but 2 mainstem sites were rated “Below Average” with higher YOY densities than in 2011 but not as high growth rates.

Table 26. TOTAL Juvenile Steelhead SITE DENSITIES (fish/ 100 ft) at Monitoring Sites in SOQUEL CREEK in 1997–2011.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997 E-M	1998 L-W	1999 L-W	2000 E-W	2001 E-D	2002 E-D	2003 L-W	2004 E-D	2005 L-W	2006 L-W	2007 E-D	2008 E-D	2009 E-D	2010 L-W	2011 L-W	Avg
1- Near Grange Hall	2.9	5.6	3.0	2.4	3.5	7.4	2.5	1.7	9.5	-	15.8	8.7	7.7	9.5	2.7	5.9
2- Adj. USGS Gage	4.5	9.4	1.2	5.9	7.7	-	4.1	3.5	4.2	-	-	-				
3- Above Bates Ck	13.2	50.6	7.6	2.2	8.4	14.8	-	-	7.9	-	-	-				
4- Adj. Flower Field	49.6	20.7	6.8	5.5	23.0	33.3	7.7	20.1	9.2	3.2	23.5	63.0	18.6	5.3	5.3	19.7
5-Adj. Beach Shack	50.3	20.6	8.1	9.2	28.0	-	-	-	-	-	-	-				
6- End of Cherryvale	24.7	9.4	2.6	5.3	5.7	47.6	15.9	13.1	16.1	-	-	-				
7- Adj. Orchard	96.6	14.0	5.6	2.0	27.5	-	-	-	-	-	-	-				
8- Below Rivervale	21.0	10.7	4.1	4.9	12.4	59.2	-	-	-	-	-	-				
9- Adj. Mt. School	61.6	18.4	5.1	7.9	20.7	94.8	26.2	45.8	26.8	-	-	-				
10- Above Allred	54.2	11.9	9.1	9.2	15.5	70.7	19.9	37.2	26.2	12.1	54.3	105.8	18.0	15.0	5.8	31.0
11- Below Purling Br	81.9	13.1	10.5	13.1	31.6	-	-	-	-	-	-	-				
12- Near Soquel Ck Bridge	83.5	19.5	17.4	12.0	34.4	65.5	20.1	48.5	21.3	-	50.7	61.8	37.4	12.3	6.0	35.0
13a- Below Mill Pond	79.4	57.6	21.5	22.8	26.2	142.0	33.3	110.5	46.9	3.2	35.0	57.9	22.8	37.1	11.2	47.2
13b- Below Hinckley	-	-	17.0	24.4	47.3	110.6	-	-	-	-	-	-				
14- Above Hinckley	49.6	47.7	23.6	18.5	37.7	107.6	86.0	78.0	39.5	-	-	-				
15- Below Amaya Ck	137.9	79.9	55.4	39.0	38.3	91.6	-	-	-	-	-	-				
16- Above Amaya Ck*	153.2	179.7	283.5	122.6	85.7	121.9	134.6	98.7	127.3	69.4	57.0	76.0	107.2	71.4	37.8	115.1
17- Above Fern Gulch*	138.3	104.2	170.9	93.8	96.3	129.5	102.4	117.2	157.3	-	-	-				
18- Above Ashbury G*	44.1	24.5	53.0	-	-	-	-	-	-	-	-	-				
19- Below Hester Ck	62.3	21.7	32.1	27.6	37.8	-	-	-	-	8.3	26.5	70.7	43.1	13.0	24.3	33.4
20- Above Hester Ck	-	28.2	36.9	37.7	28.3	52.1	49.1	87.2	50.2	22.9		-				
21- Above GS Falls I	-	-	-	-	-	119.0	112.9	99.4	102.0	44.2**	68.3**	-	49.9	26.2	13.7	70.5
22- Above GS Falls II	-	-	-	-	-	65.5	27.5	58.1	5.5	8.6	-	-				

*** Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.**

**** Raw Data obtained from NOAA Fisheries in 2006 and 2007.**

E=early large stormflows before March 1, L=late large stormflows after March 1,

M=near median baseflow, D="dry"-below median baseflow, W="wet"-above median baseflow

Table 27. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by YOUNG-OF-THE-YEAR AGE CLASS at Monitoring Sites in SOQUEL CREEK in 1997–2011.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997 E-M	1998 L-W	1999 L-W	2000 E-W	2001 E-D	2002 E-D	2003 L-W	2004 E-D	2005 L-W	2006 L-W	2007 E-D	2008 E-D	2009 E-D	2010 L-W	2011 L-W	Avg
1- Near Grange Hall	6.1	4.3	1.0	0.9	2.8	6.7	1.7	1.2	8.6	-	14.6	8.0	6.1	8.1	1.8	5.1
2- Adj. USGS Gage	4.1	8.3	0.4	5.3	6.3	-	4.9	3.5	2.6	-	-	-				
3- Above Bates Ck	11.7	48.0	5.6	2.0	8.2	14.1	-	-	6.7	-	-	-				
4- Adj. Flower Field	45.7	18.2	6.2	3.5	19.9	28.8	7.1	19.4	8.7	2.4	22.2	61.4	14.4	4.2	3.9	17.7
5-Adj. Beach Shack	54.0	19.2	5.8	7.6	27.2	-	-	-	-	-	-	-				
6- End of Cherryvale	21.1	8.3	2.4	4.4	5.1	46.4	15.8	12.8	12.9	-	-	-				
7- Adj. Orchard	94.0	13.6	5.2	1.6	26.4	-	-	-	-	-	-	-				
8- Below Rivervale	18.9	9.9	3.9	1.7	11.4	57.2	-	-	-	-	-	-				
9- Adj. Mt. School	53.4	16.0	4.5	4.9	18.8	92.5	22.7	43.6	22.2	-	-	-				
10- Above Allred	52.2	10.8	7.8	7.9	12.9	68.8	17.2	36.3	22.3	11.8	51.9	105.3	17.1	12.3	5.2	29.3
11- Below Purling Br	78.3	12.4	9.5	10.2	31.7	-	-	-	-	-	-	-				
12- Near Soquel Ck Rd Bridge	79.8	18.7	14.4	11.2	33.1	65.1	19.7	48.6	9.3	-	49.2	61.5	33.5	12.3	4.3	32.9
13a- Below Mill Pond	75.3	57.4	20.9	24.5	24.0	73.4	30.9	109.9	41.7	2.5	34.6	55.0	21.4	35.2	8.3	41.0
13b- Below Hinckley	-	-	16.2	22.0	45.9	109.5	-	-	-	-	-	-				
14- Above Hinckley	46.9	46.6	24.7	14.6	37.2	104.6	83.7	76.8	36.7	-	-	-				
15- Below Amaya Ck	139.0	76.9	49.6	35.8	35.4	87.1	-	-	-	-	-	-				
16- Above Amaya Ck*	148.6	171.9	271.6	123.8	77.6	113.9	131.1	96.4	122.4	65.8	37.1	67.3	93.5	63.9	32.8	107.8
17- Above Fern Gulch*	131.9	101.3	159.4	84.7	8.1	112.4	4.4	10.1	147.9	-	-	-				
18- Above Ashbury G*	29.4	24.8	33.3	-	-	-	-	-	-	-	-	-				
19- Below Hester Ck	60.6	5.7	30.8	27.0	36.6	-	-	-	-	8.3	24.9	70.4	38.3	12.5	22.6	30.7
20- Above Hester Ck	-	30.6	36.3	34.3	26.2	49.2	45.3	84.9	49.4	21.5	-	-				
21- Above GS Falls I	-	-	-	-	-	107.2	104.0	93.7	98.7	42.7**	63.2**	-	44.9	20.8	11.9	65.2
22- Above GS Falls II	-	-	-	-	-	56.2	24.7	53.2	1.0	6.1	-	-				

*** Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.**
**** Raw data obtained from NOAA Fisheries in 2006 and 2007.**
E=early large stormflows before March 1, L=late large stormflows after March 1,
M=near median baseflow, D=”dry”-below median baseflow, W=”wet”-above median baseflow

Table 28. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by YEARLING AND OLDER AGE CLASS at Monitoring Sites in SOQUEL CREEK in 1997–2011.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997 E-M	1998 L-W	1999 L-W	2000 E-W	2001 E-D	2002 E-D	2003 L-W	2004 E-D	2005 L-W	2006 L-W	2007 E-D	2008 E-D	2009 E-D	2010 L-W	2011 L-W	Avg.
1- Near Grange Hall	1.2	1.5	1.0	1.9	0.7	0.6	0.9	0.5	1.0	–	1.0	0.7	1.6	1.9	0.9	1.1
2- Adj. USGS Gage	0.6	1.2	0.4	0.5	1.4	–	0	0	1.3	–	–	–				
3- Above Bates Ck	2.5	2.6	2.0	0.5	0.2	0.5	–	–	1.3	–	–	–				
4- Adj. Flower Field	2.2	1.5	0.9	2.0	0.7	2.6	0.6	0.7	0.6	0.7	2.2	1.6	1.9	0.7	1.4	1.4
5-Adj. Beach Shack	2.8	1.4	2.0	1.6	0.5	–	–	–	–	–	–	–				
6- End of Cherryvale	3.2	1.7	0.7	1.0	0.5	1.3	0	0.3	3.1	–	–	–				
7- Adj. Orchard	2.2	0.5	0.4	0.4	1.1	–	–	–	–	–	–	–				
8- Below Rivervale	1.0	0.9	0.7	3.1	1.4	1.6	–	–	–	–	–	–				
9- Adj. Mt. School	3.4	1.7	1.3	4.7	1.7	2.6	3.6	2.3	4.5	–	–	–				
10- Above Allred	1.3	1.1	1.3	1.1	0.9	1.8	3.0	0.2	2.9	0.4	4.3	0.4	0.7	0.7	0.6	1.4
11- Below Purling Br	2.7	0.6	2.2	4.1	0.3	–	–	–	–	–	–	–				
12- Near Soquel Ck Rd Bridge	3.6	0.5	2.0	1.1	0.9	0.3	0.5	0	1.9	–	1.5	0.3	3.2	0	1.7	1.3
13a- Below Mill Pond	7.1	0	1.1	2.9	2.1	2.6	2.1	0.6	5.3	0.7	0.7	2.9	1.6	1.9	2.7	2.3
13b- Below Hinckley	–	–	1.1	4.7	1.4	2.0	–	–	–	–	–	–				
14- Above Hinckley	2.6	1.0	1.6	4.8	1.9	2.9	1.4	0.6	2.8	–	–	–				
15- Below Amaya Ck	0	2.5	6.7	4.0	2.9	4.3	–	–	–	–	–	–				
16- Above Amaya Ck*	3.6	5.4	11.6	2.8	8.1	8.0	3.5	2.3	4.4	3.5	20.0	11.0	13.1	7.5	5.1	7.3
17- Above Fern Gulch*	5.7	3.1	11.5	6.9	18.2	17.0	7.8	7.1	9.6	–	–	–				
18- Above Ashbury G*	13.8	9.6	19.8	–	–	–	–	–	–	–	–	–				
19- Below Hester Ck	1.2	0.4	1.6	1.2	1.2	–	–	–	–	0.3	1.6	0.4	4.6	0.4	2.4	1.4
20- Above Hester Ck	–	0.3	0.3	3.0	2.1	2.9	3.8	2.3	1.0	0.6	–	–				
21- Above GS Falls I	–	–	–	–	–	11.9	8.8	5.3	2.1	1.2**	5.1**	–	4.9	5.7	2.1	5.2
22- Above GS Falls II	–	–	–	–	–	9.3	2.8	4.9	4.5	2.5	–	–				

*** Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.**
**** Raw Data obtained from NOAA Fisheries in 2006 and 2007.**
E=early large stormflows before March 1, L=late large stormflows after March 1,
M=near median baseflow, D=”dry”-below median baseflow, W=”wet”-above median baseflow

Table 29. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by SIZE CLASS I at Monitoring Sites in SOQUEL CREEK in 1997–2011.
(Resident rainbow trout likely present at Sites 18 and 22).

	1997 E-M	1998 L-W	1999 L-W	2000 E-W	2001 E-D	2002 E-D	2003 L-W	2004 E-D	2005 L-W	2006 L-W	2007 E-D	2008 E-D	2009 E-D	2010 L-W	2011 L-W	Avg.
1- Near Grange Hall	1.7	0.2	0	0	0.5	3.5	0.3	0.5	0	-	9.2	4.9	2.6	1.6	0	1.8
2- Adj. USGS Gage	0.9	0.2	0	0	2.2	3.5	1.7	1.9	0	-	-	-				
3- Above Bates Ck	1.8	0	0	0.9	4.0	10.4	-	-	0	-	-	-				
4- Adj. Flower Field	20.1	1.5	0	0.5	7.6	20.0	4.4	13.8	0	0.4	17.2	58.1	10.5	0.4	0	10.3
5-Adj. Beach Shack	38.2	0	0.3	1.1	21.6	-	-	-	-	-	-	-				
6- End of Cherryvale	14.3	0	0	0	2.8	42.9	13.7	12.5	0.4	-	-	-				
7- Adj. Orchard	71.6	1.0	1.6	0.4	21.5	-	-	-	-	-	-	-				
8- Below Rivervale	11.7	0.2	1.0	0.2	6.3	49.6	-	-	-	-	-	-				
9- Adj. Mt. School	36.7	1.1	0.4	0.5	6.6	79.7	12.7	27.1	2.1	-	-	-				
10- Above Allred	43.2	0	3.3	0	9.4	60.8	13.8	34.7	3.5	5.8	43.0	102.7	11.8	1.0	0	22.2
11- Below Purling Br	60.5	0.9	4.1	2.8	29.1	-	-	-	-	-	-	-				
12- Near Soquel Ck Rd Bridge	68.1	3.8	9.2	5.9	28.9	60.1	16.3	44.0	4.5	-	45.9	60.4	25.5	4.3	0.4	27.0
13a- Below Mill Pond	60.2	30.4	13.0	16.4	23.1	138.3	29.8	109.9	20.8	0	31.8	53.9	11.6	4.3	0.7	36.3
13b- Below Hinckley	-	-	3.2	15.8	43.9	105.1	-	-	-	-	-	-				
14- Above Hinckley	27.4	26.9	11.8	3.5	24.3	101.7	78.9	76.1	17.8	-	-	-				
15- Below Amaya Ck	130.4	64.1	38.2	30.5	35.4	84.9	-	-	-	-	-	-				
16- Above Amaya Ck*	143.3	164.8	267.8	114.7	77.6	113.9	131.1	96.4	118.2	60.3	37.1	66.0	94.1	63.4	22.5	104.7
17- Above Fern Gulch*	130.3	90.1	151.7	82.4	78.1	112.4	94.4	110.1	130.9	-	-	-				
18- Above Ashbury G*	29.2	20.6	33.2	-	-	-	-	-	-	-	-	-				
19- Below Hester Ck	60.1	20.4	23.4	24.5	36.6	-	-	-	-	3.6	21.7	65.0	29.0	1.4	7.4	26.6
20- Above Hester Ck	-	20.6	33.2	32.4	26.2	49.2	45.3	84.9	47.3	17.1	-	-				
21- Above GS Falls I	-	-	-	-	-	107.2	103.1	91.8	90.0	30.1**	61.3**	-	43.1	8.7	1.2	59.6
22- Above GS Falls II	-	-	-	-	-	56.2	24.7	50.9	0.3	3.9	-	-				

*** Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.**
**** Raw data obtained from NOAA Fisheries in 2006 and 2007.**
E=early large stormflows before March 1, L=late large stormflows after March 1,
M=near median baseflow, D="dry"-below median baseflow, W="wet"-above median baseflow

Table 30. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by SIZE CLASS II/III at Monitoring Sites in SOQUEL CREEK in 1997–2011.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997 E-M	1998 L-W	1999 L-W	2000 E-W	2001 L-D	2002 E-D	2003 L-W	2004 E-D	2005 L-W	2006 L-W	2007 E-D	2008 E-D	2009 E-D	2010 L-W	2011 L-W	Avg
1- Near Grange Hall	1.2	5.4	3.0	2.4	3.0	3.9	2.3	1.2	9.5	–	6.6	3.8	5.1	7.9	2.7	4.1
2- Adj. USGS Gage	3.6	9.4	0.8	5.9	5.5	–	2.4	1.6	4.2	–	–	–				
3- Above Bates Ck	11.4	50.6	7.6	1.3	4.4	4.4	–	–	7.9	–	–	–				
4- Adj. Flower Field	29.5	19.2	6.8	5.0	15.4	13.3	3.3	6.3	9.2	2.8	6.3	4.9	8.1	4.9	5.3	9.4
5-Adj. Beach Shack	18.1	20.6	7.8	8.1	6.4	–	–	–	–	–	–	–				
6- End of Cherryvale	10.4	9.4	2.6	5.3	2.9	4.7	2.2	0.6	15.7	–	–	–				
7- Adj. Orchard	25.0	13.0	4.0	1.6	6.0	–	–	–	–	–	–	–				
8- Below Rivervale	9.3	10.5	3.1	4.7	6.1	9.6	–	–	–	–	–	–				
9- Adj. Mt. School	24.9	17.3	4.7	7.4	14.1	15.1	13.5	18.7	24.7	–	–	–				
10- Above Allred	11.0	11.9	5.8	9.2	6.1	9.9	6.1	2.5	22.7	6.3	11.3	3.1	6.2	14.0	5.8	8.8
11- Below Purling Br	21.4	12.2	6.4	10.3	2.5	–	–	–	–	–	–	–				
12- Near Soquel Ck Rd Bridge	15.4	15.7	8.2	6.1	5.5	5.4	3.8	4.5	16.8	–	4.8	1.5	11.9	8.0	5.6	8.1
13a- Below Mill Pond	19.2	27.2	8.5	6.4	3.1	3.7	3.5	0.6	26.1	3.2	3.1	4.0	11.2	32.8	10.1	10.8
13b- Below Hinckley	–	–	13.8	8.6	3.4	5.5	–	–	–	–	–	–				
14- Above Hinckley	22.2	20.8	11.8	15.0	13.4	5.9	7.1	1.9	21.7	–	–	–				
15- Below Amaya Ck	7.5	15.8	17.2	8.5	2.9	6.7	–	–	–	–	–	–				
16- Above Amaya Ck*	9.9	14.9	15.7	7.9	8.1	8.0	3.5	2.3	9.1	9.1	20.0	10.0	13.1	8.0	15.4	10.3
17- Above Fern Gulch*	8.0	14.1	19.2	11.4	18.2	17.1	8.0	7.1	26.4	–	–	–				
18- Above Ashbury G*	14.9	3.9	19.8	–	–	–	–	–	–	–	–	–				
19- Below Hester Ck	2.2	1.3	8.7	3.1	1.2	–	–	–	–	4.7	4.8	5.7	14.1	11.6	16.9	6.8
20- Above Hester Ck	–	7.6	3.7	5.3	2.1	2.9	3.8	2.3	2.9	5.8	–	–				
21- Above GS Falls I	–	–	–	–	–	11.8	9.8	7.6	12.0	14.1**	7.5**	–	6.8	17.5	12.4	11.1
22- Above GS Falls II	–	–	–	–	–	9.3	2.8	7.2	5.2	4.7	–	–				

*** Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.**

****Raw data obtained from NOAA Fisheries in 2006 and 2007.**

E=early large stormflows before March 1, L=late large stormflows after March 1, M=near median baseflow, D="dry"-below median baseflow, W="wet"-above median baseflow

R-9. Comparison of 2011 Densities in Aptos Creek with Previous Years

The Aptos Watershed sampling sites followed the pattern of consistently below average total and YOY densities in 2011 that were observed in the Soquel and San Lorenzo watersheds (**Figures 9 and 10**). Total and YOY densities were much less than in 2010 at the lower Aptos 3 site and nearly identical to 2010 densities at the upper Aptos 4 site (**Tables 31 and 32; Figure 27**). Below average yearling and older densities in the Aptos watershed followed the pattern found in the other two watersheds (**Figure 11**). Yearling abundance was slightly less than in 2010 at the Aptos 3 site and slightly more than in 2010 at the Aptos 4 site (**Table 33**). As in other watersheds, high spring stormflows and baseflows may have encouraged yearlings to immigrate early and likely caused poor YOY survival.

2011 Size Class II and III density was below average at the Aptos 3 site and much above average at the Aptos 4 site (high growth rate of YOY in 2011 into Size Class II and abundant cover for large YOY and yearlings under instream wood) (**Figure 12**). 2011 Size Class II density was less than in 2010 at Aptos 3 and more than in 2010 at Aptos 4 (**Table 35; Figure 28**). Size Class II and III density steadily increased since 2008 and was similar to the 2007 level in 2011. The Aptos 4 site had the highest smolt density rating in all 4 watersheds at "Very Good" while the Aptos 3 site had a "Below Average" rating (**Table 37**). Although total juvenile densities in Aptos Creek were below average in 2011 (**Figure 25**) and the lowest on average for the Aptos sites since monitoring began in 2006 (**Figure 27**), rapid YOY growth rates allowed Size Class II and III densities to be second highest in 6 years for Aptos 4 and higher than in 2008 and 2009 at Aptos 3 (**Figure 28**). A high proportion of YOY grew into Size Class II in 2011 (**Figure 19**).

R-10. Steelhead Population Estimate for the Aptos Lagoon/Estuary and Tidewater Goby Use in 2011

On 26 September 2011, 228 juvenile steelhead were captured with the 106-ft bag seine, along with 6 starry flounders, staghorn sculpins and threespine stickleback. No tidewater gobies were captured with the bag seine or the 30-foot beach seine. Species captured from 18 seine hauls around the estuary periphery with the 30-foot beach seine on 26 September 2011 included threespine stickleback (most abundant in the dead end, shallow eastern finger adjacent to beach residences), staghorn sculpins and juvenile topsmelt (3 captured in the deeper finger with the ocean outlet). No steelhead or tidewater gobies were captured in either the dead end finger adjacent to the beach residences or the finger having the ocean outlet. However, the center of the outlet finger was too deep to sample with the small seine. The dead end finger had very limited aquatic vegetation.

On 3 October 2011, 177 steelhead were captured with the 106-foot bag seine in 5 seine hauls, along with 1 tidewater goby, staghorn sculpins and threespine stickleback. An additional tidewater goby was observed and captured in the shallows, south of the jetty, prior to beaching the seine. It did not survive. Both tidewater gobies were adults. There were no steelhead mortalities with 96 steelhead recaptures. The juvenile steelhead population estimate for Aptos estuary/lagoon was 420 (standard error = +/-22).

A bimodal distribution of juvenile steelhead lengths occurred on both sampling days (**Figure 43**). Although there was an apparent shift to larger sizes on the second sampling, the median length of each size grouping remained the same for both samplings at 155-159 mm SL. The smaller grouping of smaller steelhead had a median Standard Length of 110−114 mm (4.3−4.5 inches) for both samplings. The larger grouping of larger steelhead had a median Standard length of 160−164 mm (6.3−6.5 inches) for both samplings. The largest steelhead captured was 312 mm Standard Length (340 mm Fork Length; 13.4 inches FL), it being captured on 3 October.

Aptos estuary/lagoon in fall 2011 had a significant juvenile steelhead population with relatively rapid growth rate compared to those captured in stream habitat. We suspect that a substantial percent of returning adults spent residence time in the estuary/lagoon. Soquel Lagoon is also habitat for a sizeable juvenile steelhead population. Juvenile steelhead appeared not to utilize the dead end finger of the Aptos estuary/lagoon on 26 September 2011, but were common in the main estuary/lagoon to the west of the partial jetty. The dead end finger offered only poor, shallow habitat for steelhead.

A small population of tidewater goby still existed in Aptos estuary/lagoon, although they were not captured in, and likely did not utilize, the dead end finger to the east of the partial jetty on 26 September 2011. Tidewater goby are typically found along freshwater lagoon margins having aquatic algae and other aquatic vegetation. Aquatic algae and vegetation was largely absent along most of the margin of the dead end finger of the estuary/lagoon, offering only poor habitat for tidewater goby in 2011. The estuary/lagoon fingers were larger during fish sampling than we observed earlier in the summer.

Table 31. TOTAL DENSITY of Juvenile Steelhead at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994 and 2006–2011.

Sample Site	1981	1994	2006	2007	2008	2009	2010	2011	Avg.
Aptos #3- in County Park	35.2*	–	26.2	61.7	45.4	8.5	39.4	10.3	32.4
Aptos #4- above steel Bridge Xing Nisene Marks	43.0	–	38.6	26.8	89.3	8.0	21.7	21.6	35.6
Valencia #2- below Valencia Road Xing	33.1	–	28.3	43.0	38.5	22.7	25.1	–	31.8
Valencia #3- Above Valencia Road Xing	29.8	–	33.4	23.0	55.5	26.3	39.4	–	34.6
Corralitos #1- Below Dam	–	–	–	36.2	69.9	34.2	10.4	16.2	33.4
Corralitos #3- Above Colinas Dr	39.1	18.6	35.5	42.1	35.9	14.9	6.2	16.2	26.1
Corralitos #8- Below Eureka Gulch	81.9	28.6	49.0	52.9	55.9	51.9	20.1	34.0	46.8
Corralitos #9- Above Eureka Gulch	86.1	29.9	87.1	38.5	61.7	73.2	33.6	38.7	56.1
Shingle Mill #1- Below 2nd Road Xing	24.5	30.0	33.9	16.2	18.8	6.7	11.9	22.0	20.5
Shingle Mill #3- Above 2nd Road Xing	32.6	–	22.9	12.7	24.5	21.8	33.1	22.3	24.3
Browns Valley #1- Below Dam	54.3	22.5	101.6	35.4	36.5	25.6	24.9	45.6	43.3
Browns Valley #2- Above Dam	71.6	18.5	99.5	79.0	44.8	54.9	41.4	49.2	57.4

*** Density in number of fish per 100 feet of stream.**

Table 32. YOUNG-OF-THE-YEAR Steelhead Density at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994, 2006–2011.

Sample Site	1981	1994	2006	2007	2008	2009	2010	2011	Avg.
Aptos #3- in County Park	24.4*	–	23.7	54.0	43.4	3.3	37.3	8.9	27.9
Aptos #4- above steel Bridge Xing Nisene Marks	37.1	–	35.2	9.8	84.6	3.9	20.1	20.7	30.2
Valencia #2- below Valencia Road Xing	16.6	–	24.5	26.6	27.5	8.9	16.4	–	20.1
Valencia #3- Above Valencia Road Xing	16.6	–	20.5	4.7	41.5	7.8	25.6	–	19.5
Corralitos #1- Below Dam	–	–	–	27.0	61.2	26.5	9.1	14.8	27.7
Corralitos #3- Above Colinas Dr	33.9	10.2	24.6	30.6	27.6	9.8	5.2	14.2	19.5
Corralitos #8- Below Eureka Gulch	59.7	14.3	45.0	44.0	46.6	39.3	19.0	29.4	37.2
Corralitos #9- Above Eureka Gulch	55.8	16.7	78.4	31.3	44.6	54.0	30.7	33.5	43.1
Shingle Mill #1- Below 2nd Road Xing	14.3	5.7	25.1	2.9	13.2	0	7.0	15.7	10.5
Shingle Mill #3- Above 2nd Road Xing	18.6	–	19.5	6.0	23.9	18.4	25.2	14.3	18
Browns Valley #1- Below Dam	26.9	7.0	96.6	15.3	25.0	8.9	21.4	41.8	30.4
Browns Valley #2- Above Dam	66.1	12.8	94.7	47.0	32.2	43.0	38.8	45.2	47.5

*** Density in number of fish per 100 feet of stream.**

Table 33. YEARLING AND OLDER Juvenile Steelhead Density at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994 and 2006–2011.

Sample Site	1981	1994	2006	2007	2008	2009	2010	2011	Avg.
Aptos #3- in County Park	10.8*	–	3.1	7.6	2.3	5.2	1.9	1.4	4.6
Aptos #4- above steel Bridge Xing Nisene Marks	5.9	–	3.0	17.1	4.9	3.9	1.0	2.8	5.5
Valencia #2- below Valencia Road Xing	16.5	–	3.8	16.4	11.0	13.8	8.9	–	11.7
Valencia #3- Above Valencia Road Xing	13.2	–	12.9	11.5	14.0	18.5	14.2	–	14.1
Corralitos #1- Below Dam	–	–	–	9.1	8.7	6.9	1.3	1.3	5.5
Corralitos #3- Above Colinas Dr	5.2	8.4	10.8	11.5	8.3	5.3	1.1	1.8	6.6
Corralitos #8- Below Eureka Gulch	22.2	14.3	4.0	9.0	9.4	13.2	1.1	3.9	9.6
Corralitos #9- Above Eureka Gulch	30.3	13.2	9.5	7.2	17.1	19.2	2.8	5.1	13.1
Shingle Mill #1- Below 2nd Road Xing	10.2	24.3	9.0	13.3	5.6	6.7	5.6	6.3	10.1
Shingle Mill #3- Above 2nd Road Xing	14.0	–	3.4	6.7	0.7	7.2	6.1	8.0	6.6
Browns Valley #1- Below Dam	27.4	15.5	4.3	19.6	11.5	12.9	3.7	4.5	12.4
Browns Valley #2- Above Dam	5.5	7.7	2.8	32.0	12.6	11.9	2.0	4.3	9.9

*** Density in number of fish per 100 feet of stream.**

Table 34. SIZE CLASS I (<75 mm SL) Steelhead Density at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994, 2006–2011.

Sample Site	1981	1994	2006	2007	2008	2009	2010	2011	Avg.
Aptos #3- in County Park	24.4*	–	7.2	50.8	39.4	3.3	22.2	3.2	21.5
Aptos #4- above steel Bridge Xing Nisene Marks	37.1	–	28.5	9.0	83.8	0	12.0	4.9	25.0
Valencia #2- below Valencia Road Xing	16.6	–	24.5	26.6	27.5	8.9	16.4	–	20.1
Valencia #3- Above Valencia Road Xing	16.6	–	20.5	5.7	41.5	7.8	24.6	–	19.5
Corralitos #1- Below Dam	–	–	–	27.0	61.2	20.5	1.7	8.6	23.8
Corralitos #3- Above Colinas Dr	33.9	10.2	16.2	30.6	27.6	5.6	0.7	9.6	16.8
Corralitos #8- Below Eureka Gulch	59.7	14.3	35.8	43.0	46.6	36.6	14.1	21.7	34.0
Corralitos #9- Above Eureka Gulch	55.8	16.7	45.5	31.3	44.6	53.5	22.4	24.2	36.8
Shingle Mill #1- Below 2nd Road Xing	14.3	5.7	17.7	2.9	13.2	0	5.6	15.0	9.3
Shingle Mill #3- Above 2nd Road Xing	32.4	–	19.5	6.0	23.9	18.4	25.2	14.3	20.0
Browns Valley #1- Below Dam	26.9	7.0	84.6	18.1	25.0	8.9	14.8	31.4	27.1
Browns Valley #2- Above Dam	66.1	12.8	82.6	48.8	32.2	43.0	32.0	35.9	44.1

*** Density in number of fish per 100 feet of stream.**

Table 35. SIZE CLASS II/III (=>75 mm SL) Steelhead Density at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994 and 2006–2011.

Sample Site	1981	1994	2006	2007	2008	2009	2010	2011	Avg.
Aptos #3- in County Park	10.8*	–	19.0	10.9	6.0	5.2	17.2	7.1	10.9
Aptos #4- above steel Bridge Xing Nisene Marks	5.9	–	10.1	17.8	5.5	8.0	9.7	16.7	10.5
Valencia #2- below Valencia Road Xing	16.5	–	3.8	16.4	11.0	13.8	8.7	–	11.7
Valencia #3- Above Valencia Road Xing	13.2	–	12.9	10.5	14.0	18.5	14.8	–	14.0
Corralitos #1 Below Dam	–	–	–	9.1	8.7	13.7	8.7	7.6	9.6
Corralitos #3- Above Colinas Dr.	5.2	8.4	19.3	11.5	8.3	9.3	5.5	6.6	9.3
Corralitos #8- Below Eureka Gulch	22.2	14.3	13.2	9.9	9.4	15.3	6.0	12.3	12.8
Corralitos #9- Above Eureka Gulch	30.3	13.2	41.6	7.2	17.1	19.7	11.2	14.5	19.4
Shingle Mill #1- Below 2nd Road Xing	10.2	24.3	16.2	13.3	5.6	6.7	6.3	7.0	11.2
Shingle Mill #3- Above 2nd Road Xing	4.0	–	3.4	6.7	0.7	7.2	6.1	8.0	5.2
Browns Valley #1- Below Dam	27.4	15.5	17.0	17.4	11.5	12.9	10.1	14.2	15.8
Browns Valley #2- Above Dam	5.5	5.7	16.9	30.2	12.6	11.9	9.4	13.3	13.2

*** Density in number of fish per 100 feet of stream.**

R-10. Comparison of 2011 Densities in the Corralitos Sub-Watershed

In 2011, Corralitos Creek was still recovering from the Summit fire of 2008 that caused high sedimentation over the 2009-2010 winter to Corralitos Creek mostly downstream of Shingle Mill Gulch and not in Browns Creek. In 2011, total and YOY densities at the 4 Corralitos sites were still below average, with the Shingle Mill and Browns sites being near average (**Tables 31 and 32; Figures 13 and 14**). However, total and YOY densities increased at all Corralitos sites, 1 Shingle Mill site and 1 Browns site in 2011 compared to 2010 (**Figure 29**). This is the opposite of what occurred in the San Lorenzo and Soquel drainages in 2011. Increased total densities at sites in 2011 were statistically significant when all repeated sites were compared to 2010 (**Table 42**), and increased YOY densities were nearly significant (p= 0.07).

2011 yearling and older densities were well below average at 7 of 8 sites, consistent with the other 3 sampled watersheds (**Table 33; Figure 15**). 2010 YOY densities were low. So, recruitment into the yearling year class in 2011 was low. However, unlike in other watersheds, 2011 yearling densities increased at 7 of 8 sites over 2010 levels and were unchanged at the lower Corralitos 1 site. This is because of the extremely low yearling densities in 2010. Increased yearling and older site densities were statistically significant for all repeated sites compared to 2010 (**Table 42**) and for just the Corralitos/Shingle Mill sites (**Table 43**). As in other watersheds, high spring stormflows and baseflows in 2011 may have encouraged yearlings to immigrate early and likely caused poor YOY survival, just as they had in 2010 (**Figures 38−40**). However, the March stormflows in 2011 were much greater than those of the previous year. Peak flows on Corralitos Creek near Freedom on March 23, 24 and 26 were approximately 470, 2,300 and 1,200 cfs, respectively (**Figure 41**). The middle flow was likely much above bankfull.

In 2011, Size Class II and III densities were below average at all 4 Corralitos sites, 1 Shingle Mill site and 1 Browns site (**Table 35; Figure 16**). However, densities were closer to average than was the case with total and YOY densities. This may be attributed to the high percent of YOY reaching Size Class II at sites other than in Shingle Mill, with the high growth rates experienced during high spring and summer baseflows and limited competition (**Figure 20**). Size Class II and III densities increased at 3 of the 4 Corralitos sites in 2011 compared to 2010 (**Figures 30**), as well as at both Shingle Mill and Browns sites (**Table 35; Figure 31**). Increased Size Class II and III site densities were statistically significant for all repeated sites compared to 2010 (**Table 42**). Seven of 8 sites had smolt density ratings of "Fair" to "Good," with only Shingle Mill 1 rated at "Below Average" (**Table 37**).

R-11. Rating of Smolt Rearing Habitat in 2011, Based on Site Densities of Smolt-Sized Fish

Smolt habitat was rated at sampling sites, based on soon-to-smolt-sized (=>75 mm SL and likely to smolt the following spring) fish density according to the rating scheme developed by Smith (**1982**) (**Tables 41 and 42**). In this scheme, the average standard length for soon-to-smolt-sized fish was calculated for each site. If the average was less than 89 mm SL, then the density rating assigned by density alone was reduced one level. If the average was more than 102 mm SL, then the rating was increased one level. (Note: the rating scale was applied to all sites, and lower San Lorenzo sites were rated very good to excellent in 1981.) This scheme assumed that rearing habitat was usually near saturation with smolt-sized juveniles, at least at tributary sites, and that spawning rarely limited juvenile steelhead abundance. This was highly unlikely in 2011.

Table 36. Rating of Steelhead Rearing Habitat For Small, Central Coastal Streams.*
(From Smith 1982.)

Very Poor - less than 2 smolt-sized fish per 100 feet of stream.**

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

Below Average - 4 to 8 " " "

Fair - 8 to 16 " " "

Good - 16 to 32 " " "

Very Good - 32 to 64 " " "

Excellent - 64 or more " " "

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

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

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

Table 37. 2011 Sampling Sites Rated by Potential Smolt-Sized Juvenile Density (=>75 mm SL) and Their Average Size in Standard Length Compared to 2010, with Physical Habitat Change from 2010 Conditions.

Site	2010 Potential Smolt Density (per 100 ft)/ Avg Smolt Size SL (mm)	2010 Smolt Rating (With Size Factored In)	2011 Potential Smolt Density (per 100 ft)/ Avg Smolt Size SL (mm)	2011 Smolt Rating (With Size Factored In)	Physical Habitat Change by Reach/Site Since 2010
Low. San Lorenzo #0a	19.8/ 106 mm	*Very Good*	2.1/ 124 mm	**Below Average**	+
Low. San Lorenzo #1	15.3/ 98 mm	Fair	2.6/ 148 mm	**Below Average**	+
Low. San Lorenzo #2	22.4/ 91 mm	*Good*	11.2/ 142 mm	*Good*	+
Low. San Lorenzo #4	12.6/ 87 mm	**Below Average**	3.7/ 103 mm	**Below Average**	+
Mid. San Lorenzo #6	6.1/ 80 mm	**Poor**	5.3/ 85 mm	**Poor**	+
Mid. San Lorenzo #8	8.2/ 88 mm	**Below Average**	3.4/ 82 mm	**Very Poor**	+
Up. San Lorenzo #11	4.7/ 93 mm	**Below Average**	7.9/ 84 mm	**Poor**	–
Zayante #13a	18.8/ 89 mm	Fair	4.8/ 116 mm	Fair	+
Zayante #13c	24.5/ 90 mm	*Good*	29.2/ 95 mm	*Good*	+
Zayante #13d	9.1/ 101 mm	Fair	11.7/ 97 mm	Fair	+
Lompico #13e	8.7/ 96 mm	Fair	7.8/ 95 mm	**Below Average**	+
Bean #14b	8.4/ 87 mm	**Below Average**	7.4/ 127 mm	Fair	+
Bean #14c	6.7/ 99 mm	**Below Average**	8.8/ 104 mm	*Good*	+
Fall #15	14.3/ 118 mm	*Good*	14.7/ 115 mm	*Good*	+
Newell #16	24.7/ 86 mm	Fair	13.1/ 99 mm	Fair	–
Boulder #17a	11.8/ 89 mm	Fair	10.6/ 101 mm	Fair	+
Boulder #17b	12.7/ 90 mm	Fair	13.6/ 106 mm	Good	–
Bear #18a	9.5/ 99 mm	Fair	9.4/ 98 mm	Fair	+
Branciforte #21a-2	12.6/ 105 mm	*Good*	13.6/ 100 mm	Fair	–
Soquel #1	7.9/ 108 mm	Fair	2.7/ 135 mm	**Below Average**	+
Soquel #4	4.9/ 98 mm	**Below Average**	5.3/ 118 mm	Fair	+
Soquel #10	14.0/ 96 mm	Fair	5.8/ 107 mm	Fair	+
Soquel #12	8.0/ 88 mm	**Below Average**	5.6/ 109 mm	Fair	+
East Branch Soquel #13a	32.8/ 88 mm	*Good*	10.1/ 112 mm	*Good*	+
East Branch Soquel #16	8.0/ 106 mm	*Good*	15.4/ 100 mm	Fair	+
West Branch Soquel #19	11.6/ 93 mm	Fair	16.9/ 95 mm	Fair	+
West Branch Soquel #21	17.5/ 99 mm	*Good*	12.4/ 97 mm	Fair	+
Aptos #3	17.2/ 90 mm	*Good*	7.1/ 101 mm	**Below Average**	–
Aptos #4	9.7/ 96 mm	Fair	16.7/ 104 mm	*Very Good*	**Similar**
Valencia #2	8.7/ 100 mm	Fair	–	–	**NA**
Valencia #3	14.8/ 105 mm	*Good*	–	–	**NA**
Corralitos #1	8.7/ 99 mm	Fair	7.6/ 100 mm	Fair	+
Corralitos #3	5.5/ 116 mm	Fair	6.6/ 123 mm	Fair	+
Corralitos #8	6.0/ 90 mm	**Below Average**	12.3/ 109 mm	*Good*	+
Corralitos #9	11.2/ 104 mm	*Good*	14.5/ 104 mm	*Good*	+
Shingle Mill #1	6.3/ 104 mm	Fair	7.0/ 100 mm	**Below Average**	+
Shingle Mill #3	6.1/ 99 mm	**Below Average**	8.0/ 98 mm	Fair	+
Browns #1	10.1/ 103 mm	*Good*	14.2/ 100 mm	Fair	+
Browns #2	9.4/ 104 mm	*Good*	13.3/ 101 mm	Fair	+

For 2006−2011, smolt-sized juvenile ratings for sampling sites were summarized (**Table 38**). Ratings indicated a reduction in the “Good” rating in 2011compared to 2010 for the 4 watersheds considered. In 2011, 49% were of the sites were “Fair,”, 32% were “Good,” 27% were less than “Fair” and one site in upper Aptos Creek was “Very Good” (2.7%). Most of the less than “Fair” sites were in the mainstem of the San Lorenzo River watershed. The greatest rating improvements (“Below Average” to “Good”) occurred at upper Bean 14c, which had more streamflow in 2011, and at Corralitos 8, which had reduced sediment and significant habitat improvement recovering from fire impacts. Upper Aptos 4 went from “Fair” to “Very Good” after the habitat scoured out and large wood provided more cover. The greatest rating reduction (“Very Good to “Below Average”) occurred at the San Lorenzo Mainstem 0a site (probable lack of spawning nearby). Sites that remained “Good” were San Lorenzo Mainstem 2 (deep fastwater habitat with surface turbulence and high baseflow and rapid fish growth), Fall 15 (high instream wood density and cover), East Branch 13a (high instream wood density and cover) and upper Corralitos 9 (high unembedded boulder density and cover).

Table 38. Summary of Sampling Site Ratings in 2006−2011, based on Potential Smolt-Sized Densities.

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

R-12. Statistical Analysis of Annual Difference in Juvenile Steelhead Densities

The trend in fish densities between 2010 and 2011 was analyzed by using a paired t-test (**Snedecor and Cochran 1967; Sokal and Rohlf 1995; Elzinga et al. 2001**). Comparisons were made for total density, age class densities and size class densities (AC1, AC2, SC1, SC2). The paired t-test is among the most powerful of statistical tests, where the difference in mean density (labeled "mean difference" in the analysis) is tested. This test was possible because the compared data were taken at the same sites between years with consistent average habitat conditions between years, as opposed to re-randomizing each year. The null hypothesis for the test was that among all compared sites, the site-by-site difference between years 2010 and 2011 was zero. The non-random nature of the initial choice of sites was necessary for practical reasons and does not violate the statistical assumptions of the test; the change in density is a randomly applied effect (i.e. non-predictable based on knowledge of the initial sites) that does not likely correlate with the initial choice of sites. So, the mean difference is a non-biased sample.

The null hypothesis was that the difference in mean density was zero. Results from 2011 were compared to 2010, such that a positive difference indicated that the densities in 2011 were larger than in 2010 on average. A p-value of 0.05 meant that there was only a 5% probability that the difference between densities was zero and a 95% probability that it was not zero. A 2-tailed test was used, meaning that an increase or a decrease was tested for. The confidence limits tell us the limits of where the true mean difference was. The 95% confidence interval indicated that there was a 95% probability that the true mean difference was between these limits. If these limits included zero, then it could not be ruled out that there was no difference between 2010 and 2011 densities. The 95% confidence limits are standard and a p-value of < 0.05 is considered significant.

With 14 comparable sites in the San Lorenzo drainage, the decreases in total density, YOY density and Size Class II and III density in 2011 were statistically significant (**Table 39**). With 6 comparable sites in the San Lorenzo mainstem only, decreases in total and YOY densities were statistically significant (**Table 40**). With 5 comparable sites in the Soquel watershed, none of the decreased densities were statistically significant (**Table 41**). With only 2 comparable sites in Aptos watershed, no statistical tests were made. With 8 comparable sites in the Corralitos sub-watershed, increases in total density, yearling and older density and Size Class II and III density were statistically significant (**Table 42**). With 6 comparable sites in Corralitos and Shingle Mill creeks only, the increase in yearling and older density was statistically significant (**Table 43**).

Table 39. 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 (2011 to 2010; n=14).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	-4.90	-12.53	-0.98	-14.74
Df	13	13	13	13
Std Error	1.80	4.60	0.51	4.24
t Stat	-2.73	-2.73	-1.91	-3.48
P-value (2-tail)	0.017	0.017	0.08	0.004
95% CL (lower)	-8.78	-22.46	-2.09	-23.90
95% CL (upper)	-1.02	-2.60	0.13	-5.59

Table 40. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Replicated MAINSTEM SAMPLING SITES ONLY In the SAN LORENZO Watershed (2011 to 2010; n=7).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	-6.95	-17.77	-0.58	-17.80
Df	5	5	5	5
Std Error	3.15	2.83	0.42	2.63
t Stat	-2.21	-6.28	-1.40	-6.77
P-value (2-tail)	0.08	0.002	0.22	0.001
95% CL (lower)	-15.05	-25.04	-1.66	-24.56
95% CL (upper)	-1.15	-10.49	0.49	-11.04

Table 41. 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 (2011 to 2010; n=5).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	-2.56	-2.50	-0.86	-3.44
Df	4	4	4	4
Std Error	2.41	3.47	1.01	4.22
t Stat	-1.06	-0.74	-0.85	-0.82
P-value (2-tail)	0.35	0.51	0.44	0.46
95% CL (lower)	-9.24	-12.12	-3.67	-15.15
95% CL (upper)	4.12	7.12	1.95	8.27

Table 42. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Repeated Sampling Sites in the CORRALITOS Sub-Watershed (2011 to 2010; n=8).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	2.52	6.56	1.44	7.83
Df	7	7	7	7
Std Error	0.83	3.10	0.36	3.19
t Stat	3.06	2.12	4.03	2.45
P-value (2-tail)	0.02	0.07	0.005	0.04
95% CL (lower)	0.57	-0.76	0.59	0.27
95% CL (upper)	4.48	13.88	2.28	15.38

Table 43. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Repeated CORRALITOS/SHINGLE MILL CREEK SITES Only, Within the Corralitos Creek Watershed (2011 to 2010; n=6).

Statistic	s.c. 2	a.c. 1-YOY	a.c. 2	All Sizes
Mean difference	2.03	4.28	1.40	5.68
Df	5	5	5	5
Std Error	1.04	3.23	0.45	3.55
t Stat	1.96	1.32	3.14	1.60
P-value (2-tail)	0.11	0.24	0.03	0.17
95% CL (lower)	-0.63	-4.03	0.25	-3.44
95% CL (upper)	4.70	12.60	2.55	14.80

R-13. Adult Trapping Results at the Felton Dam's Fish Ladder and 2011 Planting Records

The trap in the fish ladder at the City of Santa Cruz Felton Diversion dam was operated by Terry Umstead (aquaculture teacher), San Lorenzo Valley High School students and other volunteers for 10 days during the winter of 2006-2007 and 2007-2008, 20 days in 2008-2009 and 8 days in 2009-2010. During the winter of 2010-2011, steelhead were trapped on 19 different days between 20 January and 16 March 2011. The 2011 trapping (as the previous four years) encompassed major stormflows of the winter but was late for trapping coho salmon (**Figure 33)**. In 2011, a total of 55 adult steelhead =>14 inches (35 cm) Fork Length were captured; 30 (55%) steelhead were hatchery clipped. One coho salmon were trapped in 2011 **(T. Umstead personal communication).** In 2010, a total of 53 adult steelhead were captured; 44 (83%) steelhead were hatchery clipped. No coho salmon were captured in 2010. In 2009 during 20 nonconsecutive days encompassing major stormflows during the period 18 February−27 March, a total of 145 adult steelhead =>14 inches Fork Length and one adult coho salmon were captured; 79 (54%) steelhead were hatchery clipped. The coho salmon was captured on the first day of trapping in 2009. In 2008 during the period 5−15 February, a total of 78 adult steelhead =>14 inches Fork Length were captured; 20 (26%) were hatchery clipped. In 2007 during a similar period (15−21 February), a total of 53 adult steelhead =>18 inches Fork Length were captured; 17 (32%) were hatchery clipped. No coho salmon were captured in 2007 or 2008, likely due to the late trapping period. More adult steelhead were trapped in 2006, with 247 adult steelhead and 2 coho salmon captured in 2 months from mid-January to late March. But trapping was over much shorter periods in 2007 and 2008. The 2006 total was less than the 371 adult steelhead and 18 adult coho captured in 2005 over a longer time period, but trapping began and ended later in the 2006 season than in 2005 and began after several storm events in 2006. Since in all years the trap has operated for only a small portion of the adult migration period, no comparisons among years can be used to estimate adult abundance or trends.

In early April, steelhead smolts (16.33/ pound and 170 pounds), with the San Lorenzo as the source, were planted at the following location:

San Lorenzo River at Highlands Park (2,776 juveniles; 1 April 2011).

Table 45. Adult Steelhead Trapping Data from the San Lorenzo River With Adult Return Estimates.

Trapping Year	Trapping Period	Number of Adults	Location
1934-35	?	973	Below Brookdale (1)
1938-39	?	412	Below Brookdale (1)
1939-40	?	1,081	Below Brookdale (1)
1940-41	?	671	Near Boulder Ck (2)
1941-42	Dec 24 - Apr 11	827	Near Boulder Ck (2)
1942-43	Dec 26 - Apr 22	624	Near Boulder Ck (3)
1976-77	Jan-Apr	1,614	Felton Diversion (4)
1977-78	Nov 21 - Feb 5	3,000 (Estimate)	Felton Diversion (4)
1978-79	Jan-Apr	625 (After drought)	Felton Diversion (4)
1979-80	Jan-Apr ?	496 (After drought)	Felton Diversion (4)
1982-83		1,506	Alley Estimate from 1981 Mainstem Juve-niles only
1994-95	6 Jan- 21 Mar (48 of 105 days-Jan-15 Apr)	311 (After drought)	Felton Diversion (5) Monterey Bay Salmon & Trout Project
1996-97		1,076 (estimate)	Alley Estimate from 1994 Mainstem Juve-niles only
1997-98		1,784 (estimate)	Alley Estimate from 1995 Mainstem Juve-niles only
1998-99		1,541 (estimate)	Alley Revised Esti-mate from 1996 Main-stem Juveniles only
1999-2000	17 Jan- 10 Apr	532 (above Felton)	Monterey Bay Salmon & Trout Project
1999-2000		1,300 (estimate)	Alley Index from 1997 Mainstem Juveniles only
2000-01	12 Feb- 20 Mar	538 (above Felton)	Monterey Bay Salmon & Trout Project
2000-01		2,500 (estimate)	Alley Index from 1998 Juveniles in Mainstem and 9 Tributaries
2001-02		2,650 (estimate)	Alley Index from 1999 Juveniles in Mainstem and 9 Tributaries
2002-03		1,650 (estimate)	Alley Index from 2000 Juveniles in Mainstem and 9 Tributaries
2003-04		1,600 (estimate)	Alley Index from 2001 Juveniles in Mainstem and 9 Tributaries
2003-04	28 Jan- 12 Mar	1,007 Steelhead 14 Coho	SLV High School-Felton Diversion Dam
2004-05	12 Dec 29 Jan	371 Steelhead 18 Coho	SLV High School-Felton Diversion Dam
2005-06	17 Jan- 24 Mar	247 Steelhead 2 Coho	SLV High School-Felton Diversion Dam

2006-07	15 Feb- 21 Feb	54 Steelhead	SLV High School-Felton Div. Dam
2007-08	05 Feb- 15 Feb	78 Steelhead	SLV High School-Felton Diversion
2008-09	18 Feb	145 Steelhead	SLV High School-Felton Diversion
	27 Mar	1 Coho	
2009-10	2-11 Mar	53 Steelhead	SLV High School- Felton Diversion
2010-11		55 Steelhead	MBST Project- Felton Diversion Dam
		1 Coho	

(1) Field Correspondence from Document # 527, 1945, Div. Fish and Game.
(2) Field Correspondence from Document #523, 1942, Div. Fish and Game.
(3) Inter-office Correspondence, 1943, Div. Fish and Game.
(4) Kelley and Dettman (1981). (5) Dave Strieg, Big Creek Hatchery, 1995.

DISCUSSION OF 2011 RESULTS

D-1. Causal Factors for Continued Below Average 2011 YOY Steelhead Densities at Most Sites

Although we have no estimates of adult returns for the 4 watersheds that were sampled, it would appear that there were insufficient adult steelhead returns after the large stormflows in late March to saturate reaches with redds and egg production after the large spring stormflows passed. This combined with poor egg and YOY survival during those large stormflows best explain the much below average YOY densities at most sites in all 4 watersheds. The total 2011 adult returns may have been up from 2010, as indicated by adult counts in the Carmel River and the estimate in Scott Creek. Adult returns to the Carmel River increased in 2011, as detected at the San Clemente Dam on the Carmel River. Recent counts for 2006–2011 were 368, 222, 412, 95, 157 and 452, respectively (**Urquhart, 2011a**). Trapping data from Scott Creek indicated increased adult returns in winter 2010-2011, where adult escapement estimates in water years 2006–2010 were 219, 259, 293, 126 , 109 and 214, respectively (**Sean Hayes, NOAA Fisheries personal communication**).However, the pattern of returning adults to our watersheds may have been similar to that on the Carmel River. In the Carmel River in 2011, most adult steelhead had entered the river prior to the late March storms (85% of the adults (384) passed the San Clemente Dam counter by the end of March, with few counted in late March during the high stormflows (**Urquhart 2011b**)).

Most 2011sites in the San Lorenzo (11 of 19) and Soquel (6 of 8) drainages lacked many small YOY indicative of poor spawning success after March (**Table 46**). The stormflow pattern in 2005-2006 was similar to 2010-2011 in that late storms were large. Similar to 2011, YOY densities were depressed in 2006 but not quite as much (**Table 46**). The stormflow pattern in 2009-2010 included late stormflows, as well, but not as large as in 2006 and 2011. YOY densities were below average in 2010 in tributaries of the San Lorenzo drainage and the Soquel drainage, but small YOY were present at more sites in the San Lorenzo than in 2006 and 2011, indicating more successful late spawning (**Table 46**). With extremely low YOY densities in the San Lorenzo and Soquel watersheds in 2011, total juvenile densities were the lowest in at least the last 15 years, despite overall improved rearing habitat conditions in both watersheds. In the San Lorenzo system, the sites furthest below average in YOY density were Mainstem sites 4, 8 and 11, and lower tributary sites at Zayante 13a, Zayante 13d, Lompico 13e, Bean 14b, Newell 16 and Boulder 17a. The one site that had above average YOY density and the highest in the watershed was Fall 15. YOY success there may be attributed to good spawning effort due to its location in the watershed and higher YOY survival due to high quantities of instream wood.

In the Soquel system, sites furthest below average in YOY density were the upper Mainstem sites10 and 12, as well as 3 of the 4 Branch sites, 13a, 16 and 21, despite overall rearing habitat improvement in 2011. Site 16 in the SDSF had only about 1/3 its average YOY density, though reach habitat conditions had improved since 2009. The highly sedimented streambed of Soquel Creek likely caused egg survival to be very limited during the late spring storms of high magnitude. Spawning gravel with a high proportion of fine sediment could be easily scoured. High sedimentation resulting from erosion at the Highland slide on the upper East Branch (observed by Ed Orre, forester at the Soquel Demonstration State Forest) may have smothered redds with fine sediment. The lack of large instream wood in the watershed likely caused high YOY mortality during those stormflows. In addition, the number of adult spawners after March may have been low, leading to insufficient reproduction to saturate reaches with redds and egg production after the large spring stormflows passed.

Table 46. Presence of Small YOY from Late Spawning After Large, Late Stormflows for Sampling Sites in 2006, 2010 and 2011.

Site	At least 30% of the YOY < 75 mm SL and More than 10 in Number/ At least One Habitat 2006	At least 30% of the YOY < 75 mm SL and More than 10 in Number/ At least One Habitat 2010	At least 30% of the YOY < 75 mm SL and More than 10 in Number/ At least One Habitat 2011
Low. San Lorenzo #0a	NA	–	–
Low. San Lorenzo #1	–	–	–
Low. San Lorenzo #2	NA	+	–
Low. San Lorenzo #4	–	+	–
Mid. San Lorenzo #6	+	+	–
Mid. San Lorenzo #8	+	+	+
Up. San Lorenzo #11	–	+	–
Zayante #13a	+	+	–
Zayante #13c	–	+	+
Zayante #13d	+	+	+
Lompico #13e	+	–	–
Bean #14b	–	+	+
Bean #14c	+	+	–
Fall #15	NA	+	+
Newell #16	–	+	–
Boulder #17a	+ (barely)	+	–
Boulder #17b	+	+	+
Bear #18a	+	+	+
Branciforte #21a-2	+	–	+
Soquel #1	–	–	–
Soquel #4	–	–	–
Soquel #10	–	–	–
Soquel #12	NA	–	–
East Branch Soquel #13a	–	–	–
East Branch Soquel #16	+	+	+
West Branch Soquel #19	–	–	+ (barely)
West Branch Soquel #21	+	+ (barely)	–
Aptos #3	–	+	–
Aptos #4	+	+	–
Valencia #2	+	+	NA
Valencia #3	+ (barely)	+	NA
Corralitos #1	NA	–	+ (barely)
Corralitos #3	+	–	+
Corralitos #8	+	+ (barely)	+
Corralitos #9	+	+	+
Shingle Mill #1	+ (barely)	–	–
Shingle Mill #3	+	+	–
Browns #1	+	+	+
Browns #2	+	+	+

In the Aptos system, the continued below average YOY density at both Aptos sites are attributable to poor egg and YOY survival during the late March stormflows, as likely occurred in 2010. While the upper Aptos 4 site had similar YOY density to the previous year, the lower Aptos 3 site had even lower YOY density in 2011 than 2010. In addition, as may have been the case in other watersheds, the adult spawning population entering after March may have been small in 2011, leading to insufficient reproduction to saturate reaches with redds and egg production in April after the large spring stormflows passed.

In the Corralitos system, Corralitos Creek was still recovering from the substantial sedimentation that occurred after the Summit Fire. Habitat improvement was observed in 2011 over 2010 conditions. As a result, YOY densities improved but were still below average in the 4 Corralitos sites. As in other watersheds, the adult spawning population entering the watershed after March may have been small in 2011, leading to insufficient reproduction to saturate reaches with redds and egg production after the large spring stormflows passed.

D-2. Causal Factors for Near Average 2011 Size Class II and II Steelhead Densities at Most Sites Despite Low Overall Juvenile Densities

First of all, the near average densities of larger juveniles was not due to near average densities of yearlings and older fish. Yearling and older densities were very much below average in most San Lorenzo tributary sites, Aptos sites and Corralitos sites. In Soquel Creek, although 6 of 8 sites had near average yearling densities, average yearling densities are typically low at those sites. At the 2 upper Soquel Branch sites (East Branch 16 and West Branch 21) where yearling and older densities average the highest, densities were down at both sites in 2011. Low yearling densities may have partially resulted from high spring baseflows that allowed young yearlings to have faster growth rates and early immigration. In addition, there may have been poorer overwinter survival of yearlings during the more frequent winter/spring stormflows than occurred during drier years, such as 2007–2009. The 24 March stormflow was likely about 3 times a bankfull event in each watershed, likely encouraging those yearlings that survived to immigrate in watersheds lacking instream wood to provide overwintering cover.

The near average densities of larger juveniles resulted from accelerated growth rates of YOY leading to a high proportion reaching Size Class II by fall sampling. Rearing habitat that had relatively high food abundance associated with high spring and early summer baseflows in all stream reaches and high summer/fall baseflow in mainstem sites (**Figure 42**). In addition, low juvenile densities reduced competition for food to further enhance growth rate.

D-3. Annual Trend in YOY and Yearling Abundance Compared to Other Coastal Streams

YOY steelhead densities in 2011 continued to be below average at most sites in Gazos (**Figure 44;** data from **Smith 2011**), Waddell and Scott (**Figure 45;** data from **Smith 2011**) creeks, although they increased from 2010 densities at most Gazos sites and some Scott sites (**Smith 2011**). Data from Scott, Waddell and Gazos creeks were consistent with generally below average YOY densities at a majority of sites in the San Lorenzo, Soquel and Corralitos watersheds. However, 2 of 9 sampling sites on Scott Creek had above average YOY densities and 2 others were near average. One of 7 sampling sites on Gazos had above average YOY density.

In Scott Creek, average YOY steelhead site densities for 2007─2011 were 49, 20, 24, 45 and 41 fish/ 100 ft, respectively, with a 21-year average of 53 (**Figure 48**; data from **Smith 2011**). The average Waddell Creek YOY site densities for 2007─2011 were 13, 23, 10, 13 and 8 fish/ 100 ft and much below the 21-year average of 37. The average Gazos Creek YOY site densities for 2007 and 2009─2011 were 21, 17, 16 and 28 fish/ 100 ft and below the 18-year average of 36. YOY densities in Gazos may have increased due to better adult spawning access through two large logjams and two smaller logjams in 2011. Smith stated that summer streamflow was up in 2011 in Gazos Creek but did not result in good YOY growth.

YOY densities in Waddell Creek have been especially low since 1999, assumedly due to toxic pollution from Last Chance Creek on the East Branch. Smith suspects that lightweight solvents (not usually affecting sculpins) are the cause, originating in the Last Chance Creek sub-watershed. Surprisingly, the highest YOY density in Waddell Creek in 2009 was in the East Branch, downstream of Last Chance. Smith noted that in 2011, YOY densities in the West Branch were similarly as low as site densities on the East Branch below Last Chance, and YOY densities below the branches were even lower. Smith stated that insufficient adults may have returned to saturate the creek with young.

Densities of 1+/2+ juveniles were near or above average at most sites in Gazos Creek in 2011(**Figure 46;** data from **Smith 2011**). However, in Scott (**Figure 47;** data from **Smith 2011**) and Waddell (**Smith 2011**) creeks they were below average and less than in 2010, as was the case in the 4 watersheds we monitored. Average 1+/2+ densities in Scott Creek for 2007─2011 were 14, 8, 7, 7 and 2 fish/ 100 feet, with a 21-year average of 8.6 fish/ 100 feet and a sizeable standard error (**Figure 49;** data from **Smith 2011**). Average 1+/2+ density in Waddell Creek for 2007─2011 were 2, 1, 2, 1 and 0.4 fish/ 100 ft, with a 21-year average being 5.4 fish/ 100 ft. Average 1+/2+ density in Gazos Creek for 2007 and 2009−2011 were 4, 9, 4 and 6 fish/ 100 ft, with 18-year average being 7.5 fish/ 100 ft. In these creek sites, these age classes were likely the only fish reaching Size Class II. So, the very low Size Class II and III densities in Scott, Waddell and Gazos creek sites in 2011 were similar to poorer sites in our 4 watersheds, such as lower and middle San Lorenzo mainstem sites, upper San Lorenzo mainstem Site 11, lower Zayante 13a and Soquel mainstem sites in 2011. Average Size Class II abundance at Waddell Creek sites were less than densities at all sample sites in our four watersheds.

D-4. Data Gaps

Annual monitoring of steelhead needs to continue through the next drought period and beyond to assess the extent of population recovery. The level of fish monitoring and habitat analysis needs to be restored to 2000 levels. In 2000 in the San Lorenzo River drainage, the mainstem was sampled at 16 sites (13 reach segments habitat typed), and 9 tributaries were sampled at 20 sites (20 reach segments habitat typed). At that time, more accurate indices of juvenile and adult steelhead population sizes were possible. By 2009−2011, sampling was reduced to less than half that of 2000 and 2001, while habitat typing was reduced to less than 1/3 in 2009 and even more so in 2010 and 2011. More accurate population indices were not possible after 2001. Many upper mainstem and upper tributary sites were discontinued. Carbonera and Kings creeks are no longer sampled. While site densities are valuable, the relative contributions of mainstem reaches and tributaries to total juvenile population size are lost when only site densities are reported, rather than the total production of the reaches that the sites represent. The relative importance of mainstem reaches compared to tributaries in production of large juveniles is lost when only site densities are considered. Calculation of an *index of adult returns* is the most meaningful way to compare the value of the annual juvenile population because it weighs the juveniles according to size categories and size-dependent ocean survival rates. Although the index may not precisely predict actual adult numbers, it reflects *relative* juvenile contribution to adult returns between reaches and between years.

Fish and habitat monitoring in Soquel Creek should be restored to 2004 levels to obtain an accurate estimate of juvenile steelhead population size. Sampling in Soquel Creek was reduced from 19 sites (14 reaches) in 2004 to 15 sites (14 reaches) in 2005 to 6 sites (6 reaches) in 2006 and increased to 8 sites (8 reaches) in 2009−2011. After 2005, annual estimation of juvenile steelhead population size and calculation of adult indices from juvenile population size ceased in Soquel Creek for the first time since 1994. This is a significant loss in monitoring information. Recent data gaps in the heavily impacted mainstem of Soquel Creek have occurred. In 2008 and 2009, 2.5 miles of mainstem were habitat typed, when all 7.2 miles were habitat typed in the past to assess habitat quality. No reaches were habitat typed in the watershed in 2010, and 2mainstem reaches (1 mile) and 2 Branch reaches (1 mile) were habitat typed in 2011.

Instream wood inventories should be expanded to other reaches. With the change in County management guidelines for large instream wood, incidence of large instream wood should be annually monitored. The wood survey completed in 2002 on Soquel Creek (**Alley 2003c**) could be repeated periodically for comparison purposes. Five reach segments among 3 watersheds were inventoried for wood in 2010, and 3 reaches were inventoried in 2 watersheds in 2011.

There is a shortage of streamflow data on the San Lorenzo River mainstem and tributaries. More stream gages should be established and maintained in the watershed to better correlate streamflow with habitat conditions and fish densities and to detect insufficient streamflow. Mainstem locations for additional gages would include Waterman Gap, above and below the Boulder Creek confluence on the mainstem. Tributaries that need better gaging include Zayante Creek (above and below the Bean Creek confluence), Bean Creek (below Lockhart Gulch and just below the Mackenzie Creek confluence), Fall Creek above the water diversion and Boulder Creek (near the mouth).

There is no stream gage in the Aptos watershed. It would be beneficial to have stream gages on lower Valencia Creek and Aptos Creek near the lagoon. Any future management of Aptos Lagoon would benefit from continuous streamflow data in relation to sandbar manipulation. It is a valuable tool on

Soquel Creek with the USGS gage in Soquel Village. The only stream gage data for the Corralitos watershed is at Freedom. This is below the City of Watsonville diversions and is in a percolating reach that is dry in summer. It would be beneficial to install stream gages at the diversion dams on Browns and Corralitos Creeks. Then streamflow above and below the diversions could be monitored. If stream gaging proves prohibitively expensive, streamflow should be annually measured in mid-May and mid-September at the proposed gage locations in Valencia, Aptos, Corralitos and Browns Creeks. In addition, it would be enlightening to measure streamflow downstream of the Rider Creek confluence with Corralitos Creek, downstream of the Eureka Gulch confluence with Corralitos Creek and upstream of the Eureka Gulch confluence.

If stream gaging proves prohibitively expensive, streamflow should be annually measured in mid-April and mid-September at the proposed gage locations in the San Lorenzo watershed, as well as in the mainstem at Paradise Park, at the Henry Cowell Park bridge, downstream of the Fall Creek confluence (under Graham Hill Road bridge), downstream of the Clear Creek confluence (near Larkspur Bridge), downstream of the Boulder Creek confluence (along Erwin Way), and in the upper valley near the Mountain Store (downstream of Kings Creek) and at the Teihl Road bridge. Streamflow should also be measured in Bear Creek below Hopkins Gulch and in Newell Creek (Glen Arbor Road Bridge).

REFERENCES AND COMMUNICATIONS

Alley, D.W. 1993. Upper San Lorenzo River Watershed Reservoir Projects - Reconnaissance Level Study of Fishery Resources. Prepared by D.W. ALLEY & Associates for Camp Dresser and McKee, Inc. and the City of Santa Cruz.

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

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

Alley, D.W. 1997. Comparison of Juvenile Steelhead Densities in 1981and 1994-96 in the San Lorenzo River and Tributaries, with an Estimate of Juvenile Population Size in the Mainstem San Lorenzo River, with Expected Numbers of Adults Returning from that Production, Santa Cruz County, California.

Alley, D.W. 1998a. Comparison of Juvenile Steelhead Densities in 1981and 1994-97 in the San Lorenzo River and Tributaries, with an Estimate of Juvenile Population Size in the Mainstem River, with Expected Numbers of Adults Returns.

Alley, D.W. 1998b. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 1997 Estimate of Juvenile Production and Expected Adult Returns.

Alley, D.W. 1999a. Comparisons of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions for the San Lorenzo River, Santa Cruz County, California, 1995-1998; with an Index of Adult Returns.

Alley, D.W. 1999b. Comparison of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions for Soquel Creek, Santa Cruz County, California, 1997-98; with Expected Adult Returns.

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

Alley, D.W. 2000b. Comparison of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions for Soquel Creek, Santa Cruz County, California; 1997-1999; With Expected Adult Returns.

Alley, D.W. 2001a. Comparison of Juvenile Steelhead Densities, 1997 through 2000, in the San Lorenzo River and Tributaries, Santa Cruz County, California; With an Estimate of Juvenile Population Size and an Index of Adult Returns.

Alley, D.W. 2001b. Comparison of Juvenile Steelhead Densities, Population Estimates and Habitat Conditions in Soquel Creek, Santa Cruz County California, 1997 through 2000; With an Index of Expected Adult Returns.

Alley, D.W. 2002. Comparison of Juvenile Steelhead Densities, 1997 through 2001, in the San Lorenzo River and Tributaries, Santa Cruz County, California; With an Estimate of Juvenile Population Size and an Index of Adult Returns.

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

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

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

Alley, D.W. 2004a. Comparison of Juvenile Steelhead Densities, 1997- 2001 and 2003, in the Middle and Upper San Lorenzo River and 4 Tributaries, Santa Cruz County, California; With an Estimate of Juvenile Population Size and an Index of Adult Returns.

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

Alley, D.W., J. Dvorsky, J. Ricker, K. Schroeder and J.J. Smith. 2004c. San Lorenzo River Enhancement Plan. Prepared for Santa Cruz County by D.W.ALLEY & Associates and Swanson Hydrology and Geomorphology.

Alley D.W. 2005a. Comparison of Juvenile Steelhead Densities, 1996-2001 and 2003-2004, in the Middle and Upper San Lorenzo River and 4 Tributaries, Santa Cruz County, California; with an Estimate of Juvenile Population Size and an Index of Adult Returns.

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

Alley, D.W. 2006a. Comparison of Juvenile Steelhead Densities, 1997-2001 and 2003-2005, in the Middle and Upper San Lorenzo River and 5 Tributaries, Santa Cruz County, California; With an Index of Juvenile Population Size and Adult Returns.

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

Alley, D.W. 2006a. Comparison of Juvenile Steelhead Densities, 1997-2001 and 2003-2005, in the Middle and Upper San Lorenzo River and 5 Tributaries, Santa Cruz County, California; With an Index of Juvenile Population Size and Adult Returns.

REFERENCES AND COMMUNICATIONS (continued)

Alley, D.W. 2006b. Comparison of Juvenile Steelhead Densities, Population Indices and Habitat Conditions in Soquel Creek, Santa Cruz County California, 1997 through 2005; With an Index of Expected Adult Returns.

Alley, D.W. 2007a. 2006 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California.

Alley, D.W. 2007b. Trends in the Juvenile Steelhead Population in 1994–2006 for Santa Rosa Creek, San Luis Obispo County, California with Habitat Analysis and an Index of Adult Returns.

Alley, D.W. 2007c. Trends in the Juvenile Steelhead Population in 1994–2006 for San Simeon Creek, San Luis Obispo County, California with Habitat Analysis and an Index of Adult Returns.

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

Alley, D.W. 2009a. Soquel Lagoon Monitoring Report, 2008. Prepared for the City of Capitola.

Alley, D.W. 2009b. 2008 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With Trend Analysis in the San Lorenzo and Soquel Watersheds, 1997-2007.

Alley, D.W. 2010a. Soquel Lagoon Monitoring Report, 2009. Prepared for the City of Capitola.

Alley, D.W. 2010b. 2009 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With Trend Analysis in the San Lorenzo and Soquel Watersheds, 1997-2007.

Alley, D.W. 2011a. Soquel Lagoon Monitoring Report, 2010. Prepared for the City of Capitola.

Alley, D.W. 2011b. 2010 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With Trend Analysis in the San Lorenzo and Soquel Watersheds, 1997-2010.

Alley, D.W. 2011c. Soquel Lagoon Monitoring Report, 2011. Prepared for the City of Capitola.

Davis, L. 1995. Age Determination of Steelhead Trout (*Oncorhynchus mykiss*) in Microhabitats of a Small Central California Coastal Stream, Using Otolith Microstructural Analysis. Master's Thesis. San Jose State University.

Dettman, D.H. and D.W. Kelley. 1984. Investigations of Alternative Water Development Projects on Soquel Creek. Progress Report 1982-83. Prepared for Soquel Creek Water District.

REFERENCES AND COMMUNICATIONS (continued)

Elzinga, C. L., D. W. Salzer, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring Plant and Animal Populations. Blackwell Science, Inc., Oxford.

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

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

Hankin, D.G. and G.H. Reeves. 1998. Estimating Total Fish Abundance and Total Habitat area in small streams based on visual estimation methods. Can. J.Fish. Aquat. Sci. 45:834-844.

Hayes, Sean. 2012. Personal Communication. NOAA Fisheries Laboratory. Santa Cruz, CA.

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

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

Leicester, M.A. 2005. Recruitment and Function of Large Woody Debris in Four California Coastal Streams. M.S. Thesis. San Jose State University.

Orre, Ed. 2011. Personal Communication. State Forester at the Soquel Demonstration State Forest.

Shapovalov, L. and A. Taft. 1954. The Life Histories of Steelhead Rainbow Trout and Silver Salmon. Calif. Dept. Fish and Game. Fish Bulletin No. 98. 375 pp.

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

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

Smith, JJ. 1984. Liddell Creek Baseline Watershed Study: Fisheries Section. Prepared for Lonestar Industries by Creegan & D’Angelo, Consulting Engineers and Harvey and Stanley Associates.

Smith, J.J. 2005. Unpublished Data from Scale Analysis of Down-migrant Smolts on the San Lorenzo River, 1987-1989. Department of Biological Sciences, San Jose State University.

Smith, J.J. 2007. Distribution and Abundance of Juvenile Coho and Steelhead in Gazos, Waddell and Scott Creeks in 2006. Dept. of Biological Sciences. San Jose State Univ.

Smith, J.J. 2010. Distribution and Abundance of Juvenile Coho and Steelhead in Gazos, Waddell and Scott Creeks in 2010. Dept. of Biological Sciences. San Jose State University.

REFERENCES AND COMMUNICATIONS (continued)

Smith, J.J. 2011. Distribution and Abundance of Juvenile Coho and Steelhead in Gazos, Waddell and Scott Creeks in 2011. Dept. of Biological Sciences. San Jose State University.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical Methods. The Iowa State University Press. Ames, Iowa. Sixth Edition. 593 pp.

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

Sokal, R.R. and F.J. Rohlf. 1995. Biometry. Third edition. W.H. Freeman Company. New York.

Urquhart, Kevan. 2011a. Carmel River Staff Fishery Report for May 2011. Monterey Peninsula Water Management District. Monterey, CA.

Urquhart, Kevan. 2011b. Carmel River Staff Fishery Report for March 2011. Monterey Peninsula Water Management District. Monterey, CA.

FIGURES

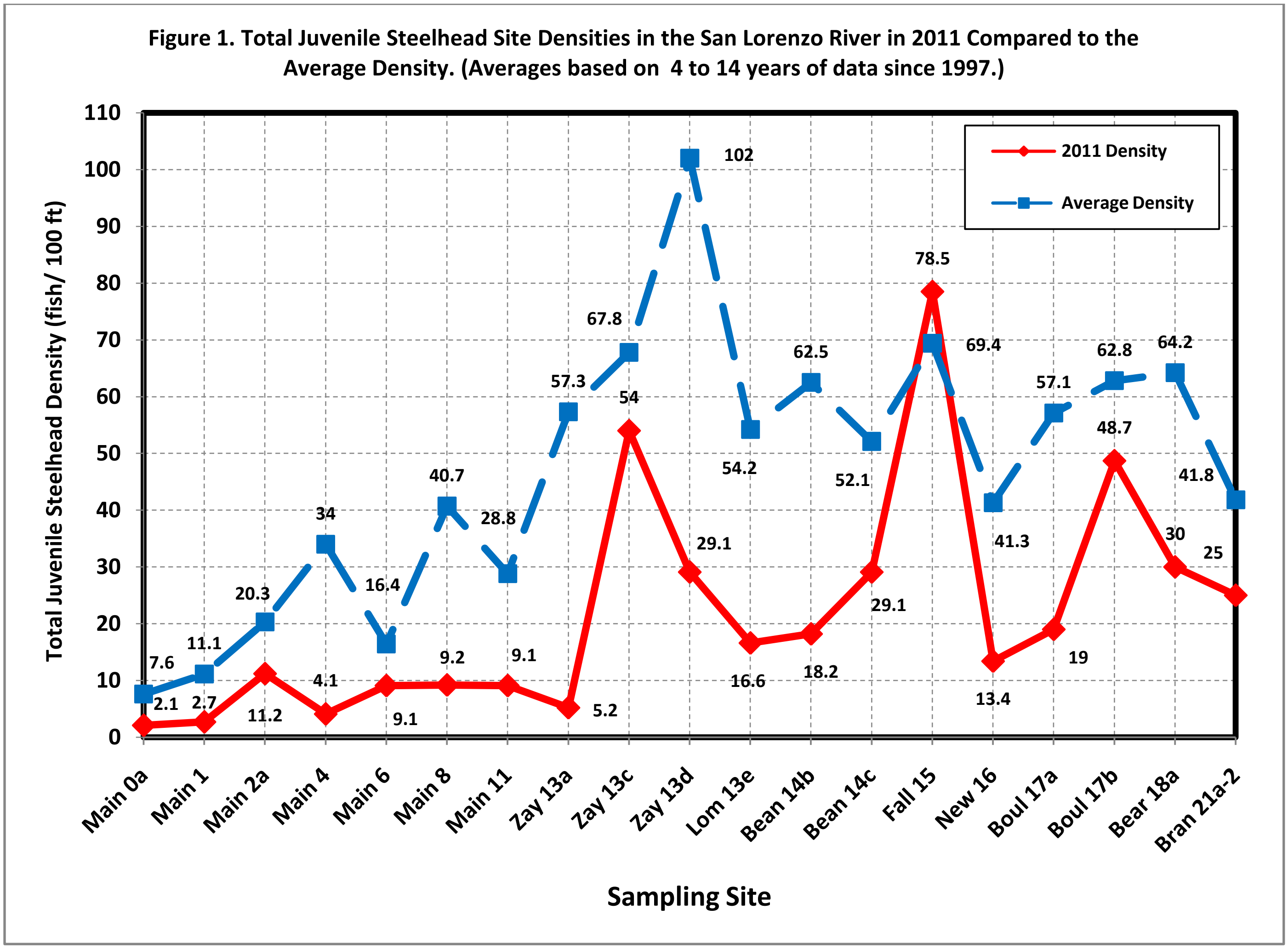


Figure 1. Total Juvenile Steelhead Site Densities in the San Lorenzo River in 2011 Compared to the Average Density. (Averages based on 4 to 14 years of data since 1997.)
2011 Density
Average Density
Total Juvenile Steelhead Density (fish/ 100 ft)
Sampling Site
Main 0a
Main 1
Main 2a
Main 4
Main 6
Main 8
Main 11
Zay 13a
Zay 13c
Zay 13d
Lom 13e
Bean 14b
Bean 14c
Fall 15
New 16
Boul 17a
Boul 17b
Bear 18a
Bran 21a-2
7.6
11.1
20.3
34
16.4
40.7
28.8
57.3
67.8
102
54.2
62.5
52.1
69.4
41.3
57.1
62.8
64.2
41.8
2.1
2.7
11.2
4.1
9.1
9.2
9.1
5.2
54
29.1
16.6
18.2
29.1
78.5
13.4
19
48.7
30
25

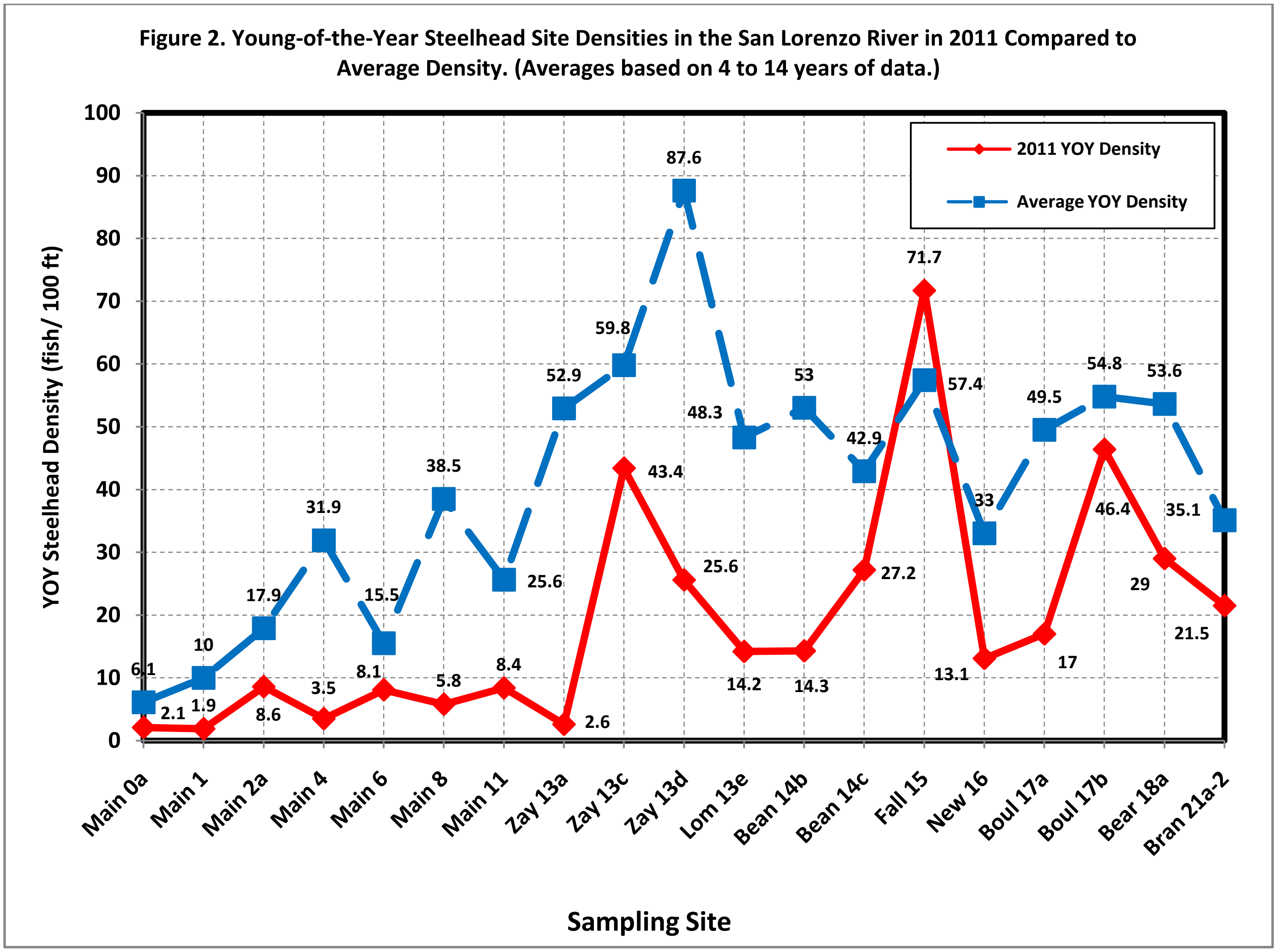


Figure 2. Young-of-the-Year Steelhead Site Densities in the San Lorenzo River in 2011 Compared to Average Density. (Averages based on 4 to 14 years of data.)
YOY Steelhead Density (fish/ 100 ft)
Sampling Site
2011 YOY Density
Average YOY Density
Main 0a
Main 1
Main 2a
Main 4
Main 6
Main 8
Main 11
Zay 13a
Zay 13c
Zay 13d
Lom 13e
Bean 14b
Bean 14c
Fall 15
New 16
Boul 17a
Boul 17b
Bear 18a
Bran 21a-2
6.1
10
17.9
31.9
15.5
38.5
25.6
52.9
59.8
87.6
48.3
53
42.9
57.4
33
49.5
54.8
53.6
35.1
2.1
1.9
8.6
3.5
8.1
5.8
8.4
2.6
43.4
25.6
14.2
14.3
27.2
71.7
13.1
17
46.4
29
21.5

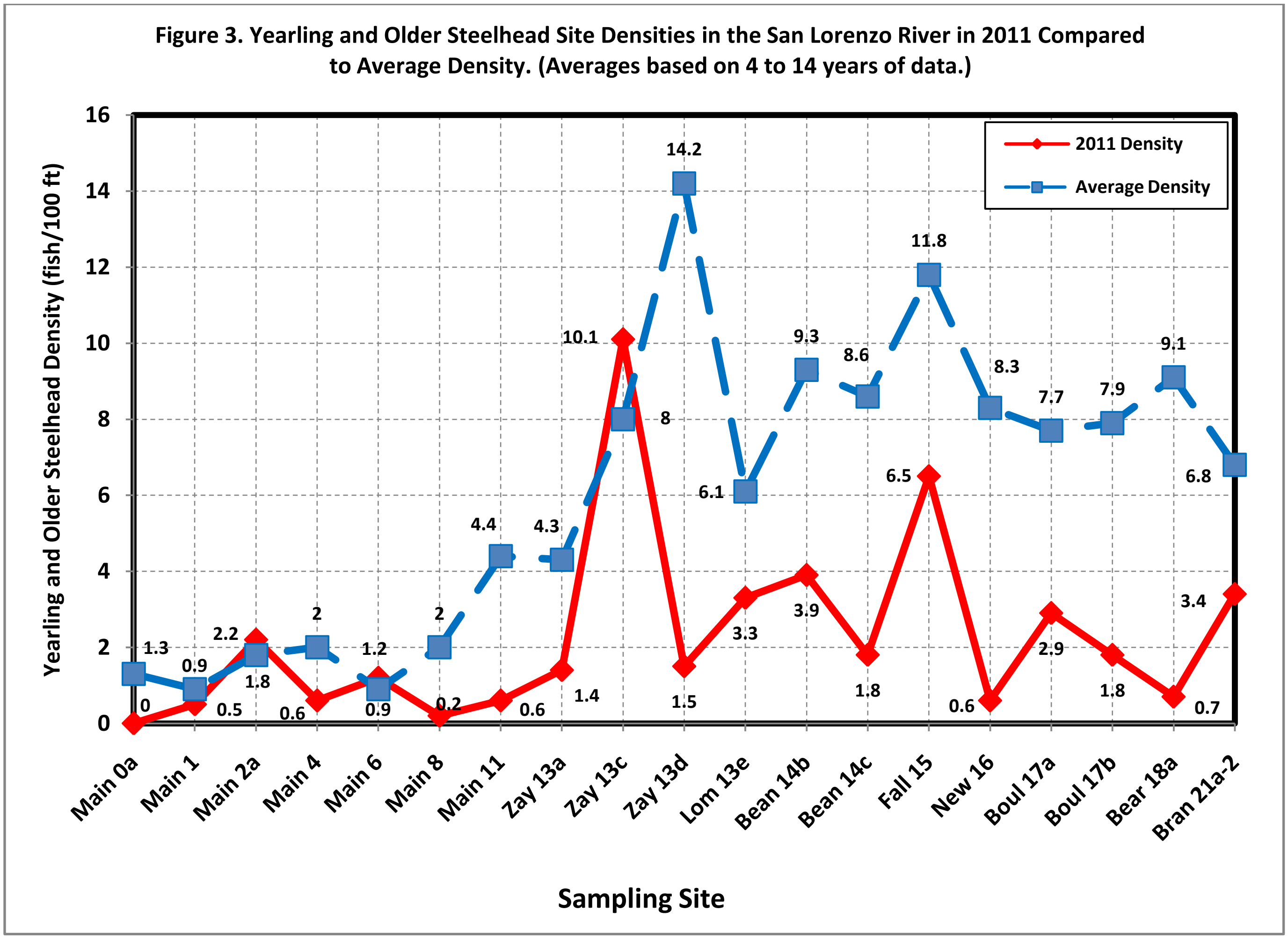


Figure 3. Yearling and Older Steelhead Site Densities in the San Lorenzo River in 2011 Compared
to Average Density. (Averages based on 4 to 14 years of data.)
Yearling and Older Steelhead Density (fish/100 ft)
16
14
12
10
8
6
4
2
0
2011 Density
Average Density
1.3
0
0.9
0.5
2.2
1.8
2
0.6
1.2
0.9
2
0.2
4.4
0.6
4.3
1.4
10.1
8
14.2
1.5
6.1
3.3
9.3
3.9
8.6
1.8
11.8
6.5
8.3
0.6
7.7
2.9
7.9
1.8
9.1
0.7
6.8
3.4
Main 0a
Main 1
Main 2a
Main 4
Main 6
Main 8
Main 11
Zay 13a
Zay 13c
Zay 13d
Lom 13e
Bean 14b
Bean 14c
Fall 15
New 16
Boul 17a
Boul 17b
Bear 18a
Bran 21a-2
Sampling Site

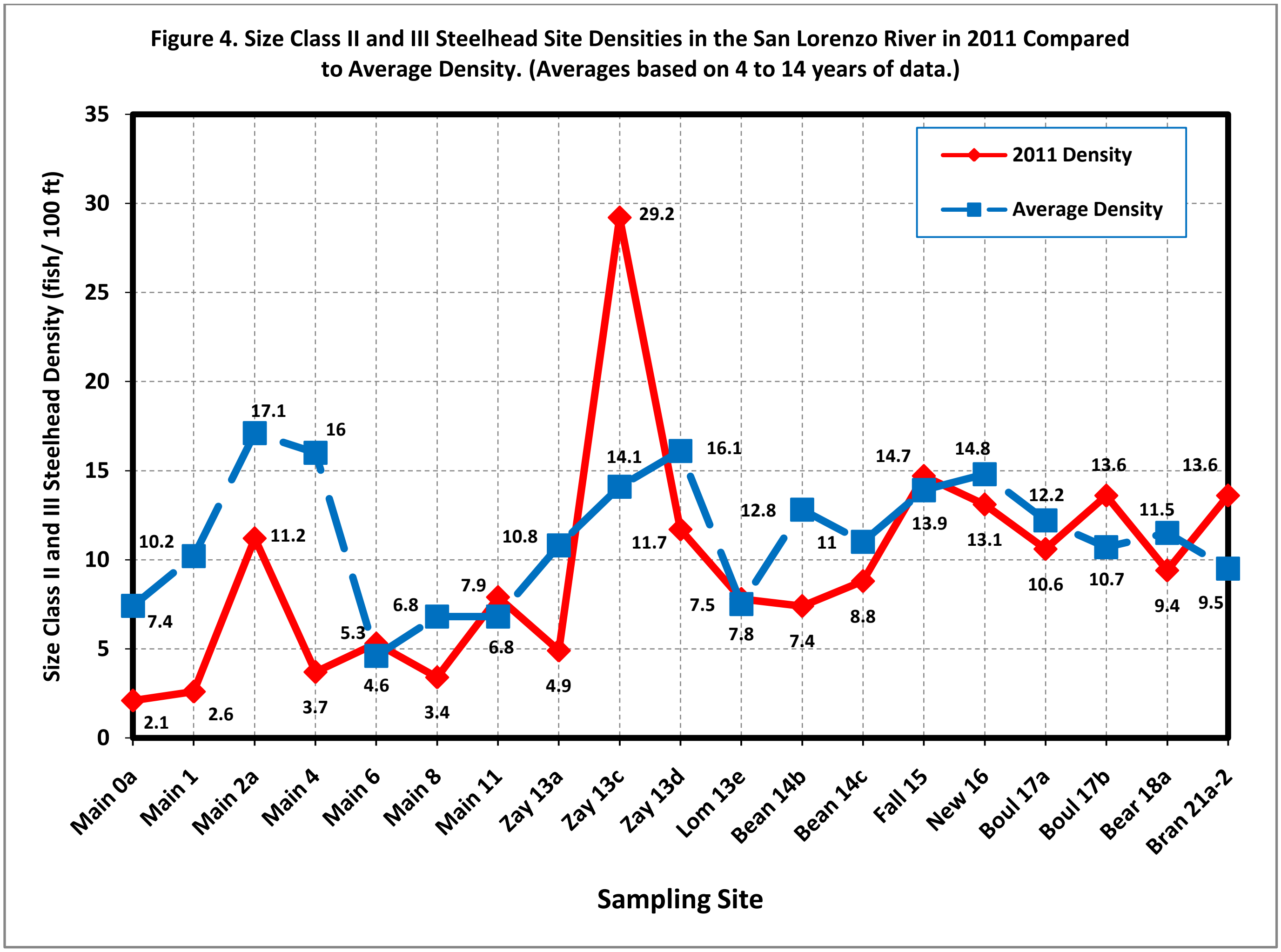


Figure 4. Size Class II and III Steelhead Site Densities in the San Lorenzo River in 2011 Compared to Average Density. (Averages based on 4 to 14 years of data.)
Size Class II and III Steelhead Density (fish/ 100 ft)
Sampling Site
2011 Density
Average Density
Main 0a
Main 1
Main 2a
Main 4
Main 6
Main 8
Main 11
Zay 13a
Zay 13c
Zay 13d
Lom 13e
Bean 14b
Bean 14c
Fall 15
New 16
Boul 17a
Boul 17b
Bear 18a
Bran 21a-2

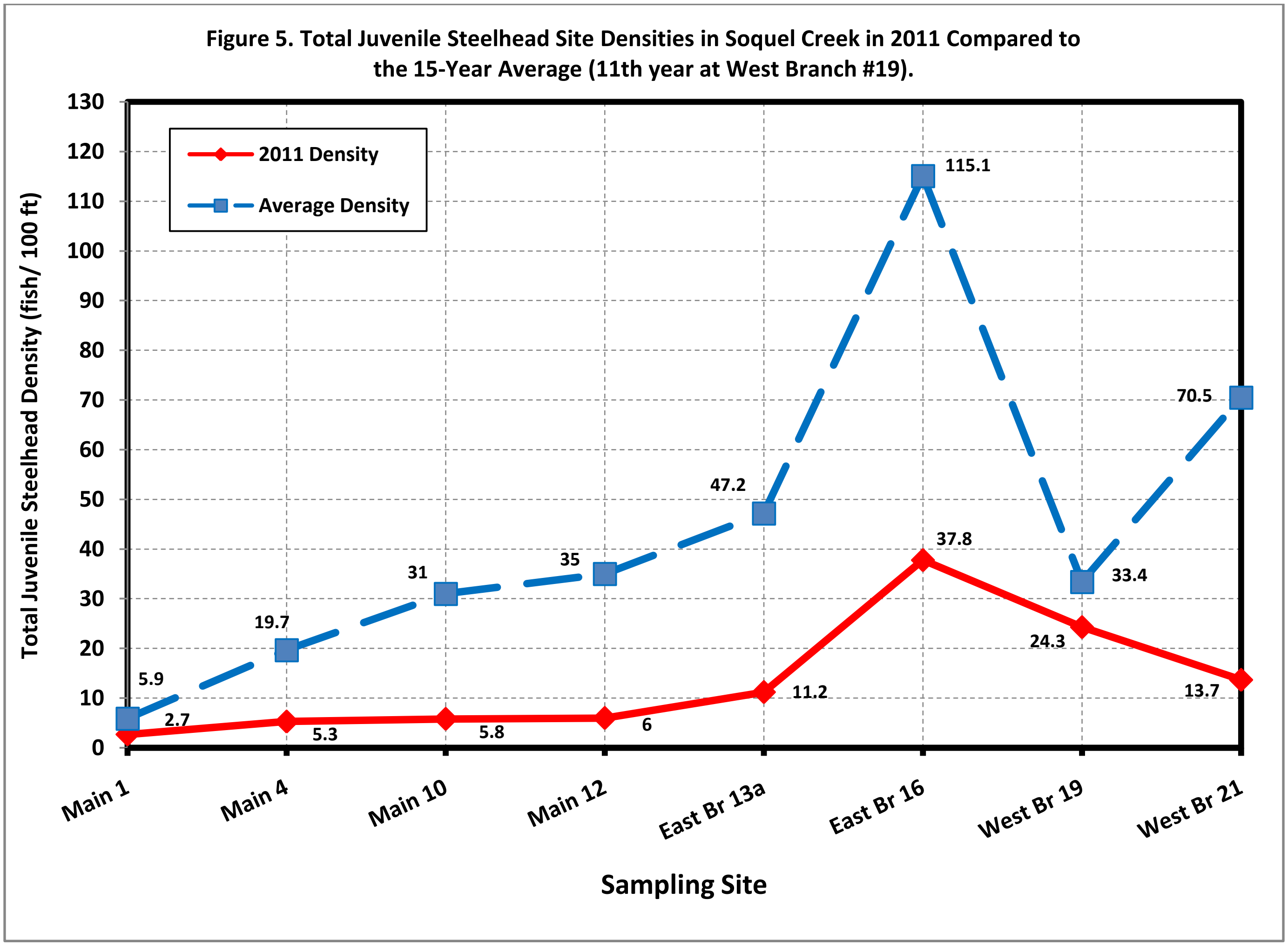
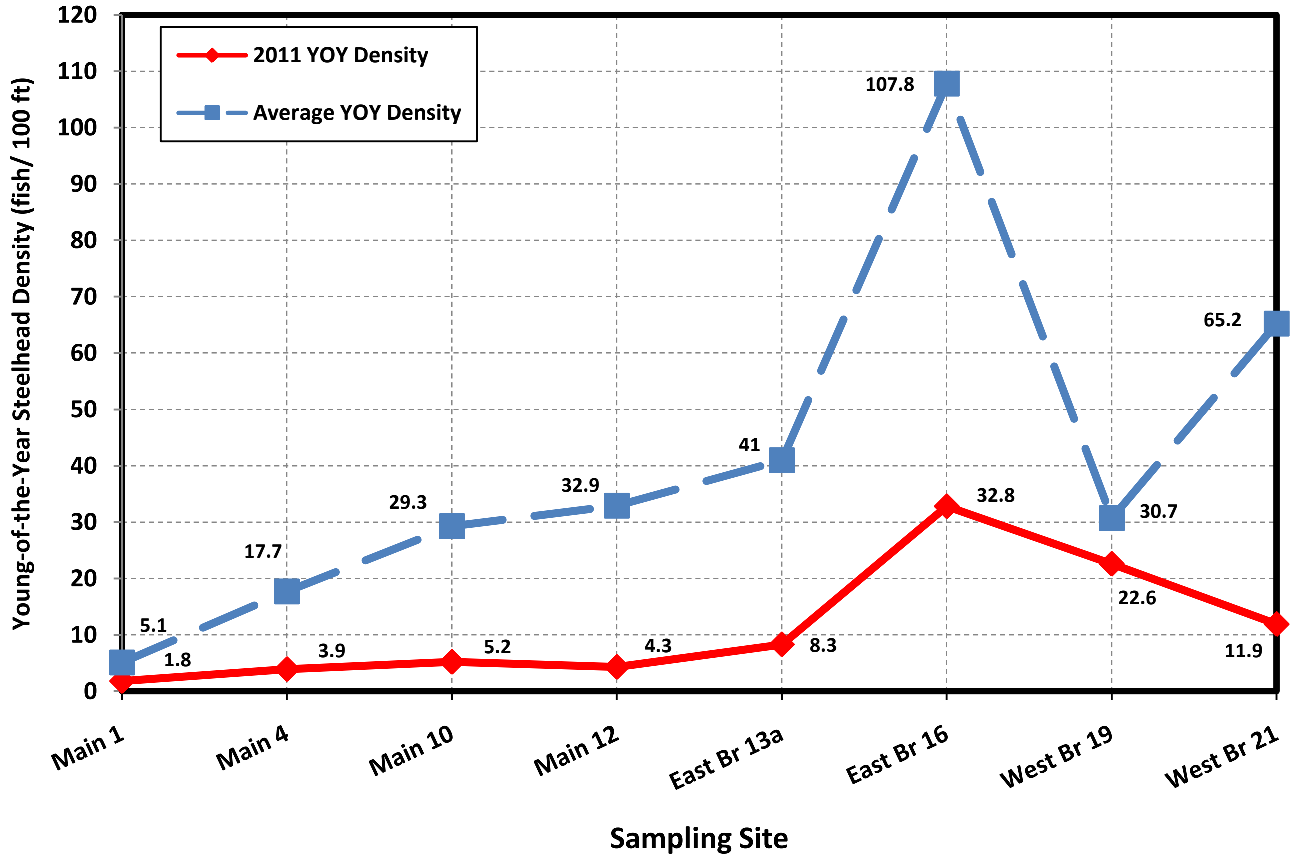


Figure 5. Total Juvenile Steelhead Site Densities in Soquel Creek in 2011 Compared to the 15-Year Average (11th year at West Branch #19).
2011 Density
Average Density
Total Juvenile Steelhead Density (fish/ 100 ft)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
5.9
19.7
31
35
47.2
115.1
33.4
70.5
2.7
5.3
5.8
6
11.2
37.8
24.3
13.7
Main 1
Main 4
Main 10
Main 12
East Br 13a
East Br 16
West Br 19
West Br 21
Sampling Site

Figure 6. Young-of-the-Year Steelhead Site Densities in Soquel Creek in 2011 Compared to the 15-Year Average (11th year for West Branch #19.)



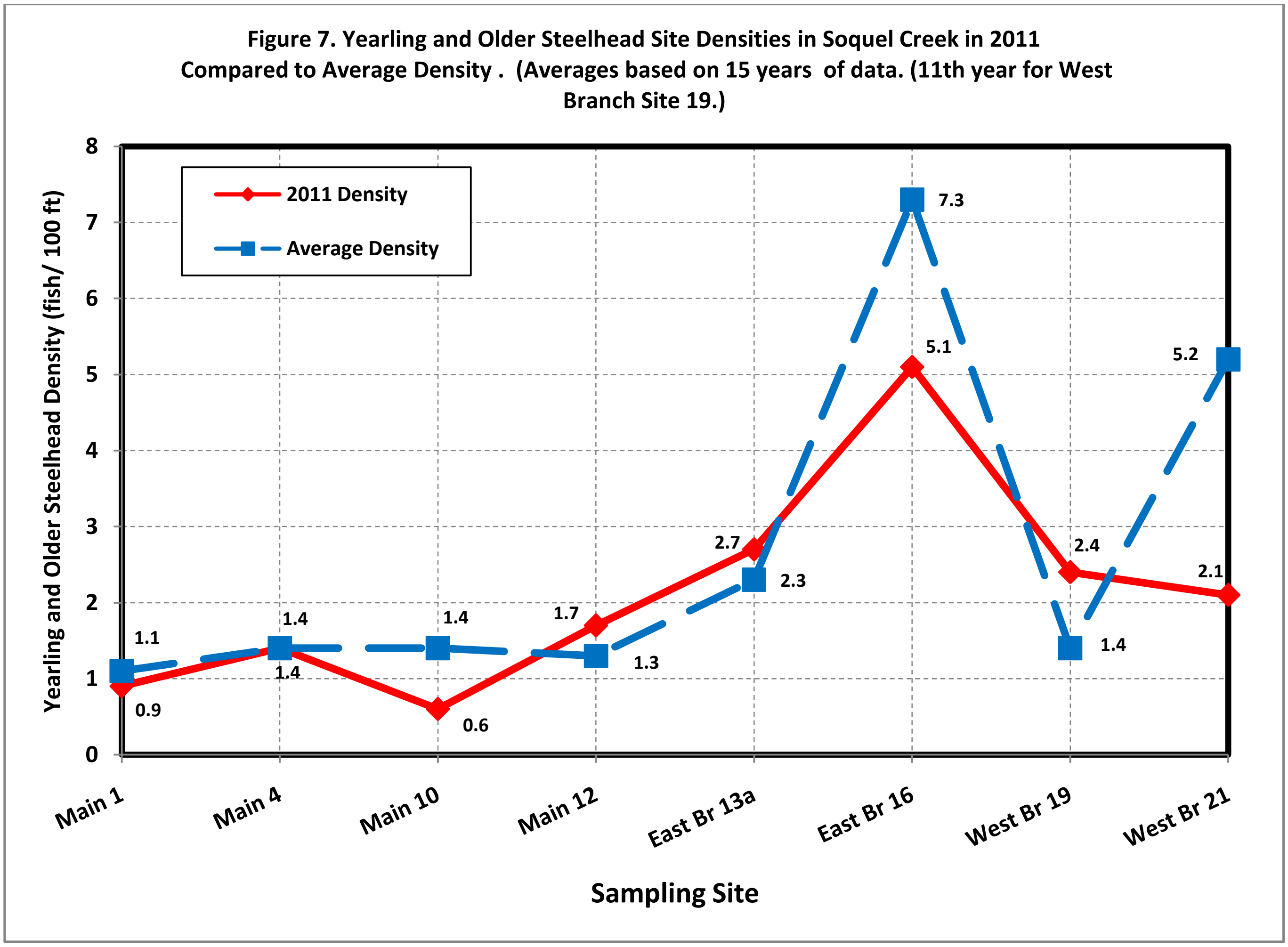


Figure 7. Yearling and Older Steelhead Site Densities in Soquel Creek in 2011
Compared to Average Density . (Averages based on 15 years of data. (11th year for West Branch Site 19.)
2011 Density
Average Density
Yearling and Older Steelhead Density (fish/ 100 ft)
8
7
6
5
4
3
2
1
0
1.1
0.9
1.4
1.4
1.4
0.6
1.7
1.3
2.7
2.3
7.3
5.1
2.4
1.4
5.2
2.1
Main 1
Main 4
Main 10
Main 12
East Br 13a
East Br 16
West Br 19
West Br 21
Sampling Site

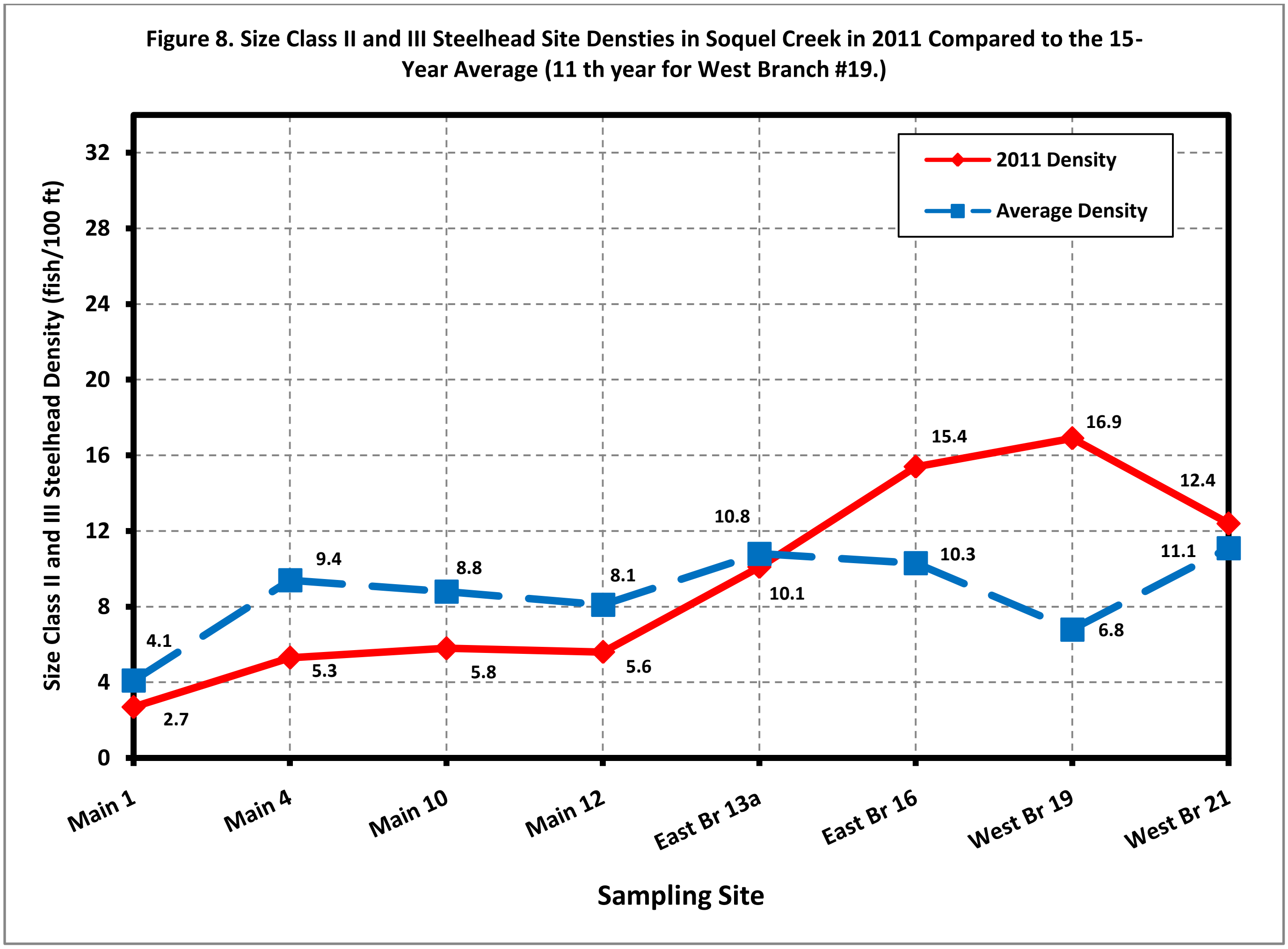
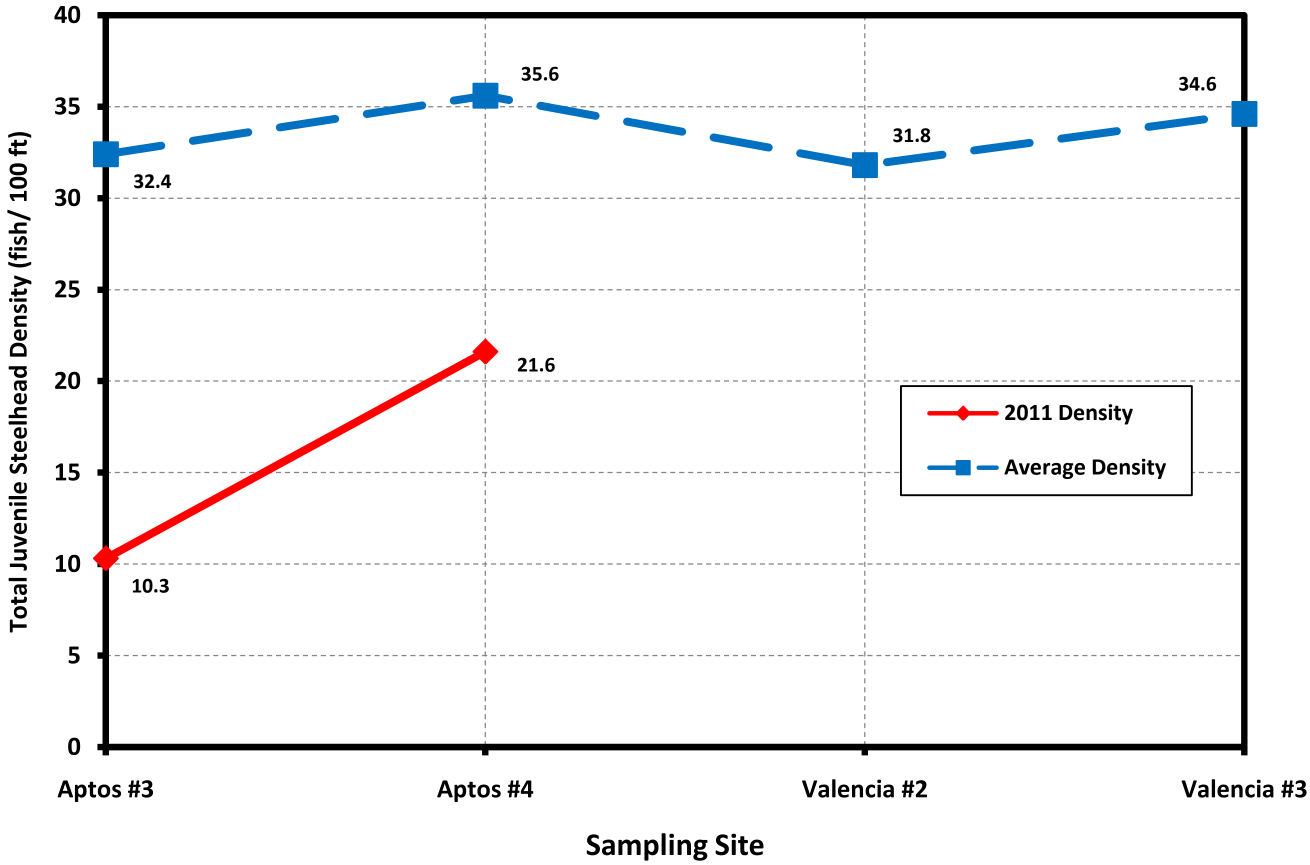


Figure 8. Size Class II and III Steelhead Site Densties in Soquel Creek in 2011 Compared to the 15-Year Average (11 th year for West Branch #19.)
2011 Density
Average Density
Size Class II and III Steelhead Density (fish/100 ft)
0
4
8
12
16
20
24
28
32
4.1
2.7
9.4
5.3
8.8
5.8
8.1
5.6
10.8
10.1
15.4
10.3
16.9
6.8
12.4
11.1
Main 1
Main 4
Main 10
Main 12
East Br 13a
East Br 16
West Br 19
West Br 21
Sampling Site

Figure 9. Total Juvenile Steelhead Site Densities in Aptos Creek in 2011, with a 7-Year Average (1981; 2006-2011).



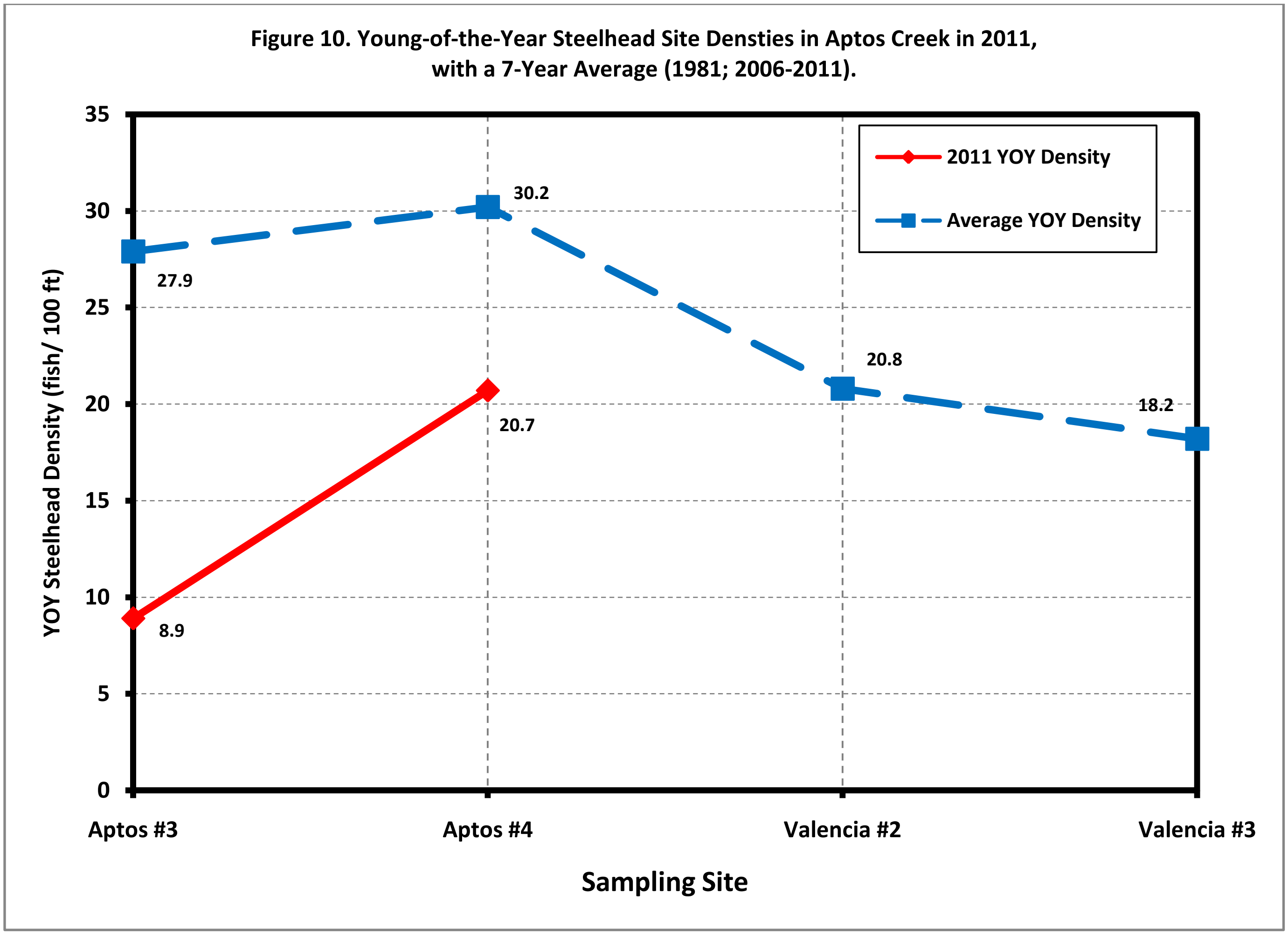


Figure 10. Young-of-the-Year Steelhead Site Densties in Aptos Creek in 2011,
with a 7-Year Average (1981; 2006-2011).
YOY Steelhead Density (fish/ 100 ft)
35
30
25
20
15
10
5
0
2011 YOY Density
Average YOY Density
30.2
27.9
20.8
18.2
20.7
8.9
Aptos #3
Aptos #4
Valencia #2
Valencia #3
Sampling Site

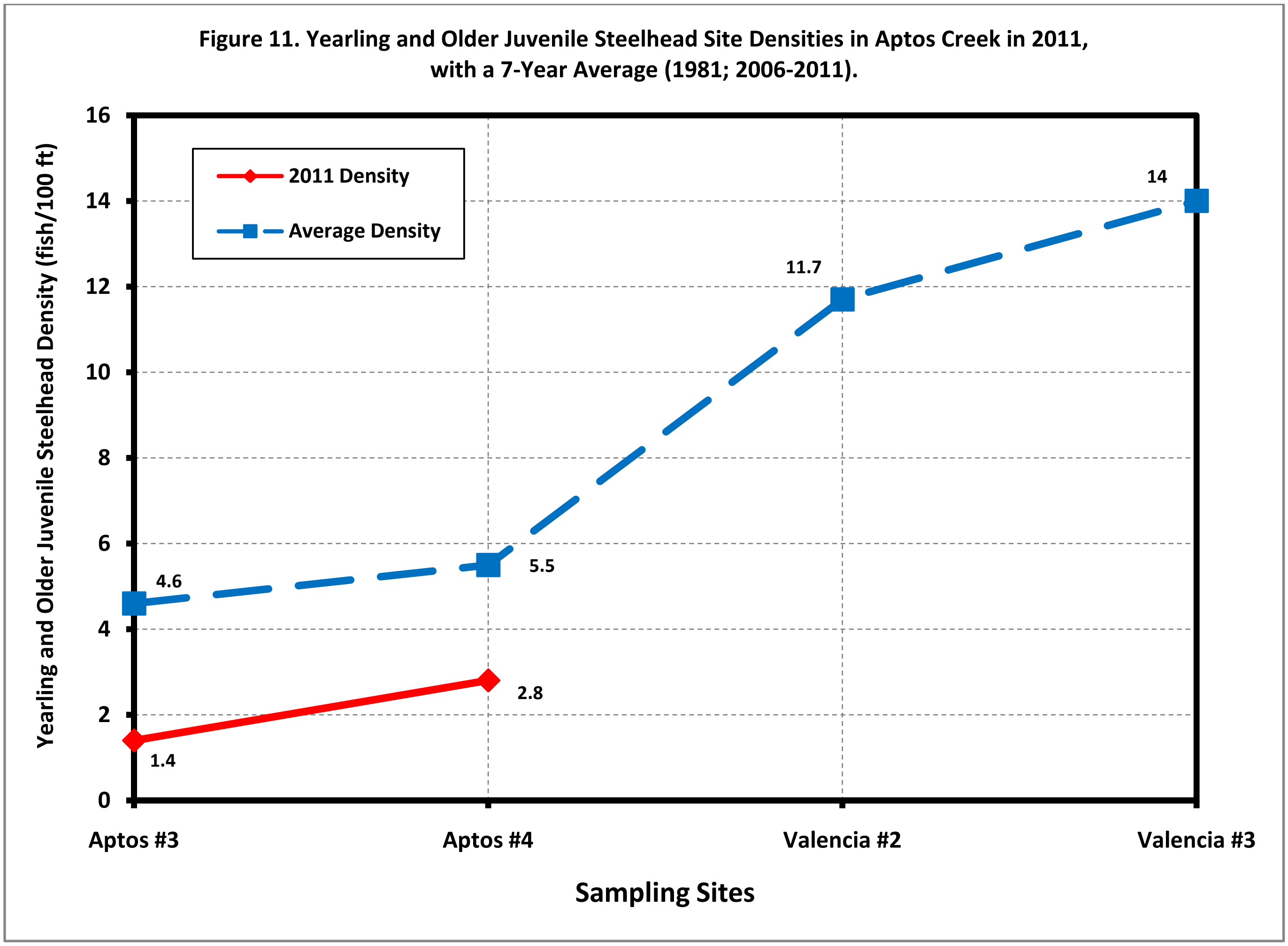


Figure 11. Yearling and Older Juvenile Steelhead Site Densities in Aptos Creek in 2011, with a 7-Year Average (1981; 2006-2011).
2011 Density
Average Density
Yearling and Older Juvenile Steelhead Density (fish/100 ft)
16
14
12
10
8
6
4
2
0
4.6
5.5
11.7
14
1.4
2.8
Aptos #3
Aptos #4
Valencia #2
Valencia #3
Sampling Sites

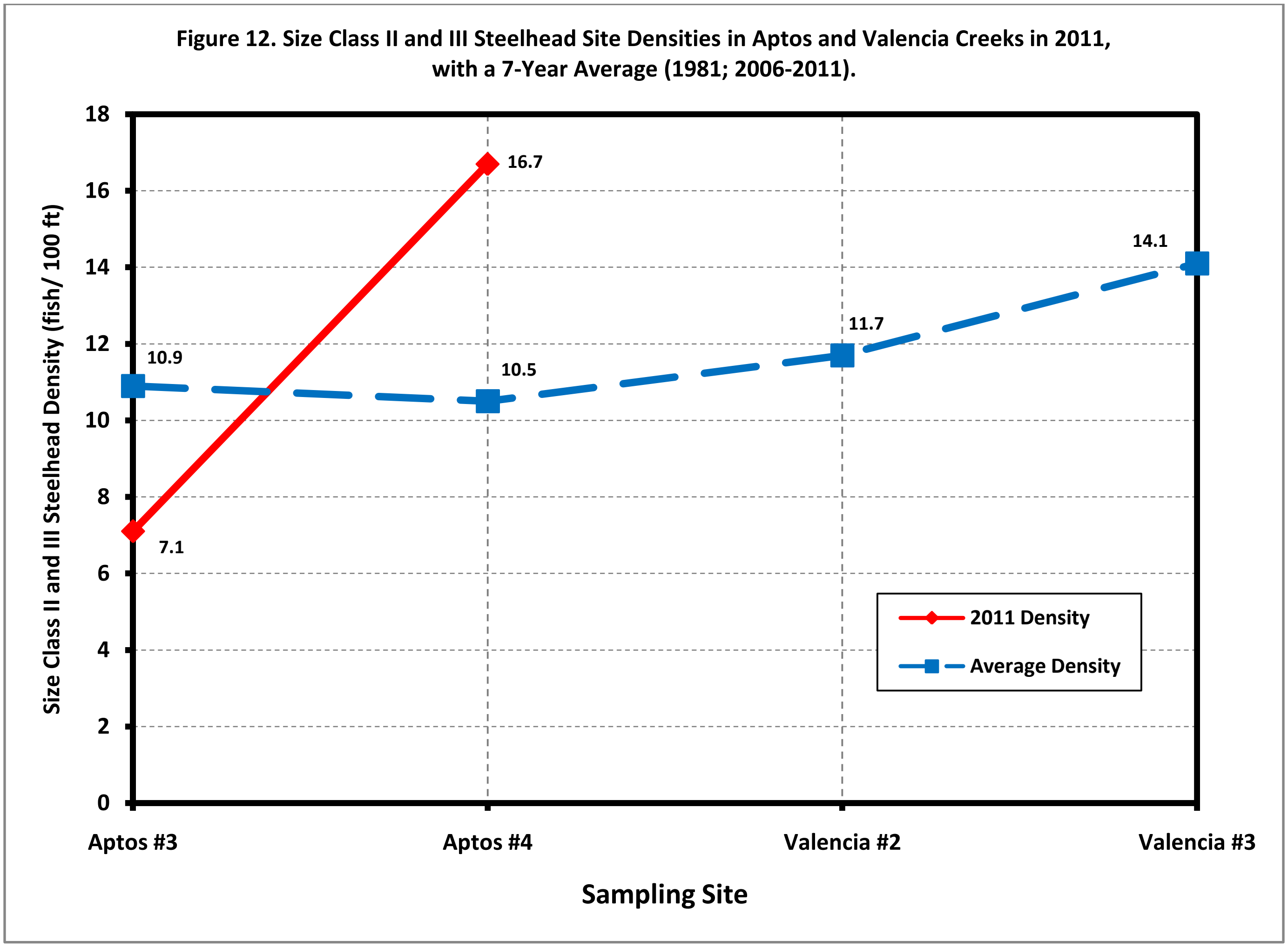


Figure 12. Size Class II and III Steelhead Site Densities in Aptos and Valencia Creeks in 2011, with a 7-Year Average (1981; 2006-2011).
Size Class II and III Steelhead Density (fish/ 100 ft)
18
16
14
12
10
8
6
4
2
0
16.7
14.1
11.7
10.9
10.5
7.1
2011 Density
Average Density
Aptos #3
Aptos #4
Valencia #2
Valencia #3
Sampling Site

Figure 13. Total Juvenile Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2011, with an 8-Year Average (1981; 1994; 2006-2011).

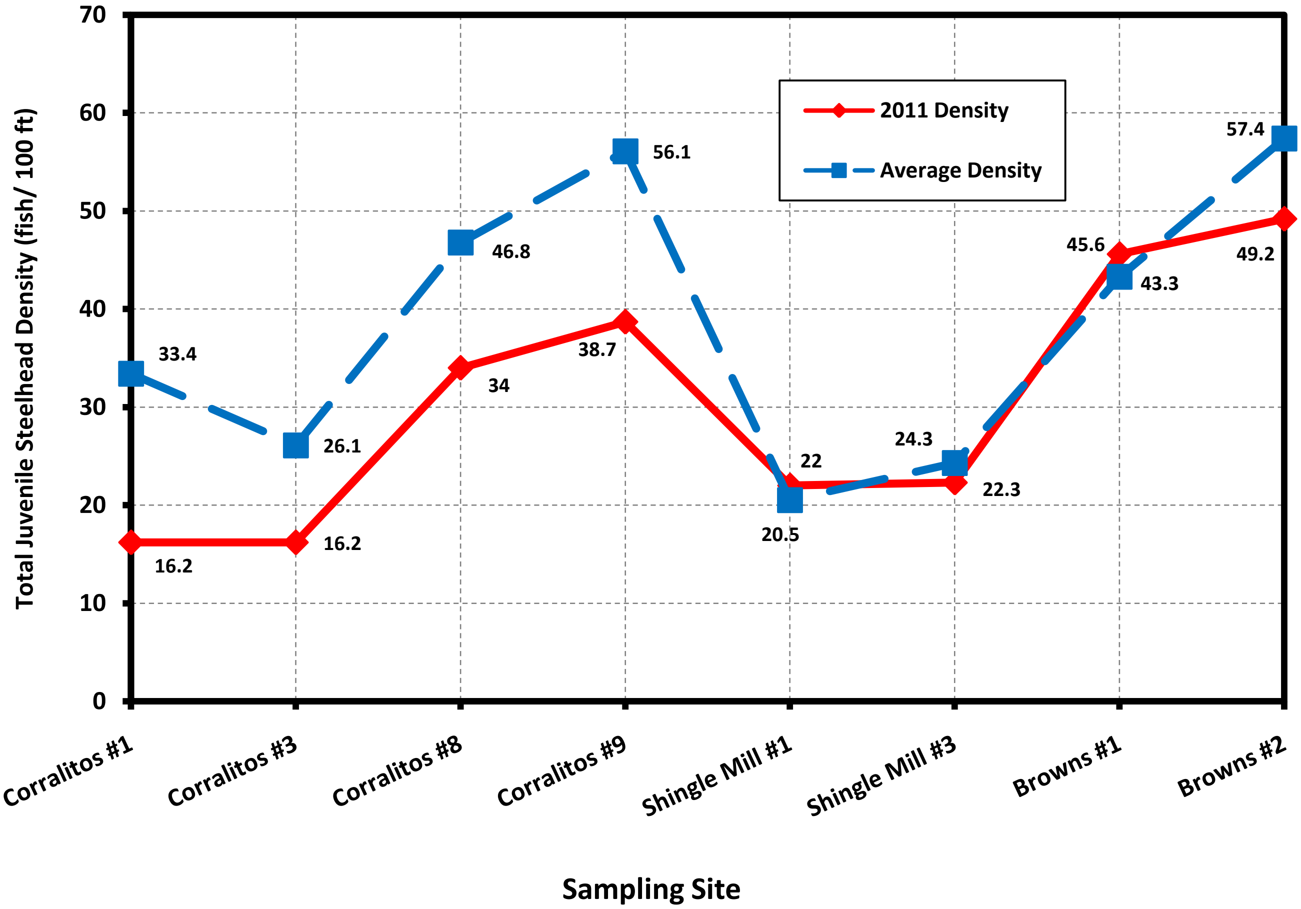


Figure 14. Young-of-the-Year Steelhead Site Densities in Corralitos, Shinglemill and Browns Creeks in 2011, with an 8-Year Average (1981; 1994; 2006-2011).

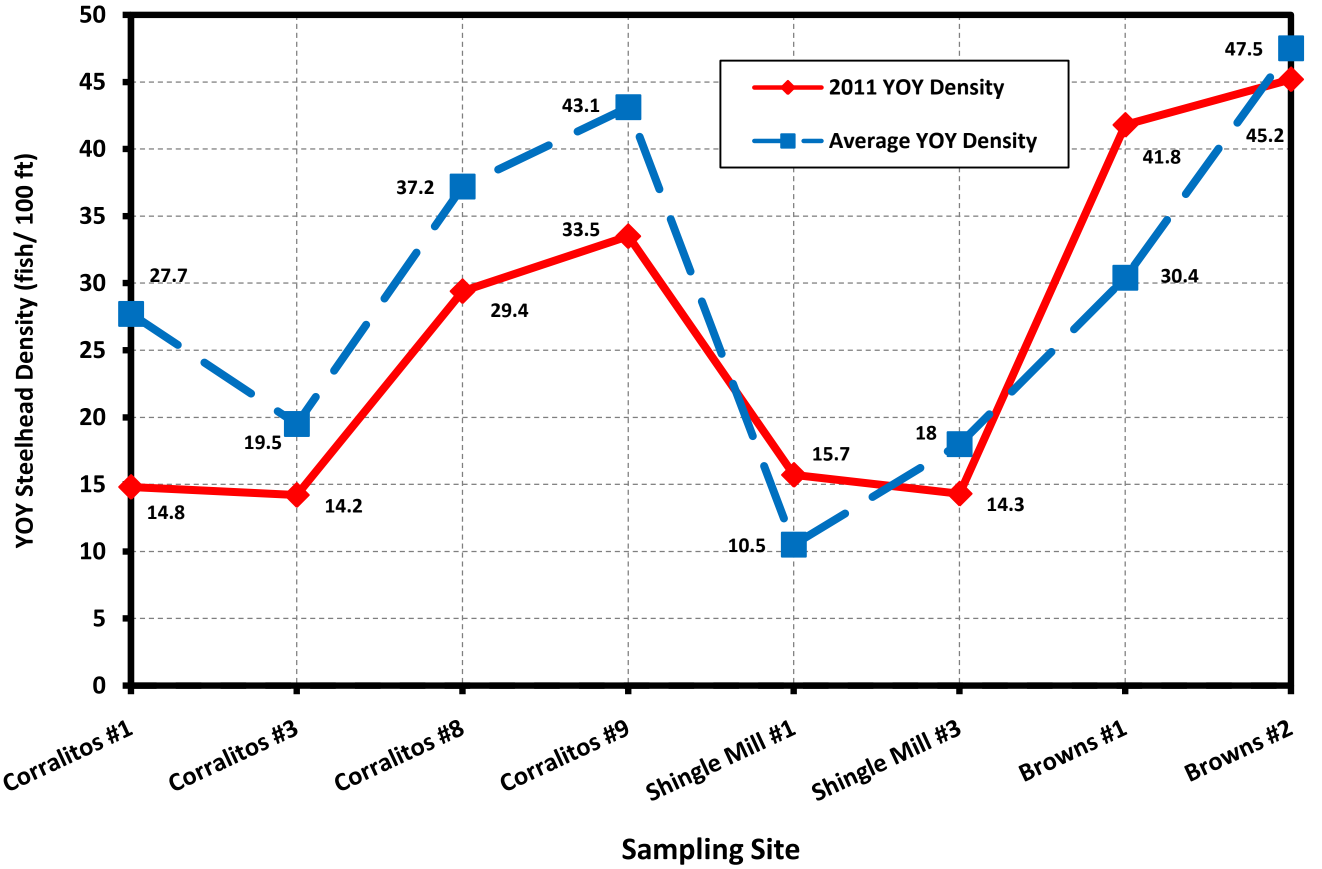


Figure 15. Yearling and Older Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2011, with an 8-Year Average (1981; 1994; 2006-2011).

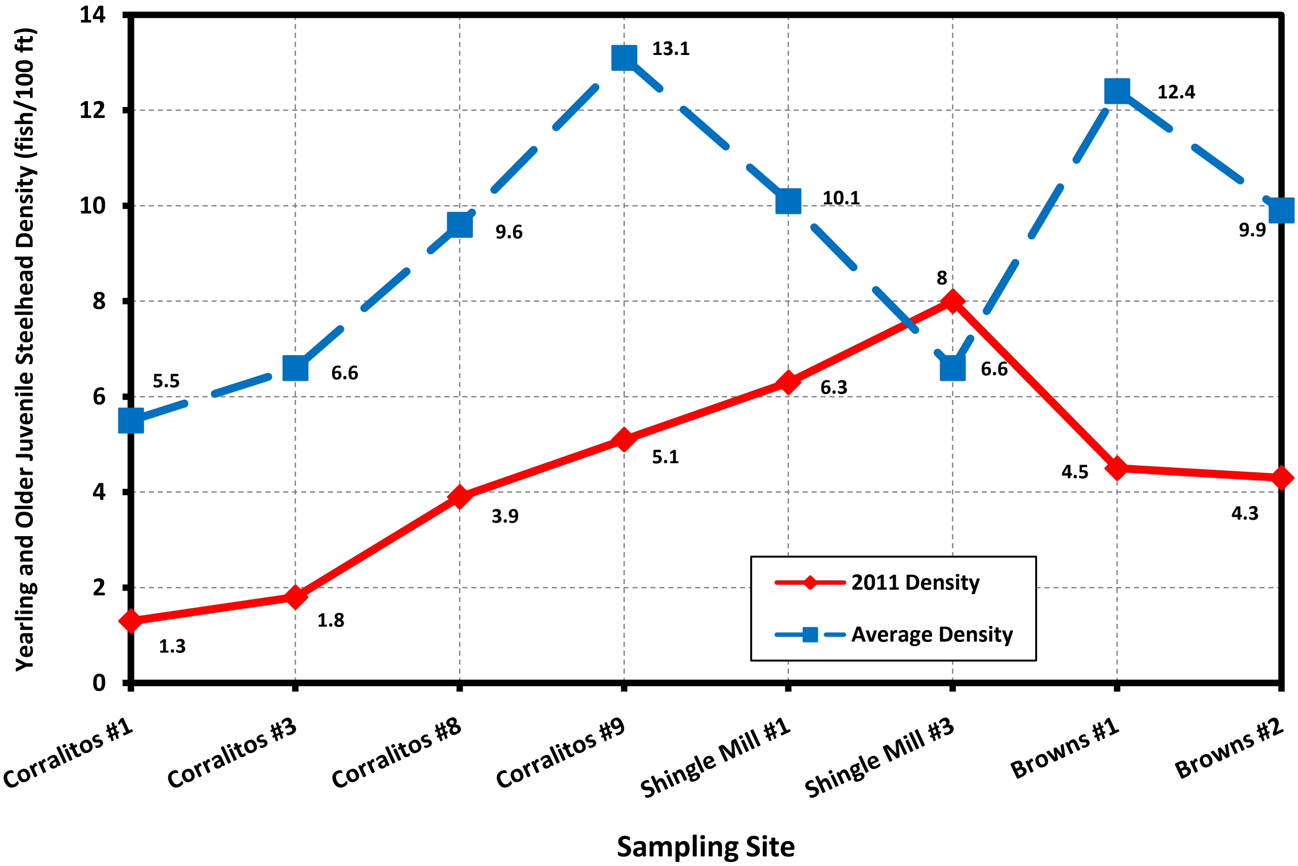
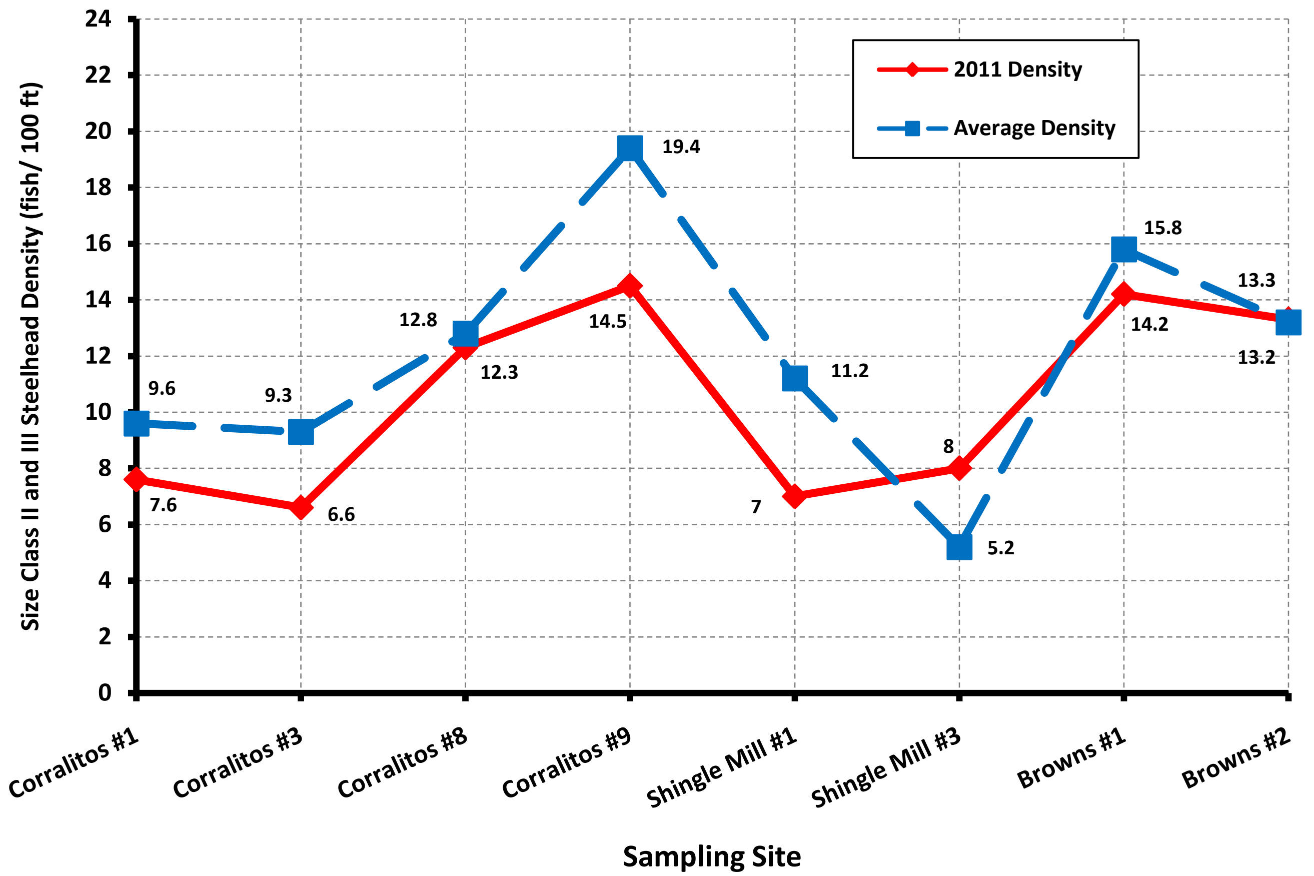


Figure 16. Size Class II and III Steelhead Site Densities in Corralitos, Shingle Mill and Browns Creeks in 2011, with an 8-Year Average (1981; 1994; 2006-2011).



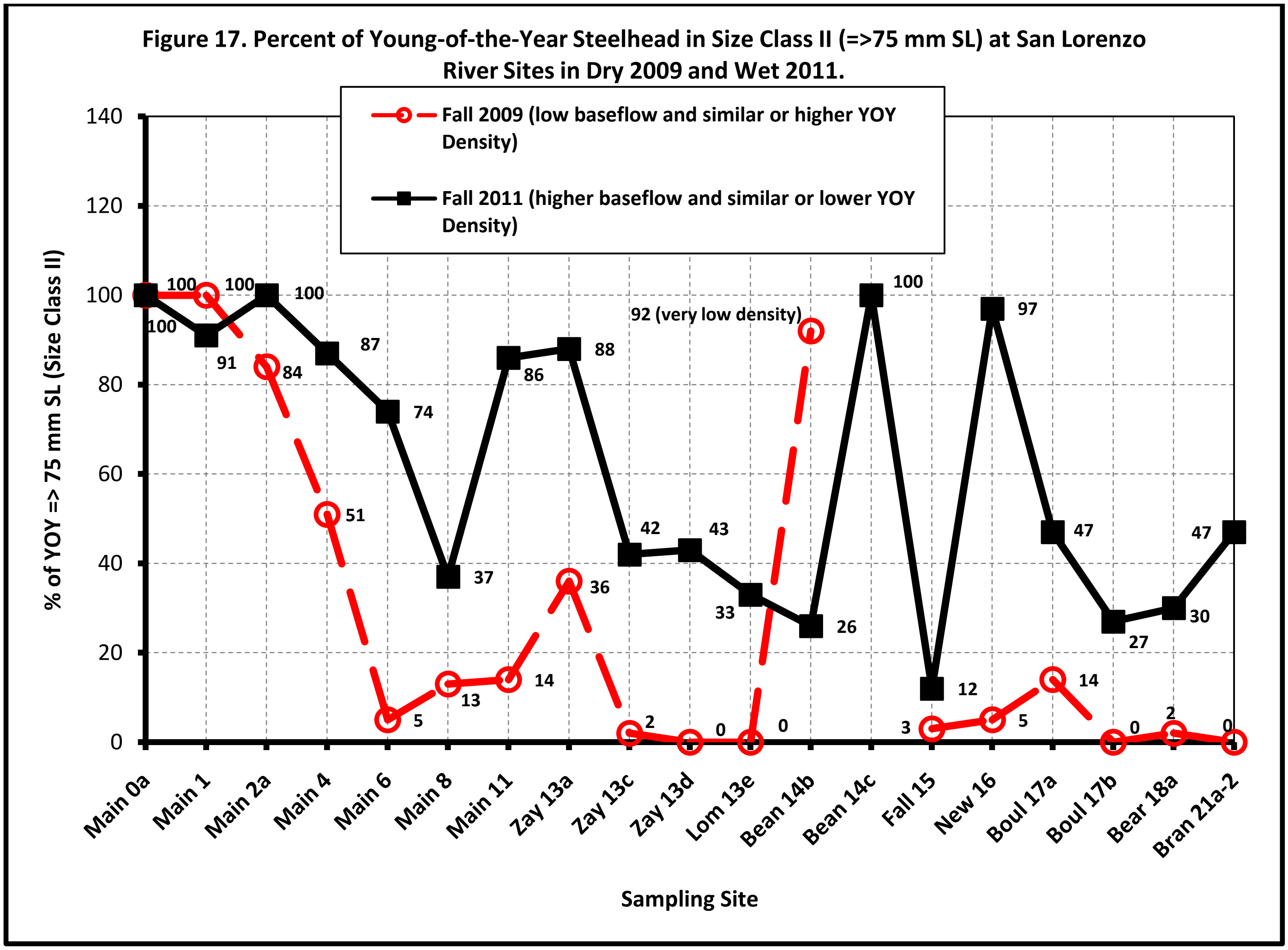


Figure 17. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at San Lorenzo River Sites in Dry 2009 and Wet 2011.
Fall 2009 (low baseflow and similar or higher YOY Density)
Fall 2011 (higher baseflow and similar or lower YOY Density)
% of YOY => 75 mm SL (Size Class II)
Sampling Site
92 (very low density)
Main 0a
Main 1
Main 2a
Main 4
Main 6
Main 8
Main 11
Zay 13a
Zay 13c
Zay 13d
Lom 13e
Bean 14b
Bean 14c
Fall 15
New 16
Boul 17a
Boul 17b
Bear 18a
Bran 21a-2

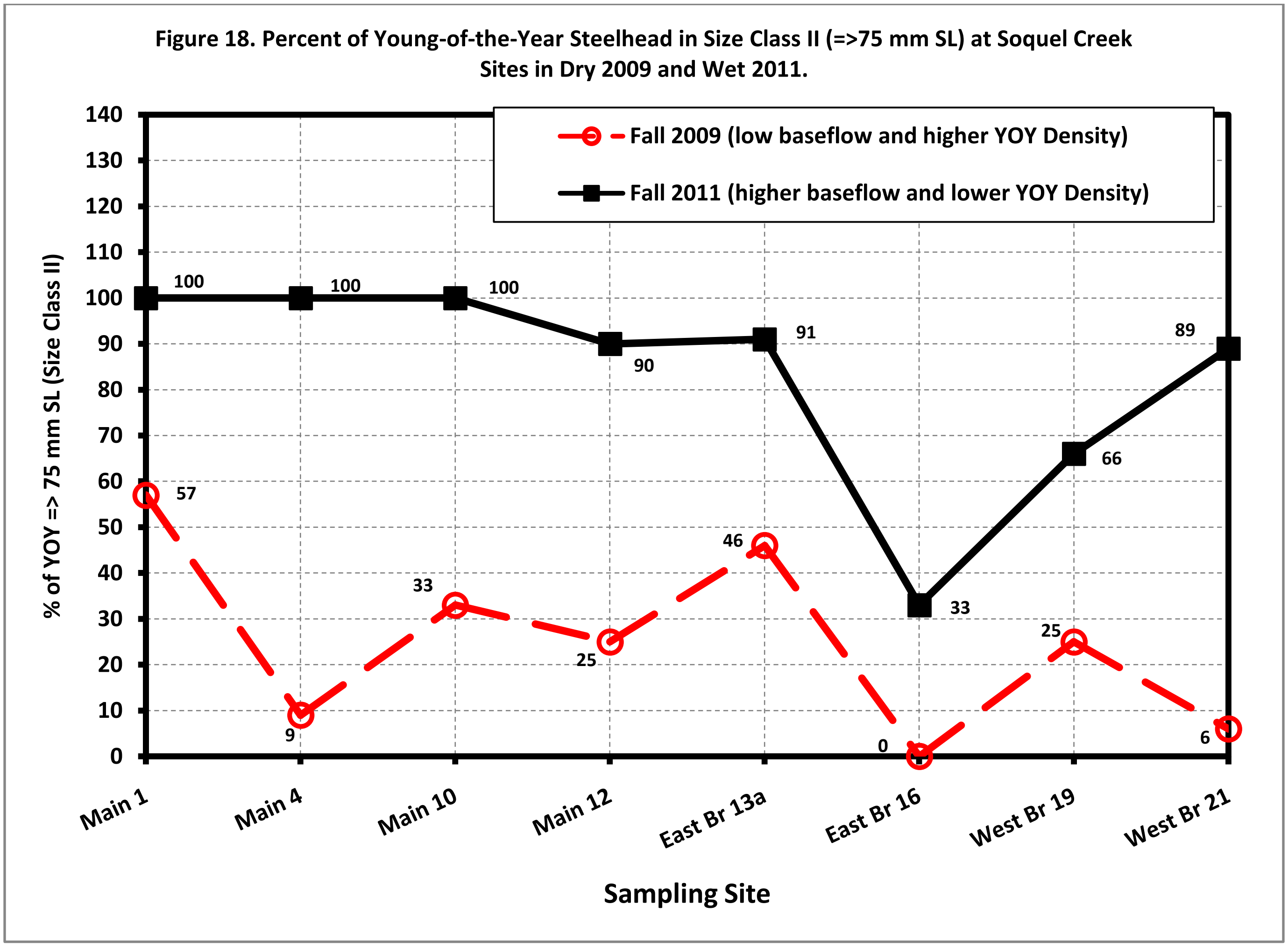


Figure 18. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Soquel Creek Sites in Dry 2009 and Wet 2011.
Fall 2009 (low baseflow and higher YOY Density)
Fall 2011 (higher baseflow and lower YOY Density)
% of YOY => 75 mm SL (Size Class II)
Sampling Site
Main 1
Main 4
Main 10
Main 12
East Br 13a
East Br 16
West Br 19
West Br 21
100
100
100
90
91
33
66
89
57
9
33
25
46
0
25
6

Figure 19. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Aptos Creek Sites in Dry 2009 and Wet 2011.

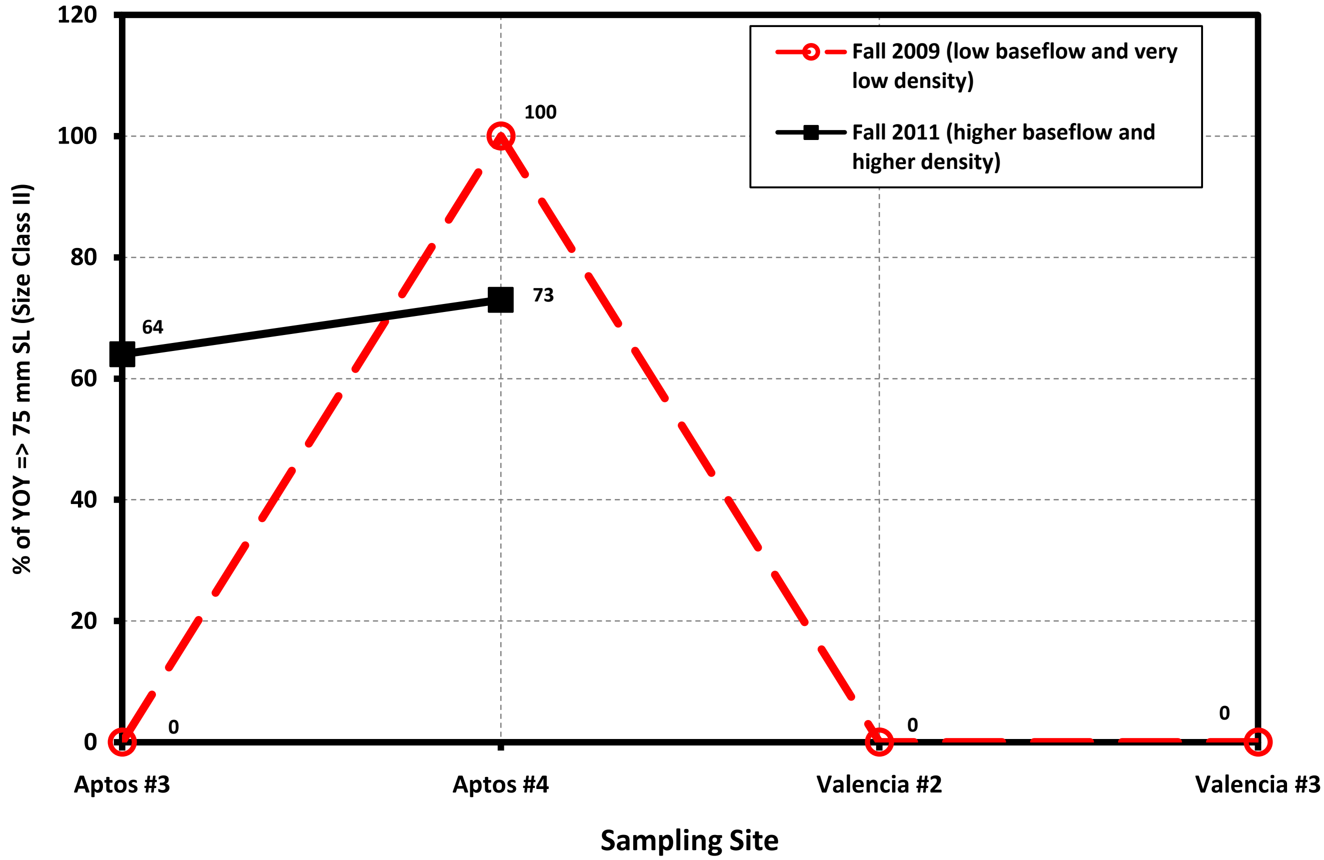


Figure 20. Percent of Young-of-the-Year Steelhead in Size Class II (=>75 mm SL) at Corralitos Watershed Sites in Dry 2009 and Wet 2011.

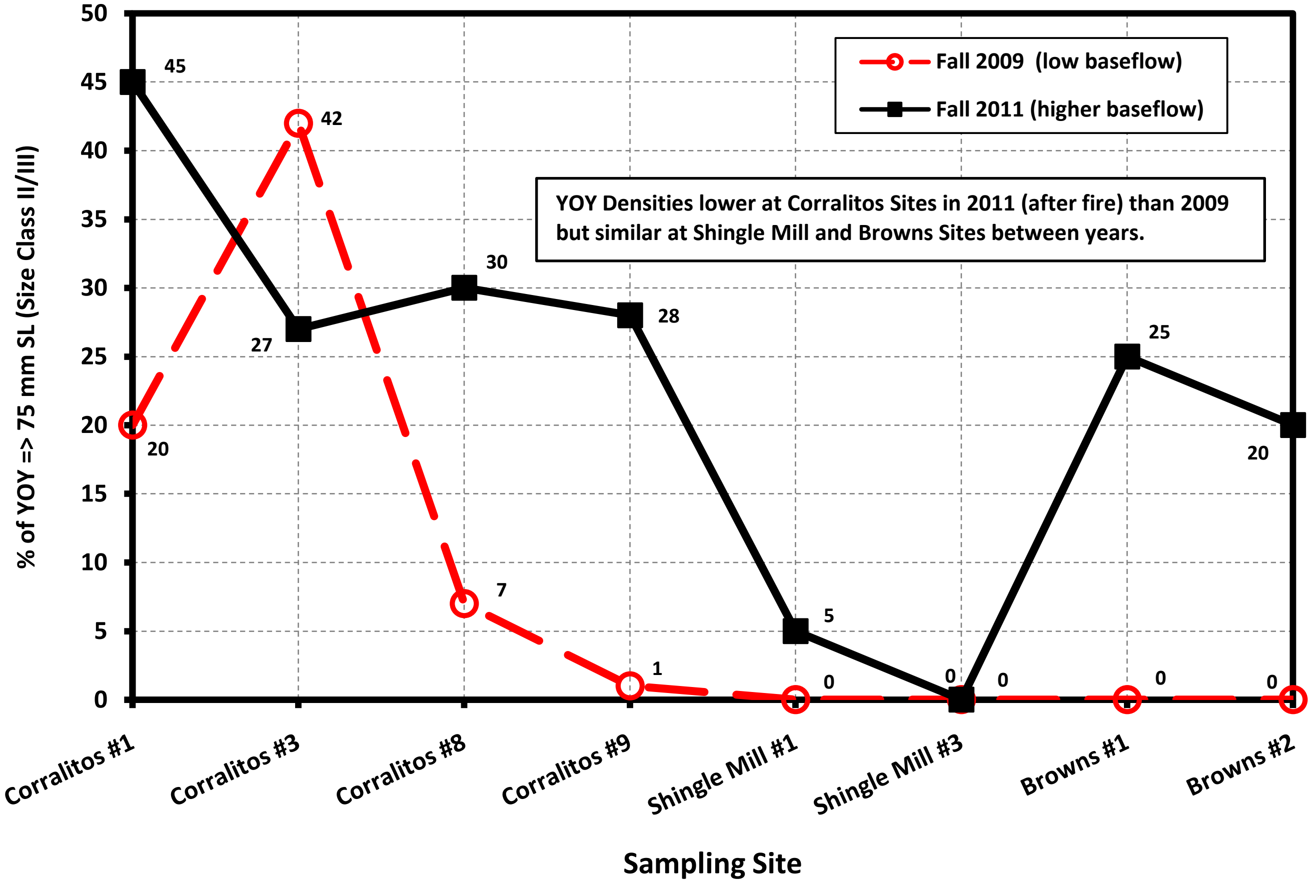
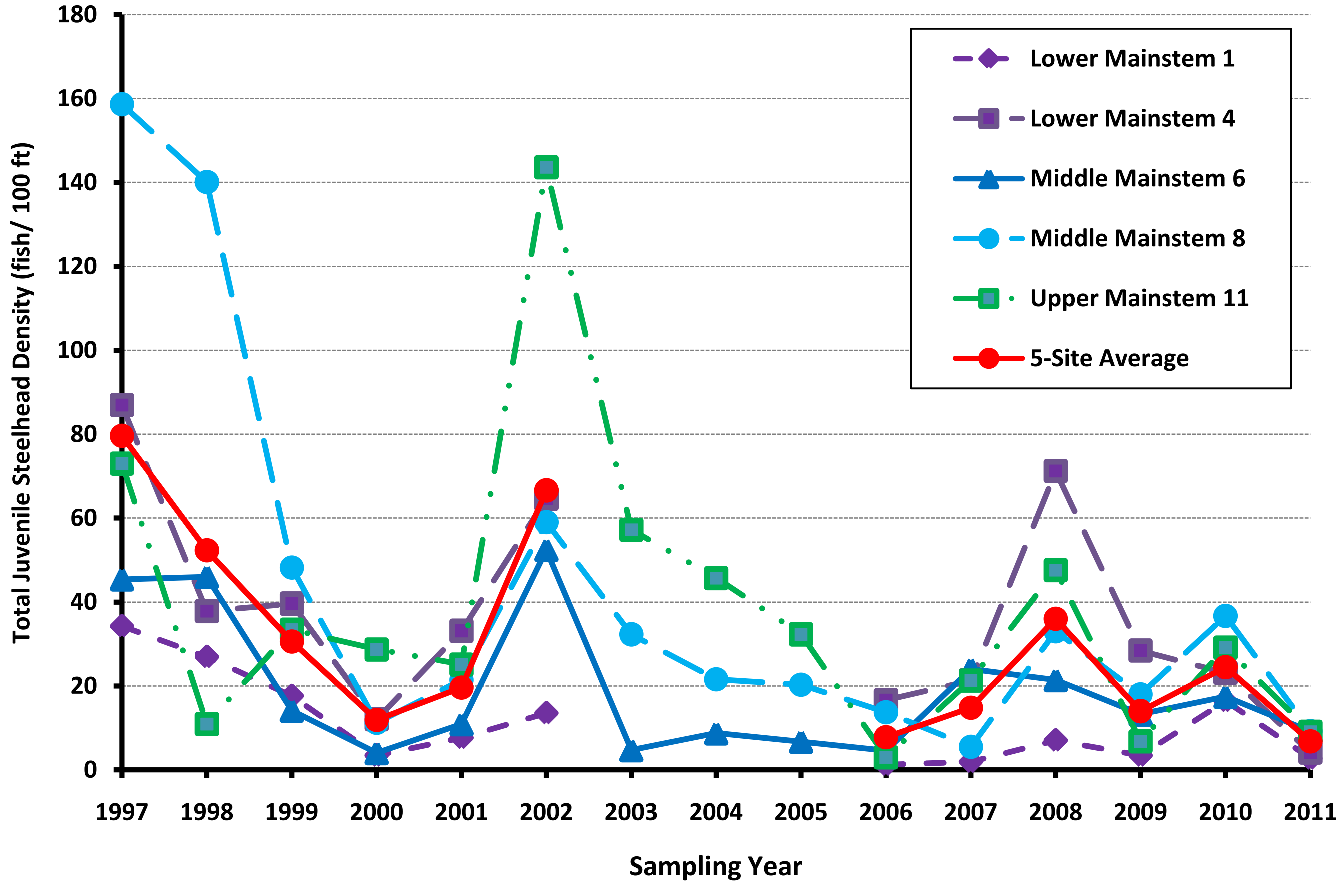


Figure 21. Trend in Total Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2011.



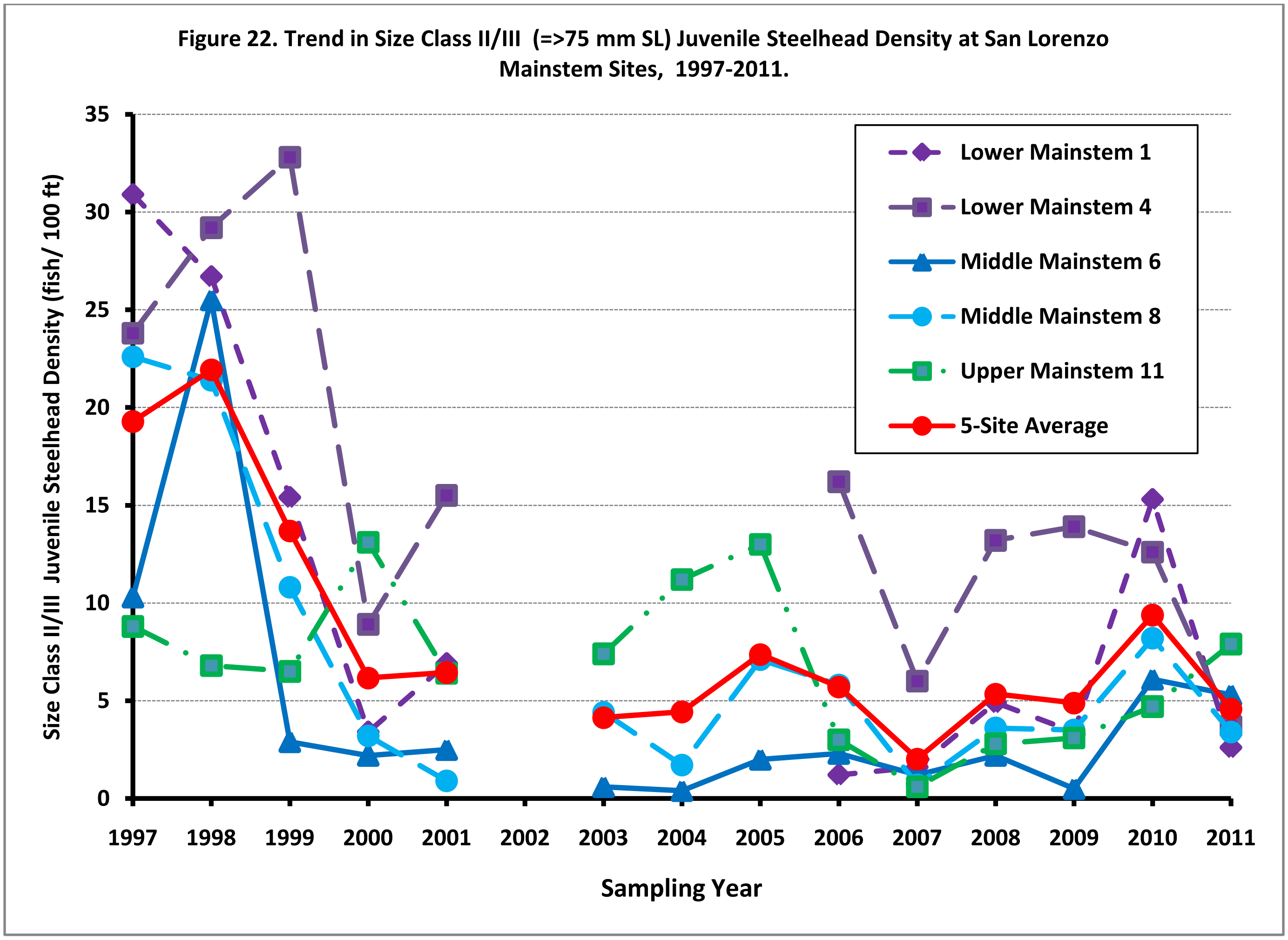


Figure 22. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Mainstem Sites, 1997-2011.
Size Class II/III Juvenile Steelhead Density (fish/ 100 ft)
0
5
10
15
20
25
30
35
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Sampling Year
Lower Mainstem 1
Lower Mainstem 4
Middle Mainstem 6
Middle Mainstem 8
Upper Mainstem 11
5-Site Average

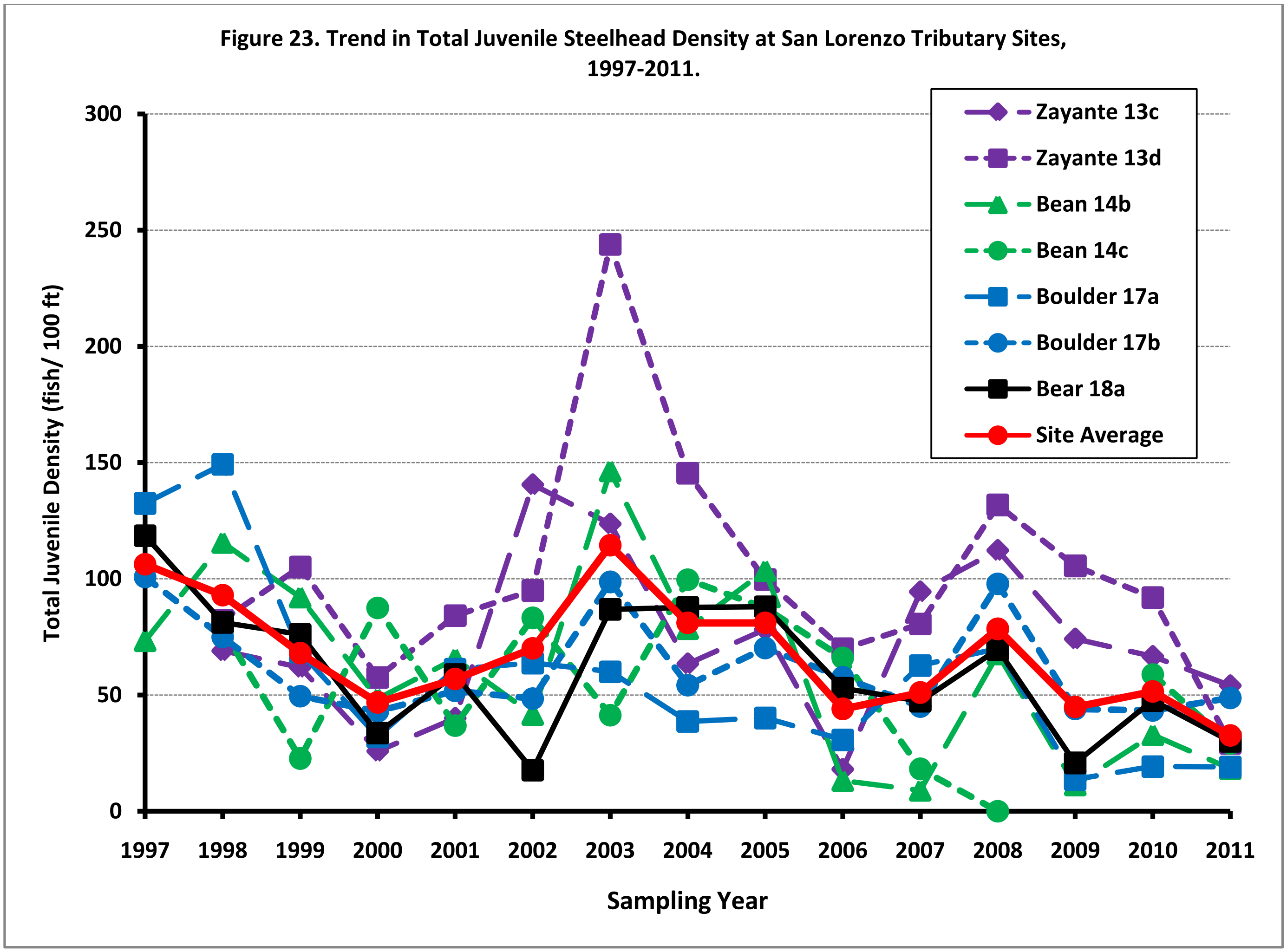


Figure 23. Trend in Total Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2011.
Total Juvenile Density (fish/ 100 ft)
0
50
100
150
200
250
300
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Sampling Year
Zayante 13c
Zayante 13d
Bean 14b
Bean 14c
Boulder 17a
Boulder 17b
Bear 18a
Site Average

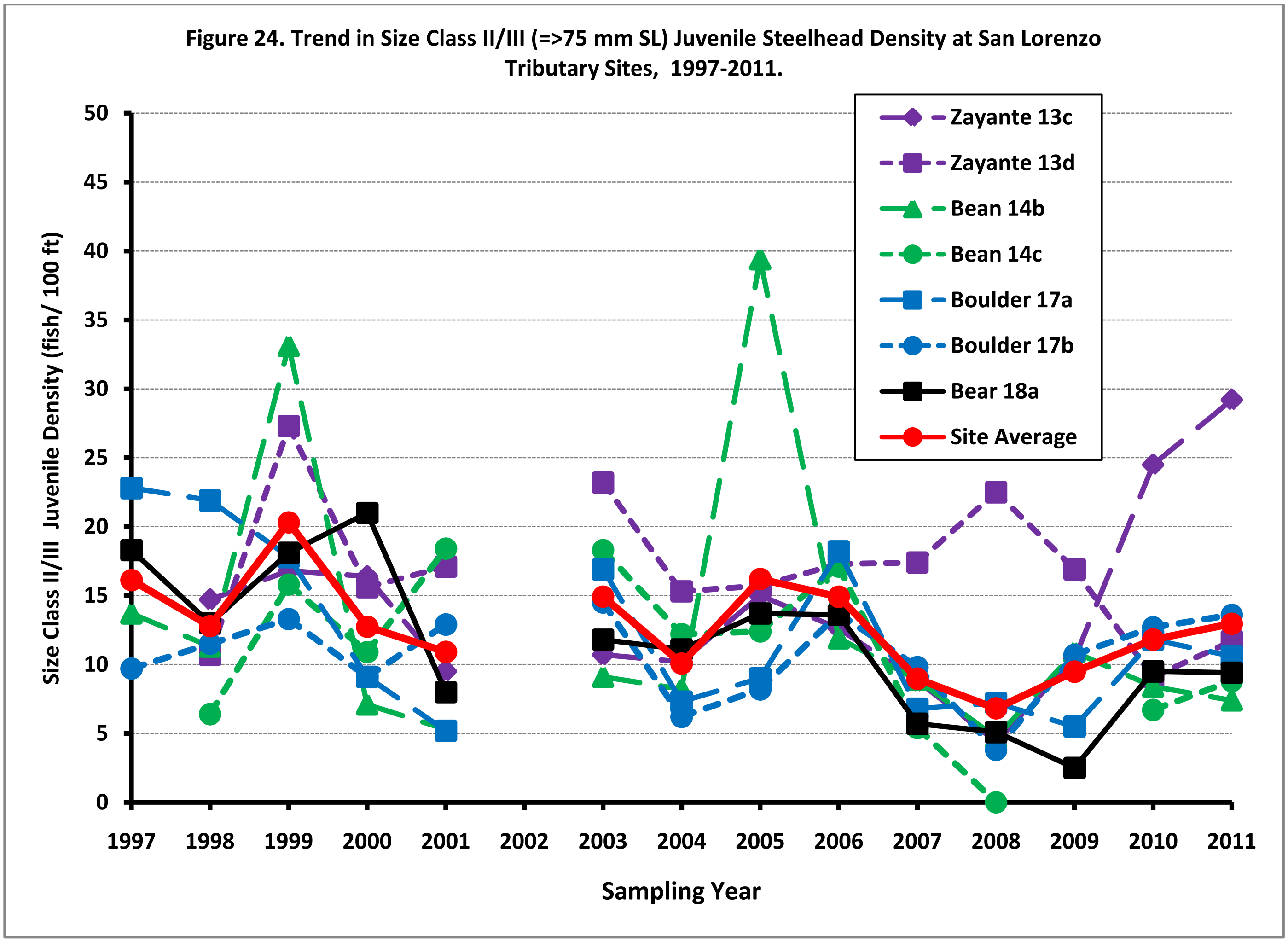


Figure 24. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at San Lorenzo Tributary Sites, 1997-2011.
Zayante 13c
Zayante 13d
Bean 14b
Bean 14c
Boulder 17a
Boulder 17b
Bear 18a
Site Average
Size Class II/III Juvenile Density (fish/ 100 ft)
0
5
10
15
20
25
30
35
40
45
50
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Sampling Year

Figure 25. Trend in Total Juvenile Steelhead Density at Soquel Creek Sites, 1997-2011.

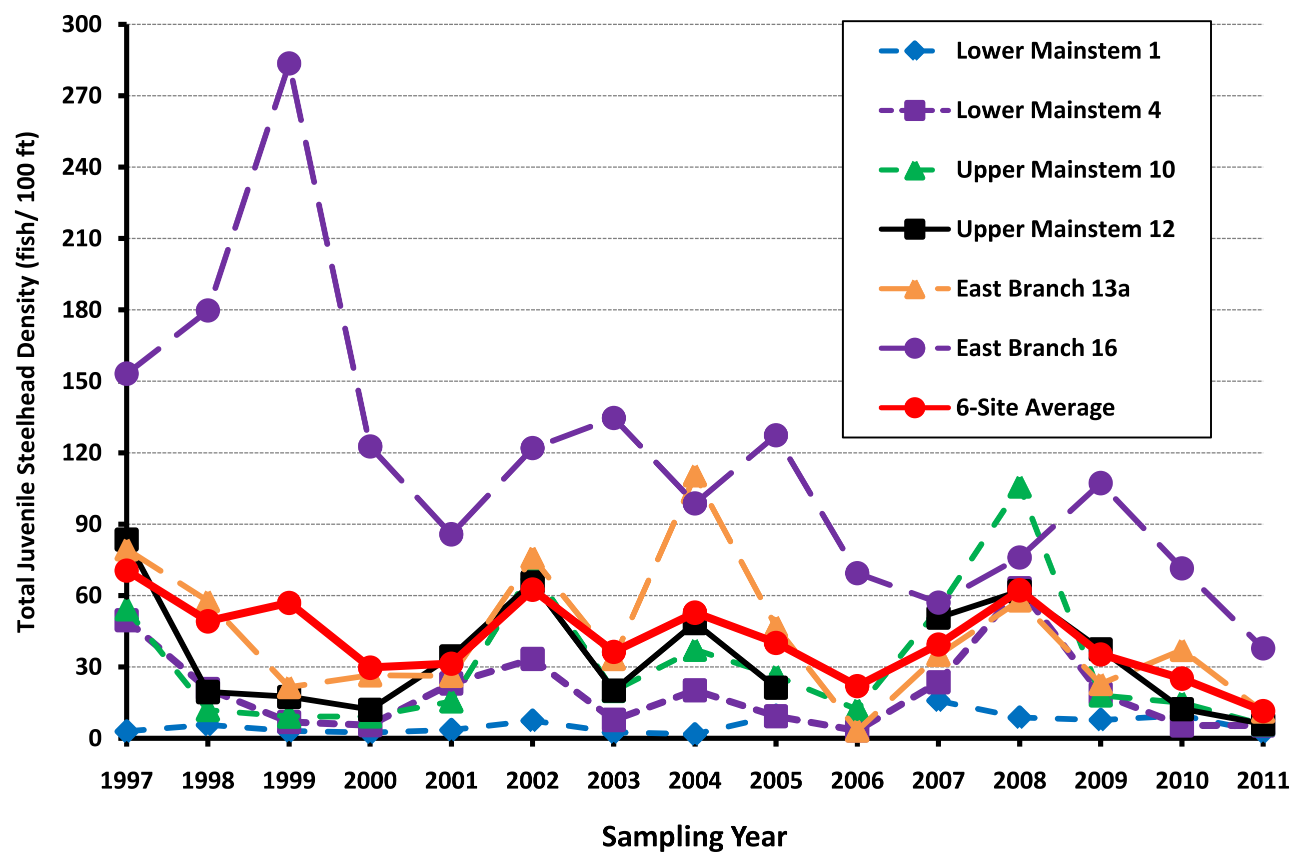
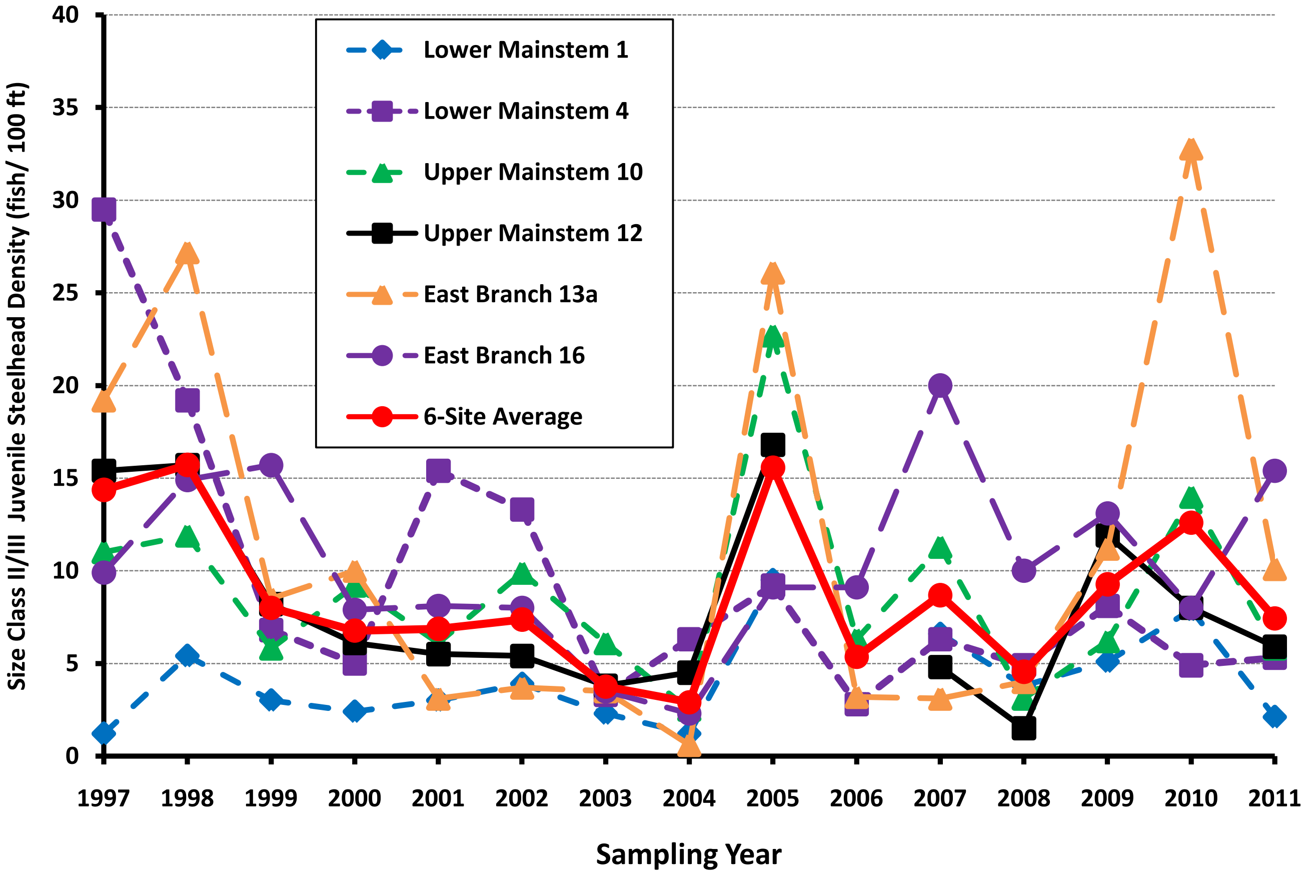


Figure 26. Trend in Size Class II/III (=>75 mm SL) Juvenile Steelhead Density at Soquel Creek Sites, 1997-2011.



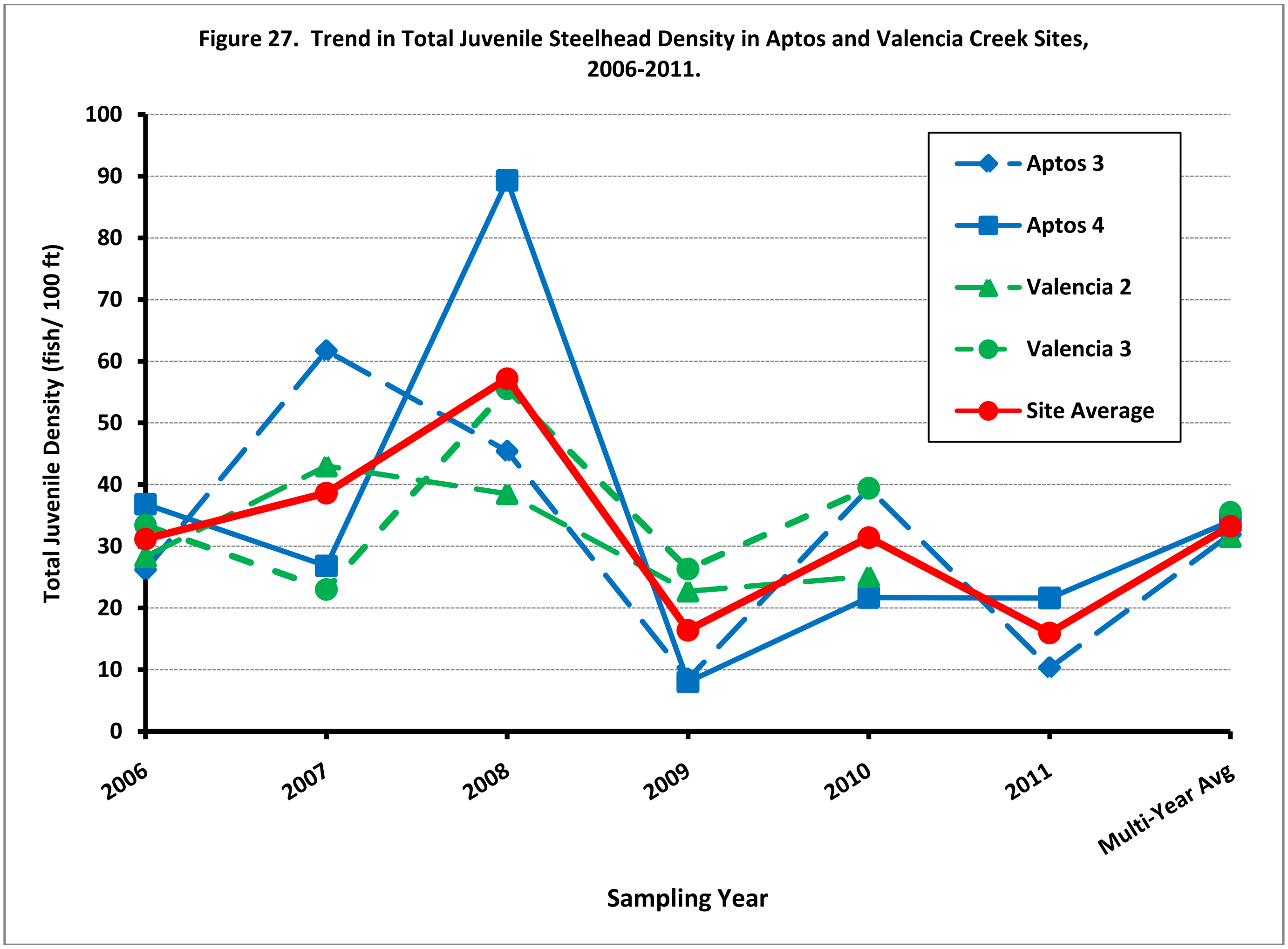


Figure 27. Trend in Total Juvenile Steelhead Density in Aptos and Valencia Creek Sites, 2006-2011.
100
90
80
70
60
50
40
30
20
10
0
Total Juvenile Density (fish/ 100 ft)
Aptos 3
Aptos 4
Valencia 2
Valencia 3
Site Average
2006
2007
2008
2009
2010
2011
Multi-Year Avg
Sampling Year

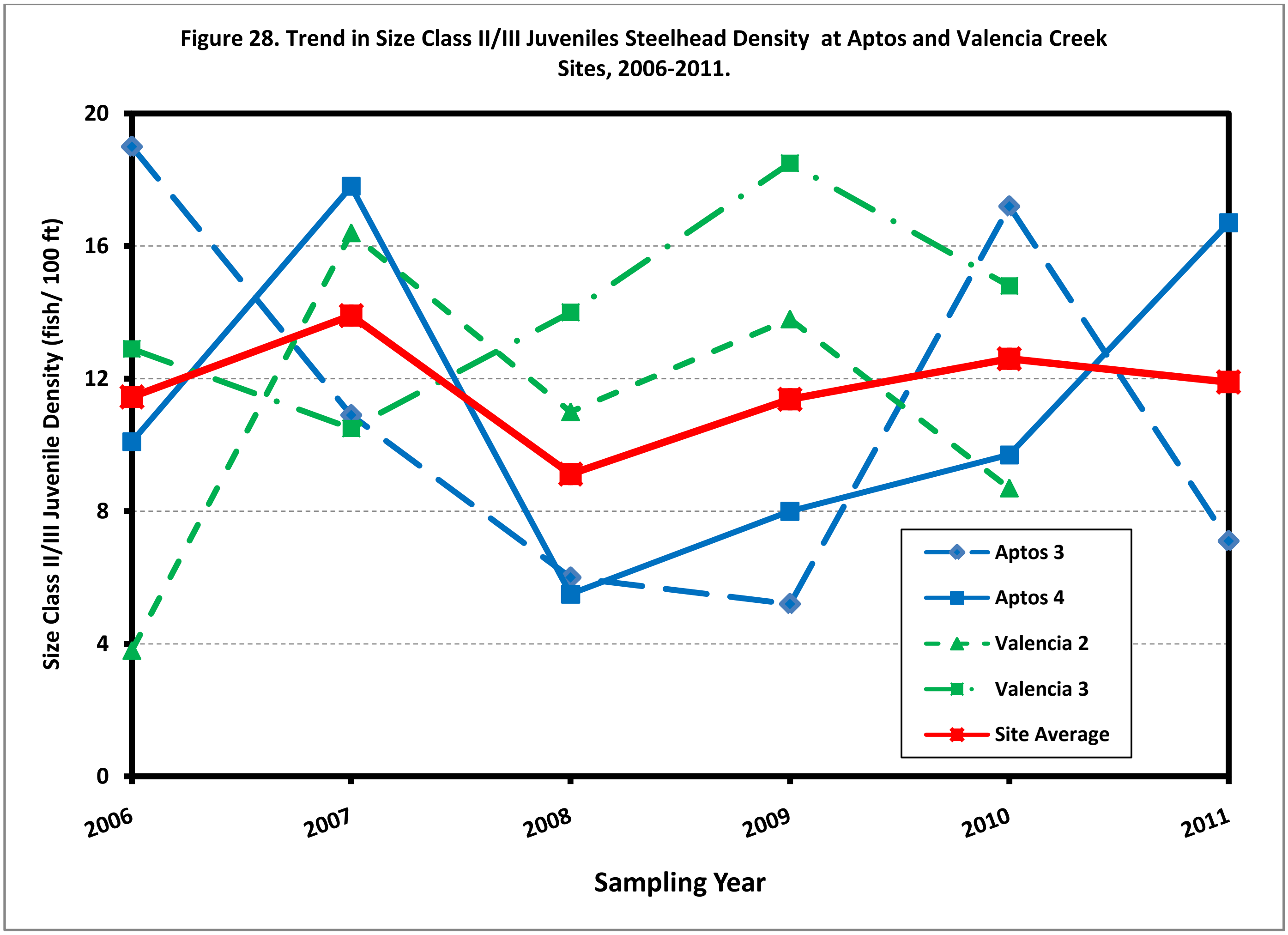


Figure 28. Trend in Size Class II/III Juveniles Steelhead Density at Aptos and Valencia Creek Sites, 2006-2011.
Size Class II/III Juvenile Density (fish/ 100 ft)
20
16
12
8
4
0
2006
2007
2008
2009
2010
2011
Sampling Year
Aptos 3
Aptos 4
Valencia 2
Valencia 3
Site Average

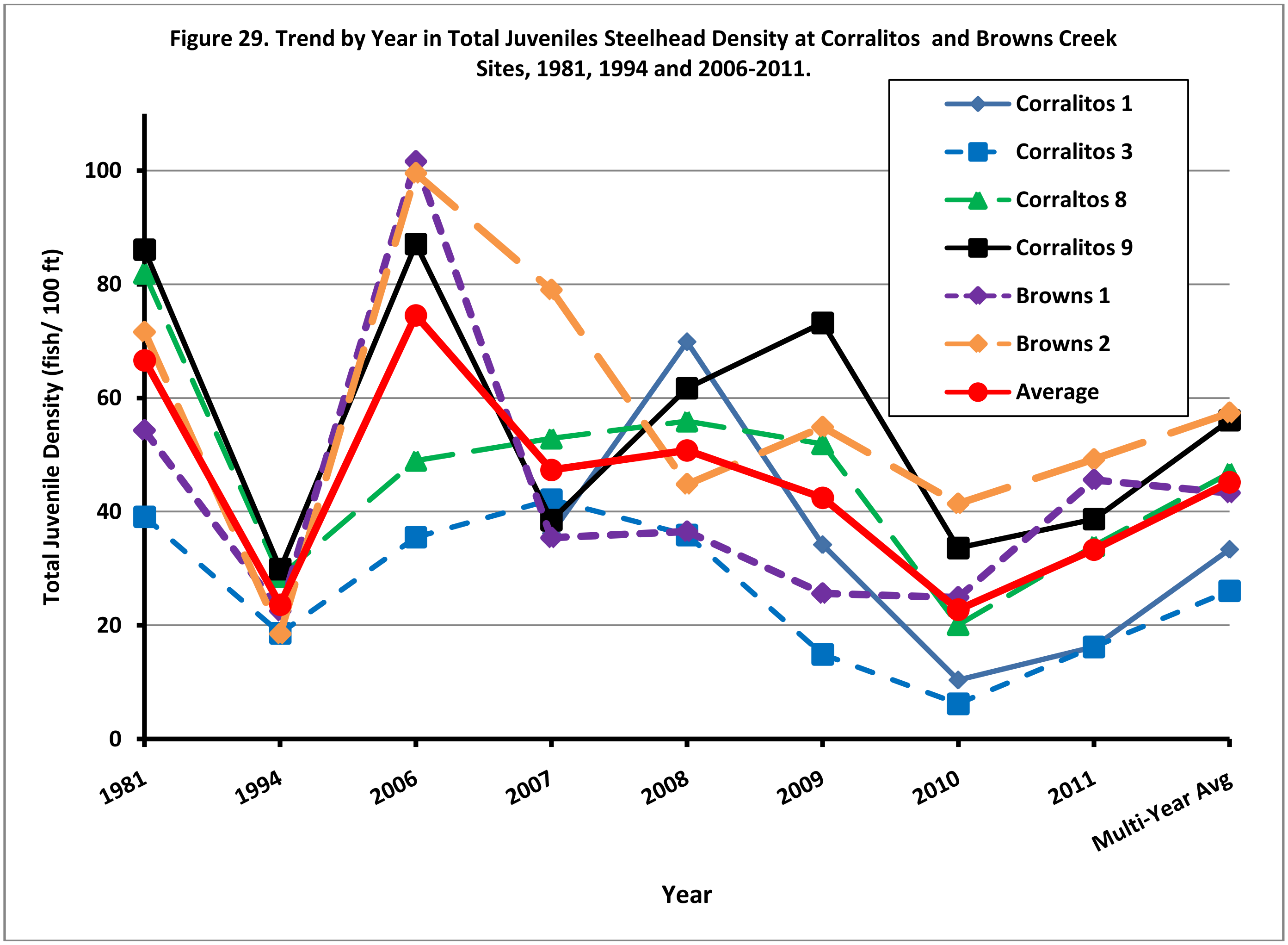
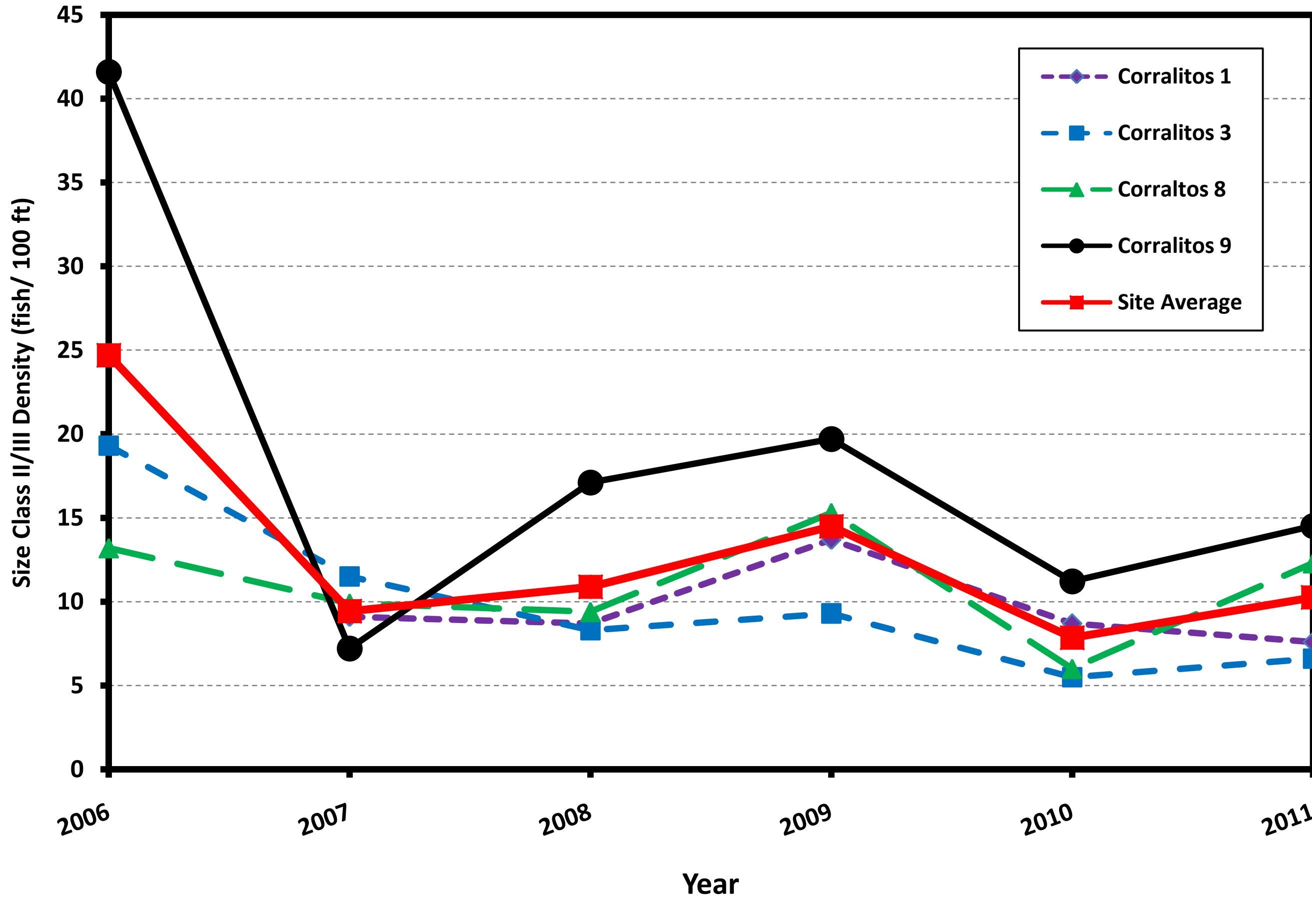


Figure 29. Trend by Year in Total Juveniles Steelhead Density at Corralitos and Browns Creek Sites, 1981, 1994 and 2006-2011.
Corralitos 1
Corralitos 3
Corraltos 8
Corralitos 9
Browns 1
Browns 2
Average
Total Juvenile Density (fish/ 100 ft)
0
20
40
60
80
100
1981
1994
2006
2007
2008
2009
2010
2011
Multi-Year Avg
Year

Figure 30. Trend by Year in Size Class II/III Juveniles Steelhead Density at Corralitos Creek Sites, 2006-2011.



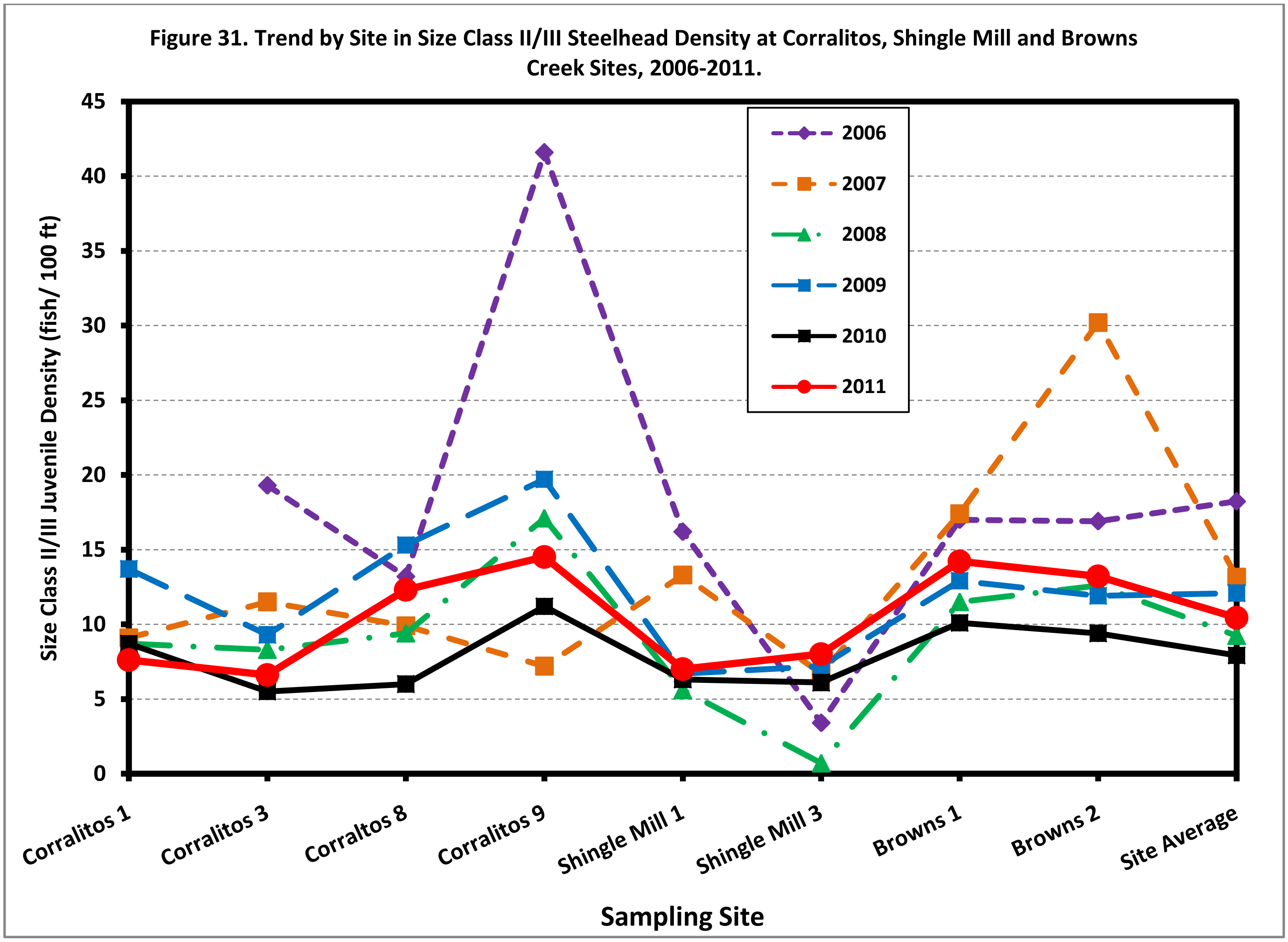


Figure 31. Trend by Site in Size Class II/III Steelhead Density at Corralitos, Shingle Mill and Browns Creek Sites, 2006-2011.
Size Class II/III Juvenile Density (fish/ 100 ft)
45
40
35
30
25
20
15
10
5
0
2006
2007
2008
2009
2010
2011
Corralitos 1
Corralitos 3
Corraltos 8
Corralitos 9
Shingle Mill 1
Shingle Mill 3
Browns 1
Browns 2
Site Average
Sampling Site

Figure 32. The 2010 Daily Average Discharge and Median Daily Flow of Record for the USGS Gage On the San Lorenzo River at Big Trees.

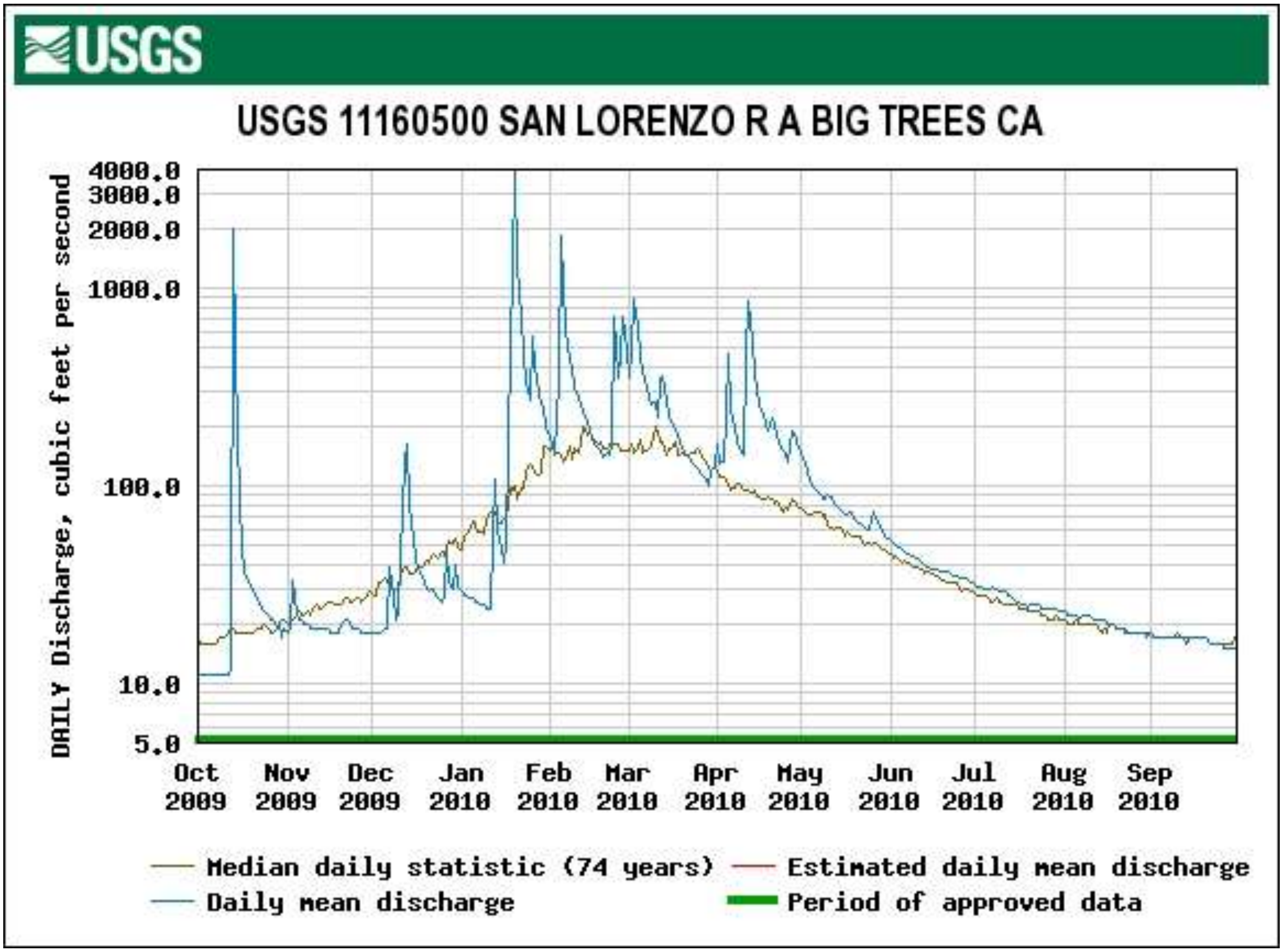


Figure 33. The 2011 Daily Average Discharge and Median Daily Flow of Record for the USGS Gage On the San Lorenzo River at Big Trees.

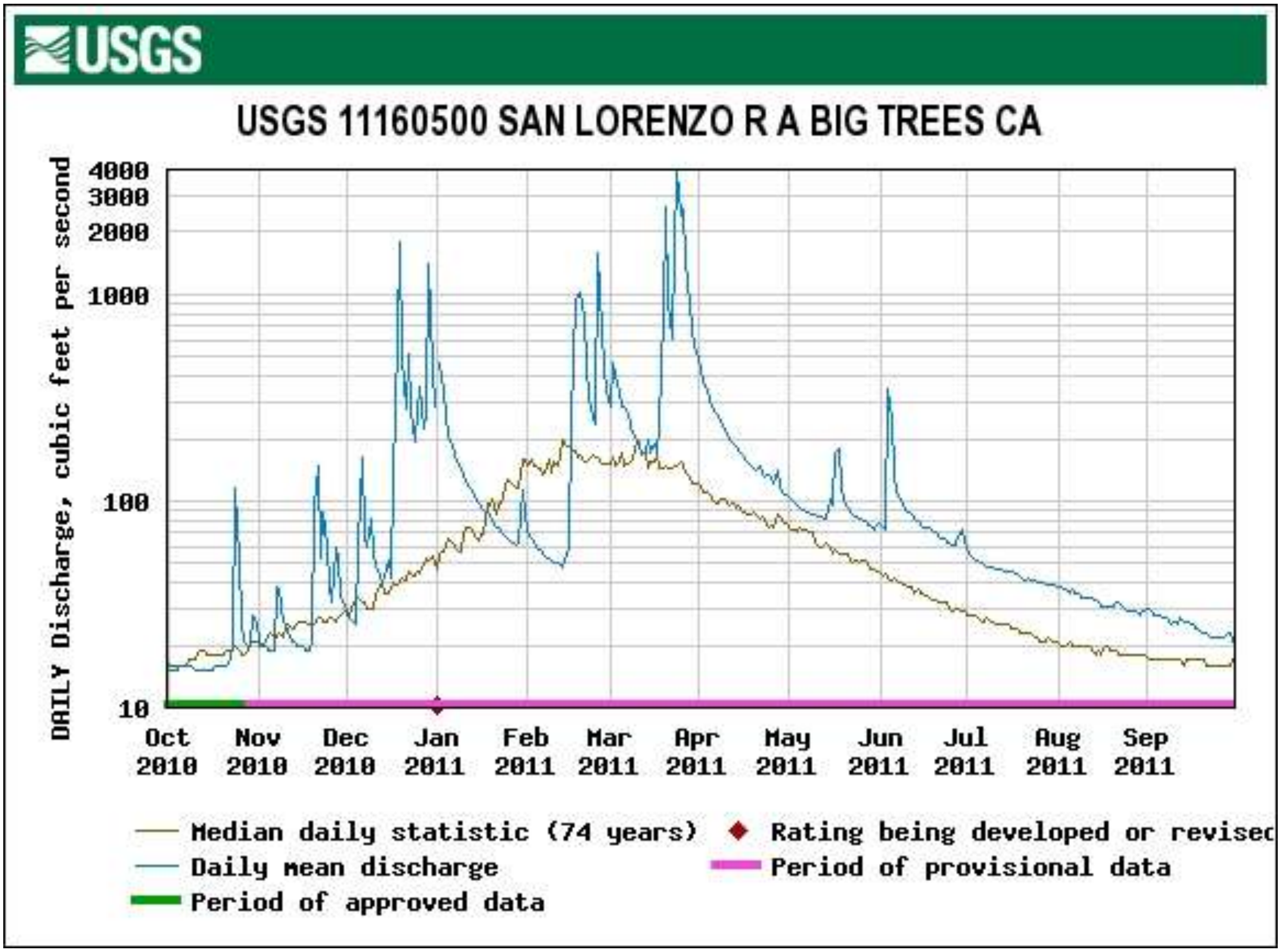


Figure 34. The Late March 2011 Discharge of Record for the USGS Gage On the San Lorenzo River at Big Trees.

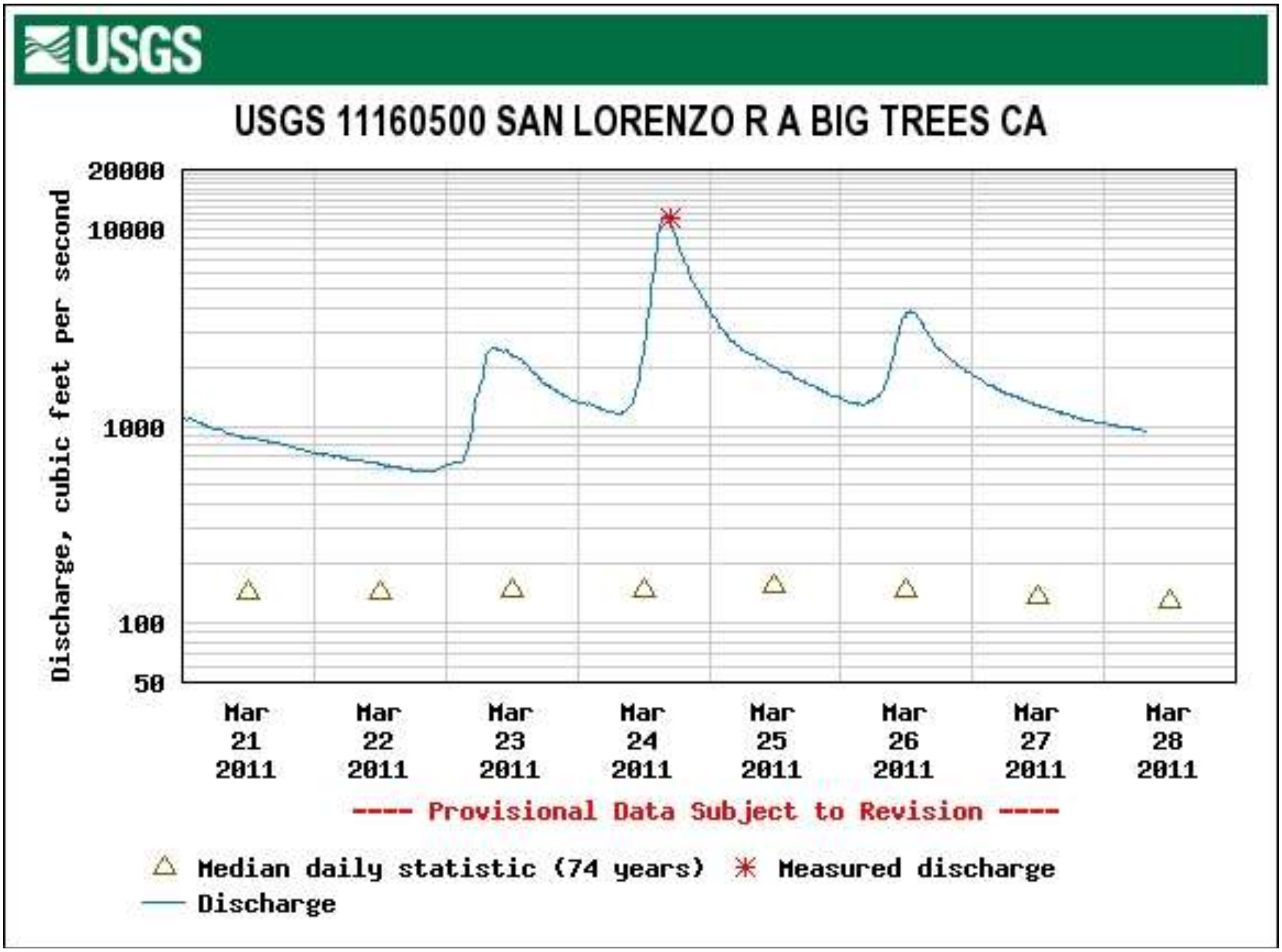


Figure 35. The 2010 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel Village.

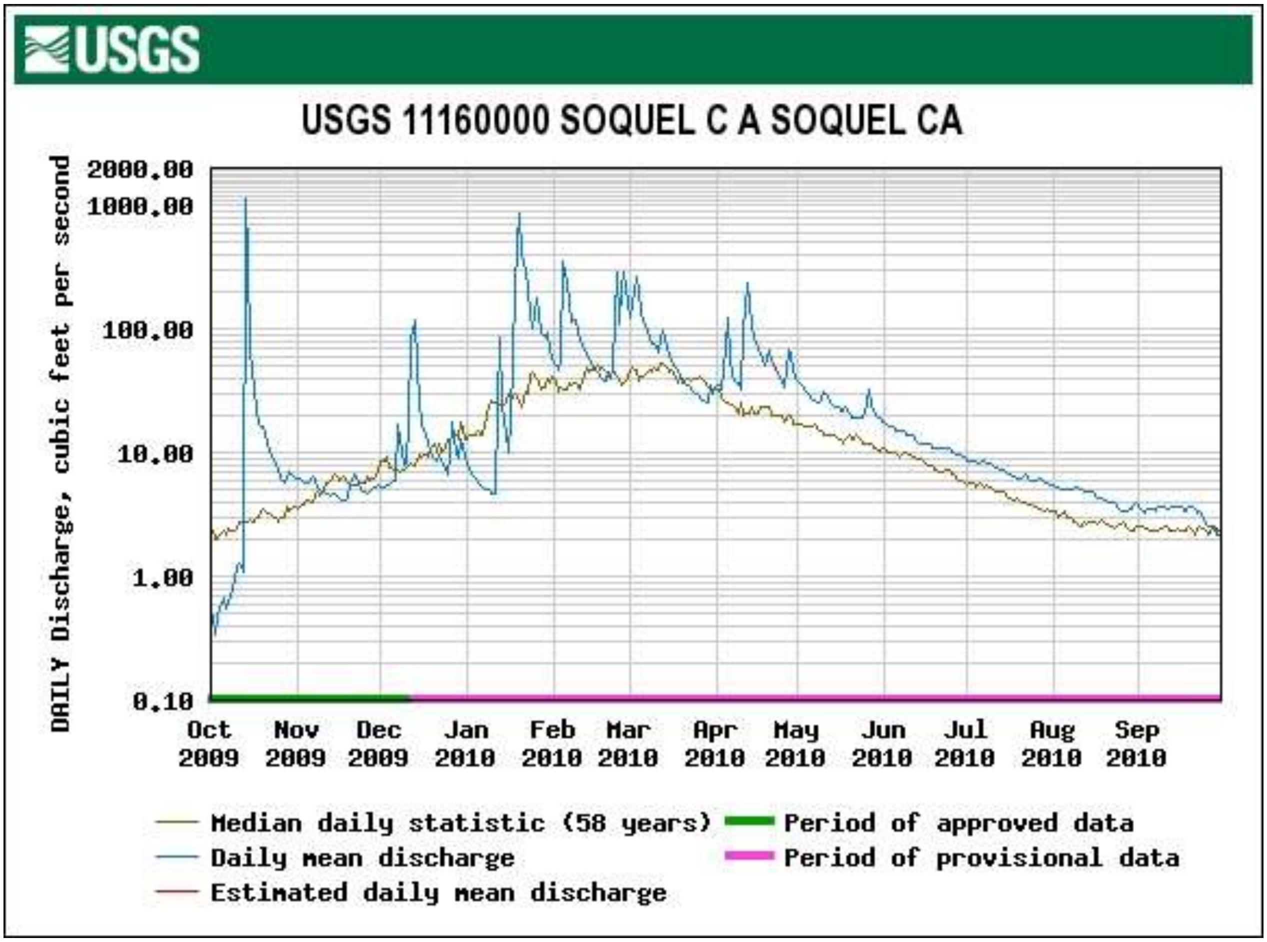


Figure 36. The 2011 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel Village.

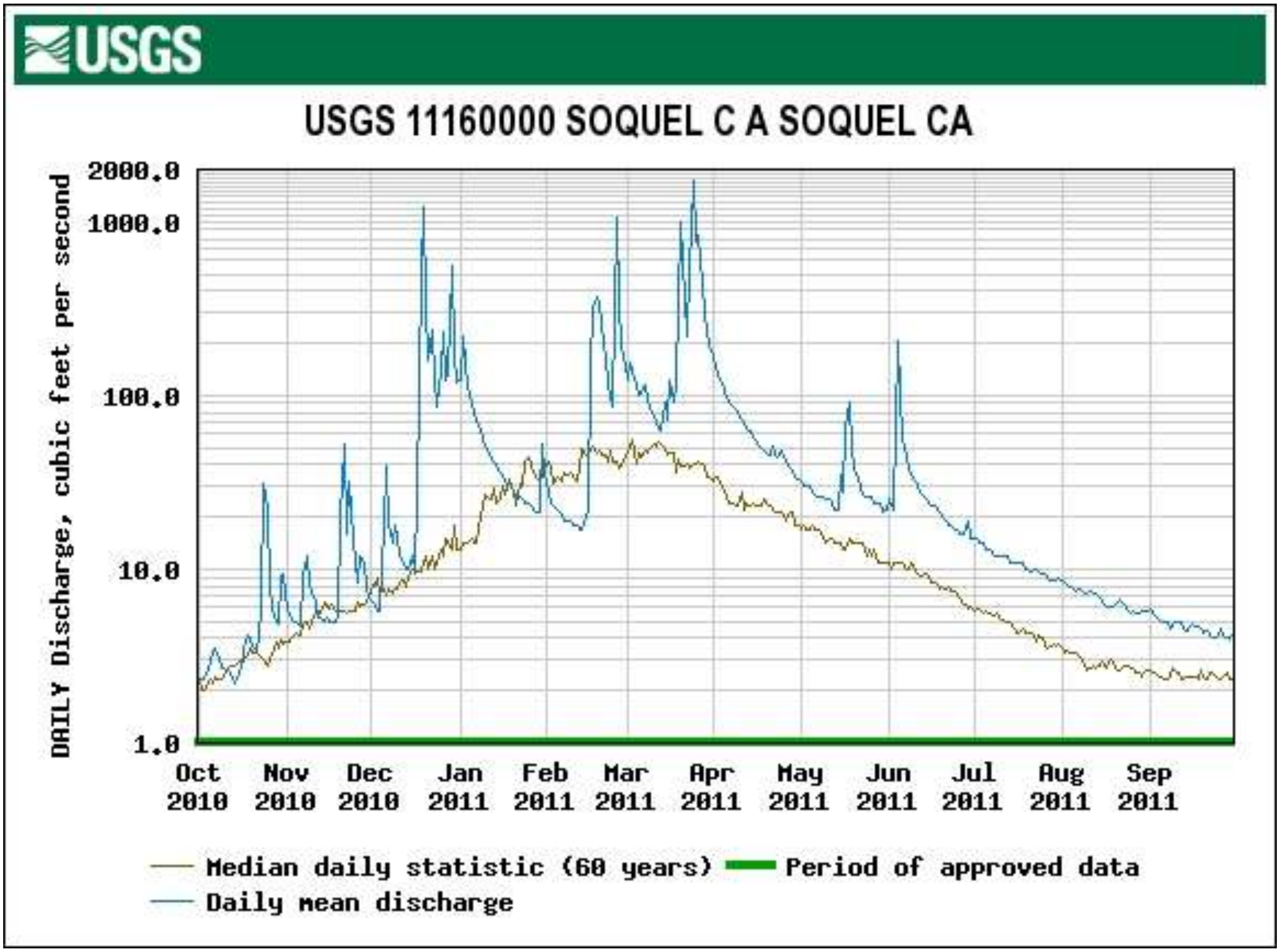


Figure 37. The Late March 2011 Discharge of Record for the USGS Gage on Soquel Creek at Soquel Village.

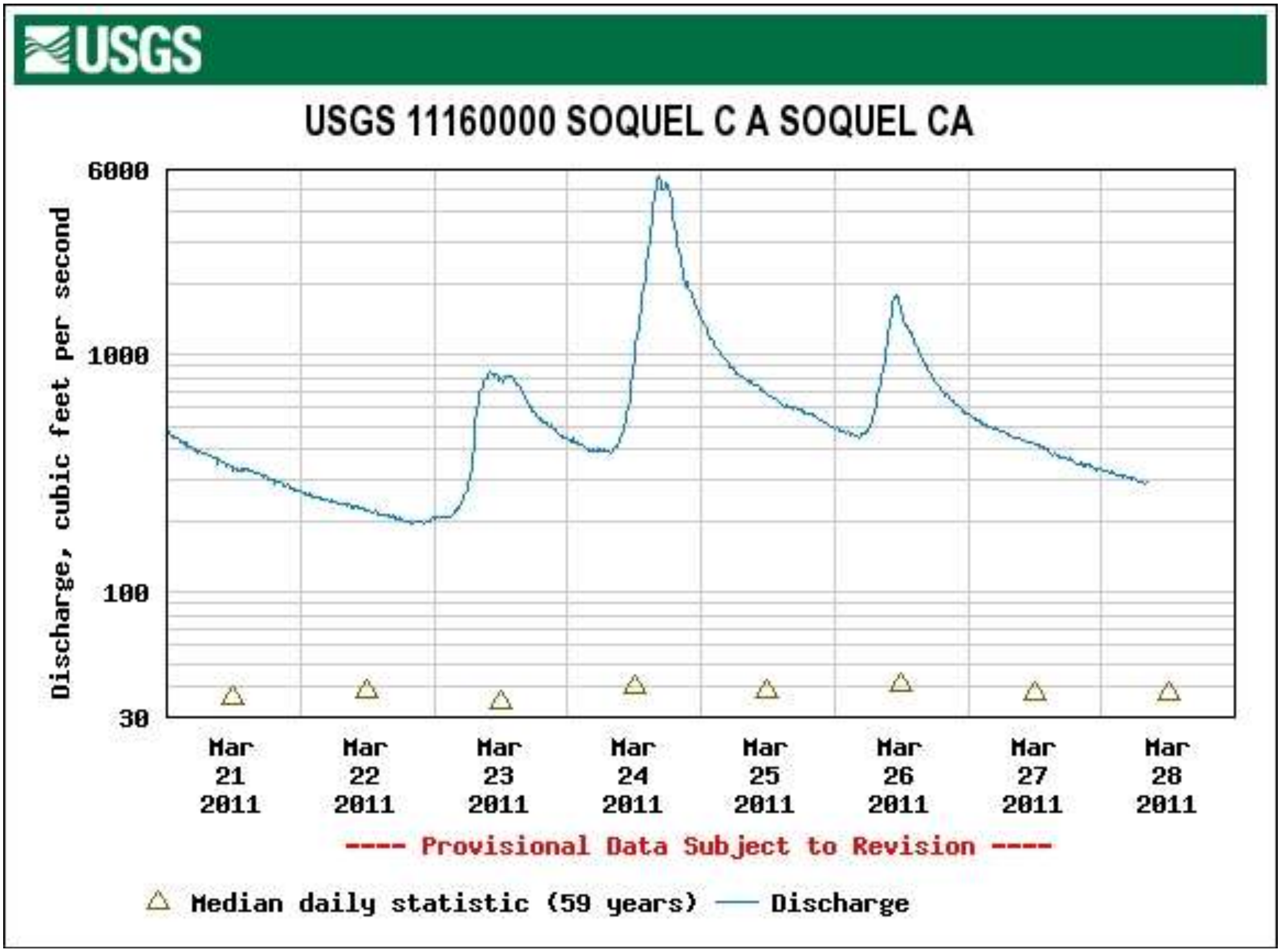


Figure 38. The 2010 Daily Mean and Median Flow at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide a logarithmic scale of discharge).

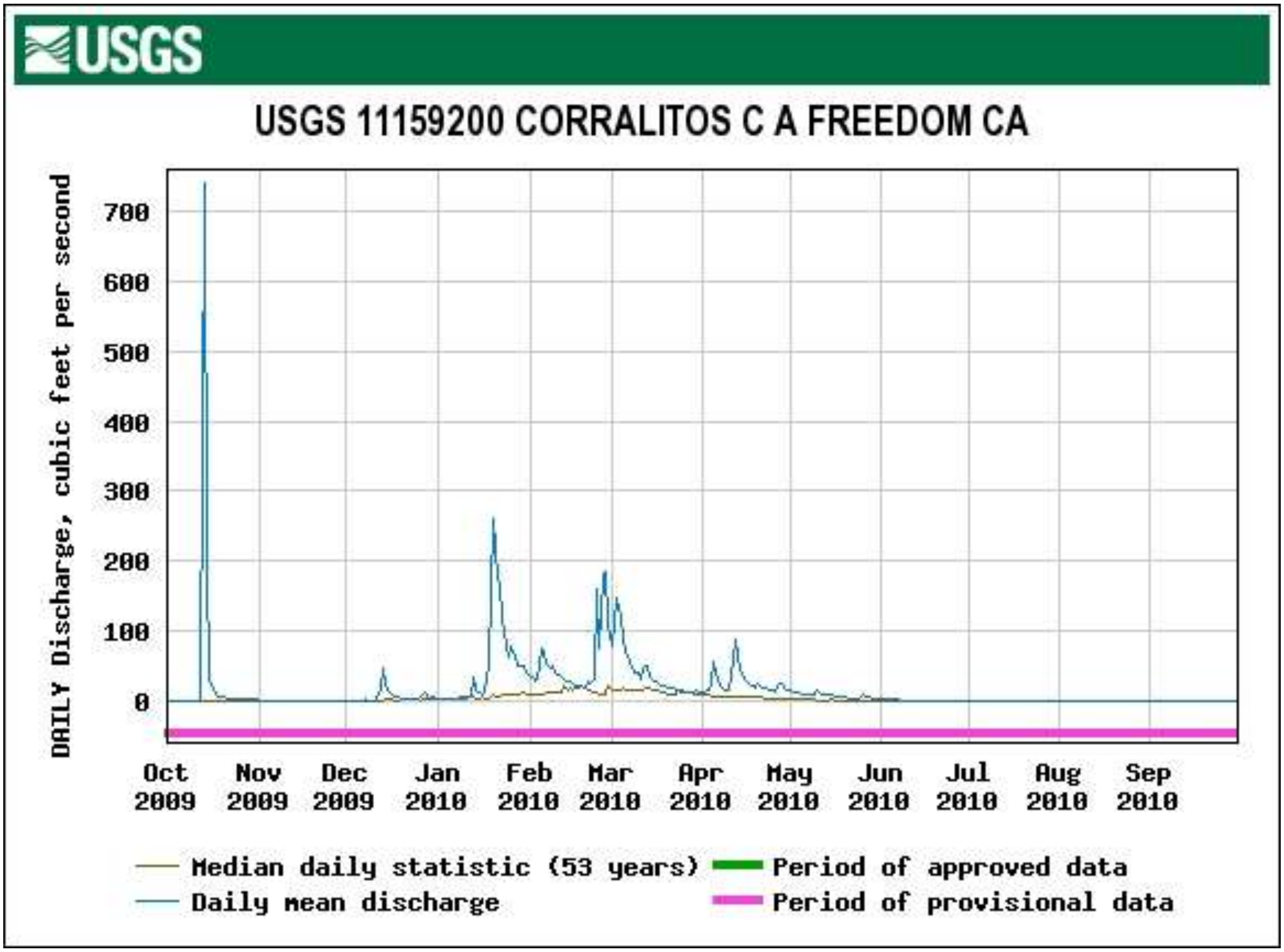


Figure 39. The 2011 Daily Mean and Median Flow at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide a logarithmic scale of discharge).

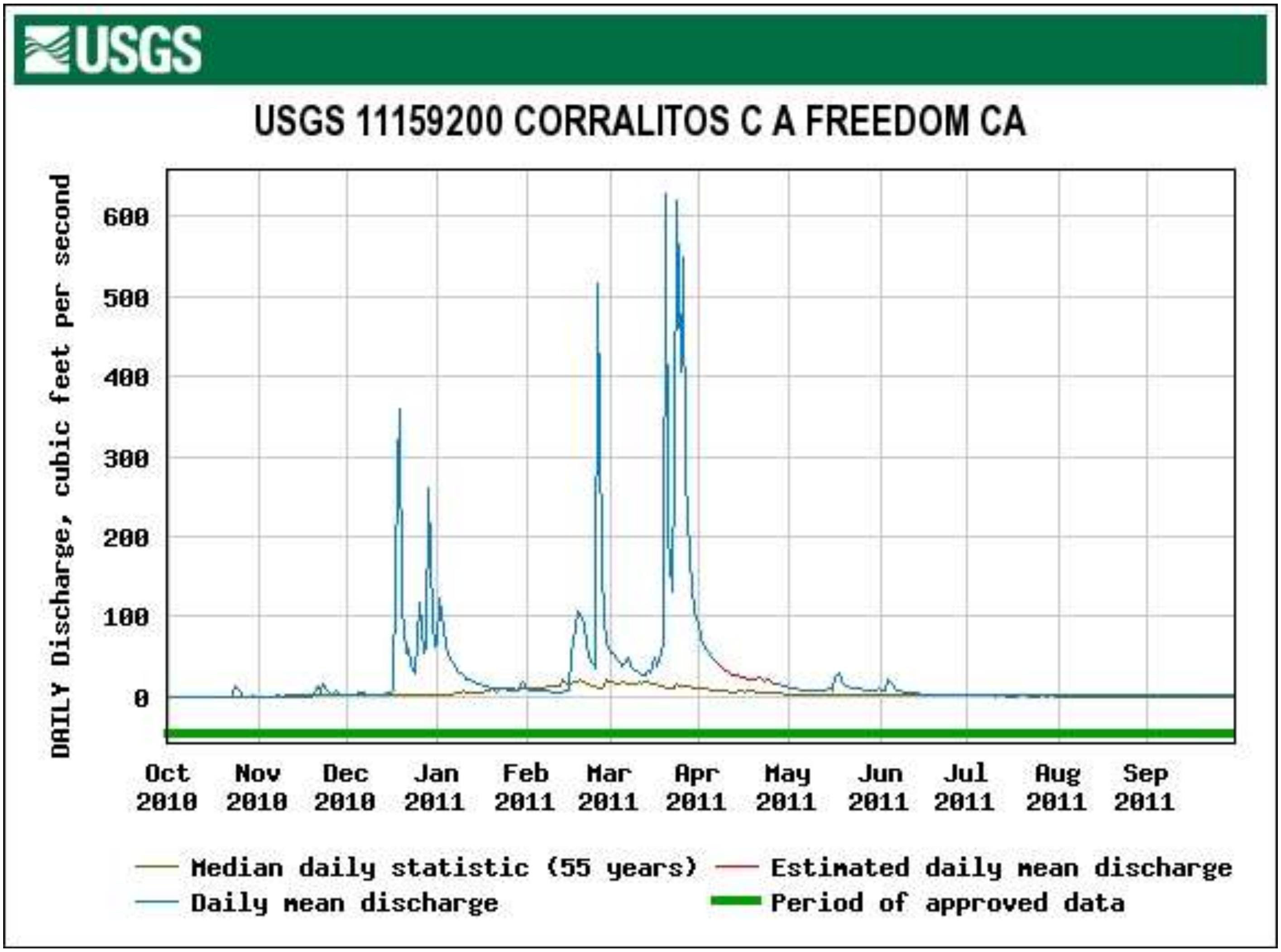


Figure 40. The Late March 2011 Discharge of Record for the USGS Gage on Corralitos Creek at Freedom.

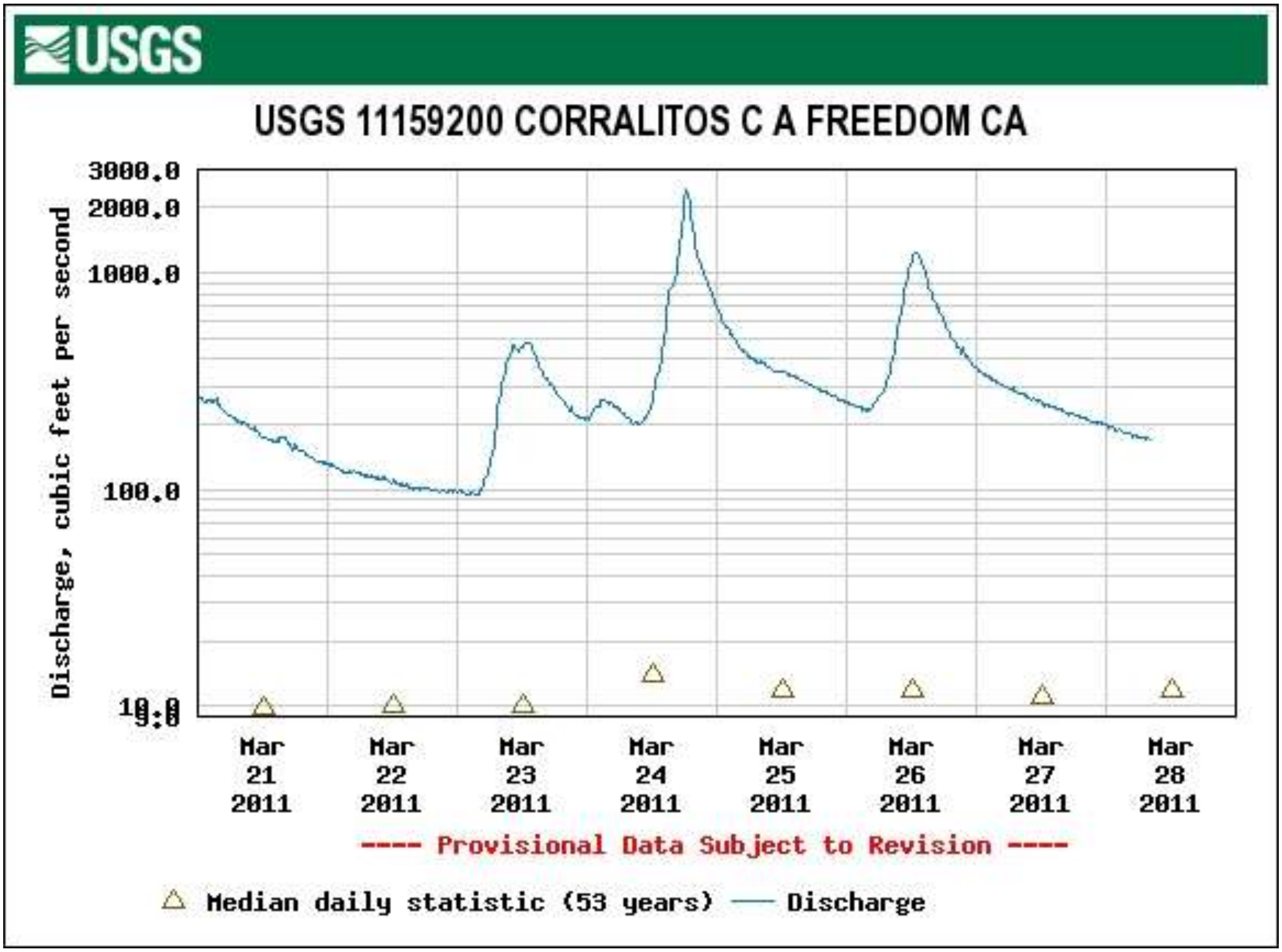


Figure 41. Averaged Mean Monthly Streamflow for May – September in the San Lorenzo and Soquel Watersheds, 1997-2011.

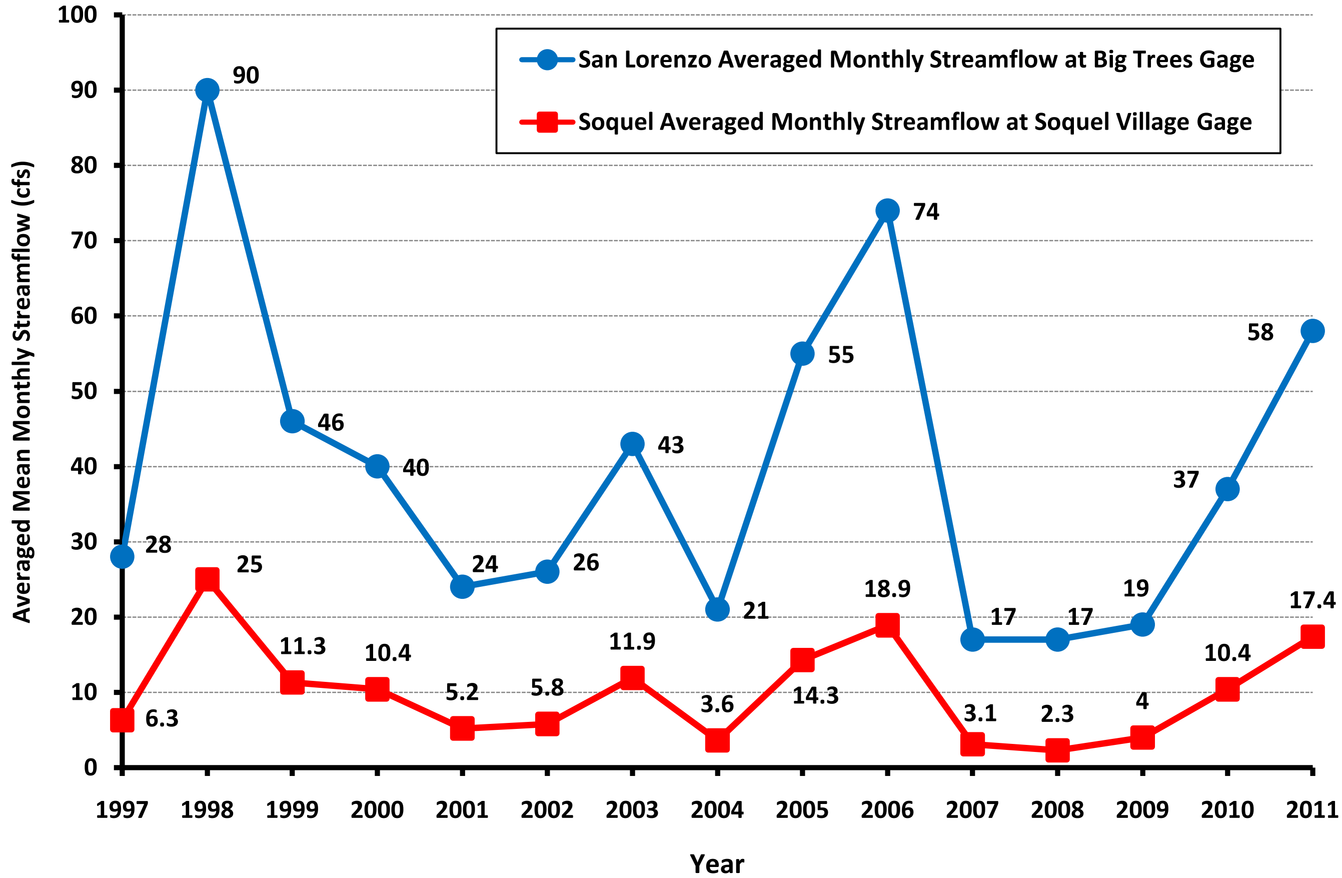


Figure 42. Illustration of Aptos Creek Estuary with Seining Locations, 2011.

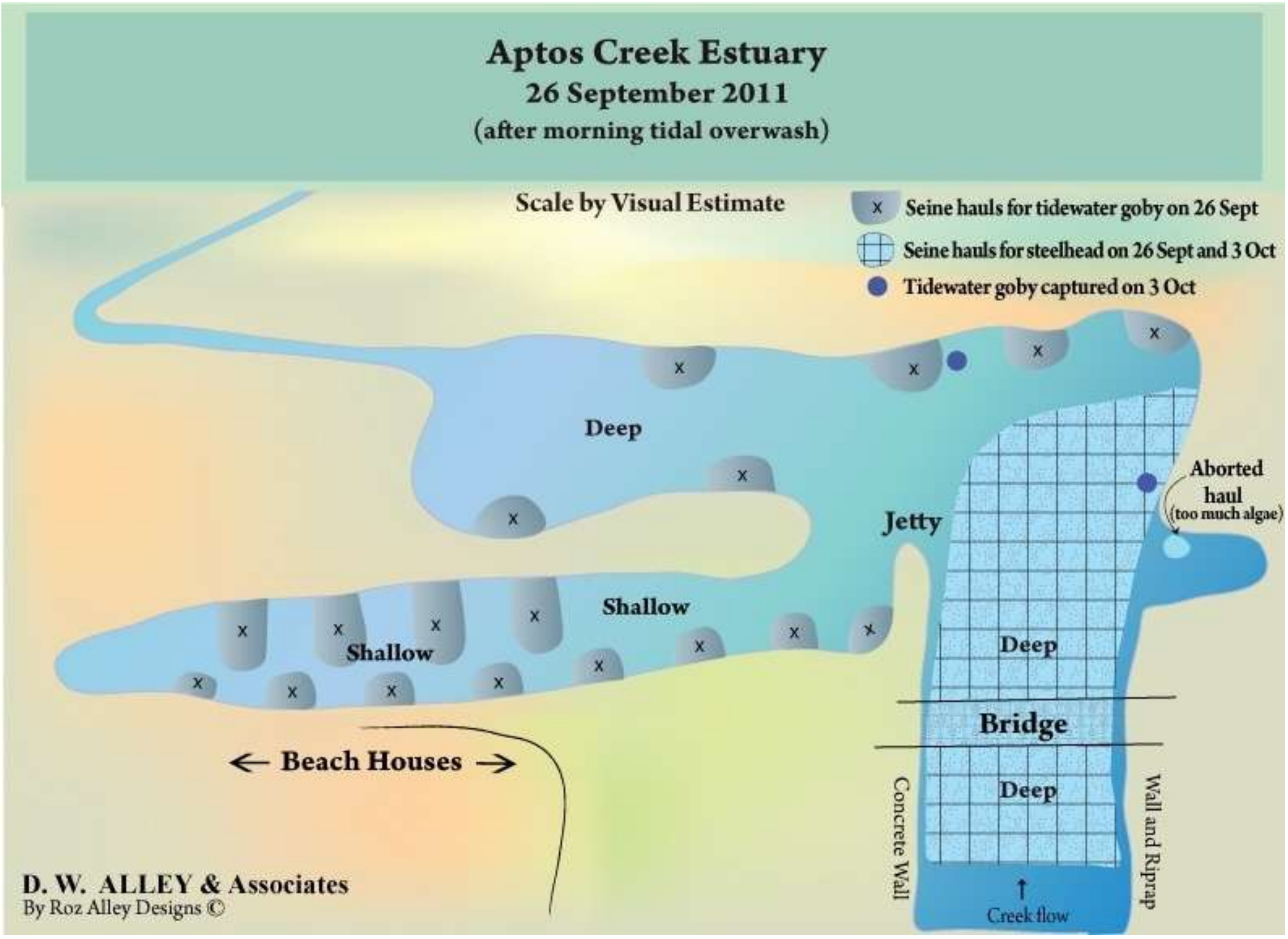
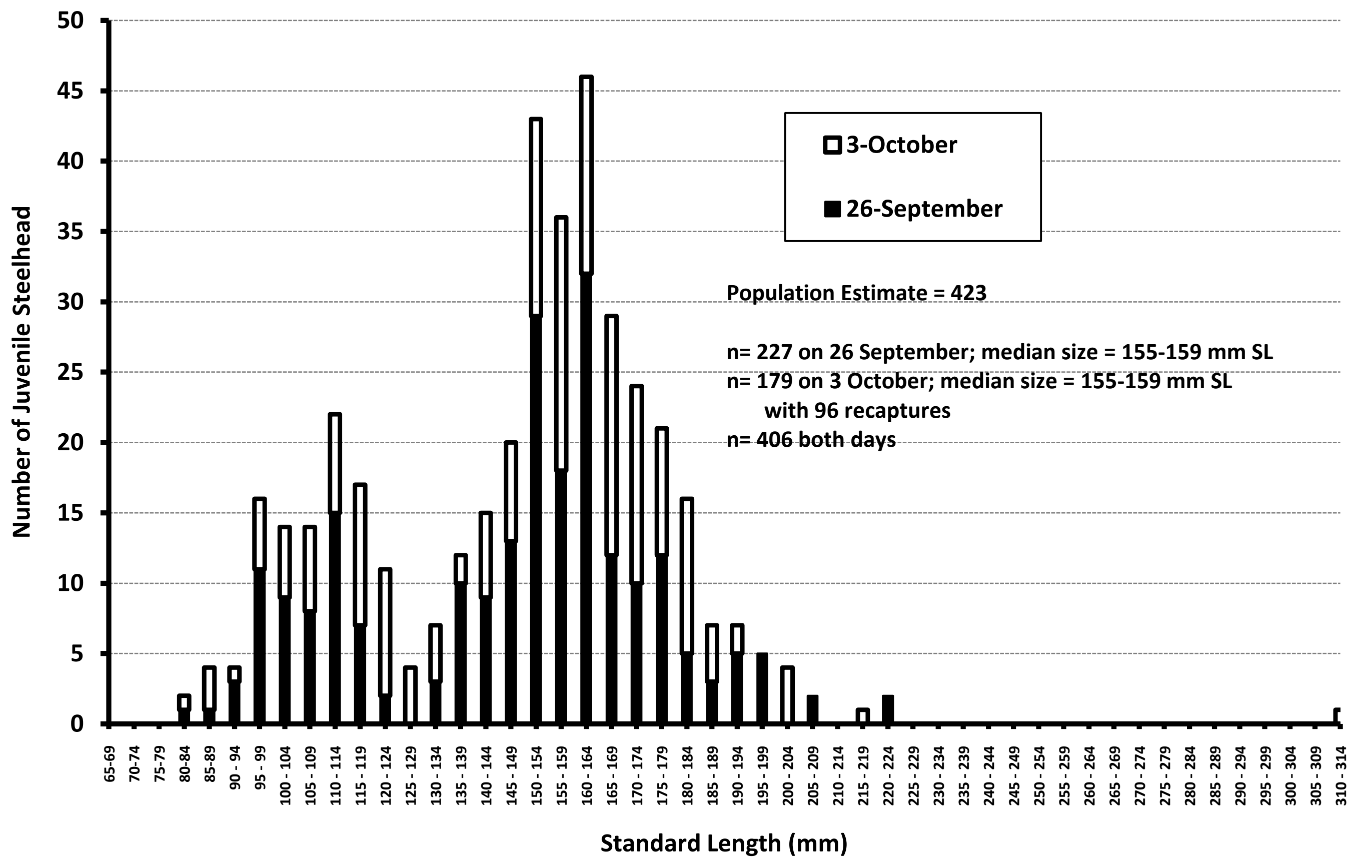


Figure 43. Size Frequency Histogram of Juvenile Steelhead Captured on 26 September and 3 October 2011 in Aptos Lagoon/Estuary.



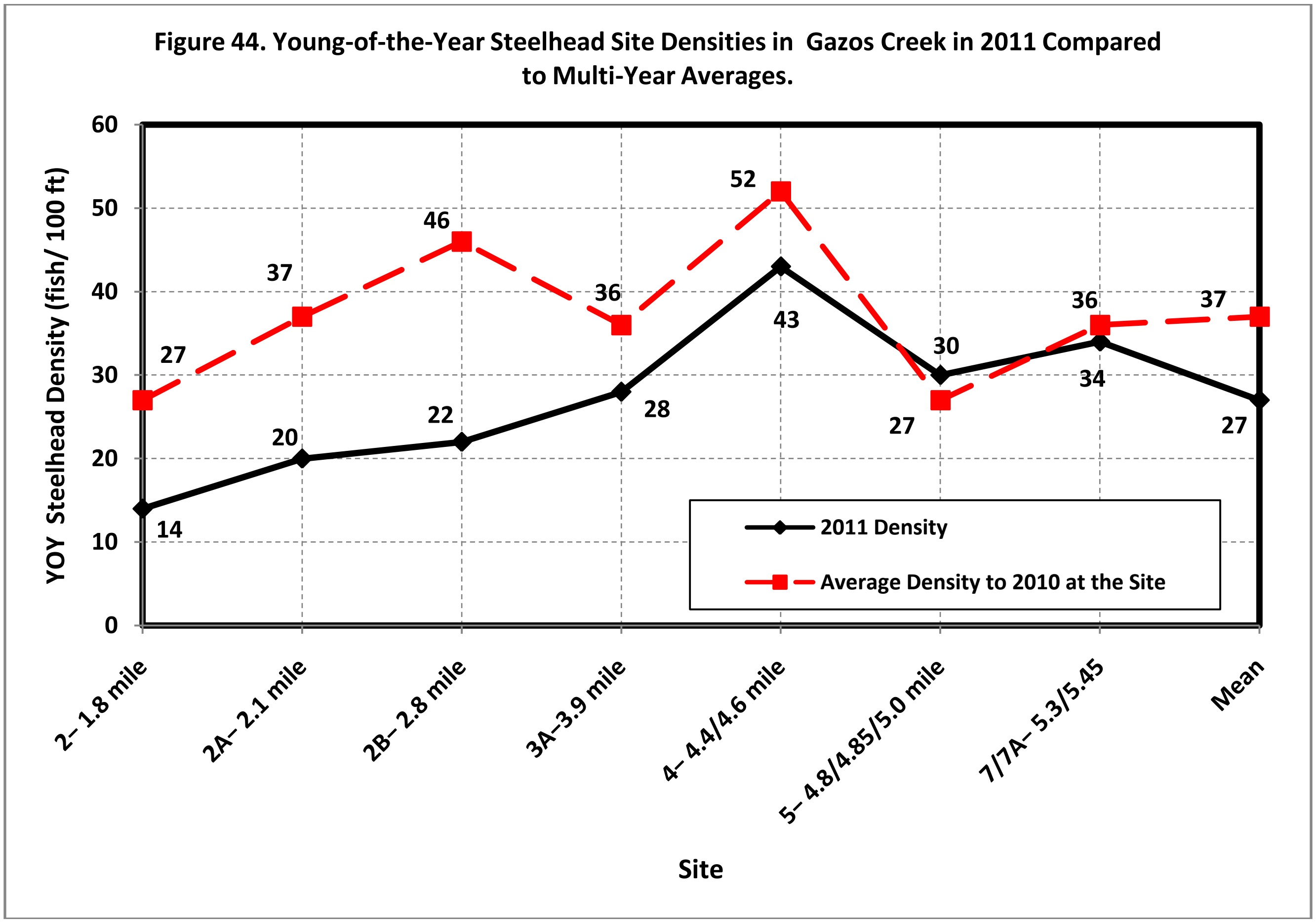


Figure 44. Young-of-the-Year Steelhead Site Densities in Gazos Creek in 2011 Compared to Multi-Year Averages.
YOY Steelhead Density (fish/ 100 ft)
0
10
20
30
40
50
60
27
37
46
36
52
27
36
37
14
20
22
28
43
30
34
27
2011 Density
Average Density to 2010 at the Site
2– 1.8 mile
2A– 2.1 mile
2B– 2.8 mile
3A–3.9 mile
4– 4.4/4.6 mile
5– 4.8/4.85/5.0 mile
7/7A– 5.3/5.45
Mean
Site

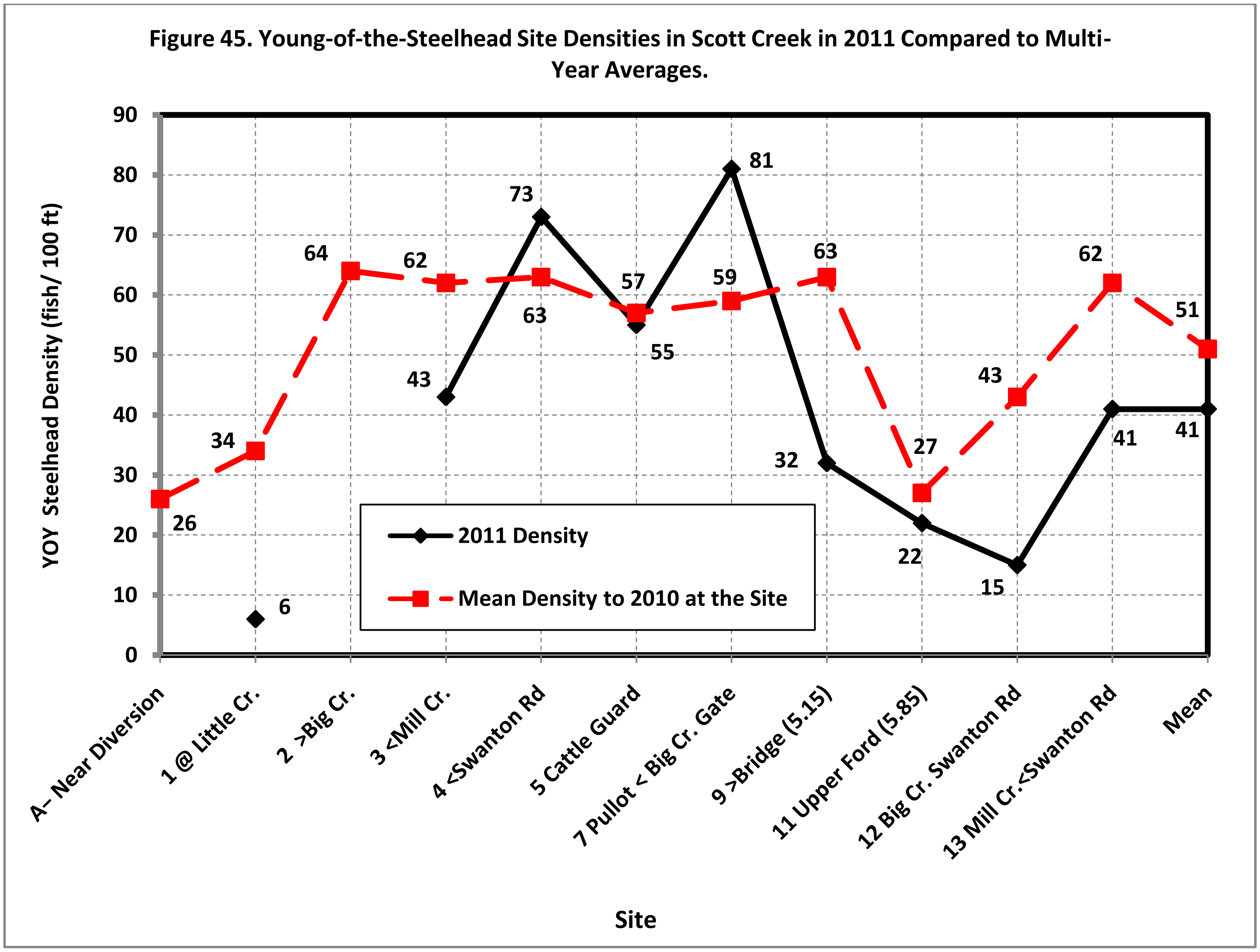


Figure 45. Young-of-the-Steelhead Site Densities in Scott Creek in 2011 Compared to Multi-Year Averages.
YOY Steelhead Density (fish/ 100 ft)
90
80
70
60
50
40
30
20
10
0
81
73
64
62
63
57
59
63
62
51
43
55
43
34
32
27
41
41
26
22
15
6
2011 Density
Mean Density to 2010 at the Site
A– Near Diversion
1 @ Little Cr.
2 >Big Cr.
3 <Mill Cr.
4 <Swanton Rd
5 Cattle Guard
7 Pullot < Big Cr. Gate
9 >Bridge (5.15)
11 Upper Ford (5.85)
12 Big Cr. Swanton Rd
13 Mill Cr.<Swanton Rd
Mean
Site

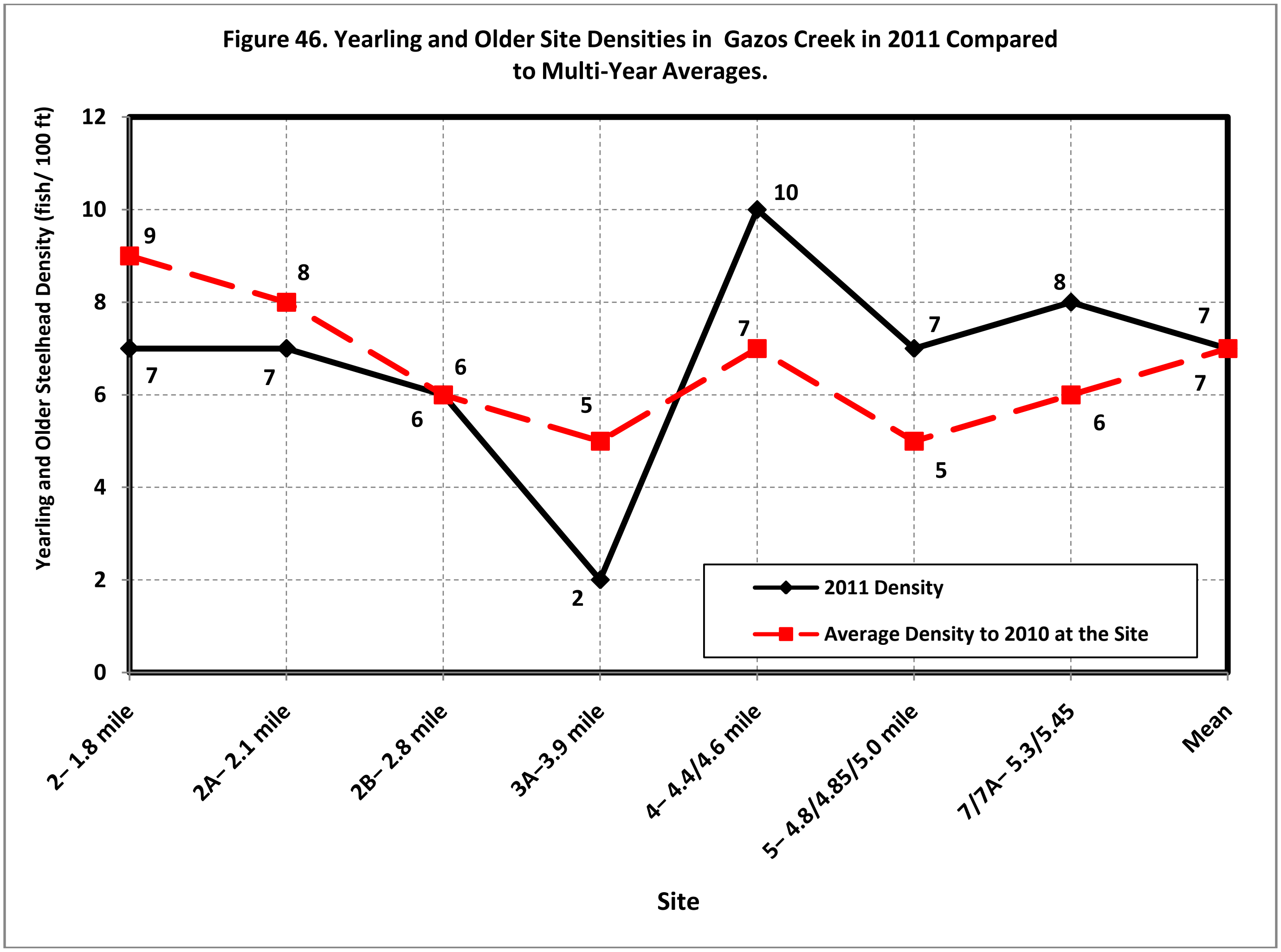
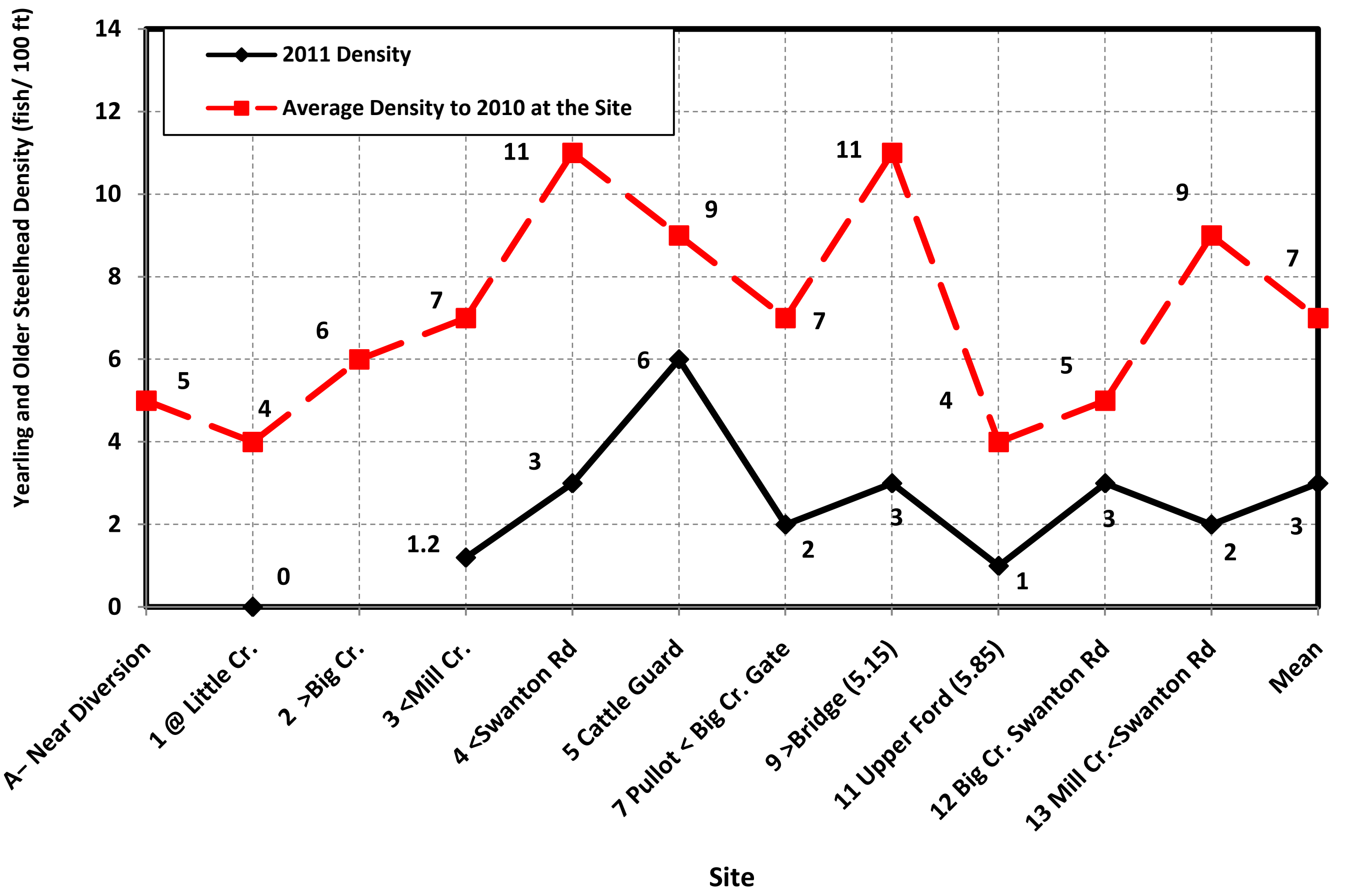


Figure 46. Yearling and Older Site Densities in Gazos Creek in 2011 Compared to Multi-Year Averages.
Yearling and Older Steelhead Density (fish/ 100 ft)
12
10
8
6
4
2
0
9
8
6
5
7
5
6
7
7
7
6
2
10
7
8
7
2011 Density
Average Density to 2010 at the Site
2– 1.8 mile
2A– 2.1 mile
2B– 2.8 mile
3A–3.9 mile
4– 4.4/4.6 mile
5– 4.8/4.85/5.0 mile
7/7A– 5.3/5.45
Mean
Site

Figure 47. Yearling and Older Steelhead Site Densities in Scott Creek in 2011 Compared to Multi-Year Averages.



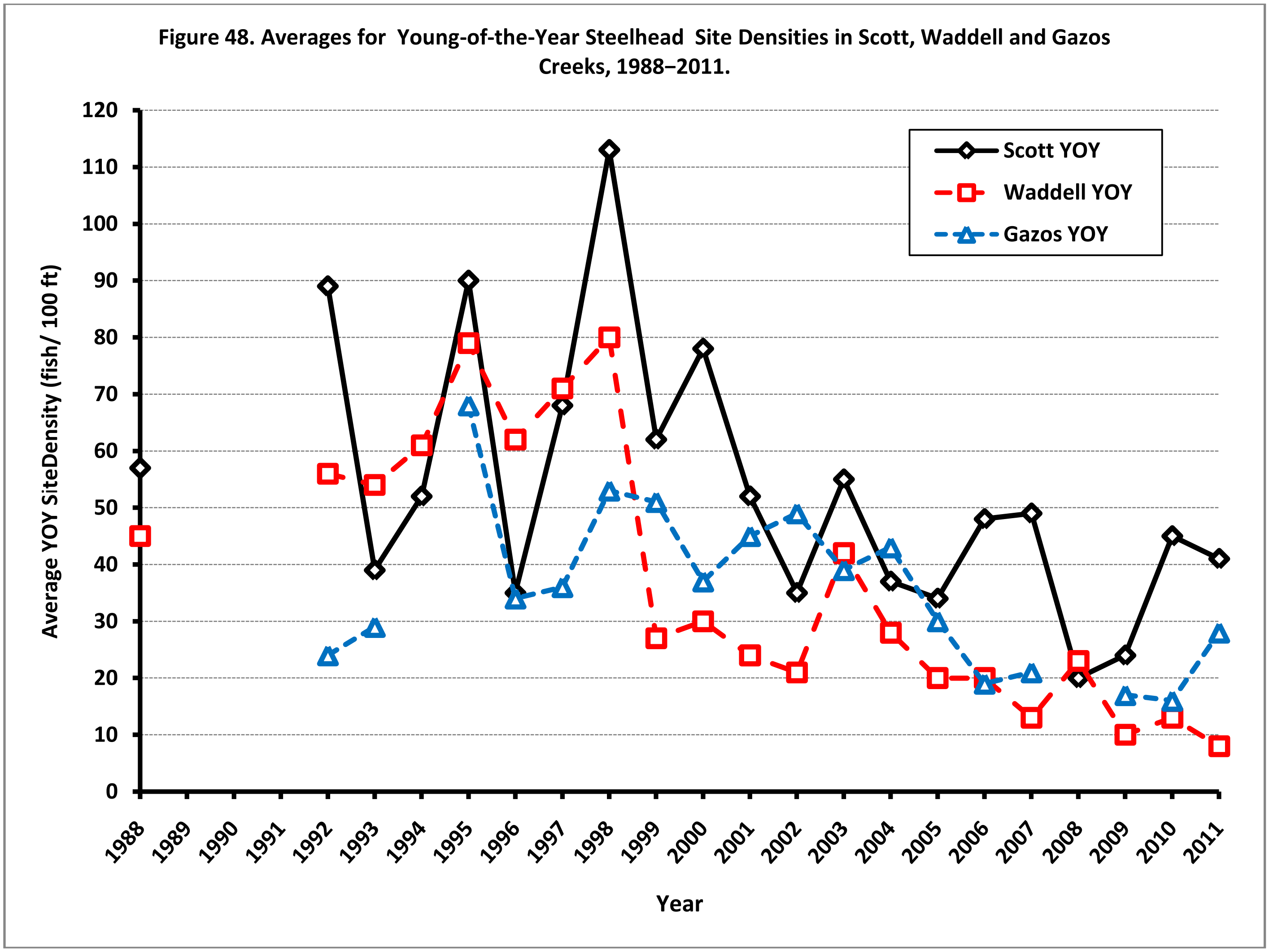
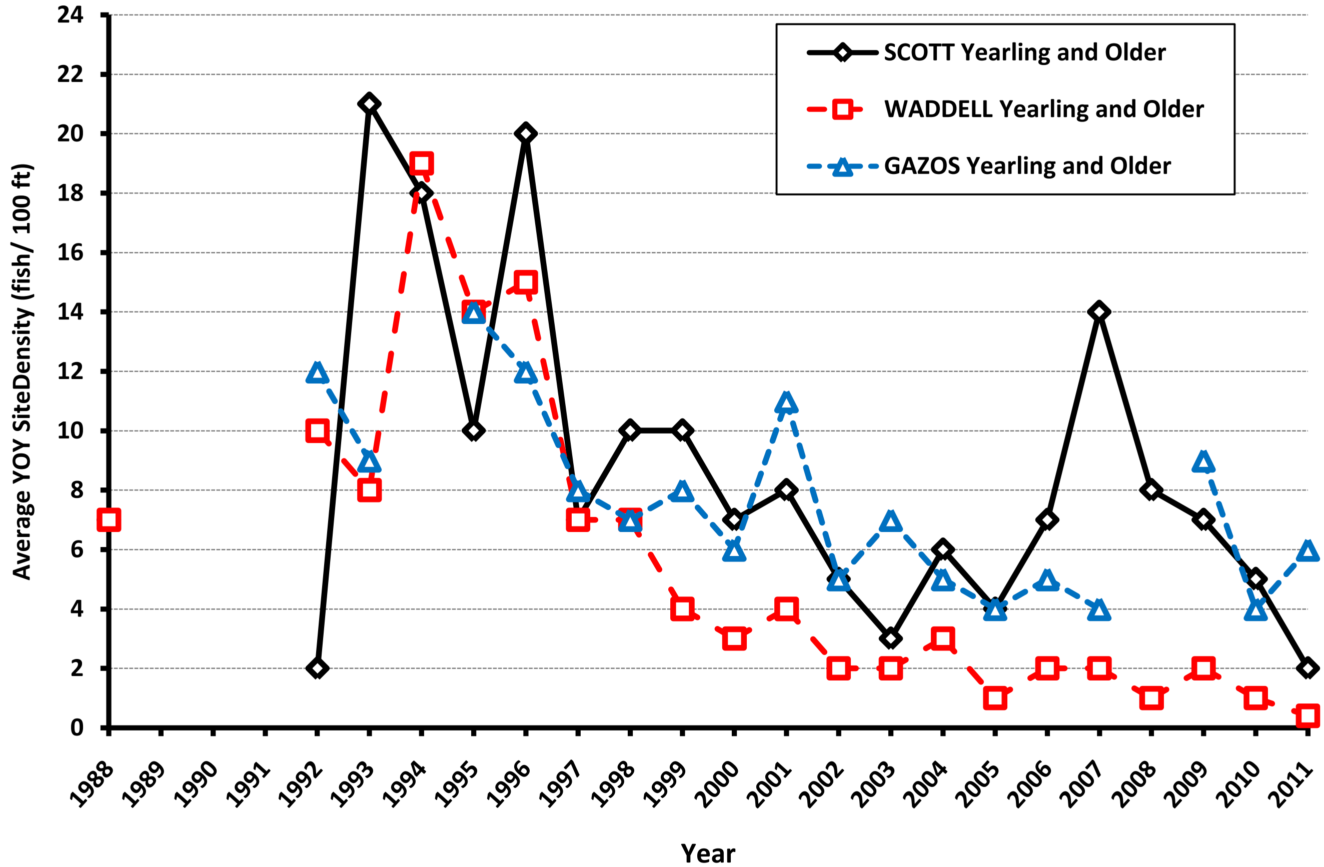


Figure 48. Averages for Young-of-the-Year Steelhead Site Densities in Scott, Waddell and Gazos Creeks, 1988–2011.
Scott YOY
Waddell YOY
Gazos YOY
Average YOY SiteDensity (fish/ 100 ft)
Year
0
10
20
30
40
50
60
70
80
90
100
110
120
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

Figure 49. Averages for Yearling and Older Steelhead Site Densities in Scott, Waddell and Gazos Creeks, 1988–2011.



APPENDIX A. Watershed Maps.

Figure 1. Santa Cruz County Watersheds.

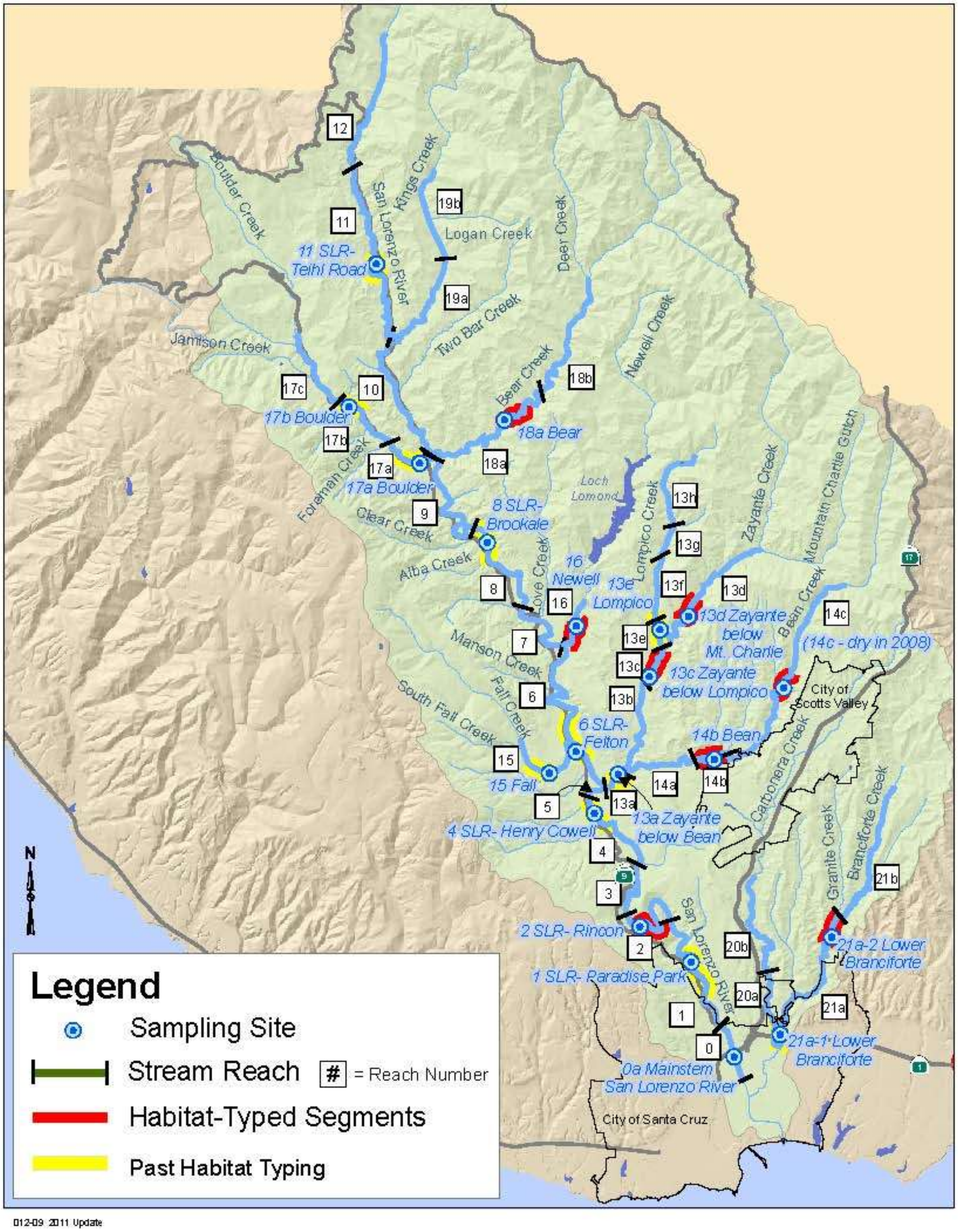


Figure 2. San Lorenzo River Watershed

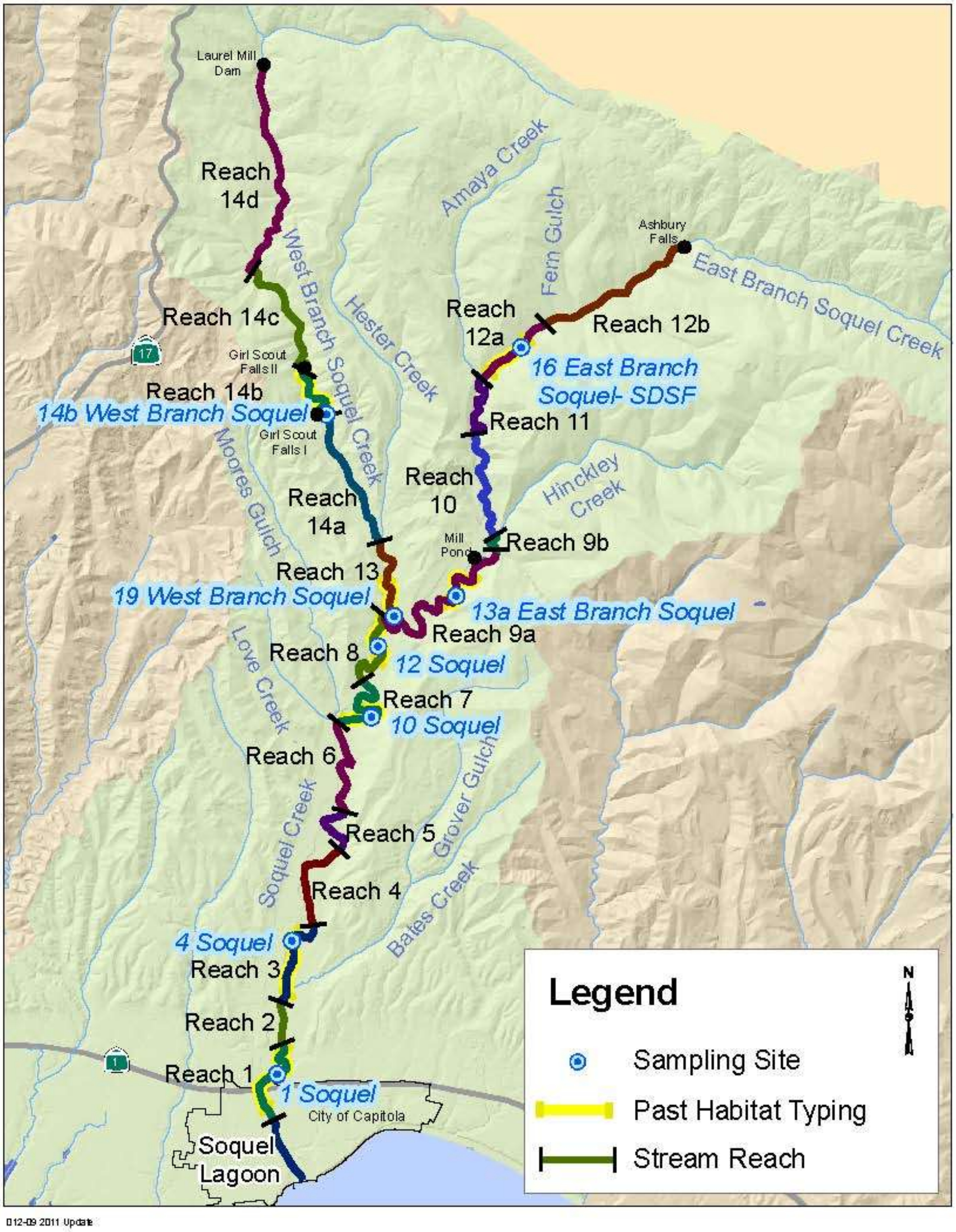
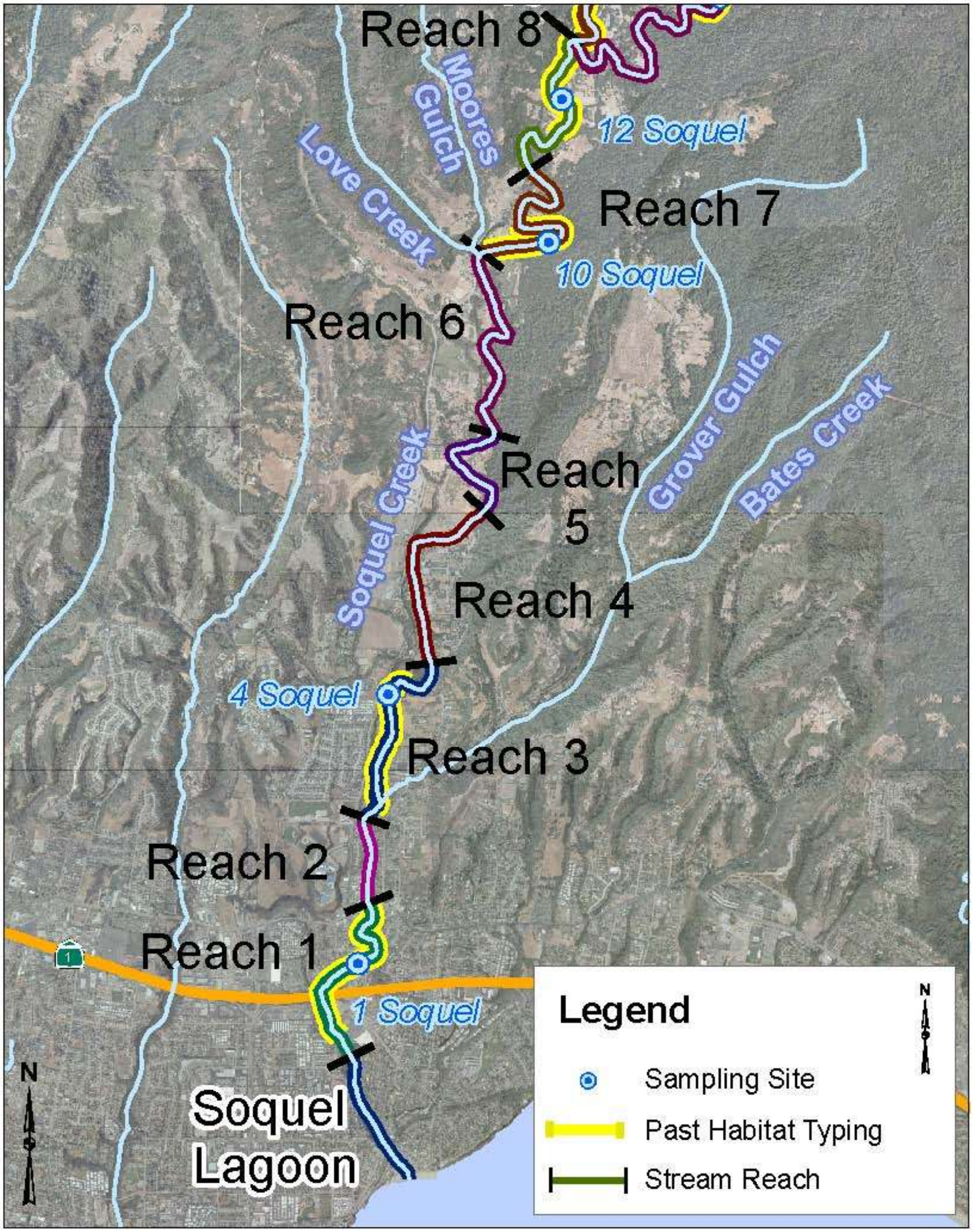


Figure 3. Soquel Creek Watershed.



012-09 2011 Update

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

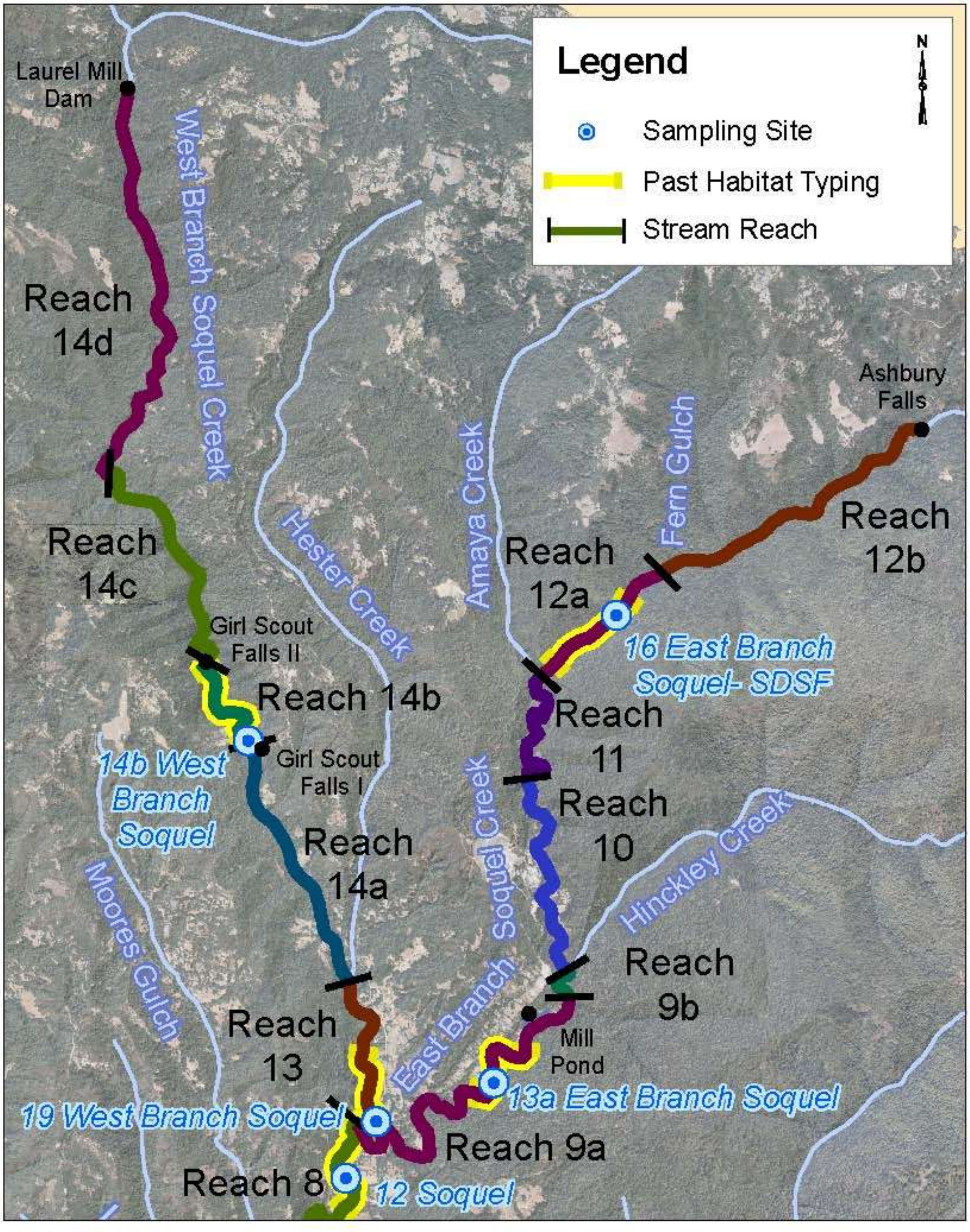


Figure 5. Upper Soquel Creek Watershed (East and West Branches).

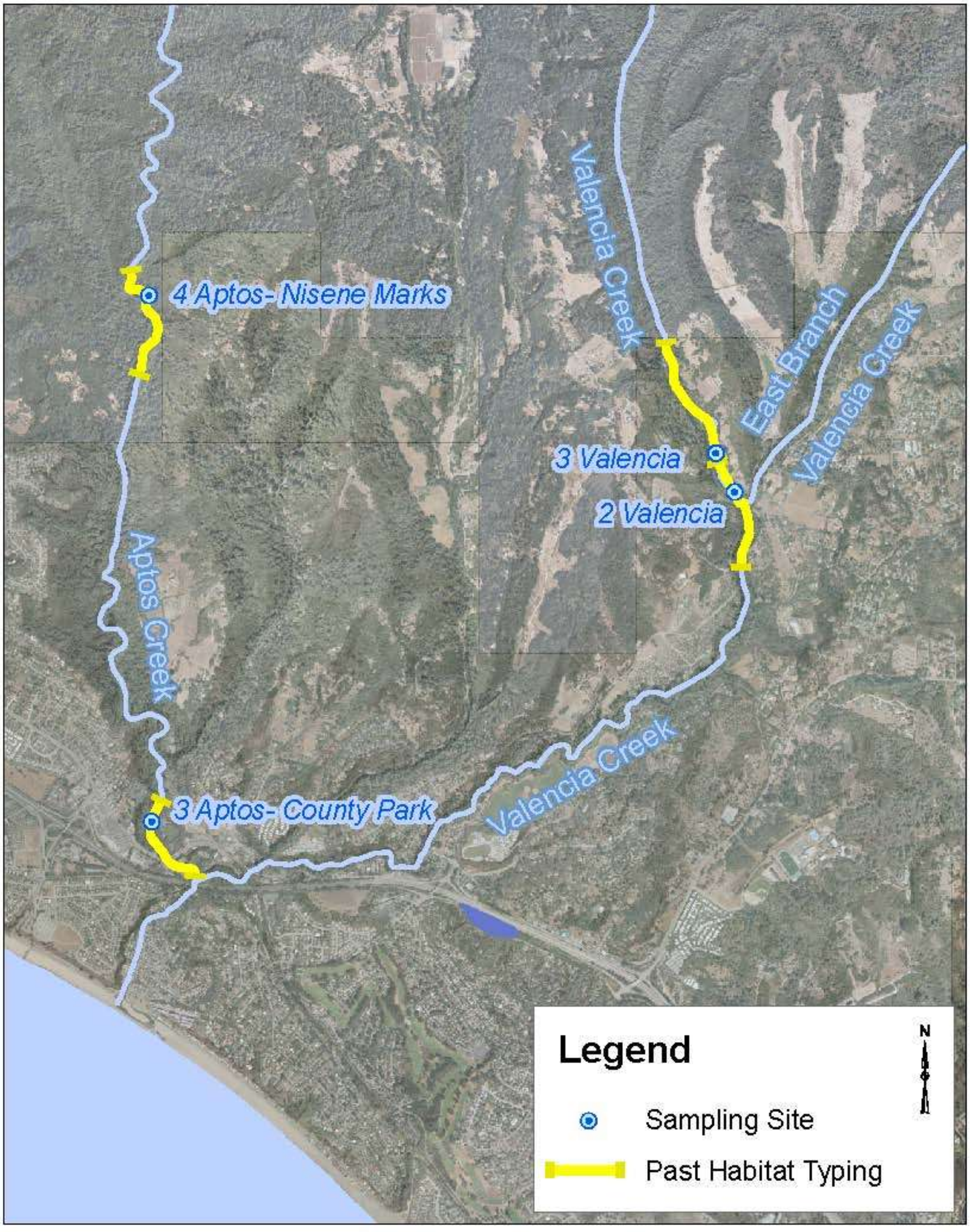


Figure 6. Map from Smith (1982) with Site #3 designation on Valencia Creek at 2006 location.

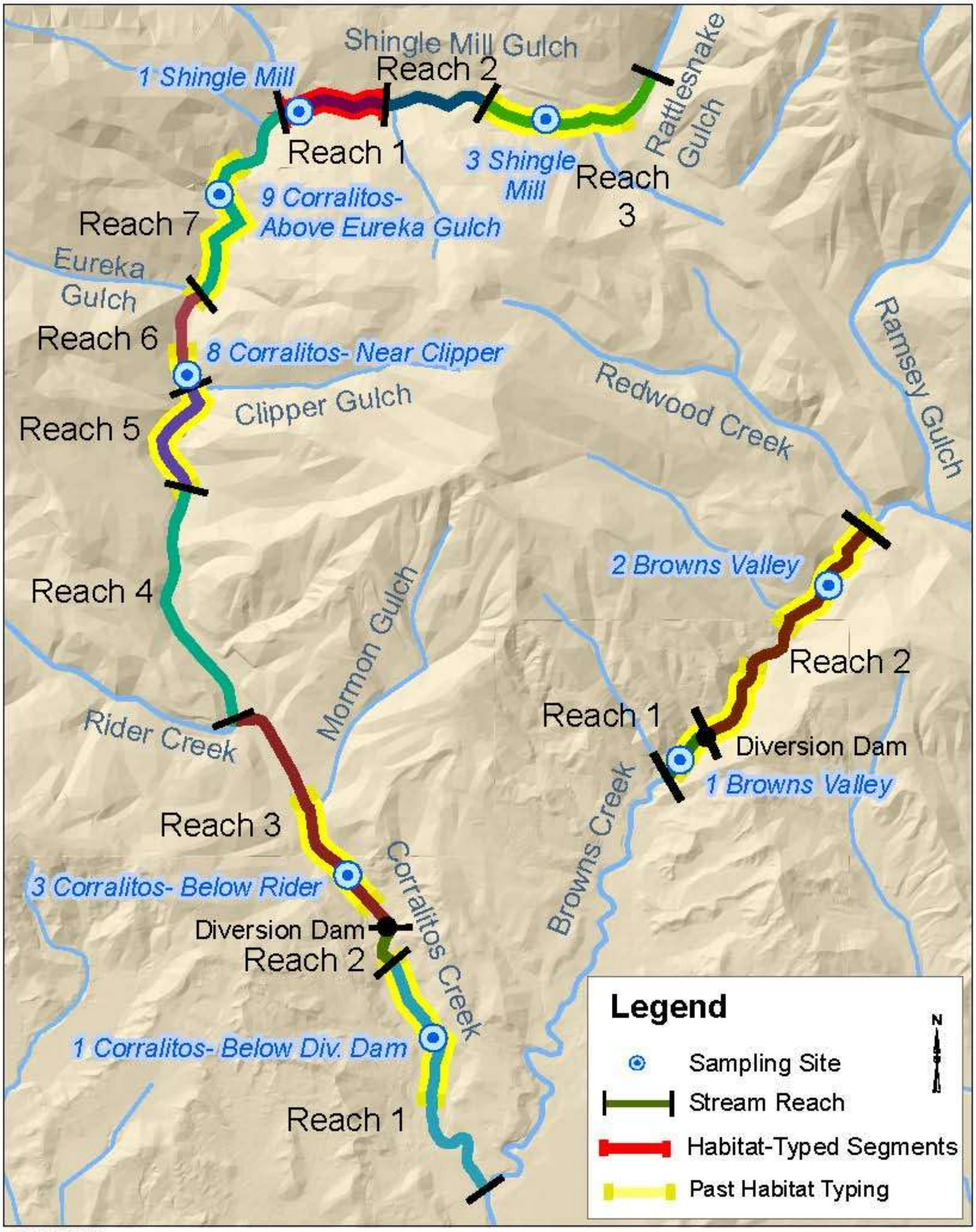


Figure 7. Upper Corralitos Creek Sub-Watershed of the Pajaro River Watershed.

APPENDIX C. Summary of 2011 Catch Data at Sampling Sites.

ORDER OF DATA ORGANIZATION IN THIS APPENDIX

The summary sheets for each sampling site were provided first as steelhead/coho sampling forms. Then the field data sheets for each sampling site were provided. The order of sampling sites corresponded to the numerical order presented in Tables 1-4 in the methods section.

EXPLANATION OF STEELHEAD/COHO SALMON SAMPLING FORMS

Electrofishing and snorkeling data were presented for each sampling site. All data pertained to steelhead because no coho salmon were captured in 2011. Snorkeled habitat is denoted. For electrofishing data, it was presented in successive passes. For underwater visual censusing data, fish counts for replicate passes were presented as passes. Density estimates for each electrofished habitat were obtained by the depletion method and regression analysis. Density estimates for mainstem pool habitats that were visually censused in 2011 were obtained by using the maximum number of steelhead seen per pass if less than 20 fish were counted and by using the average of three passes if more than 20 fish were counted.

For each pass, steelhead were divided into age and size class categories. YOY and 1+ refer to age classes. C-1, C-2 and C-3 refer to Size Classes 1, 2 and 3. For the data presented by pass, C-2 includes Size Classes 2 and 3 combined. Only in the population estimates are these two size classes differentiated.

Site densities at the bottom of the summary data forms were obtained by dividing total estimated number of fish in each size/age category by the total length of stream that was censused.

Steelhead Sampling Results

Date: 14Oct11 **Stream:** SLR **Sampled by:** Alley, Steiner, Moss

Sampling Site: 0a (Below Highway 1) **Water Temperature and Times:** 61.0° F @ 1505 hr, 14Oct11

Habitat type& Length (ft)	First Pass				Second Pass				Third Pass/ Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#2,3,4 Riffle-pool-run 193 (40+51+102) ft	4	0	0	4	0	0	0	0	0	0	0	0	4	0	0	3	1	4
All Habitats Combined 193 ft													4	0	0	3	1	4

Length of Stream Sampled (ft): 193 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0207/ 0.0
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0 /0.0207

Total Density: 0.0207

Steelhead Sampling Results

Date: 07Sep11/13Oct11 **Stream:** SLR **Sampled by:** Alley, Steiner, Kittleson, Reis, Wheeler

Sampling Site: 1 (Paradise Park) **Water Temperature and Times:** 62° F @ 1507 hr, 13Oct11.

Habitat type& Length (ft)	First Pass				Second Pass				Third Pass/ Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#8 Riffle 80 ft	4	0	0	4	2	0	1	3	0	0	1	1	6.7	0	2	7.8	2.6	10.4
#7 Run 52 ft	2	0	1	3	1	0	0	1	0	0	0	0	3.3	0	1	3.1	1.1	4.2
#10a Pool Snorkel 622 ft (10a+10b)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#10b Pool	4	1	1	3	5	1	1	4	5	1	1	4	4 Max.	1 Three	1 Passes	2	3	6
All Habitats Combined 754 ft													14	1	4	12.9	6.7	20.6

Length of Stream Sampled (ft): 754 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0186/ 0.0013
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0053 /0.0260

Total Density: 0.0273

Steelhead Sampling Results

Date: 14Sep11/14Oct11 **Stream:** SLR **Sampled by:** Alley, Steiner, Kittleson and Moss

Sampling Site: 2a (Rincon) **Water Temperature and Times:** 59°F @ 0930 hr, 14Oct11. 65°F @ 1616 hr, 26Aug11 (air temp. 71°F)

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/ Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#18 Riffle (partial) 79 ft	9	0	0	9	2	0	5	7	0	0	0	0	11.3	0	5	15	5.5	20.5
#17 Run 85 ft	8	0	2	10	2	0	2	4	2	0	0	2	12.7	0	6	13	4.3	17.3
#16 Pool Snorkel 424 ft	6 Max.	0 Three	1 Passes	7									6	0	1	6	1	7
#22 Pool Snorkel 89 ft	24	0	3	27	32	0	3	35	28	0	3	31	28 Avg.	0 Three	3	28 Passes	3	31
All Habitat Combined 677 ft													58	0	15	62	13.8	75.8

Length of Stream Sampled (ft): 677 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0857/ 0.0
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0222 /0.1120

Total Density: 0.1120

Steelhead Sampling Results

Date: 08Sep11/13Oct11 **Stream:** SLR **Sampled by:** Alley, Steiner, Kittleson, Reis, Wheeler,

Sampling Site: 4 (Henry Cowell Park) **Water Temperature and Times:** 57.5° F @ 1040 hr, 13Oct11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#17 Run 34 ft	2	0	0	2	1	0	0	1	0	0	0	0	3.3	0	0	3.3	0	3.3
#20 Riffle 47 ft	4	0	2	6	1	0	0	1	5/1	2/0	0	3/1	11	2	2	11	0	13
#21 Run 34 ft	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1
#22 Pool Snorkel 405 ft	3 Max.	0 Three	1 Passes	4									3	0	1	3	1	4
All Habitats Combined 520 ft													18.3	2	3	18.3	1	21.3

Length of Stream Sampled (ft): 520 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0352/0.0038
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0058/0.0371

Total Density: 0.0410

Steelhead Sampling Results

Date: 14Sep11/09Sep11 **Stream:** SLR **Sampled by:** Alley, Steiner, Wheeler, Kittleson

Sampling Site: 6 (below Fall Creek) **Water Temperature and Times:** 62.5°F @ 1454 hr.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#8 Riffle 40 ft	4	3	0	2	2	2	0	0	2	1	0	1	11.3	7.8	0	2	0	9.8
#9 Run 74 ft	11	4	1	7	4	4	0	0	3	1	0	0	19.8	14	1	7	0	21
#15 Long Pool Snorkel 357 ft	5 Max.	0 Three	0 Passes	5									5	0	0	5	0	5
#17 Short Pool Snorkel 109 ft	11 Max.	0 Three	6 Passes	17									11	0	6	15	2	17
All Habitats Combined 580 ft													47.1	21.8	7	29	2	52.8

Length of Stream Sampled (ft): 580 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0812/.0376
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0121/0.0534
Total Density: 0.0910

Steelhead Sampling Results

Date:21Sep11/09Sep11 Stream: SLR Sampled by: Alley, Steiner, Kittleson, Wheeler

Sampling Site: 8 (below Clear Creek) Water Temperature and Times: 63°F @ 1541hr, 09Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/ Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#9-10 Riffle 75 ft	24	16	0	8	4	3	0	1	1	0	0	1	29.1	19.3	0	10	0	29.3
#11 Run 55 ft	12	10	0	2	6	5	1	2	0	0	0	0	20	16.7	1	4	0	20.7
#16 Short Pool snorkel 163 ft													3 Max.	0 Three	0 Passes	3	0	3
#24 Long Pool snorkel 326 ft													4 Avg.	0 Three	0 Passes	4	0	4
All Habitats Combined 619 ft													56.1	36	1	21	0	57

Length of Stream Sampled (ft): 619 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0906/ 0.0582
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0016/ 0.0339
Total Density: 0.0921

Steelhead Sampling Results

Date: 06Sep11 Stream: SLR Sampled by: Alley, Steiner

Sampling Site: 11 (above Teihl Rd) Water Temp. and Times:

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#21 Run- 45 ft	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1
#23 Riffle- 10 ft	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1
#22 Pool- 61 ft	6	1	0	5	2	0	0	2	0	0	1	1	8.4	1	1	8.6	0	9.6
#24 Pool- 44 ft	0	0	0	0	3	1	0	2	0	0	0	0	3	1	0	2	0	3
All Habitats Combined 160 ft													13.4	2	1	12.6	0	14.6

Length of Stream Sampled (ft): 160 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0838/ 0.0125
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0063/ 0.0788
Total Density: 0.0913

Steelhead Sampling Results

Date: 09Sep11 **Stream:** Zayante **Sampled by:** Alley, Steiner, Wheeler

Sampling Site: 13a (below Bean Creek) **Water Temperature and Times:** 58 °F @ 1000 hr.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#17 Riffle 18 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#19&20 Pool 192 ft	5	1	1	5	2	0	0	2	1	0	1	2	8.6	1	2	11	0	12
#18 Run 80 ft	0	0	2	2	0	0	0	0	1	0	0	1	1	0	2	2	1	3
All Habitats Combined 290 ft													7.6	1	4	13	1	15

Length of Stream Sampled (ft): 290 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0262/ 0.0034
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0138/ 0.0483
Total Density: 0.0517

Steelhead Sampling Results

Date: 12Sep11 **Stream:** Zayante **Sampled by:** Alley, Steiner, Wheeler, Moss

Sampling Site: 13c (below Lompico Ck) **Water Temp. and Times:** 59.5°F @ 1304 hr, 12Sep11. 65°F @ 1914 hr, 24Aug11. (air temp. 70°F)

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#40 Run 20 ft	9	6	1	4	1	1	0	0	0	0	0	0	10.1	7.1	1	4	0	11.1
#42 Run 22 ft	2	0	0	2	2	0	0	2	0	0	0	0	4	0	0	4	0	4
#41 Pool 135 ft	22	15	7	14	15	10	7	12	8	4	2	6	60.1	36.2	25.3	48.8	1.6	86.6
#43 Pool 81 ft	29	16	1	14	2	2	0	0	5/4	2/1	0	3/3	40	21	1	20	0	41
#39 Riffle 21 ft	7	5	1	3	0	0	0	0	0	0	0	0	7	5	1	3	0	8
All Habitats Combined 279 ft													121.2	69.3	28.3	79.8	1.6	150.7

Length of Stream Sampled (ft): 279 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4344/ 0.2484
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.1014/ 0.2918
Total Density: 0.5401

Steelhead Sampling Results

Date: 12Sep11 **Stream:** Zayante **Sampled by:** Alley, Steiner, Wheeler

Sampling Site: 13d (below Mountain Charlie Gulch) **Water Temp. and Times:** 59.5°F @ 1402 hr, 09Sep10. 61.5°F @ 1442 hr, 27Aug11. (Air temp. 72.5°F)

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/ Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#5 Run 45 ft	9	5	1	5	2	2	0	0	1	1	0	0	12.1	8.6	1	5	0	13.6
#13 Run 11 ft	1	0	0	1	1	0	0	1	0	0	0	0	2	0	0	2	0	2
#3&4 Pool 55 ft	10	6	0	4	7	6	0	1	1	1	0	0	21.9	19.7	0	5.1	0	24.8
#12 Pool 88 ft	12	4	2	10	2	1	0	1	1	1	0	0	15	6.3	2	11.1	0	17.4
All Habitats Combined 199 ft													51	34.6	3	23.2	0	57.8

Length of Stream Sampled (ft): 199 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2563/ 0.1739

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0151/ 0.1166

Total Density: 0.2905

Steelhead Sampling Results

Date: 8Sep11 **Stream:** Lompico **Sampled by:** Alley, Marty

Sampling Site: 13e (below turnout) **Water Temp. and Times:**

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#42 Pool 67 ft	3	2	3	4	6	5	0	1	3/0	1/0	1/0	3/0	12	8	4	8	0	16
#44 Pool 48 ft	4	3	2	3	3	3	0	0	0	0	0	0	8.8	6	2	3	0	9
#43 Riffle 12 ft	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
#46 Step-run 56 ft	3	1	0	2	1	0	0	1	0	0	0	0	4.2	1	0	3.3	0	4.3
All Habitats Combined 183 ft													26	16	6	14.3	0	30.3

Length of Stream Sampled (ft): 183 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1421/ 0.0874
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0328/ 0.0781
Total Density: 0.1657

Steelhead Sampling Results

Date: 13Sep11 Stream: Bean Ck Sampled by: Alley, Steiner, Moss
Sampling Site: 14b (below Lockhart Gulch.) Water Temp. and Times: 59°F @ 1017 hr, 13Sep11. 60°F @ 1917 hr, 31Aug11. (air temp. 62°F)

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#39 Run 38 ft	2	1	0	1	2	2	0	0	0	0	0	0	4	3	0	1	0	4
#40 Riffle 60 ft	3	2	1	2	0	0	0	0	1	1	0	0	4	3	1	2	0	5
#41 Pool 158 ft	18	13	9	14	7	6	0	1	2	1	0	1	28.6	21.7	9	12	4	37.7
All Habitats 256 ft													36.6	27.7	10	15	4	46.7

Length of Stream Sampled (ft): 256 ft
Young-of-the-Year/ Size Class 1 per Ft of Stream: 0.1430/ 0.1082
Yearlings and 2+/ Size Classes 2 and 3 per Ft of Stream: 0.0391/ 0.0742

Total Density: 0.1824

Steelhead Sampling Results

Date: 13Sep11 Stream: Bean Ck Sampled by: Alley, Steiner, Moss, Kittleson
Sampling Site: 14c (below Lockhart Gulch.) Water Temp. and Times: 62°F @ 1615 hr.

62°F @ 1430 hr, 29Aug11. (Air temp. 72°F)

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#10 Run 68 ft	1	1	0	0	2	2	0	0	0	0	0	0	3	3	0	0	0	3
#11 Riffle 15 ft	10	10	0	0	3	3	0	0	1	1	0	0	14.4	14.4	0	0	0	14.4
#9 Riffle 28 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#12 Pool 48 ft	41	38	2	5	0	0	0	0	0	0	0	0	41	38	2	4	1	43
#8 Pool 115 ft	12	0	2	14	3	0	0	3	1	0	1	2	16.2	0	3	19.2	0	19.2
All Habitats 274 ft													74.6	55.4	5	23.2	1	79.6

Length of Stream Sampled (ft): 274 ft
Young-of-the-Year/ Size Class 1 per Ft of Stream: 0.2723/ 0.2022
Yearlings and 2+/ Size Classes 2 and 3 per Ft of Stream: 0.0182/ 0.0883
Total Density: 0.2905

Steelhead Sampling Results

Date: 15Sep11 **Stream:** Fall Ck **Sampled by:** Alley, Steiner, Wheeler

Sampling Site: 15 (above Highway 9) **Water Temp. and Times:** 56° F @ 1050 hr. 15Sep11; 57° F @ 1224 hr. 25Aug11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#9 Riffle 67 ft	13	11	0	2	12	10	0	2	2	2	0	0	27	23	0	4	0	27
#8 Pool 18 ft	13	12	3	4	3	3	2	2	1	1	0	0	17.2	16.2	6	5.6	1.1	22.9
#20 Pool 31 ft	20	15	4	9	9	8	0	1	2	2	0	0	33.5	28.1	4	8.1	2	38.2
#18 Run 39 ft	25	23	0	2	6	6	0	0	2	2	0	0	33.4	31.5	0	2	0	33.5
All Habitats Combined 155 ft													111.1	98.8	10	19.7	3.1	121.6

Length of Stream Sampled (ft): 155 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.7168/0.6374

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0645/ 0.1471

Total Density: 0.7845

Steelhead Sampling Results

Date: 15Sep11 **Stream:** Newell Ck **Sampled by:** Alley, Steiner, Wheeler

Sampling Site: 16 **Water Temp. and Times:** 59°F @ 1545 hr. 15Sep11. 59°F @ 1118 hr, 24Aug11. (Air temp. 73°F)

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#30 Riffle 23 ft	1	0	0	1	1	1	0	0	0	0	0	0	2	1	0	1	0	2
#27 Pool 113 ft	13	0	1	14	3	0	0	3	1	0	0	1	17.2	0	1	17.1	1	18.1
#31 Pool 124 ft	5	0	1	6	3	0	0	3	2	0	0	2	13.2	0	1	13.2	0	13.2
#26 Run (partial) 56 ft	5	0	0	5	1	0	0	1	3	0	0	3	9	0	0	9	0	9
All Habitats Combined 316 ft													41.4	1	2	40.3	1	42.3

Length of Stream Sampled (ft): 316 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1310/0.0032
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0063/ 0.1307
Total Density: 0.1339

Steelhead Sampling Results

Date: 16Sep11 **Stream:** Boulder Ck **Sampled by:** Alley, Steiner, Reis

Sampling Site: 17a (above Highway 9) **Water Temp. and Times:** 57° F @ 0948 hr. 16Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#6 Riffle 16 ft	3	2	1	2	1	0	0	1	0	0	0	0	4.2	2	1	3.3	0	5.3
#5 Pool 130 ft	6	5	2	3	2	1	1	2	3/1	2/0	0/0	1/1	12	8	3	5	2	15
#8 Pool 42 ft	6	4	2	4	2	1	0	1	0	0	0	0	8.4	5.1	2	4.1	1	10.2
#7 Run 51 ft	8	1	1	8	4	3	0	1	2	1	0	1	16	5	1	10	0	15
All Habitats Combined 239 ft													40.6	20.1	7	22.4	3	45.5

Length of Stream Sampled (ft): 239 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1699/0.0841
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0293/ 0.1063
Total Density: 0.1904

Steelhead Sampling Results

Date: 16Sep11 **Stream:** Boulder Ck **Sampled by:** Alley, Steiner, Reis

Sampling Site: 17b (Bracken Brae) **Water Temp. and Times:** 57.5° F @ 1353 hr, 16Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#22 Step-run 46 ft	12	10	0	2	7	5	0	2	2	1	0	1	24.3	17.7	0	5	0	22.7
#31 Riffle/ 63 ft	9	6	1	4	3	3	0	0	2	1	0	1	14.9	11.1	1	5	0	16.1
#30 Pool 34 ft	22	12	2	12	6	6	0	0	4	3	0	1	33	24	2	13.2	0	37.2
#32 Pool 28 ft	5	5	0	0	1	1	0	0	1	1	0	0	7.2	7.2	0	0	0	7.2
All Habitats Combined 171 ft													79.4	60	3	23.2	0	83.2

Length of Stream Sampled (ft): 171 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4643/0.3509
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0175/ 0.1357
Total Density: 0.4865

Steelhead Sampling Results

Date: 06Sep11 **Stream:** Bear Ck **Sampled by:** Alley, Steiner, Wheeler

Sampling Site: 18a (above and below Hopkins Gulch) **Water Temp. and Times:** 60° F @ 1650 hr, 06Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#5 Riffle 15 ft	5	4	0	1	0	0	0	0	1	1	0	0	6.7	6	0	1	0	7
#4 Pool 151 ft	21	11	0	10	5	4	0	1	2/2	1/1	1/1	2/2	30	17	2	14	1	32
#7 Pool 33 ft	12	10	0	2	2	2	0	0	0	0	0	0	14.2	12.2	0	2	0	14.2
#6 Run 30 ft	16	13	0	3	1	1	0	0	0	0	0	0	17	14	0	3	0	17
#8 Run 57 ft	14	8	0	6	1	1	0	0	0	0	0	0	15	9.7	0	6	0	15.7
All Habitats Combined 286 ft													82.9	58.9	2	26	1	85.9

Length of Stream Sampled (ft): 286 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2899/ 0.2059
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0070/ 0.0944
Total Density: 0.3003

Steelhead Sampling Results

Date: 8Sep11 **Stream:** Branciforte Ck **Sampled by:** Alley, Marty

Sampling Site: 21a-2 (below Granite Ck) **Water Temp. and Times:**

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#25 Riffle 22 ft	0	0	0	0	3	1	1	3	3/1	2/1	0	0/1	7	4	1	4	0	8
#21 Pool 59 ft	8	5	2	5	4	2	1	3	0	0	0	0	13.3	7.5	3.3	7	2.3	16.8
#22 Pool 103 ft	19	10	3	12	3	1	0	2	3/1	1/1	0	2/0	26	13	3	13	3	29
#24 Run 31 ft	0	0	0	0	0	0	0	0					0	0	0	0	0	0
All Habitats Combined 215 ft													46.3	24.5	7.3	24	5.3	53.8

Length of Stream Sampled (ft): 215 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2153/ 0.1140
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0340 / 0.1363
Total Density: 0.2502

Steelhead Sampling Results

Date: 19Sep11 **Stream:** Soquel Ck **Sampled by:** Alley, Steiner, Wheeler, Moss
Sampling Site: 1 below Grange **Water Temp. and Times:** 58° F @ 0922 hr. 19Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#17 Run 40 ft	2	0	0	2	1	0	0	1	1	0	0	1	4	0	0	4	0	4
#19 Riffle 49 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#18 Pool 364 ft	4	0	2	2	2	0	2	4	2	0	0	2	4	0	4	5	3	8
All Habitats Combined 453 ft													8	0	4	9	3	12

Length of Stream Sampled (ft): 453 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0177/ 0.0
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0088/ 0.0265
Total Density: 0.0265

Steelhead Sampling Results

Date: 19Sep11 Stream: Soquel Ck Sampled by: Alley, Steiner, Wheeler, Moss
Sampling Site: 4 Adjacent Flower Field. Water Temp. and Times: 64 F @ 1307 hr 19Sep11. 63 F @ 1338 hr 07Sep11. Air temp. 78 F 07Sep11

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#17 Run 49 ft	2	0	0	2	1	0	0	1	1	0	0	1	4	0	0	4	0	4
#19 Riffle 70 ft	1	0	0	1	2	0	0	2	0	0	0	0	3	0	0	3	0	3
#15 Pool 164 ft	2	0	2	4	2	0	0	2	0	0	2	2	4	0	4	2	6	8
All Habitats Combined 283 ft													11	0	4	9	6	15

Length of Stream Sampled (ft): 283 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0389/ 0.0
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0141/ 0.0530

Total Density: 0.0530

Steelhead Sampling Results

Date: 17Oct11 Stream: Soquel Ck Sampled by: Alley, Steiner, Reis
Sampling Site: 10 (Above Allred) Water Temp. and Times: 57° F @ 1015 hr, 17Oct11

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#22 Run 54 ft	2	0	0	2	0	0	0	0	0	0	0	0	2	0	0	2	0	2
#27 Pool 250 ft	7	0	1	8	1	0	0	1	0	0	1	1	8.1	0	2	8	2	10
#24 Riffle 35 ft	5	0	0	5	2	0	0	2	0	0	0	0	7.5	0	0	7.5	0	7.5
All Habitats Combined 339 ft													17.7	0	2	17.5	2	19.5

Length of Stream Sampled (ft): 339 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0522/ 0.0
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0059/ 0.0575

Total Density: 0.0575

Steelhead Sampling Results

Date: 20Sep11 Stream: Soquel Ck Sampled by: Alley, Steiner, Reis
Sampling Site: 12 Soquel Creek Rd Water Temp. and Times: 63° F @ 1437 hr. 20Sep11. 60°F @ 1348 hr. 30Aug11. Air temp. 66.5°F 30Aug11

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#7 Pool 131 ft	2	0	0	2	1	0	2	3	1	0	1	2	4	0	3	6	1	7
#8 Run 58 ft	3	0	0	3	0	0	0	0	0	0	0	0	3	0	0	3	0	3
#9 Riffle 45 ft	2	0	1	3	0	0	0	0	1	1	0	0	3	1	1	3	0	4
All Habitats Combined 234 ft													10	1	4	12	1	14

Length of Stream Sampled (ft): 234 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0427/ 0.0043
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0171/ 0.0556

Total Density: 0.0598

Steelhead Sampling Results

<u>Date:</u> 20Sep11 <u>Stream:</u> E. Br. Soquel Ck <u>Sampled by:</u> Alley, Steiner, Reis
<u>Sampling Site:</u> 13a (Below Millpond) <u>Water Temp. and Times:</u> 59°F @ 1030 hr, 20Sep11. 63°F @ 1705 hr, 30Aug11. Air temp. 64°F 30Aug11

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#20 Riffle 96 ft	6	1	0	5	3	0	0	3	1	0	0	1	11.1	1	0	10.6	0	11.6
#22 Run 67 ft	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1
#21 Pool 79 ft	4	1	0	3	4	0	1	5	2/0	0/0	3/0	5/0	10	1	4	11	2	14
#25 Pool 50 ft	1	0	2	3	1	0	1	2	0	0	1	1	2	0	4	4	2	6
All Habitats Combined 292 ft													24.1	2	8	25.6	4	32.6

Length of Stream Sampled (ft): <u>292 ft</u>
Young-of-the-Year / Size Class 1 per Foot of Stream: <u>0.0825/ 0.0068</u>
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: <u>0.0274/ 0.1014</u>

Total Density: <u>0.1116</u>

Steelhead Sampling Results

Date: 22Sep11 Stream: E. Br. Soquel Ck Sampled by: Alley, Steiner, Reis
Sampling Site: 16 (Below Long Ridge Rd) Water Temp. and Times: 60° F @ 1345 hr, 22Sep11. 64°F @ 1418 hr 02Sep11. Air temp. 70.5°F 02Sept11

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#4 Pool 55 ft	8	6	1	3	2	1	0	1	0	0	0	0	10.3	7.1	1	4.2	0	11.3
#32 Pool 110 ft	37	24	3	16	7	6	1	2	2	2	1	1	46.2	32.5	5.7	18	1	51.5
#39 Step-run (partial) 90 ft	24	15	4	13	1	0	1	2	2	2	1	1	27	17.7	6.3	16	0	33.7
All Habitats Combined 255 ft													83.5	57.3	13	38.2	1	96.5

Length of Stream Sampled (ft): 255 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.3275/ 0.2247
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0510/ 0.1537

Total Density: 0.3784

Steelhead Sampling Results

Date: 19Sep11 Stream: W. Br. Soquel Ck Sampled by: Alley, Steiner, Wheeler, Moss
Sampling Site: 19 (below Hester) Water Temp. and Times: 62° F @ 1628 hr, 19Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#17 Run 41 ft	6	4	1	3	2	1	0	1	1	0	0	1	9.4	5.1	1	5.7	0	10.8
#18 Riffle 44 ft	7	4	0	3	5	1	0	4	0	0	0	0	14.8	5.1	0	7	0	12.1
#19 Pool 206 ft	33	9	5	29	7	2	1	6	1	0	0	1	41.5	11.3	6.1	32.4	4	47.7
All Habitat 291 ft													65.7	21.5	7.1	45.1	4	70.6

Length of Stream Sampled (ft): 291 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2258/ 0.0739
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0244/ 0.1687

Total Density: 0.2426

Steelhead Sampling Results

Date: 17Oct11 Stream: W. Br. Soquel Ck Sampled by: Alley, Steiner, Reis
Sampling Site: 21 (above Girl Scout Falls I) Water Temp. and Times: 59° F @ 1455 hr, 17Oct11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass/Fourth				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#4 Riffle (Step-run in 2010) 21 ft	2	2	1	1	0	0	0	0	0	0	0	0	2	2	1	1	0	3
#2 Riffle 8 ft	2	0	0	2	1	1	0	0	0	0	0	0	3	1	0	2	0	3
#3 Pool 127 ft	3	0	3	6	1	0	0	1	1	0	0	1	5.7	0	3	5.1	3	8.1
#5 Pool 86 ft	15	0	1	16	2	0	0	2	1	0	0	1	18	0	1	19	0	19
All Habitat 242 ft													28.7	3	5	27.1	3	33.1

Length of Stream Sampled (ft): 242 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1186/ 0.0124
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0207/ 0.1244

Total Density: 0.1368

Steelhead Sampling Results

Date: 28Sep11 Stream: Aptos Ck Sampled by: Alley, Reis, Moss
Sampling Site: 3 (Adj. County Park) Water Temp. and Times: 59° F @ 1000 hr, 28Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#27 Pool 172 ft	9	3	3	9	8	3	1	6	2/0	0/0	0/0	2/0	19	6	4	15	2	23
#44 Run 64 ft	2	1	0	1	0	0	0	0	0	0	0	0	2	1	0	1	0	2
#21 Riffle 45 ft	4	2	0	2	0	0	0	0	0	0	0	0	4	2	0	2	0	4
All Habitats Combined 281 ft													25	9	4	18	2	29

Length of Stream Sampled (ft): 281 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0890/ 0.0320
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0142/ 0.0712
Total Density: 0.1032

Steelhead Sampling Results

Date: 28Sep11 Stream: Aptos Ck Sampled by: Alley, Reis, Moss
Sampling Site: 4 (Above Steel Bridge) Water Temp. and Times: 62° F@ 1625 hr, 28Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#37 Pool 108 ft	15	0	4	19	11	3	0	8	3	0	0	3	36.7	3	4	30.1	2.2	35.3
#42 Pool 84 ft	3	2	3	4	6	4	0	2	1	1	0	0	10	7	3	5	1	13
#41 Riffle 58 ft	5	2	0	3	3	0	0	3	0	0	0	0	8	2	0	6	0	8
#40 Run 34 ft	3	2	1	2	1	0	0	1	0	0	0	0	4	2	1	2	1	5
All Habitats Combined 284 ft													58.7	14	8	43.1	4.2	61.3

Length of Stream Sampled (ft): 284 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2067/ 0.0493
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0282/ 0.1665
Total Density: 0.2158

Steelhead Sampling Results

Date: 29Sep11 Stream: Corralitos Ck Sampled by: Alley, Steiner, Reis.
Sampling Site: 1 (below dam) Water Temp. and Times: 59° F @ 0955hr, 29Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#25 Pool 69 ft	12	7	1	6	3	2	0	1	1	1	0	0	16.2	10.3	1	7.1	0	17.4
#32 Pool 52 ft	5	2	2	5	1	0	0	1	1	1	0	0	7.2	3	2	5.1	1	9.1
#33 Riffle 32 ft	2	2	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	2
#26 Run (partial) 73 ft	7	3	0	4	1	1	0	0	0	0	0	0	8.1	4.2	0	4	0	8.2
All Habitats Combined 226 ft													33.5	19.5	3	16.2	1	36.7

Length of Stream Sampled (ft): 226 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1482/ 0.0863
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0133/ 0.0761
Total Density: 0.1624

Steelhead Sampling Results

Date: 29Sep11 Stream: Corralitos Ck Sampled by: Alley, Steiner, Reis
Sampling Site: 3 (above Colinas Drive) Water Temp. and Times: 61.5° F @ 1255 hr, 29Sep11. 56°F @ 0945 hr 01Sep11. Air temp. 59°F 01Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#6 Pool 54 ft	20	13	3	10	1	1	0	0	0	0	0	0	21	14	3	8	2	24
#11,12 & 13 Pool 143 ft	11	8	2	5	1	0	0	1	1	1	0	0	13	9.3	2	4.1	2	15.4
#8 Riffle 30 ft	2	2	0	0	1	1	0	0	0	0	0	0	3	3	0	0	0	3
#9 Run 47 ft	2	0	0	2	0	0	0	0	0	0	0	0	2	0	0	2	0	2
All Habitats Combined 274 ft													39	26.3	5	14.1	4	44.4

Length of Stream Sampled (ft): 274 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1423/ 0.0960
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0182/ 0.0661
Total Density: 0.1620

Steelhead Sampling Results

Date: 30Sep11 Stream: Corralitos Ck Sampled by: Alley, Wheeler, Steiner
Sampling Site: 8 (above Clipper Gulch) Water Temp. and Times: 58° F @ 0956 hr, 30Sep11. 59°F @ 1351 hr 01Sep11. Air temp. 68°F 01Sep11

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#38 Pool 46 ft	11	7	5	9	2	0	1	3	3/1	3/0	0/0	0/1	17	10	6	11	2	23
#40&41 Pool 75 ft	19	14	1	6	5	4	0	1	4	4	0	0	29.1	23.7	1	7.1	0	30.8
#42 Step-run 54 ft	7	5	0	2	3	3	1	1	0	0	0	0	10.8	9.3	1	2.2	1.1	12.6
#39 Riffle (partial) 32 ft	4	2	0	2	0	0	0	0	0	0	0	0	4	2	0	2	0	4
All Habitats Combined 207 ft													60.9	45	8	22.3	3.1	70.4

Length of Stream Sampled (ft): 207 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2942/ 0.2174
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0386/ 0.1227

Total Density: 0.3401

Steelhead Sampling Results

Date: 30Sep11 **Stream:** Corralitos Ck **Sampled by:** Alley, Wheeler, Steiner
Sampling Site: 9 (above Eureka Gulch) **Water Temp. and Time:** 58.5° F @ 1313 hr, 30Sep11. 58°F @ 1714 hr, 01Sep11. Air temp. 65°F @ 1714 hr 01Sep11

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#58 Step-Pools 92 ft	24	16	3	11	5	3	0	2	1	1	0	0	30.3	20	3	13.2	0	33.2
#60 Pool 60 ft	27	19	2	10	3	2	0	1	1	1	0	0	31	22	2	11.1	0	33.1
#57 Step-run 36 ft	5	4	2	3	2	2	0	0	0	0	0	0	7.5	6.7	2	3	0	9.7
#59 Step-run 48 ft	8	6	5	7	2	2	0	0	0	0	0	0	10.3	8.4	5	6	1	15.4
All Habitats Combined 236 ft													79.1	57.1	12	33.3	1	91.4

Length of Stream Sampled (ft): 236 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.3352/ 0.2419
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0508/ 0.1453
Total Density: 0.3873

Steelhead Sampling Results

Date: 04Oct11 Stream: Shingle Mill Gulch Sampled by: Alley, Steiner, Reis
Sampling Site: 1 (below 2nd Road crossing) Water Temp. and Times: 57°F @ 1621hr, 04Oct11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#67 Pool 11 ft	3	2	1	2	0	0	0	0	0	0	0	0	3	2	1	2	0	4
#69 Pool 20 ft	4	4	1	1	0	0	0	0	0	0	0	0	4	4	1	1	0	5
#71 Pool 19 ft	6	6	2	2	0	0	0	0	0	0	0	0	6	6	2	2	0	8
#65 Riffle 15 ft	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	1
#68 Step-run 32 ft	2	2	1	1	1	1	0	0	0	0	0	0	3.3	3.3	1	1	0	4.3
#70 Step-run 45 ft	5	5	4	4	0	0	0	0	0	0	0	0	5	5	4	4	0	9
All Habitats Combined 142 ft													22.3	21.3	9	10	0	31.3

Length of Stream Sampled (ft): 142 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1570/ 0.15
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0634/ 0.0704
Total Density: 0.2204

Steelhead Sampling Results

Date: 30Sep11 **Stream:** Shingle Mill Gulch **Sampled by:** Alley, Steiner, Reis
Sampling Site: 3 (above 3rd road crossing) **Water Temp. and Times:** 58° F @ 1616hr, 30Sep11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#49 Pool 19 ft	2	2	0	0	1	1	1	1	0	0	0	0	3.3	3.3	1	1	0	4.3
#51 Pool 46 ft	5	5	4	4	1	1	0	0	0	0	0	0	6.1	6.1	4	4	0	10.1
#53 Pool 36 ft	3	3	3	3	2	2	2	2	0	0	0	0	6	6	6	5	1	12
#50 Riffle 30 ft	2	2	1	1	0	0	0	0	0	0	0	0	2	2	1	1	0	3
#52 Run 20 ft	3	3	0	0	1	1	0	0	0	0	0	0	4.2	4.2	0	0	0	4.2
All Habitats Combined 151 ft													21.6	21.6	12	11	1	33.6

Length of Stream Sampled (ft): 151 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1430/ 0.1430
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0795/ 0.0795
Total Density: 0.2225

Steelhead Sampling Results

Date: 04Oct11 Stream: Browns Valley Ck Sampled by: Alley, Steiner, Reis
Sampling Site: 1 (below diversion dam) Water Temp. and Times: 58° F @ 1014hr, 04Oct11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#1 Pool 76 ft	25	20	3	8	4	2	0	2	4	3	0	1	33.2	25	3	11.2	0	36.2
#3 Pool 55 ft	17	12	4	9	5	3	0	2	2	1	0	1	24.6	16.2	4	11.1	1	28.3
#4b Run 34 ft	5	5	0	0	2	2	0	0	1	1	0	0	8.6	8.6	0	0	0	8.6
#4a Riffle-43 ft	4	2	0	2	3	3	0	0	1	1	0	0	8	6	1	2	0	8
All Habitats Combined 178 ft													74.4	55.8	8	24.3	1	81.1

Length of Stream Sampled (ft): 178 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4180/ 0.3135
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0449/ 0.1421
Total Density: 0.4556

Steelhead Sampling Results

Date: 04Oct11 **Stream:** Browns Valley Ck **Sampled by:** Alley, Reis, Steiner
Sampling Site: 2 (above diversion dam) **Water Temp. and Times:** 58° F @ 1354hr, 04Oct11.

Habitat type & Length (ft)	First Pass				Second Pass				Third Pass				Number Est. / Density Est. per ft					
	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	YOY	C-1	1+	C-2	C-3	Total
#32 Pool 65 ft	20	18	3	5	9	7	0	2	1	1	0	0	32.5	27.5	3	6.4	1.1	35
#36 Pool 36 ft	16	12	3	7	4	3	0	1	1	0	0	1	21.3	15.4	3	8	1	24.4
#31 Run 22 ft	1	1	0	0	3	3	0	0	0	0	0	0	4	4	0	0	0	4
#30 Riffle 16 ft	5	3	0	2	0	0	0	0	0	0	0	0	5	3	0	2	0	5
All Habitats Combined 139 ft													62.8	49.9	6	16.4	2.1	68.4

Length of Stream Sampled (ft): 139 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4518/ 0.3590
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0432/ 0.1331

Total Density: 0.4921

APPENDIX D. Habitat and Fish Sampling Data With Size Histograms.
(Included electronically in a separate PDF file.)

APPENDIX E. Hydrographs from San Lorenzo, Soquel and Corralitos Watersheds.
(Included electronically in a separate PDF file.)