D.W. ALLEY & Associates aquatic biology

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

Boulder Creek Sub-Watershed– Photo by Brian Steen of the Sempervirens Fund (2007)

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REPORT SUMMARY

Most Significant Findings in 2007

In All Watersheds:

- There was a reduction in fastwater habitat and depth with less streamflow; this resulted in a significant loss of habitat quality in the mainstem San Lorenzo where most juvenile steelhead utilize fastwater habitat to feed on drifting insects.

- There was a smaller proportion of young-of-the-year (YOY) steelhead growing into Size Class II after a winter/spring of relatively low streamflow that slowed growth rate.

In the San Lorenzo River Watershed:

- There was a general improvement in streambed conditions compared to 2006, with reduced percent fines and less embeddedness. Escape cover was similar to 2006 in tributary pools, but was generally less in preferred mainstem fast-water habitat because of reduced streamflow (except improvement in Reach 4 in Henry Cowell Park).

- Site densities of important larger juveniles (smolt-sized, Size Class II/III and yearlings) were far below average at all sites except where high numbers of small YOY were present in 2006 (upper Zayante, Lompico and upper Boulder creeks) and over-winter survival was high.

- The highest YOY site densities were found in Zayante, Lompico and lower Boulder creek tributaries, with the Lompico Creek site having the highest density in the watershed.

- *In Bean Creek (tributary to Zayante Creek)*–There were no YOY fish at one site and low YOY densities at the other due to low streamflow at sites and extensive dry streambed between the Ruins Creek confluence and a point upstream of the Mackenzie Creek confluence. The dry segment was between sampling sites.

In the Soquel Creek Watershed:

- There were above average YOY densities (and presumably more spawning activity) in the lower watershed and below average YOY densities in the upper watershed (and presumably due to limited spawning activity), possibly due to adult fish passage problems in the dry winter. YOY densities were especially low at the Soquel Demonstration State Forest (SDSF) site, where streamflow was only a trickle.

- Overall habitat quality was similar to 2006, Reduced streamflow reduced water velocity and insect drift rate, but streambed conditions improved throughout the watershed and pool escape cover was similar to 2006 at most sites. Pool depth declined substantially at upper branch sites only, especially in the SDSF, where there was an increase in pool frequency resulting from reduced streamflow, increase in habitat breaks and some 2006 step-run/ run habitat becoming pool habitat in 2007. Pool sedimentation also likely occurred on the West Branch.

- A relatively large, previously PIT-tagged yearling steelhead was captured on 21 September 2007 at Site 12 in Reach 8 of the mainstem (just downstream of the Soquel Creek Road Bridge). It was first tagged the previous September as a YOY at the NOAA Fisheries site at Badger Springs in the Soquel Demonstration State Forest (SDSF) on the East Branch, a distance of more than 5 miles upstream. This fish grew faster and was much larger than the recaptured, tagged fish that stayed near their tagged location in the SDSF.

- *In the SDSF site (upper East Branch Soquel Creek*)– The 2007 density of Size Class II and yearling juveniles was the highest ever detected. There was a high density of small YOY in 2006, and the mild winter apparently improved over-winter survival. Two previously PIT-tagged yearling steelhead were captured in a pool, 758 feet downstream of the Long Ridge crossing on 3 October 2007. One was tagged the previous September as a YOY at the NOAA Fisheries site above Long Ridge crossing. The other was tagged the previous December as a YOY at the NOAA Fisheries site at Badger Springs, upstream of the Long Ridge site, within ½-mile of the capture pool.

- *In West Branch Soquel* – Juvenile numbers indicated that adult steelhead passed Girl Scout Falls I on West Branch Soquel, as they are usually able to do. It is not known whether fish were able to ascend Girl Scout Falls II because the site above it was not sampled in 2007.

<u>In the Aptos Creek Watershed:</u>

- There were above average YOY densities (and presumably greater spawning activity) at lower sites and below average YOY densities at the upper sites, indicating adult passage restriction to upper Aptos and adult blockage to upper Valencia.

- There was improved habitat quality compared to 2006, with generally improved streambed conditions, more pool escape cover and similar pool depths. An exception was at the lower Aptos site, where pool escape cover was similar to 2006, but pool depth was substantially shallower due to an increase in pool frequency resulting from reduced streamflow, increase in habitat breaks and some 2006 step-run/ run habitat becoming pool habitat in 2007.

- *In upper Aptos and lower Valencia creek sites* – There were above average densities of larger juveniles (yearlings); most YOY in 2006 had been small at those sites and over-winter survival was likely high due to few winter storms.

In the Corralitos Creek Sub-watershed:

- The densities of larger juveniles were generally below or near average. The exception was at the upper Browns Valley site where high numbers of small YOY were found in 2006 and had good over-winter survival due to few winter storms.

- YOY densities were below average at all sites except the 2 lower Corralitos sites.

- The was a general decline in habitat quality compared to 2006 due to less streamflow that reduced habitat depth (particularly pool and step-run habitat in the upper watershed) and reduced water velocity and insect drift.

- There were improved streambed conditions and increased pool escape cover to the extent that the 2 lower Corralitos sites had similar habitat quality to 2006, despite lower streamflow.

Smolt habitat at sampling sites was rated, based on smolt-sized (=>75 mm SL) juvenile steelhead density according to the rating scheme developed by Smith (**1982**). (Note: the scheme was applied to all sites, and lower San Lorenzo sites were rated very good and excellent in 1981.) This rating scheme assumed that rearing habitat was usually near saturation with smolt-sized juveniles, at least in tributaries where 2 years are usually required to reach smolt size, and also assumed that spawning rarely limited juvenile steelhead abundance, except at sites with very poor spawing and/or dependent upon fry movement from upstream tributaries. These assumptions may not have been met in 2007 in many of the mainstem reaches of the San Lorenzo River and lower reaches of Zayante and Boulder creeks, where 2006 YOY growth rates were high and a high rate of smolting by yearlings likely occurred in spring 2007 and where 2007 YOY densities were below average. In particular, low stream flows may have reduced YOY movement from tributaries to the mainstem. Streamflows were too low to grow many YOY in the middle mainstem to smolt size. Lower Aptos and all Corralitos sites were probably below carrying capacity for larger juveniles for the same reasons of fewer yearling holdovers and slow YOY growth.

Refer to the following summary table for smolt-sized juvenile densities and ratings. Figures 3, 6, 9 and 12 have been excerpted from the main report to compare 2007 smolt densities to averages calculated from all monitoring years of data.

Table 41. Sampling Sites in 2007 in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds Rated by Smolt-Sized Juvenile Density (=>75 mm SL), with Average Density and Habitat Change. (Red denotes rating of poor or very poor.)

Site	Avg. Density (Smolts/100 ft)	2007 Density (Smolts/100 ft)	2007 Smolt Habitat Rating	Numerical Rating (1 to 7)	Habitat Change Since 2006
Low. San Lorenzo #1	12.3 (n=7)	1.6	Very Poor	*	–
Low. San Lorenzo #2	19.5 (n=6)	11.1	Fair	****	No 2006 data
Low. San Lorenzo #4	18.9 (n=7)	5.2	Below Average	***	+
Mid. San Lorenzo #6	5.0 (n=10)	1.2	Very Poor	*	–
Mid. San Lorenzo #8	7.6 (n=10)	0.7	Very Poor	*	–
Up. San Lorenzo #11	7.7 (n=10)	0.6	Very Poor	*	Similar
Zayante #13a	10.9 (n=9)	4.9	Below Average	***	–
Zayante #13c	12.7 (n=9)	8.8	Fair	****	No 2006 data
Zayante #13d	17.7 (n=9)	17.4	Good	*****	–
Lompico #13e	8.5 (n=2)	11.3	Fair	****	–
Bean #14b	14.9 (n=10)	8.9	Fair	****	No 2006 data
Bean #14c	13.0 (n=9)	5.4	Below Average	***	–
Boulder #17a	12.5 (n=10)	6.8	Below Average	***	–
Boulder #17b	11.0 (n=10)	9.8	Fair	****	Similar
Bear #18a	12.9 (n=10)	5.7	Below Average	***	–
Branciforte #21a-1	-	3.9	Poor	**	No 2006 data
Branciforte #21a-2	10.2 (n=7)	1.5	Very Poor	*	Similar
Soquel #1	3.8 (n=10)	6.6	Below Average	***	No 2006 data
Soquel #4	10.8 (n=11)	6.3	Below Average	***	Similar
Soquel #10	9.4 (n=11)	11.3	Fair	****	Similar
Soquel #12	8.6 (n=10)	4.8	Below Average	***	No 2006 data
East Branch Soquel #13a	9.5 (n=11)	3.1	Poor	*	Similar
East Branch Soquel #16	9.8 (n=11)	20.0	Good	*****	–
West Branch Soquel #19	3.7 (n=7)	4.8	Below Average	***	No 2006 data
West Branch Soquel #21	10.5 (n=6)	7.5	Below Average	***	Similar
Aptos #3	13.6 (n=3)	10.9	Fair	****	–
Aptos #4	11.3 (n=3)	17.8	Good	*****	+
Valencia #2	12.2 (n=3)	16.4	Good	*****	+
Valencia #3	12.2 (n=3)	10.5	Fair	****	+
Corralitos #0	-	9.1	Fair	****	No 2006 data
Corralitos #3	11.0 (n=4)	11.5	Fair	****	Similar
Corralitos #8	14.9 (n=4)	9.9	Fair	****	Similar
Corralitos #9	23.1 (n=4)	7.2	Below Average	***	–
Shingle Mill #1	16.0 (n=4)	13.3	Fair	****	–
Shingle Mill #3	4.7 (n=4)	6.7	Below Average	***	–
Browns Valley #1	19.3 (n=4)	17.4	Good	*****	–
Browns Valley #2	14.6 (n=4)	30.2	Good	*****	–

Figure 3. Juvenile Steelhead Site Densities for Size Classes II and III in the San Lorenzo River in 2007 Compared to the 9-Year Average. (7th year for Mainstem (1), 6th year for Mainstem (2a), 2nd Year for Lompico (13e) and 1st Year for Branciforte (21a-1).

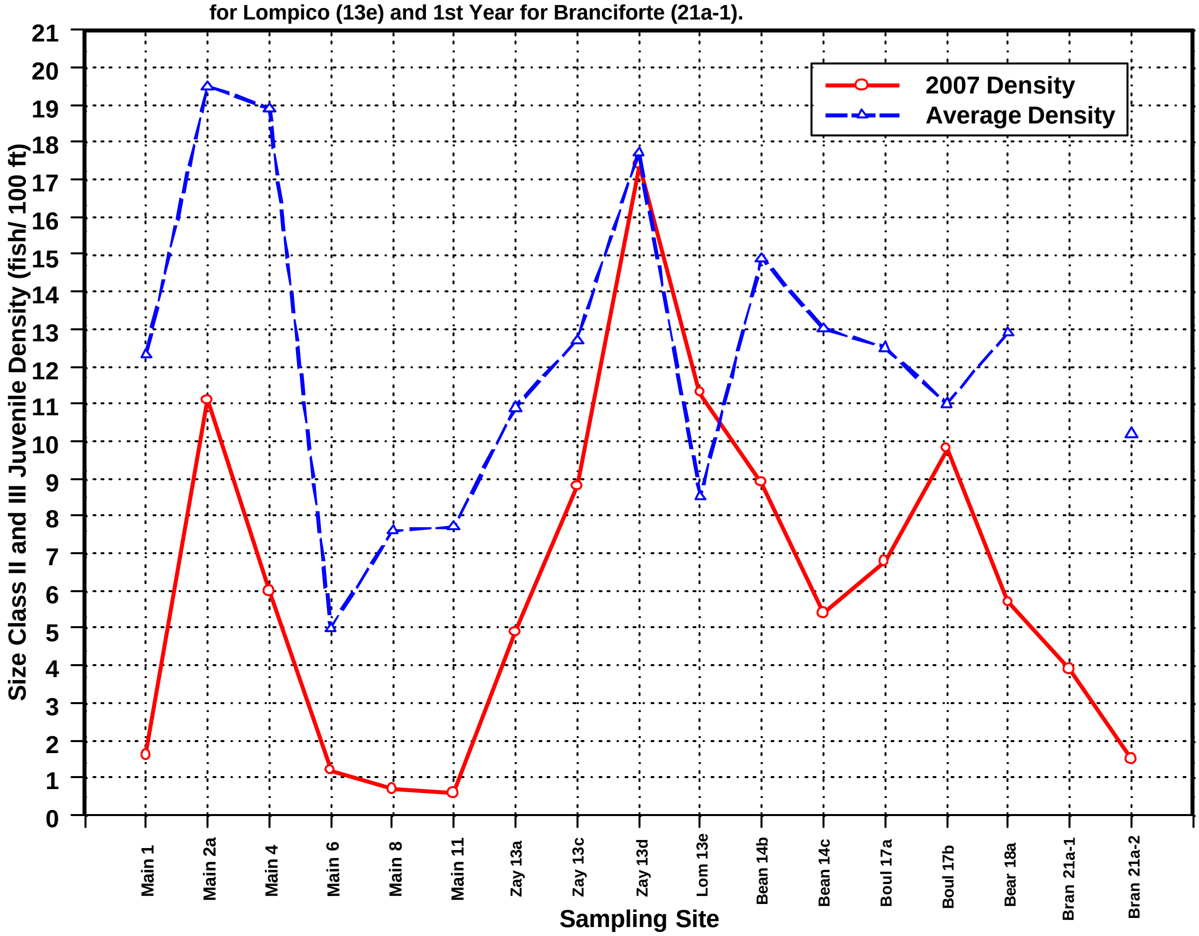


Figure 6. Juvenile Steelhead Site Densities for Size Classes II and III in Soquel Creek in 2007 Compared to the 11-Year Average Density (7th Year West Branch (19), 6th Year West Branch (21)).

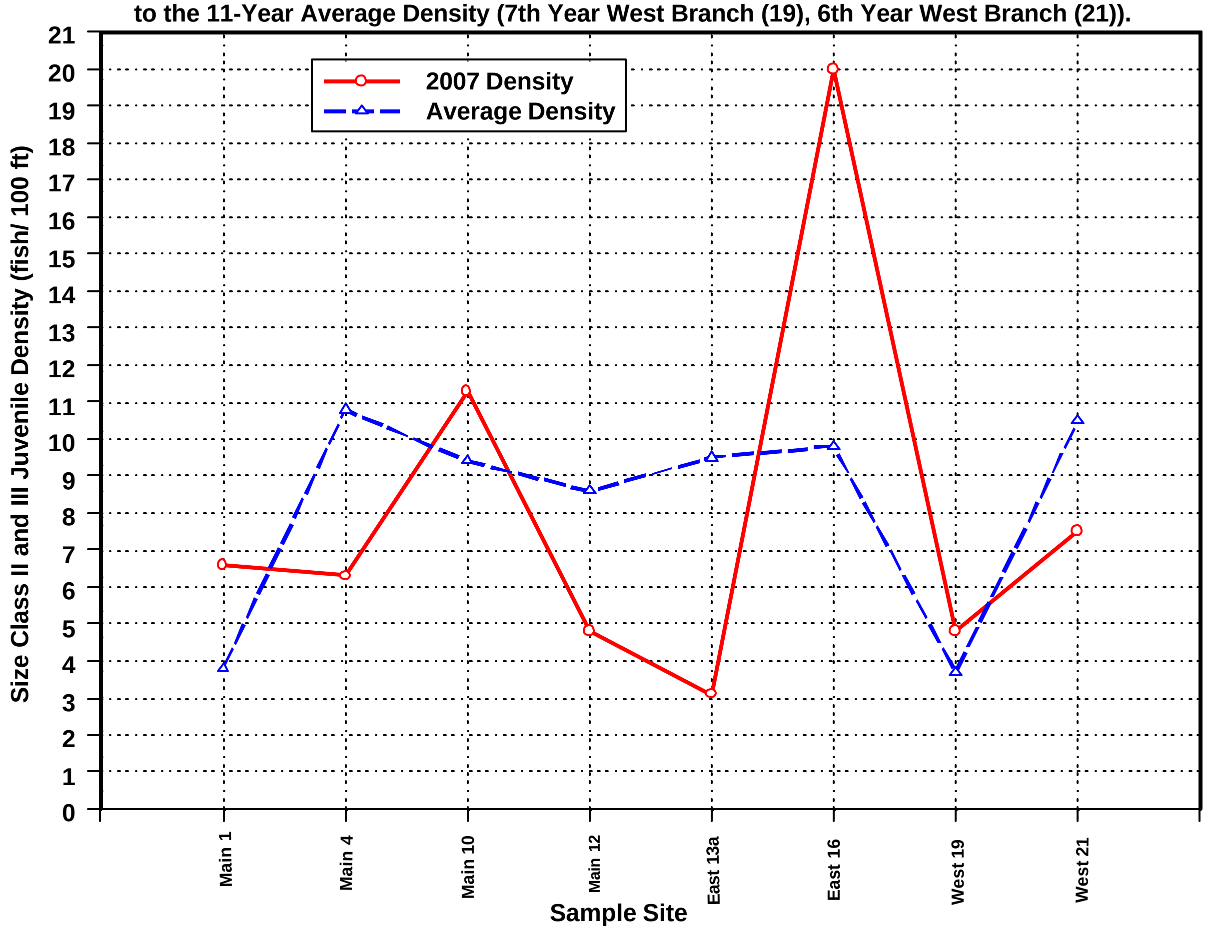


Figure 9. Juvenile Steelhead Densities for Size Classes II and III in Aptos and Valencia Creeks in 2006, 2007 and the Average, Including 1981.

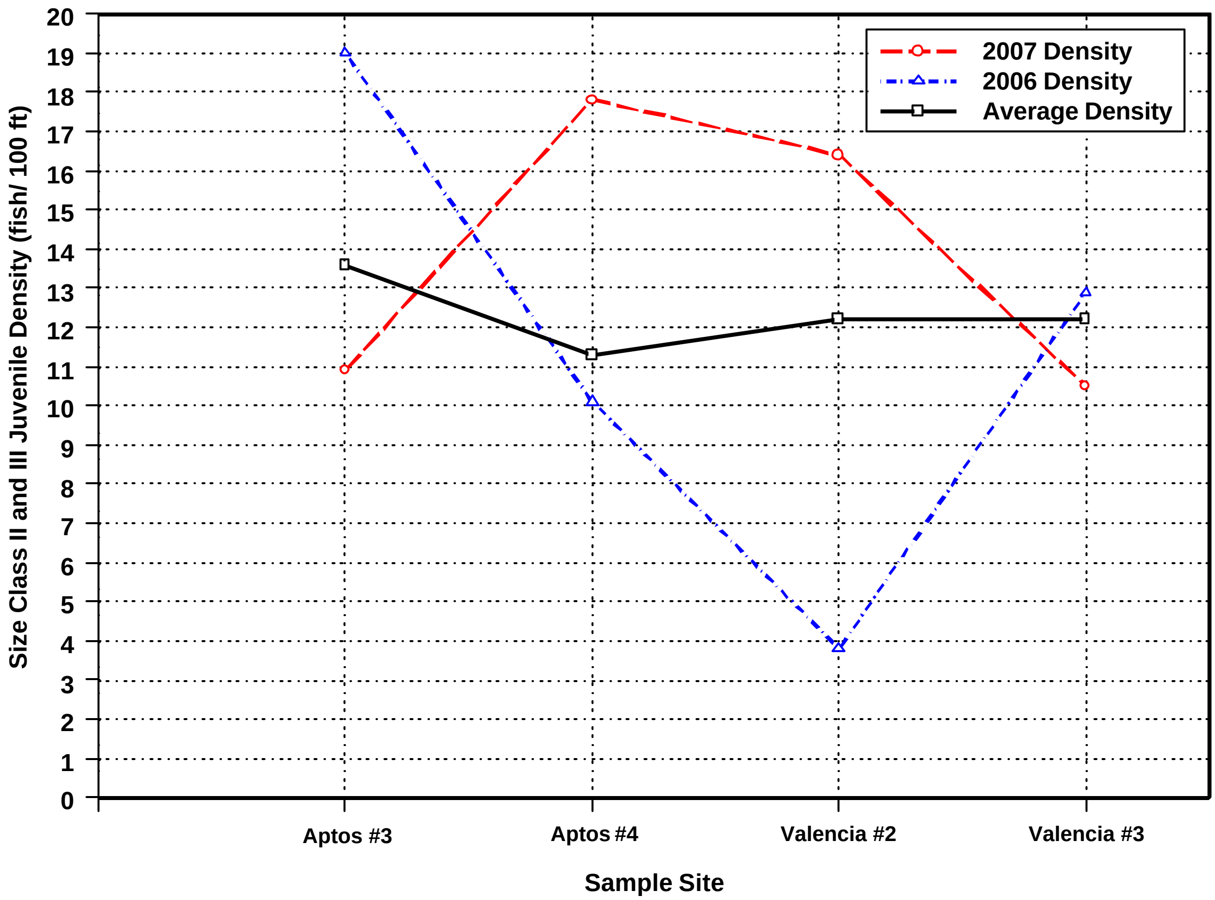
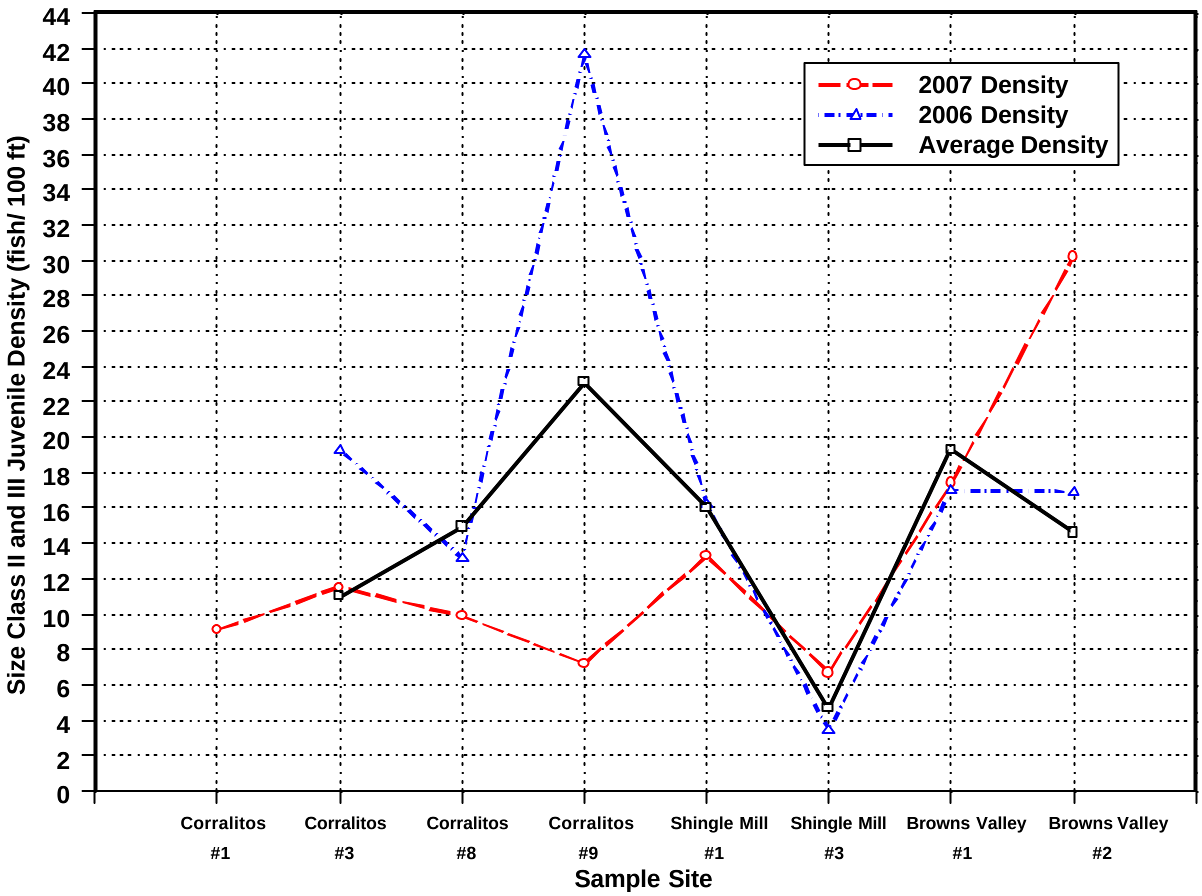


Figure 12. Juvenile Steelhead Densities for Size Classes II and III in Corralitos, Shingle Mill and Browns Valley Creeks in 2006, 2007 and the Average, Including 1981 and 1994.



Smolt-sized juvenile densities were below average at most sites in the San Lorenzo system (**Figure 3**), possibly for several reasons. In 2006, YOY growth rate was high, and many yearlings were likely large enough in spring 2007 to smolt without holding over another growing season. The exceptions were upper tributary sites (Upper Zayante, Lompico and upper Boulder creek sites) where high numbers of small YOY were present in 2006. At these slow growth sites, yearlings held over and smolt densities in fall 2007 were relatively high. In mainstem sites where many YOY reach smolt size their first year, there were not many YOY in 2007 (possibly due to limited spawning and fewer YOY moving down into the mainstem from tributaries) and fewer grew to smolt size with the reduced streamflow and food supply.

In Soquel Creek in drier winter/springs, when adult passage may be restricted by stream flows, more spawning activity tends to occur in the lower watershed. As a result, YOY densities are higher in the mainstem than usual (**Figure 5**). In 2007, the largest lagoon population of juvenile steelhead was detected since monitoring began in the early 1990's. This result was consistent with heavier spawning in the lower watershed, including relatively close to the lagoon. Habitat in the mainstem was similar to 2006 despite the reduced streamflow. Pool depths and escape cover were maintained in 2007, as streambed conditions improved.

In the upper Soquel watershed sites, water depth was relatively more severely reduced, especially in step-runs that usually produce high numbers of YOY. Therefore, there were fewer habitats for YOY there and possibly less spawning activity. YOY densities were so reduced at the SDSF Site 16 that adult migration impediments might have been responsible. The weir at the downstream end of Reach 11 may have caused passage difficulties and should be examined by an experienced fishery biologist. It has not been a problem in the past, but conditions may have changed.

There were above average YOY densities at the lower sites in Aptos and Valencia creeks and relatively higher densities than at the upper sites (**Figure 8**). There was likely more spawning activity in the lower watershed leading to relatively more YOY there. Adult passage to the upper watershed may have been hindered with few stormflows. In fact, YOY densities in upper Valencia Creek, at the site upstream of the Valencia Road culvert, were so low that it may indicate that adult steelhead had not reached the passage-improved culvert due to downstream blockage.

Densities of larger yearlings were highest at the upper Aptos and lower Valencia sites (**Figure 9**). These sites both had higher numbers of small YOY in 2006 that needed to hold over a second growing season. The lower Aptos site had more fast-growing YOY in 2006 that could smolt in spring 2007 and not hold over.

In 2007 in the Corralitos Creek watershed there were below average YOY densities at most sites. There may have been less spawning activity in the upper sites of the Corralitos watershed in 2007 compared to 2006. On Corralitos Creek, spawning access may have been impeded by a wide, unbaffled box culvert (with very shallow depth at low streamflows) that exists below Sites 8 and 9 and a steep bedrock chute that exists downstream of Site 9. In addition, there was less habitat available in upper Corralitos, Shingle Mill and all of Browns Valley creeks in 2007 due to much reduced streamflow. Although streambed conditions improved and pool escape cover increased in 2007, water depth in pools and especially in fastwater habitat at upper sites substantially reduced habitat for YOY. Step-runs and runs were more heavily used by YOY in 2006 when flows were higher and make up a large proportion of the available habitat. The lower 2 repeated sites on Corralitos Creek had similar YOY densities in 2006 and 2007, because streamflows are relatively high and habitat remained deep enough for YOY to use in 2007.

Summary of Trend Analysis of Juvenile Densities and Habitat for the San Lorenzo River and Tributaries

The lower and middle mainstem have become less important in producing juvenile steelhead in both the YOY age class and the Size Class II and III categories in recent years. Total juveniles increased in 2002 after a winter that had larger storms early in the winter and smaller ones afterwards. But densities declined after that. The years 1998 and 2006 had similarly wet winters prior to fall sampling. However, the mainstem had substantially higher juvenile densities in 1998 than 2006. Habitat conditions in 1998 that were better than in 2006 in both the lower and middle mainstem (depicted for Reaches 4 and 8, respectively) included greater depth in fastwater habitat (riffles), higher water velocity due to higher streamflow (and likely greater insect drift) and more escape cover in fastwater habitat in the middle mainstem Reach 8. However, certain riffle habitat parameters were better in 2006 in the lower mainstem Reach 4, such as greater escape cover (more overhanging willows) and less percent fines. In Reach 8 the estimated percent fines in 1998 and 2006 were the same. Rearing habitat conditions in Reach 4 in 2007 have improved since 1999 regarding greater depth, more escape cover, reduced embeddedness and reduced percent fines. However, 1997 conditions were better with regard to habitat depth and percent fines. If baseflows had been the same in 1997 and 2007, habitat conditions in Reach 8 riffles may have been similar between years, with the possible exception of less escape cover in 2007.

For tributary sites and the upper mainstem, there was a general decline in total densities from 1997 to 2000, with a general increase from 2000 to 2003, followed by a general decline from 2003 to 2007. Since most juveniles were YOY, their densities followed the same trend. Tributary densities of Size Class II and III showed no general trend, though as a group were especially low in 2007. They were similar between 1997 and 1998 but generally increased in 1999 to an 11-year high, particularly in Zayante, upper Boulder and Bear creeks. In analyzing habitat change in an important eastern tributary reach, it was noted that rearing habitat conditions have declined in Zayante Reach 13d from 1997 to 2007, judging by the shallowest pool depths in the 11-year period in 2007 (where annual differences in baseflow have limited effect on pool depth) and the relatively low pool escape cover in 2007. In analyzing habitat change in an important western tributary reach, it was noted that overall rearing habitat quality in Boulder Reach 17a has declined from 1997 to 2007 due to reach-wide pool filling and reduced pool escape cover.

Summary of Trend Analysis of Juvenile Densities and Habitat for Soquel Creek and the East Branch

In drier years with reduced baseflow, juvenile densities in the mainstem were relatively higher. In wetter years, the densities declined. The exception to our inverse relationship was 2001, when YOY and total juvenile densities were relatively low despite low streamflow (except for the uppermost mainstem site with densities all increasing from 2000 to 2001). Relatively higher YOY and total densities occurred in 1997, 2002, 2004 and 2007. Densities of Size Class II and III juveniles in the mainstem were generally low, with relatively higher densities in 1997, 1998 and 2005.

Since 1997, rearing habitat quality in the lower mainstem has improved with increased average maximum pool depth and has declined with regard to reduced escape cover. However, riffles conditions for aquatic insects and steelhead food supply have improved. During the instream wood survey in 2002, this reach was noted for its lack of large wood (**Alley 2003**). In the lower mainstem, densities of larger juveniles were not well correlated with rearing habitat conditions.

Overall rearing habitat quality declined since 1997 in the upper mainstem because of pools filling with sediment and less escape cover. During the instream wood survey in 2002, this reach was noted for its lack of large wood (**Alley 2003**). In the upper mainstem, densities of larger juveniles were not correlated with reach-wide changes in pool depth, or reach-wide changes in escape cover. However, they were positively correlated with changes in pool escape cover at sampling sites (except in 2004) and reduced embeddedness in riffle and run habitat (except for 2006). Relatively better habitat conditions were consistent with higher densities in 1997, 1998, 2005 and 2007.

The best explanation for fluctuations in Size Class II and III densities in the mainstem was related to differences in presumed spawning effort, spawning success and increased YOY growth in wetter years versus slower growth in drier years. In milder winters, there is better over-wintering survival of yearlings, which may contribute to higher densities found in the mainstem in 1997, 2001 (Site 4 only) and 2002 (Site 4 only). In wetter years, there may be less spawning effort and spawning success in the mainstem until late in the spawning season. However, the above median daily baseflow results in faster water velocity, increased insect drift and deeper feeding stations in fastwater habitat, at least in the spring. These factors all promoted faster growth rate, leading to a higher proportion of YOY reaching Size Class II their first year and resulting in higher densities of larger juveniles in 1998 and 2005.

In East Branch Soquel Creek, total and YOY densities annually fluctuated in a dissimilar fashion in lower East Branch and upper East Branch except they increased at both locations from 2001 to 2002 and decreased at both locations in 2006. After reaching an 11-year high in 2004, total and YOY densities in the lower East Branch declined in 2005 and then again in 2006 to almost zero but rebounded in 2007 to half the 1997 level. Higher YOY densities in drier years in the lower East Branch may have resulted from greater spawning effort than in wetter years, more spawning success and higher survival of YOY after emergence. In wetter years, more adult steelhead likely continued further up the East Branch into the Soquel Demonstration State Forest (SDSF). With the streambed instability of the lower East Branch, redd (nest) scour or burial in sediment may have be more common in winters with higher stormflows.

Overall rearing habitat quality declined in the lower East Branch from 1997 to 2007, primarily with regard to fastwater habitat important to YOY juveniles and aquatic insects. Other factors related to the turbidity and thin silt layer on the substrate observed at the sampling site in 2006 and 2007 may also indicate lower habitat quality. During the instream wood inventory in 2002, this reach was identified as one with small quantities of large instream wood (**Alley 2003**). The apparent disconnect between non-streamflow related rearing habitat conditions and Size Class II and III densities in the lower East Branch indicated that rearing habitat quality within the observed range in the last 11 years was overshadowed by poor over-winter survival of yearlings in years that were not wet enough to grow many YOY to Size Class II. Over-winter survival did not appear good in any year. The effect of non-streamflow related rearing habitat conditions was also overshadowed by the added potential for growth of some YOY to Size Class II in intermediate to wet years. The years with highest densities of Size Class II and III juveniles in the lower East Branch occurred in 1998 and 2005, two relatively wet years with moderate YOY production. Higher growth rate during these high spring-baseflow years allowed a higher proportion of YOY to reach Size Class II, leading to higher densities of larger juveniles.

In the upper East Branch, densities of Size Class II and III increased during 1997–1999, with a decline to less than one-fifth the 1999 density by 2004. Then the density increased up to the highest density in 11 years in the dry year of 2007. The relatively high density of Size Class II and III juveniles was likely due to at least moderate numbers of YOY in 2006 and good over-winter survival of yearlings during a mild winter. The three highest Size Class II and III densities in the upper East Branch did not correspond to any hydrologic category. They were 1998 (very wet year), 1999 (intermediate year) and 2007 (very dry year). Both the wet and moderately wet years had sufficient spring baseflows to grow some YOY into Size Class II. The dry year likely had very good over-winter survival of yearlings, although rearing conditions worsened. In addition, adult access may have been hampered in the dry 2006/2007 winter, resulting in lower YOY production and reduced competition for food.

Although improvement in pool rearing habitat was detected in the upper East Branch in some years (greater pool depth in 2006 and greater pool escape cover in 2004), data indicate that habitat quality in 2007 was similar to conditions in 2000. The apparent disconnect between non-streamflow related rearing habitat conditions and Size Class II and III densities at Site 16 indicated that non-streamflow related rearing habitat quality within the observed range in the last 11 years was overshadowed by 1) poor over-winter survival of yearlings in years that were not wet enough to grow many YOY to Size Class II, 2) the potential for growth of some YOY to Size Class II in intermediate to wet years and 3) high over-winter survival of yearlings in dry years.
Attempts to retrieve PIT-tagged juveniles has indicated very limited movement of tagged individuals from their original locations.

If the incidence of large instream wood were to increase substantially in the East Branch, rearing habitat quality and improved over-winter survival of yearlings may play more important roles in increasing Size Class II and III densities.

Scope of Work. 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 and 2006. Aptos Creek was previously sampled in 1981 and 2006. In fall 2007, 4 Santa Cruz County watersheds were sampled for juvenile steelhead with the purpose of comparing habitat quality and juvenile densities with past results. Refer to maps in **Appendix A** that delineate reaches and sampling sites. The mainstem San Lorenzo River and 6 tributaries were sampled with a total of 17 sites. Seventeen half-mile segments were habitat typed to assess habitat conditions and select habitats of average quality to sample. Tributaries included Branciforte, Zayante, Lompico, Bean, Boulder and Bear creeks. Newell Creek was dropped at the request of the City of Santa Cruz. Eight steelhead sites were sampled below anadromy barriers in Soquel Creek and its branches (one by NOAA Fisheries biologists). Eight half-mile segments were habitat typed. In the Aptos Creek watershed, 2 sites in Aptos Creek and 2 sites in

Valencia Creek were sampled, and the 4 associated half-mile segments were habitat typed. In the Corralitos sub-watershed of the Pajaro River drainage, 4 sites were sampled in Corralitos Creek, 2 sites were sampled in Shingle Mill Gulch and 2 sites were sampled in Browns Creek, along with 8 associated half-mile segments habitat typed.

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.

Steelhead Life History. Most juvenile steelhead spend 1-2 years in freshwater before smolting and migrating to the ocean to reach sexual maturity. In the ocean they spend 1-2 years of rapid growth before returning as adults to their natal streams to spawn. When juveniles reach 75 mm SL by fall sampling time (~ 3 ½ inches total length) they are considered large enough to smolt the following late winter and spring. Unpublished, independent research has shown that many returning adult steelhead in some local streams reached smolt size their first growing season (**J. Smith, pers. comm.; E. Freund, pers. comm.**). Therefore, habitat conditions are very important in portions of the watersheds that have the capacity to grow YOY most rapidly to smolt size. These portions include the lagoons of the San Lorenzo River, Aptos and Soquel creeks, the lower mainstem of the San Lorenzo River and Soquel Creek, and the middle mainstem of the San Lorenzo River. Enhancement of smolt production is necessary to increase adult returns.

YOY emerge from the spawning gravels and spread (primarily downstream) throughout the watershed in spring and early summer. Since more adult steelhead spawning tends to occur in the upstream and tributary reaches of the watershed (barring passage difficulties), the highest initial YOY densities tend to be there. Therefore, it is likely that juveniles distribute mostly in a downstream direction where competition is reduced. High streamflows probably increase downstream dispersal, and it may be reduced in drier years. Once habitats have been selected, juveniles remain in the same habitats or in close proximity throughout the summer and fall. They distribute according to the quality of feeding habitat (fastwater with adequate depth) and/ or maintenance habitat (water depth and degree of escape cover as overhanging vegetation, undercut banks, surface turbulence, cracks under boulders and submerged wood). Habitat quality improves when less sand enters the stream (called sedimentation) from soil and streambank erosion because less sand input increases aquatic insect habitat. With less sand, embeddedness of larger cobbles and boulders is reduced to provide more cracks and crevices for insects to use. Less sand and embeddedness also provide better fish habitat with more escape cover for fish to hide under and by increasing water depth around scour objects (more escape cover).

INTRODUCTION

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 peak flow 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 has developed at the Rincon riffle by 2007 with a steep cascade where the channels rejoin, making passage up the main channel difficult. 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 1998 and 1999, a difficult passage riffle was observed in the upper portion of Reach 2 in the Rincon area. A split channel was developing, causing difficult passage conditions for adults at flows less than approximately 50-70 cfs as observed in 2002. In the West Branch of Soquel Creek, there are Girl Scout Falls I and II that impede adult passage. Based on juvenile sampling, it appears that 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, 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 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. The production of young-of-the-year (YOY) fish is related to spawning success, which is a function of the quality of spawning conditions, 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. Except in streams with high summer flow volumes (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 tributaries of the San Lorenzo River. 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-winter 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, although cover (hiding areas, provided by undercut banks, large rocks which are not buried or "embedded" in finer substrate, surface turbulence, etc.) and pool, run and riffle depth 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 of the year (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. 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 correlated 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 correlated 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 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 by primarily YOY and more so in the upper mainstem than the branches where they become more 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, Aptos, Valencia, Corralitos, Shingle Mill and Browns Valley creeks 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 faster water 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 mainstem San Lorenzo River, lower reaches of larger San Lorenzo tributaries, lower reaches of Corralitos and Aptos creeks. It also includes slower growing yearlings and older fish inhabiting San Lorenzo tributaries, the mainstem San Lorenzo, Aptos, Valencia, Shingle Mill Corralitos and Browns Valley creeks.

A basic assumption in relating juvenile densities to habitat conditions where they are captured is that juveniles do not move substantially from the vicinity where they are captured during the growing season. This is a reasonable assumption 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. There has been concern expressed that summer flashboard dams without ladders may impede upstream movements of juvenile salmonids during non-migrational periods such as summer. This needs further study because evidence is lacking that would indicate ecologically significant juvenile movement upstream during the dry season. 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*.** Deeper pools, undercut banks, side channels, large unembedded rocks and large wood clusters provide shelter for fish against the high winter flows. Over-winter survival is usually a major limiting factor, since yearling fish are usually less than 10-20% as abundant as YOY. In some years, such as 1982 and 1998, extreme floods may make overwintering habitat the critical factor in 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 actually needed. The remaining coho streams, such as Gazos Waddell and Scott creeks, have considerably more instream wood for winter refuge than streams where coho have been extirpated, such as Soquel Creek (**Leicester 2005**).

I-3. Project Purpose and General Study Approach

The 2007 fall fish sampling and habitat evaluation included comparison of 2007 juvenile steelhead densities at sampling sites and rearing habitat conditions with those in 1997–2001 and 2003–2006 in the San Lorenzo River and 7 tributaries and in the Soquel Creek mainstem and branches with steelhead densities and habitat conditions in 1997–2006. Fall steelhead densities and habitat conditions in the Corralitos Creek watershed were compared to those in 1981, 1994 and 2006. Fall 2007 steelhead densities and habitat conditions in the Aptos Creek watershed were compared to those in 1981 and 2006. Habitat conditions were assessed primarily from measured streamflow, escape cover, water depth and visual estimates of streambed composition and embeddedness.

METHODS

M-1. Choice of Reaches and Vicinity of Sites to be Sampled- Methods

In 2007, fish densities at average habitat quality sampling sites in previously determined reaches and locations were compared to past fish densities. The scope since 2006 has not included estimation of fish population sizes for reaches and extrapolation to adult indices. Altering the scope reduced report length and allowed sampling of more sites in more watersheds. However, the fish density data collected by habitat type in 2006 and 2007 could potentially be combined with habitat proportions determined during habitat typing to estimate juvenile production in the reaches sampled, consistent with past years.

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. Conversations with long-time Lompico Creek resident, Kevin Collins, were used to determine reach boundaries in Lompico Creek. 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. The segment was chosen because it was downstream of, and would be affected by human impacts, such as water diversion, bridges, sediment inputs caused by development upstream and major tributaries and water quality impacts from development. The sampling site in Lompico Creek represented average habitat conditions, as did sampling sites in other reaches.

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 the Zayante tributary, Lompico Creek, was first sampled in 2006.

In 2007, sampled tributaries of the San Lorenzo included Zayante, Lompico, Bean, Boulder, lower Bear and lower Branciforte creeks. Newell Creek was dropped in 2007 because the city of Santa Cruz collected habitat and fish density data on Newell Creek independent of our effort. Those data are not incorporated into this report. Refer to **Table 1c, Appendix A, Figure 2** and page 2 for a list of sampling sites and locations in 2007. Half-mile segments in the vicinity of sampling sites were habitat typed to select sampling sites with average habitat conditions. Steelhead inhabit other tributaries, and in the past, 9 major tributaries were sampled. 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 is often associated with changes in 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 the 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. In 2007, the sampling site upstream of Girl Scout Falls II was dropped.

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.

In 2007, the number of sampling sites in the Soquel Creek watershed was increased, with 2 more sites added back in the mainstem after the upper West Branch site was dropped. All captured fish from the East and West Branches, Site 12 on the mainstem and the lagoon were scanned for PIT tags to detect any previously tagged individuals at NOAA Fisheries sites. Soquel Creek sites included 4 mainstem sites with one in Reach 1 (Site 1) upstream of the Soquel Grange (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.

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) to compare habitat conditions with 2006. Landowner objection in 2006 prevented surveying and sampling of Reach 14a in the future.

In the Aptos Creek watershed, 2 sites on Aptos were designated, 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 were sampled in the vicinity of historical sites previously sampled in 1981 (**Table 3**). Reach 2 was above passage impediments near Highway 1. 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 in the vicinity of the historical sampling sites chosen for 2006 sampling were habitat typed 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, 3 reaches were chosen: 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 (unbaffled box culvert) crossing 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 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 California Salmonid Stream Habitat Restoration Manual (**Flosi et al. 1998**). Some habitat characteristics were estimated according to the manual's guidelines, including length, width, mean depth, maximum depth, shelter rating and tree canopy (tributaries only in 1998). More data were collected for escape cover than required by the manual to obtain more detailed, biologically relevant information.

M-3. Measurement of Habitat Conditions

During habitat typing in 2007, 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 contributes to the same study, the original observer trains 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.

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. There is generally a shortage of gravel-sized substrate. 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 of the streambed. 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 comparable to the other methods. The substrate that may be sampled with core sampling is restricted by the diameter of the sampler. Both the pebble count method and the core sampling method are too labor intensive for habitat typing. We do not believe more in-depth estimates than those taken for percent fines during habitat typing are necessary for purposes of this fishery study. It is best to have annual consistency in data collecting personnel during habitat typing, however.

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.

The previous years' data was not reviewed prior to data collection so as not to bias the latest data collection. 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 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 50-75% range. There is an inverse relationship between tree canopy and insect production in riffles, which allows faster steelhead growth in larger, mainstem reaches of the San Lorenzo River having deeper, fast-water 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 2003-2007. 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 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 averages in 1997-2000, 2003, 2005-2007 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.

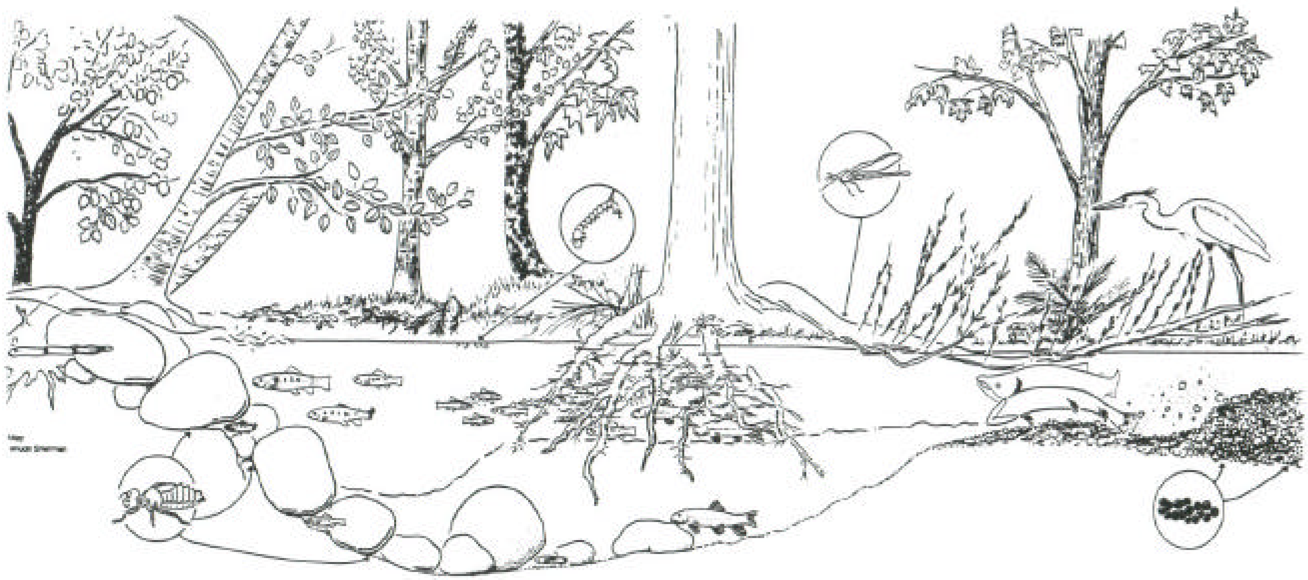


Illustration of pool habitat (stream flowing from left to right) showing escape cover under boulders and undercut bank with tree roots. Juvenile steelhead are feeding at the head of the pool. (Female steelhead covering her redd of eggs after spawning at the tail of the pool.)

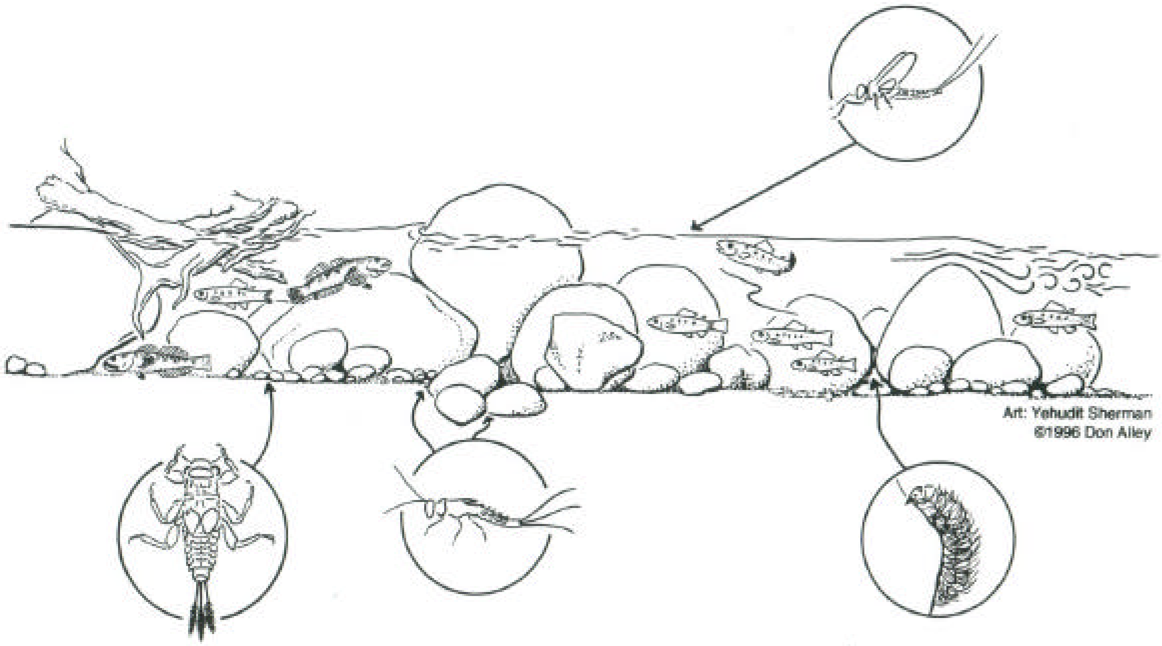


Illustration of riffle habitat (stream flowing from left to right) showing escape cover under rootwad and boulders. (Juvenile steelhead are holding feeding positions, facing upstream.)

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. 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 and 2007. 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. In 2007, streamflow measurements by Santa Cruz County staff were used for annual comparisons.

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

Based on the habitat typing conducted in each reach prior to fish sampling in 2007, 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.

For all other reaches in this study, in the upper San Lorenzo River above the Boulder Creek confluence, all San Lorenzo tributaries and in the Aptos and Corralitos watersheds, the location of representative pools with average habitat quality in terms of water depth and escape cover determined the pool habitat to be 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 had similar depth and escape cover; all runs had similar depth and escape cover; all step-runs had similar depth and escape cover; and all glides had similar depth and escape cover.

Sampled units may change from year to year since habitat conditions may 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 average fish densities for 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 densities of yearling-sized juveniles are well correlated with 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.

M-5. Consistency of Data Collection Techniques in 1994-2001 and 2003-2007

Habitat conditions were measured at the monitoring sites in 2007 consistent with methods used in 1981 and 1994-2001 and 2003-2006 in the San Lorenzo River and Soquel Creek watersheds. Donald Alley, the principal investigator and data collector in 1994-2001 and 2003-2006, 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 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 and 2007, Chad Steiner habitat typed 4 reaches in the Aptos Watershed, 2 reaches in Branciforte Creek, 2 reaches in Browns Valley Creek and 2 reaches in Shingle Mill Creek, after working with Alley since 2001. 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 2007, deeper pools were snorkel-censused at Sites 1, 2, 4 and 8 in the lower and middle mainstem to determine site densities only. All other watersheds were sampled by electrofishing.

The city of Santa Cruz funded a separate watershed sampling effort in 2002. Their data were not included in this report because the methods were inconsistent with ours. For our review of their findings, please refer to our 2003 censusing report (**Alley 2004**).

Table 1a. Defined Reaches in the Mainstem San Lorenzo River.

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

Reach #	Reach Boundaries	Reach Length (ft)
0	Water Street to Tait Street Diversion CM0.92 – CM1.92	5,277
1*	Highway 1 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.

(2007 Sites Indicated by Asterisk.)

Reach #	Sampling Site # -Channel Mile	MAINSTEM SITES 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, with 2007 Sites indicated by Asterisk (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, Above and 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 reaches 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 2007.)

Reach #	Site # –Channel Mile	Location of Sampling Sites
1	*1 –CM1.4	Above 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	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 2006 and 2007.)

Reach #	Site # -Channel Mile	Location of Sampling Sites
Aptos Creek		
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	0.15 miles (840 ft) Below Valencia Road Crossing
3	*3 –CM3.26	0.26 miles (1,400 ft) Above Valencia Road Crossing

Table 4a. Defined Reaches in the Corralitos Sub-Watershed.
(Refer to Appendix A for map designations. Reaches surveyed indicated by asterisk.)

Corralitos Creek

Reach #	Reach Boundaries (Downstream to Upstream)	Reach Length (ft)
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 CM2.70 - CM3.54	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)

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

Reach #	Reach Boundaries (Downstream to Upstream)	Reach Length (ft)
Browns Valley Creek *		
1*	First Bridge Crossing on Browns Valley Road below the Diversion Dam to the Diversion Dam	1,015
2*	Diversion Dam to Redwood Canyon Creek Confluence	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 amount 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 2007.)

Corralitos Creek

Reach #	Site # -Channel Mile	Location of Sampling Sites
1	*0 –CM10.1	Downstream of Diversion Pipe Crossing
2	1 –CM10.3	Below Diversion Dam Around the Bend
3	2 –CM10.6	Just Upstream of Diversion Dam
	*3 –CM11.1	0.6 miles Upstream of Diversion Dam (above 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 Confluence
7	*9 –CM13.6	0.4 miles Above Eureka Gulch Confluence

Shingle Mill Gulch

Reach #	Site # -Channel Mile	Location of Sampling Sites
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	Above Washed Out Check Dams below Grizzly Flat on Shingle Mill Gulch

Browns Valley Creek

Reach #	Site # -Channel Mile	Location of Sampling Sites
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

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M-6. Juvenile Steelhead Densities at Sampling Sites - Methods

Electrofishing was used at sampling sites to determine densities according to two juvenile age classes and three size classes in all 4 watersheds in 2007. Block nets were used at all sites to separate habitats during electrofishing. A three-pass depletion process was used to estimate fish densities. If there was poor depletion on 3 passes, a fourth pass was performed and the fish captured in 4 passes were assumed to be a total count of fish in the habitat. Electrofishing mortality rate has been approximately 0.5% 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, underwater censusing of deeper pools was incorporated into density estimates with electrofishing data from more shallow habitats.

Visual censusing was judged inappropriate in other habitats because it would be inaccurate in fastwater habitat in the mainstem and in 80-90% of the habitat in tributaries. For example, twenty-four of 26 sampled tributary pools had more than 20 fish in 2005. Most tributary sites are well shaded and many pools have substantial escape cover, making it very difficult to count all of the juveniles, much less divide them into size and age classes. Riffles, step-runs, runs and glides are usually too shallow to snorkel in tributaries. Dense shading in most tributaries also reduces snorkeling effectiveness.

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. 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 average number of steelhead observed per pass in each age and size category became the density estimate. Visual censusing of deeper pools occurred prior to electrofishing of the sites in 2006. 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. In Reaches 1-4, most juveniles were greater than 75 mm SL, and yearlings were considerably larger than YOY fish. Therefore, 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 for some individuals in deciding size class division between Classes 1 and 2. However, there was no difficulty in distinguishing age classes.

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 15 feet or more, making the streambed and counting lanes observable. Very few steelhead used these pools in 1999-2001 and 2003-2007, 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. Capture and Mortality Statistics

For this study overall in 2007, 2,929 juvenile steelhead were captured by electrofishing among all sites, with 16 mortalities (0.55% mortality rate). All but one of the lost steelhead were small YOY fish. Six mainstem sites and 11 tributary sites were sampled in the San Lorenzo watershed in 2007. A total of 1,381 juvenile steelhead were captured with 6 mortalities (0.4%). A total of 647 juvenile steelhead were captured at 7 sites in the Soquel watershed in 2007 with 6 mortalities (0.9%). A total of 335 juveniles steelhead were captured in the Aptos Watershed at 4 sites with 3 mortalities (0.9%). A total of 566 juveniles were captured in the Corralitos watershed at 8 sites with 5 mortalities (0.9%).

M-8. 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. 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. Density estimates were measured in the lowest baseflow period of the year when juvenile salmonids remain in specific habitats without up or downstream movement. Density is typically provided per channel length by convention and convenience. Channel length may be accurately measured quickly. If the density measure is consistent from year to year, valid comparisons can be made.

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 2007, the lower mainstem of the San Lorenzo River and Soquel Creek, many YOY steelhead reached Size Class 2 size in one growing season, as did some in the middle mainstem San Lorenzo and upper mainstem of Soquel Creek. In this monitoring report, sampling site densities were compared for 10 years in the San Lorenzo system by size and age (1997-2001 and 2003-2007) and for 11 years in Soquel Creek (1997-2007). 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 for annual site density comparisons.

RESULTS FOR 2007

R-1. Habitat Change in the San Lorenzo River and Tributaries

Refer to **Appendix A** for maps of reach locations. Overall habitat quality declined in Reaches 1, 6 and 8 of the **lower and middle mainstem** (downstream of the Boulder Creek confluence) from 2006 to 2007, with overall improvement in Reach 4 immediately downstream of the Zayante Creek confluence (**Table 41**). These mainstem reaches showed general streambed improvement with regard to reduced fine sediment and lower embeddedness between 2006 and 2007 in run and riffle habitats (**Tables 7 and 8**). However, habitat depth was substantially shallower in 2007 with the reduced streamflow compared to 2006 (**Table 5b**) and sedimentation of pools (**Table 6**). All lower mainstem reaches showed increased pool habitat 8-18% more than in 2006 but less of the fastwater habitat where juvenile densities were the highest in the lower and mainstem reaches (**Table 5c**). Insect producing habitat was reduced with less fastwater habitat, and drift rate was less with lower water velocity. There was generally less escape cover in fastwater habitat (riffles and runs) except for Reach 4 and runs in Reach 8 (**Tables 9 and 10**). Escape cover in lightly used pools was similar between years except for improvement in Reach 4 in 2007 with more overhanging vegetation after the mild winter (**Table 11**).

Mainstem Reach 2 in the Rincon area of Henry Cowell State Park had not been sampled since 2000 (**Alley 2001**). In comparing habitat conditions between 2000 and 2007, overall habitat quality was reduced in 2007 due to shallower conditions in fastwater habitat (**Table 6**) and slower water velocities resulting from less streamflow (**Tables 5a-b**). However, streambed conditions were much improved in 2007 with less fine sediment (**Table 7**) and reduced embeddedness (**Table 8**). Escape cover in riffles was similar between years, but cover in runs was much improved in 2007 (**Tables 9 and 10**). The one **upper mainstem reach** sampled (Reach 11) had similar habitat quality between 2006 and 2007, with improved streambed conditions in pools and riffles but not runs. Pool depth and escape cover in pools were similar.

San Lorenzo tributary reaches showed reduced habitat quality in 6 of the 8 reaches (all 3 Zayante reaches (13a, 13c and 13d), upper Bean (14a), lower Bear (18a) and lower Boulder (17a)) comparing 2007 to 2006 and similar habitat quality in 2 reaches (upper Boulder (17b) and lower Branciforte (21a-2)) (**Table 41**). In these tributary reaches where pools were most heavily used by juvenile steelhead, pools were somewhat shallower due, in some cases, to an increase in pool frequency resulting from reduced streamflow, increase in habitat breaks and 2006 step-run/ run habitat becoming pool habitat in 2007 (Zayante 13d, Lompico 13e, and Bear 18a) (**Table 5b**). Pool sedimentation was likely a factor in pool shallowing in Zayante 13a, Boulder 17a and Boulder 17b (**Table 6**). For the reaches with smaller channels (upper mainstem and tributaries) 4 reaches had a higher percent of pool habitat (as much as 10% more), 2 reaches had the same amount (lower Zayante 13a and upper Bean 14c), and the Boulder Creek reaches had slightly lower percentages of pool habitat (**Table 5c**). Streambed conditions in tributaries were generally improved in 2007 or similar between years with regard to reduced percent fines and less embeddedness (**Tables 7 and 8**). Pool escape cover was similar between years except for noticeable improvement in middle Boulder Creek (17b) (**Table 12**).

R-2. Habitat Change in Soquel Creek and Its Branches

Refer to **Appendix A** for maps of reach locations. Generally throughout the watershed, habitat quality declined in 2007 due to reduced streamflow, slower water velocity (reduced insect drift rate) and shallower habitat. Pool habitat increased in all reaches, but fastwater habitat where most aquatic insects live was diminished (**Table 5c**). Streambed conditions generally improved with less percent fines and less embeddedness. Escape cover generally improved slightly or was similar to past years. Reach 12 in the Soquel Demonstration State Forest was most heavily impacted by reduced streamflow and showed the greatest habitat decline; it did not show the stable escape cover rating and streambed improvements found in the rest of the watershed.

The **lower mainstem** (from the lagoon to the Moores Gulch confluence, as indicated from data collected in Reaches 1 and 3) had overall lower habitat quality in 2007 compared to 2005 in Reach 1 and compared to 2006 in Reach 3. This was largely due to reduced streamflow (**Tables 5a-b**) that caused slower water velocity at the important heads of pools, slightly shallower pools (**Table 14**) and much shallower fastwater habitats making them of more limited value. There was similar pool escape cover in Reach 3 pools between years (**Table 17**). Improvements included reduced fine sediment in pools but not other habitats (**Table 15**) and reduced embeddedness in Reach 3 (all habitat types) and in pools in Reach 1 (**Table 16**). Reach 1 pools also had more escape cover in 2007 due to more overhanging willows after a relatively dry winter.

The **upper mainstem** (from the Moores Gulch confluence to the Branches) (as indicated from data collected in Reaches 7 and 8) had overall lower habitat quality in 2007 compared to 2005 in Reach 8 and 2006 in Reach 7. As in the lower mainstem, this was due to reduced streamflow (**Tables 5a-b**). Although pools had similar averaged depth, fastwater habitat was substantially shallower and slower, making their utilization much less (**Table 14**). On the positive side, pools had less fine sediment (**Table 15**) and were less embedded (**Table 16**). Reach 7 pools had somewhat more escape cover in 2007 (**Table 17**).

The **lower East Branch** (as indicated from data collection in Reach 9 below Mill Pond) had lower overall habitat quality in 2007 largely due to reduced streamflow (**Table 5b**) that resulted in slower water velocities, somewhat shallower pools and much shallower fastwater habitat (**Table 14**). However, streambed conditions improved, such as less fine sediment in pools (**Table 15**) and somewhat (< 10%) less embeddedness throughout, except in runs/step-runs where conditions improved more (**Table 16**). There was also some improvement in pool escape cover (**Table 17**).

The important **upper East Branch** (as indicated from data collection in Reach 12a in the Soquel Demonstration State Forest) showed overall habitat quality decline in 2007 that resulted from severe reduction in streamflow (**Table 5b**) and reduced pool escape cover (**Table 17**). Although we have no streamflow estimates from 2006 (probably more than 1 cfs based on the 1998 estimate at the East Branch weir), in 2007 the streamflow was visually estimated at 0.03 cfs (a trickle), with 130 ft of stream dry in the ½-mile habitat typed section on 30 August. Water temperature was also much warmer in

2007, with it reaching 75º F by 1600 hr on 30 August (air temperature 77º F) compared to only 63º F at 1500 hr on 23 August 2006 (air temperature 74.5º F). With the reduced streamflow, water depth was substantially shallower in all habitat types (**Table 14**). Pools and step-runs averaged 11 and 8 feet, respectively in width in 2007 compared to 14 and 12 feet, respectively in 2006. Streambed conditions improved only with reduced fines in pools but not in other habitats (**Table 15**). Unlike in most sites in 2007, embeddedness was similar in pools between years and worse in fastwater habitat (**Table 16**).

In the **West Branch** downstream of Hester Creek (**Reach 13**), overall habitat quality declined from 2000 to 2007. Streamflow was similar in 2007 (**Alley 2005 and Table 5b**), but shallower pool depth (**Table 14**) indicated sedimentation and more habitat breaks (shorter pools). Pool embeddedness and escape cover were similar, with reduced percent fine sediment in pools in 2007 (**Tables 15-17**).

In the **West Branch** between Girl Scout Falls I and II (**Reach 14b**), habitat quality was reduced primarily due to reduced habitat depth (**Table 14**) and slower water velocity caused by reduced streamflow (**Table 5b**). Streambed conditions improved in 2007 with less percent fines (**Table 15**) and less embeddedness (**Table 16**). Pool escape cover was similar between years (**Table 17**).

R-3. Habitat Change in Aptos and Valencia Creeks

Refer to **Appendix A** for maps of reach locations. 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 other watersheds by 1999, such as the San Lorenzo River (**Alley 2000**). From 2006 to 2007 habitat conditions continued to improve in 3 of 4 studied reaches in the Aptos Creek watershed, with the exception of the lower reach in Aptos Creek (Table 41). Despite the reduced baseflow in 2007 (**Table 5b**), pool depth was similar between years in upper Aptos Reach 4, pool escape cover increased and streambed conditions improved (reduced embeddedness and less percent fines) (**Table 18-20**). In the lower Aptos Reach 3, streambed conditions also greatly improved, but escape cover in pools remained similar and average pool depth decreased due to an increase in pool frequency resulting from reduced streamflow, increase in habitat breaks and some 2006 step-run/ run habitat becoming pool habitat in 2007. The percent of pool habitat increased in the Aptos Creek reaches 5-11% but not in the Valencia Creek reaches (**Table 5c**).

Improved habitat quality in both Valencia Creek reaches included more pool escape cover, lower embeddedness and generally less percent fines, with similar pool depth between years (**Tables 18-20**). Pools and runs in the lower Reach 2 remained similarly high in percent fines in 2006 and 2007. However, in the lower Valencia reach, the already limited and poorly developed pool habitat, where steelhead densities were the highest, was reduced even further from 33% in 2006 to 21% in 2007 (**Table 5c**).

R-4. Trends in Habitat Change in Corralitos, Shingle Mill and Browns Valley Creeks

Refer to **Appendix A** for maps of reach locations. No habitat typing data were collected for reaches of the Corralitos sub-watershed in 1981 or 1994. Substrate measurements were made at fish sampling sites in 1981 and 1994 (**Smith 1982**; **Alley 1995a**) and in habitat typed reaches in 2006 and 2007. Habitat quality in the lower 2 of the 3 repeated reaches of Corralitos Creek in 2007 was similar between 2006 and 2007, while the upper reach declined in quality. Water depth in all 3 repeated reaches declined in 2007 due to reduced streamflow, but the decline was more substantial in upper Reach 9. Pool habitat increased 3-10% in all reaches and fastwater habitat, where most aquatic insects live, was diminished compared to 2006 (**Table 5c**). In the lower Reaches 3 and 8, escape cover increased in both pools and step-runs, while it was only slightly improved in Reach 9 in pools. Embeddedness lessened in pools and step-runs of Reaches 3 and 8 but only in Pools of Reach 9. Percent fines in pools declined 9-10% in Reaches 3 and 8 but was similar in Reach 9 between years.

Habitat quality in Shingle Mill Gulch declined in both studied reaches in 2007. This was due to the reduced streamflow that caused shallower pools and step-runs (**Tables 18 and 20**) and loss of step-run habitat that could support juveniles to increased shallow riffles (**Tables 5c and 19**) that were mostly unused. Streambed conditions improved in 2007 with less embeddedness and less percent fines in pools and step-runs (**Tables 18 and 20**). Pool habitat increased in both reaches and overall fastwater habitat where most aquatic insects live was diminished (**Table 5c**). Pool escape cover remained similar in 2006 and 2007 (**Table 18**).

Overall habitat quality in the two studied reaches of Browns Valley Creek declined in 2007 compared to 2006. This was due to reduced streamflow (**Table 5b**) that caused much shallower pools and step-runs and slower water velocity (reduced insect drift rate) (**Tables 18 and 20**). Step-run habitat that could have provided habitat to juveniles was lost to shallow riffle habitat (**Table 5c**) that was poorly used. However, streambed conditions improved in both reaches with reduced embeddedness and percent fines in pools and step-runs. Escape cover in pools and step-runs also increased in 2007. Pool habitat increased in both reaches and fastwater habitat where most aquatic insects live was diminished (**Table 5c**).

Table 5a. Fall STREAMFLOW (cubic feet/ sec) Measured by Flowmeter at SAN LORENZO Sampling Sites Before Fall Storms, 1995-2001 and 2003-2006.

Site # - Location	1995	1996	1998	1999	2000	2001	2003	2004	2005	2006
1- SLR/ Paradise Pk	22.9	25.5	34.3	26.2	21.7	19.6				26.2
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 Ck	4.2		10.3	4.9	4.2	3.1	4.2	2.7	7.1	6.4
9- SLR/Below Boulder Ck	4.6		7.2	3.5		3.0	3.7	2.1	5.8	
10- SLR/Below Kings Ck				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	
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*
13b- Zayante above Bean			3.9	2.9	2.8	1.9	2.1	1.7	3.2	2.8
14b- Bean below Lockhart G	1.5		1.1	1.1	1.0	1.1	1.1	0.77	1.0	1.1
15- Fall	2.0		3.4	2.2	1.7	1.7				
16- Newell	1.6				0.51					
17a- Boulder	2.0		2.2		1.1	1.0	1.25	0.9	1.6	1.7
18a- Bear				0.45	0.61	0.34	0.6	0.51	0.90	1.1
19a- Lower Kings			1.1	0.11	0.17	0.02				
20a- Lower Carbonera	0.33	0.36								
21a-2- Branciforte			0.80							

*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 and 2007 and Obtained from Stream Gages.

Location	2006	2007
SLR at Sycamore Grove	34.8	14.6
SLR at Big Trees	26	11
SLR above Love Cr	13.14	5.42 After*
SLR below Boulder Cr	7.49	2.87 After
SLR @ Two Bar Cr	1.81	0.78
Zayante @ SLR	6.51	3.80
Zayante below Lompico Cr	1.21	0.96
Bean at Mt. Hermon	2.6	1.9
Bean Below Lockhart Gulch	1.37	0.72
Newell Cr @ Rancho Rio	1.18	1.16
Boulder Cr @ SLR	2.09	0.84
Bear Cr @ SLR	1.87	0.37
Soquel Cr at USGS Gage	7.1**	1.3**
Soquel Cr @ Bates Cr	5.73	-
W. Branch Soquel @ S.J. Olive Springs	2.17 (1.6 cfs in 2000)	1.75 After
W. Branch above Hester Creek (Soquel Creek Water District Weir/ Brook Kraeger - preliminary)	1.48 (15 Sep)	1.04 (15 Sep)
E. Branch Soquel @ 152 Olive Springs Rd.	-	1.01 After
E. Branch below Amaya and above Olive Springs Quarry (Soquel Creek Water District Weir/ Brook Kraeger- preliminary)	1.53 (15 Sep)	0.43 (15 Sep)
Aptos Cr @ Valencia Cr	2.48	1.21 After
Corralitos Cr below Browns Valley Road Bridge	15.94 (May)	0.49 (May)
Corralitos Cr @ Rider Cr	3.35	2.50 After
Browns Cr @ 621 Browns Valley Rd	0.96	0.30 After

* After 2 early October storms that increased baseflow.
** Estimated from USGS Hydrographs.

Table 5c. Habitat Proportions in Habitat-Typed Reaches of the San Lorenzo, Soquel, Aptos and Corralitos Watersheds in 2006 and 2007.

Reach	2006 Pool Habitat Feet/ Percent / # Habitats	2007 Pool Habitat Feet/ Percent / # Habitats	2006 Riffle Habitat Feet/ Percent / # Habitats	2007 Riffle Habitat Feet/ Percent / # Habitats	2006 Run/Step-run Habitat Feet/ Percent / # Habitats	2007 Run/ Step-run Habitat Feet/ Percent / #Habitats
Low. San Lorenzo #1	1423/ 4%/ 4	**1653/ 1%/ 5**	657/ 1%/ 8	**533/ 20%/ 8**	1122/ 35%/ 7	**527/ 19%/ 6**
Low. San Lorenzo #2		**2371/68%/ 12**		**873/ 25%/ 10**		**232/ 7%/ 4**
Low. San Lorenzo #4	2728/64%/ 5	**3347/82%/ 7**	745/ 18%/ 8	**480/ 12%/ 8**	776/ 18%/ 7	**269/ 7%/ 3**
Mid. San Lorenzo #6	3172/67%/ 8	**3456/75%/ 12**	616/ 13%/ 9	**592/ 13%/ 11**	939/ 20%/ 10	**569/ 12%/ 8**
Mid. San Lorenzo #8	3349/80%/ 11	**3481/83%/ 16**	421/ 10%/ 7	**224/ 5%/ 8**	437/ 10%/ 4	**487/ 12%/ 8**
Up. San Lorenzo #11	2012/60%/ 20	**2310/70%/ 21**	490/ 15%/ 13	**235/ 7%/ 12**	836/ 25%/ 10	**775/ 23%/ 16**
Zavante #13a	1704/61%/ 15	**1669/61%/ 15**	612/ 22%/ 15	**546/ 20%/ 14**	473/ 17%/ 7	**523/ 19%/ 7**
Zavante #13c		**2371/83%/ 23**		**292/ 10%/ 14**		**195/ 7%/ 7**
Zavante #13d	1404/55%/ 24	**1857/71%/ 36**	200/ 8%/ 8	**120/ 5%/ 9**	943/ 37%/ 17	**651/ 25%/ 22**
Lompico #13e	1474/50%/ 33	**1667/62%/ 39**	594/ 20%/ 20	**432/ 16%/ 26**	878/ 30%/ 19	**600/ 22%/ 21**
Bean #14b		**1719/61%/ 25**		**529/ 19%/ 19**		**580/ 21%/ 11**
Bean #14c	1833/71%/ 27	**662/ 71%/ 30**	477 19%/ 22	**19 21%/ 26**	265 10%/ 5	**68/ 7%/ 5**
Newell # 16	1421/59%/ 15		477 20%/ 16		52 21%/ 10	
Boulder #17a	1433 55%/ 17	**1369 52%/ 19**	42 16%/ 14	**40 15%/ 16**	76 29%/ 13	**873/ 33%/ 17**
Boulder #17b	1350 66%/ 22	**1345 63%/ 20**	411 20%/ 11	**28 13%/ 10**	28 14%/ 4	**514 24%/ 7**
Bear #18a	2128/64%/ 17	**2395 70%/ 23**	66 20%/ 14	**30 9%/ 12**	53 16%/ 11	**709/ 21%/ 17**
Branciforte #21a-1		**2279 83%/ 21**		**31 12%/ 19**		**158/ 6%/ 10**

Reach	2006 Pool Habitat Feet/ Percent / # Habitats	2007 Pool Habitat Feet/ Percent / # Habitats	2006 Riffle Habitat Feet/ Percent / # Habitats	2007 Riffle Habitat Feet/ Percent / # Habitats	2006 Run/Step-run Habitat Feet/ Percent / # Habitats	2007 Run/ Step-run Habitat Feet/ Percent / #Habitats
Branciforte #21a-2	1776/69%/ 22	**1998/ 3%/ 28**	347/ 13%/ 11	**268/ 10%/ 18**	465/ 18%/ 7	**472/ 17%/ 18**
Soquel #1		**3380/80%/ 16**		**445/ 10%/ 12**		**411/ 10%/ 9**
Soquel #3a	1419/56%/ 11	**1618/64%/ 11**	627/ 25%/ 13	**409/ 16%/ 10**	471/ 19%/ 8	**499/ 20%/ 10**
Soquel #7	1870/55%/ 15	**2104/62%/ 20**	773/ 23%/ 17	**446/ 13%/ 14**	729/ 22%/ 12	**832/ 25%/ 11**
Soquel #8		**1514/63%/ 11**		**381/ 16%/ 9**		**495/ 21%/ 5**
E. Branch Soquel #9a	1405/46%/ 15	**1732/56%/ 18**	815/ 26%/ 16	**338/ 11%/ 12**	858/ 28%/ 9	**1018/ 33%/ 14**
E. Branch Soquel #12a	906/ 35%/ 16	**1126/45%/ 25**	285/ 11%/ 13	**122/ 5%/ 9**	1430/ 54%/ 13	**1238/ 50%/ 18**
W Branch Soquel #13		**1833/67%/ 16**		**371/ 14%/ 14**		**517/ 19%/ 10**
W. Branch Soquel #14b	1876/62%/ 27	**2218/71%/ 33**	666/ 22%/ 21	**313/ 10%/ 14**	473/ 16%/ 11	**604/ 19%/ 17**
Aptos #2	1627/59%/ 16	**1911/70%/ 21**	348/ 13%/ 13	**443/ 16%/ 19**	774/ 28%/ 9	**379/ 14%/ 9**
Aptos #3	1461/56%/ 20	**1744/61%/ 23**	586/ 23%/ 14	**730/ 26%/ 22**	548/ 21%/ 12	**367/ 13%/ 12**
Valencia #2	955/ 33%/ 37	**608/ 21%/ 19**	296/ 10%/ 12	**759/ 26%/ 31**	1634/ 57%/ 28	**1508/ 52%/ 25**
Valencia #3	1828/70%/ 43	**1797/69%/ 43**	317/ 12%/ 22	**507/ 19%/ 32**	454/ 18%/ 10	**314/ 12%/ 11**
Corralitos #0		**1520/56%/ 22**		**241/ 9%/ 11**		**938/ 35%/ 13**
Corralitos #3	1287/47%/ 16	**1417/54%/ 18**	1035/38%/ 16	**477/ 18%/ 18**	407/ 15%/ 6	**709/ 27%/ 11**
Corralitos #8	1275/43%/ 20	**1479/51%/ 26**	705/ 24%/ 19	**322/ 11%/ 14**	961/ 33%/ 13	**1126/ 38%/ 16**
Corralitos #9	839/ 32%/ 25	**983/ 35%/ 27**	170/ 6%/ 8	**77/ 3%/ 4**	1624/ 62%/ 21	**1780/ 63%/ 23**
Shingle Mill #1	543/ 26%/ 24	**719/ 35%/ 39**	138/ 7%/ 4	**264/ 13%/ 15**	1402/ 67%/ 21	**1098/ 53%/ 27**

Reach	2006 Pool Habitat Feet/ Percent / # Habitats	2007 Pool Habitat Feet/ Percent / # Habitats	2006 Riffle Habitat Feet/ Percent / # Habitats	2007 Riffle Habitat Feet/ Percent / # Habitats	2006 Run/Step-run Habitat Feet/ Percent / # Habitats	2007 Run/ Step-run Habitat Feet/ Percent / #Habitats
Shingle Mill #3	1373/52%/ 42	**1591/61%/ 61**	279/ 11%/ 14	**686/ 26%/ 41**	992/ 37%/ 24	**338/ 13%/ 16**
Browns Valley #1	1194/44%/ 26	**1321/51%/ 30**	317/ 12%/ 10	**513/ 20%/ 20**	1198/ 44%/ 14	**757/ 29%/ 16**
Browns Valley #2	1213/46%/ 29	**1479/56%/ 43**	92/ 3%/ 5	**641/ 24%/ 29**	1341/ 51%/ 19	**530/ 20%/ 18**

Table 6. Averaged Mean and Maximum WATER DEPTH (ft) of Habitat in SAN LORENZO Reaches Since 2003.

Reach	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Run/Step Run 2003	Run/Step Run 2005	Run/Step-Run 2006	Run/Step Run 2007
1- L. Main			2.5/ 4.4	**1.8/ 3.0**			1.1/ 1.5	**0.8/ 1.2**			2.4/ 3.1	**1.0/1.5**
2- L. Main	3.0/ 5.2 (2000)			**2.5/ 4.1**	1.2/ 2.0 (2000)			**0.9/ 1.4**	1.7/ 2.4 (2000)			**1.4/ 2.2**
3- L. Main												
4- L. Main			2.6/ 4.4	**1.9/ 3.8**			0.9/ 1.5	**0.7/ 1.2**			1.6/ 2.2	**1.4/ 2.1**
5- L. Main												
6- M. Main	1.9/ 3.5	1.9/ 3.4	2.2/ 4.3	**1.7/ 3.4**	0.6/ 0.9	0.9/ 1.4	0.8/ 1.3	**0.6/ 1.0**	1.2/ 1.9	1.1/ 2.1	1.3/ 1.85	**0.9/ 1.3**
7- M. Main	1.8/ 3.7	2.0/ 3.5			0.6/ 1.0	0.7/ 1.1			0.9/ 1.4	1.1/ 1.4		
8- M. Main	2.5/ 5.2	2.6/ 5.8	2.7/ 5.5	**2.3/ 4.3**	0.6/ 1.0	1.0/ 1.5	1.1/ 1.6	**0.6/ 1.0**	1.0/ 1.4	1.3/ 2.1	1.3/ 2.25	**0.8/ 1.2**
9- M. Main	1.7/ 3.0	1.9/ 3.5			0.6/ 1.1	0.7/ 1.1			0.8/ 1.2	1.0/ 1.4		
10- U. Main	1.4/ 2.9	1.4/ 2.8			0.3/ 0.5	0.4/ 0.7			0.5/ 0.9	0.7/ 1.0		
11- U. Main		1.1/ 2.0	1.1/ 2.1	**1.0/ 1.9**		0.4/ 0.7	0.5/ 0.8	**0.2/ 0.4**		0.5/ 1.0	0.6/ 1.1	**0.4/ 0.6**
12b- U. Main		1.3/ 2.2				0.3/ 0.6				0.5/ 0.8		
Zavante 13a	1.1/ 2.1	1.5/ 2.5	1.6/ 2.6	**1.4/ 2.2**	0.7/ 1.1	0.6/ 0.9	0.6/ 0.9	**0.5/ 0.8**	0.7/ 1.2	0.8/ 1.1	0.85/ 1.2	**0.6/ 1.0**
Zavante 13b	1.5/ 2.4	1.7/ 2.9			0.5/ 0.7	0.5/ 0.9			0.8/ 1.1	0.7/ 1.2		
Zavante 13c	1.2/ 2.2	1.35/ 2.4		**1.2/ 2.2**	0.4/ 0.7	0.5/ 0.8		**0.2/ 0.5**	0.5/ 1.0	0.7/ 1.0		**0.5/ 0.9**
Zavante 13d	1.1/ 1.7	1.1/ 2.1	1.35/ 2.1	**1.0/ 1.5**	0.4/ 0.6	0.5/ 0.7	0.45/ 0.8	**0.3/ 0.5**	0.8/ 1.3	0.8/ 1.4	0.9/ 1.4	**0.6/ 1.0**
Lompico 13e			1.1/ 1.8	**0.8/ 1.5**			0.3/ 0.6	**0.15 /0.4**			0.45/ 0.8	**0.35/ 0.65**
Bean 14a	0.8/ 1.6	1.0/ 1.9			0.4/ 0.7	0.4/ 0.7			0.6/ 1.2	0.7/ 1.1		

Reach	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Run/Step Run 2003	Run/Step Run 2005	Run/Step-Run 2006	Run/Step Run 2007
Bean 14b	0.9/ 1.5	1.0/ 1.9		**1.1/ 1.8**	0.3/ 0.6	0.3/ 0.5		**0.2/ 0.4**	0.6/ 0.9	0.6/ 0.8		**0.4/ 0.8**
Bean 14c	1.0/ 1.7	1.0/ 1.7	1.0/ 1.8	**0.8/ 1.5**	0.1/ 0.3	0.1/ 0.3	0.2/ 0.3	**0.03 /0.1**	0.25/ 0.4	0.2/ 0.5	0.35/ 0.5	**0.1/ 0.2**
Newell 16			1.6/ 2.8				0.3/ 0.5				0.6/ 0.9	
Boulder 17a		1.8/ 2.9	2.0/ 3.1	**1.7/ 2.7**		0.5/ 0.9	0.6/ 1.0	**0.4/ 0.7**		0.7/ 1.2	0.9/ 1.4	**0.6/ 1.0**
Boulder 17b		1.7/ 2.8	1.7/ 2.8	**1.6/ 2.7**		0.4/ 1.0	0.6/ 1.0	**0.4/ 0.75**		0.7/ 1.2	0.8/ 1.4	**0.6/ 1.1**
Boulder 17c		1.9/ 2.9				0.4/ 0.8				0.9/ 1.5		
Bear 18a	2.0/ 3.4	2.0/ 3.4	2.0/ 3.35	**1.4/ 2.4**	0.4/ 0.7	0.4/ 0.7	0.6/ 0.9	**0.2/ 0.4**	0.6/ 0.9	0.7/ 1.1	0.8/ 1.25	**0.4/ 0.7**
Bear 18b												
Branciforte 21a-1				**1.2/ 2.2**				**0.15 /0.3**				**0.3/ 0.5**
Branciforte 21a-2			1.1/ 1.9	**1.0/ 1.7**			0.3/ 0.5	**0.2/ 0.4**			0.5/ 1.0	**0.4/ 0.7**
Branciforte 21b		1.1/ 1.7				0.4/ 0.7				0.3/ 0.6		

Table 7. Average PERCENT FINE SEDIMENT* IN SAN LORENZO Reaches River Since 2003.

Reach	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Run/Step-Run 2003	Run/Step-Run 2005	Run/Step Run 2006	Run/Step Run 2007
1			80	**65**			20	**15**			40	**46**
2	70 (2000)			**42**	25 (2000)			**10**	50 (2000)			**26**
3												
4			75	**46**			20	**13**			50	**42**
5												
6	70	70	75	**61**	25	20	25	**17**	35	40	38	**18**
7	70	70			25	20			50	40		
8	55	65	60	**41**	25	20	20	**7**	40	25	25	**11**
9	70	60			25	15			30	30		
10	60	70			20	15			25	35		
11	55	35	40	**32**	40	15	25	**10**	45	25	15	**24**
12b	50	35			35	35			40	10		
Zavante 13a	85	65	65	**59**	40	25	35	**22**	70	50	40	**36**
Zavante 13b	65	65			30	30			45	30		
Zavante 13c	50	45		**45**	25	10		**9**	30	20		**27**
Zavante 13d	40	40	50	**38**	25	25	15	**13**	25	25	40	**21**
Lompico 13e			50	**49**			20	**15**			30	**24**
Bean 14a	80	70			40	25			70	35		
Bean 14b	85	80		**67**	45	15		**18**	80	45		**58**
Bean 14c	70	60	65	**42**	25	5	15	**6**	40	30	40	**28**
Newell 16			25				5				20	
Boulder 17a		30	35	**31**		20	5	**12**		15	20	**17**
Boulder 17b		30	35	**31**		5	10	**5**		15	15	**12**
Boulder 17c		25				5				5		
Bear 18a	55	50	60	**41**	15	15	15	**7**	25	20	25	**13**
Bear 18b												
Branciforte 21a-1				**65**				**7**				**30**
Branciforte 21a-2			75	**50**			40	**12**			55	**35**
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 2003.

Reach	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Run/Step-Run 2003	Run/Step-Run 2005	Run/Step-Run 2006	Run/Step -Run 2007
1			59	**50**			31	**23**			49	**48**
2				**26**	30* (2000)			**13**	30* (2000)			**23**
3												
4			64	**43**			37	**19**			47	**37**
5												
6	52	49	56	**45**	27	31	31	**18**	38	46	41	**34**
7	53	54			34	27			49	40		
8	49	53	56	**40**	32	25	28	**18**	44	29	35	**28**
9	52	39			32	25			40	31		
10	38	39			32	27			32	34		
11		58	48	**34**		30	33	**22**		45	27	**31**
12b		58				27				45		
Zavante 13a	44	45	54	**44**	33	29	23	**25**	41	44	50	**36**
Zavante 13b	44	46			36	25			43	39		
Zavante 13c	48	48		**36**	29	25		**19**	33	38		**31**
Zavante 13d	41	47	51	**55**	35	48	37	**30**	33	43	42	**39**
Lompico 13e			55	**52**			42	**16**			46	**37**
Bean 14a	46	45			32	21			49	37		
Bean 14b	35	41		**45**	35	20		**22**	41	29		**36**
Bean 14c	49	50	62	**39**	19	27	36	**8**	43	46	52	**25**
Newell 16			36				12				33	
Boulder 17a		34	48	**37**		24	29	**18**		30	33	**27**
Boulder 17b		36	43	**33**		14	24	**22**		29	34	**33**
Boulder 17c		31				18				13		
Bear 18a	48	42	54	**33**	28	22	35	**28**	47	30	41	**36**
Bear 18b												
Brancifort e 21a-1				**60**				**31**				**55**
Brancifort e 21a-2			68	**62**			41	**30**			59	**36**
Brancifort e 21b		41				28				32		

* Was from sampling sites and not reaches.

Table 9. Reach-wide ESCAPE COVER Index (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
1	0.187	0.244	0.084	-	-	0.270	0.257
2	-	0.503	0.260	-	-		0.228
3	0.250	0.216	0.257	-	-		
4	0.125	0.078	0.109	-	-	0.183	0.354
5	0.032	0.001	0.222	-	-		
6	**0.099**	**0.093**	**0.042**	**0.027**	**0.152**	**0.101**	**0.072**
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**
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
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 10. Reach-wide ESCAPE COVER Index (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
1	0.273	0.130	0.064	-	-	0.131	0.120
2	0.228	0.136	0.100	-	-		0.282
3	0.186	0.113	0.144	-	-		
4	0.234	0.159	0.091	-	-	0.125	0.204
5	0.071	0.249	0.261	-	-		
6	**0.145**	**0.107**	**0.044**	**0.068**	**0.098**	**0.101**	**0.049**
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**
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
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 Index (Habitat Typing Method*) in Pool Habitat in MAINSTEM Reaches of the SAN LORENZO, Based on Habitat Typed Segments.

Reach	Pools 2003	Pools 2005	Pools 2006	Pools 2007
1	-	-	0.271	0.186
2	-	-		0.076
3	-	-		
4	-	-	0.203	0.275
5	-	-		
6	**0.077**	**0.077**	**0.044**	**0.083**
7	**0.134**	**0.105**		
8	**0.026**	**0.027**	**0.039**	**0.057**
9	**0.037**	**0.070**		
10	0.054	0.051		
11	0.054 (2000)	0.059	0.031	0.034
12	-	0.178		

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

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

Reach	1998	1999	2000	2003	2005	2006	2007
Zayante 13a	0.320	0.069	0.056	0.169	0.081	0.074	**0.071**
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**
Zayante 13d	0.145	0.191	0.132	0.237	0.269	0.126	**0.117**
Lompico 13e						0.089	**0.082**
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**
Bean 14c	0.259	0.093	0.100	0.142	0.141	0.131	**0.142**
Newell 16	0.285		0.325			0.120	
Boulder 17a	0.131	0.051	0.061	-	0.108	0.064	**0.076**
Boulder 17b	0.129	0.141	0.164	-	0.232	0.100	**0.140**
Boulder 17c	0.250	0.072	0.057	-	0.143		
Bear 18a	0.069	-	0.103	0.119	0.114	0.074	**0.088**
Branciforte 21a-1							**0.140**
Branciforte 21a-2						0.121	**0.134**
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 13. ESCAPE COVER Index (Habitat Typing Method*) for RUN/STEP-RUN HABITAT in TRIBUTARY Reaches of the SAN LORENZO.

Reach	1998	1999	2000	2003	2005	2006	2007
Zayante 13a	0.127	0.059	0.059	0.065	0.031	0.038	**0.027**
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**
Zayante 13d	0.050	0.098	0.143	0.223	0.297	0.071	**0.101**
Lompico 13e						0.001	**0.042**
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**
Bean 14c	-	0.018	0.023	0.015	0.012	0.009	**0.0**
Newell 16	0.072		0.129			0.020	
Boulder 17a	0.188	0.093	0.170	-	0.135	0.169	**0.138**
Boulder 17b	0.116	0.156	0.137	-	0.194	0.102	**0.114**
Boulder 17c	0.019	0.122	0.107	-	0.114		
Bear 18a	0.073	-	0.177	0.063	0.088	0.063	**0.027**
Branciforte 21a-1							**0.087**
Branciforte 21a-2						0.028	**0.045**
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 14. Averaged Mean and Maximum WATER DEPTH (ft) of Habitat in SQOUEL CREEK Reaches Since 2003 with Pool Depths Since 2000.

Reach	Pool 2000	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Run/StepRun 2003	Run/Step Run 2005	Run/Step Run 2006	Run/Step Run 2007
1	1.3/ 2.5	1.4/ 2.7	1.1/ 2.8		**1.2/ 2.7**	-/ 0.5	-/ 0.7		**0.3/ 0.4**	-/ 0.7	-/ 0.8		**0.4/ 0.5**
2	1.0/ 1.9	1.0/ 1.6	1.0/ 1.7			-/ 0.5	-/ 0.6			-/ 0.7	-/ 1.1		
3	1.3/ 2.4	1.35/ 2.5	1.3/ 2.3	1.4/ 2.5 partial*	**1.4/ 2.3** partial*	-/ 0.5	-/ 0.7	0.5/ 0.8 partial	**0.3/ 0.5**		-/ 1.0	0.7/ 1.0 partial	**0.4/ 0.6** partial
4	1.3/ 2.3	1.2/ 2.6	1.1/ 2.6			-/ 0.6	-/ 0.8			-/ 0.7	-/ 0.9		
5	1.3/ 2.2	1.2/ 2.2	1.2/ 2.3			-/ 0.5	-/ 0.7			-/ 0.8	-/ 0.9		
6	1.3/ 2.4	1.45/ 2.5	1.25/ 2.2			-/ 0.6	-/ 0.7			-/ 0.8	-/ 0.9		
7	1.4/ 2.4	1.6/ 2.9	1.2/ 2.2	1.3/ 2.3 partial	**1.2/ 2.1** partial	-/ 0.7	-/ 0.8	0.5/ 0.8 partial	**0.3/ 0.6** partial	-/ 0.9	-/ 0.9	0.8/ 1.2 partial	**0.3/ 0.6** partial
8	1.5/ 2.7	1.6/ 2.9	1.4/ 2.7		**1.45/ 2.9** partial	-/ 0.6	-/ 0.8		**0.4/ 0.6** partial	-/ 0.9	-/ 0.9		**0.5/ 0.9** partial
9	1.4/ 2.3		1.3/ 2.1	1.5/ 2.5	**1.25/ 2.2**		-/ 0.6	0.4/ 0.6	**0.2/ 0.4**		-/ 0.9	0.6/ 1.0	**0.4/ 0.6**
10	1.5/ 2.4												
11	1.9/ 3.3												
12a	1.1/ 1.6		1.1/ 1.7	1.3/ 2.05	**0.8/ 1.4**		-/ 0.6	0.45/ 0.8	**0.1/ 0.2**		-/ 1.1 (S.run)	0.7/ 1.2	**0.3/ 0.7**
12b	1.3/ 2.0		1.1/ 1.6				-/ 0.5				-/ 1.0 (S.Run)		
13	1.3/ 2.7				**1.1/ 2.2 partial**				**0.3/ 0.5 partial**				**0.5/ 0.8 partial**
14a	1.3/ 2.4		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**			0.4/ 0.6	**0.2/ 0.4**			0.7/ 1.0	**0.5/ 0.8**
14c		1.4/ 2.4 2002											

*Partial, ½-mile segments habitat typed in 2006–2007. Previously, the entire reach was habitat typed.

Table 15. Average PERCENT FINE SEDIMENT in Habitat-typed Reaches in SOQUEL CREEK Since 2003 with Pool Sediment Since 2000.

Reach	Pool 2000	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Run/Step-Run 2003	Run/Step-Run 2005	Run/Step-Run 2006	Run/Step-Run 2007
1	81	73	84		59	21	25		18	45	36		29
2	71	69	80			20	24			47	34		
3	77	70	75	62 partial*	55 partial*	25	17	14 partial	17 partial	34	43	29 partial	29 partial
4	69	72	61				21				29		
5	72	66	69				21				27		
6	68	59	63				14				26		
7	80	66	69	69 partial	52 partial		17	21 partial	20 partial		35	33 partial	25
8	70	59	64		46 partial		16		14 partial		24		25 partial
9	65		56	62	47	13	17	12	13		25	30	24
10	63												
11	56												
12a	48		33	40	29		9	12	6		15 (S.run)	21 (S.run)	20 (S.run)
12b	49		36				5				18		
13	73				64 partial				26 partial				29 partial
14a	71		55	66			15	14			31 (run)	28 (run)	
14b				51	40			15	9			35 (run)	26 (run)
14c													

*Partial, ½-mile segments habitat typed in 2006–2007. Previously, the entire reach was habitat typed.

Table 16. Average EMBEDDEDNESS in Pool and Fastwater (Riffle and Run) Habitat of SOQUEL CREEK Reaches Since 2003 with Pool Embeddedness Since 2000.

Reach	Pool 2000	Pool 2003	Pool 2005	Pool 2006	Pool 2007	Riffle 2003	Riffle 2005	Riffle 2006	Riffle 2007	Run/Step-Run 2003	Run/Step-Run 2005	Run/Step-Run 2006	Run/Step-Run 2007
1	47	55	57		**48**	33	25		**22**	55	35		**29**
2	55	60	56			39	34			69	46		
3	57	59	58	55 partial*	**40 partial**	30	27	27 partial	**17 partial**	46	42	46 partial	**28 partial**
4	55	58	61			40	31			54	48		
5	51	52	55			36	27			48	42		
6	52	50	53			31	28			43	40		
7	49	53	53	56 partial	**42 partial**	33	30	25 partial	**25** partial	43	43	39 partial	**35 partial**
8	53	49	60		**44** partial	38	29		**25** partial	46	45		**35 partial**
9	56		59	54	**47**		34	26	**18**		45	50	**37 partial**
10	51												
11	54												
12a	55		53	53	**55**		29	30	**41**		37 (S.run)	38 (S.run)	**47**
12b	51		59				30				47		
13	55				**50** partial				**26** partial				**39 partial**
14a	50		58	57			47	18			59(run)	34(run)	
14b		55 2002		57	**47**	33 2002		32	**17**	47(run) 2002		46(run)	**25**
14c		61 2002				30 2002				45 2002			

*Partial, ½-mile segments habitat typed in 2006–2007. Previously, the entire reach was habitat typed.

Table 17. ESCAPE COVER Index (Habitat Typing Method*) in Pool Habitat in SOQUEL CREEK, Based on Habitat Typed Segments.

Reach	Pool 2000	Pool 2003	Pool 2005	Pool 2006	Pool 2007
1	0.091	0.103	0.107		**0.147**
2	0.086	0.055	0.106		
3	0.085	0.092	0.141	0.178 partial**	**0.177** partial
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 partial	**0.164**
8	0.047	0.036	0.060		**0.070** partial
9	0.146		0.101	0.086	**0.117**
10	0.100				
11	0.068				
12a	0.113		0.222	0.175	**0.121**
12b	0.129		0.158		
13	0.077				**0.081** partial
14a	0.064			0.048	
14b		0.051 (2002)		**0.058**	**0.076**
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 2006–2007. Previously, the entire reach was habitat typed.

Table 18. Average POOL HABITAT CONDITIONS and Escape Cover Indices for Reaches in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks in 2006 and 2007 (and at Sampling Sites only in Aptos/ Valencia in 1981 and in Corralitos/ Browns in 1981 and 1994).

Sample Site	Mean Depth/ Maximum Depth		Escape Cover*		Embeddedness				Percent Fines			
	2006	2007	2006	2007	1981	1994	2006	2007	1981	1994	2006	2007
Aptos #3- in County Park	1.4/ 3.0	1.1/ 2.3	0.123	0.133	35		82	49	75		85	76
Aptos #4- Above Steel Bridge Xing (Nisene Marks)	1.3/ 2.4	1.2/ 2.2	0.059	0.102	35		80	59	65		78	62
Valencia #2- Below Valencia Road Xing	0.7/ 1.2	0.8/ 1.4	0.115	0.148	35		88	70	85		93	98
Valencia #3- Above Valencia Road Xing	1.0/ 1.7	0.9/ 1.6	0.119	0.154	55		82	56	70		83	78
Corralitos #0- Below Dam		1.25/ 1.95		0.106	65	40		35	45	40		37
Corralitos #3- Above Colinas Drive	1.5/ 2.6	1.3/ 2.3	0.138	0.191	60	45	52	41	45	35	47	38
Corralitos #8- Below Eureka Gulch	1.3/ 2.2	1.1/ 1.9	0.061	0.084	54	50	54	42	35	20	45	35
Corralitos #9- Above Eureka Gulch	1.2/ 1.8	1.0/ 1.6	0.160	0.185	56	60	47	37	35	15	33	30
Shingle Mill #1- Below 2nd Road Xing	1.15/ 1.8	0.8/ 1.3	0.180	0.198	42	45	71	58	23	8	49	33
Shingle Mill #3- Above 3rd Road Xing	1.15/ 1.8	0.9/ 1.4	0.190	0.196	60		71	62			55	38
Browns Valley #1- Below Dam	1.4/ 2.4	1.1/ 1.8	0.051	0.127	58	37	71	60	38	47	61	40
Browns Valley #2- Above Dam	1.45/ 2.35	1.0/ 1.7	0.120	0.161	73	47	69	59	47	37	53	36

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

Table 19. Average RIFFLE HABITAT CONDITIONS for Reaches in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks in 2006 and 2007 (and at Sampling Sites only in Aptos/Valencia in 1981 and Corralitos/Browns in 1981 and 1994).

Sample Site	Mean Depth/ Maximum Depth		Escape Cover*		Embeddedness				Percent Fines			
	2006	2007	2006	2007	1981	1994	2006	2007	1981	1994	2006	2007
Aptos #3- in County Park	0.4/ 0.7	0.3/ 0.6	0.007	0.061	50		48	21	68 riffle & run		26	14
Aptos #4- Above Steel Bridge Xing (Nisene Marks)	0.5/ 0.8	0.3/ 0.65	0.004	0.026	40		47	34	30 riffle & run		25	16
Valencia #2- Below Valencia Road Xing	0.3/ 0.4	0.2/ 0.4	0.003	0.022	15		54	29	48 riffle & run		50	36
Valencia #3- Above Valencia Road Xing	0.3/ 0.5	0.2/ 0.4	0.004	0.010	30		56	15	30 riffle & run		33	17
Corralitos #0- Below Dam		0.3/ 0.5		0.033	60	30		17	20	20		10
Corralitos #3- Above Colinas Dr.	0.5/ 0.9	0.4/ 0.6	0.028	0.080	53	30	26	12	35	10	18	7
Corralitos #8- Below Eureka Gulch	0.4/ 0.7	0.3/ 0.5	0.021	0.034	50	50	28	22	25	5	14	12
Corralitos #9- Above Eureka Gulch	0.5/ 0.8	0.3/ 0.5	0.041	0.0	60	30	33	23	35	7	7	8

Shingle Mill #1-Below 2nd Road Xing	0.25/ 0.5	0.1/ 0.3	0.022	0.029	45	40	19	30	10	0	31	3
Shingle Mill #3-Above 3rd Road Xing	0.2/ 0.3	0.1/ 0.2	0.020	0	20		25	30			5	4
Browns Valley #1-Below Dam	0.4/ 0.7	0.2/ 0.4	0	0.017	60	45	36	36	20	10	15	9
Browns Valley #2-Above Dam	0.3/ 0.6	0.2/ 0.4	0	0.005	35		40	33			15	13

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

Table 20. Average RUN or STEP-RUN (Most Common Used) HABITAT CONDITIONS for Reaches in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks in 2006 (and at Sampling Sites only in Aptos/Valencia in 1981 and Corralitos/Browns in 1981 and 1994).

Sample Site	Mean Depth/ Maximum Depth		Escape Cover*		Embeddedness				Percent Fines			
	2006	2007	2006	2007	1981	1994	2006	2007	1981	1994	2006	2007
Aptos #3- in County Park	0.75/ 1.4 run	0.4/ 0.8 run	0.030	0.023	40		66	32	68 riffle & run		53	52
Aptos #4- Above Steel Bridge Xing (Nisene Marks)	0.7/ 1.0 run	0.55/ 0.95 run	0.014	0.007			61	44	30 riffle & run		39	25
Valencia #2- Below Valencia Road Xing	0.3/ 0.6 run	0.3/ 0.6 run	0.018	0.025			77	-	48 riffle & run		90	98
Valencia #3- Above Valencia Road Xing	0.4/ 0.7 run	0.4/ 0.6 run	0.008	0.031			59	29	30 riffle & run		48	33
Corralitos #0- Below Dam		0.45/ 0.8 both		0.035				25				25
Corralitos #3- Above Colinas Dr.	0.75/ 1.1 run	0.6/ 0.9 run	0.017	0.052	60	40	43	16	90	60	25	19
Corralitos #8- Below Eureka Gulch	0.6/ 0.95 step-run	0.4/ 0.9 step-run	0.010	0.046	60	50	48	27	49	5	21	16
Corralitos #9- Above Eureka Gulch	0.8/ 1.3 step-run	0.5/ 1.0 step-run	0.063	0.055			34	40			16	18
Shingle Mill #1- Below 2nd Road Xing	0.6/ 1.2 step-run	0.4/ 0.8 step-run	0.013	0.034	45	30	48	35	18	5	19	5

Shingle Mill #3- Above 3rd Road Xing	0.4/ 0.8 step-run	0.3/ 0.6 step-run	0.023	0.060			45	38			18	14
Browns Valley #1- Below Dam	0.6/ 1.05 step-run	0.4/ 0.6 run	0.015	0.038	70	35	58	42	35	10	36	15
Browns Valley #2- Above Dam	0.6/ 1.05 step-run	0.4/ 0.65 run	0.015	0.066			58	39			32	19

* Habitat typing method = total feet of linear run and step-run cover divided by total habitat typed channel length as run and step-run habitat.

STEELHEAD DENSITY COMPARISONS

R-5. Comparison of 2007 Steelhead Densities in the San Lorenzo Drainage with Those Since 1997

Juvenile densities at 5 of the 6 mainstem sites sampled in 2007 were 36-89 percent below average for total density (Site 6 that was above average), and the pattern was similar for YOY juveniles (**Tables 21 and 22; Figures 1 and 2**). **All figures presented within the text may be found in color in the FIGURES section (page 221) after the REFERENCES AND COMMUNICATIONS.** Yearling and Size Class II/III densities were all below average (smolt-sized juveniles 43-92% below average) (**Tables 23 and 25; Figure 3**). Though below average, total densities and YOY densities were greater in 2007 than 2006 at 4 of 5 sites. Yearling densities were similarly low in both years and greater in 2007 at 2 of 5 sites. Size Class II/III densities were greater at only 1 of 5 sites in 2007 and generally less than 2 fish/ 100 ft. Mainstem sites were mostly rated as very poor based on smolt densities, but ranged as high as fair at Site 2 (**Table 41**).

At the 10 tributary sites with multiple-year density measurements in 2007, the total juvenile density was above average at 3 of 10 sites, and YOY density was above average at 4 of 10 sites (**Tables 26 and 27; Figures 1 and 2**). Lompico Zayante and lower Boulder creek sites had the highest total and YOY densities (Lompico highest in the watershed), followed by intermediate densities in upper Boulder, Bear and the uppermost sampled Branciforte creek sites. There were unusually low densities in Bean and the lowermost Branciforte creek sites. Yearling densities in 2007 were above average at 4 of 10 sites and greater than in 2006 at 9 of 9 sites (**Table 28**). Size Class II/II densities were above average at only 1 of 10 sites (**Table 29; Figure 3**). 4 of 10 Size Class II/III densities in 2007 were less than half the average density for those sites. The upper Zayante site was near average, and the Lompico site was above average. Half the tributaries sites were rated between very poor and below average based on smolt densities, with 4 fair and 1 good rating (upper Zayante 13d) (**Table 41**).

No juvenile coho salmon were captured in 2007 during our sampling or snorkeling at sites in the San Lorenzo system, as was the case in 2006. This was in contrast to 2005 when 4 juvenile coho were electrofished in Bean Creek and 5 were observed during NOAA Fisheries snorkel surveys in Bean Creek.

Figure 1. Total Juvenile Steelhead Site Densities in the San Lorenzo River in 2007 Compared to the 9-Year Average Density. (7th year for Mainstem (1), 6th year for Mainstem (2a), 2nd year for Lompico (13e) and 1st Year for Branciforte (21a-1)).

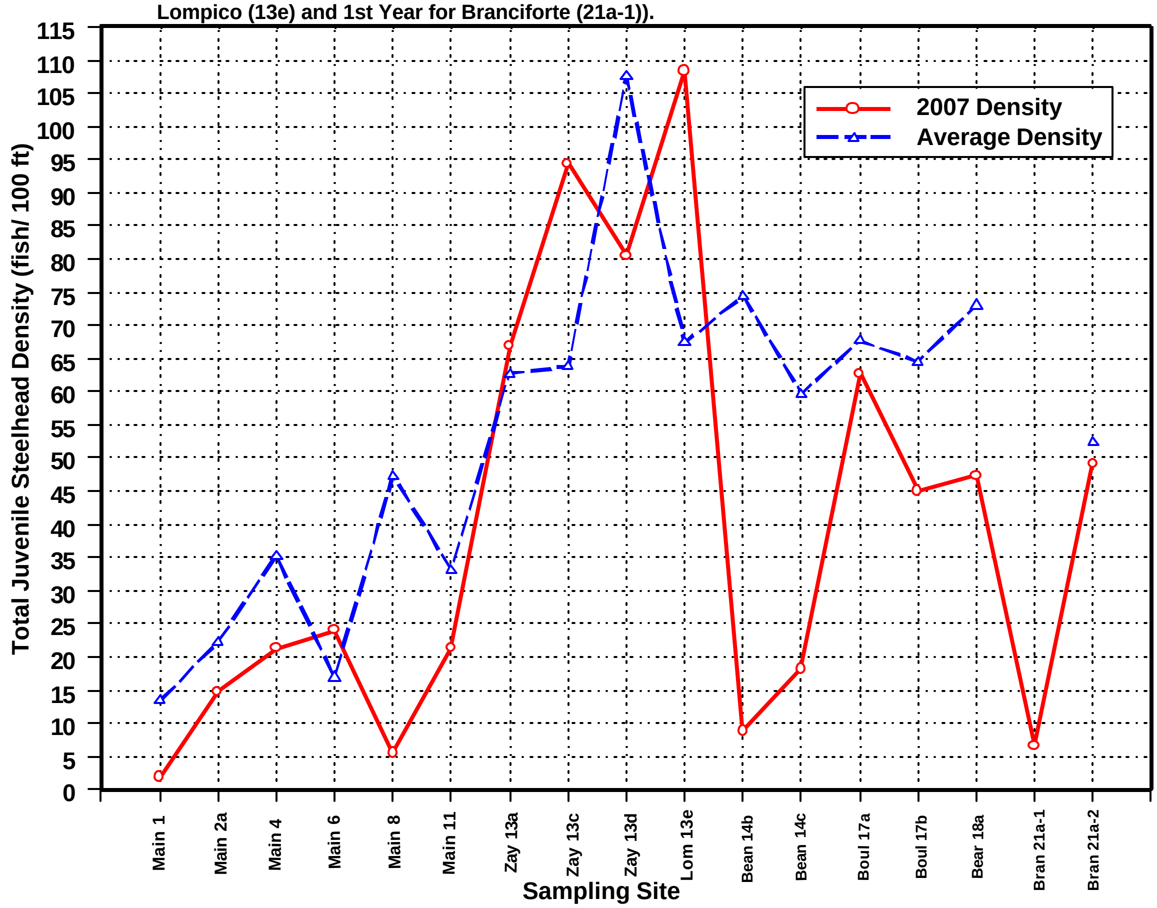


Figure 2. Juvenile Steelhead Site Densities for Young-of-the-Year in the San Lorenzo River in 2007 Compared to the 9-Year Average. (7the year for Mainstem (1), 6th year for Mainstem (2a), 2nd year for Lompico (13e) and 1st Year for Branciforte (21a-1).

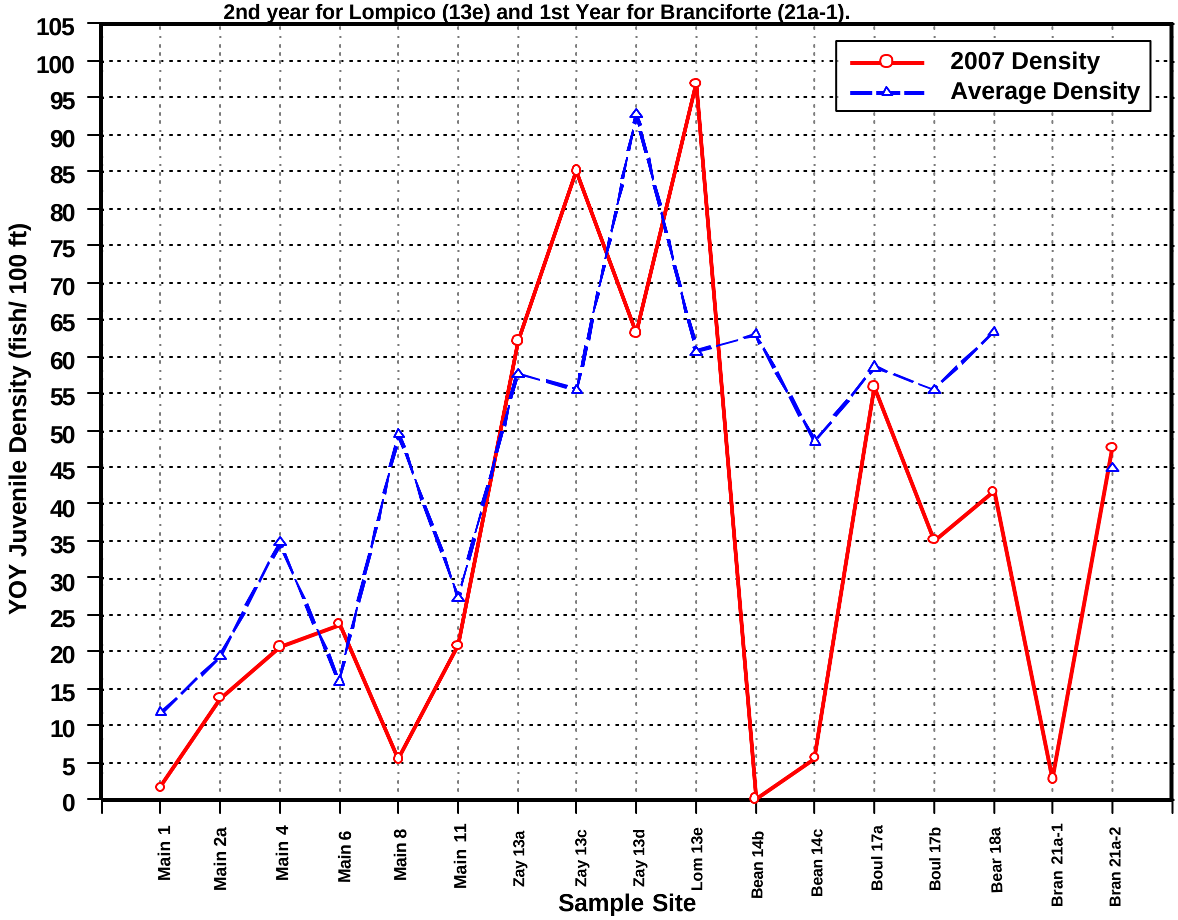


Figure 3. Juvenile Steelhead Site Densities for Size Classes II and III in the San Lorenzo River in 2007 Compared to the 9-Year Average. (7th year for Mainstem (1), 6th year for Mainstem (2a), 2nd Year for Lompico (13e) and 1st Year for Branciforte (21a-1).

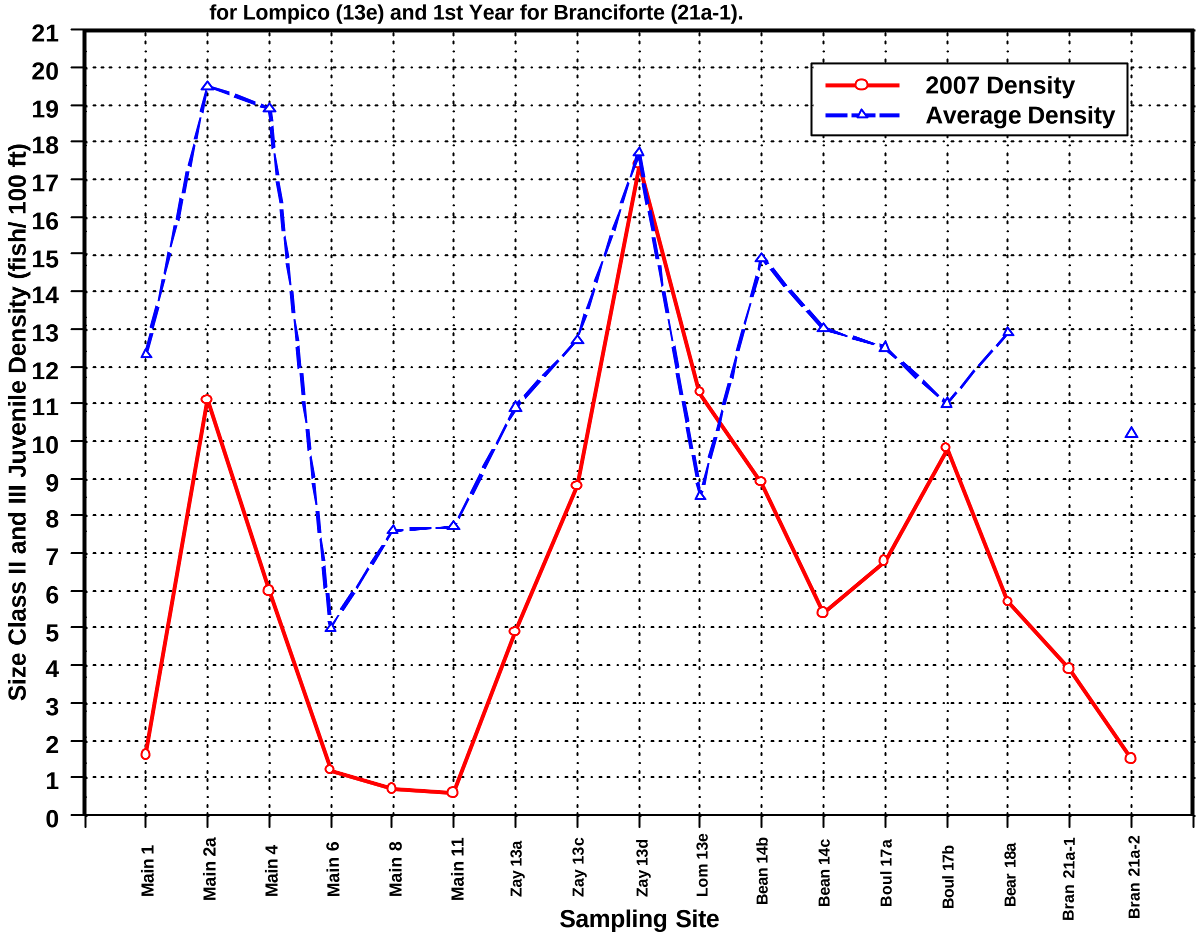


Table 21. Density of Juvenile Steelhead for ALL SIZES at MAINSTEM SAN LORENZO River Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
0a				5.4							
0b				4.3	5.2						4.8
1	34.2*	26.9	17.6	3.4	7.6				1.2	1.9	13.3
2a	74.9	21.4	4.6	3.9	13.5					14.8	22.2
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	35.3
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	16.9
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	47.3
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	25.1	57.2	45.7	32.3	3.0	21.3	33.1
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 22. Density of Juvenile Steelhead for the YOUNG-OF-THE-YEAR Age Class at MAINSTEM SAN LORENZO River Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
0a				2.2							
0b				3.3	2.3						2.8
1	32.3*	25.6	12.6	1.8	6.8				1.2	1.6	11.7
2a	66.3	19.2	3.2	2.7	11.0					13.7	19.4
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	34.7
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	16.0
7	143.5	19.8	5.7	3.6	12.0	29.7	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	49.5
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	15.9	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	27.3
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 Reach

Table 23. Density of Juvenile Steelhead for YEARLINGS AND OLDER at MAINSTEM SAN LORENZO River Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
0a				2.2							
0b				1.0	2.9						2.0
1	1.6*	1.4	2.9	1.9	0.5				0	0.3	1.2
2a	7.9	1.5	0.9	1.2	1.5					0.9	2.3
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	2.7
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	1.2
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	2.3
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	5.5
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 Reach

Table 24. Density of Juvenile Steelhead for SIZE CLASS I (<75 mm SL) at MAINSTEM SAN LORENZO River Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
0a				0							
0b				0	0						0
1	3.3*	0.2	2.2	0	0.7				0	0.3	1.0
2a	7.9	1.3	0.4	0.2	2.5					3.7	2.7
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	16.4
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	11.9
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	39.7
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	25.4
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 25. Density of Juvenile Steelhead for SIZE CLASS II/ III (=>75 mm SL) at MAINSTEM SAN LORENZO River Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
0a				5.4							
0b				4.3	5.2						4.8
1	30.9*	26.7	15.4	3.4	6.9				1.2	1.6	12.3
2a	67.0	20.1	4.2	3.7	11.0					11.1	19.5
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	18.9
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	5.0
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	7.6
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	7.7
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.

Table 26. TOTAL DENSITY of Juvenile Steelhead at SAN LORENZO TRIBUTARY Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
Zavante 13a		83.0	104.0	46.6	54.8	68.3	69.9	53.6	17.0	66.9	62.7
Zavante 13b	74.9*	50.7	74.9	24.9	38.0	70.0	65.1	53.3			56.5
Zavante 13c		69.0	61.9	25.8	40.0	123.6	63.4	78.2	18.0	94.4	63.8
Zavante 13d		82.2	105.0	57.5	84.1	243.8	145.3	99.7	69.8	80.5	107.5
Lompico 13e									26.2	108.3	67.3
Bean 14a		44.2	45.9	17.0	38.0	50.9	31.9	54.0			45.4
Bean 14b	73.0	115.6	92.1	48.3	65.5	146.4	78.5	103.5	13.1	8.9	74.5
Bean 14c		78.2	22.7	87.5	36.8	41.3	99.6	87.4	66.0	18.2	59.7
Fall 15	84.5	82.7	85.0	55.0	59.8						73.4
Newell 16	94.9	76.3	40.5	28.8	40.3				26.0		51.1
Boulder 17a	134.2	149.2	68.5	32.0	61.1	60.0	38.6	40.1	30.7	62.7	67.7
Boulder 17b	100.7	74.9	49.5	43.0	51.8	98.6	54.2	70.2	57.6	45.1	64.6
Boulder 17c		42.8	33.9	36.0	39.4	75.8	81.5	67.4			53.9
Bear 18a	118.5	81.2	76.0	33.6	58.8	86.8	87.7	87.9	52.9	47.3	73.1
Bear 18b		69.5	116.1	67.6	63.5						79.2
Kings 19a		10.8	0.5	8.4	7.6						6.8
Kings 19b	52.7	22.9	44.9	37.5	41.6						39.9
Carbonera 20a	13.4	21.0	18.9	9.7	19.6						16.5
Carbonera 20b		53.4	51.7	45.2	45.2						48.9
Branciforte 21a-1										6.6	
Branciforte 21a-2	70.0	60.2	47.1	65.2	45.2				29.5	49.1	52.3
Branciforte 21b		67.8	57.6	59.6	57.5			20.4			52.1

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

Table 27. Density of Juvenile Steelhead for YOUNG-OF-THE-YEAR Fish at SAN LORENZO TRIBUTARY Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
Zavante 13a		80.0	96.4	29.0	52.9	64.4	68.3	50.1	14.6	62.1	57.6
Zavante 13b	64.9*	43.5	60.6	7.7	31.2	60.4	58.7	48.1			46.9
Zavante 13c		66.9	50.2	9.4	30.9	112.9	53.2	74.2	17.1	85.1	55.5
Zavante 13d		77.4	77.7	41.9	67.0	220.6	130.0	88.5	68.0	63.1	92.7
Lompico 13e									24.2	96.9	60.6
Bean 14a		43.4	42.0	11.1	36.0	46.4	30.0	50.9			37.1
Bean 14b	60.7	104.3	59.0	41.3	60.2	137.3	70.3	84.7	10.9	0	62.9
Bean 14c		71.8	6.9	76.6	18.1	23.0	87.4	81.5	61.1	5.6	48.5
Fall 15	79.6	74.8	68.1	45.1	45.4						62.6
Newell 16	77.1	67.6	17.7	19.9	35.6				20.1		43.6
Boulder 17a	119.2	141.5	50.7	22.9	55.9	45.6	31.3	36.5	25.3	55.9	58.5
Boulder 17b	91.8	68.0	36.2	33.9	38.9	84.1	48.0	62.0	56.1	35.1	55.4
Boulder 17c		37.6	15.3	27.5	30.7	64.0	69.7	61.3			43.7
Bear 18a	100.2	72.4	57.9	12.6	50.8	75.0	76.6	75.2	51.0	41.7	63.3
Bear 18b		66.6	89.2	58.3	48.1						65.6
Kings 19a		9.8	0	6.6	6.0						5.6
Kings 19b	48.2	20.8	32.1	31.5	28.5						32.2
Carbonera 20a	9.1	17.2	13.2	5.6	16.5						12.3
Carbonera 20b		50.9	40.3	29.7	33.4						38.6
Branciforte 21a-1										2.8	
Branciforte 21a-2	64.6	54.1	35.5	47.2	34.2				30.6	47.6	44.9
Branciforte 21b		60.1	44.2	45.8	49.4			9.1			41.7

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

Table 28. Density of Juvenile Steelhead for YEARLING and OLDER Fish at SAN LORENZO TRIBUTARY Monitoring Sites in 1997-2001 and 2003-2007.

Sample Site	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
Zayante 13a		3.0	7.6	17.7	1.9	3.9	1.6	3.5	3.2	4.9	5.3
Zayante 13b	10.0*	7.2	14.3	17.2	6.8	9.6	6.4	5.2			13.2
Zayante 13c		2.1	11.7	16.4	9.1	10.7	10.2	4.0	1.0	8.8	8.2
Zayante 13d		4.7	27.3	15.6	17.1	23.2	15.3	11.2	1.7	17.4	14.8
Lompico 13e									1.9	11.3	6.6
Bean 14a		0.8	3.9	5.9	2.0	4.5	1.9	3.1			4.6
Bean 14b	12.3	11.3	33.1	7.0	5.3	9.1	8.2	18.8	2.0	8.9	11.6
Bean 14c		6.4	15.8	10.9	18.7	18.3	12.2	5.9	4.1	5.4	10.8
Fall 15	4.9	7.9	16.9	9.9	14.4						10.8
Newell 16	17.8	8.7	22.8	8.9	4.7				5.4		11.4
Boulder 17a	15.0	7.7	17.8	9.1	5.2	14.4	7.3	3.6	5.9	6.8	9.3
Boulder 17b	8.9	6.9	13.3	9.1	12.9	14.5	6.2	8.2	1.1	9.8	9.1
Boulder 17c		5.2	18.6	8.5	8.7	11.8	11.8	6.1			10.4
Bear 18a	18.3	7.8	18.1	21.0	8.0	11.8	11.1	12.7	1.6	5.7	11.6
Bear 18b		2.9	26.9	9.3	15.4						13.6
Kings 19a		1.0	0.5	1.8	1.6						1.2
Kings 19b	4.5	2.1	12.8	6.0	13.1						7.7
Carbonera 20a	4.3	3.8	5.7	4.1	3.1						4.2
Carbonera 20b		2.5	11.4	15.5	11.8						10.3
Branciforte 21a-1										3.9	
Branciforte 21a-2	5.4	6.1	11.6	18.0	11.0				0	1.5	7.7
Branciforte 21b		7.6	13.4	11.1	8.1			11.3			12.7

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

Table 29. Density of Juvenile Steelhead for SIZE CLASS II/III (=>75 mm SL) Fish at SAN LORENZO TRIBUTARY Monitoring Sites in 1998-2001 and 2003-2007.

Sample Site	1998	1999	2000	2001	2003	2004	2005	2006	2007	Avg
Zayante 13a	12.3*	13.5	17.7	1.9	3.9	1.6	31.4	11.7	4.9	10.8
Zayante 13b	14.9	19.9	17.2	7.1	9.6	6.4	17.3			13.2
Zayante 13c	14.7	16.8	16.4	9.5	10.7	10.2	15.0	12.6	8.8	12.7
Zayante 13d	10.7	27.3	15.6	17.1	23.2	15.3	15.7	17.3	17.4	17.7
Lompico 13e								5.7	11.3	8.5
Bean 14a	2.1	3.9	5.9	2.0	4.5	1.9	12.0			4.6
Bean 14b	11.3	33.1	7.1	5.3	9.1	8.2	39.4	11.9	8.9	14.9
Bean 14c	6.4	15.8	10.9	18.4	18.3	12.2	12.4	17.1	5.4	13.0
Fall 15	13.3	16.9	9.9	13.0						13.3
Newell 16	14.9	22.8	8.9	4.7				16.2		13.5
Boulder 17a	21.9	17.8	9.1	5.2	16.9	7.3	9.0	18.2	6.8	12.5
Boulder 17b	11.5	13.3	9.1	12.9	14.5	6.2	8.2	13.7	9.8	11.0
Boulder 17c	5.2	18.6	8.5	8.7	11.8	11.8	8.4			10.4
Bear 18a	13.0	18.1	21.0	8.0	11.8	11.1	13.7	13.6	5.7	12.9
Bear 18b	6.2	26.9	9.3	13.2						13.9
Kings 19a	6.2	0.5	1.8	1.6						2.5
Kings 19b	6.2	12.8	6.0	10.0						8.8
Carbonera 20a	11.5	5.7	4.1	3.1						6.1
Carbonera 20b	11.4	11.4	15.5	11.8						12.5
Branciforte 21a-1									3.9	
Branciforte 21a-2	8.5	11.6	18.0	10.8				10.8	1.5	10.2
Branciforte 21b	14.8	13.4	11.1	8.1			16.0			12.7

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

R-6. Comparison of 2007 Steelhead Densities in Soquel Creek with Those Since 1997

In the Soquel Creek watershed in 2007, YOY densities were higher in the lower watershed and lower in the upper watershed, presumably resulting from more spawning lower in the watershed that is typical of a drier winter. Our juvenile population estimate in Soquel Lagoon was the highest on record at over 6,000, 90%+ of which were YOY (**Alley 2008**). This was consistent with heavier spawning near the lagoon. Juveniles grew more slowly in 2007 than 2006 due to lower streamflows, and densities of larger Size Class II/III juveniles were mostly similar to or below average. Despite the mere trickle of streamflow and reduced habitat quality on the upper East Branch in the Soquel Demonstration State Forest (SDSF), the density of these larger juveniles was much above average and the highest ever detected. Perhaps more yearlings than usual held over from the previous year due to slower than usual growth rate or over-winter survival was much better due to the drier winter. However, this preponderance of yearlings was not observed at the uppermost site on the West Branch. Total densities at Site 21 were greater than in 2006, so it was apparent that adult steelhead passed Girl Scout Falls I in 2007. The site above Girl Scout Falls II was not sampled but was not likely passed by adults in 2007.

The 4 sampled mainstem sites had above average total and YOY densities in 2007 (**Table 30; Figures 4 and 5**), while the 4 sampled Branch sites were below average (**Table 31**). Total and YOY densities were greater than 2006 at 5 of 6 sites. Site 16 in the SDSF had only 44% of the average total density and only 30% of the average YOY density. However, Site 16 had nearly 3 times the average density of yearlings and the highest detected since monitoring began in 1997 (**Table 32**). Yearling densities in 2007 were higher than in 2006 at 5 of 6 sites and equal at the 7^{th}. In 2007, yearling densities were above average at 5 of 10 sites and equaled the average at another.

Size Class II/III densities were above average at 4 of 8 sites (2 in the mainstem and 2 in the branches) and twice the average at Site 16 (**Table 34; Figure 6**). Smolt densities were higher in 2007 than 2006 at 4 of 6 sites, with only 53% of the 2006 density at Site 21 between 2 falls on the West Branch. Six of the 8 Soquel Creek sites were rated either poor or below average based on smolt densities, with one fair rating at Site 10 on the mainstem and one good rating in the SDSF (**Table 41**).

Figure 4. Total Juvenile Steelhead Site Densities in Soquel Creek in 2007 Compared to the 11-Year Average. (7th year West Branch (19), 6th year West Branch (21)).

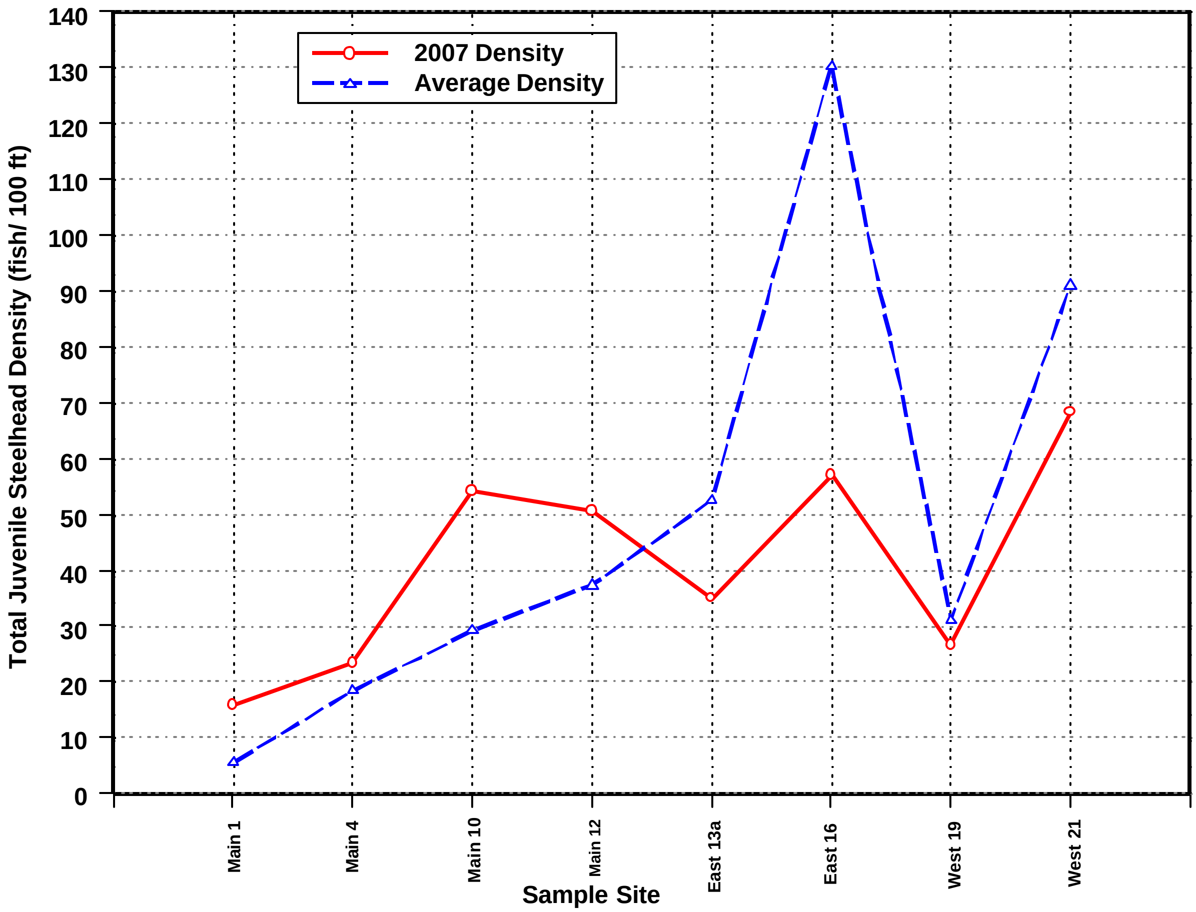


Figure 5. Juvenile Steelhead Site Densities for Young-of-the-Year in Soquel Creek in 2007 Compared to the 11-Year Average (7th Year West Branch (19), 6th Year West Branch (21)).

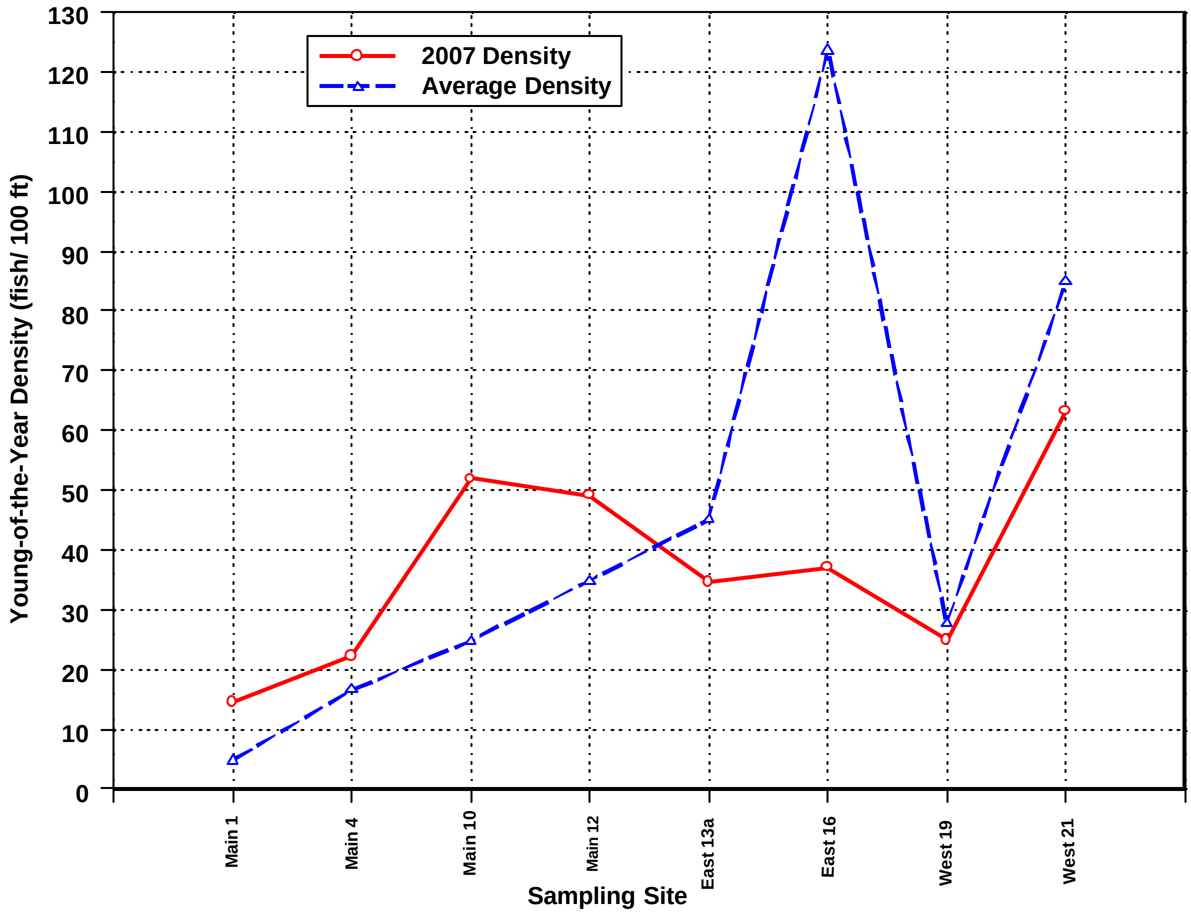


Figure 6. Juvenile Steelhead Site Densities for Size Classes II and III in Soquel Creek in 2007 Compared to the 11-Year Average Density (7th Year West Branch (19), 6th Year West Branch (21)).

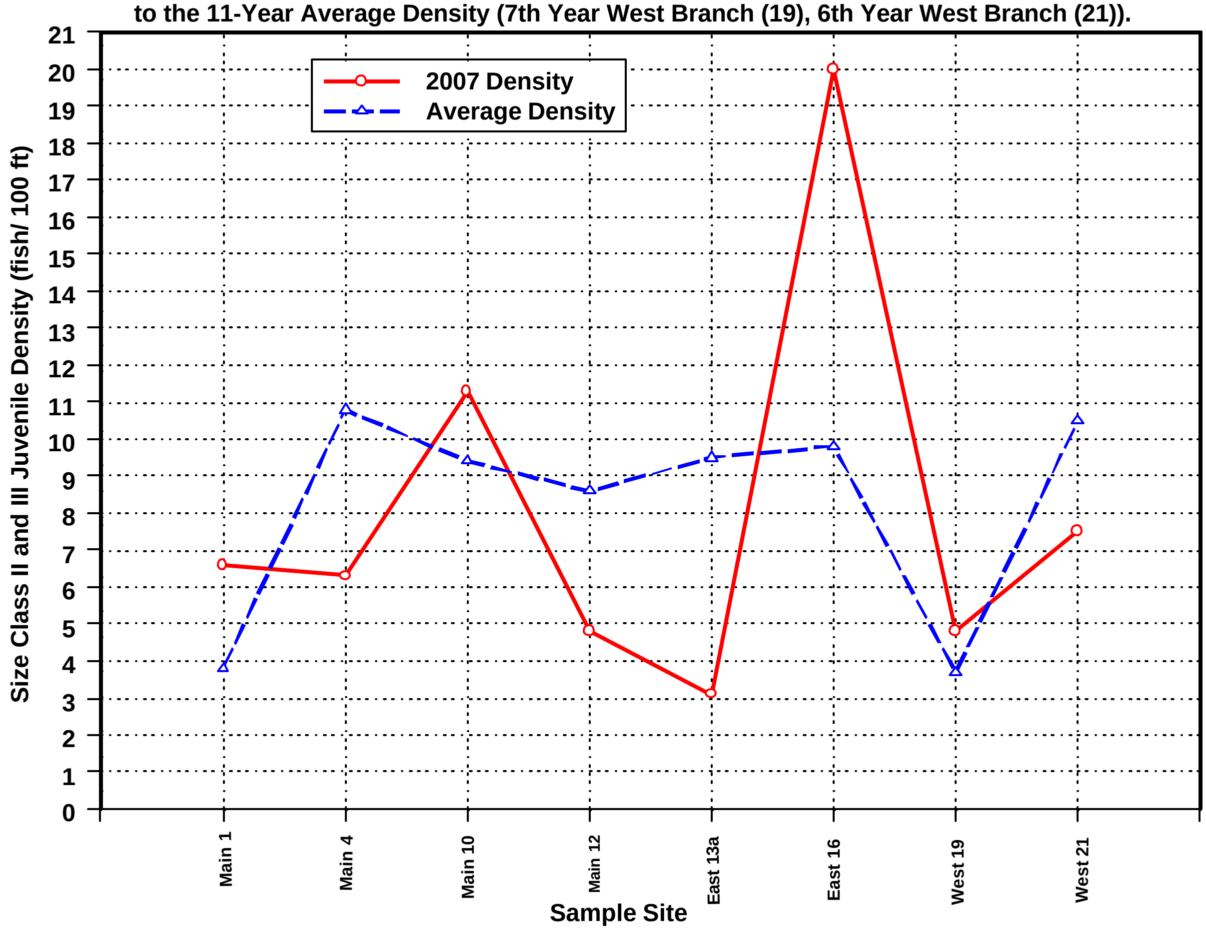


Table 30. TOTAL Juvenile Steelhead SITE DENSITIES (fish/ 100 ft) at Monitoring Sites in SOQUEL CREEK in 1997–2007.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg
1- Near GrangeHall	2.9	5.6	3.0	2.4	3.5	7.4	2.5	1.7	9.5	-	15.8	5.5
2- Adj. USGS Gage	4.5	9.4	1.2	5.9	7.7	-	4.1	3.5	4.2	-		5.1
3- Above Bates Ck	13.2	50.6	7.6	2.2	8.4	14.8	-	-	7.9	-		15.0
4- Adj. Flower Fld	49.6	20.7	6.8	5.5	23.0	33.3	7.7	20.1	9.2	3.2	23.5	18.4
5-Adj. Beach Shk	50.3	20.6	8.1	9.2	28.0	-	-	-	-	-		23.2
6- End of Cherryvale	24.7	9.4	2.6	5.3	5.7	47.69	15.9	13.1	16.1	-		15.6
7- Adj. Orchard	96.6	14.0	5.6	2.0	27.5	-	-	-	-	-		29.1
8- Below Rivervale	21.0	10.7	4.1	4.9	12.4	59.2	-	-	-	-		18.7
9- Adj. Mt. School	61.6	18.4	5.1	7.9	20.7	94.8	26.2	45.8	26.8	-		28.2
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	29.1
11- Below Purling Bk	81.9	13.1	10.5	13.1	31.6	-	-	-	-	-		30.0
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	37.3
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	52.5
13b- Below Hinckley	-	-	17.0	24.4	47.3	110.6	-	-	-	-		49.8
14- Above Hinckley	49.6	47.7	23.6	18.5	37.7	107.6	86.0	78.0	39.5	-		54.2
15- Below Amaya Ck	137.9	79.9	55.4	39.0	38.3	91.6	-	-	-	-		73.7
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	130.3
17- Above Fern Glch*	138.3	104.2	170.9	93.8	96.3	129.5	102.4	117.2	157.3	-		123.4
18- Above Ashbury G*	44.1	24.5	53.0	-	-	-	-	-	-	-		40.5
19- Below Hester Ck	62.3	21.7	32.1	27.6	37.8	-	-	-	-	8.3	26.5	30.9
20- Above Hester Ck	-	28.2	36.9	37.7	28.3	52.1	49.1	87.2	50.2	22.9		43.6
21- Above GS Falls I	-	-	-	-	-	119.0	112.9	99.4	102.0	44.2**	68.3**	91.0
22- Abv GS Falls II	-	-	-	-	-	65.5	27.5	58.1	5.5	8.6		33.1

* Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.
** Raw Data obtained from NOAA Fisheries in 2006 and 2007.

Table 31. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by YOUNG-OF-THE-YEAR AGE CLASS at Monitoring Sites in SOQUEL CREEK in 1997–2007.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	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	4.8
2- Adj. USGS Gage	4.1	8.3	0.4	5.3	6.3	-	4.9	3.5	2.6	-		4.4
3- Above Bates Ck	11.7	48.0	5.6	2.0	8.2	14.1	-	-	6.7	-		13.8
4- Adj. Flower Fld	45.7	18.2	6.2	3.5	19.9	28.8	7.1	19.4	8.7	2.4	22.2	16.6
5-Adj. Beach Shk	54.0	19.2	5.8	7.6	27.2	-	-	-	-	-		22.8
6- End of Cherryvale	21.1	8.3	2.4	4.4	5.1	46.4	15.8	12.8	12.9	-		14.4
7- Adj. Orchard	94.0	13.6	5.2	1.6	26.4	-	-	-	-	-		28.2
8- Below Rivervale	18.9	9.9	3.9	1.7	11.4	57.2	-	-	-	-		17.2
9- Adj. Mt._School	53.4	16.0	4.5	4.9	18.8	92.5	22.7	43.6	22.2	-		31.0
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	24.8
11- Below Purling Bk	78.3	12.4	9.5	10.2	31.7	-	-	-	-	-		28.4
12- Near Soquel Ck Bridge	79.8	18.7	14.4	11.2	33.1	65.1	19.7	48.6	9.3	-	49.2	34.9
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	45.1
13b- Below Hinckley	-	-	16.2	22.0	45.9	109.5	-	-	-	-		48.4
14- Above Hinckley	46.9	46.6	24.7	14.6	37.2	104.6	83.7	76.8	36.7	-		52.4
15- Below Amaya Ck	139.0	76.9	49.6	35.8	35.4	87.1	-	-	-	-		70.6
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	123.6
17- Above Fern Glch*	131.9	101.3	159.4	84.7	8.1	112.4	4.4	10.1	147.9	-		113.4
18- Above Ashbury G*	29.4	24.8	33.3	-	-	-	-	-	-	-		29.2
19- Below Hester Ck	60.6	5.7	30.8	27.0	36.6	-	-	-	-	8.3	24.9	27.7
20- Above Hester Ck	-	30.6	36.3	34.3	26.2	49.2	45.3	84.9	49.4	21.5		41.9
21- Above GS Falls I	-	-	-	-	-	107.2	104.0	93.7	98.7	42.7**	63.2**	84.9
22- Abv GS Falls II	-	-	-	-	-	56.2	24.7	53.2	1.0	6.1		28.2

* Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.
** Raw data obtained from NOAA Fisheries in 2006 and 2007.

Table 32. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by YEARLING AND OLDER AGE CLASS at Monitoring Sites in SOQUEL CREEK in 1997–2007.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg
1- Near GrangeHall	1.2	1.5	1.0	1.9	0.7	0.6	0.9	0.5	1.0	-	1.0	1.0
2- Adj. USGS Gage	0.6	1.2	0.4	0.5	1.4	-	0	0	1.3	-		0.7
3- Above Bates Ck	2.5	2.6	2.0	0.5	0.2	0.5	-	-	1.3	-		1.4
4- Adj. Flower Fld	2.2	1.5	0.9	2.0	0.7	2.6	0.6	0.7	0.6	0.7	2.2	1.3
5-Adj. Beach Shk	2.8	1.4	2.0	1.6	0.5	-	-	-	-	-		1.7
6- End of Cherryvale	3.2	1.7	0.7	1.0	0.5	1.3	0	0.3	3.1	-		1.3
7- Adj. Orchard	2.2	0.5	0.4	0.4	1.1	-	-	-	-	-		0.9
8- Below Rivervale	1.0	0.9	0.7	3.1	1.4	1.6	-	-	-	-		1.5
9- Adj. Mt. School	3.4	1.7	1.3	4.7	1.7	2.6	3.6	2.3	4.5	-		2.9
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	1.4
11- Below Purling Bk	2.7	0.6	2.2	4.1	0.3	-	-	-	-	-		2.0
12- Near Soquel Ck Bridge	3.6	0.5	2.0	1.1	0.9	0.3	0.5	0	1.9	-	1.5	1.2
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	2.2
13b- Below Hinckley	-	-	1.1	4.7	1.4	2.0	-	-	-	-		2.3
14- Above Hinckley	2.6	1.0	1.6	4.8	1.9	2.9	1.4	0.6	2.8	-		2.2
15- Below Amaya Ck	0	2.5	6.7	4.0	2.9	4.3	-	-	-	-		3.4
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	6.6
17- Above Fern Gch*	5.7	3.1	11.5	6.9	18.2	17.0	7.8	7.1	9.6	-		9.7
18- Above Ashbury G*	13.8	9.6	19.8	-	-	-	-	-	-	-		14.4
19- Below Hester Ck	1.2	0.4	1.6	1.2	1.2	-	-	-	-	0.3	1.6	1.1
20- Above Hester Ck	-	0.3	0.3	3.0	2.1	2.9	3.8	2.3	1.0	0.6		1.8
21- Above GS Falls I	-	-	-	-	-	11.9	8.8	5.3	2.1	1.2**	5.1**	5.7
22- Abv GS Falls II	-	-	-	-	-	9.3	2.8	4.9	4.5	2.5		4.8

* Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.
** Raw Data obtained from NOAA Fisheries in 2006 and 2007.

Table 33. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by SIZE CLASS I at Monitoring Sites in SOQUEL CREEK in 1997–2007.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg
1- Near GrangeHall	1.7	0.2	0	0	0.5	3.5	0.3	0.5	0	-	9.2	1.6
2- Adj. USGS Gage	0.9	0.2	0	0	2.2	3.5	1.7	1.9	0	-		0.9
3- Above Bates Ck	1.8	0	0	0.9	4.0	10.4	-	-	0	-		2.4
4- Adj. Flower Fld	20.1	1.5	0	0.5	7.6	20.0	4.4	13.8	0	0.4	17.2	7.7
5-Adj. Beach Shk	38.2	0	0.3	1.1	21.6	-	-	-	-	-		12.2
6- End of Cherryvale	14.3	0	0	0	2.8	42.9	13.7	12.5	0.4	-		9.6
7- Adj. Orchard	71.6	1.0	1.6	0.4	21.5	-	-	-	-	-		19.2
8- Below Rivervale	11.7	0.2	1.0	0.2	6.3	49.6	-	-	-	-		11.5
9- Adj. Mt. School	36.7	1.1	0.4	0.5	6.6	79.7	12.7	27.1	2.1	-		18.5
10- Above Allred	43.2	0	3.3	0	9.4	60.8	13.8	34.7	3.5	5.8	43.0	19.7
11- Below Purling Bk	60.5	0.9	4.1	2.8	29.1	-	-	-	-	-		19.5
12- Near Soquel Ck Bridge	68.1	3.8	9.2	5.9	28.9	60.1	16.3	44.0	4.5	-	45.9	28.7
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	43.1
13b- Below Hinckley	-	-	3.2	15.8	43.9	105.1	-	-	-	-		42.0
14- Above Hinckley	27.4	26.9	11.8	3.5	24.3	101.7	78.9	76.1	17.8	-		40.9
15- Below Amaya Ck	130.4	64.1	38.2	30.5	35.4	84.9	-	-	-	-		63.9
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	120.5
17- Above Fern Glch*	130.3	90.1	151.7	82.4	78.1	112.4	94.4	110.1	130.9	-		108.9
18- Above Ashbury G*	29.2	20.6	33.2	-	-	-	-	-	-	-		27.7
19- Below Hester Ck	60.1	20.4	23.4	24.5	36.6	-	-	-	-	3.6	21.7	27.2
20- Above Hester Ck	-	20.6	33.2	32.4	26.2	49.2	45.3	84.9	47.3	17.1		39.6
21- Above GS Falls I	-	-	-	-	-	107.2	103.1	91.8	90.0	30.1**	61.3**	80.6
22- Abv GS Falls II	-	-	-	-	-	56.2	24.7	50.9	0.3	3.9		27.2

*** Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.**
**** Raw data obtained from NOAA Fisheries in 2006 and 2007.**

Table 34. SITE DENSITIES (fish/ 100 ft) of Juvenile Steelhead by SIZE CLASS II/III at Monitoring Sites in SOQUEL CREEK in 1997–2007.
(Resident rainbow trout likely present at Sites 18 and 22).

Sample Site	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg
1- Near GrangeHall	1.2	5.4	3.0	2.4	3.0	3.9	2.3	1.2	9.5	-	6.6	3.8
2- Adj. USGS Gage	3.6	9.4	0.8	5.9	5.5	-	2.4	1.6	4.2	-		4.2
3- Above Bates Ck	11.4	50.6	7.6	1.3	4.4	4.4	-	-	7.9	-		12.5
4- Adj. Flower Fld	29.5	19.2	6.8	5.0	15.4	13.3	3.3	6.3	9.2	2.8	6.3	10.8
5-Adj. Beach Shk	18.1	20.6	7.8	8.1	6.4	-	-	-	-	-		12.2
6- End of Cherryvale	10.4	9.4	2.6	5.3	2.9	4.7	2.2	0.6	15.7	-		6.0
7- Adj. Orchard	25.0	13.0	4.0	1.6	6.0	-	-	-	-	-		9.9
8- Below Rivervale	9.3	10.5	3.1	4.7	6.1	9.6	-	-	-	-		7.2
9- Adj. Mt. School	24.9	17.3	4.7	7.4	14.1	15.1	13.5	18.7	24.7	-		15.6
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	9.4
11- Below Purling Bk	21.4	12.2	6.4	10.3	2.5	-	-	-	-	-		10.6
12- Near Soquel Ck Bridge	15.4	15.7	8.2	6.1	5.5	5.4	3.8	4.5	16.8	-	4.8	8.6
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	9.5
13b- Below Hinckley	-	-	13.8	8.6	3.4	5.5	-	-	-	-		7.8
14- Above Hinckley	22.2	20.8	11.8	15.0	13.4	5.9	7.1	1.9	21.7	-		13.3
15- Below Amaya Ck	7.5	15.8	17.2	8.5	2.9	6.7	-	-	-	-		9.8
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	9.8
17- Above Fern Glch*	8.0	14.1	19.2	11.4	18.2	17.1	8.0	7.1	26.4	-		14.4
18- Above Ashbury G*	14.9	3.9	19.8	-	-	-	-	-	-	-		12.9
19- Below Hester Ck	2.2	1.3	8.7	3.1	1.2	-	-	-	-	4.7	4.8	3.7
20- Above Hester Ck	-	7.6	3.7	5.3	2.1	2.9	3.8	2.3	2.9	5.8		4.0
21- Above GS Falls I	-	-	-	-	-	11.8	9.8	7.6	12.0	14.1**	7.5**	10.5
22- Above GS Falls II	-	-	-	-	-	9.3	2.8	7.2	5.2	4.7		5.8

* Raw data obtained from the Soquel Demonstration State Forest, 1997–1999.
**Raw data obtained from NOAA Fisheries in 2006 and 2007.

R-7. Comparison of 2007 Steelhead Densities in Aptos and Valencia Creeks with Those in 1981, 1994 and 2006

In the Aptos Creek watershed, 2 sites were sampled in Aptos Creek and 2 sites were sampled in the tributary, Valencia Creek. Total and YOY densities followed similar patterns in 2007, with densities of these two groups above average and greater than in 2006 at the lower two sites in each stream but below average and less than in 2006 at the upper 2 sites (**Tables 35 and 36; Figures 7 and 8**). YOY densities were so low at the upper Valencia Creek site that it appeared unlikely that adult steelhead accessed the upper reach to spawn during the relatively dry winter of 2007, unlike during the wet winter of 2006. YOY production may have been due to resident rainbow trout reproduction in 2007.

The densities of soon-to-smolt larger juveniles in Size Classes II/III were much less than in 2006 and below average at the lower Aptos site and similar to the 2006 density and the average at the upper Valencia Creek site (**Table 38; Figure 9**). However, at the upper Aptos Creek site and lower Valencia Creek site, smolt-sized juvenile densities were much above average and greater than in 2006. This could be explained by higher over-winter survival or by a higher percentage of yearlings holding over in spring 2007 (**Table 37**) at sites of slower growth in 2006 (**Alley 2007**) and spring 2007 and a lower percentage holding over at the lower Aptos site where growth was much faster for YOY in 2006 and spring 2007. Yearling densities in 2007 were greater than in 2006 at 3 of 4 sites. Growth rate of YOY in Valencia Creek in 2006 and 2007 was slow, preventing lack of smolting by yearlings. However, our monitoring record in this watershed is short, making it difficult to interpret data.

The 4 sites in the Aptos watershed were rated either fair or good for smolt densities (**Table 41**).

Figure 7. Total Juvenile Steelhead Site Densities in Aptos and Valencia Creeks in 2006, 2007 and 3-Year Average, Including 1981.

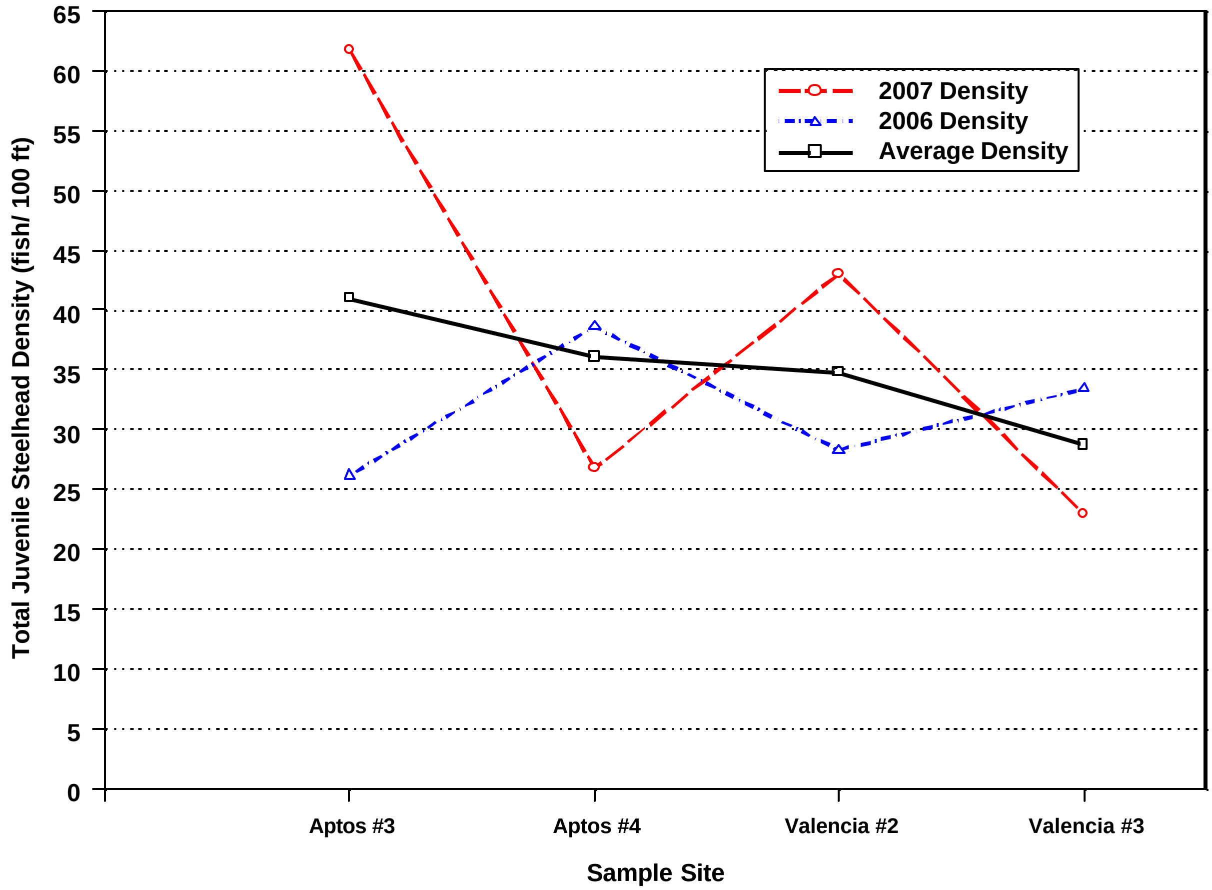


Figure 8. Juvenile Steelhead Site Densities for Young-of-the-Year in Aptos and Valencia Creeks in 2006, 2007 and the Average, Including 1981.

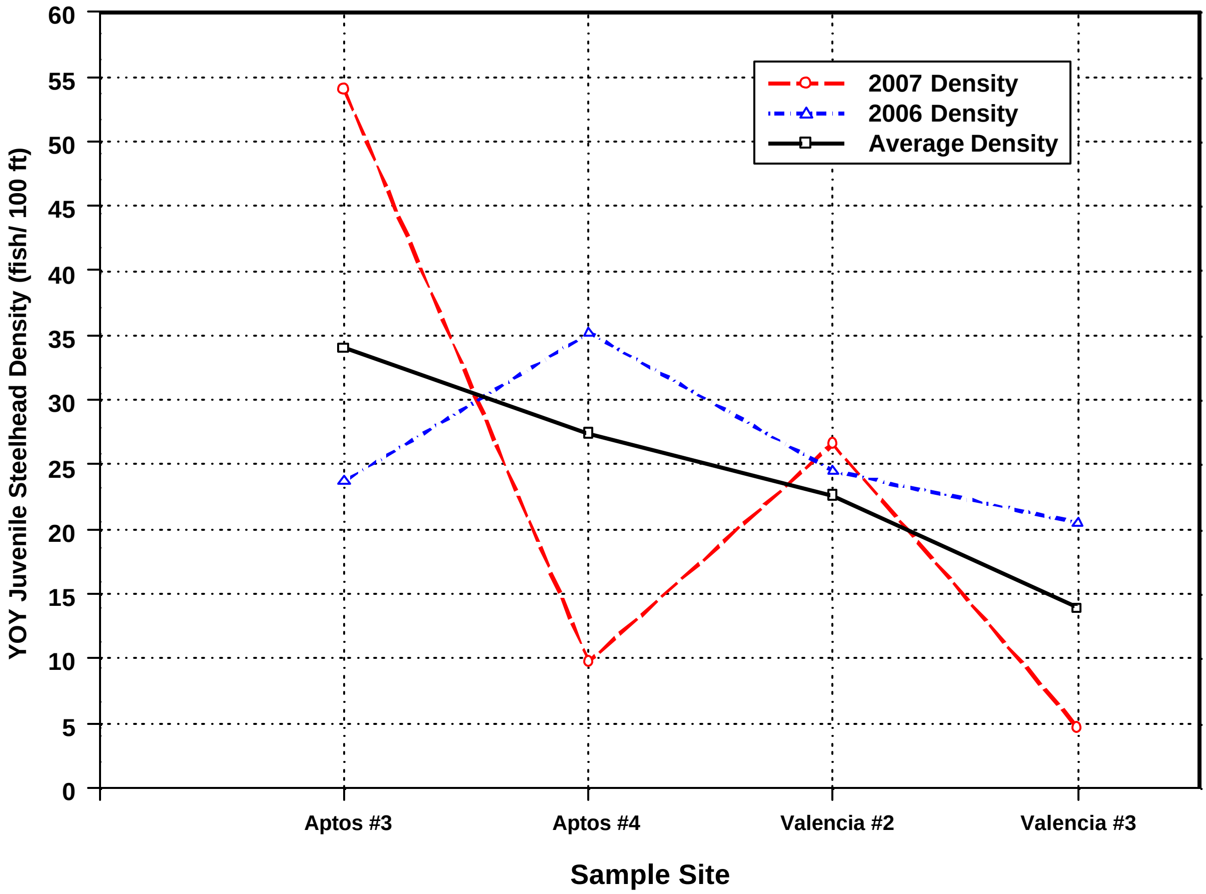
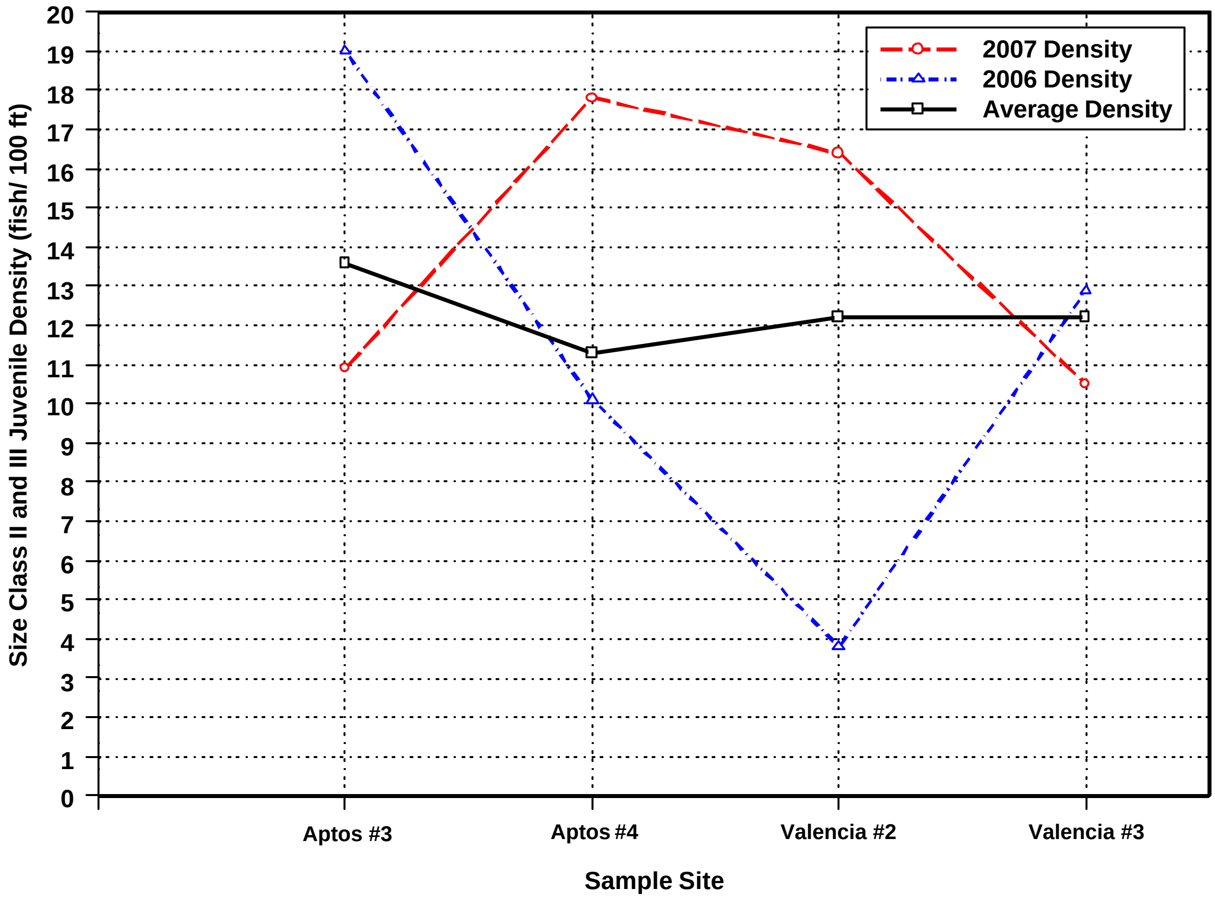


Figure 9. Juvenile Steelhead Densities for Size Classes II and III in Aptos and Valencia Creeks in 2006, 2007 and the Average, Including 1981.



R-8. Comparison of 2007 Steelhead Densities in Corralitos, Browns Valley and Shingle Mill with those in 1981, 1994 and 2006, and Density Comparisons Above and Below the Corralitos Diversion Dam

In the Corralitos Creek watershed, 4 sites were sampled in Corralitos, 2 sites were sampled in Shingle Mill and 2 sites were sampled in Browns Valley. With the exception of the 2 lowermost repeated sites on Corralitos Creek, 2007 total and YOY site densities were generally less than 2006 densities and below average (**Tables 35 and 36; Figures 10 and 11**). For those 2 lower sites on Corralitos, 2007 (Sites 3 and 8), densities were similar to 2006 and the average. Site 1 below the diversion dam had similar, but slightly lower, YOY density to Site 3 above the dam. YOY density at the uppermost Corralitos site was much less in 2007 than in 2006. In Browns Valley and Shingle Mill creeks, YOY densities were much less in 2007 than in 2006. More annual monitoring will be necessary to evaluate adult passage impedance as a possible explanation for low YOY densities at upper sites in 2007.

For the soon-to-smolt, larger Size Class II/III juveniles, 2007 site densities in Corralitos Creek were generally much less than in 2006 (when a high percent of YOY reached smolt size) and below average (**Figure 12**). In 2007, site densities of Size Class II/III and yearling fish were similar at Site 1 below the diversion dam and at Site 3 above. In Browns Valley and Shingle Mill creeks where YOY growth rate had been much slower in 2006, densities of Size Class II/III and yearling juveniles were similar, except at the upper most Browns Valley site (**Tables 37 and 39; Figure 12**). In the Corralitos watershed in 2007, yearling densities were above average at 3 of 7 sites and greater than in 2006 at 6 of 7 sites. Yearlings at the uppermost Browns Valley site survived the winter or held over in much higher numbers, as had occurred in upper Aptos Creek and Lompico Creek. This was inconsistent with the upper Corralitos site, which had faster growth rate of many YOY in 2006 and fewer holdovers as yearlings in 2007.

Six of 8 sites in the Corralitos watershed were rated fair or good for smolt densities, with the upper sites on Corralitos and Shingle Mill rated below average (**Table 41**).

Figure 10. Total Juvenile Steelhead Site Densities in Corralitos, Shingle Mill and Browns Valley Creeks in 2006, 2007 and the Average, Including 1981 and 1994.

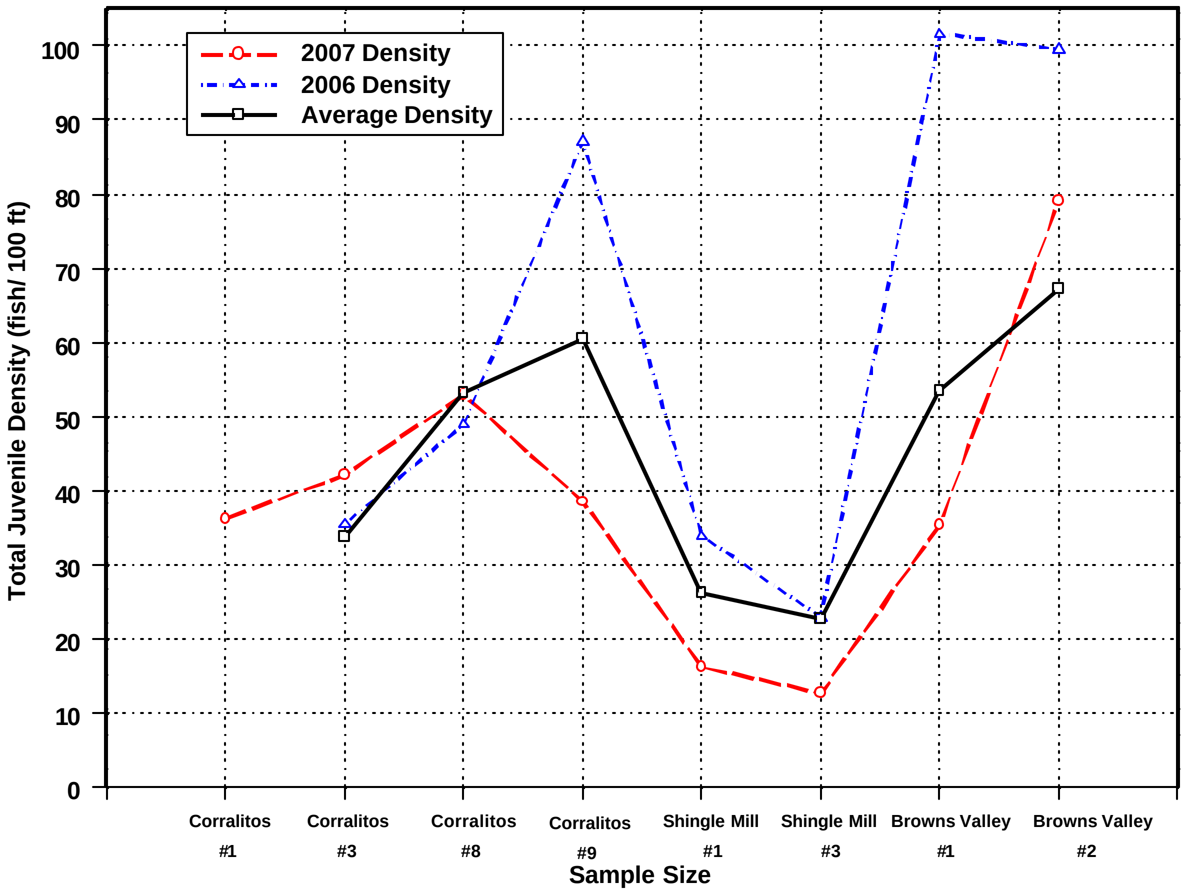


Figure 11. Juvenile Steelhead Densities for Young-of-the-Year in Corralitos, Shingle Mill and Browns Valley Creeks in 2006, 2007 and the Average, Including 1981 and 1994.

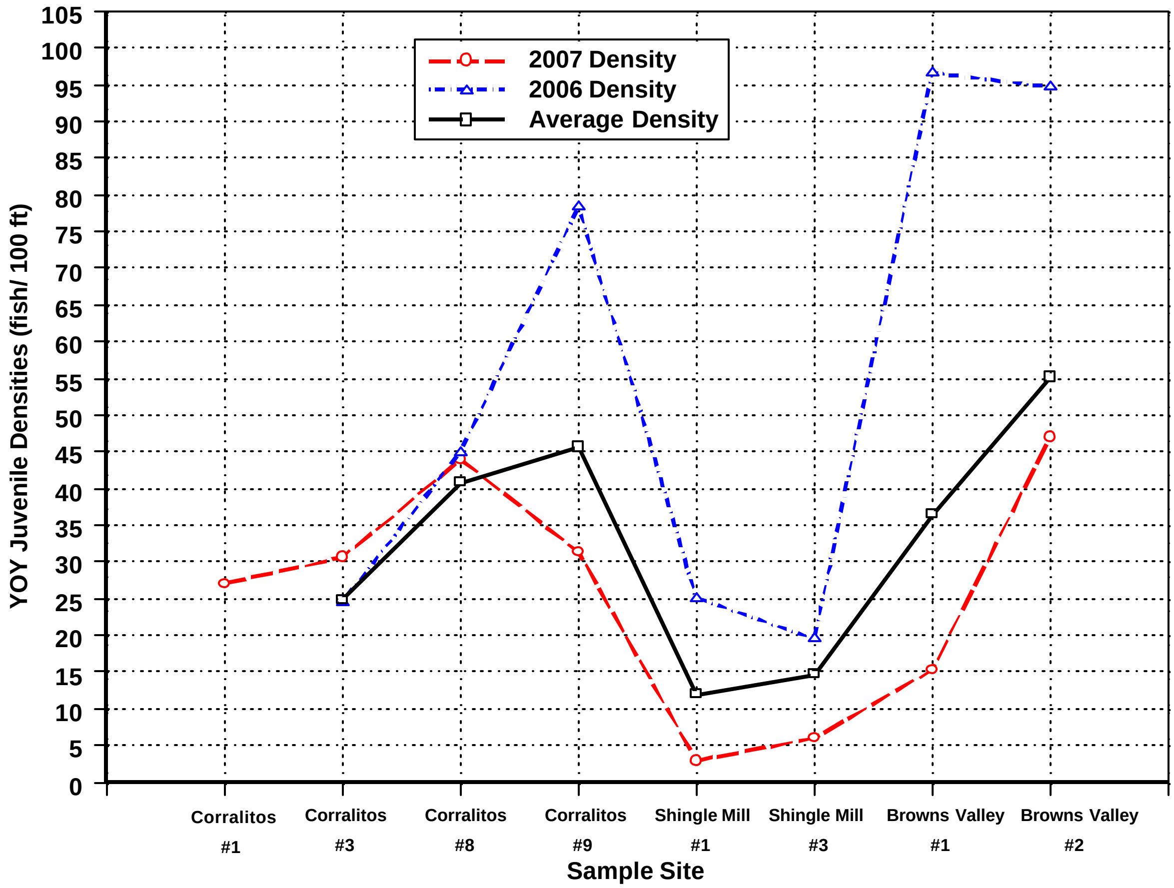


Figure 12. Juvenile Steelhead Densities for Size Classes II and III in Corralitos, Shingle Mill and Browns Valley Creeks in 2006, 2007 and the Average, Including 1981 and 1994.

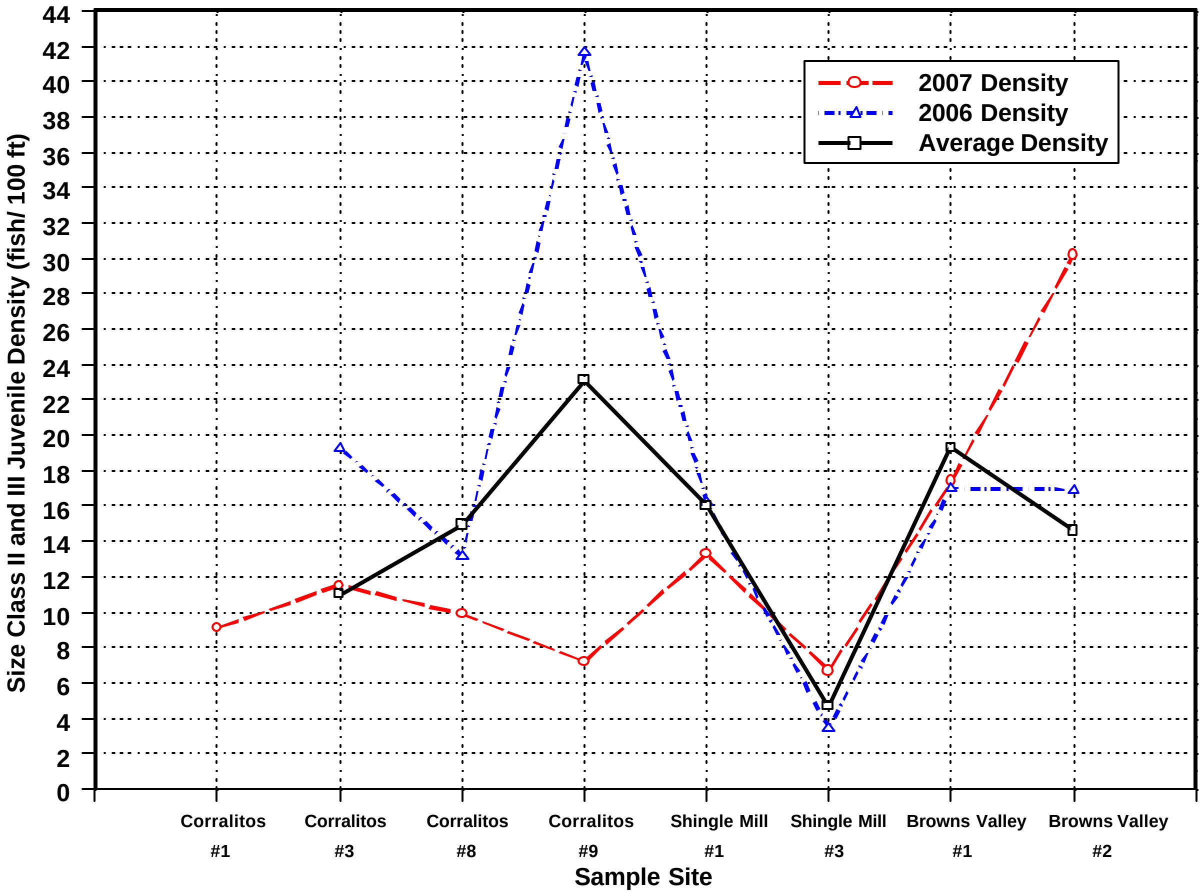


Table 35. TOTAL DENSITY of Juvenile Steelhead at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994, 2006 and 2007.

Sample Site	1981	1994	2006	2007	Avg
Aptos #3- in County Park	35.2*	–	26.2	61.7	41.0
Aptos #4- above steel Bridge Xing (Nisene Marks)	43.0	–	38.6	26.8	36.1
Valencia #2- below Valencia Road Crossing	33.1	–	28.3	43.0	34.8
Valencia #3- Above Valencia Road Crossing	29.8	–	33.4	23.0	28.7
Corralitos #1- Below Dam				36.2	
Corralitos #3- Above Colinas Drive	39.1	18.6	35.5	42.1	33.8
Corralitos #8- Below Eureka Gulch	81.9	28.6	49.0	52.9	53.1
Corralitos #9- Above Eureka Gulch	86.1	29.9	87.1	38.5	60.4
Shingle Mill #1- Below 2nd Road Crossing	24.5	30.0	33.9	16.2	26.2
Shingle Mill #3- Above 2nd Road Crossing	32.6	–	22.9	12.7	22.7
Browns Valley #1- Below Dam	54.3	22.5	101.6	35.4	53.5
Browns Valley #2- Above Dam	71.6	18.5	99.5	79.0	67.2

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

Table 36. Density of Juvenile Steelhead for YOUNG-OF-THE-YEAR Fish at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994, 2006 and 2007.

Sample Site	1981	1994	2006	2007	Avg
Aptos #3- in County Park	24.4*	–	23.7	54.0	34.0
Aptos #4- above steel Bridge Xing (Nisene Marks)	37.1	–	35.2	9.8	27.4
Valencia #2- below Valencia Road Crossing	16.6	–	24.5	26.6	22.6
Valencia #3- Above Valencia Road Crossing	16.6	–	20.5	4.7	13.9
Corralitos #1 Below Dam				27.0	
Corralitos #3- Above Colinas Drive	33.9	10.2	24.6	30.6	24.8
Corralitos #8- Below Eureka Gulch	59.7	14.3	45.0	44.0	40.8
Corralitos #9- Above Eureka Gulch	55.8	16.7	78.4	31.3	45.6
Shingle Mill #1- Below 2nd Road Crossing	14.3	5.7	25.1	2.9	12.0
Shingle Mill #3- Above 2nd Road Crossing	18.6	–	19.5	6.0	14.7
Browns Valley #1- Below Dam	26.9	7.0	96.6	15.3	36.5
Browns Valley #2- Above Dam	66.1	12.8	94.7	47.0	55.2

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

Table 37. Density of Juvenile Steelhead for YEARLING AND OLDER Fish at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994, 2006 and 2007.

Sample Site	1981	1994	2006	2007	Avg
Aptos #3- in County Park	10.8*	–	3.1	7.6	7.2
Aptos #4- above steel Bridge Xing (Nisene Marks)	5.9	–	3.0	17.1	4.5
Valencia #2- below Valencia Road Crossing	16.5	–	3.8	16.4	12.2
Valencia #3- Above Valencia Road Crossing	13.2	–	12.9	11.5	12.5
Corralitos #1 Below Dam				9.1	
Corralitos #3- Above Colinas Dr.	5.2	8.4	10.8	11.5	9.0
Corralitos #8- Below Eureka Gulch	22.2	14.3	4.0	9.0	12.4
Corralitos #9- Above Eureka Gulch	30.3	13.2	9.5	7.2	15.1
Shingle Mill #1- Below 2nd Road Crossing	10.2	24.3	9.0	13.3	14.2
Shingle Mill #3- Above 2nd Road Crossing	14.0	–	3.4	6.7	8.7
Browns Valley #1- Below Dam	27.4	15.5	4.3	19.6	16.7
Browns Valley #2- Above Dam	5.5	7.7	2.8	32.0	12.0

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

Table 38. Density of Juvenile Steelhead for SIZE CLASS I Fish (<75 mm SL) at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994, 2006 and 2007.

Sample Site	1981	1994	2006	2007	Avg
Aptos #3- in County Park	24.4*	–	7.2	50.8	27.5
Aptos #4- above steel Bridge Xing (Nisene Marks)	37.1	–	28.5	9.0	24.9
Valencia #2- below Valencia Road Crossing	16.6	–	24.5	26.6	22.6
Valencia #3- Above Valencia Road Crossing	16.6	–	20.5	5.7	14.3
Corralitos #1 Below Dam				27.0	
Corralitos #3- Above Colinas Drive	33.9	10.2	16.2	30.6	18.0
Corralitos #8- Below Eureka Gulch	59.7	14.3	35.8	43.0	38.2
Corralitos #9- Above Eureka Gulch	55.8	16.7	45.5	31.3	37.3
Shingle Mill #1- Below 2nd Road Crossing	14.3	5.7	17.7	2.9	10.2
Shingle Mill #3- Above 2nd Road Crossing	32.4	–	19.5	6.0	19.3
Browns Valley #1- Below Dam	26.9	7.0	84.6	18.1	34.2
Browns Valley #2- Above Dam	66.1	12.8	82.6	48.8	52.6

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

Table 39. Density of Juvenile Steelhead for SIZE CLASS II/III Fish (=>75 mm SL) at Monitoring Sites in APTOS, VALENCIA, CORRALITOS, SHINGLE MILL and BROWNS VALLEY Creeks, 1981, 1994, 2006 and 2007.

Sample Site	1981	1994	2006	2007	Avg
Aptos #3- in County Park	10.8*	–	19.0	10.9	13.6
Aptos #4- above steel Bridge Xing (Nisene Marks)	5.9	–	10.1	17.8	11.3
Valencia #2- below Valencia Road Xing	16.5	–	3.8	16.4	12.2
Valencia #3- Above Valencia Road Xing	13.2	–	12.9	10.5	12.2
Corralitos #1 Below Dam				9.1	
Corralitos #3- Above Colinas Dr.	5.2	8.4	19.3	11.5	11.0
Corralitos #8- Below Eureka Gulch	22.2	14.3	13.2	9.9	14.9
Corralitos #9- Above Eureka Gulch	30.3	13.2	41.6	7.2	23.1
Shingle Mill #1- Below 2nd Road Xing	10.2	24.3	16.2	13.3	16.0
Shingle Mill #3- Above 2nd Road Xing and check dams	4.0	–	3.4	6.7	4.7
Browns Valley #1- Below Dam	27.4	15.5	17.0	17.4	19.3
Browns Valley #2- Above Dam	5.5	5.7	16.9	30.2	14.6

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

R-9. Rating of Smolt Rearing Habitat in 2007, Based on Site Densities of Smolt-Sized Fish

Smolt habitat was rated at sampling sites, based on smolt-sized (=>75 mm SL) fish density according to the rating scheme developed by Smith (**1982**) (**Tables 40 and 41**). (Note: the rating scale was applied to all sites, and lower San Lorenzo sites were rated very good and 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. These assumptions may not have been met in 2007 in much of the mainstem reaches of the San Lorenzo River and lower reaches of Zayante and Boulder creeks, where 2006 YOY growth rates were high and early smolting of yearlings likely occurred and YOY densities were below average. YOY densities may have been low in these reaches possibly due to low production of fry upstream in the tributaries or poor movement from the tributaries to the mainstem. However, streamflows were too low to grow many YOY in the middle mainstem to smolt size. Lower Aptos and all Corralitos sites were probably below carrying capacity for larger juveniles for the same reasons of less yearling holdovers and slow YOY growth in 2007. However, in upper East Branch Soquel in the SDSF, in upper Aptos Creek, both sites in Valencia Creek, both sites in Shingle Mill Gulch and both sites in Browns Valley Creek, where mostly small YOY were present in 2006, less early smolting likely occurred and over-winter survival of yearlings was likely high due to the few winter storms. Therefore, smolts may have been close to carrying capacity at those creek sites.

Table 40. Rating of Steelhead Rearing Habitat For Small, Central Coastal Streams.*
(From Smith 1982.)

<u>Very Poor</u> - less than 2 smolt-sized fish per 100 feet of stream.**			
<u>Poor</u> - from 2 to 4	"	"	"
<u>Below Average</u> - 4 to 8	"	"	"
<u>Fair</u> - 8 to 16	"	"	"
<u>Good</u> - 16 to 32	"	"	"
<u>Very Good</u> - 32 to 64	"	"	"
<u>Excellent</u> - 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.

Table 41. Sampling Sites in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds Rated by Smolt-Sized Juvenile Density (=>75 mm SL) in 2006 and 2007 and Habitat Change from 2006.

Site	2006 Density (Smolts/100 ft)	2006 Smolt Habitat Rating	2007 Density (Smolts/100 ft)	2007 Smolt Habitat Rating (1 to 7)	Habitat Change by Reach
Low. San Lorenzo #1	1.2	Very Poor	1.6	Very Poor	–
Low. San Lorenzo #2	-	-	11.1	Fair	No 2006 data
Low. San Lorenzo #4	16.2	Good	5.2	Below Average	+
Mid. San Lorenzo #6	2.3	Poor	1.2	Very Poor	–
Mid. San Lorenzo #8	5.8	Below Average	0.7	Very Poor	–
Up. San Lorenzo #11	3.0	Poor	0.6	Very Poor	Similar
Zayante #13a	11.7	Fair	4.9	Below Average	–
Zayante #13c	12.6	Fair	8.8	Fair	No 2006 data
Zayante #13d	17.3	Good	17.4	Good	–
Lompico #13e	5.7	Below Average	11.3	Fair	–
Bean #14b	11.9	Fair	8.9	Fair	No 2006 data
Bean #14c	17.1	Good	5.4	Below Average	–
Newell # 16	16.2	Good	-	-	No 2007 data
Boulder #17a	18.2	Good	6.8	Below Average	–
Boulder #17b	13.7	Fair	9.8	Fair	Similar
Bear #18a	13.6	Fair	5.7	Below Average	–
Branciforte #21a-1	-	-	3.9	Poor	No 2006 data
Branciforte #21a-2	10.8	Fair	1.5	Very Poor	Similar
Soquel #1	-	-	6.6	Below Average	No 2006 data
Soquel #4	2.8	Poor	6.3	Below Average	Similar
Soquel #10	6.3	Below Average	11.3	Fair	Similar
Soquel #12	-	-	4.8	Below Average	No 2006 data
East Branch Soquel #13a	3.2	Poor	3.1	Poor	Similar
East Branch Soquel #16	9.1	Fair	20.0	Good	–
West Branch Soquel #19	4.7	Below Average	4.8	Below Average	No 2006 data
West Branch Soquel #20	5.8	Below Average	-	-	No 2007 data
West Branch Soquel #21	14.1	Fair	7.5	Below Average	Similar
Aptos #3	19.0	Good	10.9	Fair	–
Aptos #4	10.1	Fair	17.8	Good	+
Valencia #2	3.8	Poor	16.4	Good	+
Valencia #3	12.9	Fair	10.5	Fair	+
Corralitos #0	-	-	9.1	Fair	No 2006 data
Corralitos #3	19.3	Good	11.5	Fair	Similar
Corralitos #8	13.2	Fair	9.9	Fair	Similar
Corralitos #9	41.6	Very Good	7.2	Below Average	–
Shingle Mill #1	16.2	Good	13.3	Fair	–
Shingle Mill #3	3.4	Poor	6.7	Below Average	–
Browns Valley #1	17.0	Good	17.4	Good	–
Browns Valley #2	16.9	Good	30.2	Good	–

For 2007, the breakdown of ratings for the 37 sampling sites was the following;

5 (13.5%) = "**Very Poor**"
2 (5.4%) = "**Poor**"
12 (32.4%) = "**Below Average**"
12 (32.4%) = "**Fai**r"
6 (16.2%) = "**Good**"

Therefore, 51% (19 of 37) of the sites were rated less than fair in 2007 compared to 35% in 2006. Sites that fell into the less than fair categories included 5 mainstem San Lorenzo sites, lower Zayante, upper Bean, lower Boulder, lower Bear, lower Branciforte, 3 mainstem Soquel sites, lower East Branch, lower and upper West Branch sites.

R-10. Statistical Analysis of Annual Difference in Juvenile Steelhead Densities

The trend in fish densities between 2006 and 2007 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 data were taken at the same sites between years when consistent with average habitat conditions between years, as opposed to re-randomizing each year. The null hypothesis for the test was that among all sites, the site-by-site difference between years 2006 and 2007 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 2007 were compared to 2006, such that a positive difference indicated that the densities in 2007 were larger than in 2006 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 2006 and 2007 densities. The 95% confidence limits are standard and a p-value of < 0.05 is considered significant.

Despite only 13 comparable sites in the San Lorenzo drainage, the decline in Size Class II/III site densities and increase in yearling site densities were statistically significant (**Table 42**). With only 5 comparable sites in the Soquel drainage, the increase in total site densities was considered statistically significant (**Table 43**). No statistically significant changes were detected in the Aptos and Corralitos watersheds due to small sample sizes (**Tables 44 and 45**).

Table 42. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Repeated Sites In the San Lorenzo Watershed (2007 to 2006; n=13).

Statistic	s.c. 1	s.c. 2	a.c. 1	a.c. 2	All Sizes
Mean difference	15.65	-5.26	14.59	2.42	17.62
Df	12	12	12	12	12
Std Error	9.77	1.43	9.82	1.08	10.04
t Stat	1.60	-3.69	1.48	2.24	1.76
P-value (2-tail)	0.1352	0.0031	0.1635	0.0451	0.1046
95% CL (lower)	-5.64	- 8.37	-6.82	0.0623	-4.25
95% CL (upper)	36.95	-2.15	35.99	4.7685	39.49

Table 43. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Repeated Sites In the Soquel Creek Watershed (2007 to 2006; n=5).

Statistic	s.c. 1	s.c. 2	a.c. 1	a.c. 2	All Sizes
Mean difference	18.76	2.54	16.76	5.22	23.20
Df	4	4	4	4	4
Std Error	11.02	2.89	11.98	2.99	7.41
t Stat	1.70	0.88	1.40	1.75	3.13
P-value (2-tail)	0.1639	0.4295	0.2343	0.1557	0.0352
95% CL (lower)	-11.84	- 5.49	-16.50	-3.08	2.61
95% CL (upper)	49.36	10.57	50.02	13.52	43.79

Table 44. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Repeated Sites In the Aptos Creek Watershed (2007 to 2006; n=3).

Statistic	s.c. 1	s.c. 2	a.c. 1	a.c. 2	All Sizes
Mean difference	10.73	-5.97	-13.03	8.43	-2.50
Df	2	2	2	2	2
Std Error	6.55	4.41	8.06	4.94	8.61
t Stat	1.64	-1.35	-1.62	1.71	-0.29
P-value (2-tail)	0.2434	0.3092	0.2472	0.2296	0.7989
95% CL (lower)	-17.49	-24.97	-47.71	-12.80	-39.54
95% CL (upper)	38.95	13.03	21.64	29.67	34.54

Table 45. Paired T-test for the Trend in Steelhead Site Densities by Size Class and Age Class at All Repeated Sites In the Corralitos Creek Watershed (2007 to 2006; n=4).

Statistic	s.c. 1	s.c. 2	a.c. 1	a.c. 2	All Sizes
Mean difference	- 6.43	-1.38	-14.05	9.55	-5.05
Df	3	3	3	3	3
Std Error	10.87	4.58	11.92	6.61	6.33
t Stat	-0.59	-0.30	-1.18	1.44	-0.80
P-value (2-tail)	0.5962	0.7837	0.3235	0.2442	0.4834
95% CL (lower)	-41.03	-15.96	-51.98	-11.48	-25.20
95% CL (upper)	28.18	13.21	23.88	30.58	15.10

R-11. Adult Trapping Results at the Felton Dam's Fish Ladder and 2007 Planting Records

The trap 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 1 week during the winter of 2006-2007. It was used from 15 February 2007 through the morning of 21 February 2007 during a rainy period (**Table 46; Figure 25)**. A total of 53 adult steelhead =>18 inches Fork Length were captured; 17 (32%) were hatchery clipped. No coho salmon were captured. This was less than the 247 adult steelhead and 2 coho salmon captured in 2 months in 2006 from mid January to late March, but sampling was over a much shorter period in 2007. 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 year can be used to estimate actual adult abundance or trends.

Based on the planting log from the Monterey Bay Salmon and Trout Native Anadromous Fish Hatchery, in early April 2007 an estimated 5,650 juvenile smolts (500 lbs.) were planted at each of the following locations:

San Lorenzo River at Camp Campbell
Kings Creek – San Lorenzo River confluence
Boulder Creek – San Lorenzo River confluence
Bear Creek – San Lorenzo River confluence

In addition, an estimated 13,334 juveniles (1,180 lbs.) were planted in Zayante Creek near its mouth, and 8,656 juveniles (766 lbs.) were planted in the San Lorenzo at Henry Cowell State Park Bridge. All planted juveniles were offspring of adults trapped in 2006 in the San Lorenzo River at the Felton Diversion Dam.

Table 46. 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 Juveniles 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 Juveniles only
1997-98		1,784 (estimate)	Alley Estimate from 1995 Mainstem Juveniles only
1998-99		1,541 (estimate)	Alley Revised Estimate from 1996 Mainstem 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 Diversion Dam

(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 2007 RESULTS

D-1. Comparisons of the Annual Trend in Young-of-the-Year and Yearling Steelhead Densities in Santa County Streams with Trends in Other Local Coastal Streams

YOY steelhead densities in 2007 in Scott, Waddell and Gazos creeks were relatively low (**Smith 2007**). This was consistent with the majority of sites in the San Lorenzo, Soquel and Corralitos watersheds, especially in upper watershed sites. Higher YOY densities in 2007 than 2006 at some mainstem San Lorenzo and Soquel sites probably resulted from more spawning effort in lower watershed sites in 2007 with reduced passage flows that likely made spawning access more difficult to upper watershed reaches except during the few stormflows. In Aptos watershed sites, the 2 upper sites had lower YOY densities while the 2 lower sites had higher YOY densities. Smith attributed low YOY densities at some sites to difficulty in adult spawning access during a narrow access window in February and early March and to low summer streamflows in 2007. Waddell Creek continued to have a fish kill downstream of Last Chance Creek but had low YOY densities upstream, as well.

Yearling (smolt) abundance in 2007 in Gazos Creek was similar to the past 3 years, despite much lower YOY densities in 2006 (**Smith 2007**). Smith attributed this to better over-winter survival during the relatively mild 2006-2007 winter. In Scott Creek in 2007, yearling densities were relatively low (14/100 ft) but twice the average of the last 10 years and higher than the site average at 10 of 11 sites, apparently due to higher over-winter survival (**Smith 2007**). In Waddell Creek in 2007, yearling densities were low due to fish kills, but no comparison to past years was noted in the report (**Smith 2007**). Yearling site densities in 2007 in the San Lorenzo, Soquel, Aptos and Corralitos watersheds indicated better over-winter survival of yearlings during a very mild winter, with the great majority of sites having larger yearling densities than in 2006, as was the case in Scott and Gazos creeks. Yearling densities were especially higher when high densities of small YOY had been present in 2006 and there was presumably good over-winter survival during a winter with few storms, such as at upper watershed sites in Lompico, East Branch Soquel, Aptos and Browns Valley creeks. High yearling densities during fall sampling were unaffected by hatchery planting of large smolts the previous spring. Those fish out-migrated to the bay soon after being planted.

D-2. Causal Factors for Below Average Size Class II/ III (Smolt-Sized) Steelhead Densities in 2007 and Generally Lower Total Juvenile Densities Compared to Previously in the San Lorenzo Watershed

There are likely multiple reasons for the low juvenile densities in 2007. The below average smolt-sized juvenile densities occurred in the mainstem up to Boulder Creek confluence because of reduced growth rate in a drier year such as 2007 when fewer YOY grew to smolt size. Habitat quality was below average due to the shallower habitat and slower water velocity and less insect drift. It was really only at upper tributary sites (Zayante, Lompico and Boulder) where high numbers of small YOY in 2006 apparently stayed over as yearlings in 2007 after a mild winter (**Figure 3**). The mild winter allowed high survival of yearlings, which is likely the best explanation of higher densities in upper Lompico, Zayante and Boulder creeks. These sites had many small YOY in 2006 that were likely not large enough to smolt early in spring 2007 and had to stay a second summer. Also, with the small stormflows, fewer yearlings likely moved into the lower watershed. At other sites, higher proportions of 2006 YOY were already smolt size in 2006 due to the high streamflows and rapid growth rates (**Alley 2007**), allowing them to leave early as yearlings in spring 2007. Plantings of smolt-sized juveniles by the Monterey Bay Salmon and Trout project in the spring do not affect later fall juvenile densities of Size II/ III steelhead because planted smolts are quite large and out-migrate soon after being released in spring.

The below average total densities at mainstem sites below Boulder Creek probably resulted from poor spawning success in the mainstem and low movement of fry from tributaries producing greatly reduced YOY during a dry winter and reduced habitat quality in fastwater habitat in summer (**Figures 1 and 2**). The one exception was Site 6 below Fall Creek. The higher density was due to heavy use of fastwater habitat by small YOY and an artifact of choosing a shorter pool to census in 2007. The average or above average total densities in most Zayante sites and the Lompico site resulted from good YOY production and apparently improved spawning perhaps from reduced fine sediment and reduced loss of redds from scouring in a drier winter.

The drastically reduced total densities in Bean Creek resulted from very low YOY densities. Site 14b was downstream of a lengthy stretch of dry streambed that prevented recruitment of YOY into that site from upstream. No YOY were found at the site. Site 14c was flowing at a trickle, which greatly reduced habitat quality and survival of YOY, leaving primarily below average numbers of yearlings holding over. A substantial wood cluster was observed in lower Bean Creek prior to the 2006/2007 winter (**C. Berry personal communication**). However, adult steelhead had access to Bean Creek that winter because YOY were detected at the upper Site 14c in 2007. We did not find any migrational barrier in lower Bean Creek in April 2008, though large downed redwoods and smaller wood were observed, clustered in the channel below a previous landslide but not blocking the thalweg. Lower Boulder Creek had a near-average total density resulting from near-average YOY density. This indicated that spawning was reasonably successful. Middle Boulder Creek had below average total density due to below average YOY density that may have resulted from reduced spawning activity or success and greater competition from yearlings holding over at that site. Lower Bear Creek had below average total density because of reduced YOY and yearling densities. Habitat quality was greatly reduced there due to much shallower conditions and slower water velocity.

D-3. Causal Factors for Above Average Total and Young-of-the-Year Densities in Mainstem Soquel Creek Sites and Below Average Densities in Branch Sites, with Wide Fluctuation in Smolt Densities in the East Branch

The above-average total densities in mainstem sites likely resulted from heavier spawning effort late in the spawning season, when adult access to the upper watershed was impeded by low flows (**Figure 4**). In addition, fewer spawning redds were likely scoured out due to the limited stormflows after February 2007, resulting in better egg survival and YOY production in the mainstem (**Figure 74**). Pool depths were maintained in 2007 in the mainstem, with streambed conditions improved and similar amounts of escape cover. Reduced total and YOY densities in the Branches, particularly in the SDSF and above Girl Scout Falls I may have been due to reduced adult spawning access. The weir at the entrance to the canyon on the East Branch, as well as Girl Scout Falls I on the West Branch, may have been difficult to pass without stormflows later in the spawning season. A qualified fishery biologist should examine the weir for potential downcutting that may have occurred over the wet 2005-2006 winter that could have made passage difficult. Habitat quality was greatly reduced due to low streamflows in the SDSF, particularly in step-runs that are usually heavily used by YOY.

The below average density of smolt-sized juveniles at Site 13a below Mill Pond (**Figure 6**) resulted from much below average densities of YOY in 2006 at that site (**Alley 2007**). That site has been covered with fine silt and had high water turbidity at the time of sampling. The ownership of the Mill Pond changed hands, and the management of the pond may have changed for the worse. There has been considerably more sediment exiting the pond the past 2 years. Site 16 in the SDSF in 2007 had the highest smolt density ever detected, despite reduced habitat quality. In 2006, the YOY density had been extremely high at this site with the high streamflow and easy adult access (**Alley 2007**). The high yearling density in 2007 may have occurred because a high proportion of these many small YOY from 2006 held over, combined with high over-winter survival of yearlings and few 2007 YOY present to compete for food.

D-4. Causal Factors for Differences in Juvenile Densities between 2006 and 2007 in the Aptos Creek Watershed

Total density at the lower Aptos site was much higher in 2007 than 2006 because of the much higher YOY density. The upper Aptos site's density was much lower in 2007 than 2006 because of much lower YOY densities in 2007. Most of the spawning activity must have occurred in the lower creek in 2007. Results indicate that there may be a passage impediment between the upper and lower sites on Aptos Creek. Densities of smolt-sized juveniles showed the opposite pattern to YOY. At the lower Aptos site there was a lack of fast growing YOY in the smolt category in 2007 due to lower streamflow and growth rate. At the upper Aptos site, more yearlings held over that were slow growing YOY in 2006 and benefited from improved habitat quality. There was also likely good over-winter yearling survival due to the mild winter.

We believe that Valencia Creek in 2006 was an unusual year in that the old fish ladder below Site 2 and the culvert below Site 3 were both somewhat passable to adult steelhead during the wet winter of 2005/2006. In the summer of 2006, adult steelhead fish passage at the Valencia Creek culvert was improved due to a County retrofit project. We believe that in 2007, the old fish ladder below Site 2 was also passable but adults did not make it into Reach 3, upstream of the Valencia Road culvert. There were debris jams downstream that may have prevented adults from reaching the Valencia Road culvert. It appeared passable after the project was completed, prior to the 2006/ 2007 winter. The lower Site 2 had higher total densities in 2007 than 2006 (**Figure 7**) because habitat quality improved and a high proportion of yearlings (smolt-sized) held over (**Figure 9**). There was an above-average density of YOY in 2006, and they were slow-growing throughout the spring of 2007. The upper Site 3 likely lacked adult steelhead spawning in 2007 due to the small winter stormflows that likely prevented adults from reaching the site. As a result, YOY densities were especially low (**Figure 8**), resulting in low total density (**Figure 7**). Yearling (smolt) density remained similar between years with improved habitat quality. The few YOY detected above Valencia Road may have resulted from spawning of resident rainbow trout.

D-5. Causal Factors for Differences in Total and Size Class II/III (Smolt-Sized) Juvenile Densities between 2006 and 2007 in the Corralitos Creek Watershed

Reduced total densities at all Corralitos watershed sites except the two lowermost repeated sites on Corralitos Creek likely resulted from reduced spawning success and/or reduced YOY survival resulting from reduced habitat quality. Habitat quality was reduced due to lower streamflow during spawning and rearing, with much shallower habitat depth and water velocity (less insect drift) in 2007 compared to 2006. Step-runs were less valuable in 2007 and made up a sizeable proportion of the habitat in upper Corralitos, Shingle Mill and Browns Valley creeks (**Table 5c**). In 2006 (**Alley 2007**), fastwater habitat was more heavily used than in 2007, when it became too shallow.

Density of larger Size Class II/III and yearling juveniles was so much less at the upper Corralitos site in 2007 presumably because the high density of fast growing YOY in this size class in 2006 smolted early as yearlings in spring 2007, leaving few yearlings and smolt sized fish in fall 2007. The habitat quality for larger smolt-sized fish was also greatly reduced in 2007 due to reduced streamflow and habitat shallowing.

Density of larger Size Class II/III and yearling juveniles was so much more at the upper Browns Creek site in 2007 compared to 2006, presumably because a high proportion of the very high density of slow-growing YOY in 2006 held over as yearlings in 2007. Over-winter survival of yearlings was also likely good with the mild winter. The lower Browns Creek site also had a much higher yearling density in 2007 than 2006, but similar smolt-sized fish between years and lower yearling and smolt densities than the upper site in 2007. This could be because habitat conditions were better at the upper site in 2007 for yearlings, with more escape cover in pools and step-runs.

D-6. Data Gaps

Annual monitoring of steelhead needs to continue through the next drought period and beyond to assess the extent of population recovery. For 2003-2005, only the middle and upper mainstem of the San Lorenzo and 5 tributaries were sampled (except for 1 site in upper Branciforte in 2005), and sampling in several tributaries or portions of them was discontinued. By 2007, only 3 sites were re-established in the lower River below the Zayante Creek confluence, as well as two in lower Branciforte Creek. But the Newell Creek site was removed because the City of Santa Cruz Water Department was collecting its own data. Only 1 mainstem site is sampled upstream of the Boulder Creek confluence. Therefore, there are data gaps in several key tributaries that are influenced by human activities. Those include the upper San Lorenzo mainstem, Carbonera, Newell, Kings and upper Bear creeks. More fish and habitat monitoring must occur in the lower mainstem, including the flood control channel and lagoon/estuary, in order to assess success of management efforts. More fish sampling must occur in upper Zayante Creek and Mt. Charlie Gulch adjacent to Santa Cruz City watershed lands to assess success of management efforts.

In 2006 and 2007, annual estimation of juvenile steelhead population size and calculation of adult indices from juvenile population size ceased for the first time since 1994. This is a significant loss in monitoring information when trends in overall juvenile populations can no longer be assessed. While determination of site densities is very valuable, the relative contributions of different reaches and tributaries to juvenile total population size is lost when only site densities are reported, rather than the total density of the reaches the sites represent. In particular, 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 annual juvenile population numbers because it weights the juveniles according to size categories and size-dependent survival rates. Although the index may not accurately predict actual adult numbers, it reflects *relative* adult production.

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 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) and Boulder Creek (near the mouth).

We are aware of streamflow measurements made by County staff each year but noted that many former sites have been removed or are measured only occasionally. It would be beneficial if more streamflow sites could be added to the Soquel, Aptos and Corralitos watersheds and if sites in the San Lorenzo watershed could be visited more regularly in the fall before early storms.

There is no stream gage for 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 Valley and Corralitos Creeks. Then the streamflow above and below the diversions could be monitored.

Recent data gaps on juvenile steelhead use and habitat quality in the heavily impacted mainstem of Soquel Creek have occurred. In 2007, only 2.5 miles of mainstem was habitat typed (increased over 2006 work), when all 7.2 miles were habitat typed in the past to assess habitat quality. Sampling in Soquel creek was increased from 6 to 8 sites in 2007, though in earlier years there were 21 sites annually sampled. On the plus side, fish sampling and habitat monitoring in the Aptos and Corralitos watersheds were renewed and one passage impediment on Valencia Creek was remedied prior to the 2006/2007 winter.

CONCLUSIONS FOR 2007 SAMPLING RESULTS

In all 4 watersheds in 2007, there was an increase in pool habitat in many reaches and a reduction in fastwater habitat with less streamflow, which was a significant loss in the lower mainstem San Lorenzo where most juvenile steelhead utilize fastwater habitat. In all 4 watersheds, there was a much smaller proportion of YOY steelhead growing into Size Class II after a winter/spring of relatively low streamflow that slowed growth rate in 2007.

In the San Lorenzo system, most YOY production was detected in Zayante, Lompico and lower Boulder creek tributaries, with the Lompico Creek site having the highest density in the watershed. Densities of important larger juveniles (Size Class II/III and yearlings) were far below average at all sites except where high numbers of small YOY's were present in 2006 (Upper Zayante, Lompico and upper Boulder creeks). There was a general decline in habitat quality from 2006 due primarily to reduced streamflow that reduced habitat depth and insect drift rate, especially in important mainstem fastwater habitat. There was a general improvement in streambed conditions compared to 2006, with reduced percent fines and less embeddedness, though escape cover was generally less in important mainstem fastwater habitat (except for improvement in Reach 4 in Henry Cowell Park) and similar to 2006 in tributary pools.

Bean Creek sites in the Zayante sub-watershed exhibited none or very low YOY densities with low streamflow at sites and extensive dry streambed between Ruins Creek confluence and a point beyond the Mackenzie creek confluence,

In the lower Soquel Creek watershed, above average YOY densities (and presumably spawning activity) occurred in 2007, and below average YOY densities were found in the upper watershed, especially at the Soquel Demonstration State Forest (SDSF) site where streamflow was only a trickle. At the SDSF site (upper East Branch Soquel Creek), the highest density of Size Class II and yearling juveniles ever detected was found. This was a site with a high density of small YOY's in 2006. In the Soquel Creek system in 2007, habitat quality was generally similar to 2006 (except for substantial decline in the SDSF), despite reduced streamflow that reduced water velocity and insect drift rate. Streambed conditions improved throughout the watershed in 2007, with similar pool escape cover except for decline in the SDSF. There was greatly reduced pool and step-run depth in upper Branch sites. Adult steelhead passed Girl Scout Falls I on the West Branch Soquel in winter 2006/2007.

At lower sites in Aptos and Valencia creeks were found above average YOY densities (and presumably more spawning activity). Below average YOY densities were found at the upper sites, indicating adult spawning blockage at Valencia Road crossing. At the upper Aptos and lower Valencia creek sites in 2007, there were above average densities of larger juveniles (yearlings) where most YOY's in 2006 had been small. In the Aptos system, habitat quality improved in 2007 compared to 2006, with improved streambed conditions (reduced percent fines and less embeddedness), more pool escape cover and similar pool depths (except reduced habitat quality at lower Aptos site that had similar pool escape cover and the most shallowing of pools).

In the Corralitos system, YOY densities were below average at all sites except the 2 lower repeated Corralitos sites. Densities of larger juveniles were below or near average except higher at the upper Browns Valley site where high numbers of small YOY's were found in 2006. There was a general decline in habitat quality compared to 2006 due to less streamflow that reduced habitat depth (particularly pool and step-run habitat in the upper watershed) and reduced water velocity and insect drift. However, as in the other 3 studied watersheds, streambed conditions were improved, and pool escape cover increased to the extent that the 2 lower Corralitos sites had similar habitat quality to 2006, despite lower streamflow.

Statistical Results. With 13 comparable sites in the San Lorenzo drainage, the decline in Size Class II/III site densities and increase in yearling site densities were statistically significant (**Table 42**). With 5 comparable sites in the Soquel drainage, the increase in total site densities was considered statistically significant (**Table 43**). No statistically significant changes were detected in the Aptos and Corralitos watersheds with small sample sizes (**Tables 44 and 45**).

TRENDS IN JUVENILE STEELHEAD DENSITY AND HABITAT CONDITIONS IN THE SAN LORENZO RIVER, 1997-2007

The lower and middle mainstem have become less important in producing juvenile steelhead in both the YOY age class and the Size Class II and III categories in recent years. Total juveniles increased in 2002 after a winter that had larger storms early in the winter and smaller ones afterwards. But densities declined after that. The years 1998 and 2006 had similarly wet winters prior to fall sampling. However, the mainstem had substantially higher juvenile densities in 1998 than 2006. Habitat conditions in 1998 that were better than in 2006 in both the lower and middle mainstem (depicted for Reaches 4 and 8, respectively) included greater depth in fastwater habitat (riffles), higher water velocity due to higher streamflow (and likely greater insect drift) and more escape cover in fastwater habitat in the middle mainstem Reach 8. However, certain riffle habitat parameters were better in 2006 in the lower mainstem Reach 4, such as greater escape cover (more overhanging willows) and less percent fines. In Reach 8 the estimated percent fines in 1998 and 2006 were the same. Rearing habitat conditions in Reach 4 in 2007 have improved since 1999 regarding greater depth, more escape cover, reduced embeddedness and reduced percent fines. However, 1997 conditions were better with regard to habitat depth and percent fines. If baseflows had been the same in 1997 and 2007, habitat conditions in Reach 8 riffles may have been similar between years, with the possible exception of less escape cover in 2007.

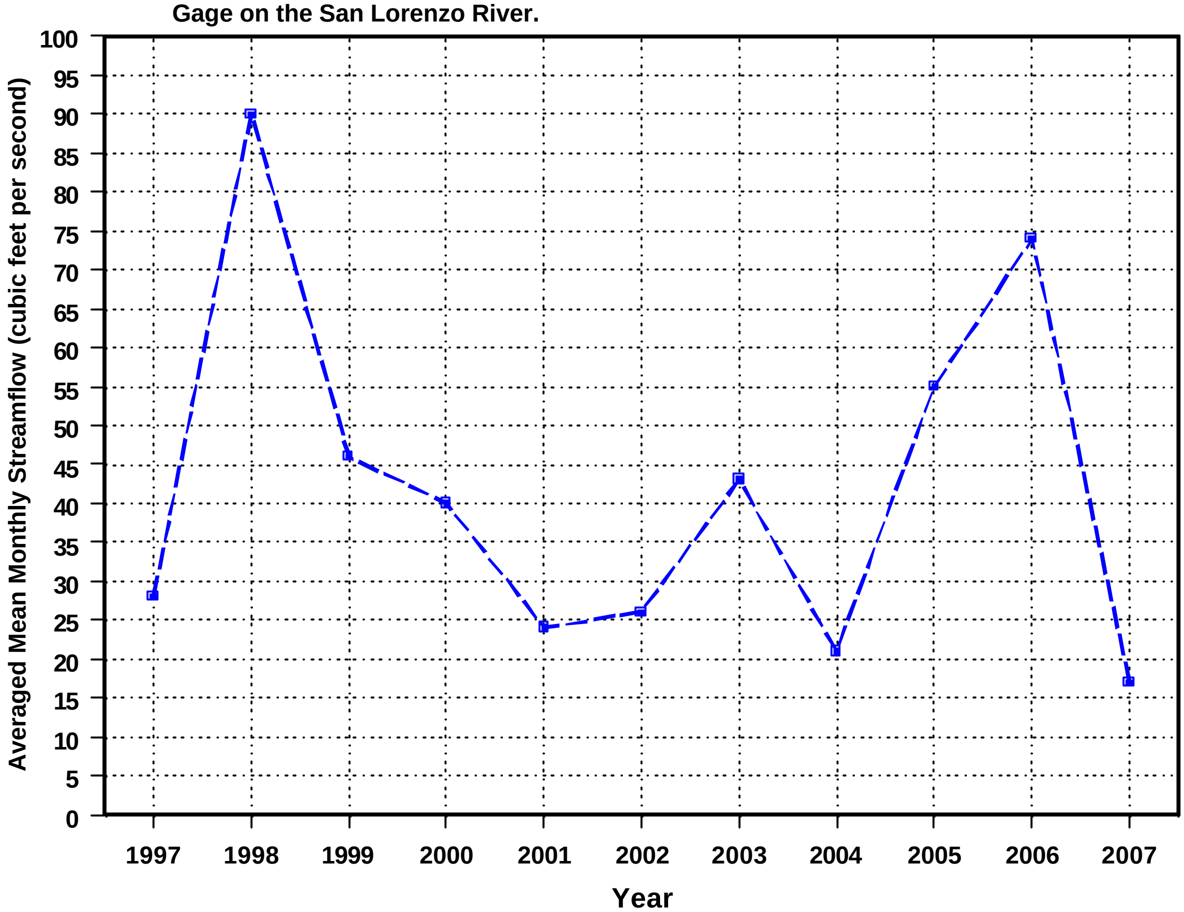
For tributary sites and the upper mainstem, there was a general decline in total densities from 1997 to 2000, with a general increase from 2000 to 2003, followed by a general decline from 2003 to 2007. Since most juveniles were YOY, their densities followed the same trend. Tributary densities of Size Class II and III showed no general trend, though as a group were especially low in 2007. They were similar between 1997 and 1998 but generally increased in 1999 to an 11-year high, particularly in Zayante, upper Boulder and Bear creeks. In analyzing habitat change in an important eastern tributary reach, it was noted that rearing habitat conditions have declined in Zayante Reach 13d from 1997 to 2007, judging by the shallowest pool depths in the 11-year period in 2007 (where annual differences in baseflow have limited effect on pool depth) and the relatively low pool escape cover in 2007. In analyzing habitat change in an important western tributary reach, it was noted that overall rearing habitat quality in Boulder Reach 17a has declined from 1997 to 2007 due to reach-wide pool filling and reduced pool escape cover.

Ecological Considerations

The density of juvenile steelhead in the lower and middle mainstem San Lorenzo River is dependent upon the number of spawning adults, spawning effort in these segments, spawning success (survival rate from egg to emerging fry), the number of juveniles that enter the lower and middle mainstem from tributaries, survival of emerging YOY in spring and the rearing habitat quality primarily in fastwater habitat (riffles, runs and heads of pools) in the spring and summer. The lower and middle mainstem are inhabited by primarily fast growing YOY with much fewer yearlings. In relatively drier winter/springs more spawning effort occurs in the lower and middle mainstem and less in the tributaries due to more limited access to the upper watershed reaches. In the last 11 years, 1997, 2001, 2002 2004 and 2007 were relatively dry, based on averaged mean monthly streamflow (May–September) (**Figure 25**). Spawning success is likely greater in drier years in the lower and middle mainstem because fewer storms are likely to destroy spawning redds after spawning. However, shallow water depth in spawning glides may make it more difficult for adults to spawn, and water percolates more slowly through the gravels to buried eggs in drier years. Years in which most of the larger winter storms occur early in the winter and they are of sufficient number to maintain a high but steady decline in the hydrograph through the late winter and spring, with the help of smaller stormflows will maximize spawning effort later in the spawning season, spawning success and juvenile survival after emergence in the lower and middle mainstem. The years of 1997 and 2002 were examples of this hydrologic pattern. The year 2007 had few late winter storms but also few early winter storms, it being the driest of the last 11 years.

In wetter years, more spawning effort occurs in the upper reaches of the watershed, namely in the upper mainstem and the tributaries. Relative wet years included 1998, 1999, 2000, 2005 and 2006 (**Figure 25**). Spawning success and survival of emerging YOY may be reduced in the lower and middle mainstem in these years due to later storms that destroy redds and wash away emerging YOY. There may be fewer of the large yearlings in those segments because growth rate may have been substantial in early spring to encourage yearlings to smolt early. Large storms may also reduce the survival of yearlings over the winter, as well. However, after wetter winters the baseflow will be higher, and growth rate of YOY in the lower and middle mainstem will be substantial. The density of Size Class II and III juveniles may be quite high due to YOY reaching this smolt size their first winter.

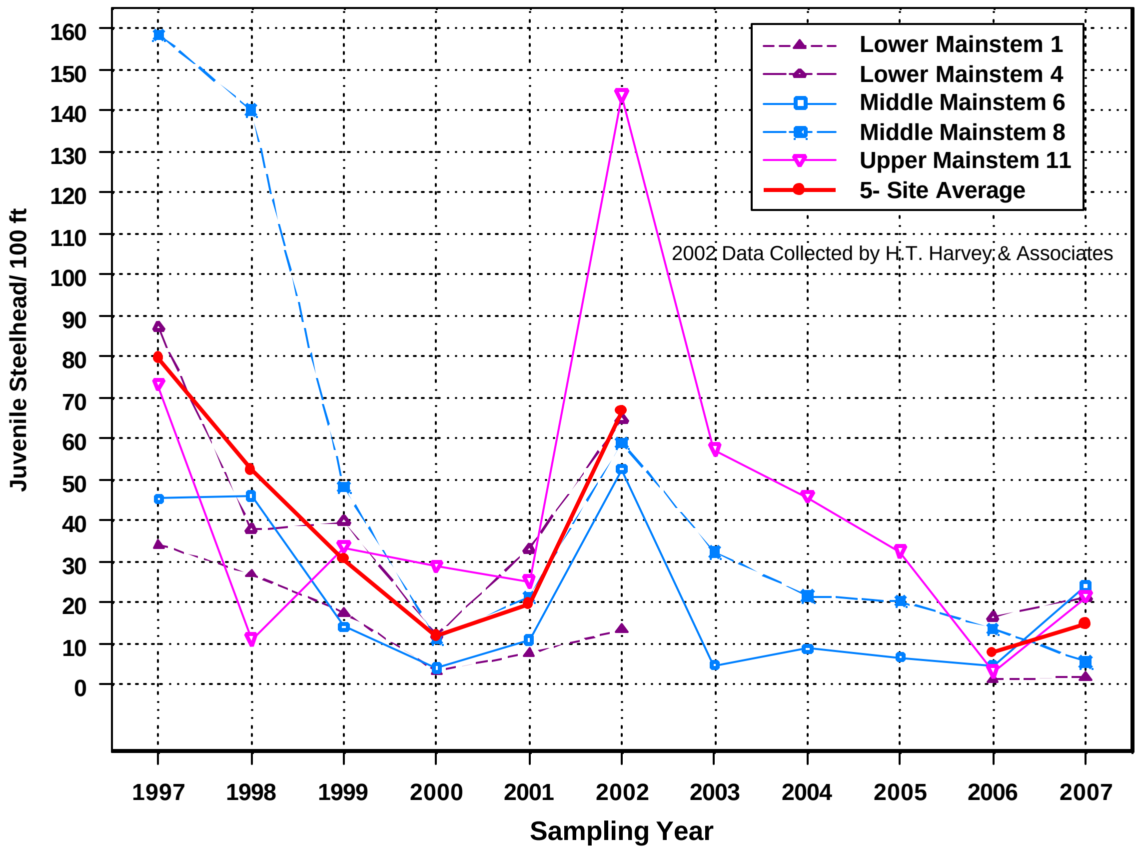
Figure 25. Averaged Mean Monthly Streamflow for May - September, 1997 - 2007 at the Big Trees Gage on the San Lorenzo River.



Trends in Juvenile Steelhead Densities in the Lower and Middle Mainstem San Lorenzo River

In looking at the trends in total juvenile density, there has been a general decline from 1997 to 2007 in the lower, middle and upper mainstem (**Figure 13**). There was a general increase in total juvenile densities in 2002, as was expected in a year with larger early winter storms and smaller storms later, though density comparisons with other years are weakened because different methods were employed in 2002 by H.T. Harvey & Associates (HTH) (**2003**) to choose sampling sites. We saw the same increased densities in the adjacent Soquel Creek in 2002 to strengthen the comparison. After 2002, total juvenile densities generally declined in the lower and middle mainstem.

Figure 13. Plot of Annual Total Juvenile Densities at San Lorenzo Mainstem Sites, 1997-2007.



No data were available from the HTH report (**2003**) regarding YOY or Size Class II and III densities. YOY densities generally declined from 1997 to 2000, increased in 2001 and 2003 but generally declined from 2003 to 2007, which had lower densities at all sites compared to 1997–1999 (**Figure 15**). For Size Class II and III juvenile densities in the lower and middle mainstem, they were higher in the years 1997-1999 than later years with relatively low densities from 2000 until 2007, which had the lowest densities measured in the last 11 years (**Figure 17**). The lower and middle mainstem have become less important in producing larger juveniles in recent years. In order for adult returns to increase substantially, the mainstem will need to again support at least the densities of Size Class II and III juveniles that were present in 1997, 1998 and 2002 and hopefully much higher densities in the future. Habitat quality will need to improve substantially in these segments to increase adult returns.

The upper mainstem site in this analysis is upstream of major tributaries (Branciforte, Zayante, Fall, Newell, Boulder and Bear creeks) and may be categorized with tributary sites because few of its YOY grow into Size Class II their first growing season.

Figure 15. Plot of Annual YOY Juvenile Densities at San Lorenzo Mainstem Sites, 1997-2007.

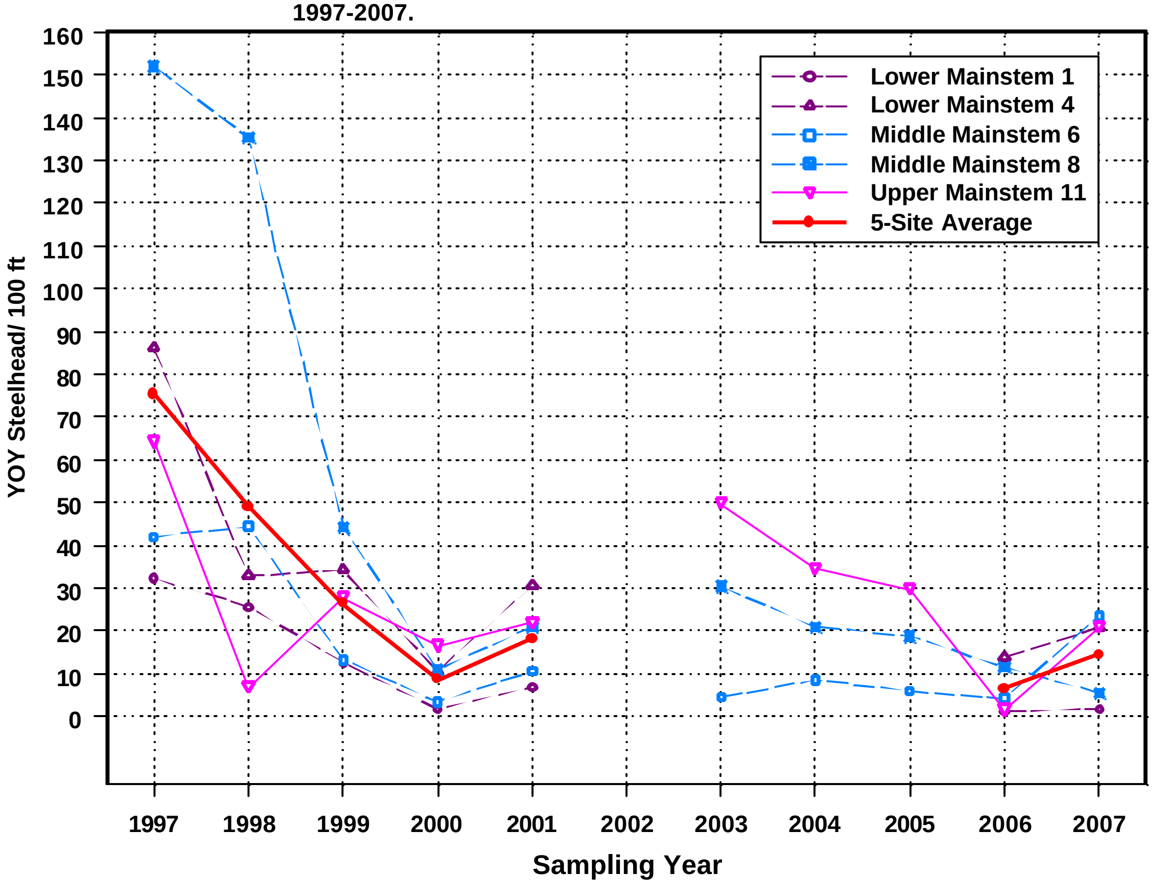
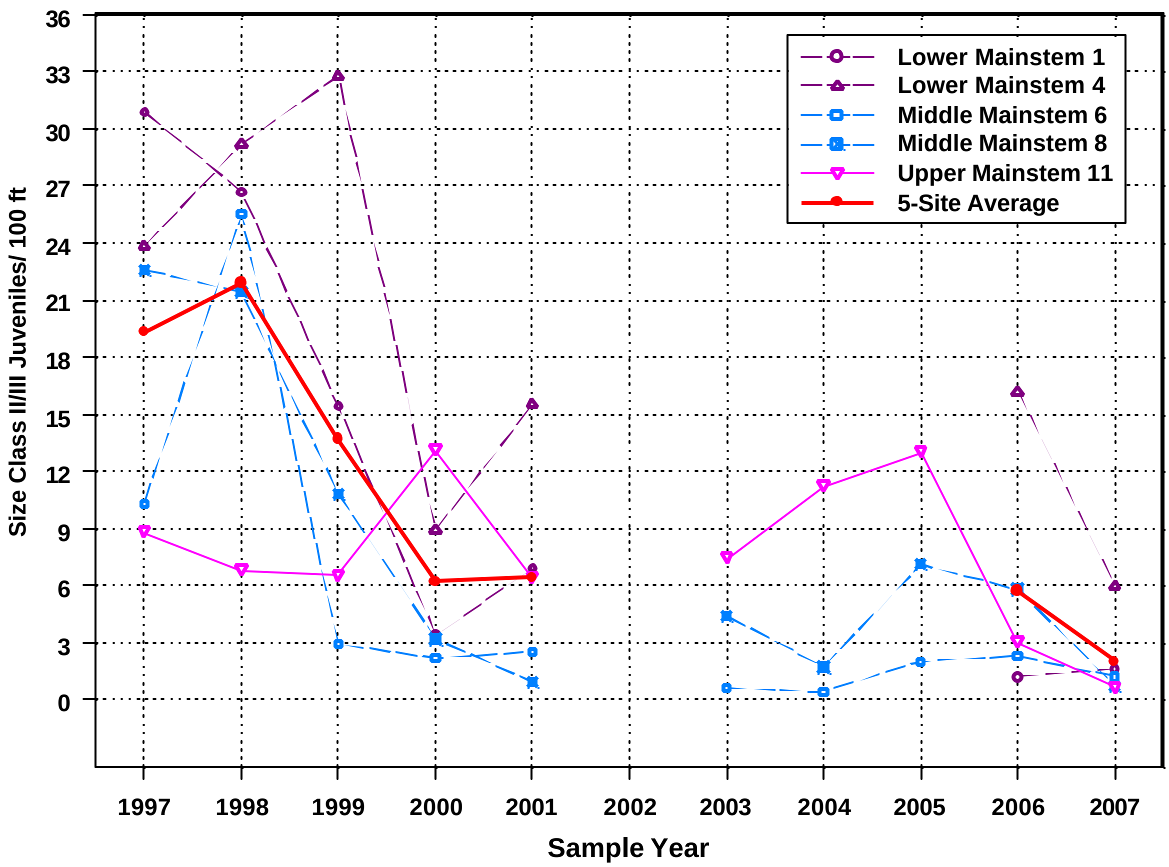


Figure 17. Scatter Plot of Annual Size Class II/ III Juvenile Densities at San Lorenzo Mainstem Sites, 1997-2007.



The years 1998 and 2006 had similarly wet winters prior to fall sampling (**Figure 25**). However, the mainstem had substantially higher juvenile densities in 1998 than 2006. The lower 2006 densities may have resulted from fewer adults returning (not confirmed), reduced spawning success (not confirmed), fewer juveniles filtering down from the tributaries due to lower juvenile densities there (confirmed by **Figure 14** shown in the tributary section of the summary) and reduced rearing habitat quality compared to 1998. Habitat conditions that were better in 1998 than 2006 in both the lower and middle mainstem (depicted for Reaches 4 and 8) included greater depth in fastwater habitat (riffles) (**Figures 27 and 30**), higher water velocity due to higher streamflow (and likely greater insect drift) and more escape cover in fastwater habitat in the middle mainstem Reach 8 (**Figure 31**). However, certain riffle habitat parameters were better in 2006 in the lower mainstem Reach 4, such as greater escape cover (more overhanging willows) and less percent fines (**Figures 28 and 29**). In Reach 8 the estimated percent fines in 1998 and 2006 were the same (**Figure 32**).

Figure 27. Averaged Maximum and Mean Riffle Depth in Reach 4 of the Lower Mainstem San Lorenzo River, 1997-2002 and 2006-2007.

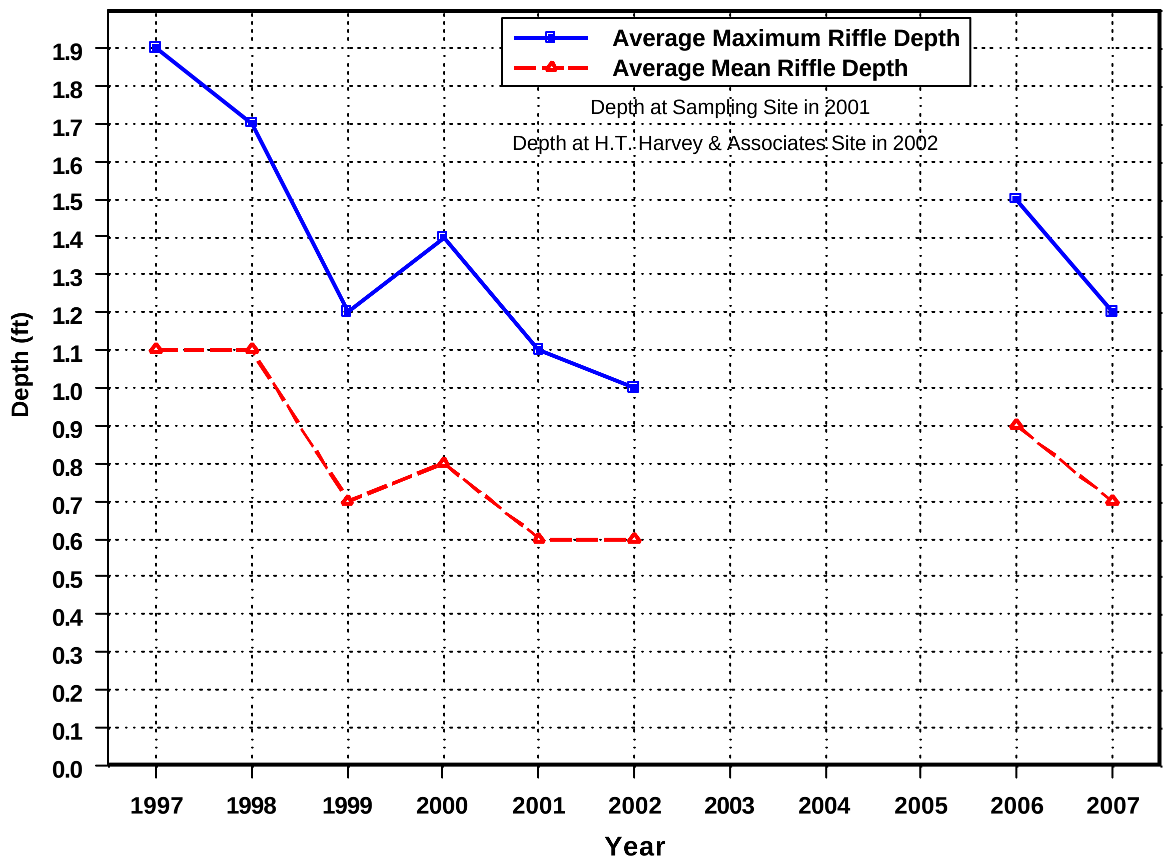


Figure 30. Averaged Maximum and Mean Riffle Depth in Reach 8 of the Middle Mainstem San Lorenzo River, 1997-2007.

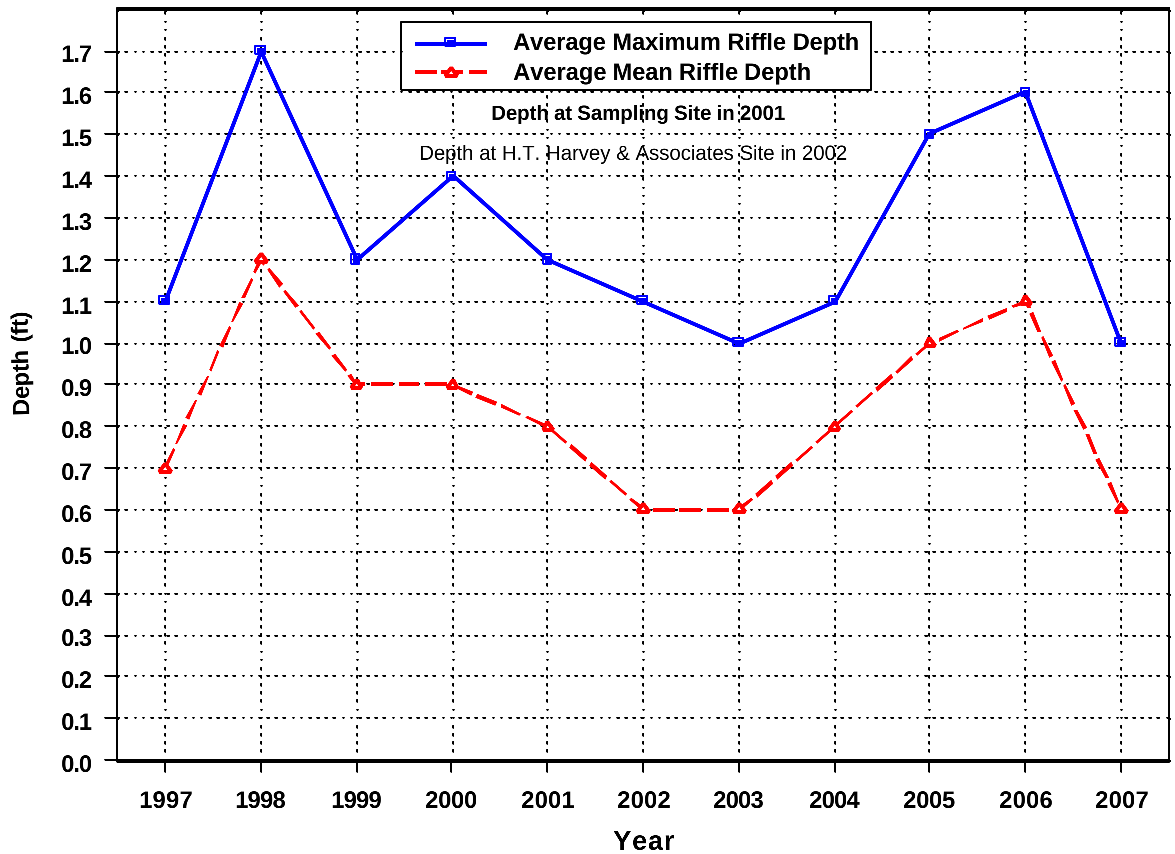


Figure 31. Escape Cover Index for Riffle Habitat in Reach 8 of the Middle Mainstem San Lorenzo River, 1998-2000, 2003 and 2005-2007.

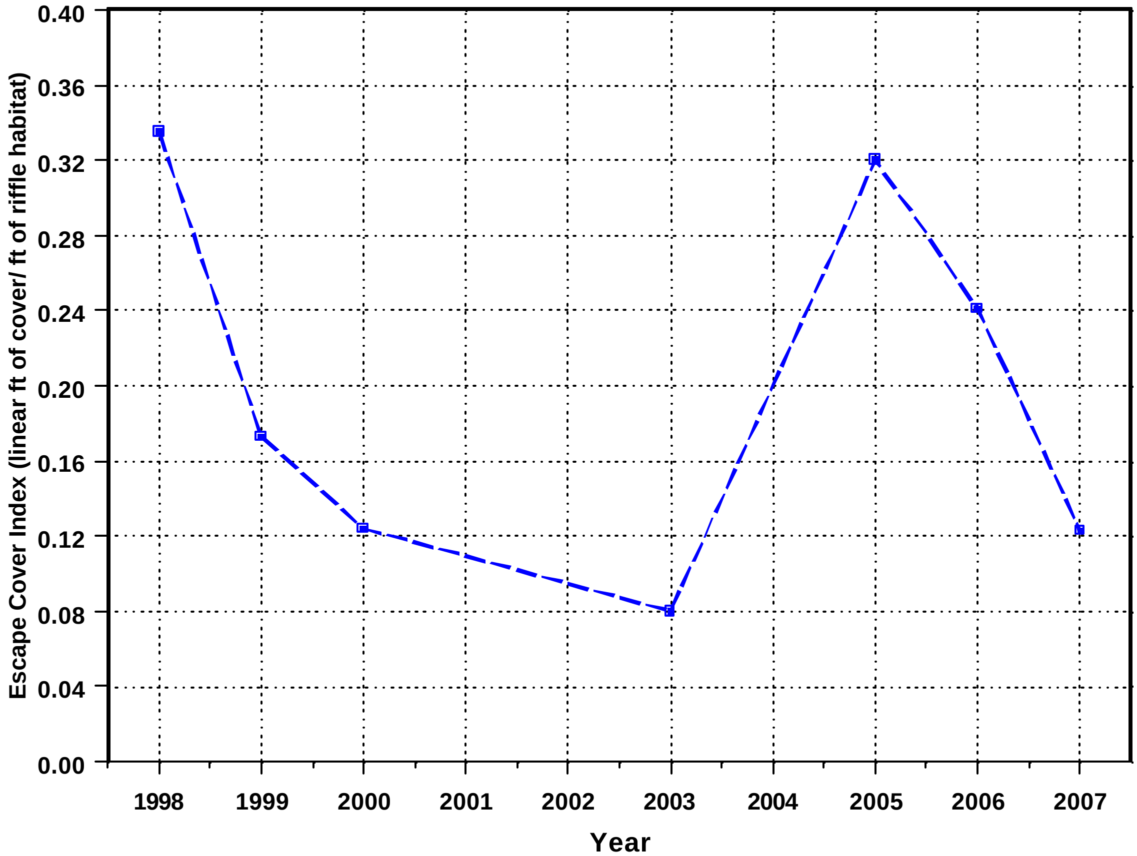


Figure 28. Escape Cover Index for Riffle Habitat in Reach 4 of the Lower Mainstem San Lorenzo River, 1998-2000 and 2006-2007.

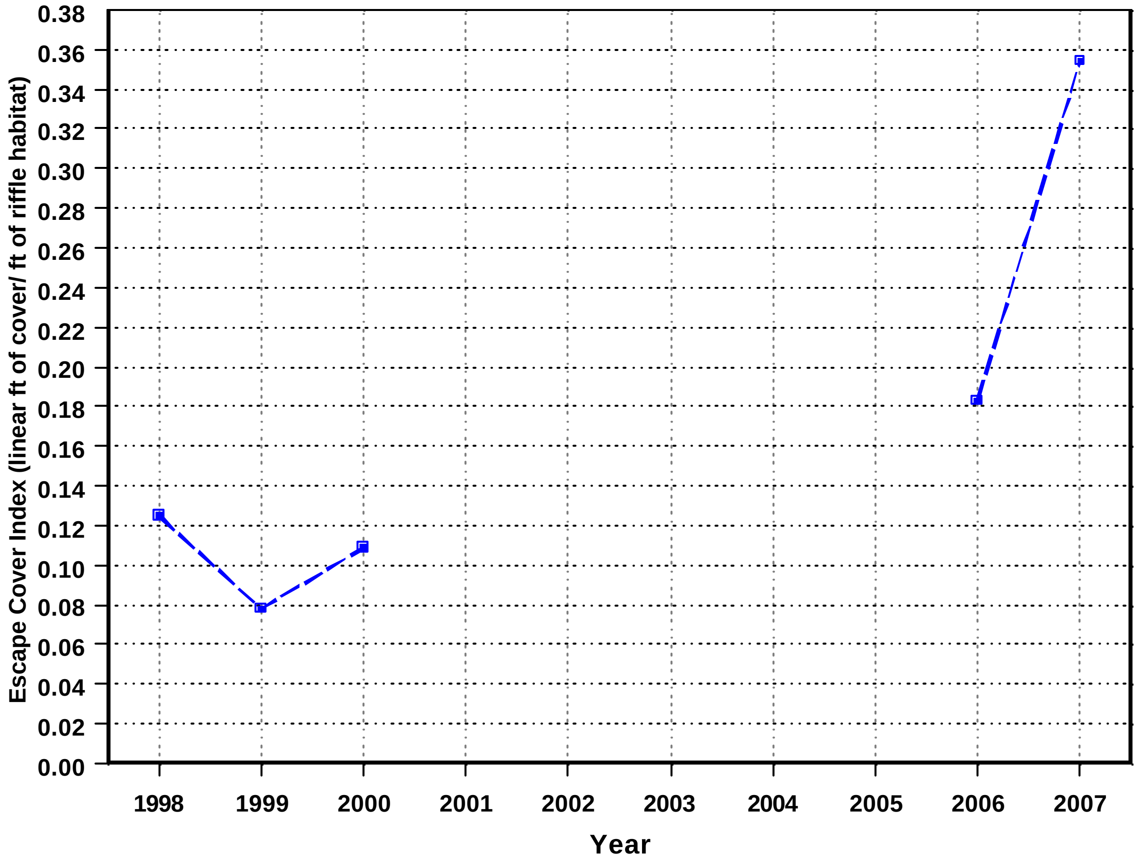


Figure 29. Averaged Percent Fines in Riffle Habitat in Reach 4 of the Lower Mainstem San Lorenzo River, 1997-2001 and 2006-2007.

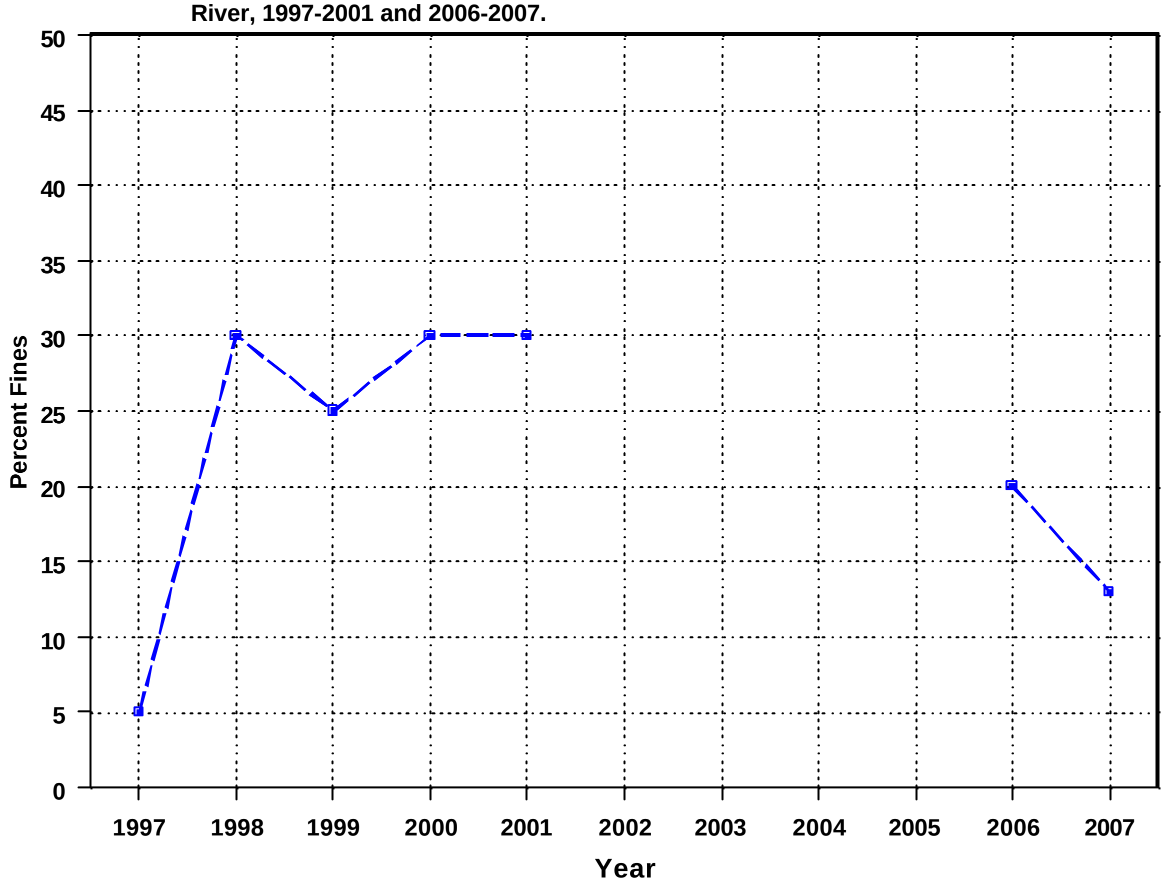
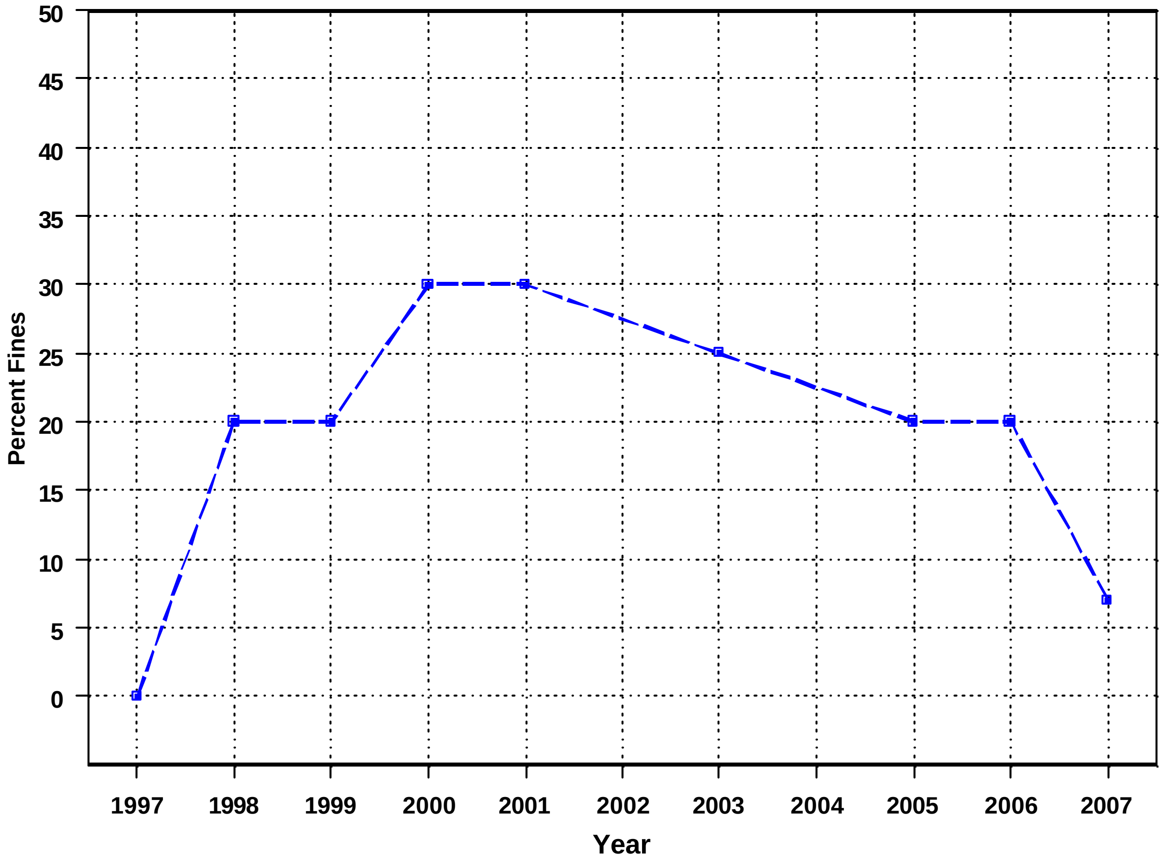


Figure 32. Averaged Percent Fines in Riffle Habitat in Reach 8 of the Middle Mainstem San Lorenzo River, 1997-2001, 2003 and 2005-2007.



In 2007, the driest year in the last 11 years, flow-related habitat conditions were relatively poorer in the lower and middle mainstem, while substrate conditions were improved over recent years. However, despite the low flow conditions, juvenile densities were lower than expected and much less than in 1997, 1998 and 2002, indicating that much fewer juveniles filtered down into the lower and middle mainstem from tributaries. Adults may have had difficulties passing shallow riffles and impediments in the mainstem River and tributaries to access some tributary sites for spawning (unconfirmed). Supporting evidence was that YOY densities at upper tributary sites in Zayante, Bean and Boulder creeks were less in 2007 than 2006, although reduced rearing habitat quality may have also played a role in the decline. Also, there may have been a smaller adult population returning in 2007 (unconfirmed). Habitat conditions worsened from 2006 to 2007 when riffle depth declined considerably from 2006 to 2007 in both the lower and middle mainstem (shown for Reaches 4 and 8). With the lowest streamflow in the 11-year period, 2007 had the lowest water velocity in riffles in the lower and middle mainstem and likely the lowest insect drift rate. But riffle depth in 2007 was similar to past years when juvenile densities were higher. Average maximum riffle depth in 2007 in the lower mainstem Reach 4 was within

0.1 ft of that in 1999 and the same as it was in 2001. The average mean depth in 2007 was the same as in 1999, 0.1 ft deeper than in 2001 and 2002 and 0.1 ft shallower than 2000. In the middle mainstem Reach 8, riffle depth (reach-averaged maximum and mean) in 2007 was the same as in 2003 and 0.1 ft shallower than in 1997. Riffle escape cover continued to increase in the lower mainstem (Reach 4) in 2007 (highest in 5 years of measure since 1998), as well as less percent fines in Reach 4 (still greater than 1997). Percent fines also lessened in the middle mainstem Reach 8 in 2007 (second lowest but still greater than 1997), but Reach 8 had less escape cover (among the 3 lowest years in 11, similar to 2000 and still more than 2003).

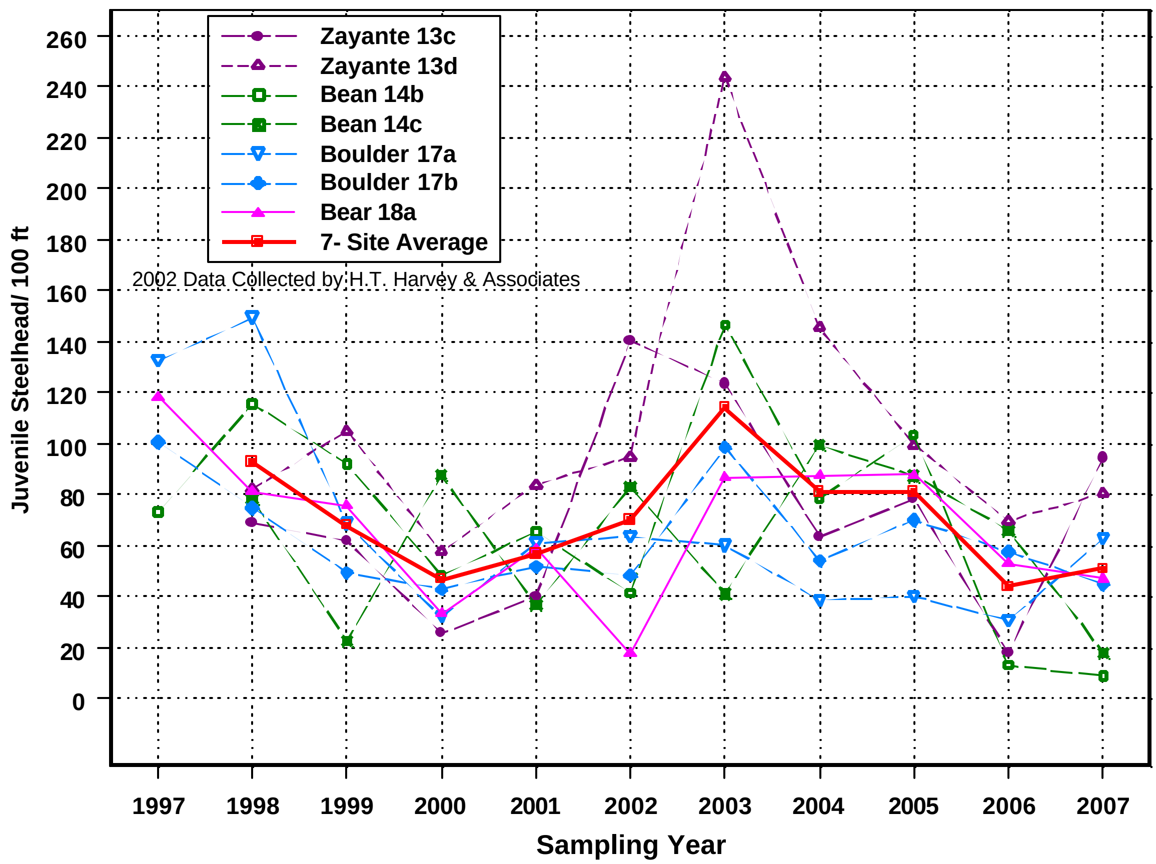
Trends in Juvenile Densities in San Lorenzo River Tributaries and the Upper Mainstem

Looking for overall trends in juvenile densities for all of the tributaries combined is difficult. Each tributary drains a sub-watershed with its own climate, geology, gradient, habitat proportions, residential density and human activities (logging, bridge building, paving and water extraction). Adult spawning access and habitat conditions do not necessarily fluctuate annually in parallel between sub-watersheds. Some sub-watersheds are accessible in most years while others are difficult to pass in drier winters. Some sub-watersheds are more stable regarding sedimentation while others are more erosive. Some have high annual variability in baseflow while others are stable.

Most of the juvenile population in tributaries consists of YOY juveniles. YOY densities at tributary sites are influenced by several factors; 1) number of adults returning to the respective tributaries, 2) spawning effort, 3) spawning success, 4) survival of emerging YOY in late winter and spring and 5) rearing habitat quality in primarily pools. Spawning conditions are better in the tributaries than the mainstem, but late stormflows may be very successful in destroying many spawning redds because of the high percent fines in spawning glides in nearly all tributary spawning sites. Water velocities from late stormflows may also wash newly emerged YOY away with high mortality in the face of little instream wood to provide velocity shelter.

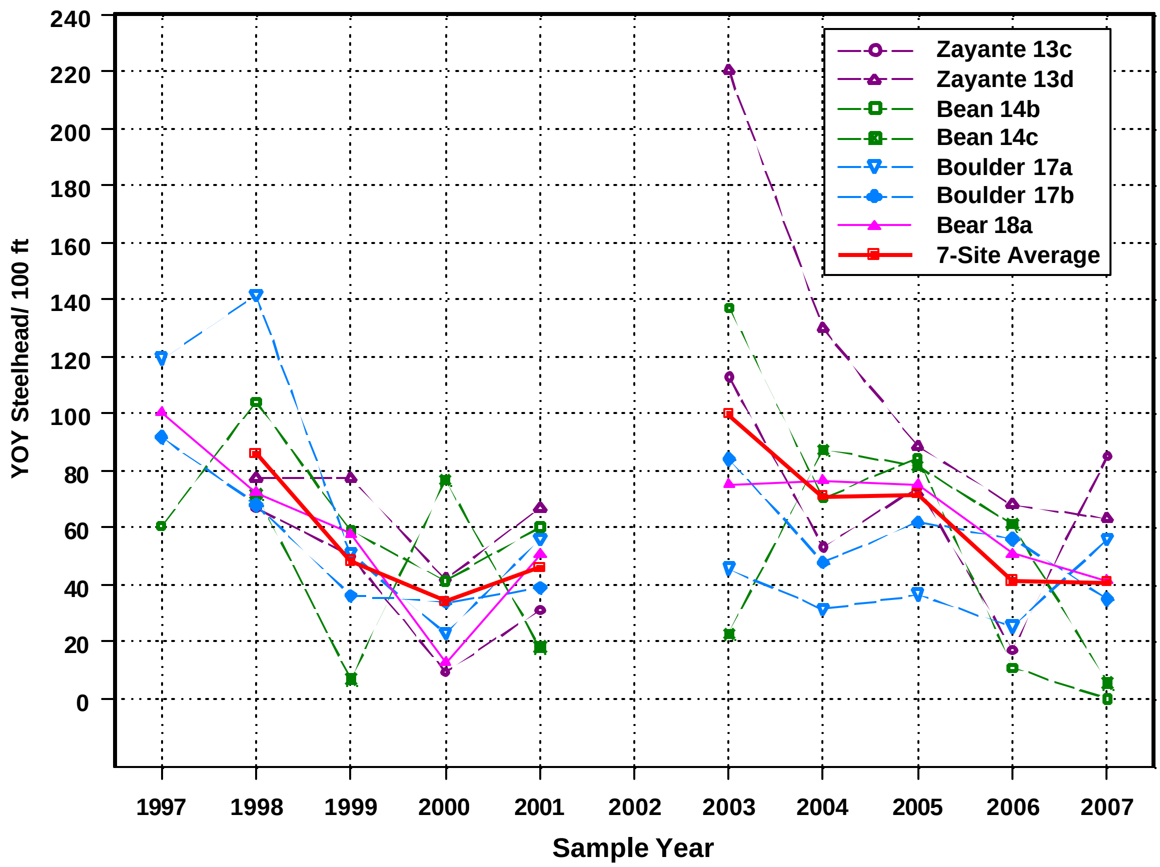
For tributary sites and the upper mainstem, there was a general decline in total densities from 1997 to 2000, with a general increase from 2000 to 2003, followed by a general decline from 2003 to 2007 (**Figures 13 and 14**). The extremely high juvenile density measured in 2002 at Site 11 by HTH (**2003**) seemed highly unusual, considering our 13 other years of sampling experience with Reach 11 in the upper mainstem. In 2007, total densities bounced back up in Zayante Creek, but continued to decline in Bean and Bear creeks. Total densities in 2006 and 2007 were generally less than they had been in 1997 and 1998.

Figure 14. Plot of Annual Total Juvenile Densities at San Lorenzo Tributary Sites, 1997-2007.



YOY densities at tributary and upper mainstem sites generally followed the same pattern as total density, since most juvenile fish at tributary sites are YOY. YOY densities generally declined from 1997 to 2000, increased from 2000 to 2003 to an overall high for the 11-year period, followed by a general decline from 2003 to 2007 (**Figure 16**). Although there were no YOY data available in 2002, we can guess that YOY densities followed the same trend as total densities. YOY densities fluctuated greatly through the years at certain sites. YOY density at Site 14c in upper Bean Creek fluctuated the most. This reach is greatly impacted by well pumping. During the 2003–2007 period, Site 14b in middle Bean Creek surprisingly had no YOY in 2007, presumably because a long segment of the creek upstream of the site was dry and prevented YOY recruitment. YOY density at Site 13c on Zayante Creek annually fluctuated up and down, and Site 13d on Zayante Creek declined significantly, with its 2007 density the second lowest in 11 years.

Figure 16. Plot of Annual YOY Juvenile Densities at San Lorenzo Tributary Sites, 1997-2007.



YOY densities in San Lorenzo tributaries may be relatively higher in years like 1997 and 2002 because of no large, late storms but smaller late storms sufficient to promote spawning through the winter and spring. YOY densities may also be higher in wet years, such as 1998, which had high winter flows for good spawning access and high baseflows later on for good rearing habitat, with no large stormflows occurring between March and June but still adequate spawning flows for late spawners. 1999 had relatively large stormflows in April and May that may have reduced YOY survival. The year 2000 had multiple large stormflows from January through early March, making egg survival likely difficult, followed by rapid decline in baseflow with no storms except for a short one in late April. In addition, it was hypothesized that there were reduced adult returns in 2000 associated with the El Niño storm pattern and associated ocean conditions. There was likely high mortality of smolts in winter of 1997-1998 due to large flood flows. The El Niño period began in summer 1997 and persisted through spring and summer of 1998. Warm water, low macronutrient levels and low chlorophyll and primary production along the continental shelf characterized the event. Poor smolt survival in the ocean may have resulted from high competition for food under warm water conditions, contributing to low adult returns in 2000.

The drier to moderate rainfall years of 2001–2004 likely allowed for relatively higher egg and young YOY survival, with enough small storms to allow adult access to tributaries and the largest storms occurring in early winter. Years 2004 and 2005 produced similar YOY densities as 1999 with very different hydrographs (**Figures 61 and 62**). The year 2004 had no significant storms after early March and below average baseflows after that. The year 2005 had periodic stormflows throughout March, April and early May, with above average baseflows through the summer. YOY densities declined in 2006 with periodic stormflows through mid-May as in 2005, but the storms were of larger dimension and lasted longer in 2006, thus likely leading to poor egg and young YOY survival (**Figure 64**). The year 2007 had only very small storms in January that would have provided limited access to tributaries and only two moderate stormflows in March that would have provided access and flows conducive to spawning in tributaries, likely limiting spawning effort in the tributaries (**Figure 65**). Egg survival was likely good but competition for food associated with low baseflow likely reduced YOY survival.

Figure 61. The 2004 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

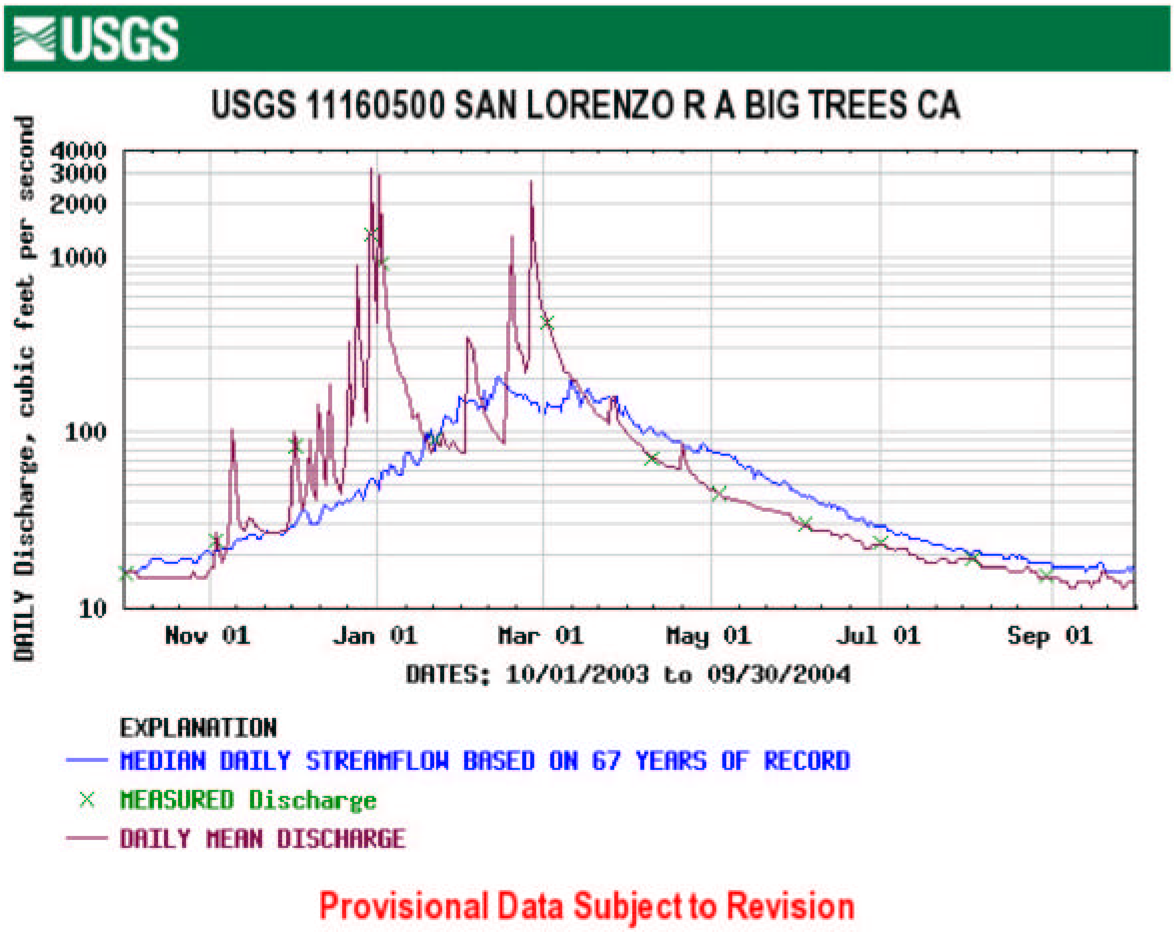


Figure 62. The 2005 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

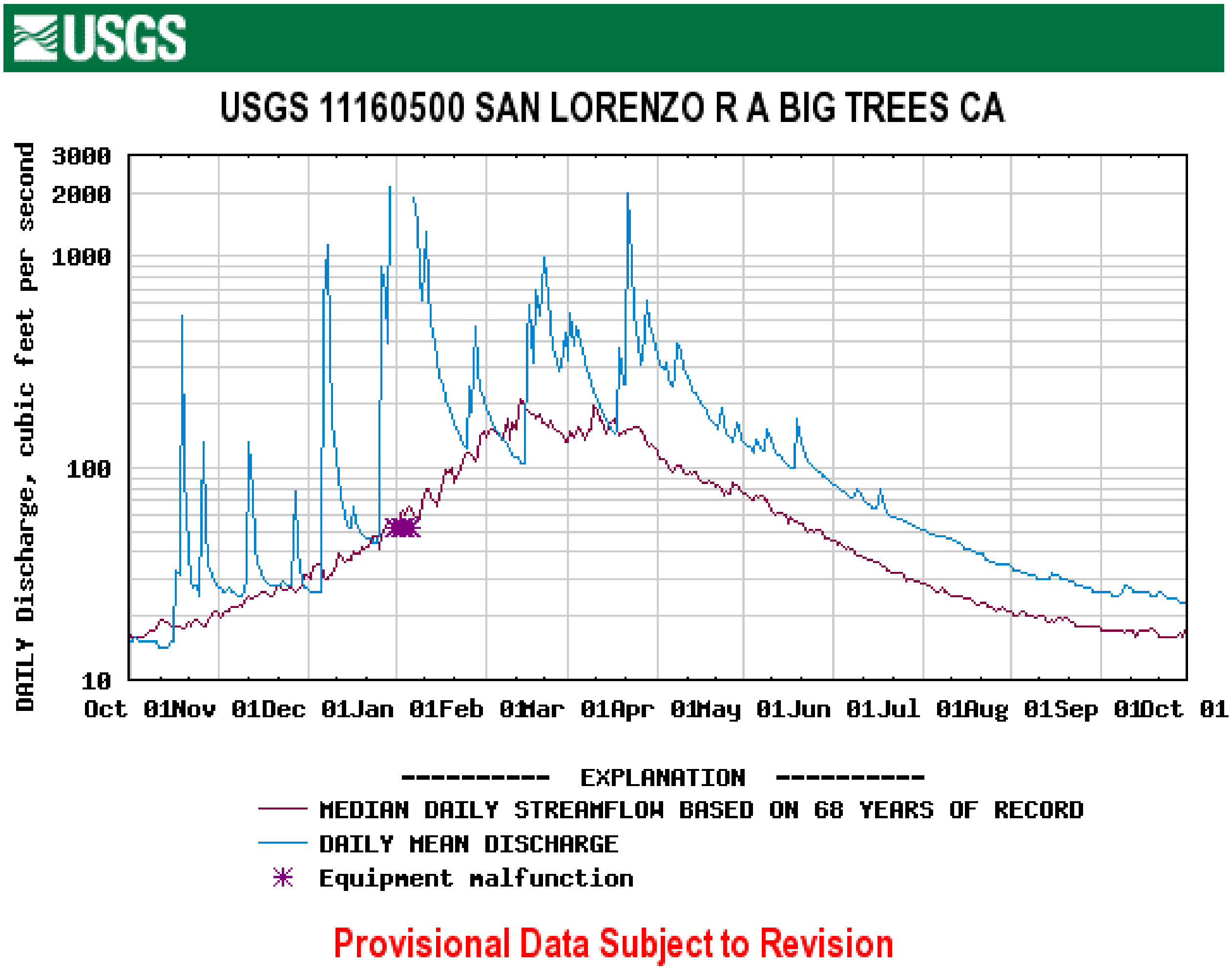


Figure 64. The 2006 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

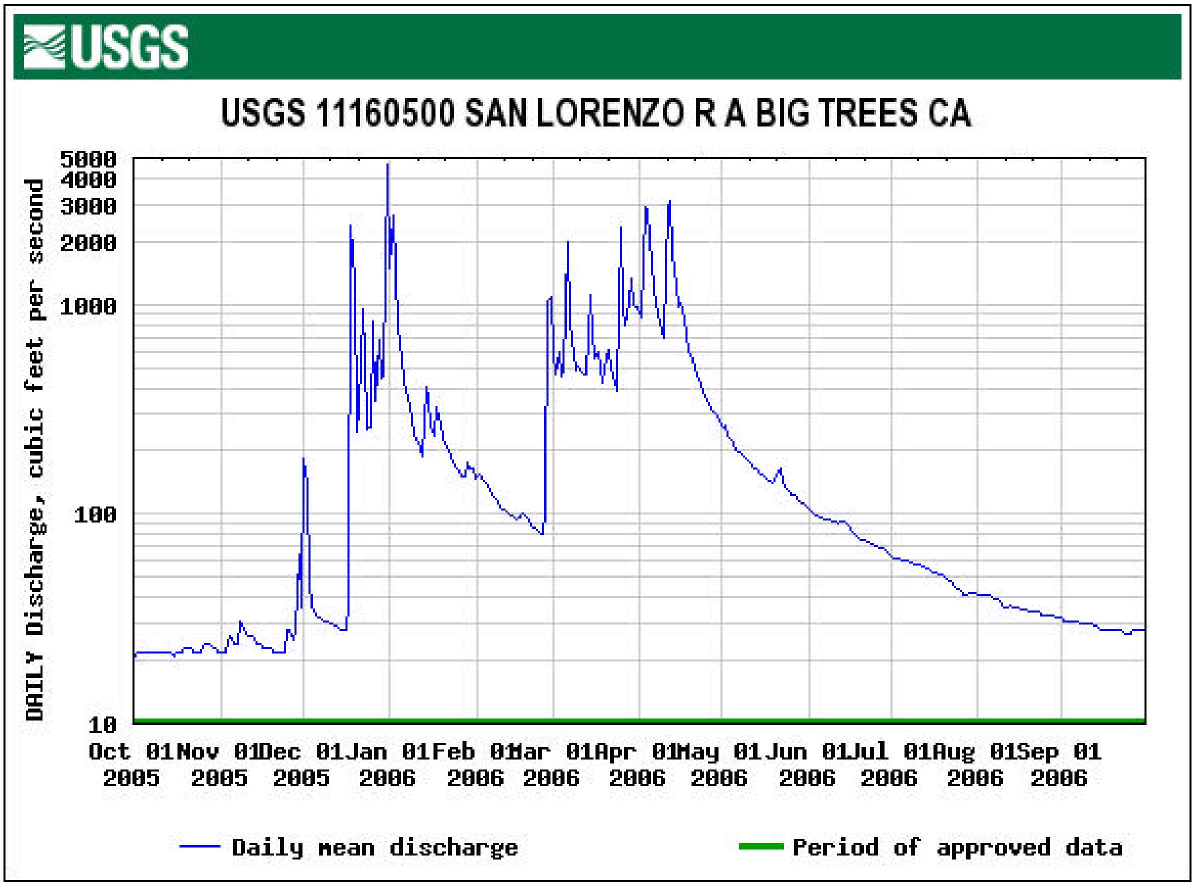
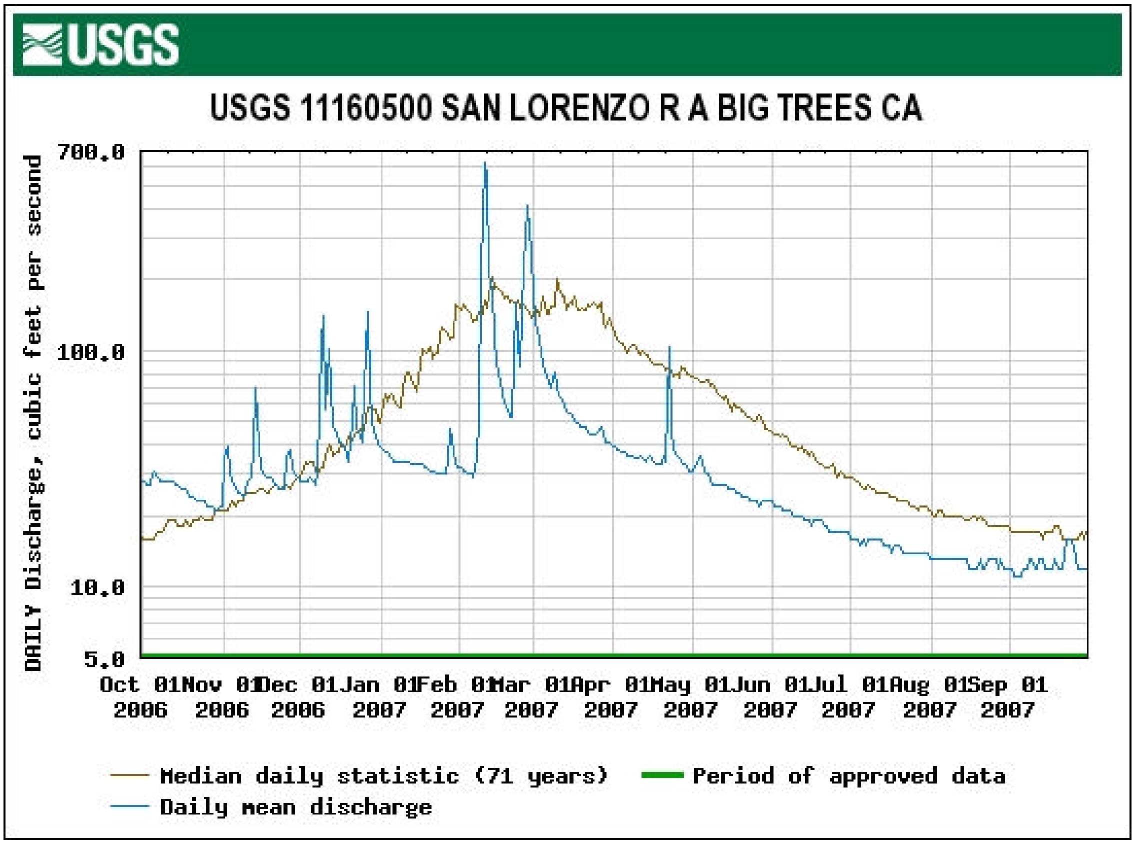


Figure 65. The 2007 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.



Tributary densities of larger Size Class II and III juveniles (almost entirely yearlings) in fall are determined mainly by 1) over-wintering survival the previous winter, 2) growth rate in spring that may allow early smolting of yearlings their first spring and 3) rearing habitat quality through the summer.

Tributary densities of Size Class II and III showed no general trend, though as a group were very low in 2007. They were similar between 1997 and 1998 but generally increased in 1999 to an 11-year high, especially in Zayante, upper Boulder and Bear creeks (**Figure 18**). Then in 2000 there was a general decline except in Bear Creek. The year 2001 showed mixed changes in densities of larger juveniles, with some sites increasing in density and others declining. There was a data gap in 2002. However, if trends were similar to Soquel Creek in that year (**Figures 23 and 24**), densities of larger juveniles were likely similar to 2001 in San Lorenzo tributaries. Densities of larger juveniles increased in 2003, declined in 2004 and rebounded in 2005, especially in middle Bean Creek. Densities generally increased in 2006, except for a return to more typical densities in middle Bean Creek that year. Densities of these larger juveniles declined at all sites under consideration in 2007 except for upper Zayante Creek.

Figure 18. Plot of Annual Size Class II/ III Juvenile Densities at San Lorenzo Tributary Sites, 1997-2007.

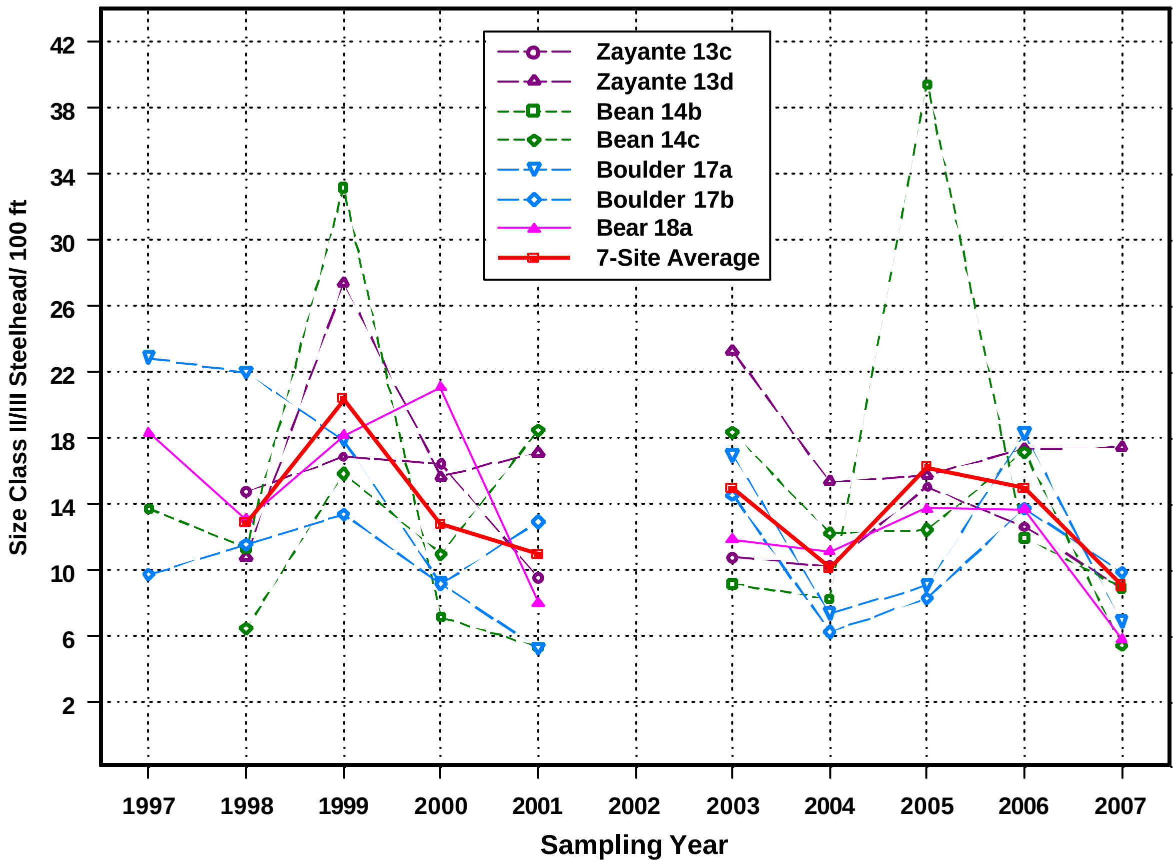


Figure 23. Plot of Annual Size Class II/ III Juvenile Densities at Soquel Mainstem Sites, 1997-2007.

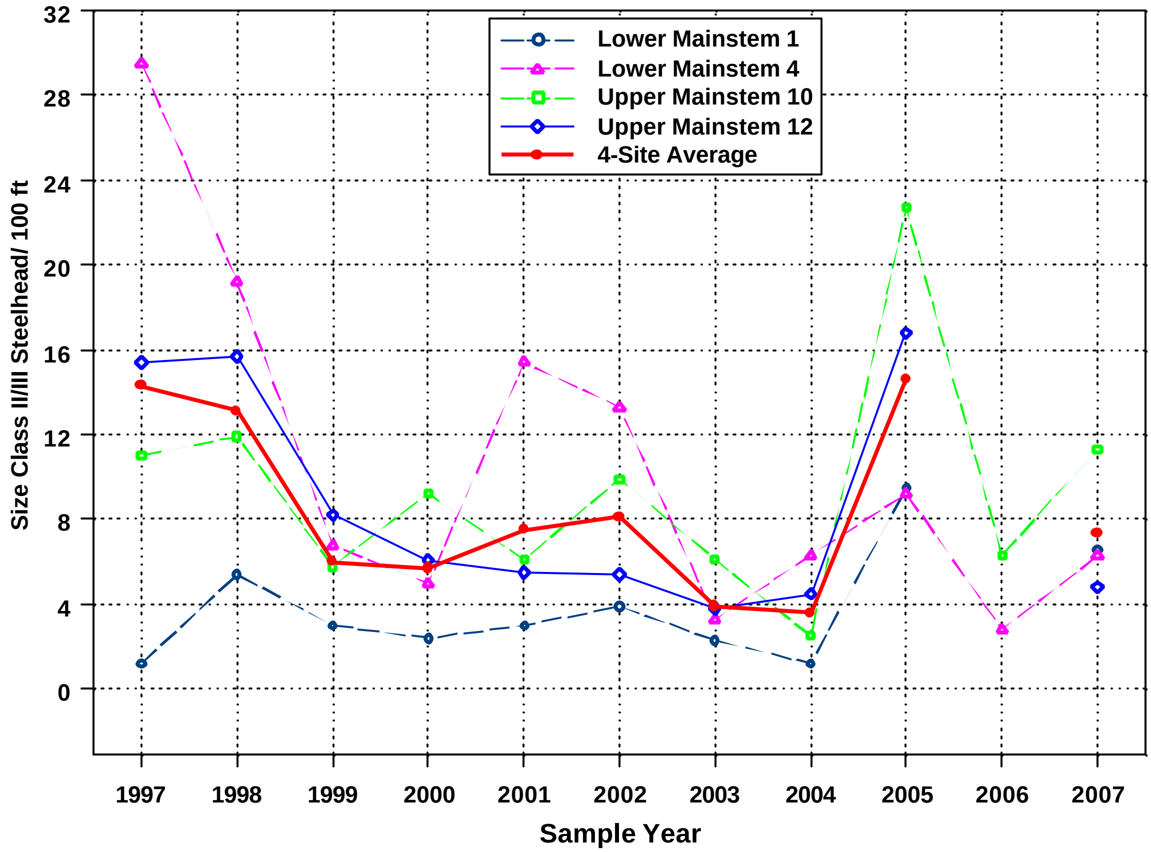
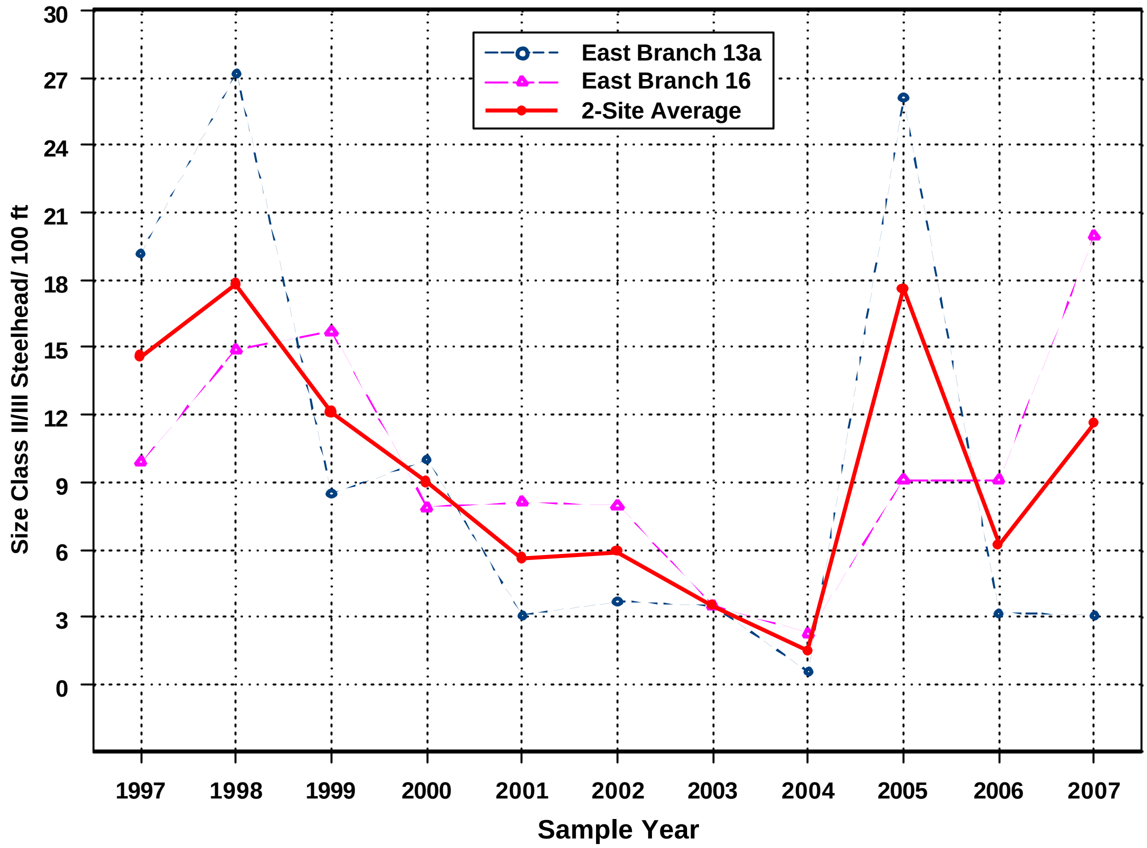


Figure 24. Plot of Annual Size Class II/ III Juvenile Densities at East Branch Soquel Creek Sites, 1997-2007.



The highest overall Size Class II and III densities at most sites occurred in 1999, which was a relatively wet year without flows reaching bankfull streamflow (2,800– 4,300 cfs at Big Trees; (**Alley 1999**), an intermediate value for averaged mean monthly streamflow for May through September in the last 11 years and much above median daily flow for May through September for the years of record (**Figure 56**). Years that had overall low site densities of larger juveniles were 2001, 2004 and 2007, all of which had relatively low averaged mean monthly streamflow for May through September in the last 11 years and below the median daily flow for the years of record (**Figures 25, 58, 62 and 65**). When one takes a less detailed look at the changes in densities of larger juveniles, there has been little overall change in densities except in 2007, when most densities declined substantially. If adult returns are to substantially improve, densities of these larger, soon to smolt, juveniles must greatly increase from much improved tributary habitat quality.

Figure 56. The 1999 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

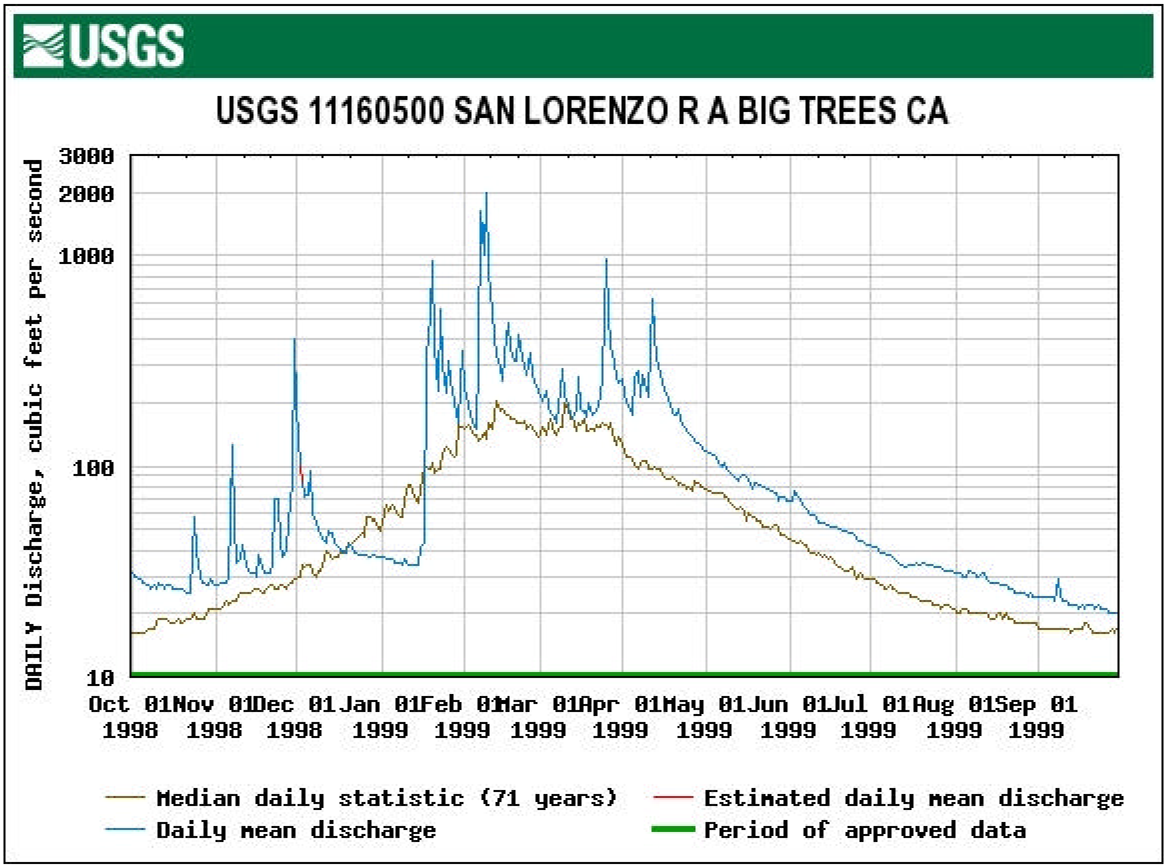
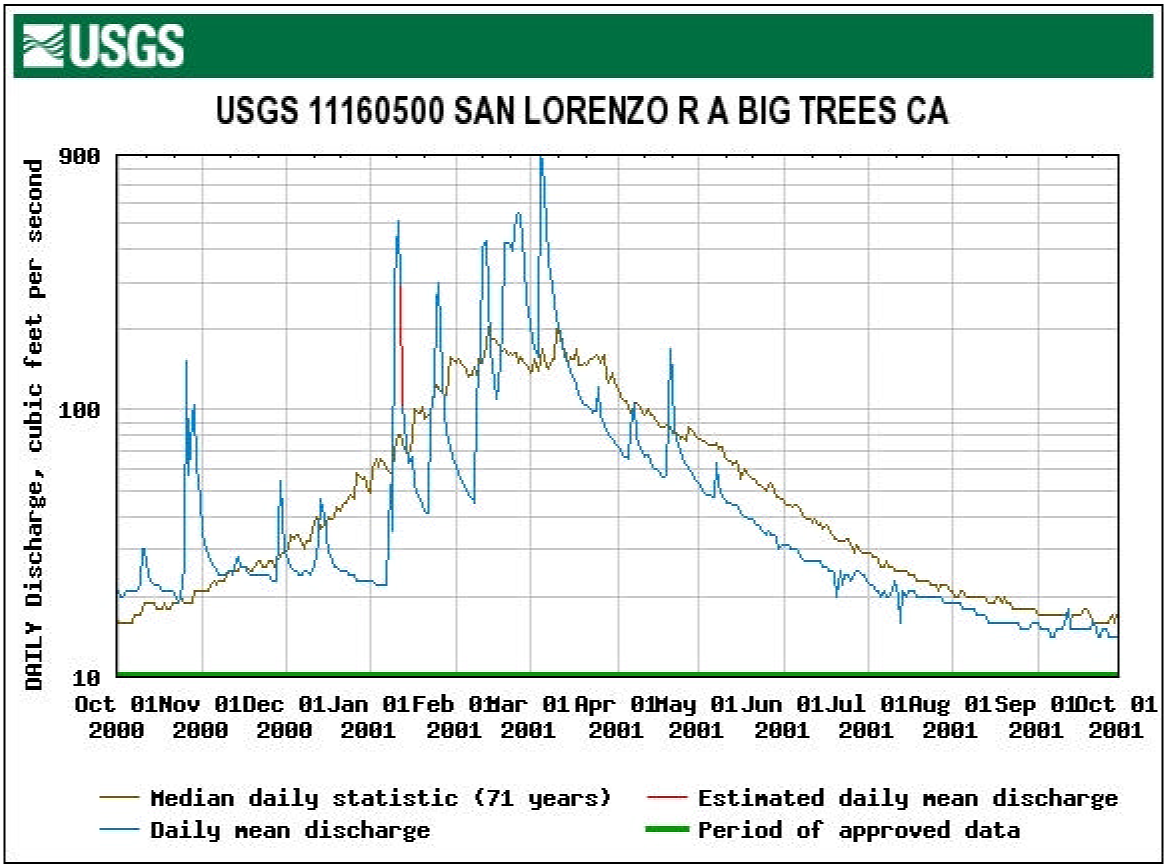


Figure 58. The 2001 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.



Annual trends in Size Class II and III densities at the upper Zayante Site 13d did not correlate well with changes in reach-wide pool depth for the years of available data. However, no reach data were available for drier years of 2001, 2002 or 2004 (**Figure 33**). Changes in densities in upper Zayante Creek correlated well with changes in sampling site escape cover in pools until 2006 and 2007, when densities were stable at 2005 levels despite reduced escape cover (**Figures 18 and 34b**). They may have remained constant because of higher baseflow in 2006 and higher over-winter survival in 2007 after a mild winter. Changes in densities also correlated well with reach-wide escape cover in 1998–2000 and 2003 (**Figure 34a**). However, somewhat higher reach-wide escape cover in 2005 did not correspond to high Size Class II and II fish density in that year, presumably because escape cover at sampled pools remained similar between 2004 and 2005. The decline in step-run percent fines was only positively correlated with increased densities from 2001 to 2003, but pool escape cover was also relatively high in 2003 to encourage higher densities (**Figure 35**).

Figure 33. Averaged Maximum and Mean Pool Depth in Reach 13d of Zayante Creek, 1998-2000, 2003 and 2005-2007.

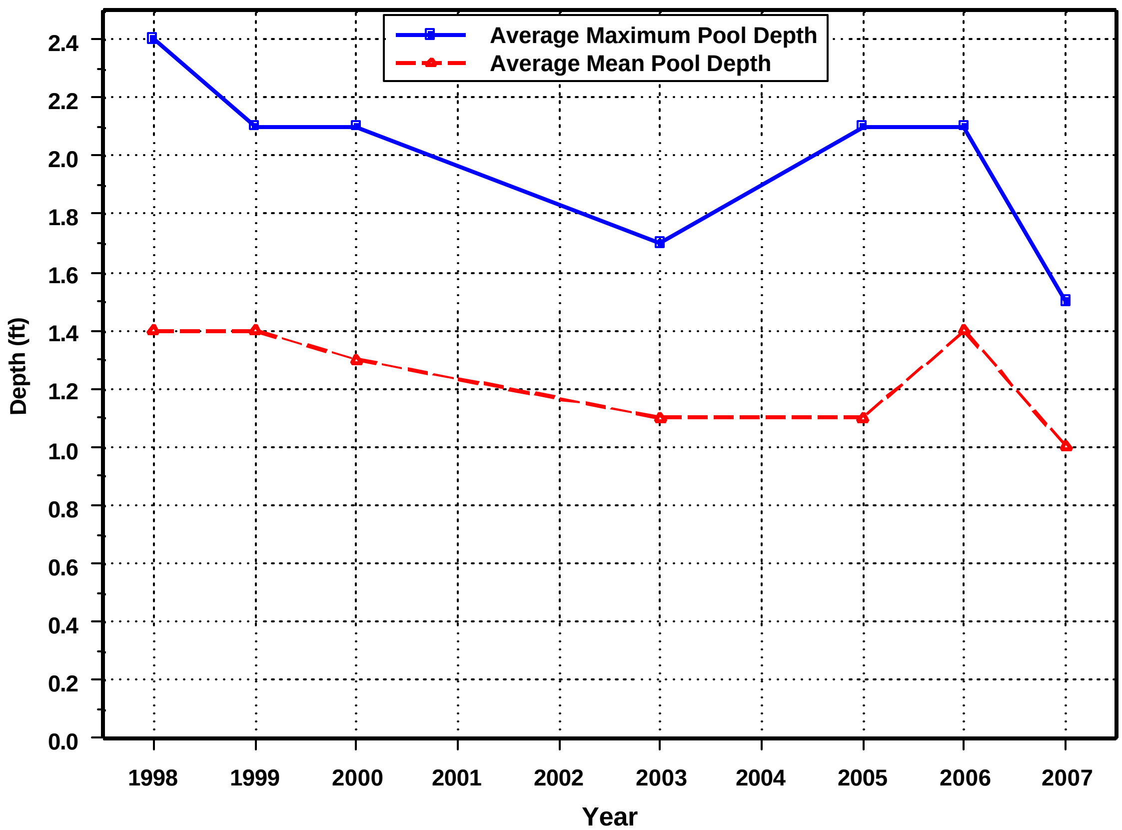


Figure 34a. Escape Cover Index for Pool Habitat in Reach 13d of Zayante Creek, 1998-2000, 2003 and 2005-2007.

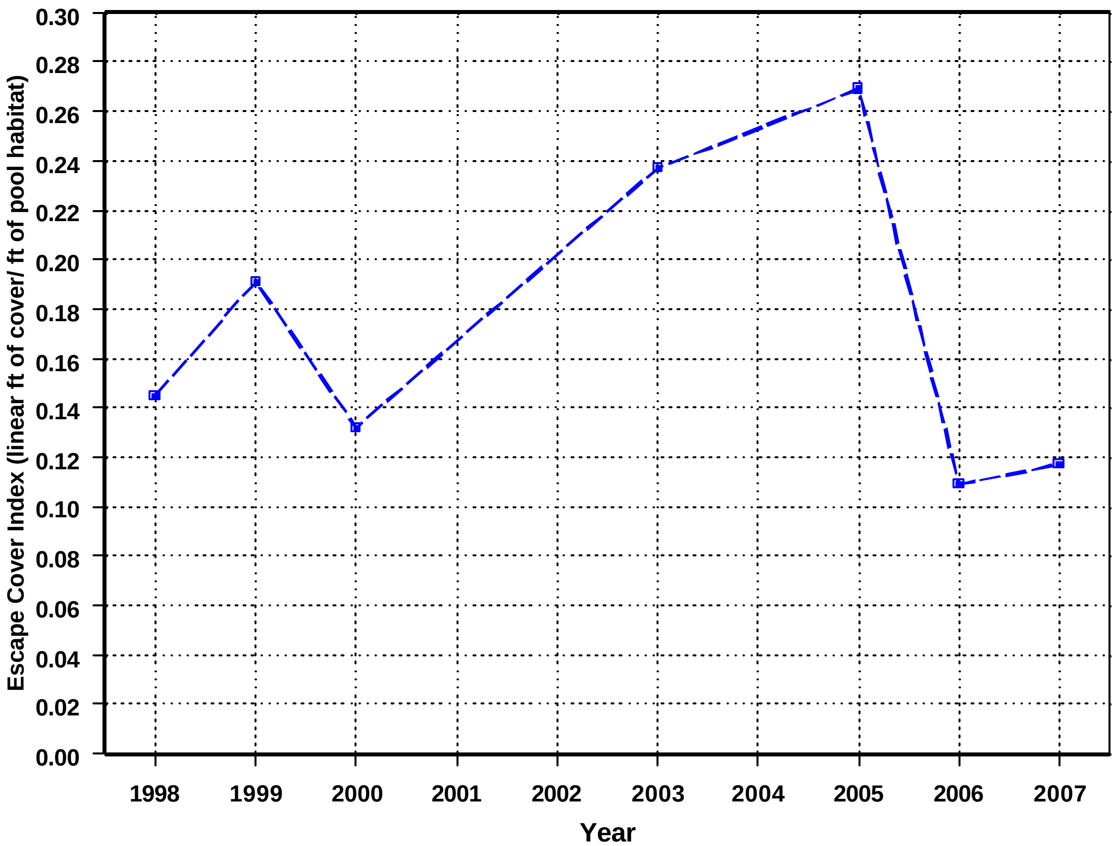


Figure 34b. Escape Cover Index for Pool Habitat at Site 13d in Zayante Creek, 1998-2001 and 2003-2007.

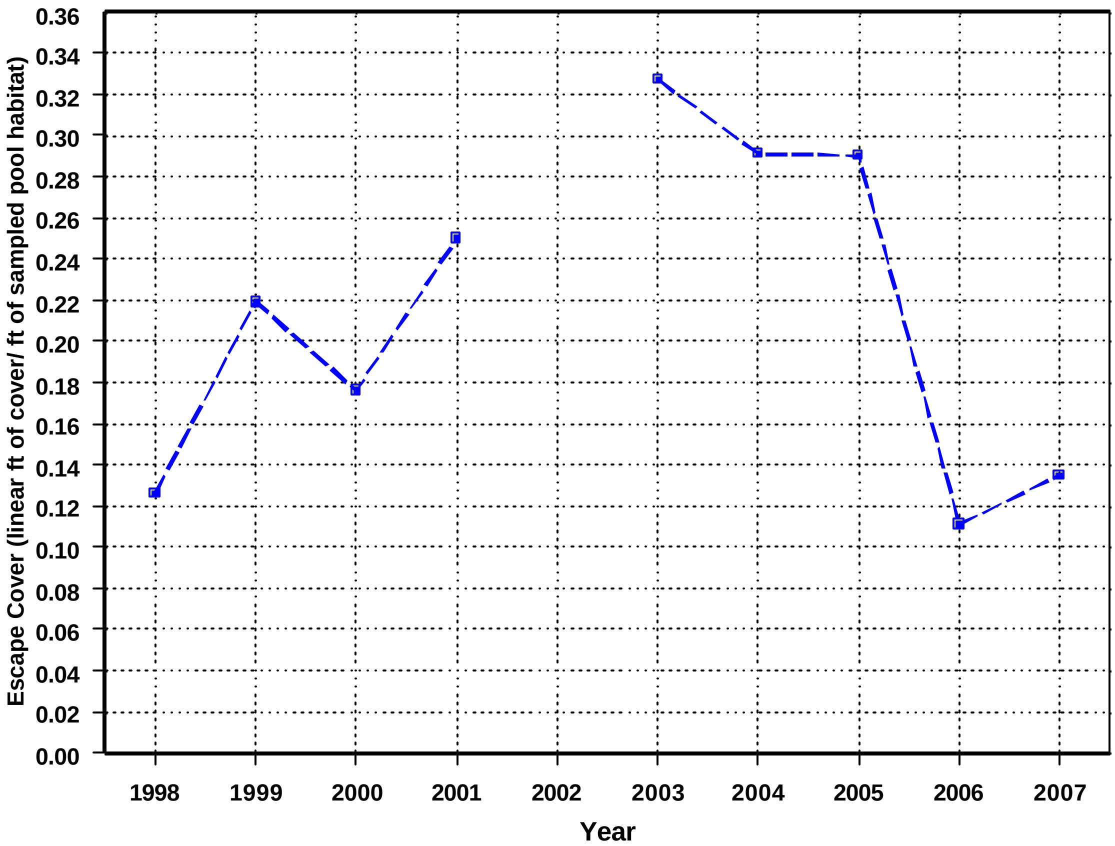
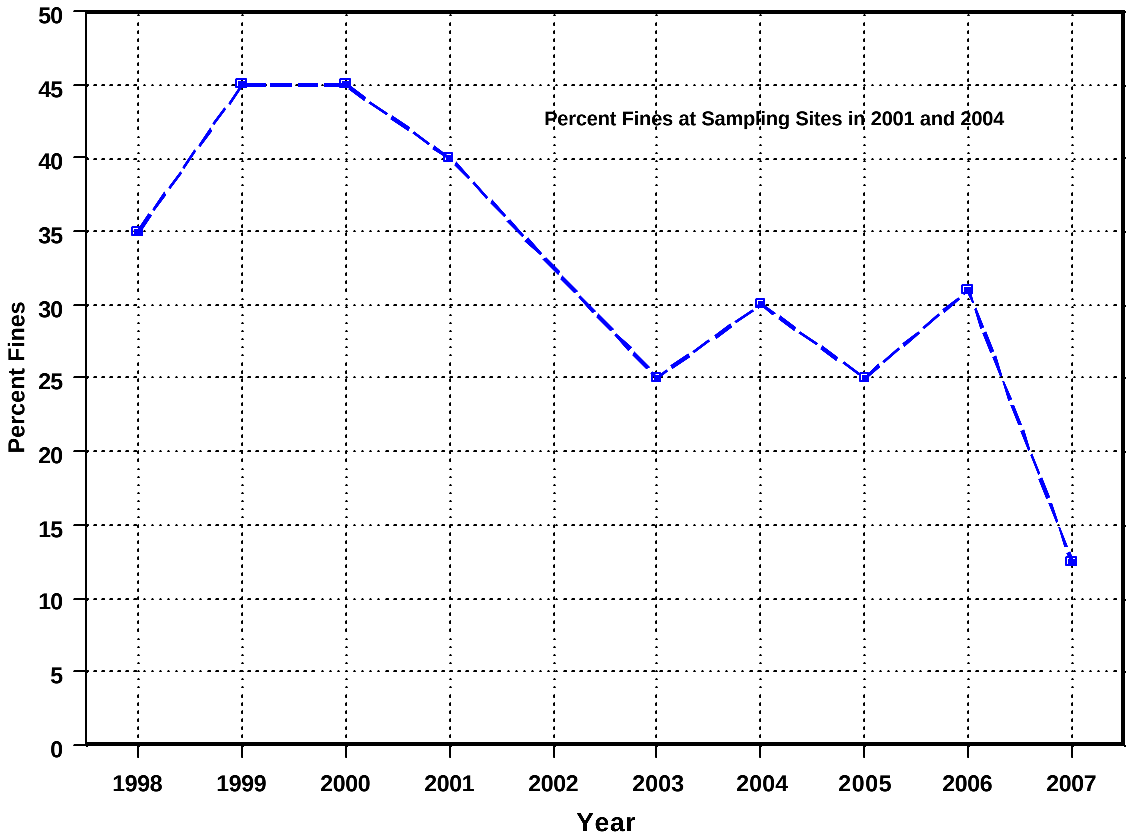


Figure 35. Averaged Percent Fines in Step-Run Habitat in Reach 13d of Zayante Creek, 1998-2001, 2003-2007.



For the lower Boulder Creek Site 17a, annual changes in density of Size Class II and III juveniles were well correlated with reach-wide changes in pool depth for the years of data (1998–2000 and 2005–2007) (**Figure 36**). Changes in density were not correlated with changes in escape cover in sampled pools or with reach-wide changes in pool escape cover (**Figures 37a-b**). The poor correlation may result from no consideration of step-run escape cover and depth in a reach where step-runs are a large proportion of the habitat and deep enough to be inhabited by larger juveniles. Also, except for 1997 and 2007, the annual differences in pool escape cover were small in sampled pools that generally lacked much escape cover. Therefore, other factors may have played larger roles in determining densities. The 2007 density was much less than the 2006 density, despite increased pool escape cover in 2007. However, large yearlings from the previous wet year may have smolted and out-migrated in spring 2007 prior to fall sampling, leading to small fall yearling densities. Densities were sometimes positively correlated with increases in percent fines in step-runs, though percent fines did not increase a substantial amount except from 1998 to 1999 (**Figure 38**). This is the opposite of what was expected because increased percent fines indicates a decline in habitat quality. Apparently the negative effect of increased percent fines measured in 1999 and 2006 were overcome by relatively high streamflow and water velocity, greater water depth in step-runs and better feeding stations in step-runs and the heads of pools.

Figure 36. Averaged Maximum and Mean Pool Depth in Reach 17a of Boulder Creek, 1998-2000 and 2005-2007.

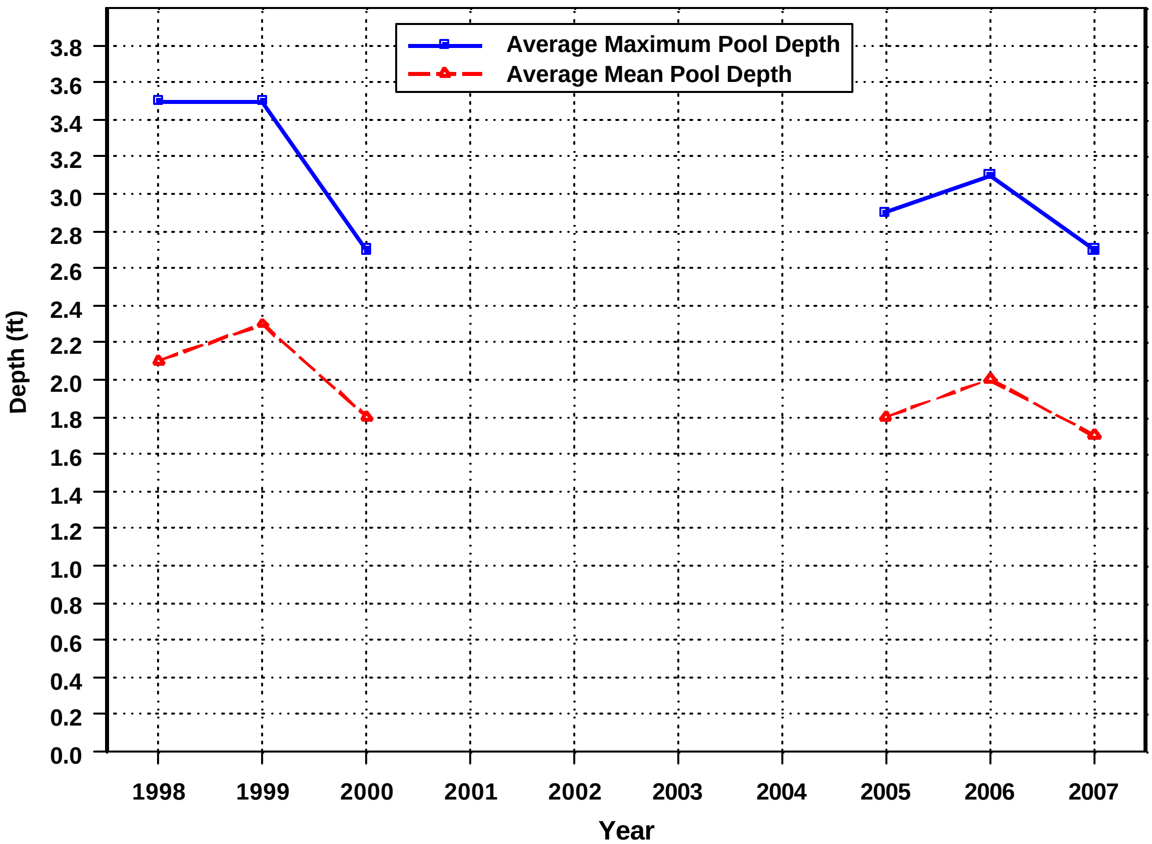


Figure 37a. Escape Cover Index for Pool Habitat in Reach 17a of Boulder Creek, 1998-2000 and 2005-2007.

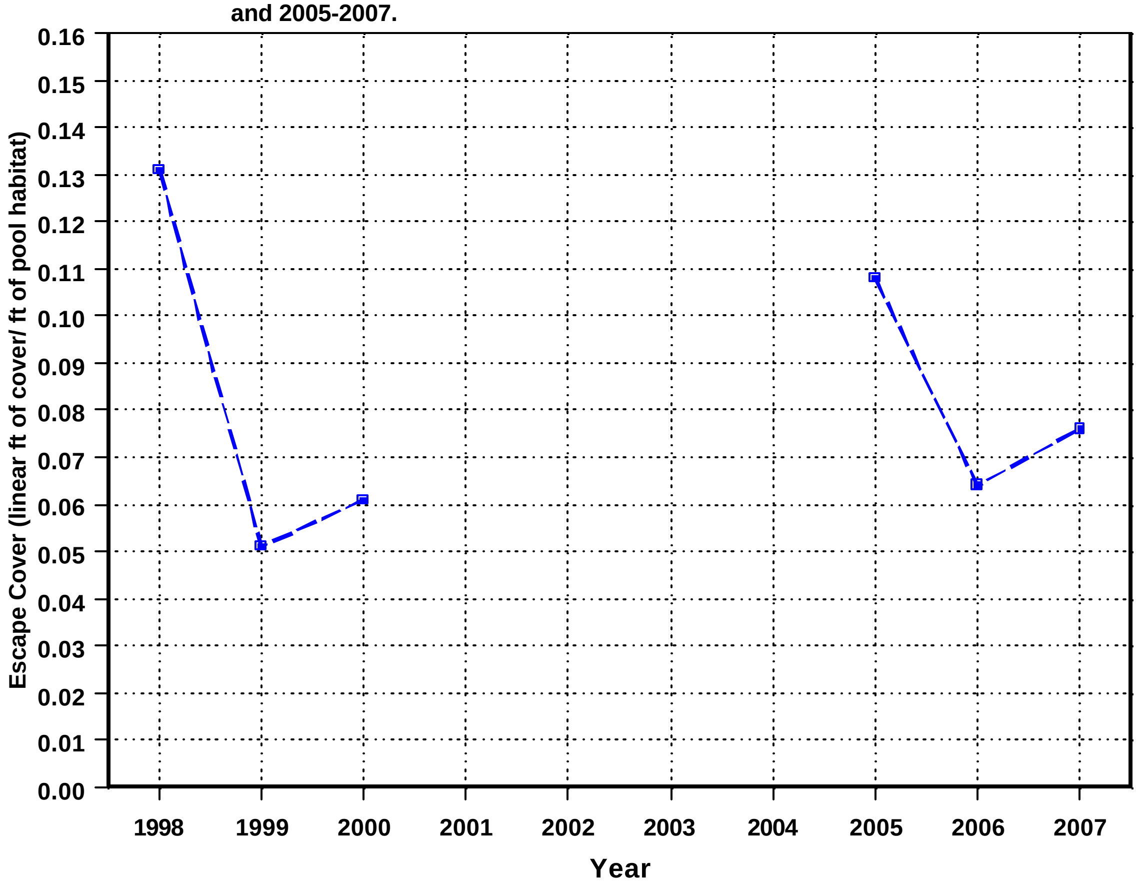
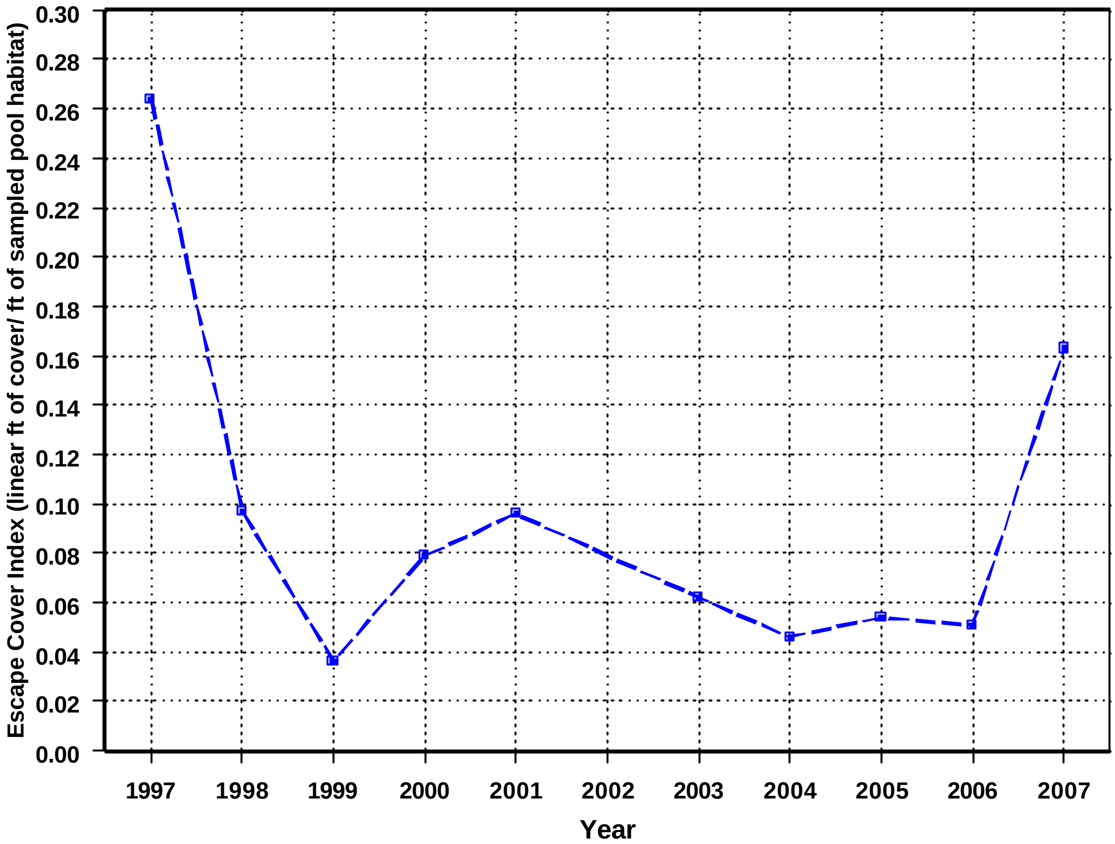


Figure 37b. Escape Cover Index for Pool Habitat at Site 17a in Boulder Creek, 1997-2001 and 2003-2007.



Habitat Trends in the Lower and Middle Mainstem of the San Lorenzo River

In the lower mainstem (downstream of the Zayante Creek confluence) habitat conditions in Reach 4 (above the gorge and below the Felton water diversion) were analyzed since 1997. Riffles were focused on because warm water temperatures increase the energy requirements of juvenile steelhead, forcing them to select fastwater habitat where water velocity and insect drift are maximized. Since 1997, the wettest winters have been 1997/1998 and 2005/2006 (**Figures 55 and 65**). The largest storm events were in December 1997 and February 1998, both much above bankfull discharges. These storms (and the onslaught of sediment coming in from the upper watershed and especially the Zayante sub-watershed) brought streambank erosion, bankfull channel widening, channel braiding, large trees entering the channel (subsequently cut up and lost during later stormflows) and general channel instability to upper Reach 4.

Figure 55. The 1998 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

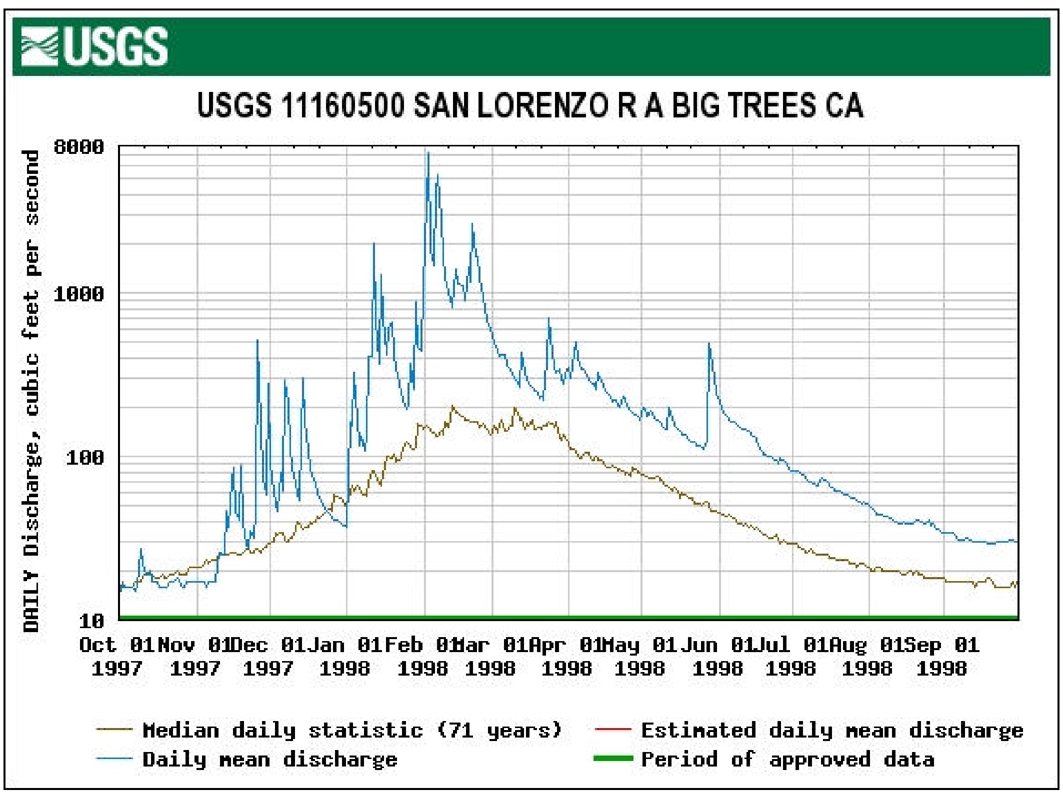
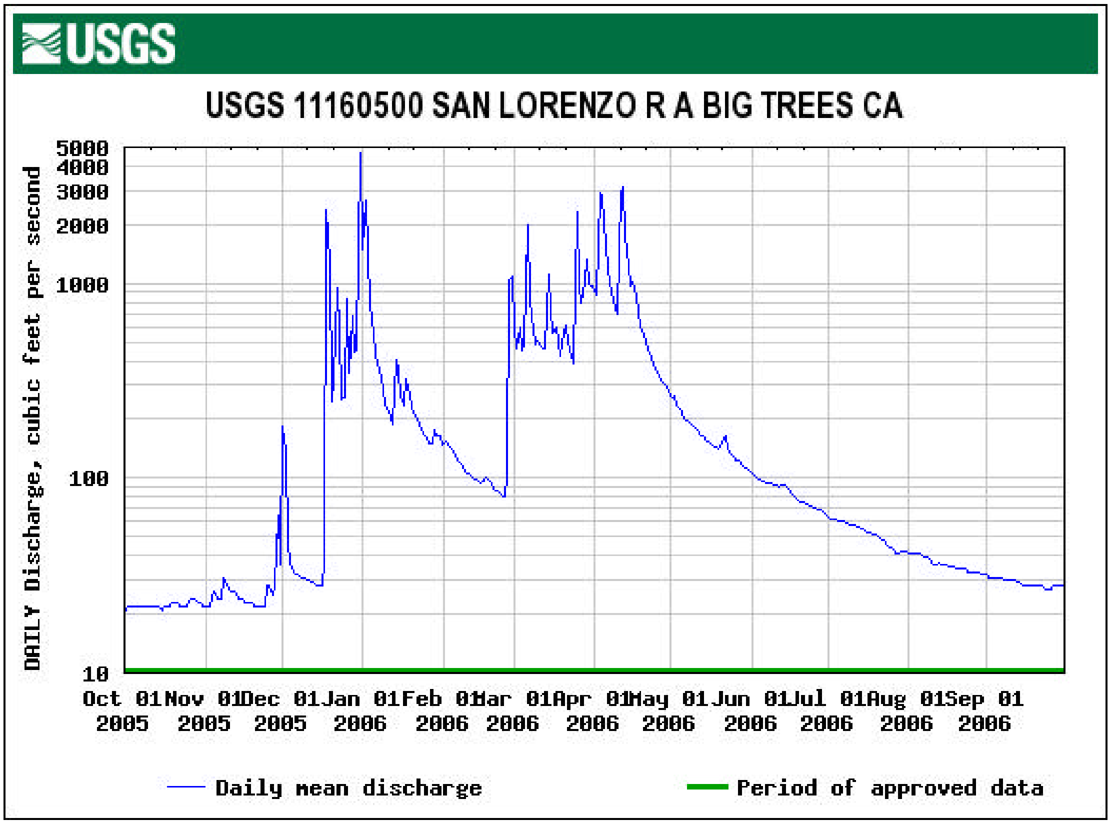


Figure 64. The 2006 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.



Water depth in riffles is mainly influenced by 1) streamflow, 2) channel width and 3) the degree of filling in between the larger cobbles and boulders with fine sediment (sedimentation) and smaller rocks. Wetted channel width in fall 1997–2000 and 2006–2007 were 33, 35, 30 (1999), 39, 39 and 25 feet, respectively. By comparing the averaged mean monthly flow (May through September) with riffle depth in Reach 4, it is evident that habitat substrate conditions were likely best in 1997 (deepest riffles despite lower streamflows and low percent fines) and 2007 (deeper than in 2001 and 2002 despite lower streamflow and low percent fines) (**Figures 25 and 27–29**). Substantial filling was detected in 1999 (extreme shallowing evident) with improvement in 2000. By 2007, channel conditions had improved with greater depth than in 2001–2002 despite lower baseflow, but were still not as deep as 1997 conditions. Reduced escape cover in 1999 was consistent with sedimentation that year. However, riffle embeddedness for 1997–2000 at Sampling Site 4 was not consistent with sedimentation in 1999, with riffle embeddedness for 1997–2000 being 40, 45, 30 (1999) and 45%, respectively. Reach-wide riffle embeddedness for 2006–2007 showed improvement from previous years at 37 and 19%, respectively (embeddedness at sampling sites being 25% in both years). Apparently, the wet winter of 2005/2006 did not cause the erosion and sedimentation that the wet winter of 1997/1998 had produced. Percent fines were relatively high during the 1998–2001 period. Percent fines were also reduced by 2007 and approaching 1997 levels. Escape cover in 2007 was created by primarily overhanging willows along the channel margin, rootmasses and large instream wood and very little from cracks and crevices in the substrate. **In summary, although rearing habitat conditions in Reach 4 in 2007 have improved since 1999 regarding greater depth, more escape cover, reduced embeddedness and reduced percent fines, 1997 conditions were better with regard to habitat depth and percent fines.** Unfortunately, riffle escape cover was not measured reach-wide in 1997 for comparisons.

Figure 25. Averaged Mean Monthly Streamflow for May - September, 1997 - 2007 at the Big Trees Gage on the San Lorenzo River.

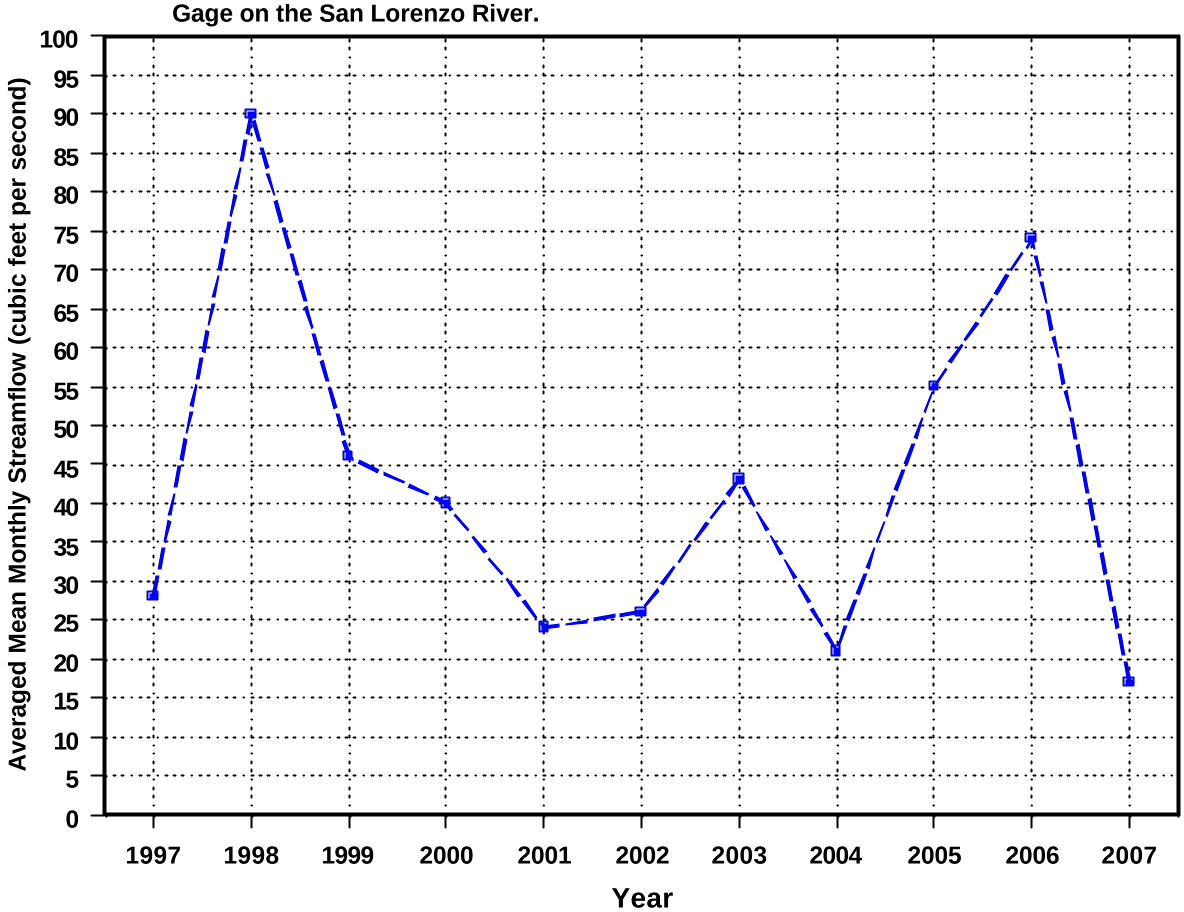


Figure 27. Averaged Maximum and Mean Riffle Depth in Reach 4 of the Lower Mainstem San Lorenzo River, 1997-2002 and 2006-2007.

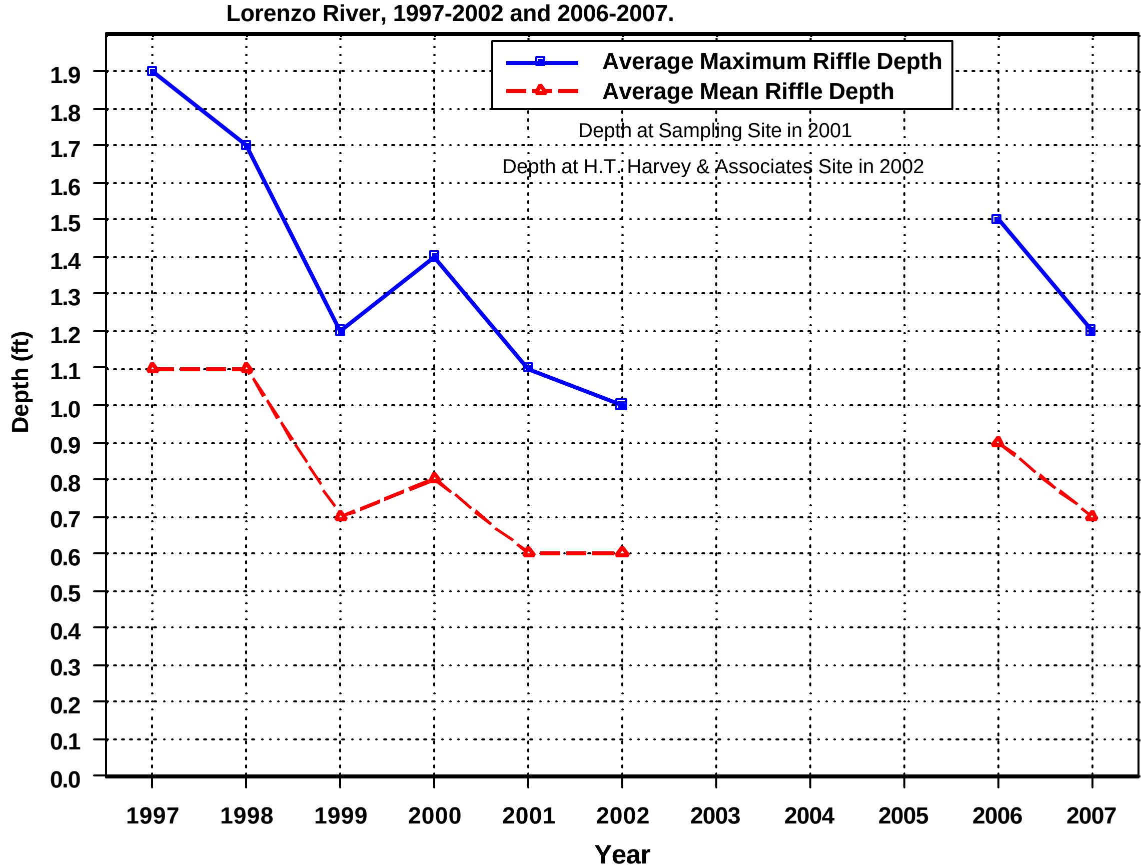


Figure 28. Escape Cover Index for Riffle Habitat in Reach 4 of the Lower Mainstem San Lorenzo River, 1998-2000 and 2006-2007.

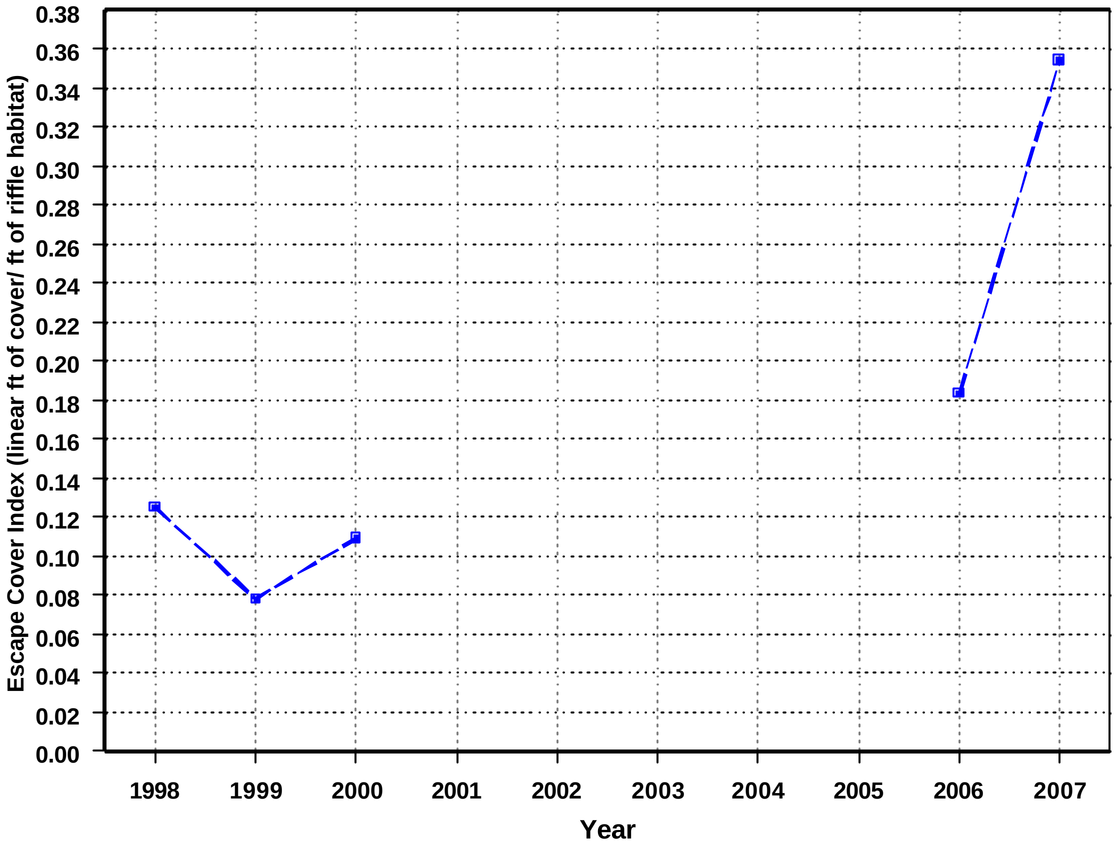
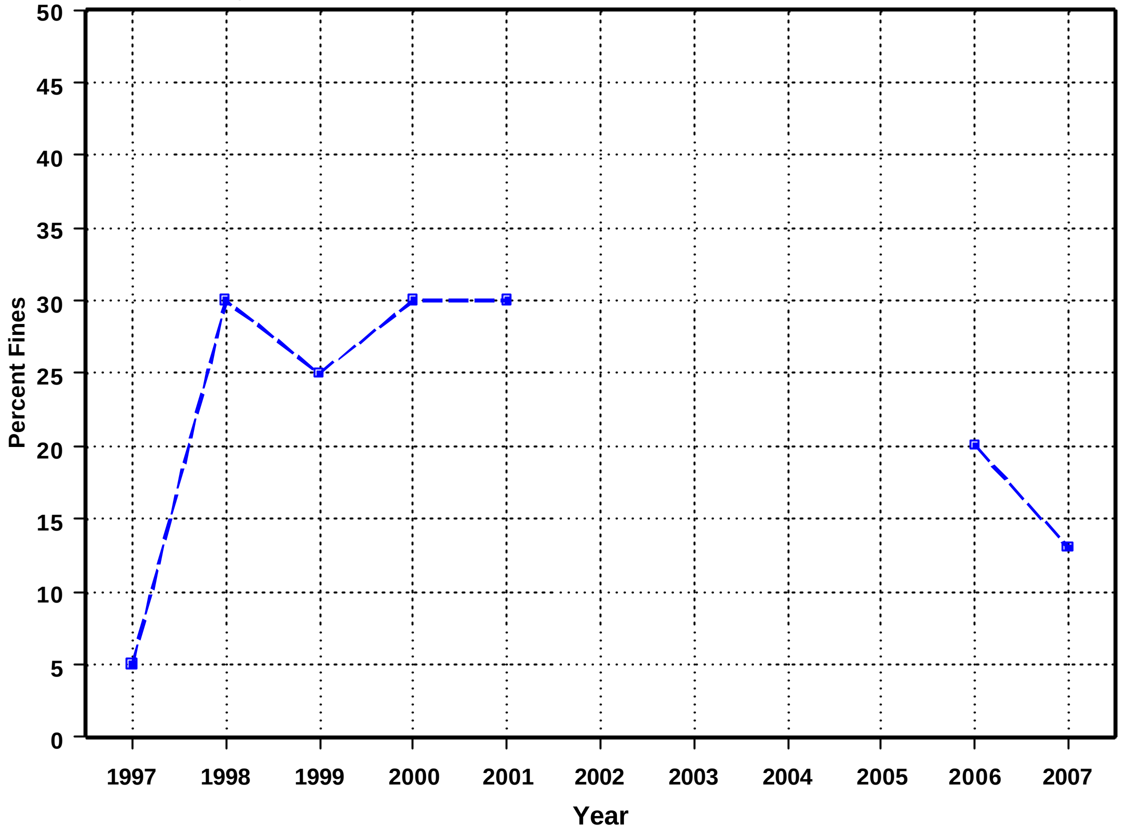


Figure 29. Averaged Percent Fines in Riffle Habitat in Reach 4 of the Lower Mainstem San Lorenzo River, 1997-2001 and 2006-2007.



In the middle mainstem (between the Zayante and Boulder creek confluences) habitat conditions in Reach 8 (from upper Ben Lomond to Brookdale past the Alba Creek confluence and ending at the Clear Creek confluence) were analyzed since 1997. Riffle habitat was focused on because under warm water conditions in the middle mainstem, juvenile steelhead are found primarily in fastwater habitat. Habitat conditions in Reach 8 were best in the wet year of 1998 (highest baseflow, greatest depth, fastest water velocity and most escape cover) (**Figures 30, 31 and 55**). As in Reach 4, we see the dip in riffle depth in 1999, indicating filling by sediment and smaller rocks and gravels, and subsequent improvement in 2000. Changes in riffle depth approximately followed changes in averaged mean monthly streamflow (May-September) except maximum riffle depth continued to decline in 2002 and 2003 despite greater streamflow (**Figure 25**). Then improved depth was detected in 2004 despite lower baseflow. Conditions in 2005 were also relatively good with high riffle depth and escape cover. As in Reach 4, percent fines greatly improved in 2007 since 1998 and were approaching the 1997 low (**Figure 32**). Riffle embeddedness in the same sampled riffle in 1997 and 2007 was 35% and 15%, respectively, indicating that 2007 had some of the best substrate conditions in 11 years when the low percent fines are also considered. However, overall rearing habitat conditions in 2007 were not as good as in 1997 with regard to depth and percent fines, though embeddedness was better in 2007. It is unlikely that creation of deeper pockets in riffles has improved in 2007 due to any change in substrate conditions since 1997. Unfortunately, reach-wide escape cover was not measured in riffles in 1997. However, escape cover in 2007 was much less than in 1998 or 2005, indicating reduced habitat quality in that regard. **If baseflows had been the same in 1997 and 2007, habitat conditions in Reach 8 riffles may have been similar between years, with the possible exception of less escape cover in 2007.**

Figure 30. Averaged Maximum and Mean Riffle Depth in Reach 8 of the Middle Mainstem San Lorenzo River, 1997-2007.

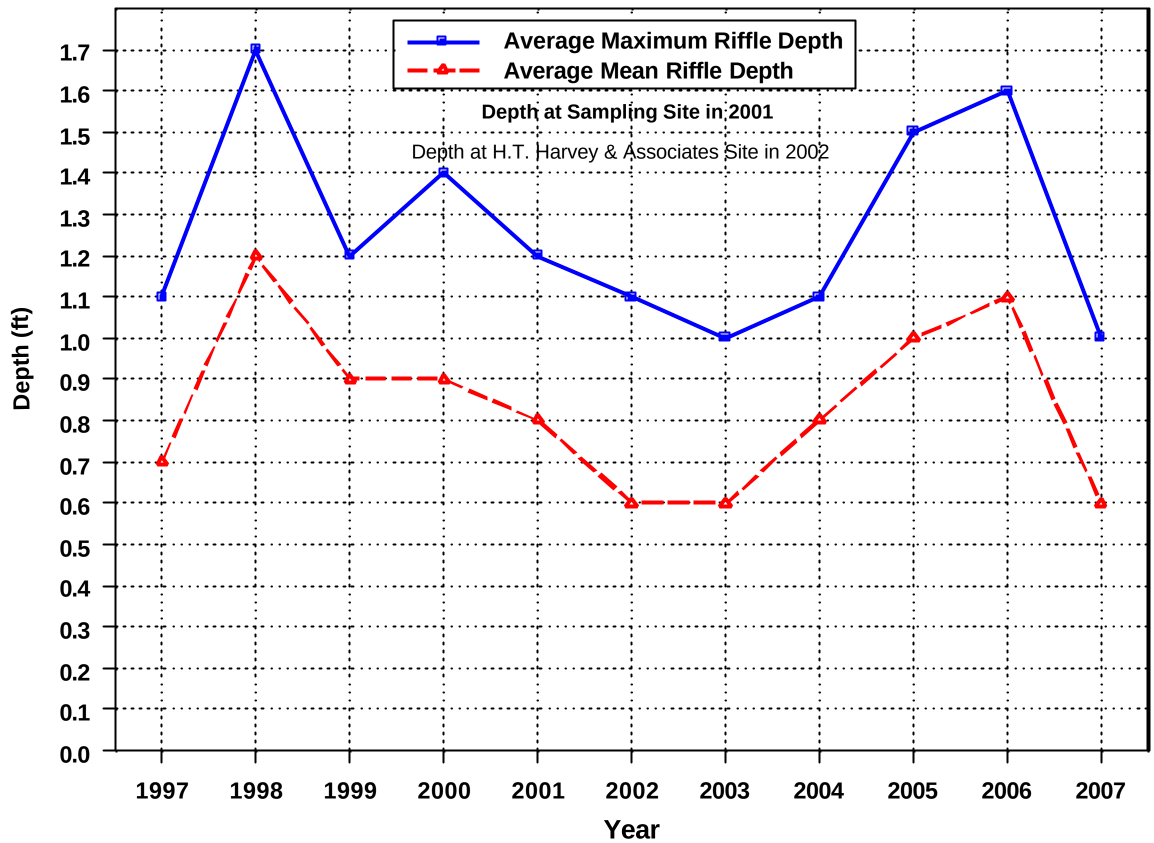


Figure 31. Escape Cover Index for Riffle Habitat in Reach 8 of the Middle Mainstem San Lorenzo River, 1998-2000, 2003 and 2005-2007.

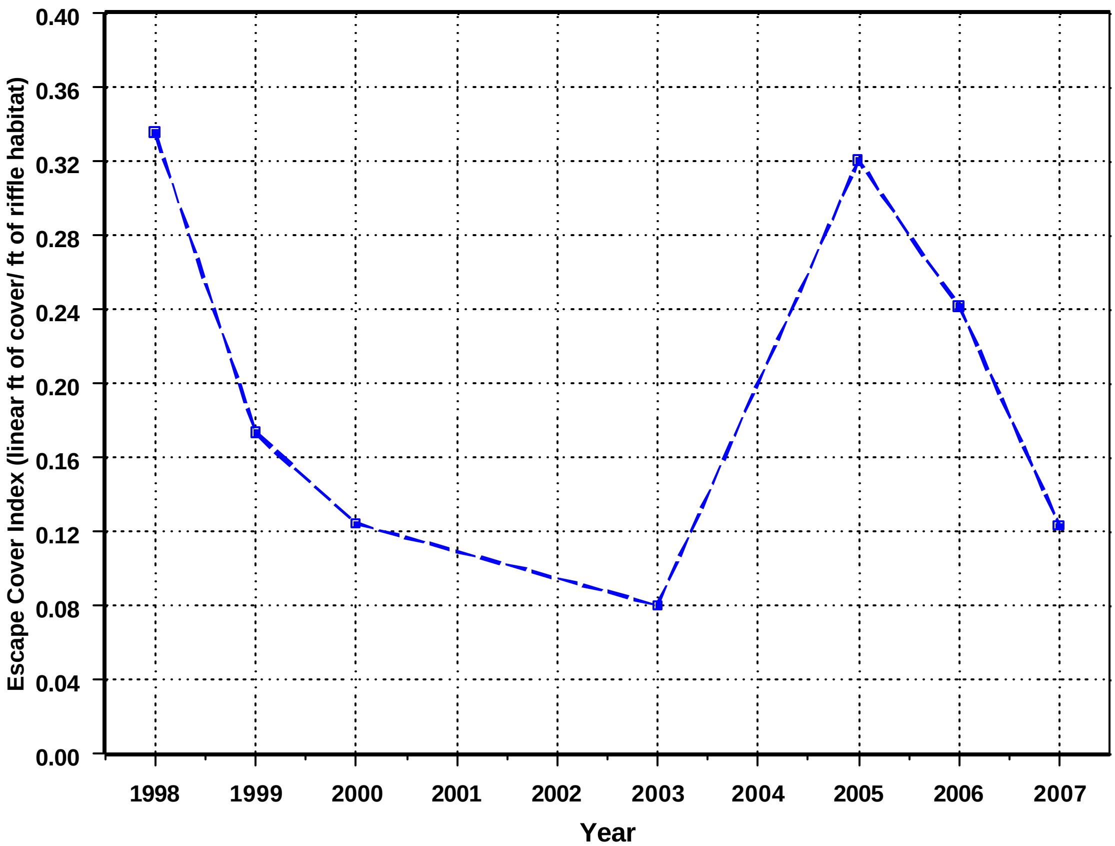
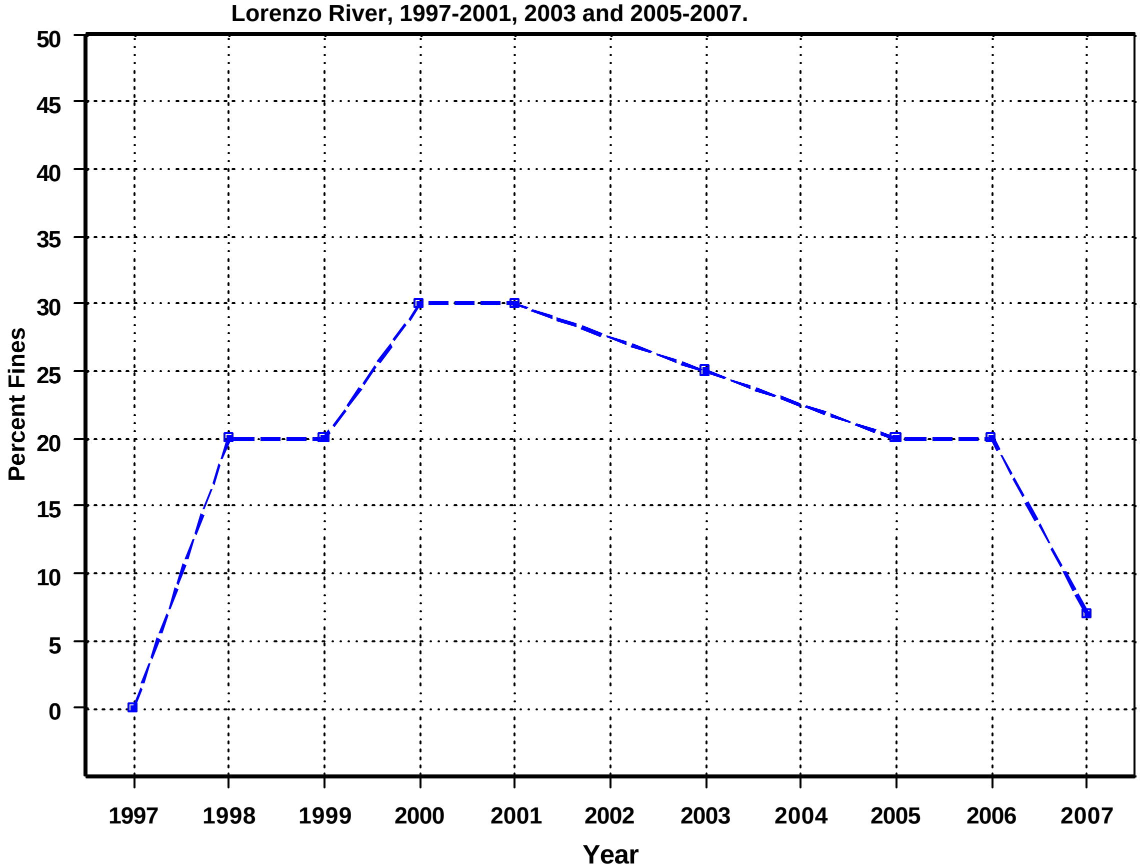


Figure 32. Averaged Percent Fines in Riffle Habitat in Reach 8 of the Middle Mainstem San Lorenzo River, 1997-2001, 2003 and 2005-2007.



Habitat Trends in San Lorenzo Tributaries

In general, sub-watersheds on the west side of the drainage (largest being Fall and Boulder) are "generally" steeper in gradient, are from granitic origin with generally larger boulders present in their lower reaches, flow through deeper and narrower canyons without floodplains, are relatively more shaded and cooler and are impacted by primarily surface water diversions and logging. The sub-watersheds from the east (largest being Branciforte-Carbonera, Zayante-Bean, Newell, Bear and Kings) are generally lower gradient, are mostly from shale and sandstone origin (except Branciforte-Carbonera), have reaches that do not always flow through narrow canyons, are sporadically less shaded by primarily deciduous trees and warmer. Streamside vegetation plays little role in pool formation in Boulder Creek but plays an important role in other tributaries. The flatter sub-watersheds of the eastern tributaries are more impacted than the western tributaries by higher residential and urban density, more human activities (more paved surfaces, quarrying, logging and business- and road-generated chemical pollution) and greater water extraction primarily from wells (except Lompico Creek, which has a surface diversion). The upper mainstem has a mix of influences from western and eastern tributaries with low gradient and long pools except where gradient increases in the upper reaches beginning near Waterman Gap.

In Zayante Creek, the largest eastern sub-watershed of the San Lorenzo system, habitat trends were analyzed in Reach 13d since 1998 when habitat typing of tributary reaches began. This was the uppermost reach under study and downstream of Mountain Charlie Gulch. Pool habitat was focused on for depth and escape cover parameters because in smaller tributary channels, most juvenile steelhead inhabit pools, with important Size Class II and III juveniles restricted to primarily pools and step-runs. In Reach 13d, annual changes in pool depths paralleled annual changes in averaged mean monthly streamflow record at Big Trees gage (May–September) except for additional shallowing between 2000 and 2003 caused by streambed filling despite increased baseflow in 2003 (**Figures 25 and 33**). However, percent fines in step-runs declined substantially through the period (**Figure 35**). Percent fines in step-runs in 2007 were at a 10-year low. The important reach-wide pool escape cover showed improvement from 1998 to 2005 but substantial reduction in 2006 and continued low in 2007 (**Figure 34a**). (Escape cover in sampled pools mirrored reach-wide changes in an effort to sample average habitat conditions but should not be used to detect reach-wide trends (**Figure 34b**).) **Rearing habitat conditions have declined in Zayante Reach 13d from 1997 to 2007, judging by the shallowest pool depths in the 11-year period in 2007 (where annual differences in baseflow have limited effect on pool depth) and the relatively low pool escape cover in 2007.**

Figure 33. Averaged Maximum and Mean Pool Depth in Reach 13d of Zayante Creek, 1998-2000, 2003 and 2005-2007.

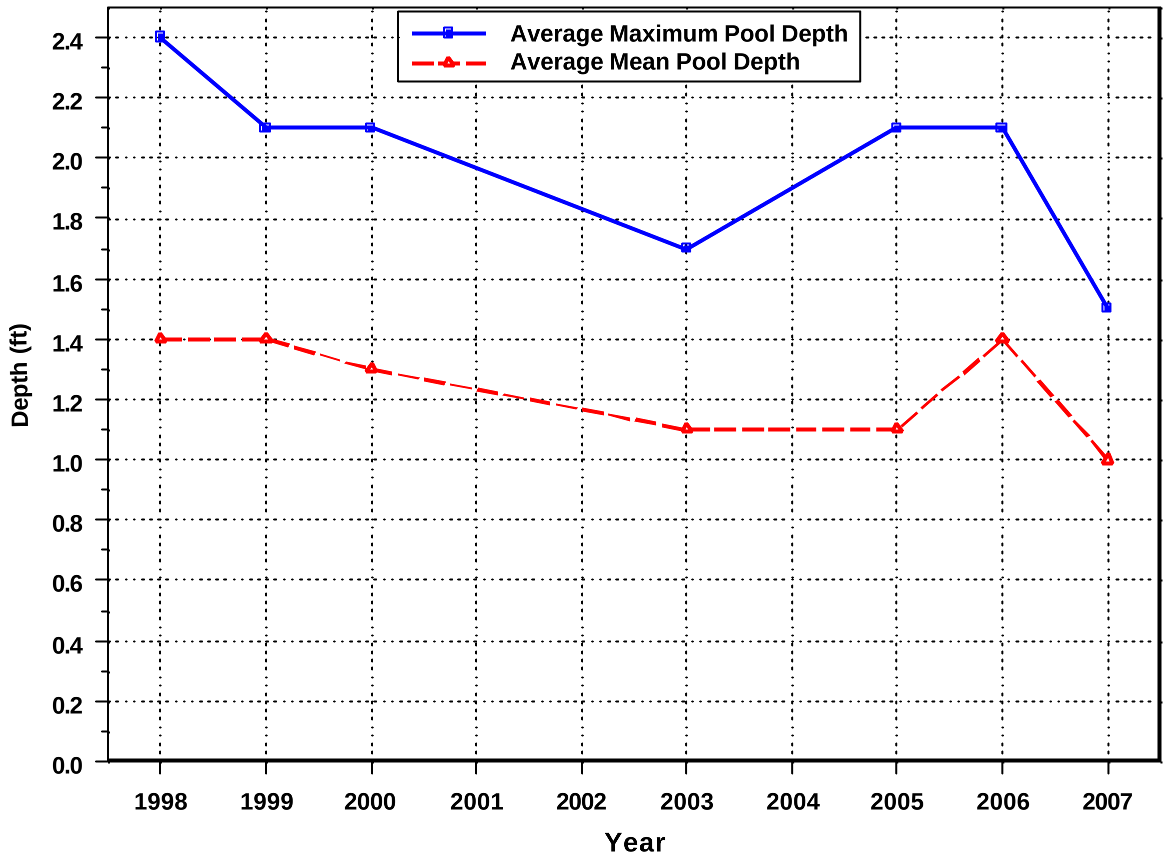


Figure 34a. Escape Cover Index for Pool Habitat in Reach 13d of Zayante Creek, 1998-2000, 2003 and 2005-2007.

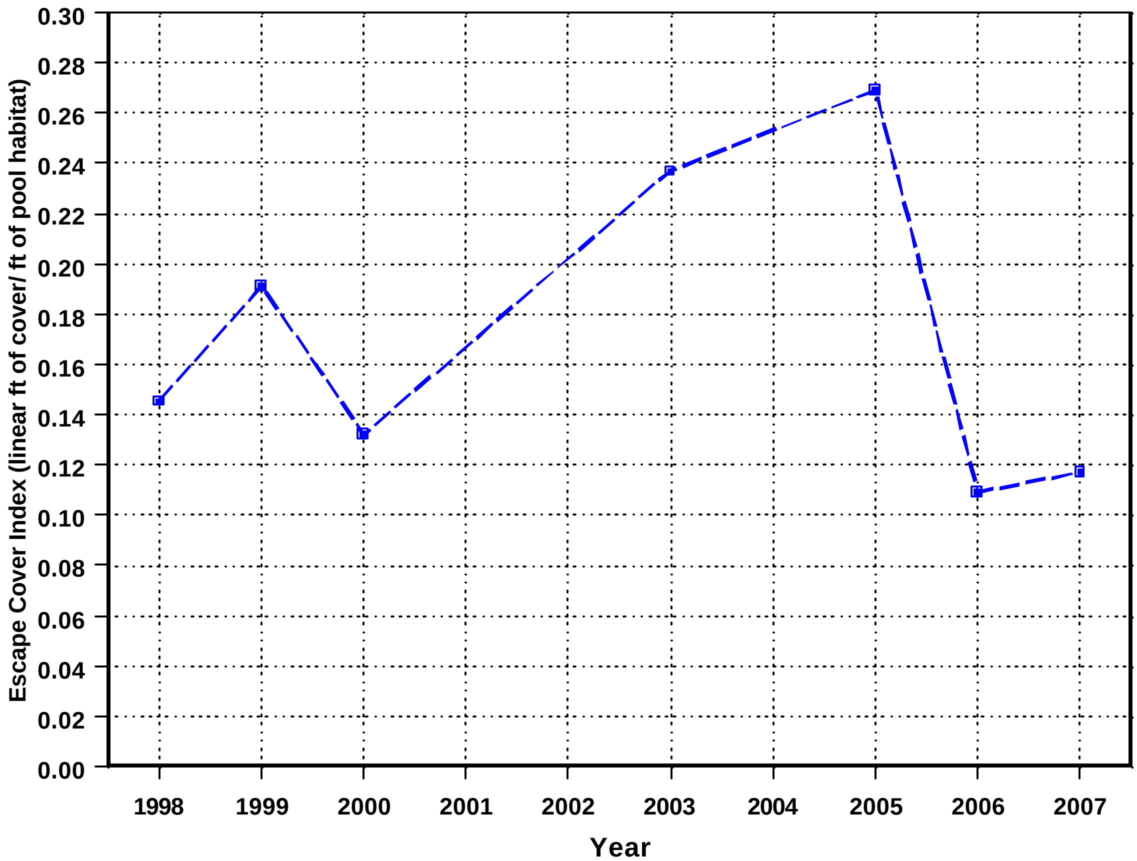


Figure 34b. Escape Cover Index for Pool Habitat at Site 13d in Zayante Creek, 1998-2001 and 2003-2007.

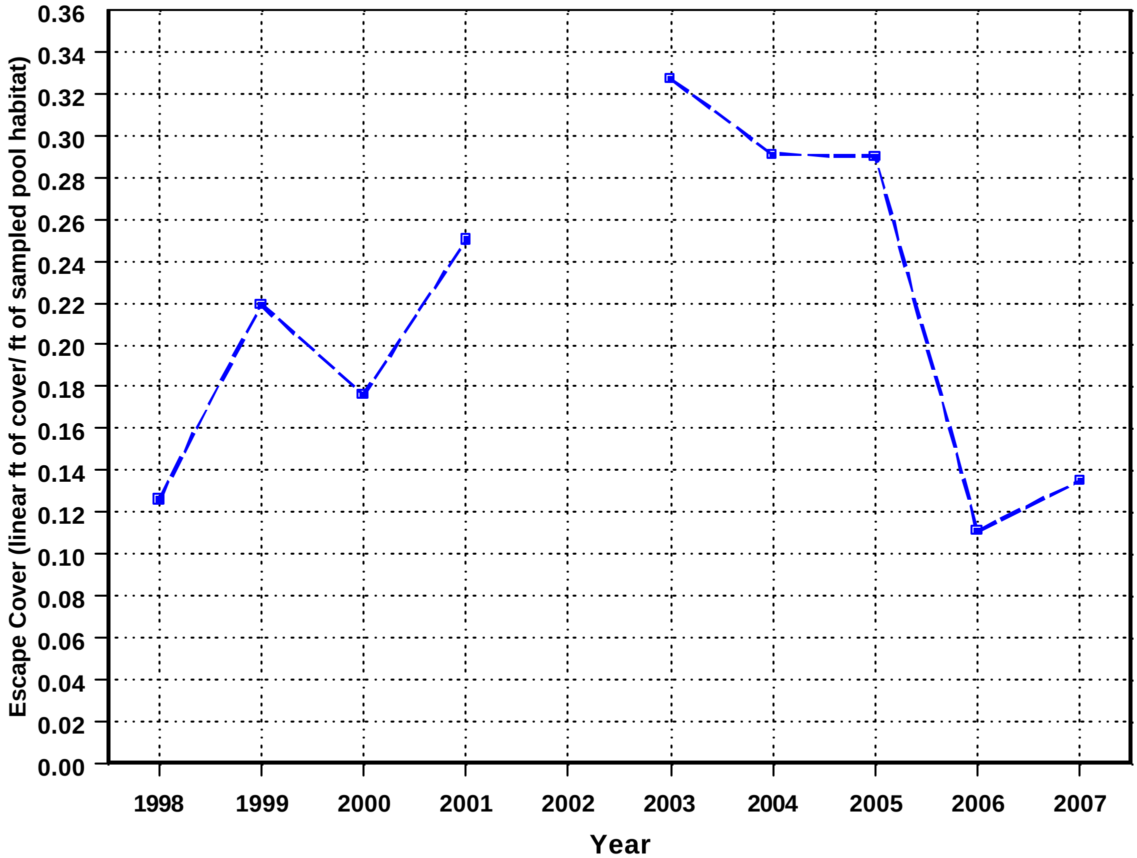
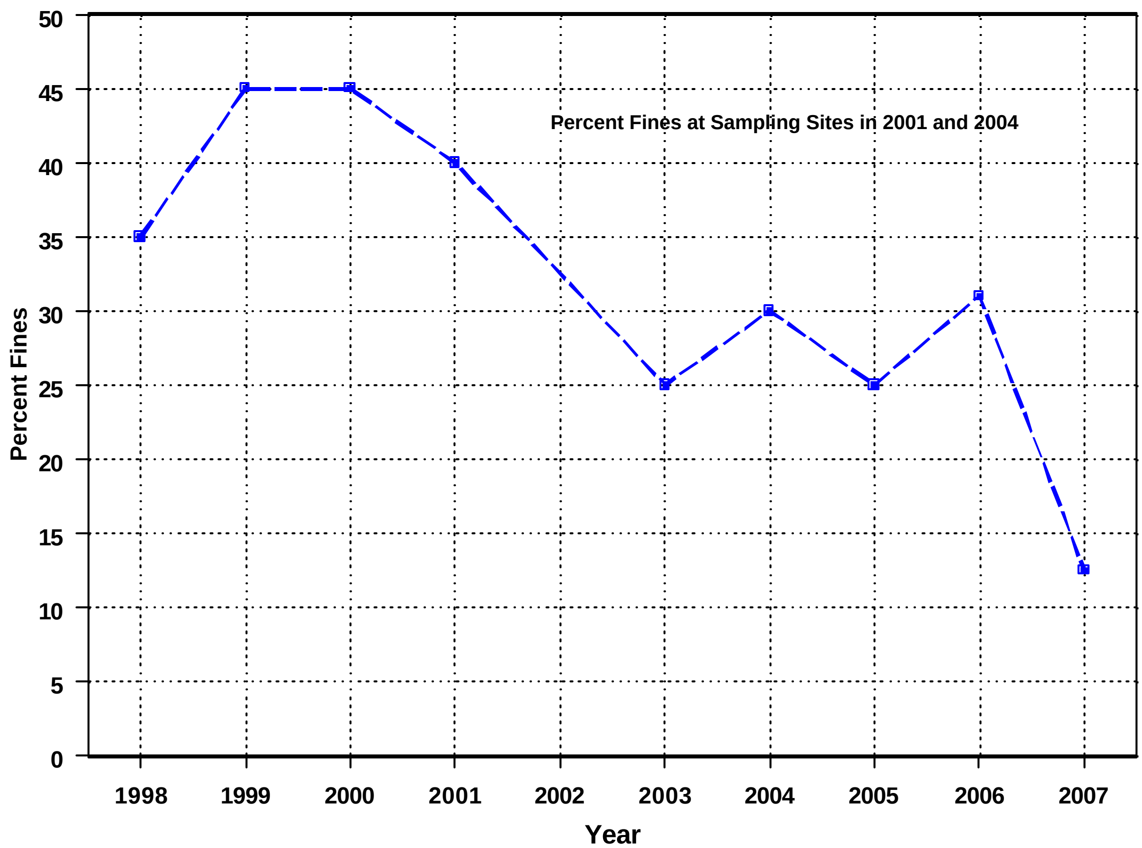


Figure 35. Averaged Percent Fines in Step-Run Habitat in Reach 13d of Zayante Creek, 1998-2001, 2003-2007.



In Boulder Creek, the largest western sub-watershed of the San Lorenzo system, habitat trends were analyzed in Reach 17a since 1998. Annual changes in reach-wide pool depths did not parallel annual changes in averaged mean monthly streamflow record at Big Trees gage (May–September) in 1998–2000 but did in 2005–2007. Pool depth in 1999 remained similar to 1998 and actually improved despite reduced baseflow (**Figures 25 and 36**). Pool depth increased in 2006 and declined in 2007, consistent with changes in baseflow. Overall pool filling appeared evident from 1998 to 2007 from reduced pool depths beyond the effects of baseflow differences. Reduced pool escape cover, reach-wide, was evident from 1998 to 2007, though it was limited in general (**Figure 37a**). Reach-wide escape cover was highest in 1998, declined considerably in 1999, rebounded in 2005 but declined in 2006 and remained low in 2007. High escape cover at the sampled pool habitat in 1997 in the same vicinity of later sampling offered evidence that escape cover was once much higher (**Figure 37b**). Escape cover was generally less in lower Boulder Creek than in Reach 13d in Zayante Creek over the 10-year period. Percent fines in valuable step-run habitat increased from 1998 to 1999 but declined to a low in 2005 and maintained low level in 2007. This aspect of rearing habitat improved. Percent fines in Boulder Reach 17a were generally less than in the Zayante Creek Reach 13d, although both were similarly low in 2007 (**Figure 38**). **However, overall rearing habitat quality in Boulder Reach 17a has declined from 1997 to 2007 (as they have in Reach 13d) due to reach-wide pool filling and reduced pool escape cover.**

Figure 36. Averaged Maximum and Mean Pool Depth in Reach 17a of Boulder Creek, 1998-2000 and 2005-2007.

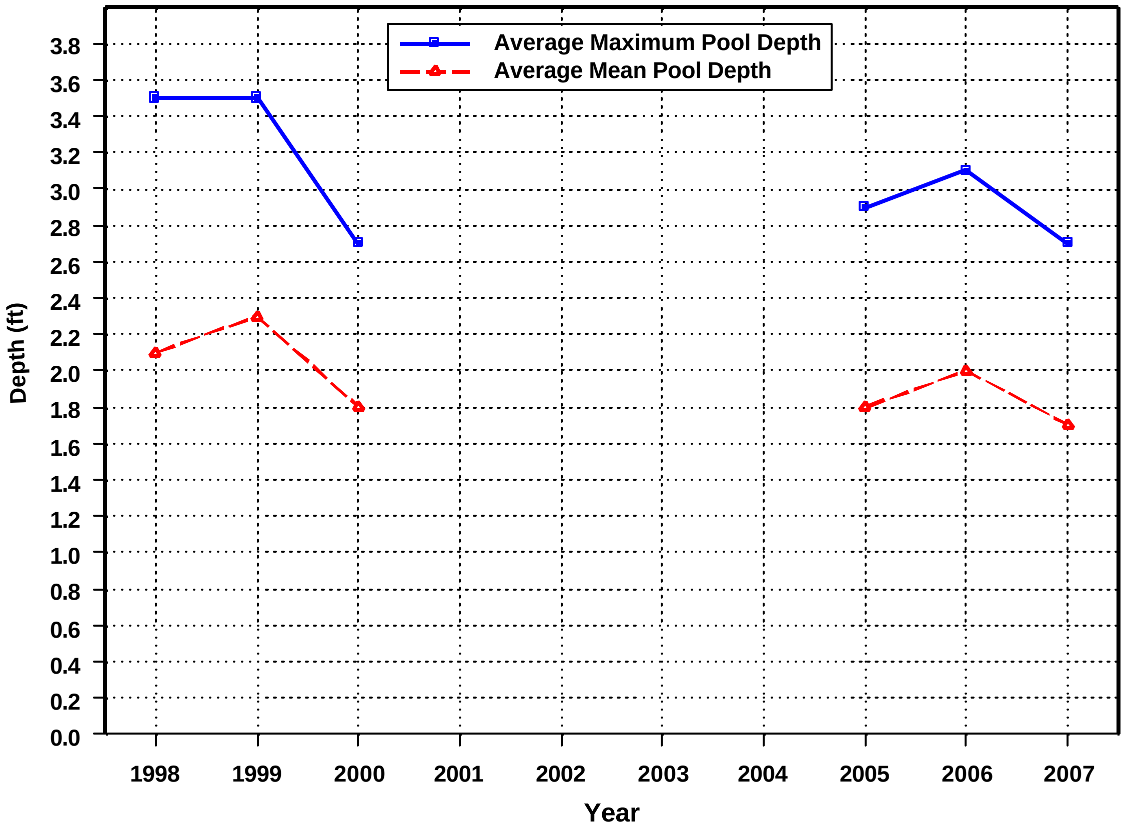


Figure 37a. Escape Cover Index for Pool Habitat in Reach 17a of Boulder Creek, 1998-2000 and 2005-2007.

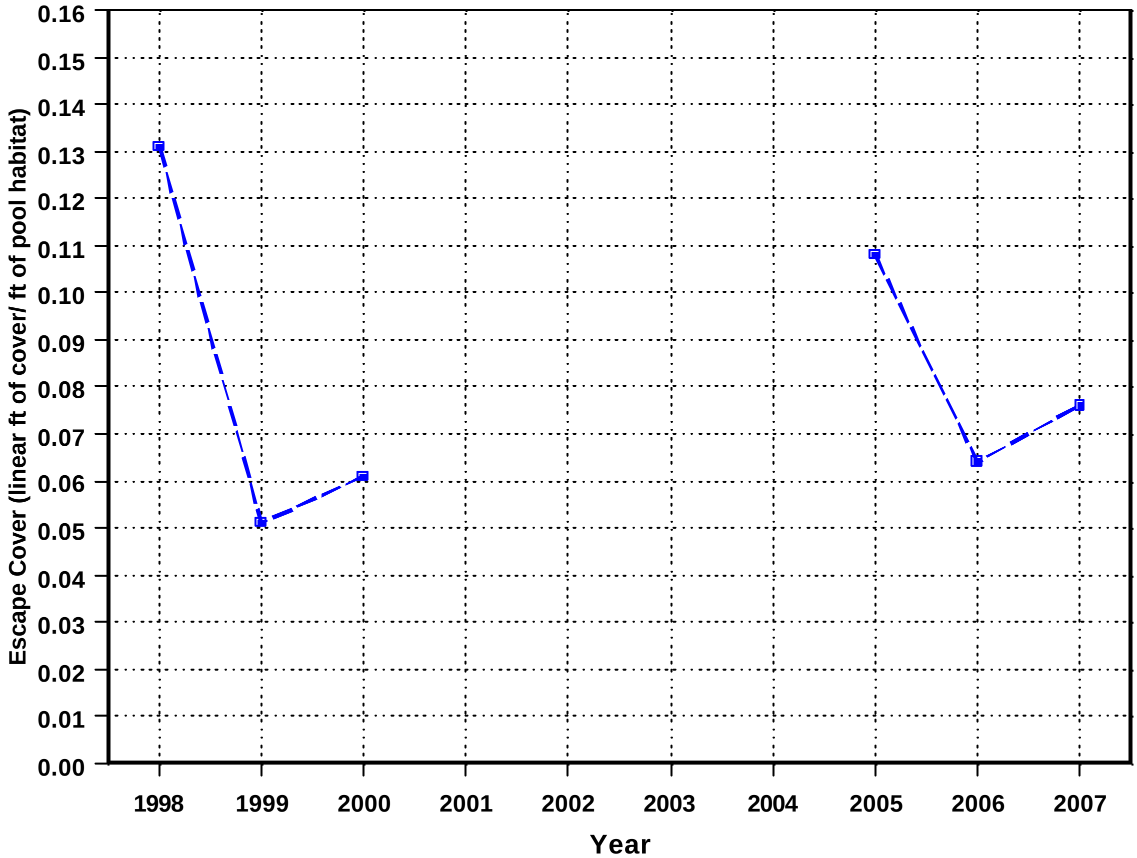


Figure 37b. Escape Cover Index for Pool Habitat at Site 17a in Boulder Creek, 1997-2001 and 2003-2007.

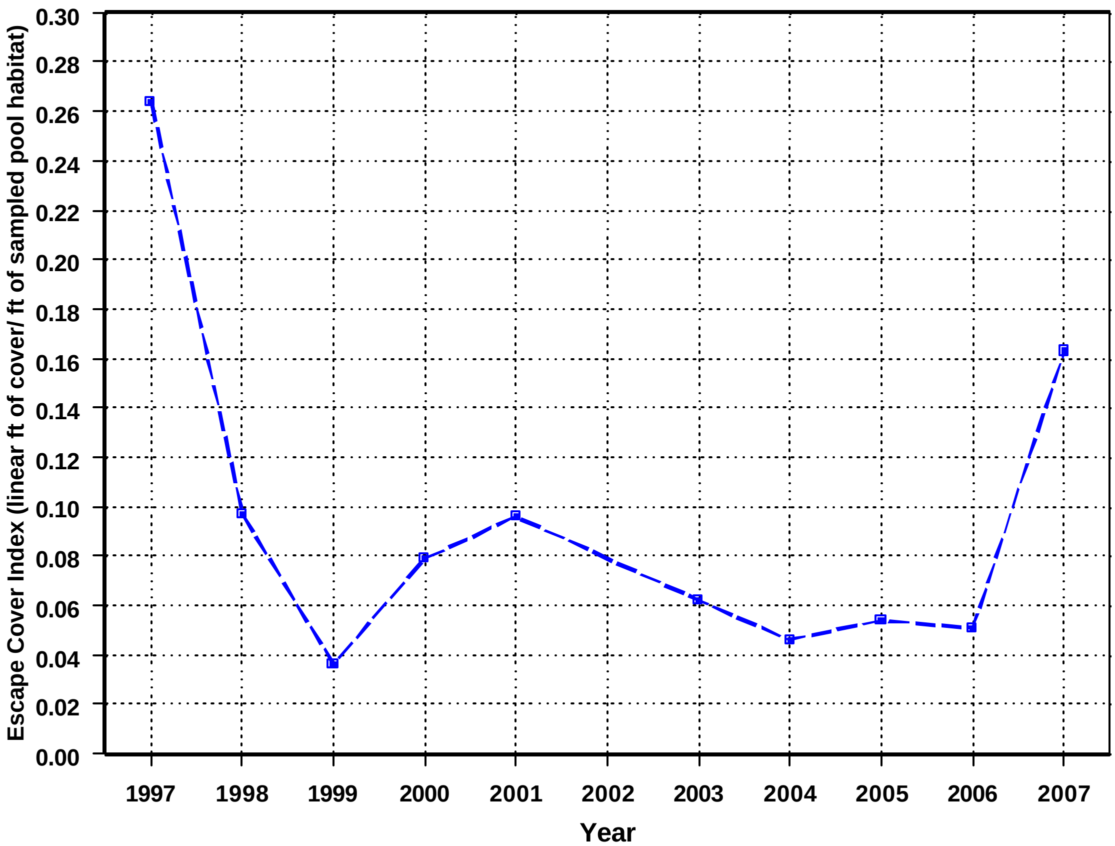
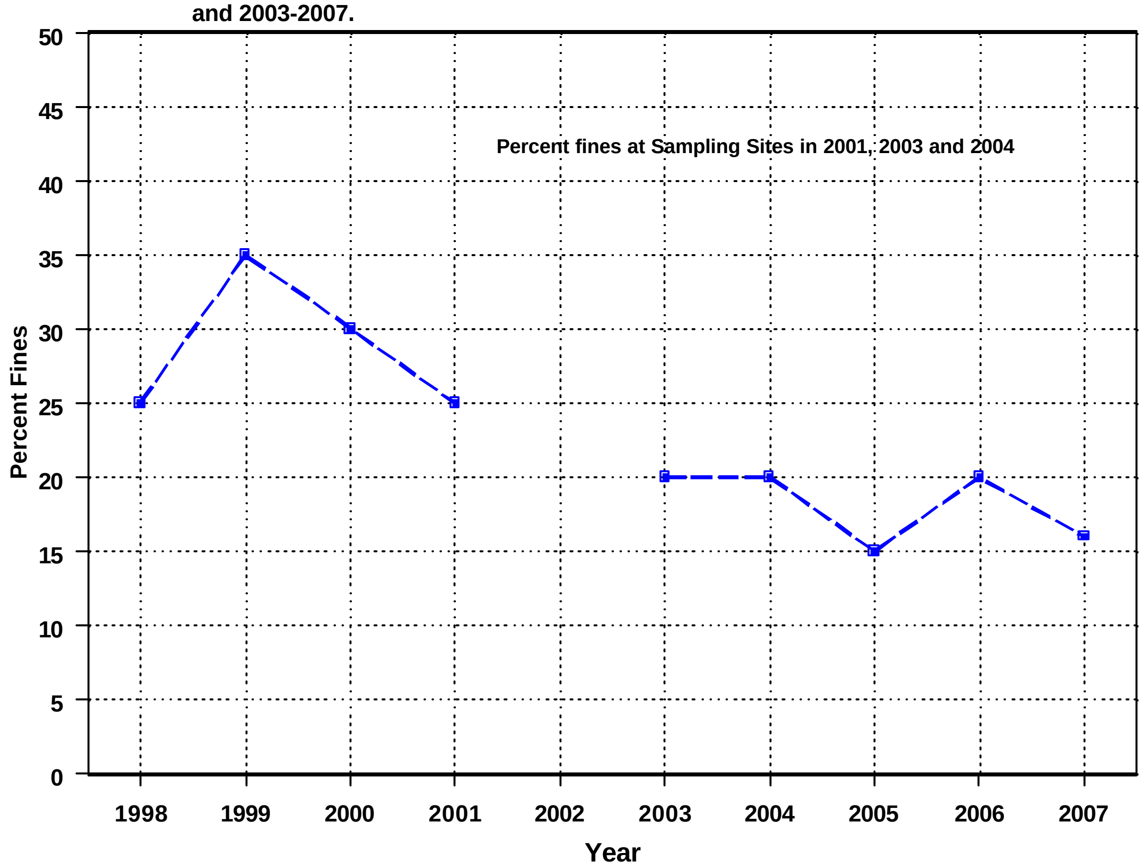


Figure 38. Averaged Percent Fines in Step-Run Habitat in Reach 17a of Boulder Creek, 1998-2001 and 2003-2007.



TRENDS IN JUVENILE STEELHEAD DENSITY AND HABITAT CONDITIONS IN SOQUEL CREEK, 1997-2007

In drier years with reduced baseflow, juvenile densities in the mainstem were relatively higher. In wetter years, the densities declined. The exception to our inverse relationship was 2001, when YOY and total juvenile densities were relatively low despite low streamflow (except for the uppermost mainstem site with densities all increasing from 2000 to 2001). Relatively higher YOY and total densities occurred in 1997, 2002, 2004 and 2007. Densities of Size Class II and III juveniles in the mainstem were generally low, with relatively higher densities in 1997, 1998 and 2005.

Since 1997, rearing habitat quality in the lower mainstem has improved with increased average maximum pool depth and has declined with regard to reduced escape cover. However, riffles conditions for aquatic insects and steelhead food supply have improved. During the instream wood survey in 2002, this reach was noted for its lack of large wood (**Alley 2003**). In the lower mainstem, densities of larger juveniles were not well correlated with rearing habitat conditions.

Overall rearing habitat quality declined since 1997 in the upper mainstem because of pools filling with sediment and less escape cover. During the instream wood survey in 2002, this reach was noted for its lack of large wood (**Alley 2003**). In the upper mainstem, densities of larger juveniles were not correlated with reach-wide changes in pool depth, or reach-wide changes in escape cover. However, they were positively correlated with changes in pool escape cover at sampling sites (except in 2004) and reduced embeddedness in riffle and run habitat (except for 2006). Relatively better habitat conditions were consistent with higher densities in 1997, 1998, 2005 and 2007.

The best explanation for fluctuations in Size Class II and III densities in the mainstem was related to differences in presumed spawning effort, spawning success and increased YOY growth in wetter years versus slower growth in drier years. In milder winters, there is better over-wintering survival of yearlings, which may contribute to higher densities found in the mainstem in 1997, 2001 (Site 4 only) and 2002 (Site 4 only). In wetter years, there may be less spawning effort and spawning success in the mainstem until late in the spawning season. However, the above median daily baseflow results in faster water velocity, increased insect drift and deeper feeding stations in fastwater habitat, at least in the spring. These factors all promoted faster growth rate, leading to a higher proportion of YOY reaching Size Class II their first year and resulting in higher densities of larger juveniles in 1998 and 2005.

In East Branch Soquel Creek, total and YOY densities annually fluctuated in a dissimilar fashion in lower East Branch and upper East Branch except they increased at both locations from 2001 to 2002 and decreased at both locations in 2006. After reaching an 11-year high in 2004, total and YOY densities in the lower East Branch declined in 2005 and then again in 2006 to almost zero but rebounded in 2007 to half the 1997 level. Higher YOY densities in drier years in the lower East Branch may have resulted from greater spawning effort than in wetter years, more spawning success and higher survival of YOY after emergence. In wetter years, more adult steelhead likely continued further up the East Branch into the Soquel Demonstration State Forest (SDSF). With the streambed instability of the lower East Branch, redd (nest) scour or burial in sediment may have be more common in winters with higher stormflows.

Overall rearing habitat quality declined in the lower East Branch from 1997 to 2007, primarily with regard to fastwater habitat important to YOY juveniles and aquatic insects. Other factors related to the turbidity and thin silt layer on the substrate observed at the sampling site in 2006 and 2007 may also indicate lower habitat quality. During the instream wood inventory in 2002, this reach was identified as one with small quantities of large instream wood (**Alley 2003**). The apparent disconnect between non-streamflow related rearing habitat conditions and Size Class II and III densities in the lower East Branch indicated that rearing habitat quality within the observed range in the last 11 years was overshadowed by poor over-winter survival of yearlings in years that were not wet enough to grow many YOY to Size Class II. Over-winter survival did not appear good in any year. The effect of non-streamflow related rearing habitat conditions was also overshadowed by the added potential for growth of some YOY to Size Class II in intermediate to wet years. The years with highest densities of Size Class II and III juveniles in the lower East Branch occurred in 1998 and 2005, two relatively wet years with moderate YOY production. Higher growth rate during these high spring-baseflow years allowed a higher proportion of YOY to reach Size Class II, leading to higher densities of larger juveniles.

In the upper East Branch, densities of Size Class II and III increased during 1997–1999, with a decline to less than one-fifth the 1999 density by 2004. Then the density increased up to the highest density in 11 years in the dry year of 2007. The relatively high density of Size Class II and III juveniles was likely due to at least moderate numbers of YOY in 2006 and good over-winter survival of yearlings during a mild winter. The three highest Size Class II and III densities in the upper East Branch did not correspond to any hydrologic category. They were 1998 (very wet year), 1999 (intermediate year) and 2007 (very dry year). Both the wet and moderately wet years had sufficient spring baseflows to grow some YOY into Size Class II. The dry year likely had very good over-winter survival of yearlings, although rearing conditions worsened. In addition, adult access may have been hampered in the dry 2006/2007 winter, resulting in lower YOY production and reduced competition for food.

Although improvement in pool rearing habitat was detected in the upper East Branch in some years (greater pool depth in 2006 and greater pool escape cover in 2004), data indicate that habitat quality in 2007 was similar to conditions in 2000. The apparent disconnect between non-streamflow related rearing habitat conditions and Size Class II and III densities at Site 16 indicated that non-streamflow related rearing habitat quality within the observed range in the last 11 years was overshadowed by 1) poor over-winter survival of yearlings in years that were not wet enough to grow many YOY to Size Class II, 2) the potential for growth of some YOY to Size Class II in intermediate to wet years and 3) high over-winter survival of yearlings in dry years.
Attempts to retrieve PIT-tagged juveniles has indicated very limited movement of tagged individuals from their original locations.

If the incidence of large instream wood were to increase substantially in the East Branch, rearing habitat quality and improved over-winter survival of yearlings may play more important roles in increasing Size Class II and III densities.

Trends in Juvenile Steelhead Density in the Soquel Creek Mainstem

At the 4 mainstem sites tracked for the past 11 years, annual trends in total and YOY juvenile densities paralleled each other (**Figures 19 and 21**). Because the juvenile population in the mainstem is largely YOY, spawning effort, spawning success and early YOY survival largely dictate total juvenile densities in these reaches. Relatively higher YOY and total densities occurred in 1997, 2002, 2004 and 2007. The higher density in 1997 was followed by three low-density years with increases in 2001 and 2002. Then there was a drop in density in 2003, an increase in 2004, a decrease for two years in 2005 and 2006 and a strong rebound in 2007. In drier years the juvenile densities were relatively higher in the mainstem sites. In wetter years, the densities declined. The years of highest YOY and total juvenile density corresponded to years with the lowest averaged mean monthly streamflow (May–September), indicating the drier years (**Figure 26**). This inverse relationship may be explained by assuming that in drier years, adult spawners have poorer access to the upper watershed, having more shallow riffles and other impediments to pass. Thus they expend more spawning effort in the mainstem. Also, in drier years, survival of eggs and emerging YOY may be increased without substantial late stormflows to scour or smother redds and wash away YOY. We learned from our spawning gravel study, which involved streambed coring and particle size analysis, that spawning gravel conditions in the mainstem were reasonably good in 2002, a year that was likely without large bankfull stormflows that would move considerable sediment (**Alley 2003**). The exception to our inverse relationship was 2001, when YOY and total juvenile densities were relatively low despite low streamflow (except for the uppermost mainstem site with densities all increasing from 2000 to 2001).

Figure 19. Plot of Annual Total Juvenile Densities at Mainstem Soquel Creek Sites, 1997-2007.

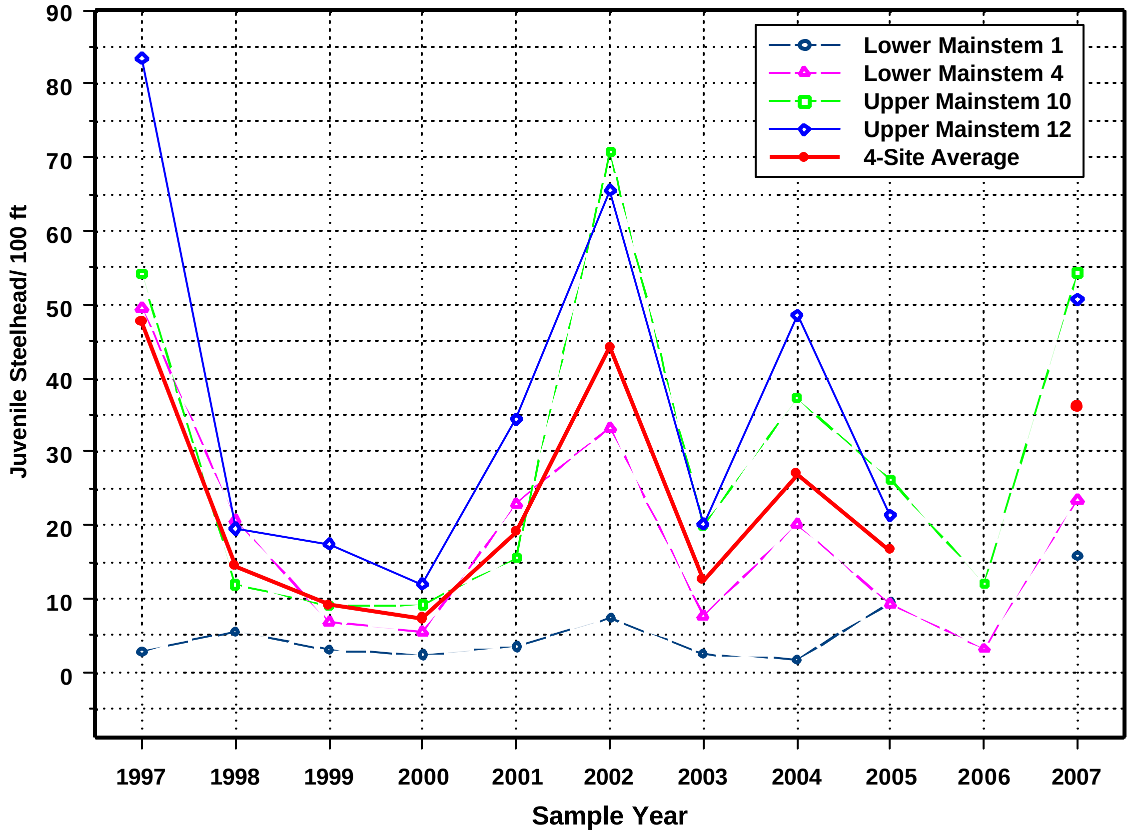


Figure 21. Plot of Annual YOY Densities at Mainstem Soquel Creek Sites, 1997-2007.

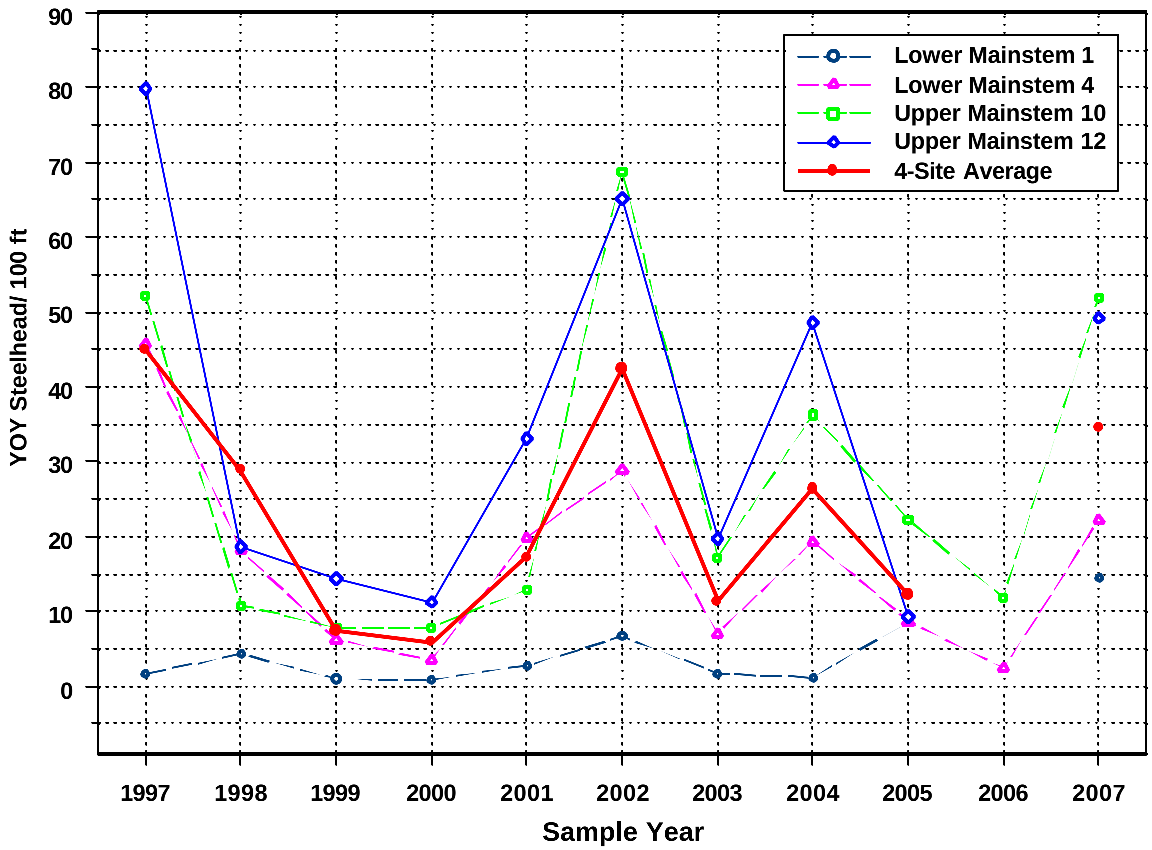
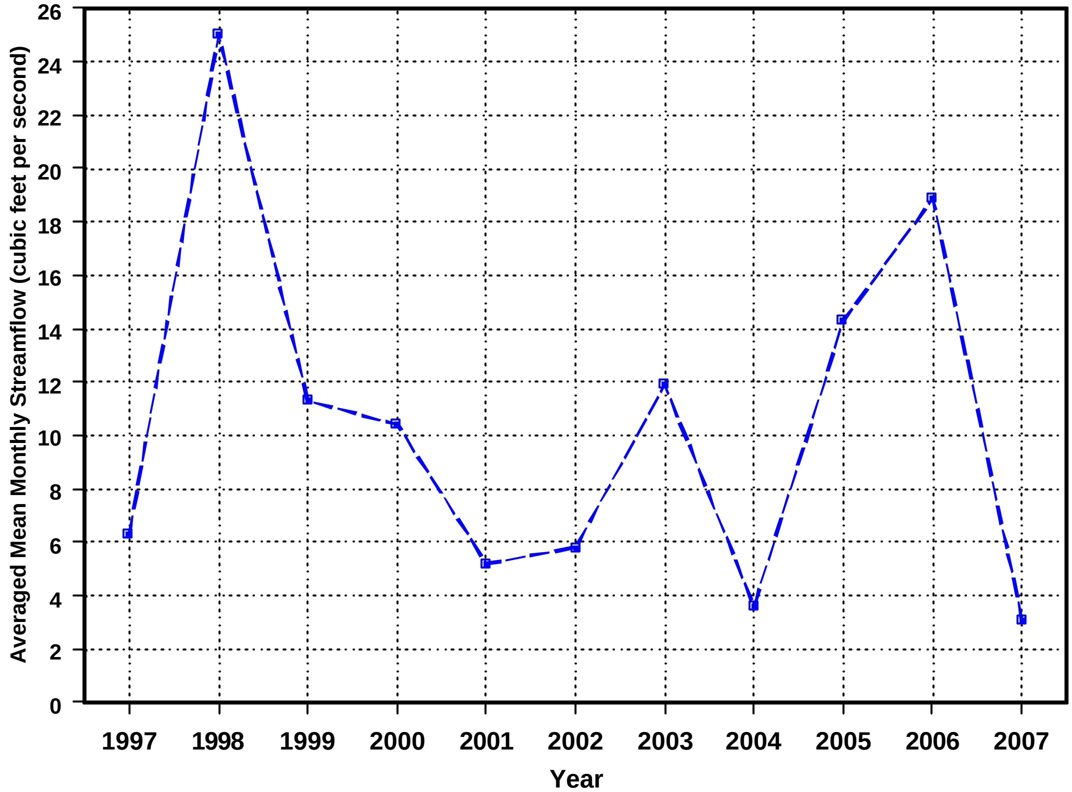
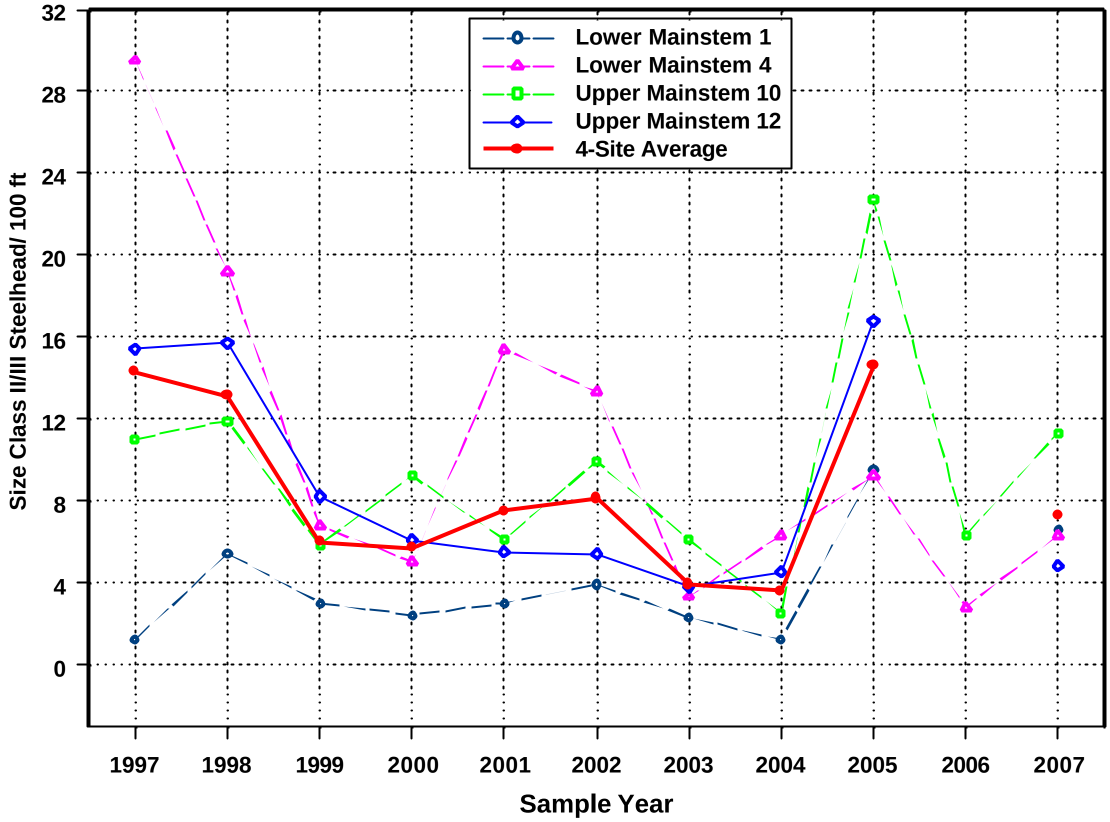


Figure 26. Averaged Mean Monthly Streamflow for May-September, 1997-2007 at the Soquel Village Gage on Soquel Creek.



Densities of Size Class II and III juveniles graphed at the 4 mainstem sites changed mostly in parallel over the past 11 years (**Figure 23**). In general, densities were low, with relatively higher densities in 1997, 1998 and 2005. Site 4 also showed relatively higher densities in 2001 and 2002. Thus, the pattern was different than that for YOY and total densities. These larger juveniles consisted of primarily YOY that grow to Size Class II their first year and yearlings that have held over from the previous year in the mainstem or have filtered down from the East and West Branches. However, multiple years of limited scanning of juveniles at our sampling sites for juveniles PIT tagged by NOAA fisheries biologists has detected very little movement from where they were originally tagged, except for one large juvenile that moved from one of the branches into Reach 8 of the mainstem. In wetter years, there may be less spawning effort and spawning success in the mainstem until late in the spawning season. However, the above median daily baseflow results in faster water velocity, increased insect drift and deeper feeding stations in fastwater habitat, at least in the spring. These factors all promoted faster growth rate, leading to a higher proportion of YOY reaching Size Class II their first year and resulting in higher densities of larger juveniles in 1998 and 2005.

Figure 23. Plot of Annual Size Class II/ III Juvenile Densities at Soquel Mainstem Sites, 1997-2007.



Rearing habitat conditions were graphed to compare to densities of Size Class II and III juveniles, whose densities typically correlate best to rearing habitat quality. At the lower mainstem Site 1, well below the Moores Gulch and Bates Creek confluences, densities of these larger juveniles were not well correlated with rearing habitat conditions averaged for the reach. Densities of these larger juveniles were similarly low throughout the years, with highest relative values in 2005 and 2007. No corresponding 2005 increase in reach-wide pool depth, escape cover in sampling site pools or reach-wide escape cover were detected (**Figures 39-40b**). Reach-wide averages in maximum and mean pool depth did not change much through the years, except in 1999 (no reach-wide data in 1998). The one habitat improvement in 2005 was reduced embeddedness in riffle and run habitat at the sampling site (**Figure 41**). High densities that year are best explained by the increased baseflow in spring that allowed a higher proportion of YOY to reach Size Class II (**Figure 26**). The increased density in 2007 correlated with modestly improved escape cover in sampled pool habitat, modestly improved reach-wide escape cover and further reduced embeddedness in riffle and run habitat at the sampling site. The modest increase in Size Class II and III densities in 2007 may have been partially due to improved, non-flow related rearing habitat, but were most likely from good over-winter survival of yearlings, more spawning effort and higher spawning success in Reach 1, with some YOY reaching Size Class II even during a dry year.

Figure 39. Averaged Maximum and Mean Pool Depth in Reach 1 of Soquel Creek, 1997-2007.

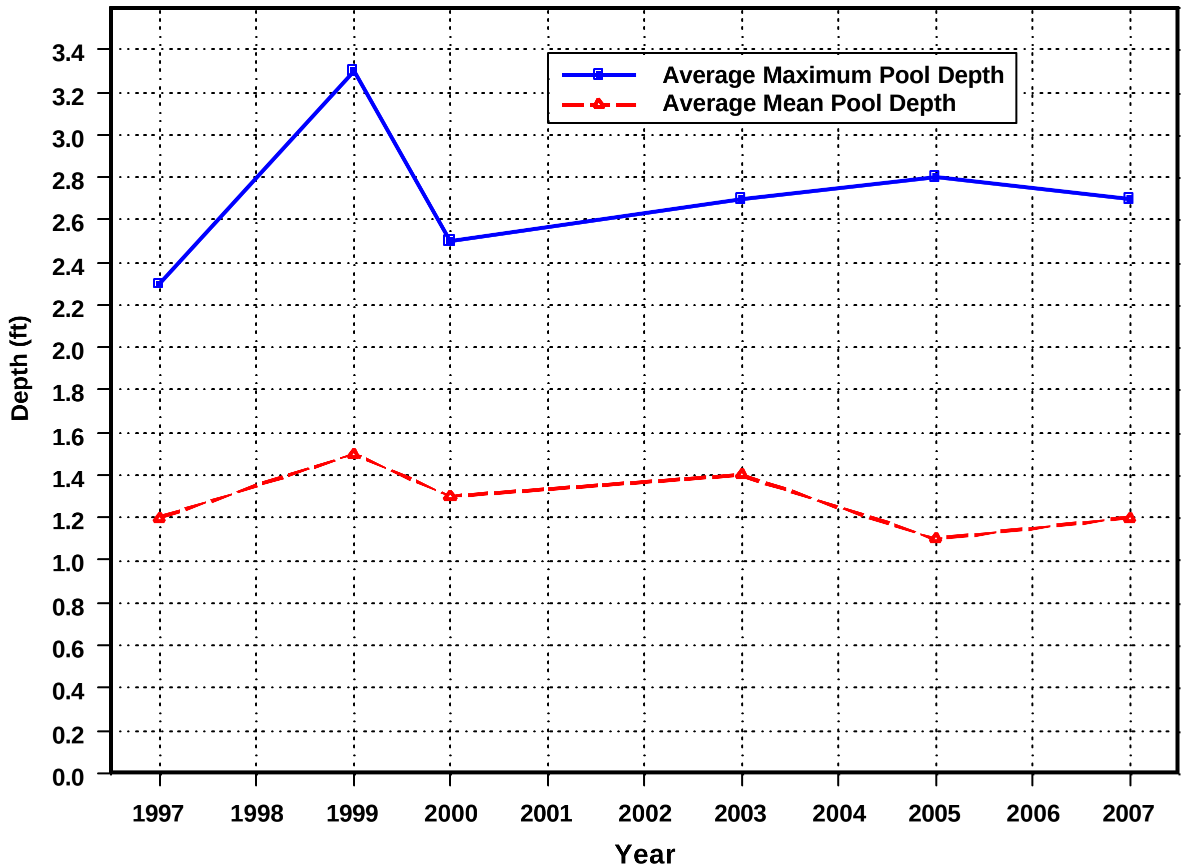


Figure 40a. Escape Cover Index for Pool Habitat in Reach 1 of Soquel Creek, 1997-2007.

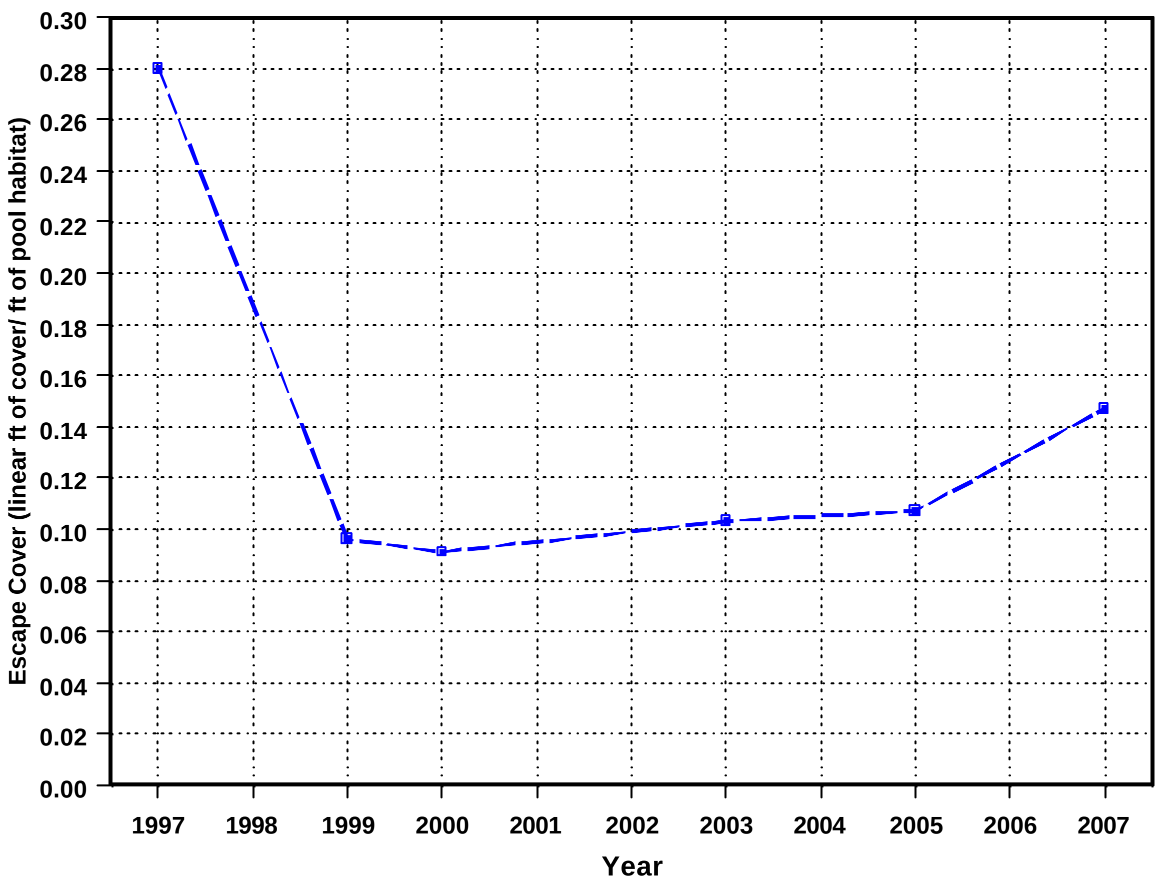


Figure 40b. Escape Cover Index for Pool Habitat at Site 1 in Soquel Creek, 1997-2006 and 2007.

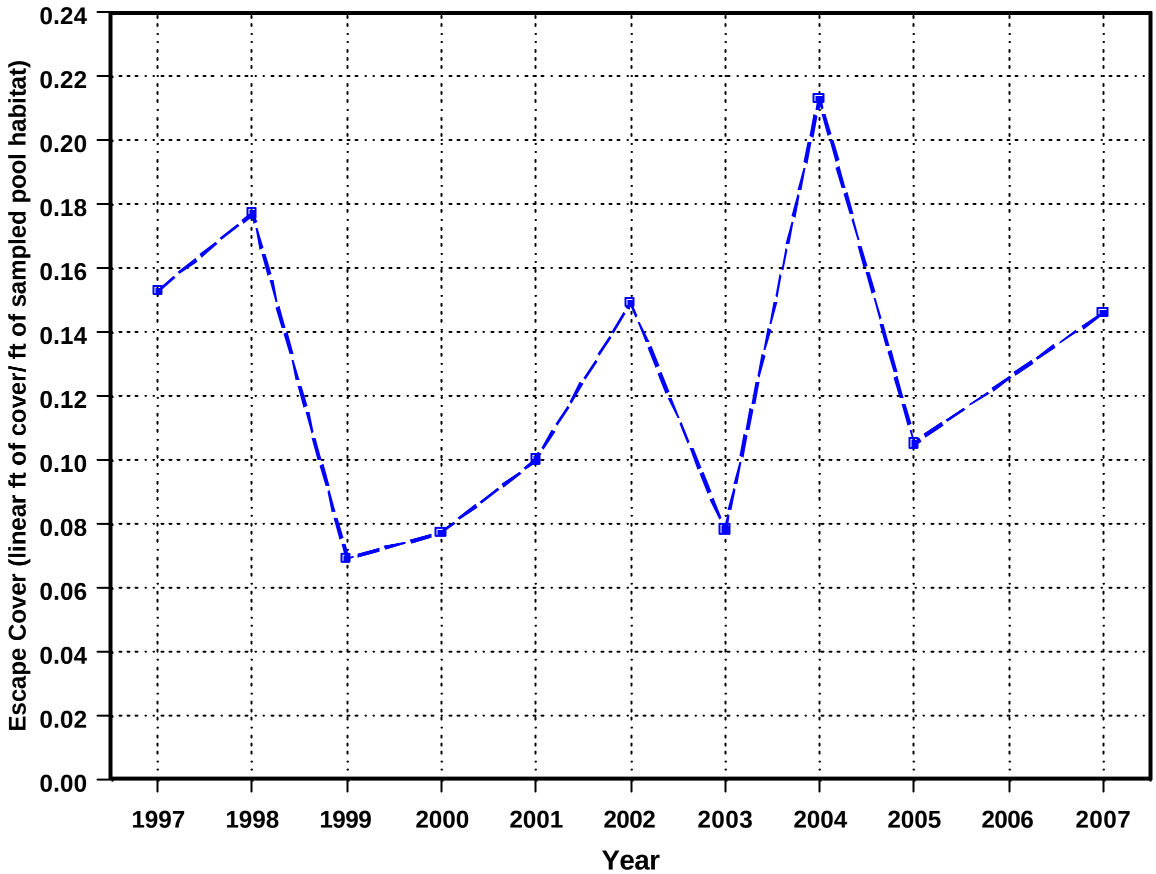
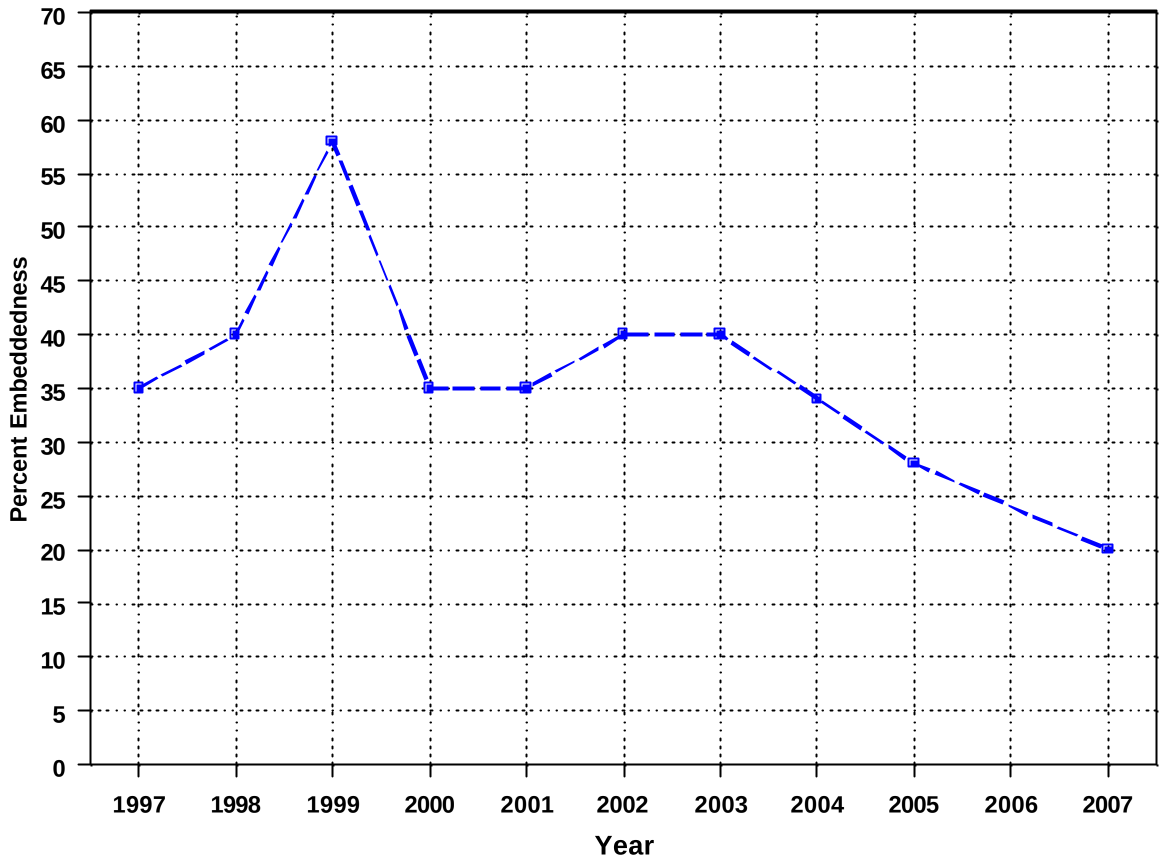


Figure 41. Average Embeddedness for Riffle and Run Habitat at the Sampling Site in Reach 1, of Soquel Creek, 1997-2007.



Densities of Size Class II and III juveniles at the upper mainstem Site 10 (Reach 7), upstream of the Moores Gulch confluence, were not correlated with reach-wide changes in pool depth (**Figure 42**), or reach-wide changes in escape cover (**Figure 43a**). However, they were positively correlated with changes in pool escape cover at sampling sites (except in 2004) (**Figure 43b**) and reduced embeddedness in riffle and run habitat (except for 2006) (**Figure 44**). Non-streamflow related rearing habitat quality likely explained the small fluctuations in densities from 1999 through 2004. Relatively better habitat conditions were consistent with higher densities in 1997, 1998, 2005 and 2007. However, higher densities in 1998 and 2005 were also influenced by a larger proportion of YOY growing into Size Class II in these wetter years. The slightly higher densities in 1997 and 2007 may have partially resulted from greater spawning effort, spawning success and over-winter survival of yearlings in the mainstem during a drier winter.

Figure 42. Averaged Maximum and Mean Pool Depth in Reach 7 (Above Moores Gulch) of Soquel Creek, 1997-2007.

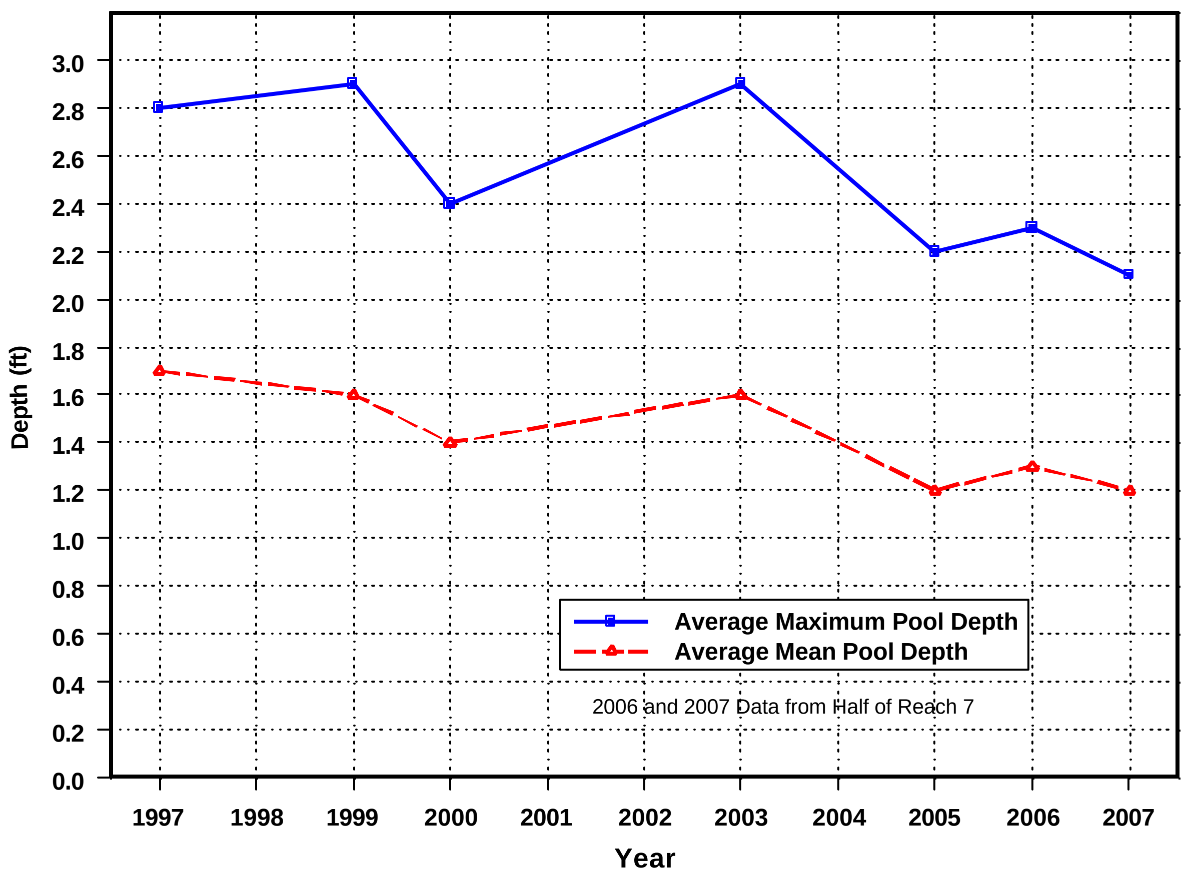


Figure 43a. Escape Cover Index for Pool Habitat in Reach 7 (Above Moores Gulch) of Soquel Creek, 1997-2007.

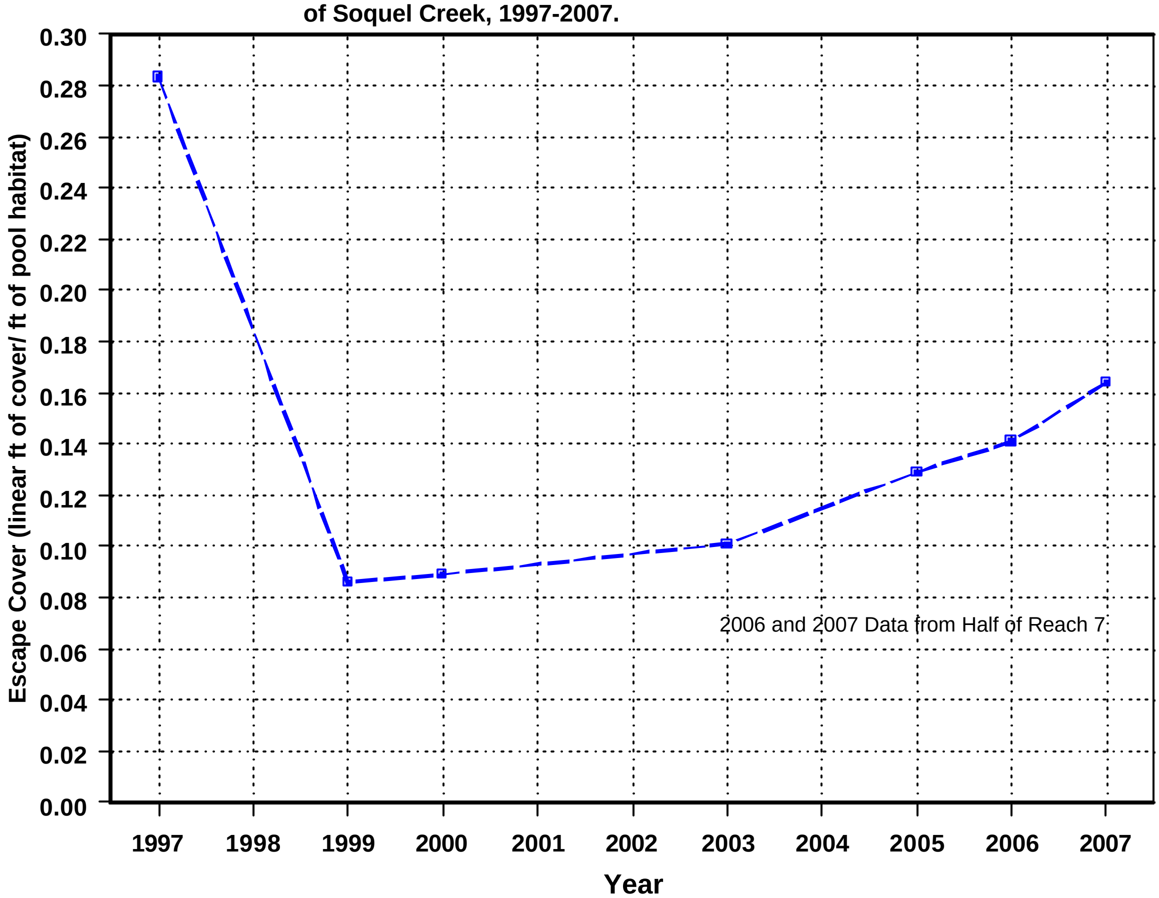


Figure 43b. Escape Cover Index for Pool Habitat at Site 10 (Reach 7 Above Moores Gulch) in Soquel Creek, 1997-2007.

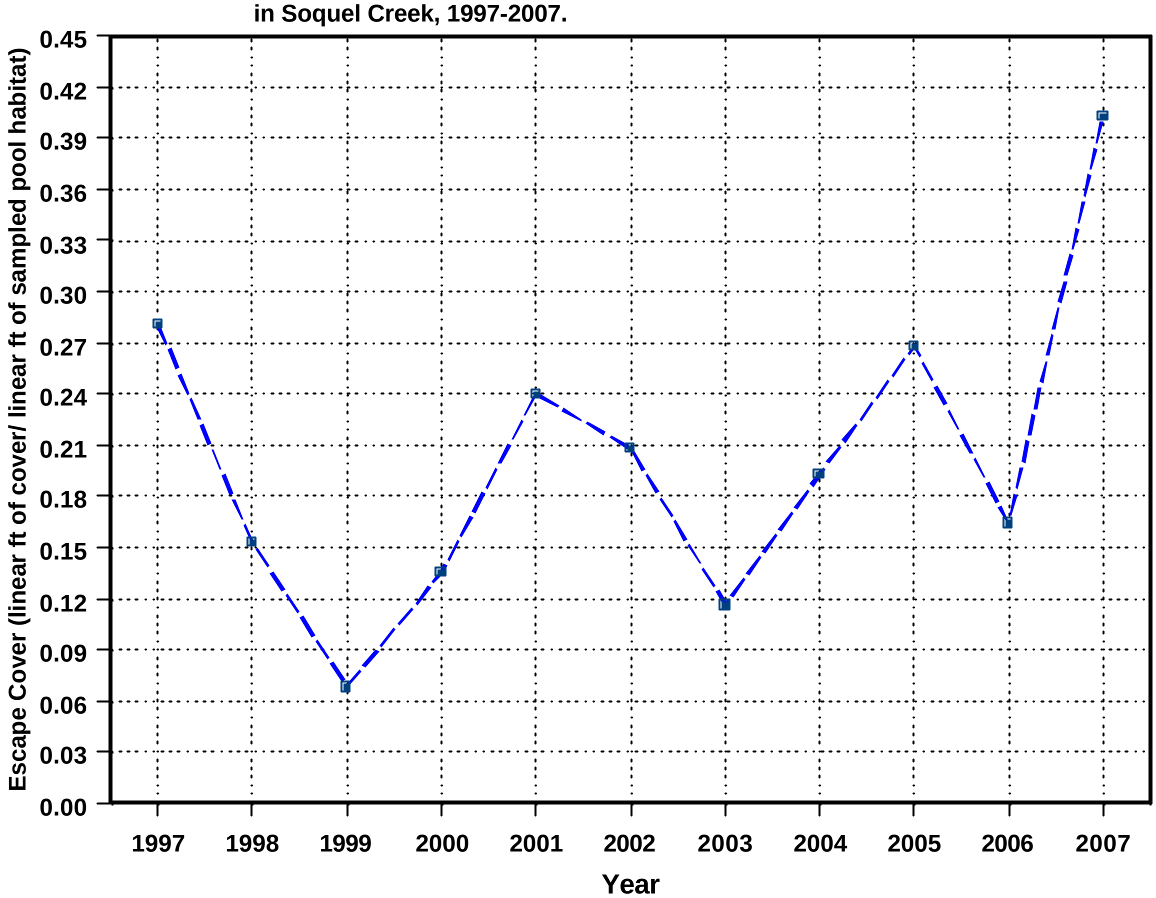
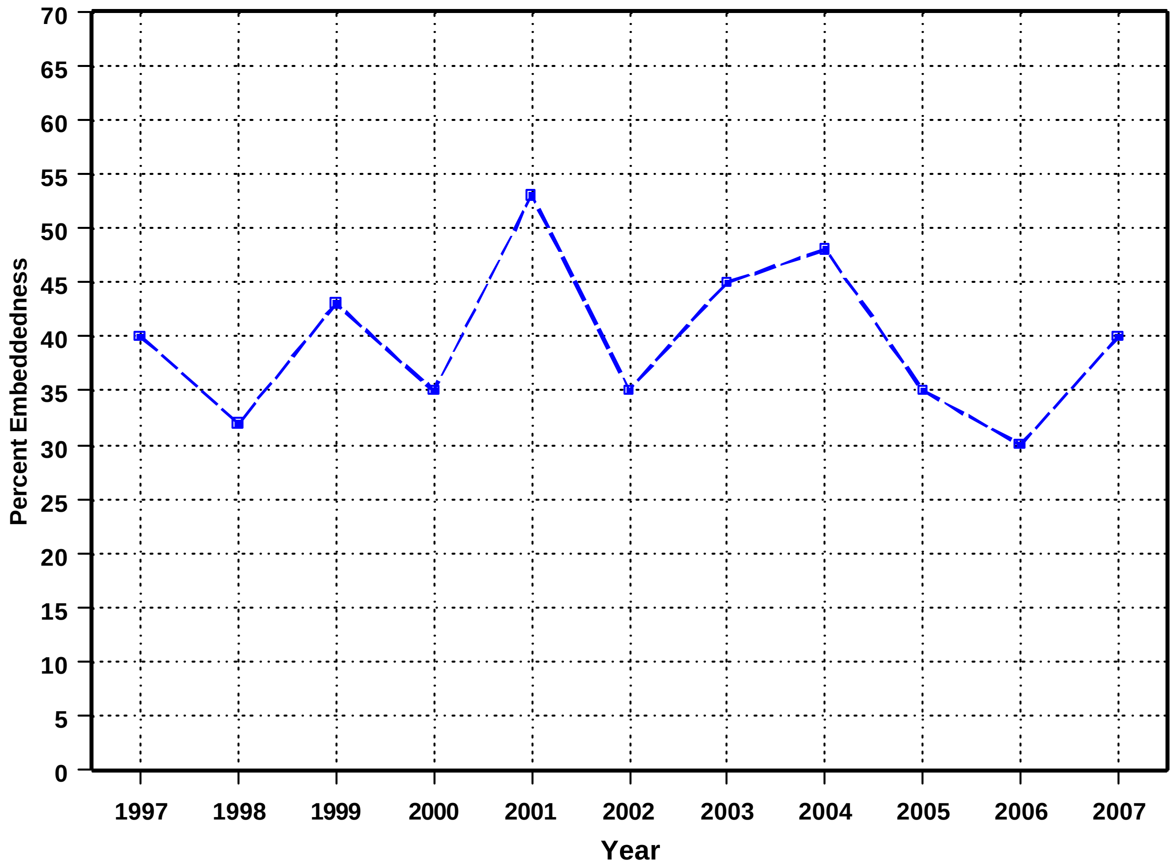


Figure 44. Average Embeddedness for Riffle and Run Habitat at Sampling Site 10 in Reach 7 (Above Moores Gulch) of Soquel Creek, 1997-2007.



In the East Branch of Soquel Creek, trends in juvenile steelhead densities were tracked since 1997 at Sites 13a (Reach 9a) and 16 (Reach 12a). Site 16 is located in the Soquel Demonstration State Forest (SDSF) and above permanent water diversions. Site 13a is located downstream of the Amaya Creek confluence, the quarry water diversion, the Hinckley Creek confluence and the Mill Pond water diversion and outfall (under new ownership prior to the 2006 sampling). Site 13a is in a geomorphically unstable reach where streambank erosion and fallen trees are common, and streambed rocks are poorly sorted by size (**Barry Hecht, personal observation**). Habitat conditions in Reach 9a may change considerably during high winter stormflows. During and after drier winters, spawning access and summer baseflow are much less at Site 16 than Site 13a.

Total and YOY densities annually fluctuated in a dissimilar fashion at Sites 13a and 16 in 1997–2007, except they increased at both sites from 2001 to 2002 and they decreased at both sites in 2006 (**Figures 20 and 22**). In all but 2004 and 2007 (the two driest years of the 11 years examined) YOY densities were much higher at Site 16. Usually, less than 10% of the juveniles at these sites were larger yearlings. YOY growth rate is less at Site 16, with only a few YOY reaching Size Class II only after the wettest winters. A higher proportion of YOY reach Size Class II in wetter years because more food is available during higher spring baseflow.

Figure 20. Plot of Annual Total Juvenile Densities at East Branch Soquel Creek Sites, 1997-2007.

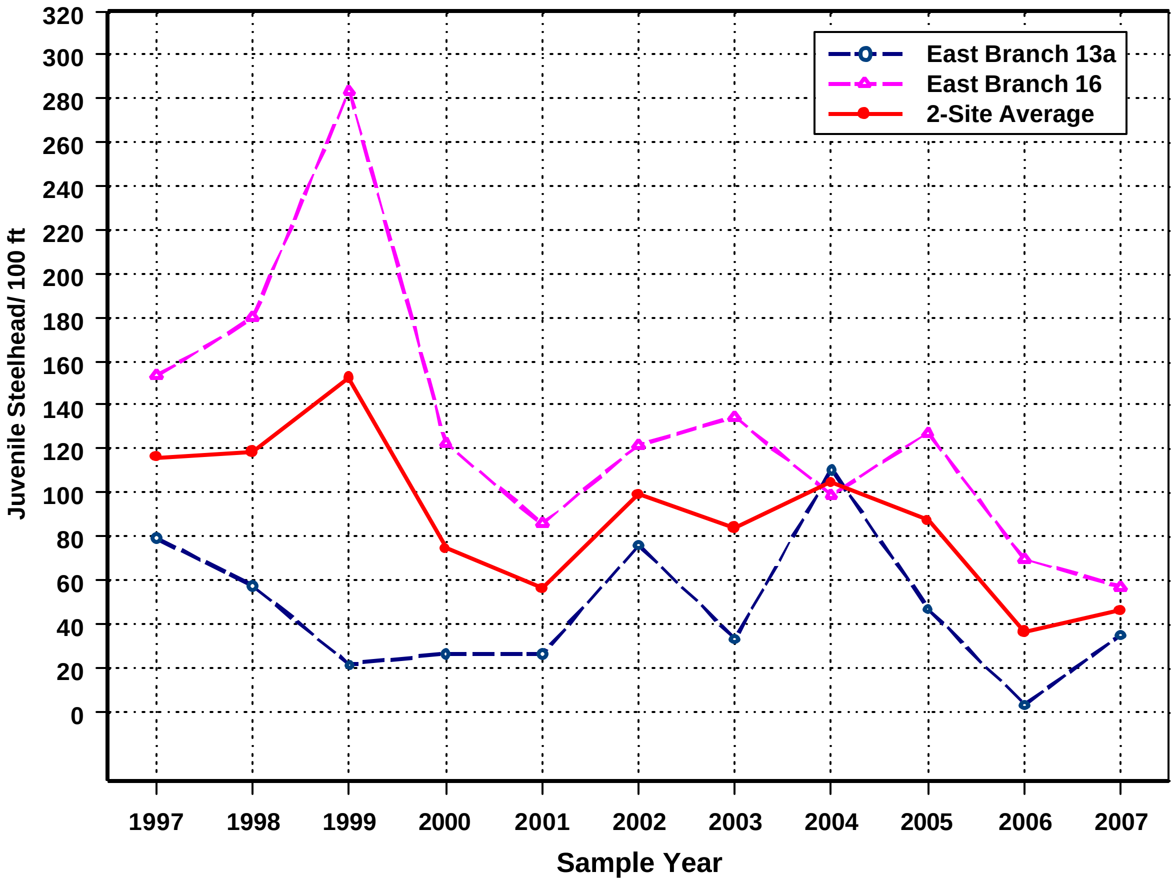
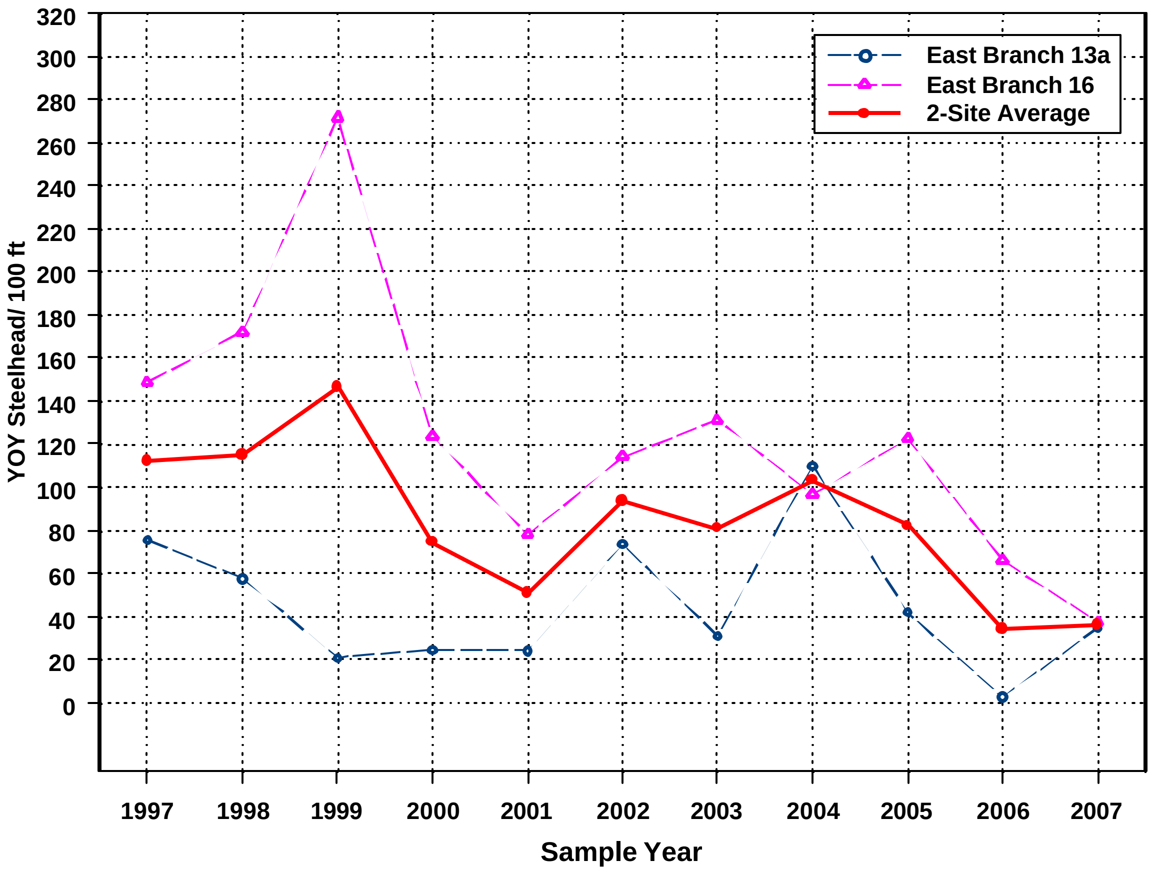


Figure 22. Plot of Annual YOY Densities at East Branch Soquel Creek Sites, 1997-2007.

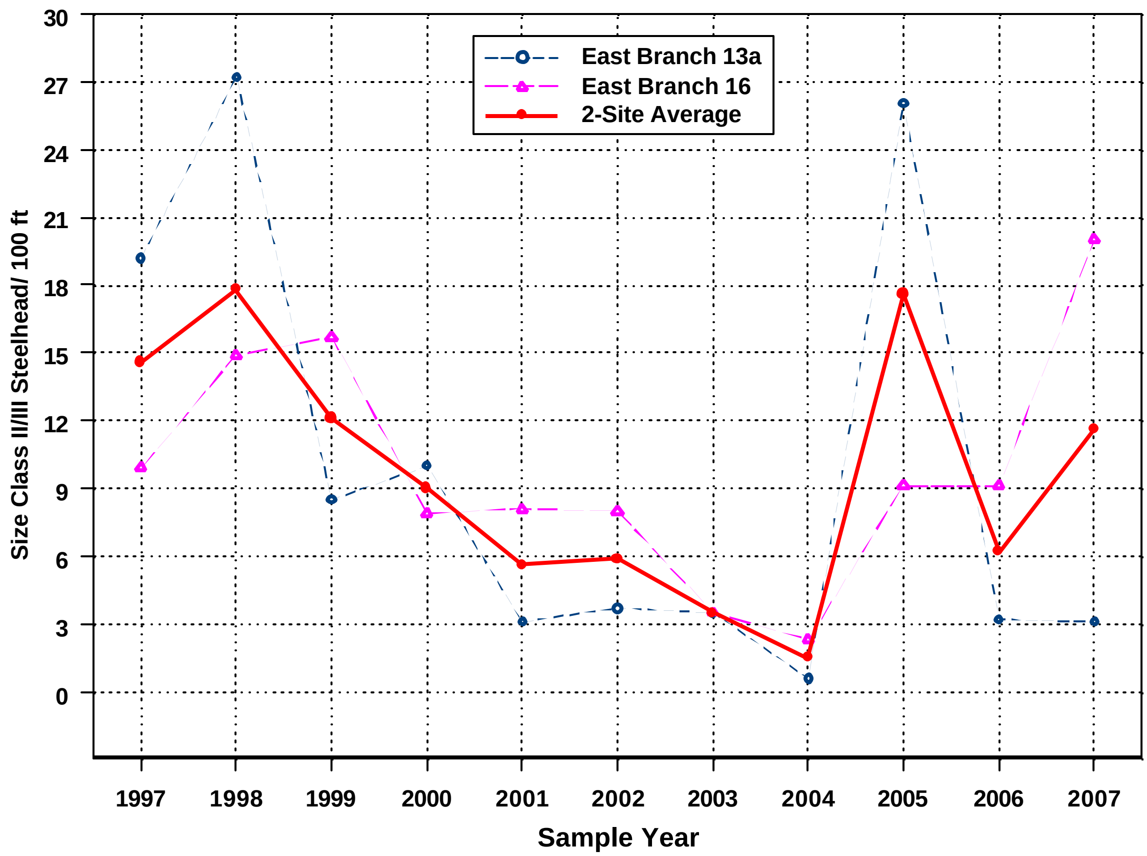


At Site 13a, total and YOY densities declined in 1997–1999 from a relatively high YOY density (near 80 fish/ 100 ft) in 1997 to one-fourth that in 1999. Total and YOY densities remained at that relatively low level in 1999–2003, except for an increase to nearly the 1997 level in 2002. Then densities declined in 2003 and increased to the 11-year high in 2004. Total and YOY densities declined in 2005 and then again in 2006 to almost zero but rebounded in 2007 to half the 1997 level.

The three years with highest total and YOY densities at Site 13a were drier years (1997, 2002 and 2004) (**Figure 26**). Most of the low YOY densities occurred after intermediate to wet winters (1999, 2000, 2003 and 2006). Higher YOY densities in drier years may have resulted from greater spawning effort than in wetter years, more spawning success and higher survival of YOY after emergence. In wetter years, more adult steelhead likely continued further up the East Branch into the SDSF. With the streambed instability of Reach 9a, redd scour or burial in sediment may have be more common in winters with higher stormflows.

At Site 13a, the years with highest densities of Size Class II and III juveniles occurred in 1998 and 2005, two relatively wet years with moderate YOY production (**Figures 24 and 26**). Higher growth rate during these high spring-baseflow years allowed a higher proportion of YOY to reach Size Class II, leading to higher densities of larger juveniles. After relative high densities in 1997 (19/ 100 ft) and 1998 (27/ 100 ft), densities dropped considerably to one-third the 1998 level in 1999 and continued to drop during the 1999–2004 period to just 1 fish/ 100 ft in 2004. Surprisingly, from the dry 2004 year to the relatively wet 2005 year, densities jumped to 26 fish/ 100 ft, second highest in 11 years, only to drop precipitously to 3 fish/ 100 ft in 2006–2007, similar to the low densities of 2001–2004. The wide fluctuation in Size Class II and III juveniles in 2004–2006 was puzzling.

Figure 24. Plot of Annual Size Class II/ III Juvenile Densities at East Branch Soquel Creek Sites, 1997-2007.



At Site 13a, annual densities of Size Class II and III juveniles were not correlated with changes in pool escape cover at sampling sites (**Figure 46b**). Insufficient years of data were available for reach-wide changes in pool depth, escape cover or percent fines in run and step-run habitat to make comparisons with trends in juvenile densities (**Figures 45, 46a and 47**). In 2005–2007, densities were not correlated with these habitat parameters. Average embeddedness in riffles and runs at sampling sites generally increased through the years as densities declined in 1997–2000 (**Figure 48**). But densities were not correlated with changes in embeddedness in 2001–2005. However, the relatively high density in 1997 was consistent with the highest escape cover in sampled pool habitat and the lowest embeddedness in sampled riffle and run habitat in 11 years.

The apparent disconnect between non-streamflow related rearing habitat conditions and Size Class II and III densities at Site 13a indicated that rearing habitat quality within the observed range in the last 11 years was overshadowed by poor over-winter survival of yearlings in years that were not wet enough to grow many YOY to Size Class II. Over-winter survival did not appear good in any year. Non-streamflow related rearing habitat conditions were also overshadowed by the added potential for growth of some YOY to Size Class II in intermediate to wet years. If the incidence of large instream wood were to increase substantially, rearing habitat quality and improved over-winter survival of yearlings may play more important roles in increasing Size Class II and III densities. Our stream inventory of instream wood in 2002 indicated that it was very scarce in Reach 9a (**Alley 2003**).

Figure 45. Average Maximum and Mean Pool Depth in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 2000 and 2005-2007.

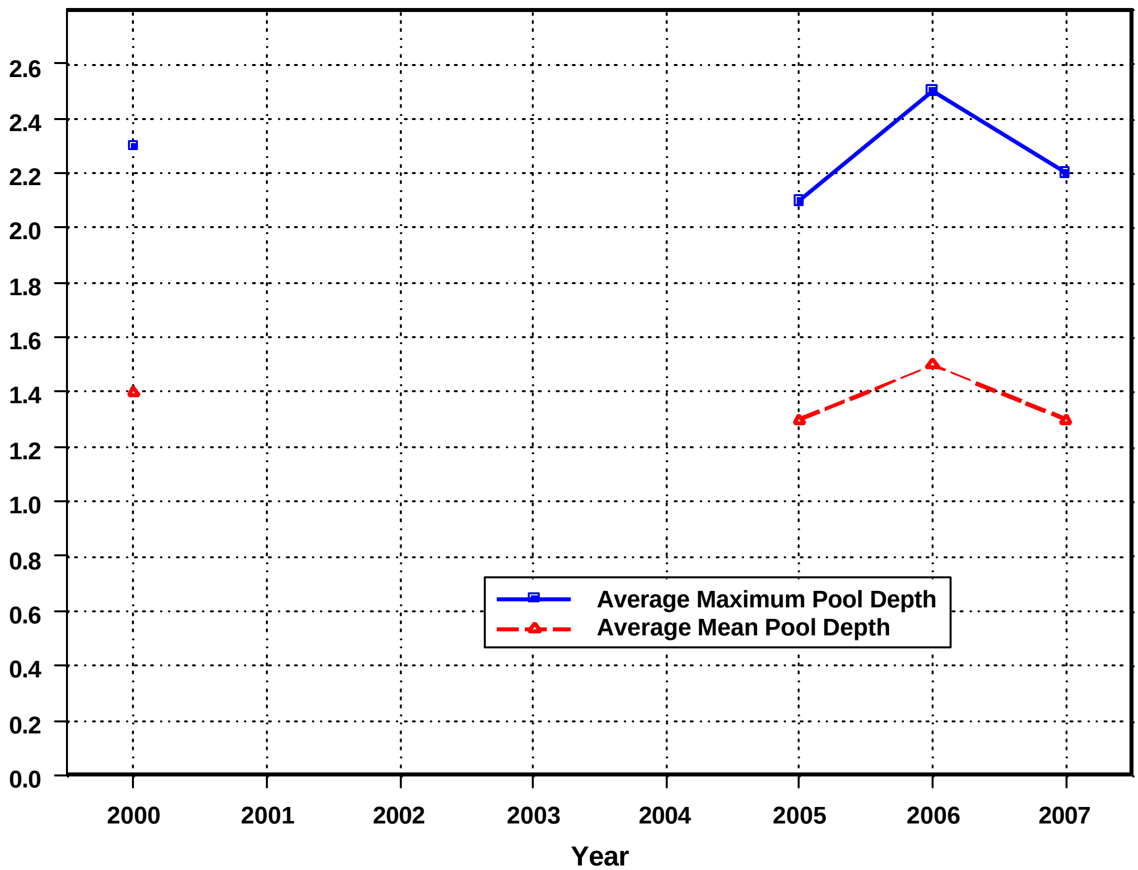


Figure 46a. Escape Cover Index for Pool Habitat in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 2000 and 2005-2007.

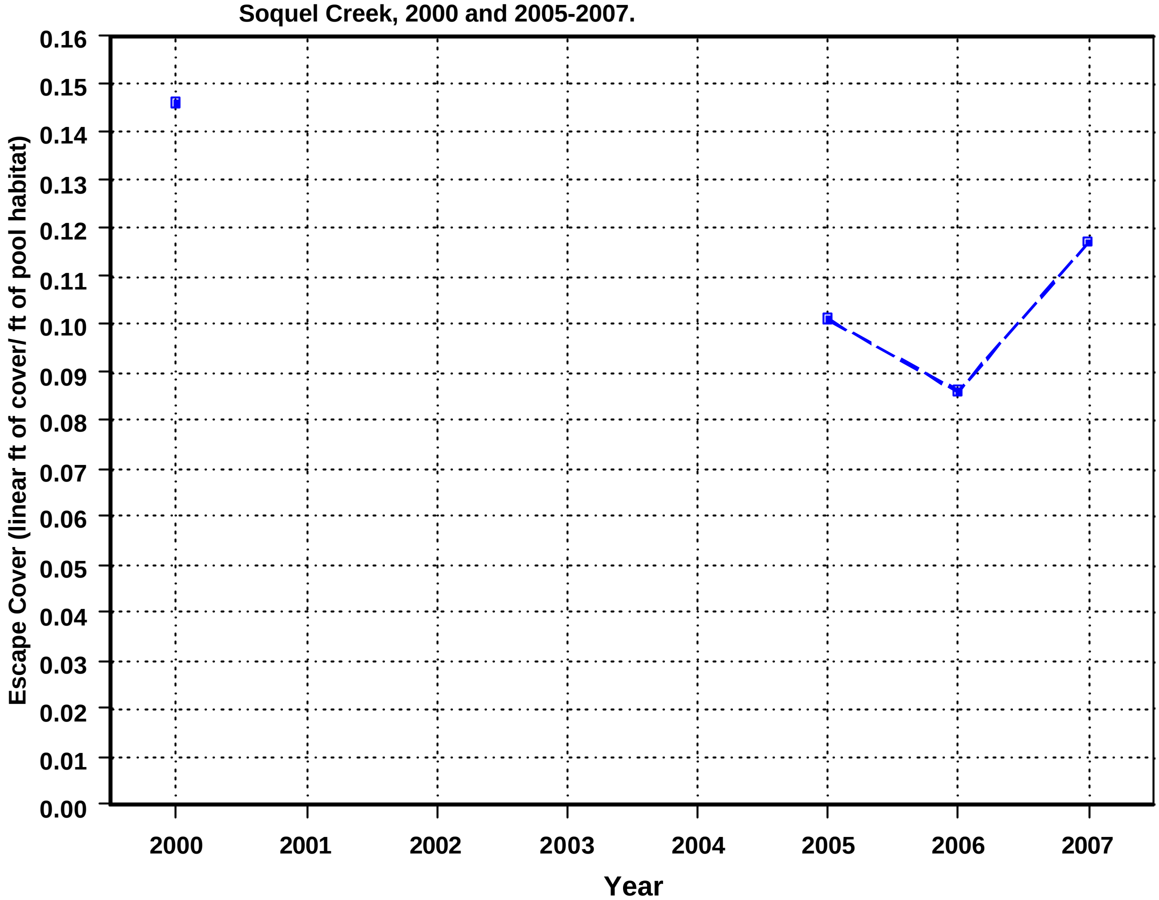


Figure 46b. Escape Cover Index for Pool Habitat at Site 13a (Reach 9a below Mill Pond) in East Branch Soquel Creek, 1997-2007.

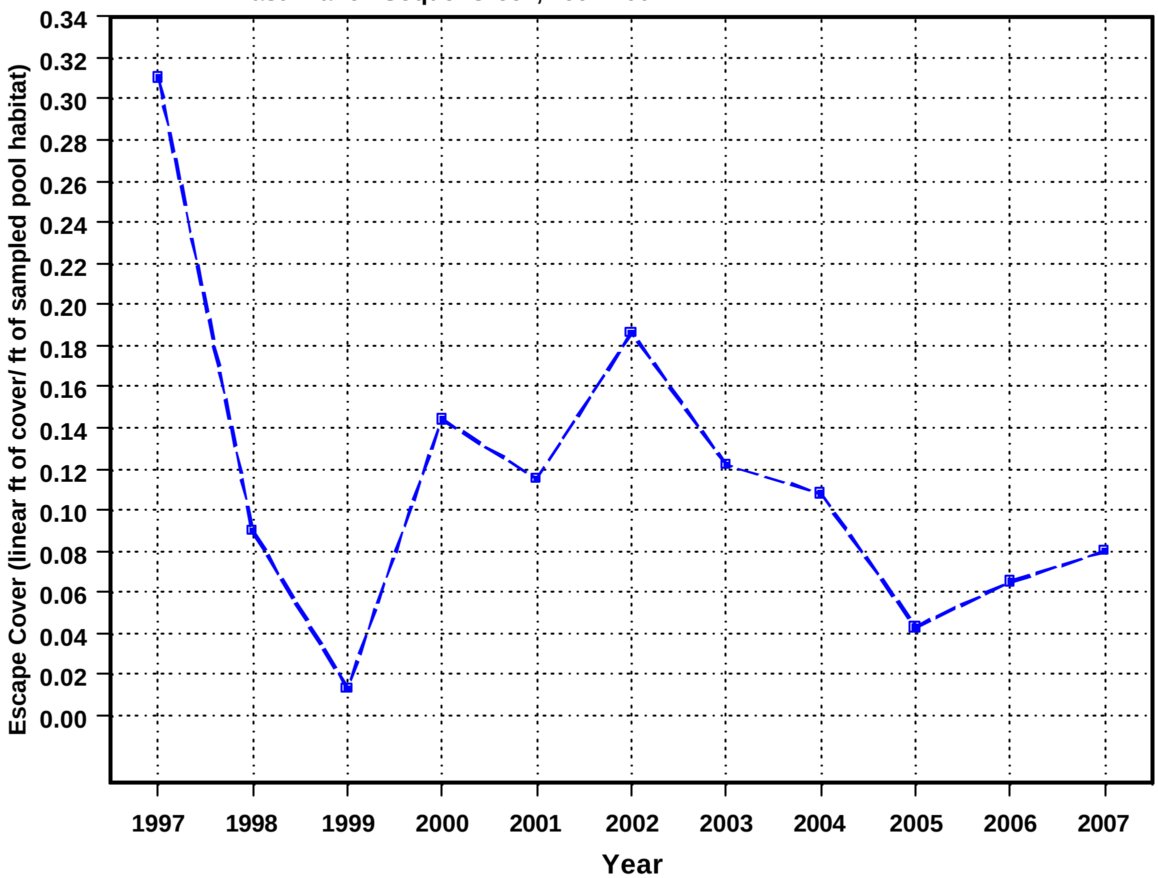


Figure 47. Averaged Percent Fines in Run and Step-Run Habitat in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 2000 and 2005-2007.

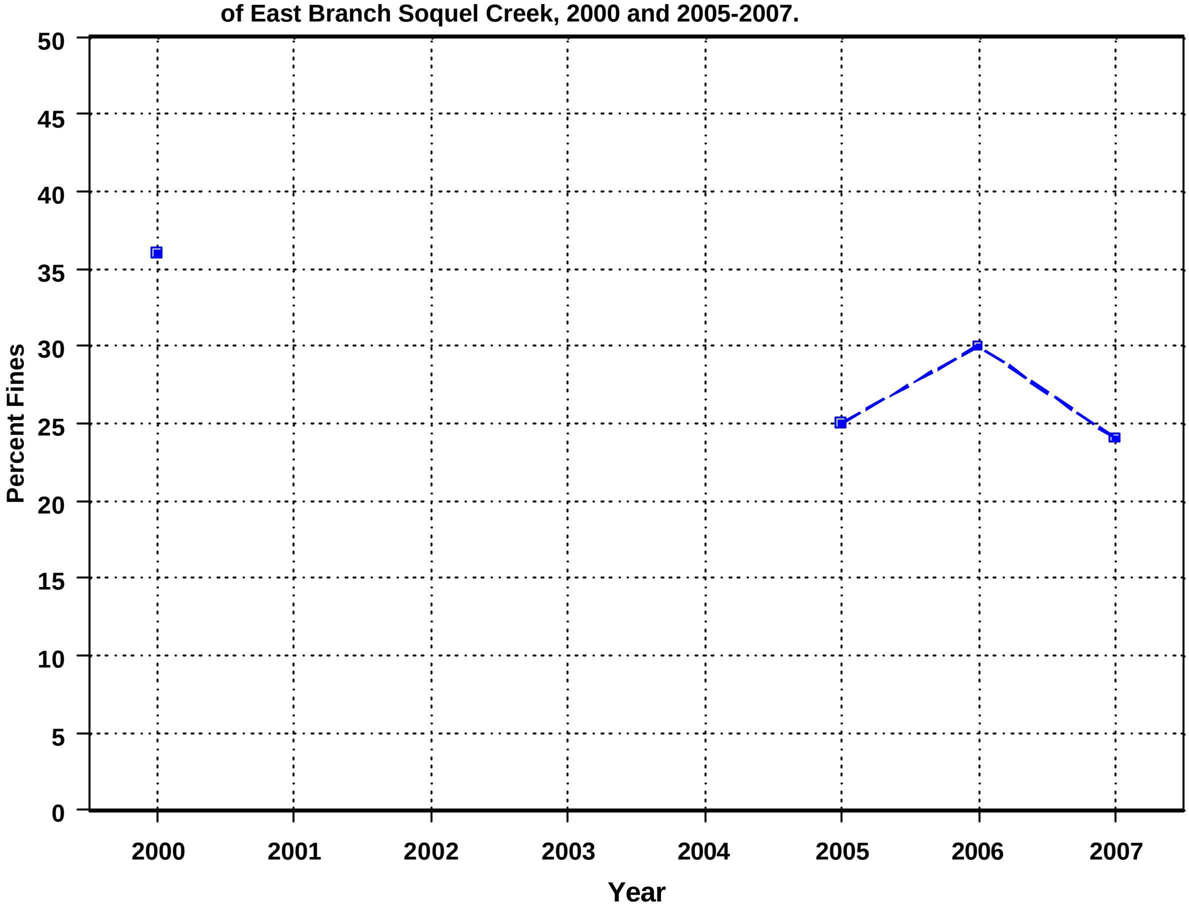
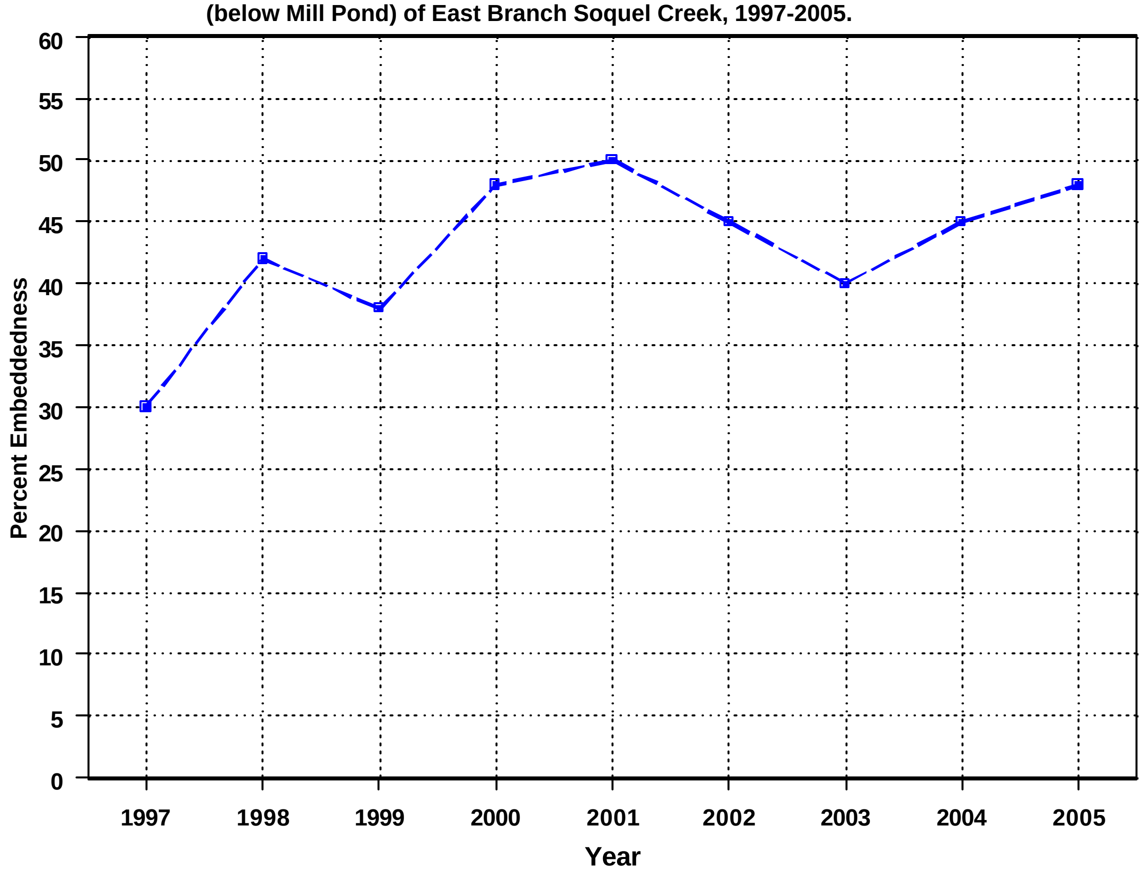


Figure 48. Average Embeddedness for Riffle and Run Habitat at the Sampling Site in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 1997-2005.



At Site 16, total and YOY densities increased in 1997–1999 (while they declined at Site 13a) (**Figures 20 and 22**). Then densities declined from 1999 to 2001, increased from 2001 to 2003, decreased in 2004, increased in 2005 and declined in both the wet year of 2006 and the dry year of 2007. Since 1999, YOY densities have not risen above 140 YOY per 100 ft. YOY densities may have been higher in 1997–1999 because data in those years came from sampling by SDSF personnel at a site consisting of mostly step-run habitat that is more heavily used by YOY compared to our data from 2000 onward in which a higher proportion of pools were sampled. Larger yearlings preferred pools.

The highest total and YOY densities at Site 16 occurred after moderate to wet winters (1998, 1999, 2000, 2003 and 2005) except for relatively high densities in drier winters of 1997 and 2002, which had larger storms early in the winter and smaller storms later (**Figures 26, 68 and 73**). The lowest total and YOY densities were in the drier years of 2001 and 2007, with a decline in 2004 between two wetter years. There may have been adult access issues in 2007. Reduced baseflow in these drier years likely increased YOY competition for food and escape cover between each other and with yearlings.

Figure 68. The 1997 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

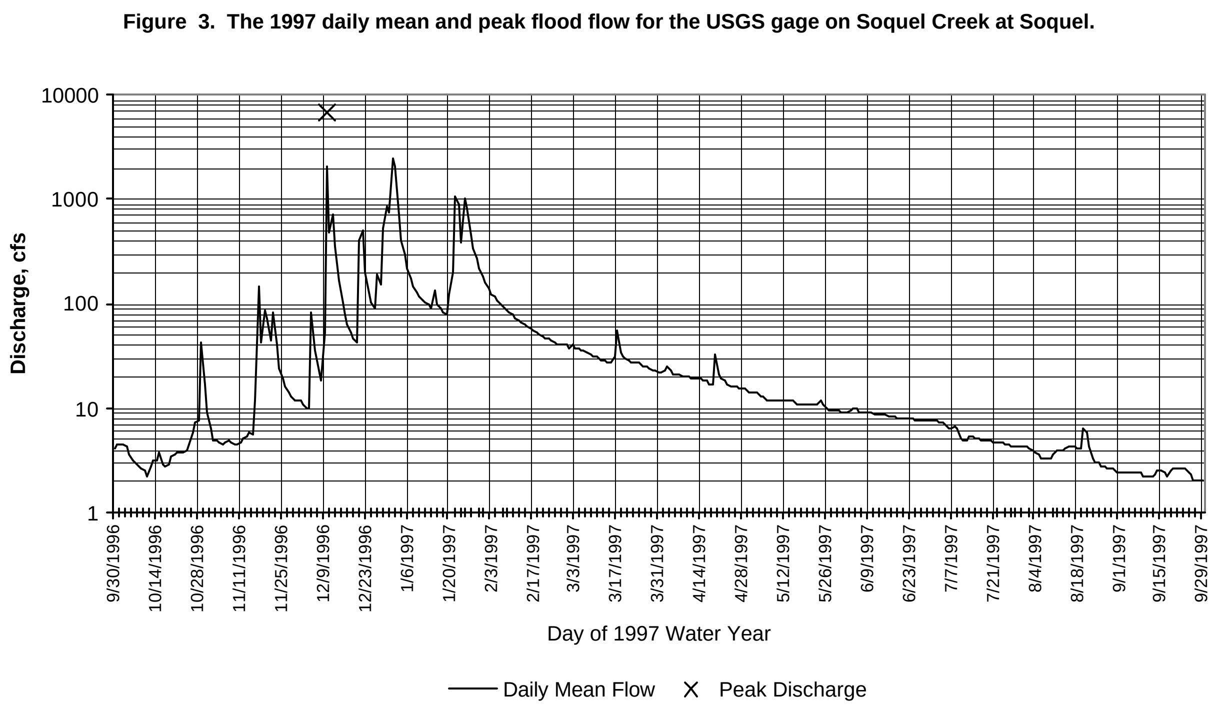
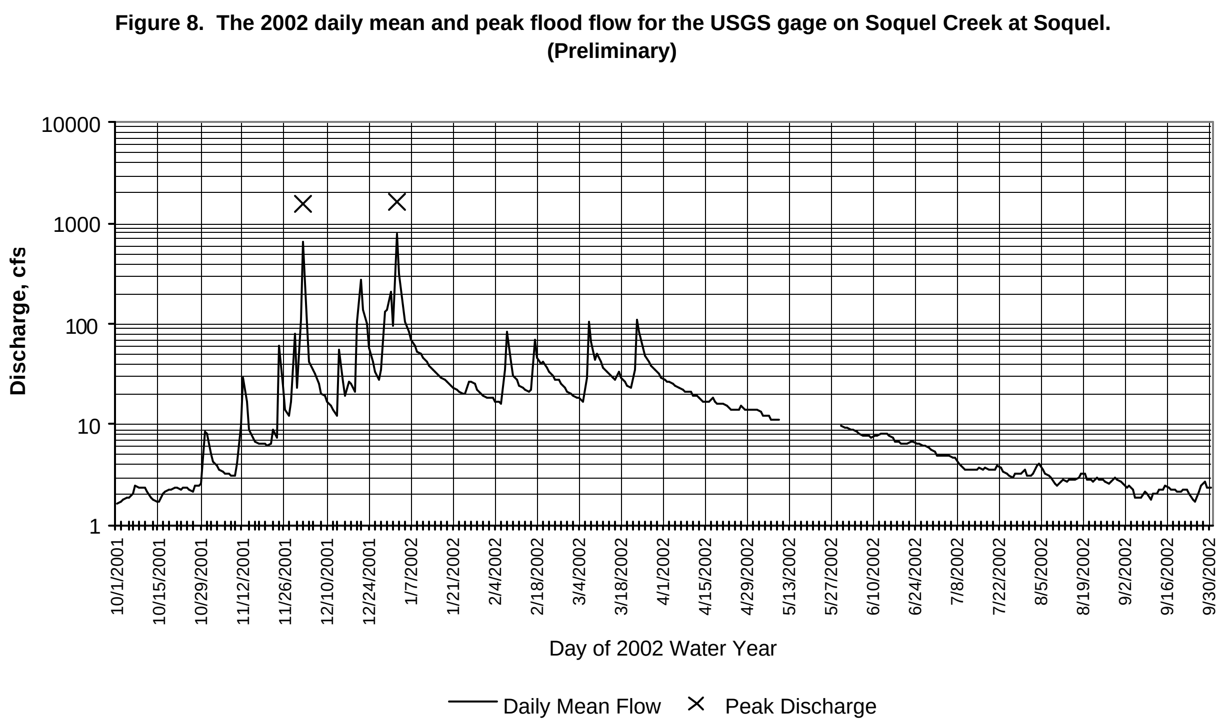


Figure 73. The 2002 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.



At Site 16, densities of Size Class II and III increased during 1997–1999, with a decline to less than one-fifth the 1999 density (15/ 100 ft) by 2004, with a plateau at 8 fish/ 100 ft for 2000–2002 (**Figure 24**). Then the density increased back to 9/ 100 ft in 2005–2006 and up to the highest density in 11 years (20/ 100 ft) in the dry year of 2007. The relatively high density of Size Class II and III juveniles was likely due to at least moderate numbers of YOY in 2006 and good over-winter survival of yearlings during a mild winter.

The three highest Size Class II and III densities did not correspond to any hydrologic category. They were 1998 (very wet year), 1999 (intermediate year) and 2007 (very dry year). Both the wet and moderately wet years had sufficient spring baseflows to grow some YOY into Size Class II. The dry year likely had very good over-winter survival of yearlings, although rearing conditions worsened. In addition, adult access may have been hampered in the dry 2006/2007 winter, resulting in lower YOY production and reduced competition for food.

At Site 16, annual densities of Size Class II and III juveniles were not correlated with changes in pool escape cover at sampling sites (**Figure 50b**). In fact, densities were the lowest in 2004 when pool escape cover at sampling sites was the highest. Densities increased from 2004 to 2007 despite a decline in pool escape cover at sampling sites. Insufficient years of data were available for reach-wide changes in pool depth and escape cover or in percent fines in run and step-run habitat for comparison to trends in juvenile densities (**Figures 49, 50a and 51**). Densities were not positively correlated with changes in these habitat parameters but, in fact, increased despite reach-wide decline in pool escape cover for 2005–2007. The density decline in 2000–2004 was correlated with relatively high percent embeddedness in riffles and step-runs at sampling sites except for the embeddedness improvement in 2003 (**Figure 52**). Densities increased in 2005 with reduced embeddedness.

The apparent disconnect between rearing habitat conditions and Size Class II and III densities at Site 16 indicated that rearing habitat quality within the observed range in the last 11 years was overshadowed by 1) poor over-winter survival of yearlings in years that were not wet enough to grow many YOY to Size Class II, 2) the potential for growth of some YOY to Size Class II in intermediate to wet years and 3) high over-winter survival of yearlings in dry years. If the incidence of large instream wood were to increase substantially, rearing habitat quality and improved over-winter survival in intermediate to wetter years may play more important roles in increasing Size Class II and III densities.

Figure 49. Averaged Maximum and Mean Pool Depth in Reach 12a (SDSF) of East Branch Soquel Creek, 2000 and 2005-2007.

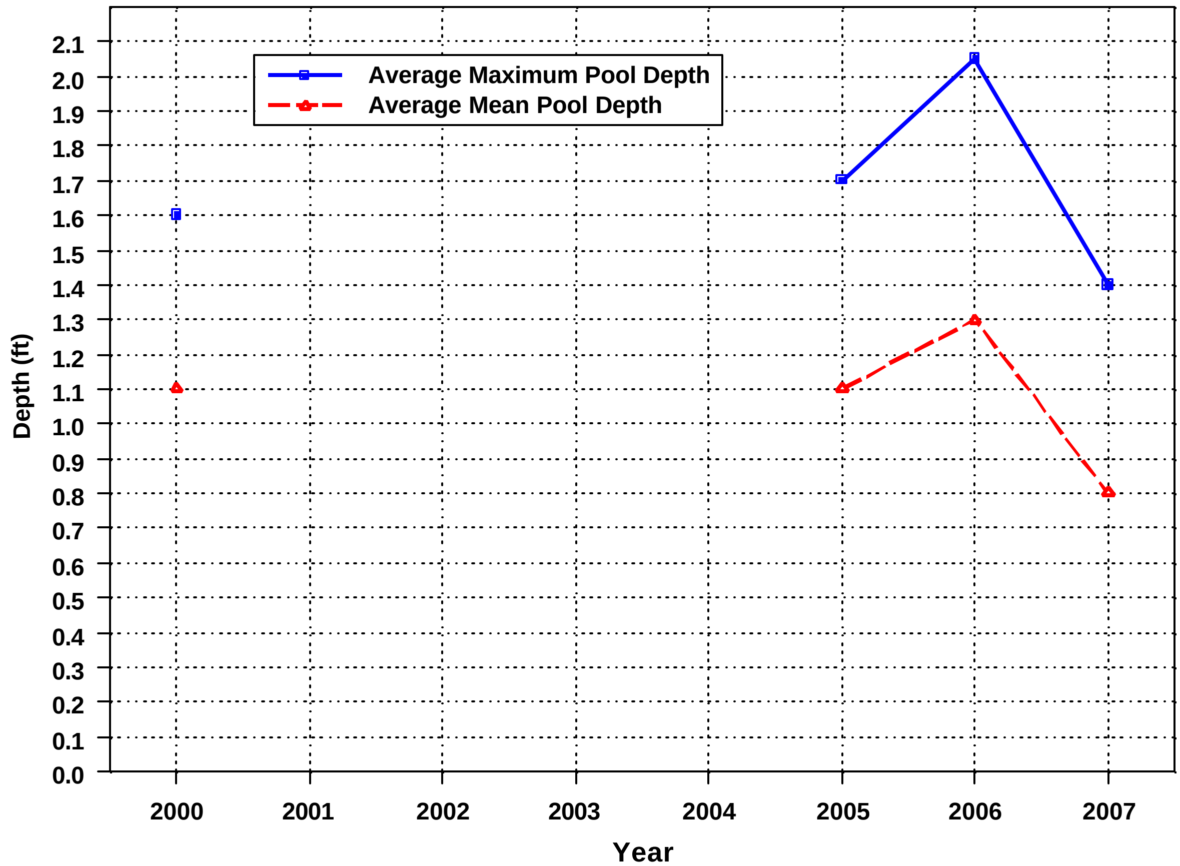


Figure 50a. Escape Cover Index for Pool Habitat in Reach 12a (SDSF) of East Branch Soquel Creek, 2000 and 2005-2007.

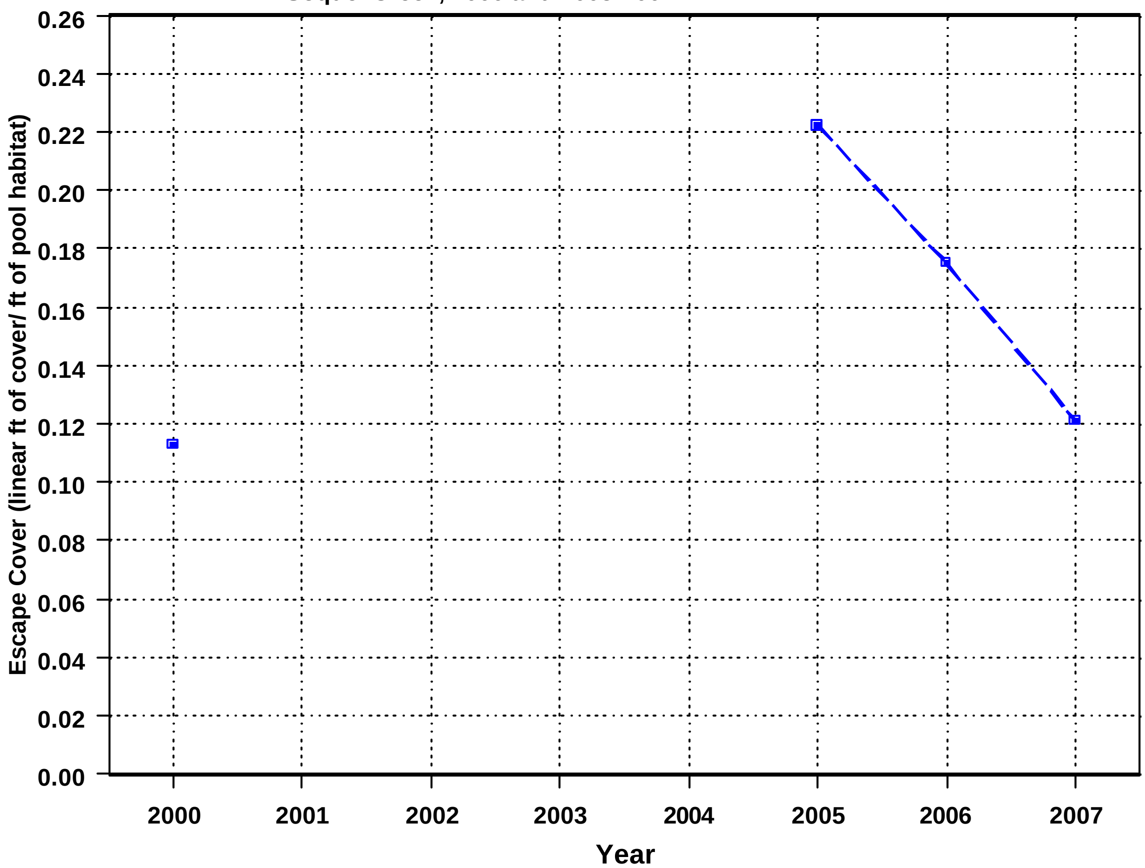


Figure 50b. Escape Cover Index for Pool Habitat at Site 16 (Reach 12a in SDSF) in East Branch Soquel Creek, 2000-2007.

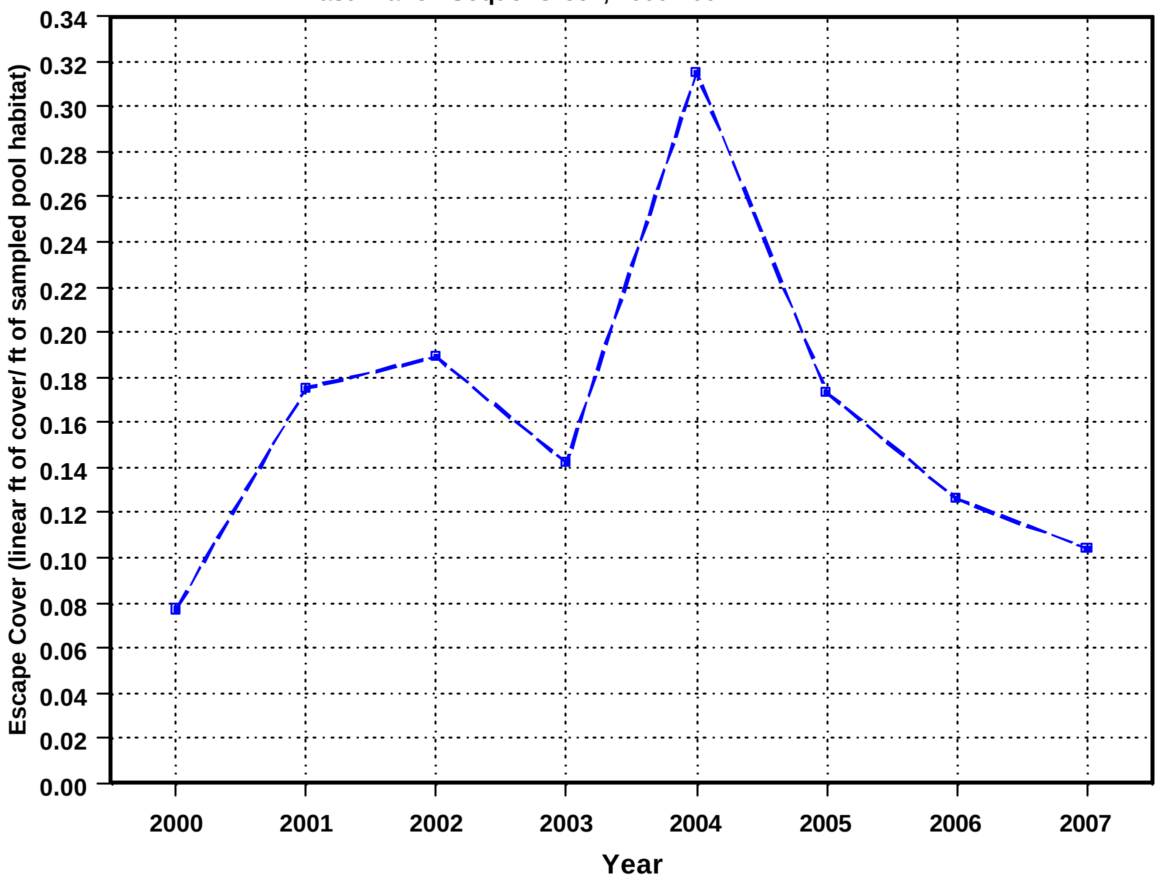


Figure 51. Averaged Percent Fines in Step-Run Habitat in Reach 12a (SDSF) of East Branch Soquel Creek, 2000 and 2005-2007.

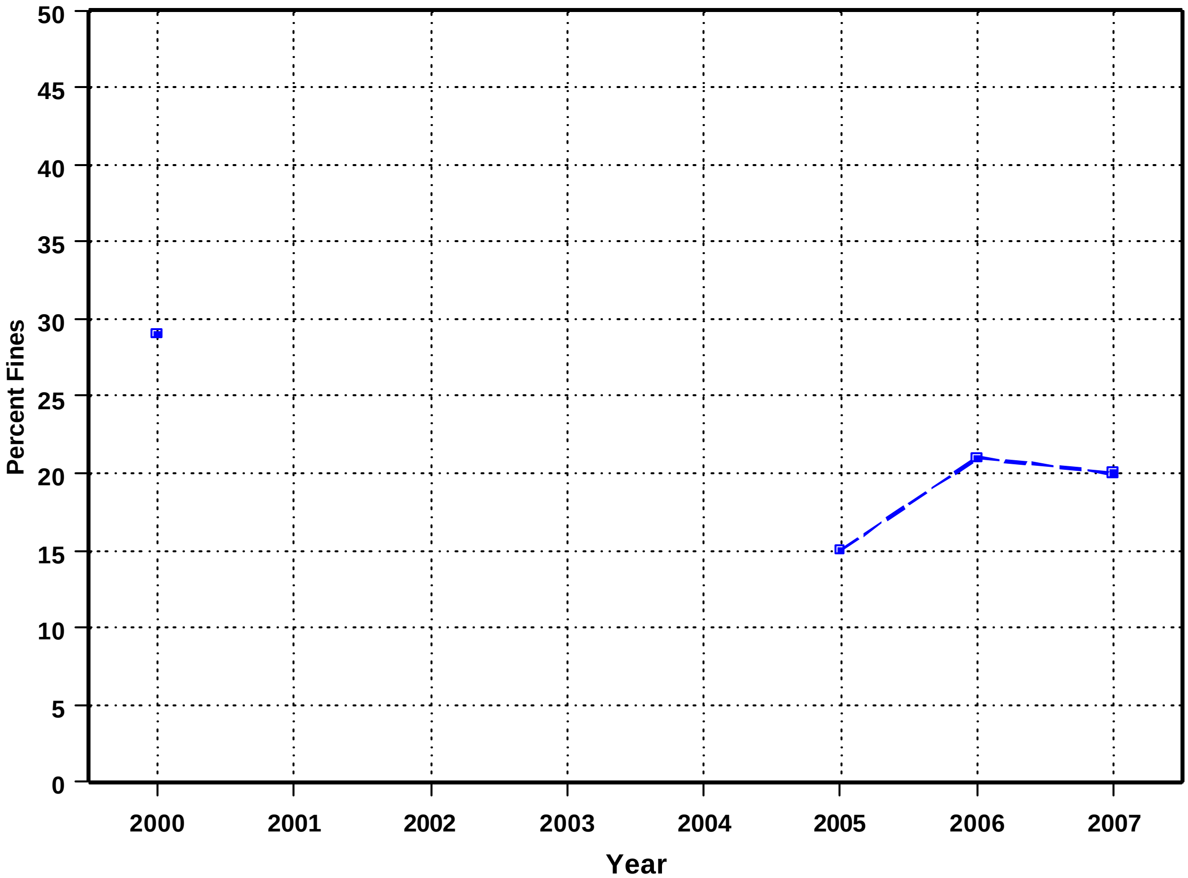
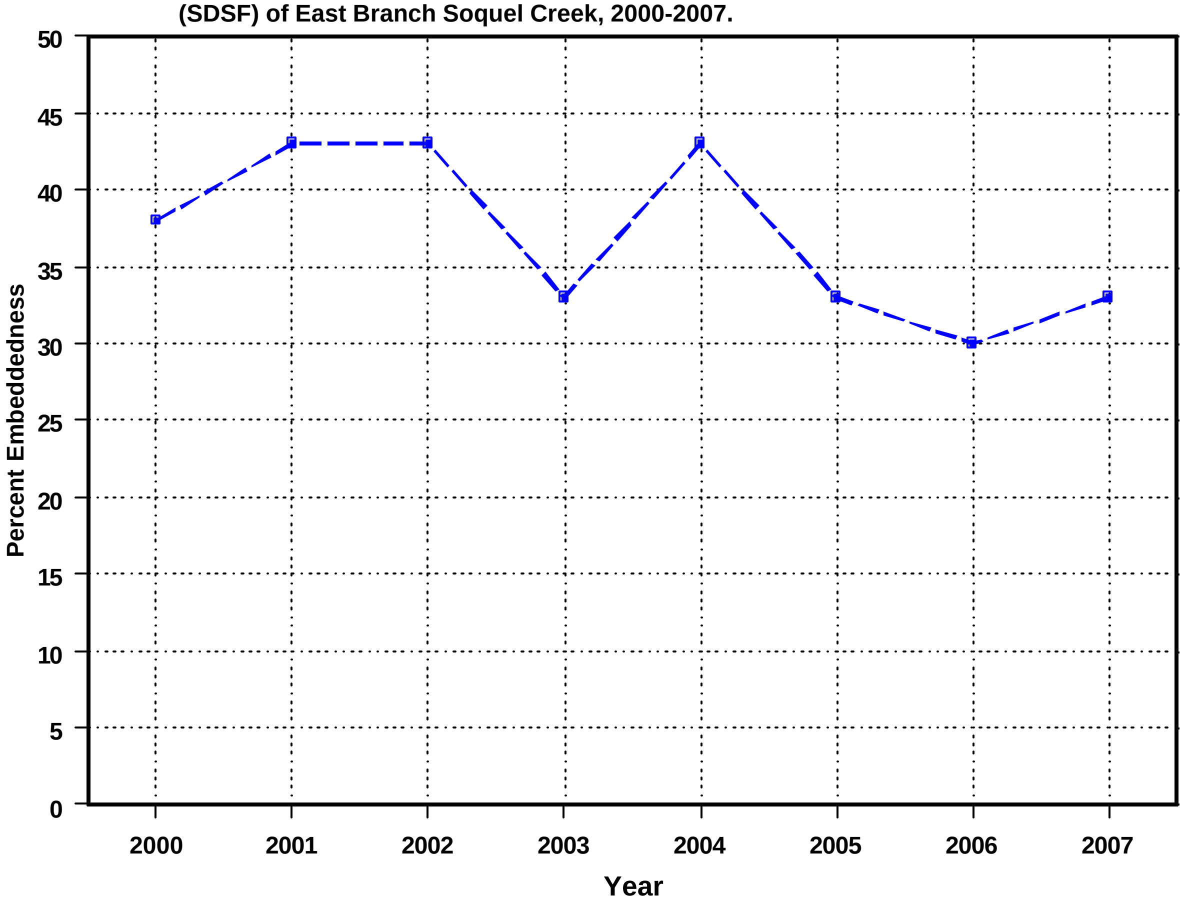


Figure 52. Average Embeddedness for Riffle and Step-run Habitat at the Sampling Site in Reach 12a (SDSF) of East Branch Soquel Creek, 2000-2007.



Trends in Habitat Quality in the Soquel Creek Mainstem

In the lower mainstem (downstream of the Moores Gulch confluence) habitat conditions in Reach 1 (between the lagoon and Soquel Avenue Bridge) were analyzed since 1997. Reach-wide pool depth did not fluctuate nearly as much as averaged mean monthly streamflow (May–September) (**Figures 26 and 39**). The exception was in 1999 when especially deep maximum pool depth, and, to a lesser degree, deeper mean pool depth, were substantially higher than in other years, despite its intermediate streamflow level. With the typically low baseflows in fall during habitat typing, streamflow will have only a limited effect on pool depth in Soquel Creek. Overall, averaged maximum pool depth increased as much as a foot during the 11-year period and ended up 0.4 ft deeper in 2007 than 1997. Averaged mean pool depth increased as much as 0.3 feet but was the same in 1997 and 2007. Reach-wide escape cover was highest in 1997 but dropped by two-thirds by 1999 and has remained near this low level since (**Figure 40a**). Trends in embeddedness in fastwater habitat at sampling sites since 1997 indicated a decided increase in 1999 followed by a general decline to the lowest level in 2007 (**Figure 41**). **Since 1997, rearing habitat quality has improved with increased average maximum pool depth in Reach 1 and has declined with regard to reduced escape cover. However, riffles conditions for aquatic insects and steelhead food supply have improved. During the instream wood survey in 2002, this reach was noted for its lack of large wood (Alley 2003).**

In the upper mainstem (upstream of the Moores Gulch confluence) habitat conditions in Reach 7 (between the Moores Gulch confluence and the Purling Brook ford) were analyzed since 1997. Changes in reach-wide pool depth somewhat paralleled changes in averaged mean monthly flow rate (May- September) until 2005 (**Figures 26 and 42**). In 2005, depths decreased despite increased streamflow, indicating pool filling with sediment. Data from the lower half of the reach in 2006 and 2007 indicated that that pool depth has not likely recovered, leading to an overall decline in pool depth since 1997. Reach-wide escape cover was highest in 1997, showed a substantial two-thirds decline by 1999 and a steady increase to 2007, although it was still ½ the 1997 level (**Figure 43a**). (Escape cover at sampling sites varied more than it did reach-wide, indicating the difficulty in finding pool habitat that fit average conditions for both depth and escape cover in this reach (**Figure 43b**).) Riffle and run embeddedness at sampling sites fluctuated annually since 1997 and was the same in 2007 as in 1997 (**Figure 44**). It did not fluctuate in an inverse way to averaged mean monthly streamflow (May-September), as might be expected if one assumed that higher winter flow would bring more erosion and sedimentation that would lead to increased embeddedness. However, streamflow in the late spring and summer does not necessarily correlate positively with the size of stormflows earlier in the winter. In addition, if the larger storms occur early in the winter, there is more time and lower flows after to transport sediment away than if larger storms occur later in the winter. We see the largest increase in embeddedness in 2001 when the largest storm came in early March (**Figure 72**). We see the largest decrease in embeddedness in 2002 when the largest storms came in November and early January (**Figure 73**). However, the decrease in 2005 came despite the largest storm in April. It is alarming that riffle and run embeddedness increased in 2007 without large stormflows to create erosion and sedimentation. **In summary, overall rearing habitat quality declined in Reach 7 since 1997 because of pool filling with sediment and less escape cover. During the instream wood survey in 2002, this reach was noted for its lack of large wood (Alley 2004).**

Figure 72. The 2001 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

Figure 7. The 2001 daily mean and peak flood flow for the USGS gage on Soquel Creek at Soquel. (Preliminary, subject to change)

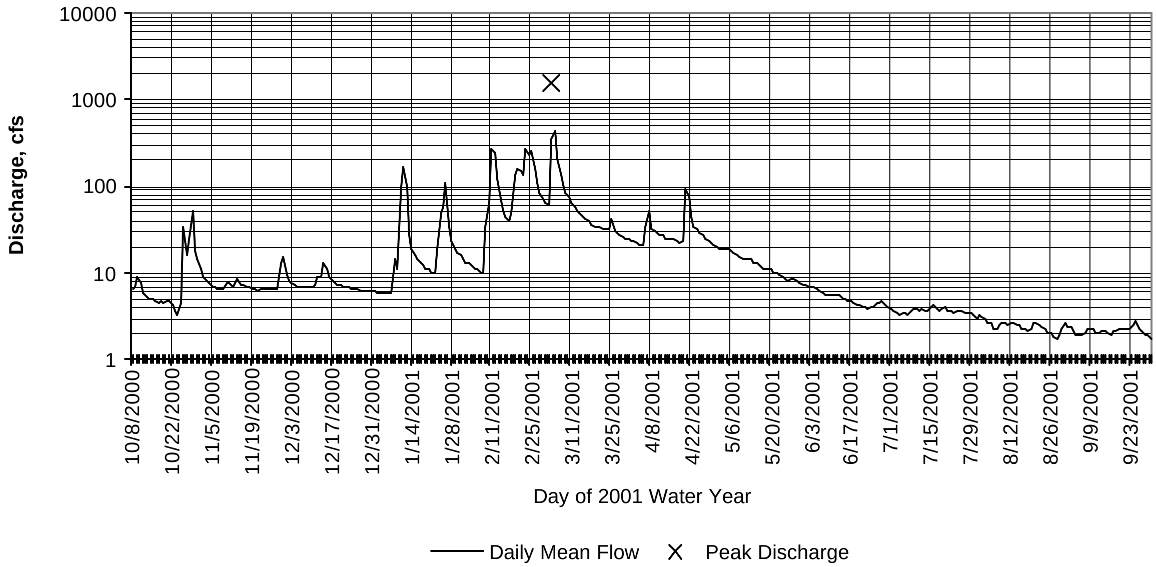
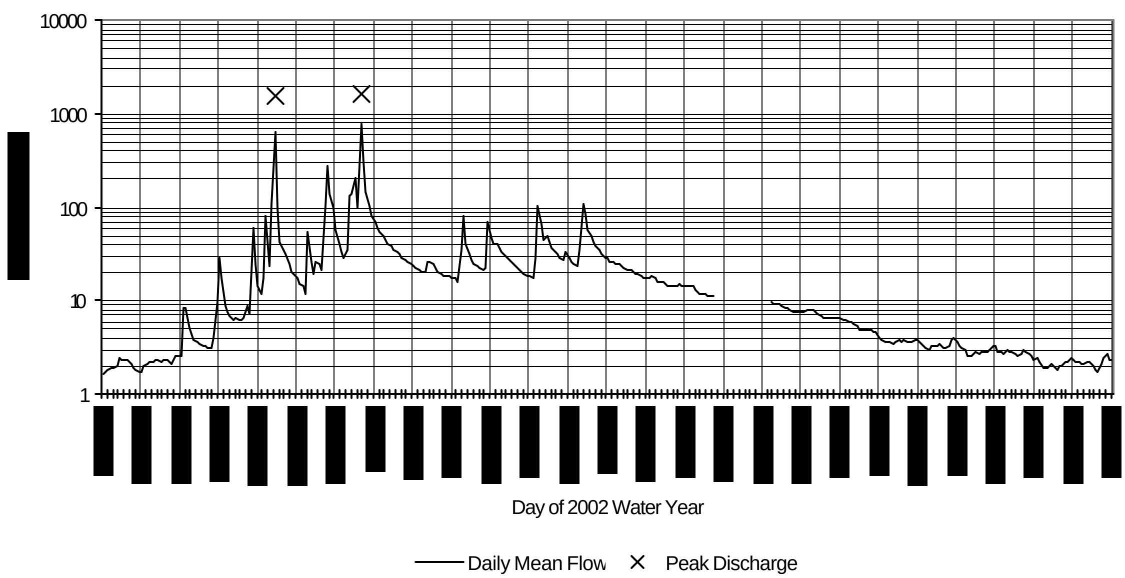


Figure 73. The 2002 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

Figure 8. The 2002 daily mean and peak flood flow for the USGS gage on Soquel Creek at Soquel. (Preliminary)



Trends in Habitat Conditions in East Branch Soquel Creek

In the lower East Branch (above the West Branch confluence) habitat conditions in Reach 9a (between West Branch confluence and Mill Pond) were analyzed primarily since 2000. Some habitat conditions at sampling sites were graphed since 1997. Reach-wide pool depth increased in 2006, consistent with higher averaged mean monthly streamflow (May–September) and decreased in 2007, consistent with lower baseflow (**Figure 45**). Averaged maximum and mean pool depth was 0.1 ft shallower in 2007 than 2000. However, baseflow likely had only a minor effect on pool depth in a reach that typically has low fall baseflow when habitat typing is done. Reach-wide pool depths in 2007 were slightly less than in 2000. We see that pool escape cover has been low since 2000 and has not declined much. Reach-wide pool escape cover had declined somewhat in 2005 compared to 2000, continued to decline slightly in 2006 and increased slightly in 2007 to somewhat less than in 2000 (**Figure 46a**).

Since the same pools were sampled for steelhead in 1997–1999 and for 2000–2004, and sampled pools in 2000 were chosen to represent average habitat conditions for depth and escape cover for the reach in 2000, then graphing of pool escape cover at sampled pools since 1997 may reflect general trends in escape cover. Based on sampled pool escape cover, we see a significant drop in escape cover from 1997 to 1998 and 1999, consistent with data collected in Reaches 1 and 7 (**Figures 40b, 43b and 46b**). Then it increased to 2002 at Site 13a, decreased steadily in 2003–2005 and increased slightly in 2006 and 2007 to one-fourth the 1997 level. The slight increase from 2005 to 2007 is consistent with reach-wide measurements in Reach 9a and results in downstream Reaches 1 and 7 (**Figures 40a, 43a, and 46a**). The pool escape cover was slightly less in sampled pools in 2007 than 2000, as was the case reach-wide. Percent fines in runs and step-runs increased slightly in 2006 and declined slightly in 2007 (**Figure 47**). The 2007 difference from 2000 was considered a real decrease, since differences of more than 10% are considered real. A more complete data record of embeddedness in riffle and run habitat at sampling sites indicated an overall, real increase from 1997 to 2007 (**Figure 48**). Little change in reach-wide pool depth or pool escape cover was detected between 2000 and 2007 (slight decreases), although habitat degradation was indicated with increased embeddedness and percent fines in fastwater habitat. **Thus, data indicate that overall rearing habitat quality has declined in Reach 9a primarily with regard to fastwater habitat important to YOY juveniles and aquatic insects. Other factors related to the turbidity and thin silt layer on the substrate observed at the sampling site in 2006 and 2007 may also indicate lower habitat quality. During the instream wood inventory in 2002, this reach was identified as one with small quantities of large instream wood (Alley 2003).**

In the Upper East Branch (above the stream gaging station) habitat conditions in Reach 12a (between Amaya Creek confluence to the gradient increase and the beginning of bedrock pools) were analyzed primarily since 2000. As in Reach 9a, reach-wide pool depth in Reach 12a increased in 2006, consistent with higher averaged mean monthly streamflow (May–September) and decreased in 2007, consistent with lower baseflow (**Figures 26 and 49**). Level of baseflow may have affected reach-wide measure of pool depth because former step-run habitat during higher baseflow conditions may have become shallow pool habitat in 2007 with only a trickle of streamflow. Reach-wide pool depths in 2007 were less than in 2000 but may have been due more to conversion of step-run habitat to pool habitat in a very dry year than to pools filling with sediment. Reach-wide escape cover increased from 2000 to 2005 and has decreased in 2006 and 2007 to near 2000 levels **(Figure 50a**). Since sampled pools in 2000 were chosen to represent average habitat conditions for depth and escape cover for the reach in 2000 and were sampled repeatedly for fish for 5 years, graphing of pool escape cover at the same sampled pools for 2000–2004 may reflect general trends in escape cover for the reach. These results from sampled pools indicated that pool escape cover increased from 2000 to 2002, declined in 2003 and increased to an 8-year high in 2004 (**Figure 50b**). Then it declined reach-wide during the last 2 years down to slightly more than the 2000 level. Reach-wide percent fines in important step-run habitat declined less than 10% since 2000, not indicating a real change (**Figure 51**). Embeddedness in riffle and step-run habitat at sampling sites has fluctuated since 2000, decreasing an overall 5% between 2006 and 2007 (**Figure 52**). This is less than 10% and did not indicate real change. Real declines were detected in 2003 and 2005, with a real increase in 2004. The 2002 to 2004 embeddedness fluctuations at Site 16 were consistent with fluctuations at Site 13a, though fastwater embeddedness has been consistently less at Site 16 than Site 13a since 2000. **In summary, although improvement in pool rearing habitat in Reach 12a was detected in some years (greater pool depth in 2006 and greater pool escape cover in 2004), data indicate that habitat quality in 2007 was similar to conditions in 2000. Increased incidence of large instream wood would substantially improve rearing habitat in this reach with limited pool development, shallow pools and very limited escape cover in most years.**

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. 1995a. 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.

REFERENCES AND COMMUNICATIONS (continued)

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.

REFERENCES AND COMMUNICATIONS (continued)

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

Alley, D.W. 2007a. 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. 2007b. 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.

Berry, Christopher. 2008. City of Santa Cruz Water Department staff member.

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.

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.

REFERENCES AND COMMUNICATIONS (continued)

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.

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, 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.

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

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

FIGURES

Figure 1. Total Juvenile Steelhead Site Densities in the San Lorenzo River in 2007 Compared to the 9-Year Average Density. (7th year for Mainstem (1), 6th year for Mainstem (2a), 2nd year for Lompico (13e) and 1st Year for Branciforte (21a-1)).

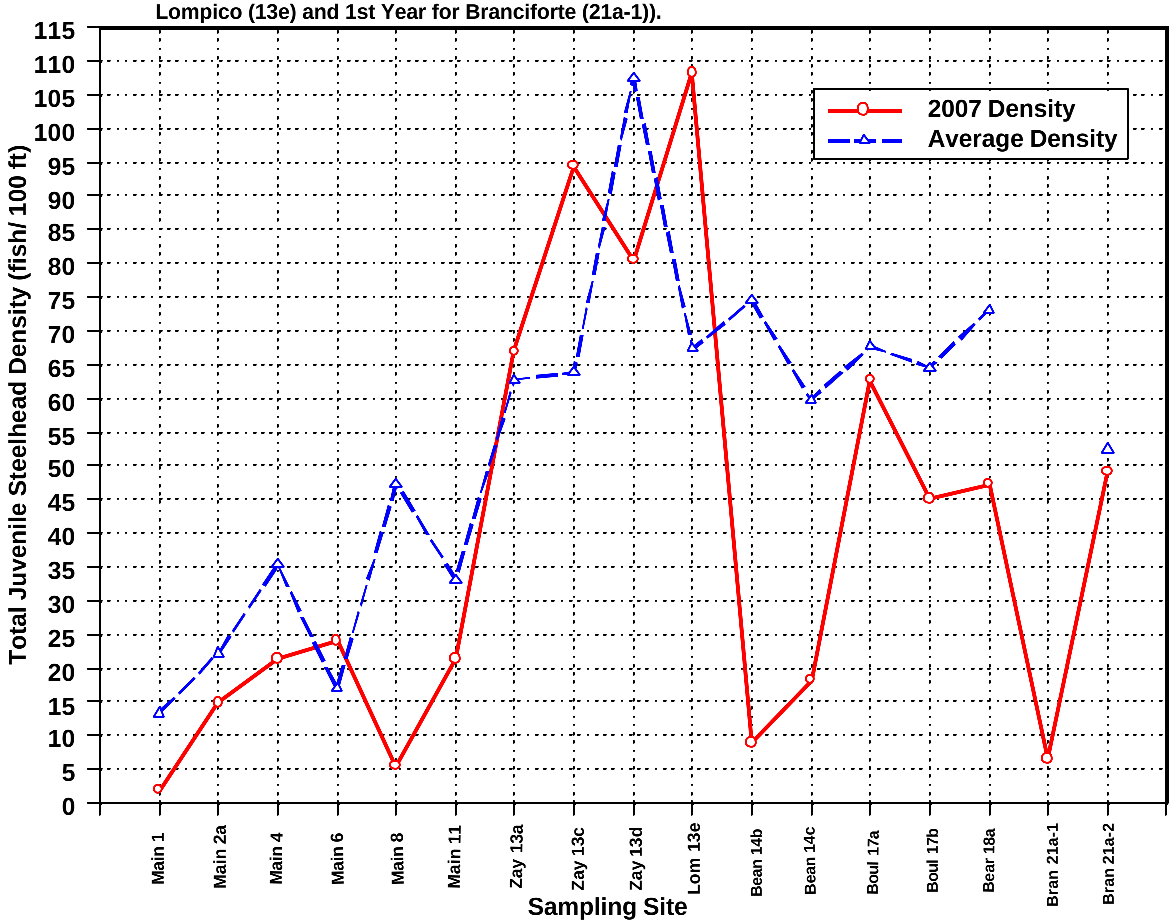


Figure 2. Juvenile Steelhead Site Densities for Young-of-the-Year in the San Lorenzo River in 2007 Compared to the 9-Year Average. (7the year for Mainstem (1), 6th year for Mainstem (2a), 2nd year for Lompico (13e) and 1st Year for Branciforte (21a-1).

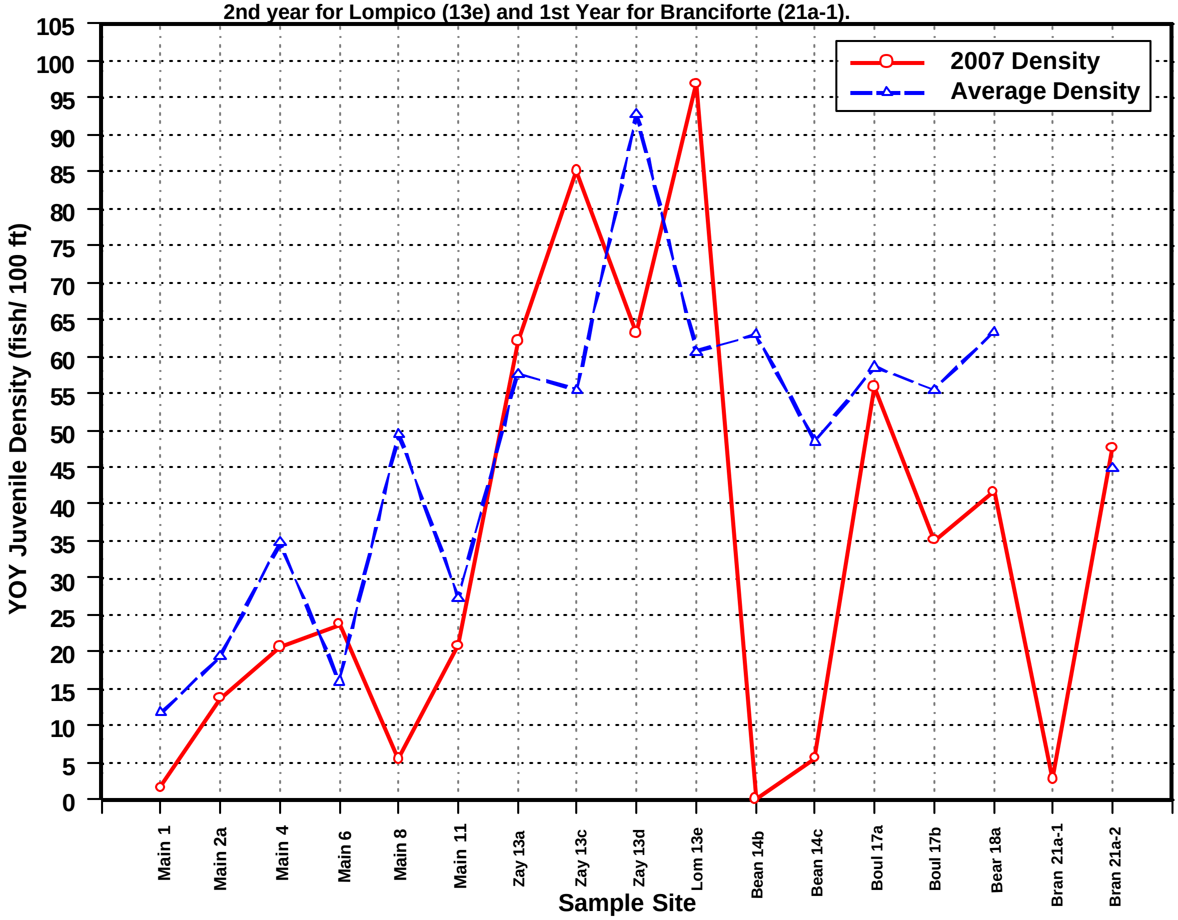


Figure 3. Juvenile Steelhead Site Densities for Size Classes II and III in the San Lorenzo River in 2007 Compared to the 9-Year Average. (7th year for Mainstem (1), 6th year for Mainstem (2a), 2nd Year for Lompico (13e) and 1st Year for Branciforte (21a-1).

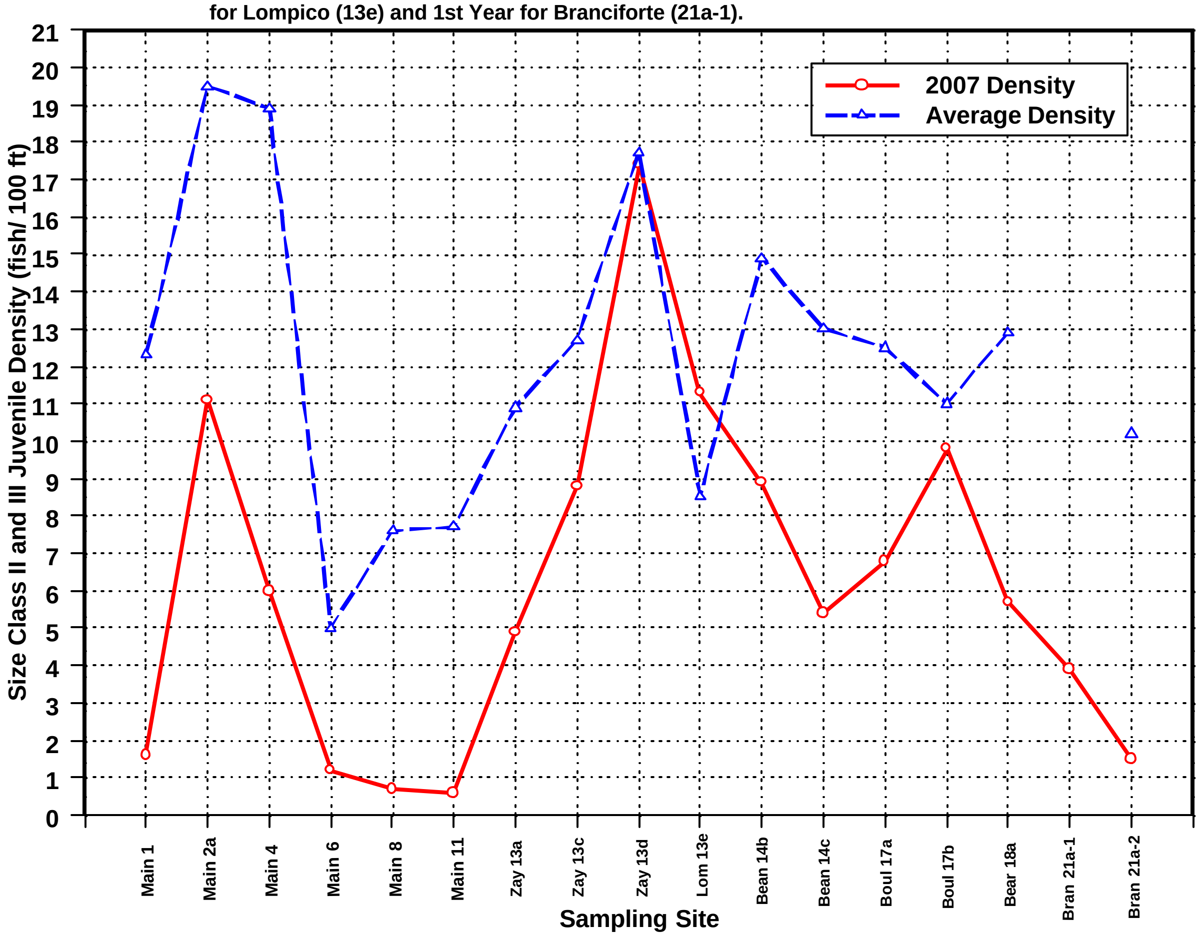


Figure 4. Total Juvenile Steelhead Site Densities in Soquel Creek in 2007 Compared to the 11-Year Average. (7th year West Branch (19), 6th year West Branch (21)).

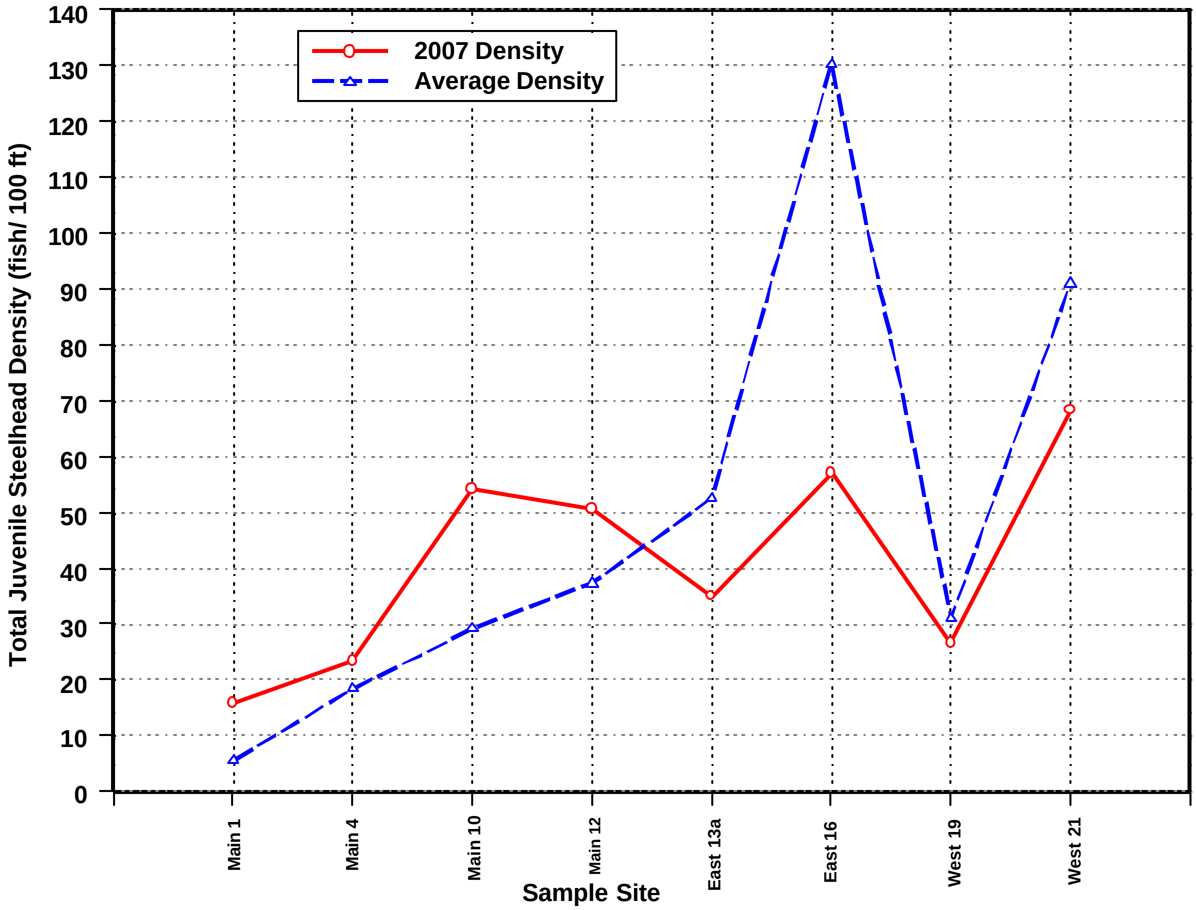


Figure 5. Juvenile Steelhead Site Densities for Young-of-the-Year in Soquel Creek in 2007 Compared to the 11-Year Average (7th Year West Branch (19), 6th Year West Branch (21)).

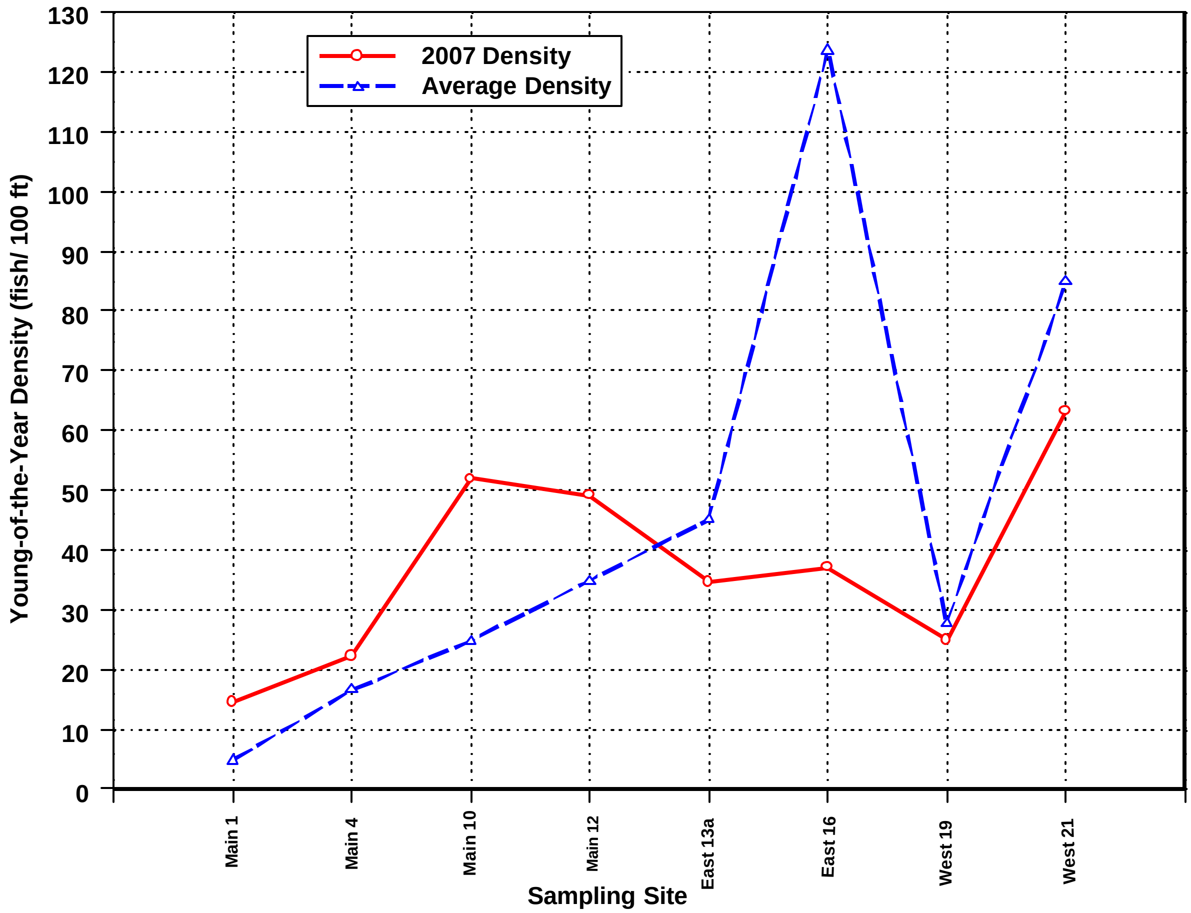


Figure 6. Juvenile Steelhead Site Densities for Size Classes II and III in Soquel Creek in 2007 Compared to the 11-Year Average Density (7th Year West Branch (19), 6th Year West Branch (21)).

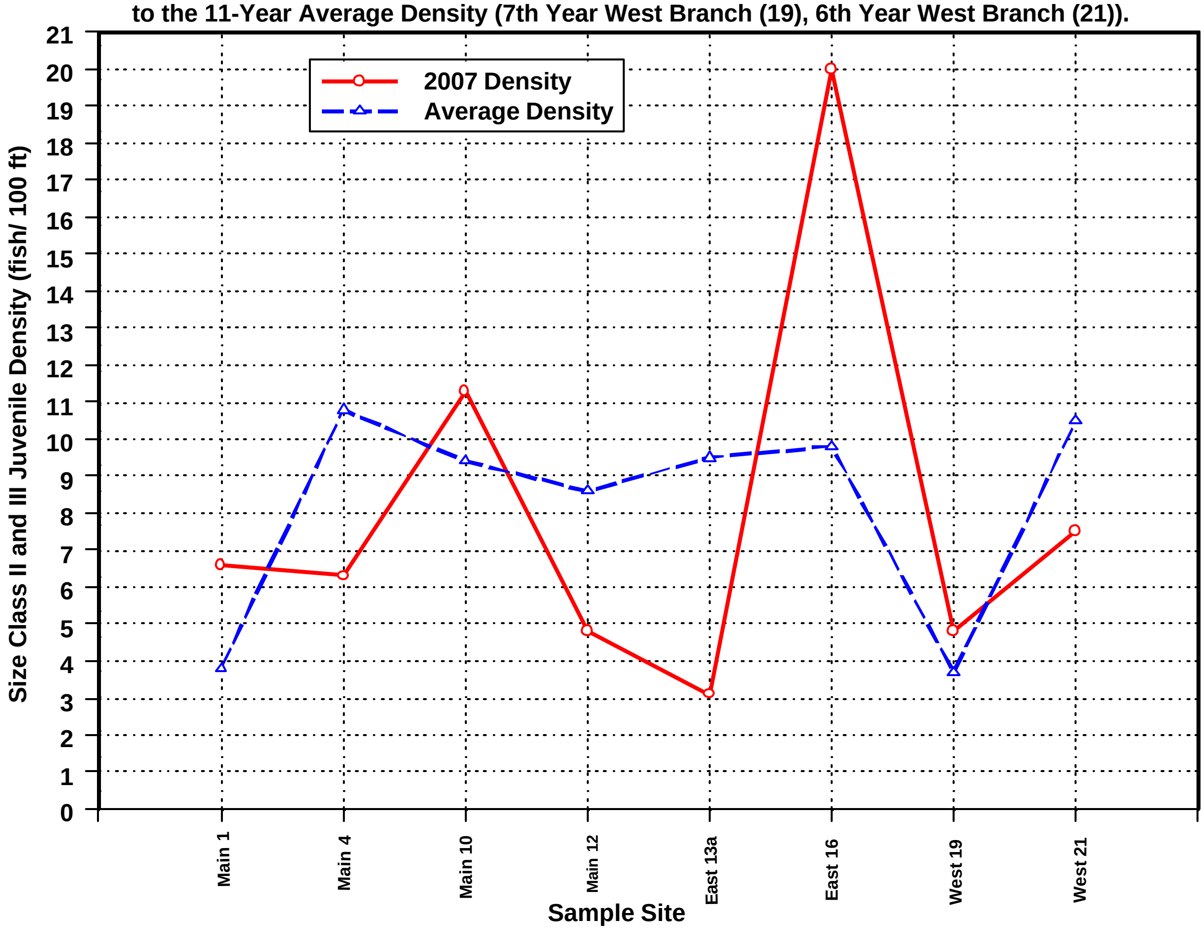


Figure 7. Total Juvenile Steelhead Site Densities in Aptos and Valencia Creeks in 2006, 2007 and 3-Year Average, Including 1981.

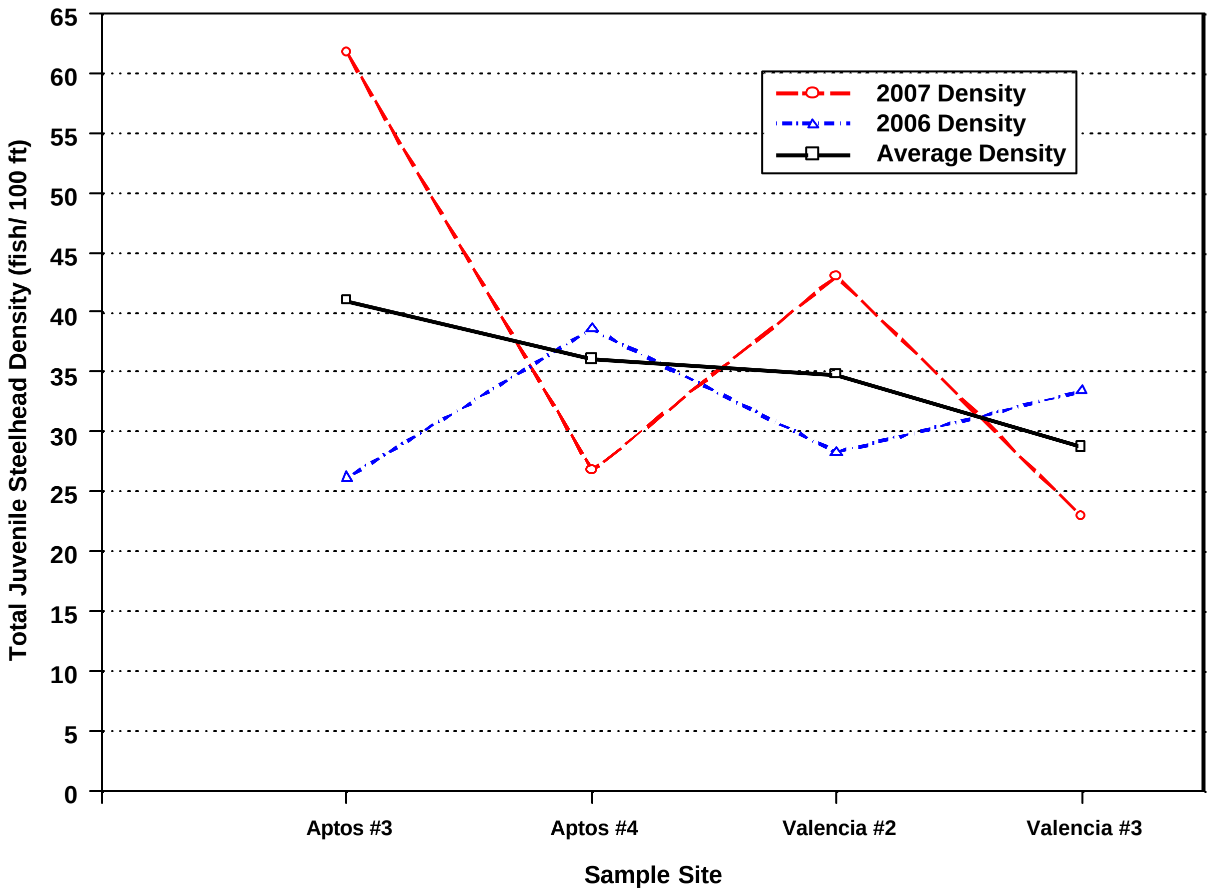


Figure 8. Juvenile Steelhead Site Densities for Young-of-the-Year in Aptos and Valencia Creeks in 2006, 2007 and the Average, Including 1981.

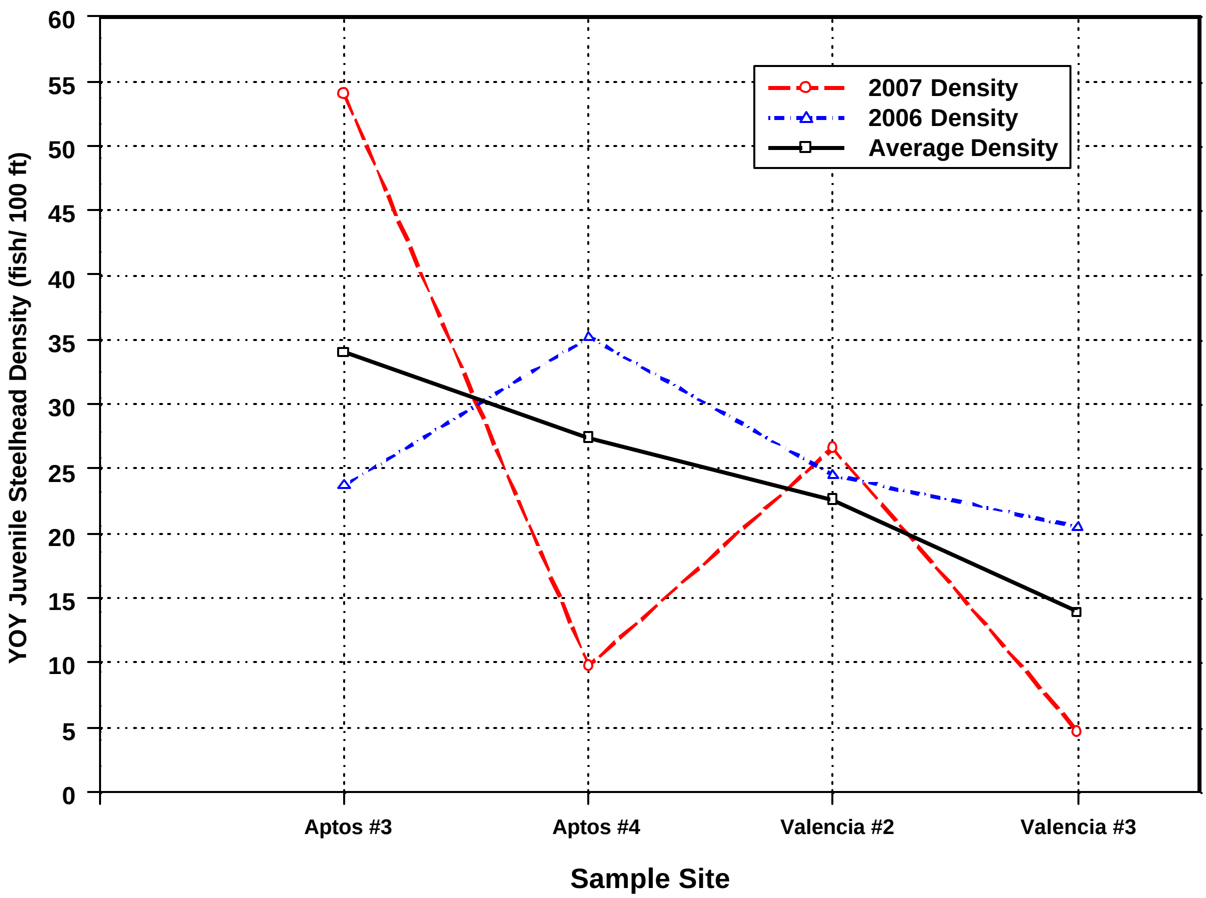


Figure 9. Juvenile Steelhead Densities for Size Classes II and III in Aptos and Valencia Creeks in 2006, 2007 and the Average, Including 1981.

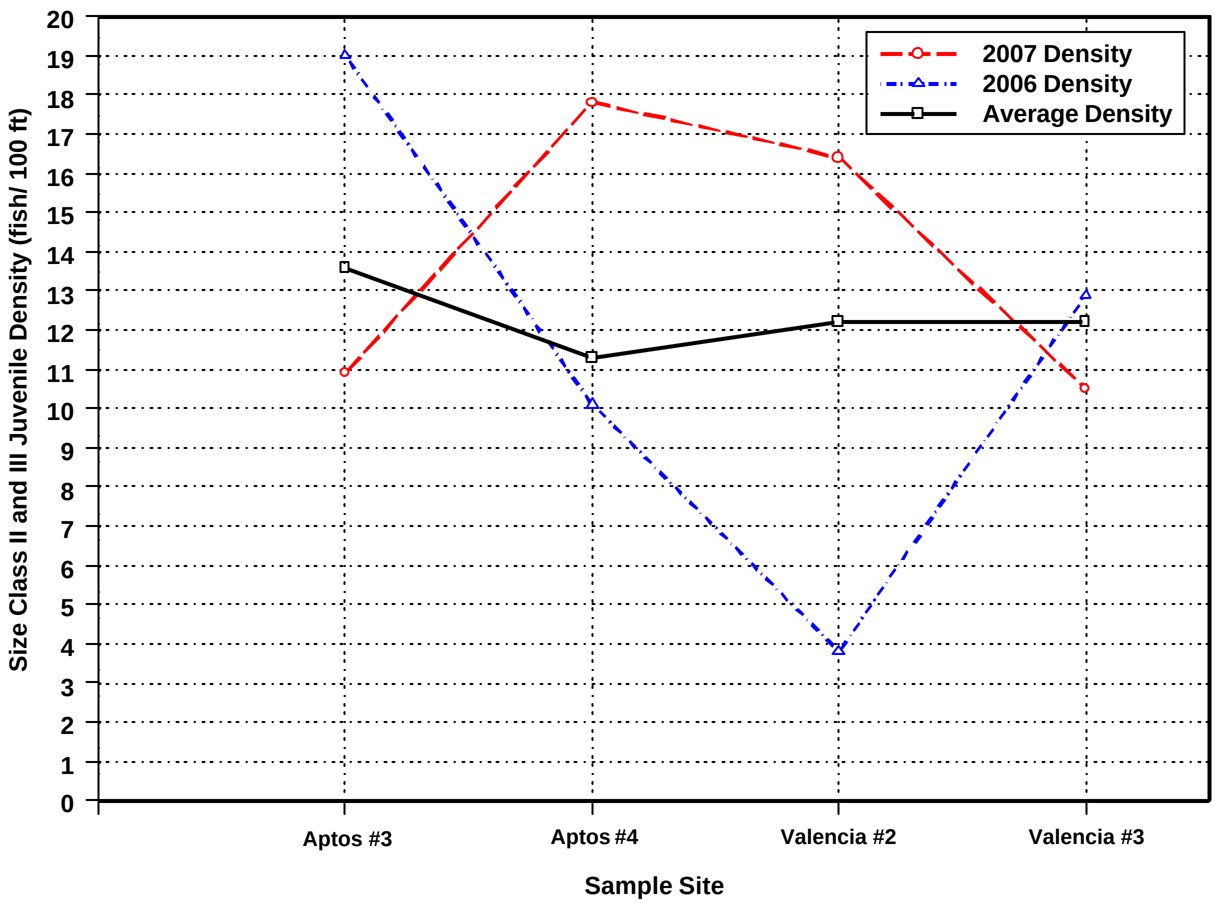


Figure 10. Total Juvenile Steelhead Site Densities in Corralitos, Shingle Mill and Browns Valley Creeks in 2006, 2007 and the Average, Including 1981 and 1994.

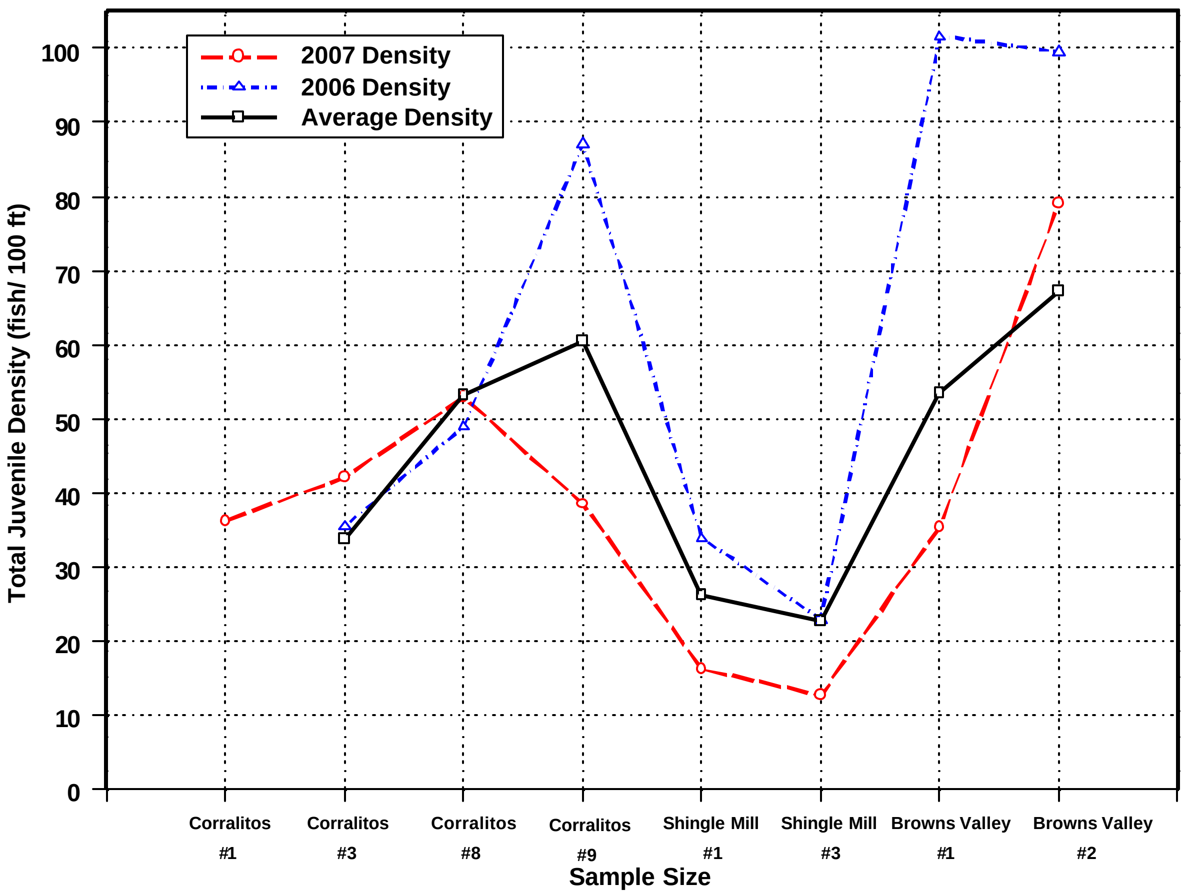


Figure 11. Juvenile Steelhead Densities for Young-of-the-Year in Corralitos, Shingle Mill and Browns Valley Creeks in 2006, 2007 and the Average, Including 1981 and 1994.

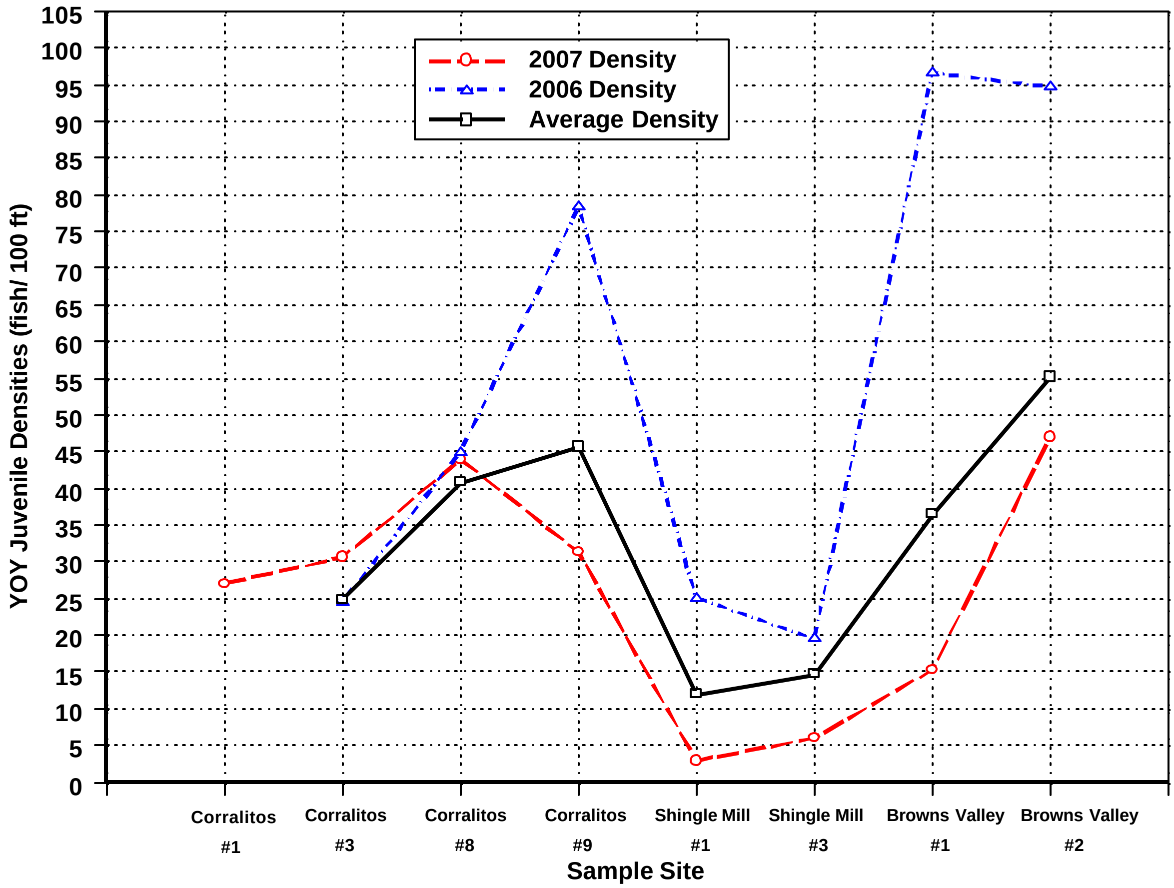


Figure 12. Juvenile Steelhead Densities for Size Classes II and III in Corralitos, Shingle Mill and Browns Valley Creeks in 2006, 2007 and the Average, Including 1981 and 1994.

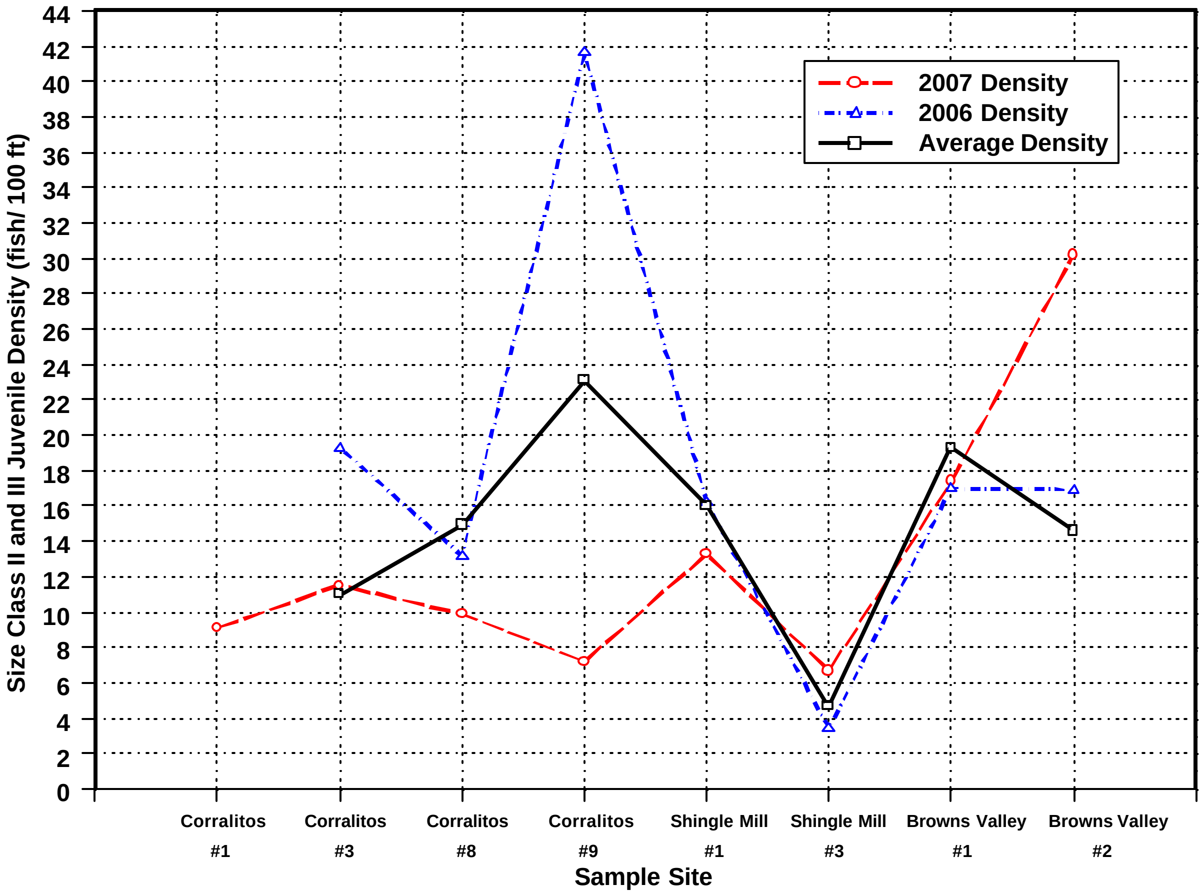


Figure 13. Plot of Annual Total Juvenile Densities at San Lorenzo Mainstem Sites, 1997-2007.

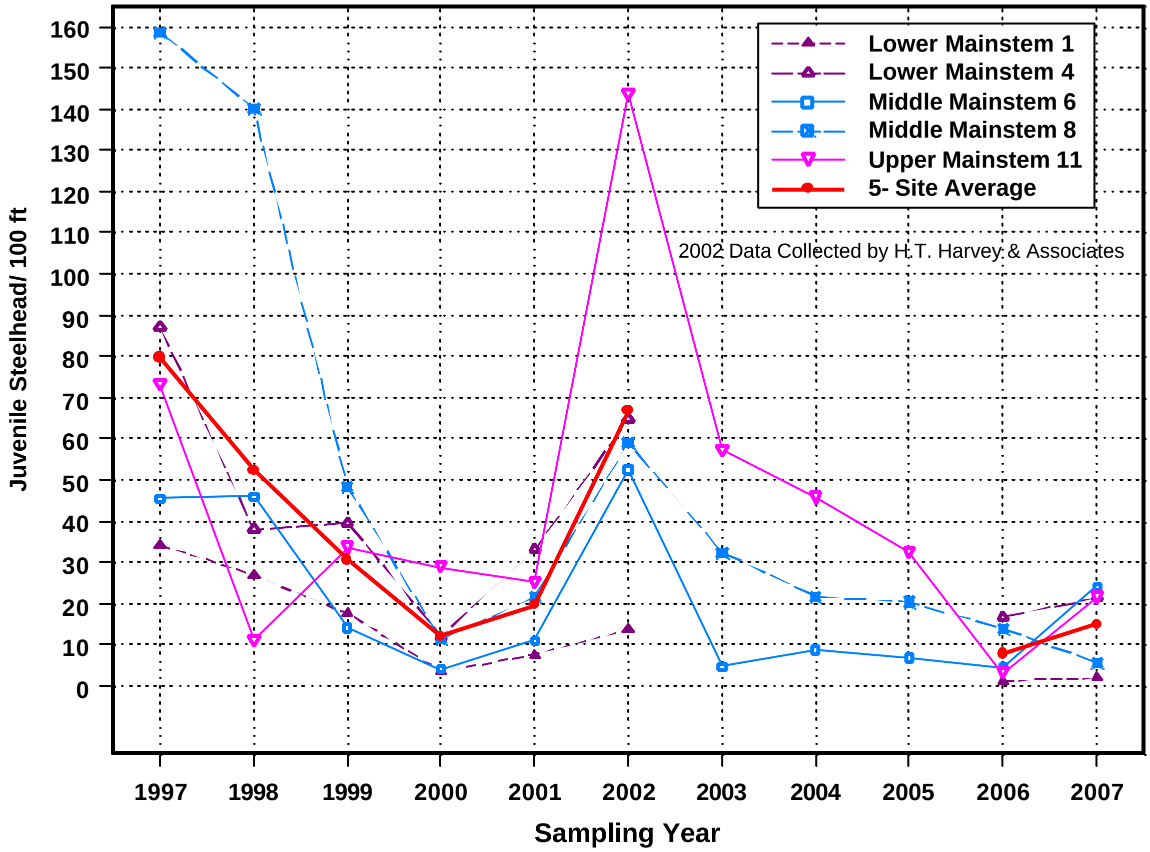


Figure 14. Plot of Annual Total Juvenile Densities at San Lorenzo Tributary Sites, 1997-2007.

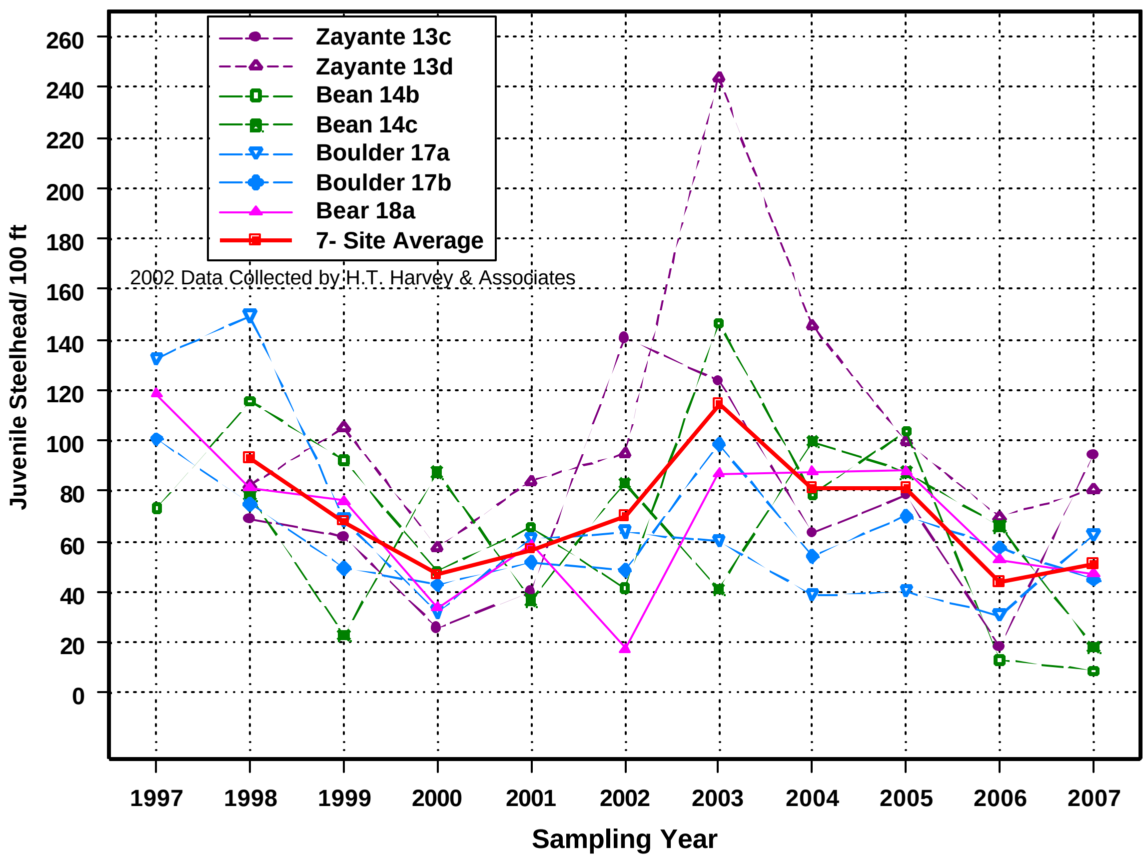


Figure 15. Plot of Annual YOY Juvenile Densities at San Lorenzo Mainstem Sites, 1997-2007.

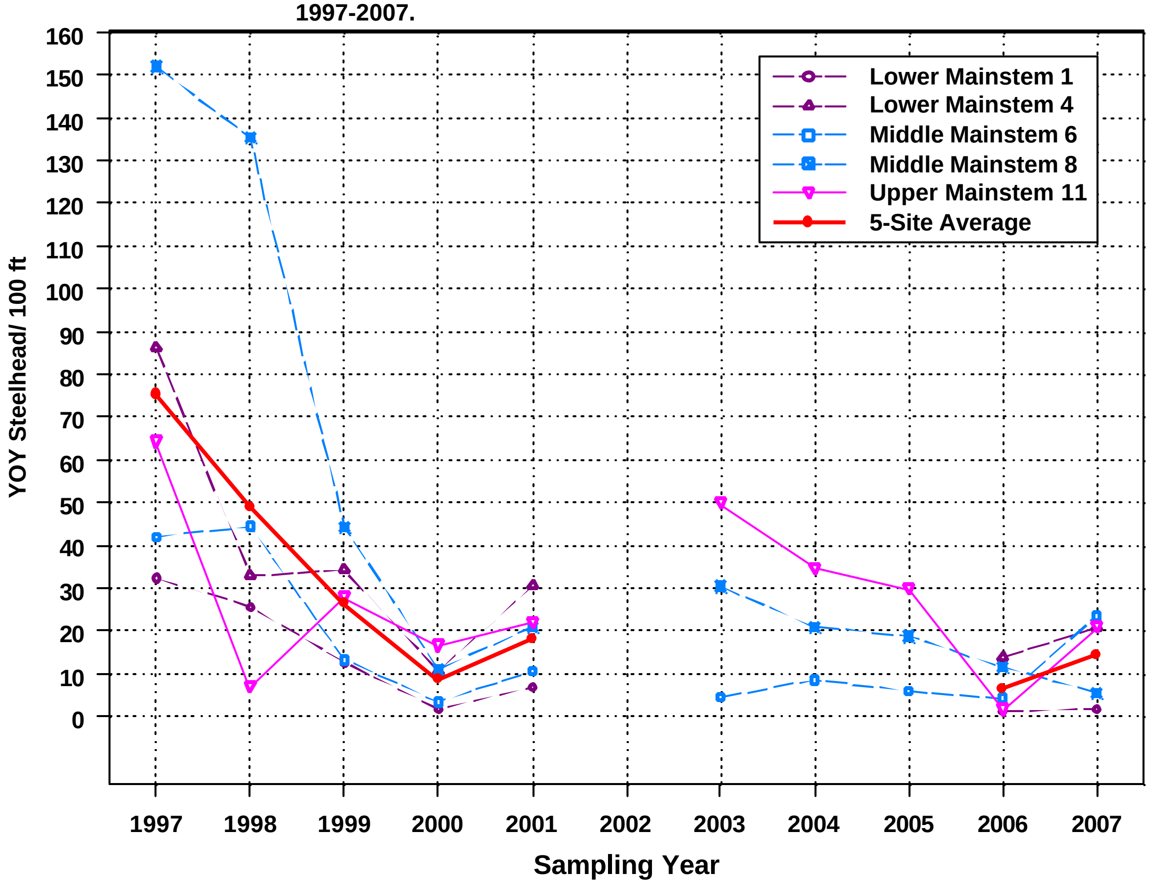


Figure 16. Plot of Annual YOY Juvenile Densities at San Lorenzo Tributary Sites, 1997-2007.

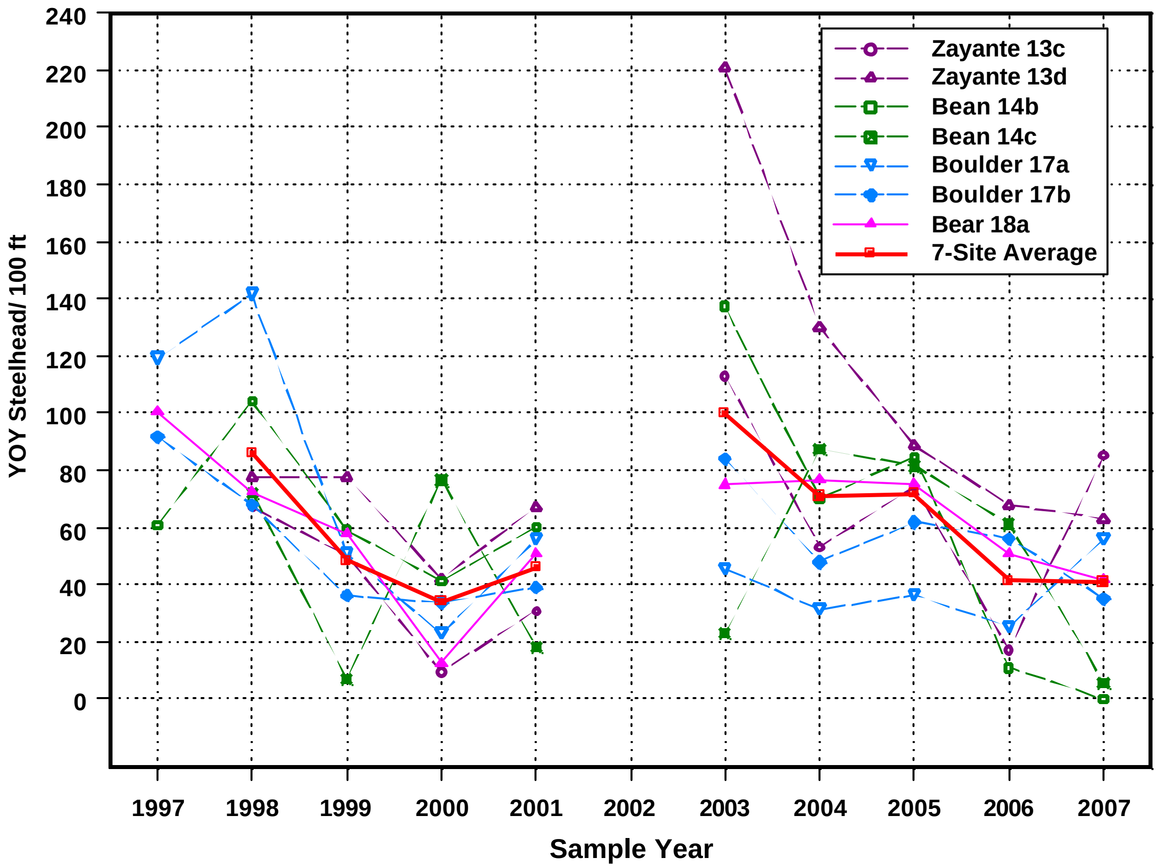


Figure 17. Scatter Plot of Annual Size Class II/ III Juvenile Densities at San Lorenzo Mainstem Sites, 1997-2007.

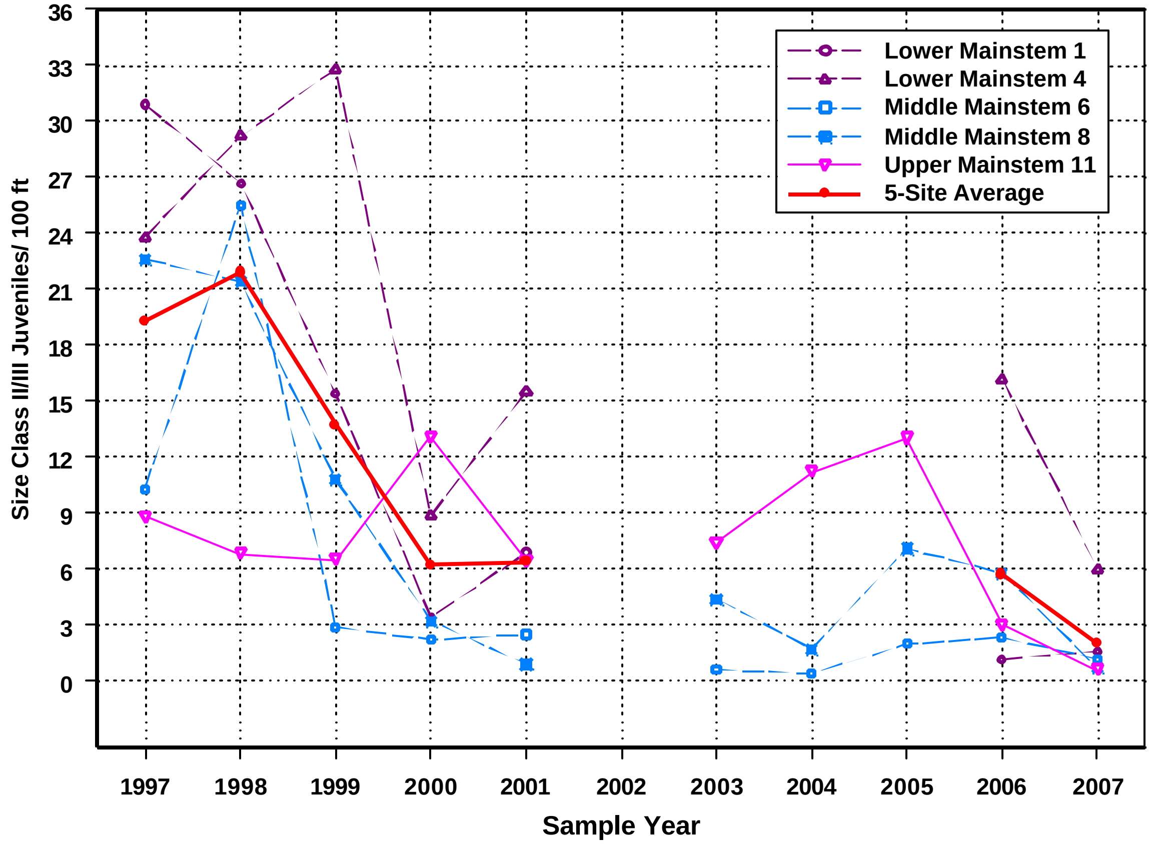


Figure 18. Plot of Annual Size Class II/ III Juvenile Densities at San Lorenzo Tributary Sites, 1997-2007.

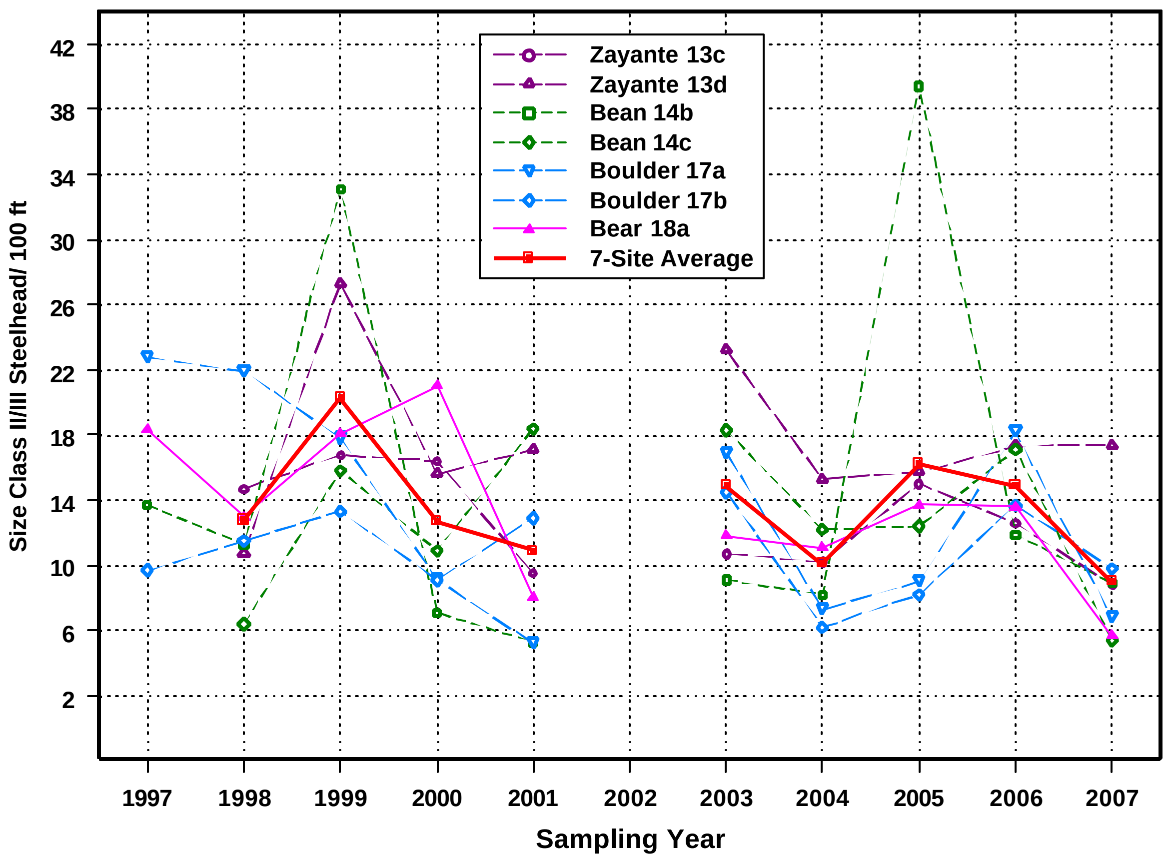


Figure 19. Plot of Annual Total Juvenile Densities at Mainstem Soquel Creek Sites, 1997-2007.

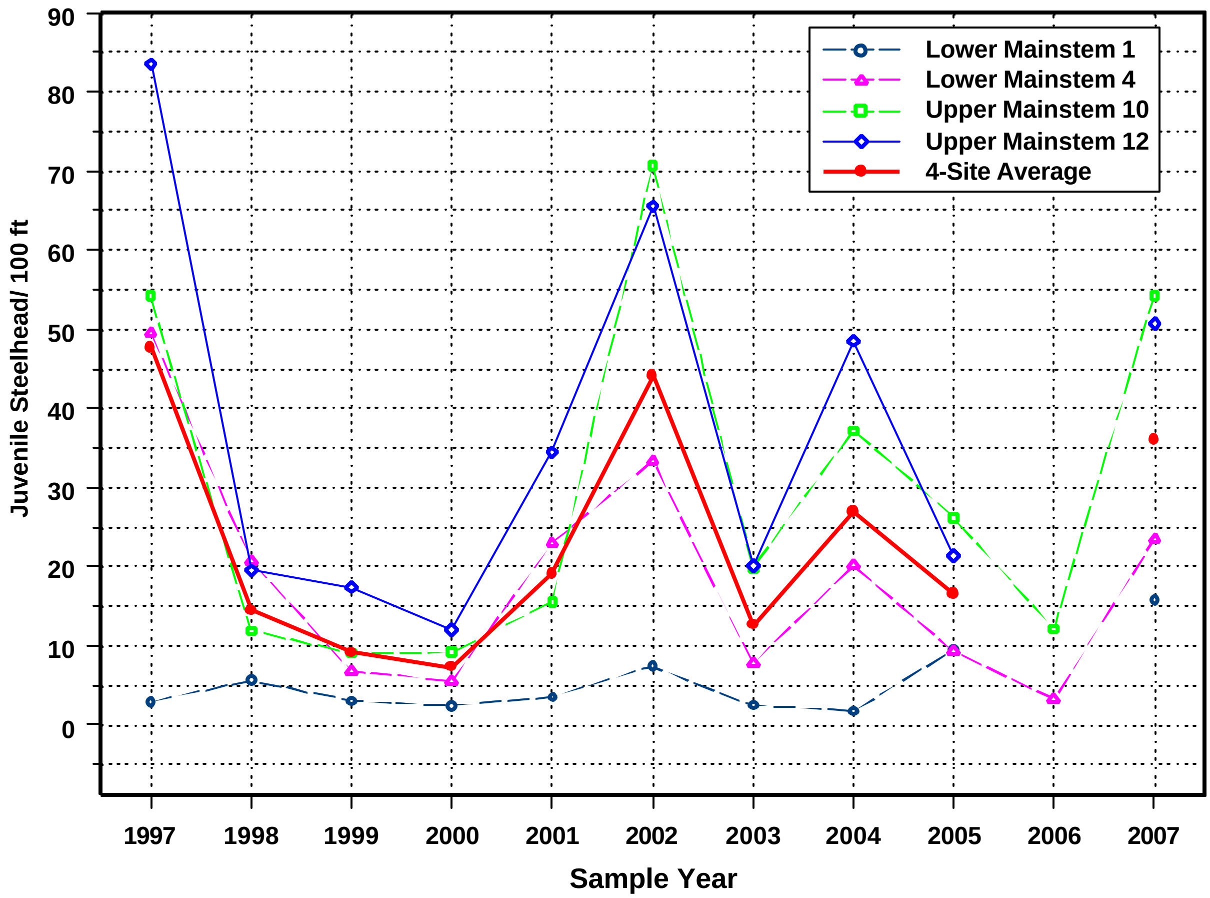


Figure 20. Plot of Annual Total Juvenile Densities at East Branch Soquel Creek Sites, 1997-2007.

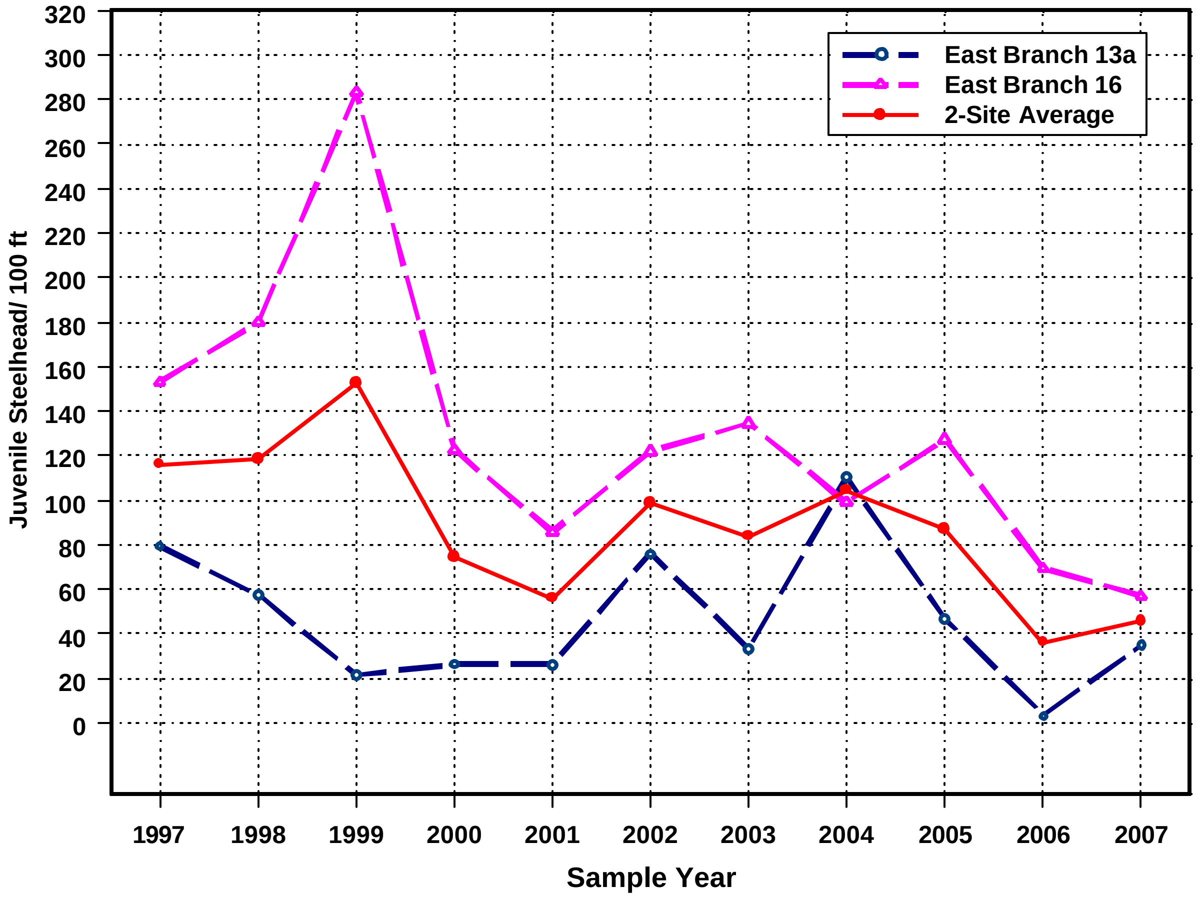


Figure 21. Plot of Annual YOY Densities at Mainstem Soquel Creek Sites, 1997-2007.

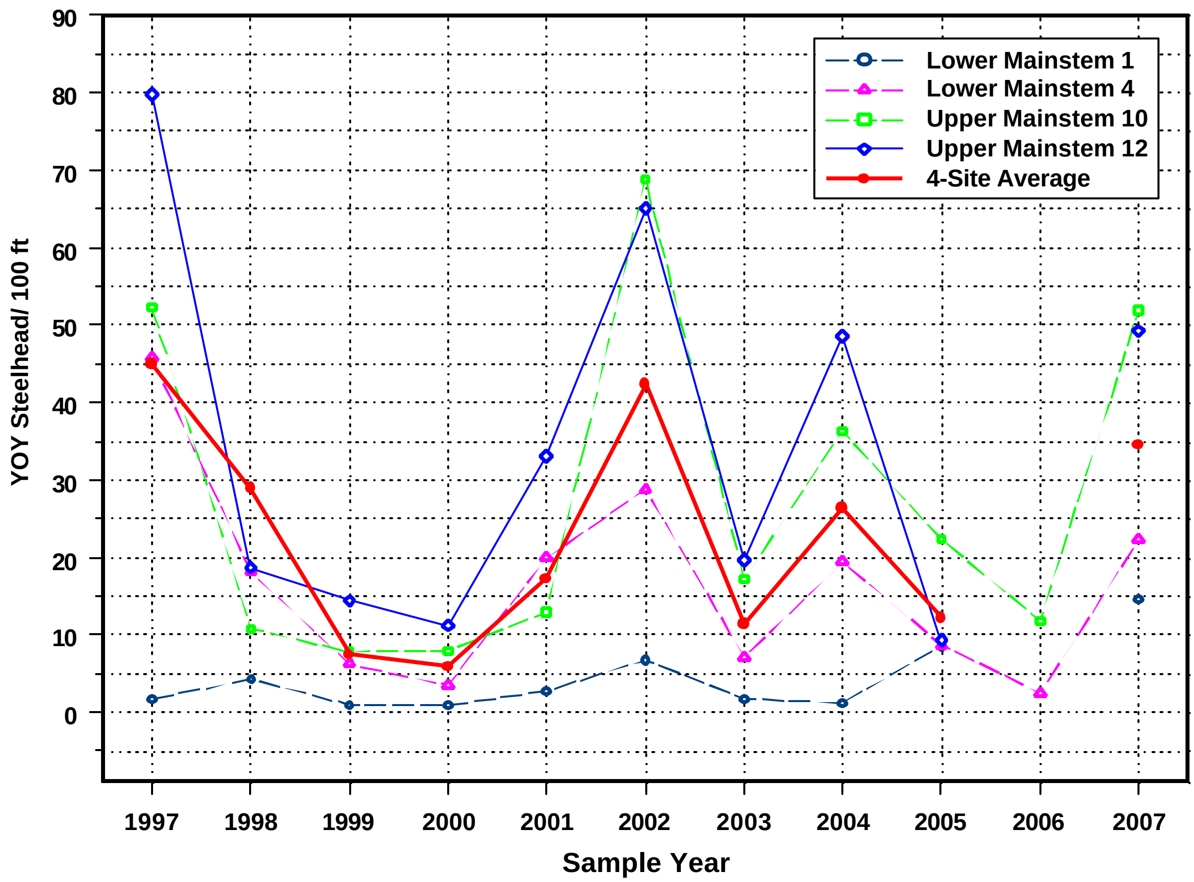


Figure 22. Plot of Annual YOY Densities at East Branch Soquel Creek Sites, 1997-2007.

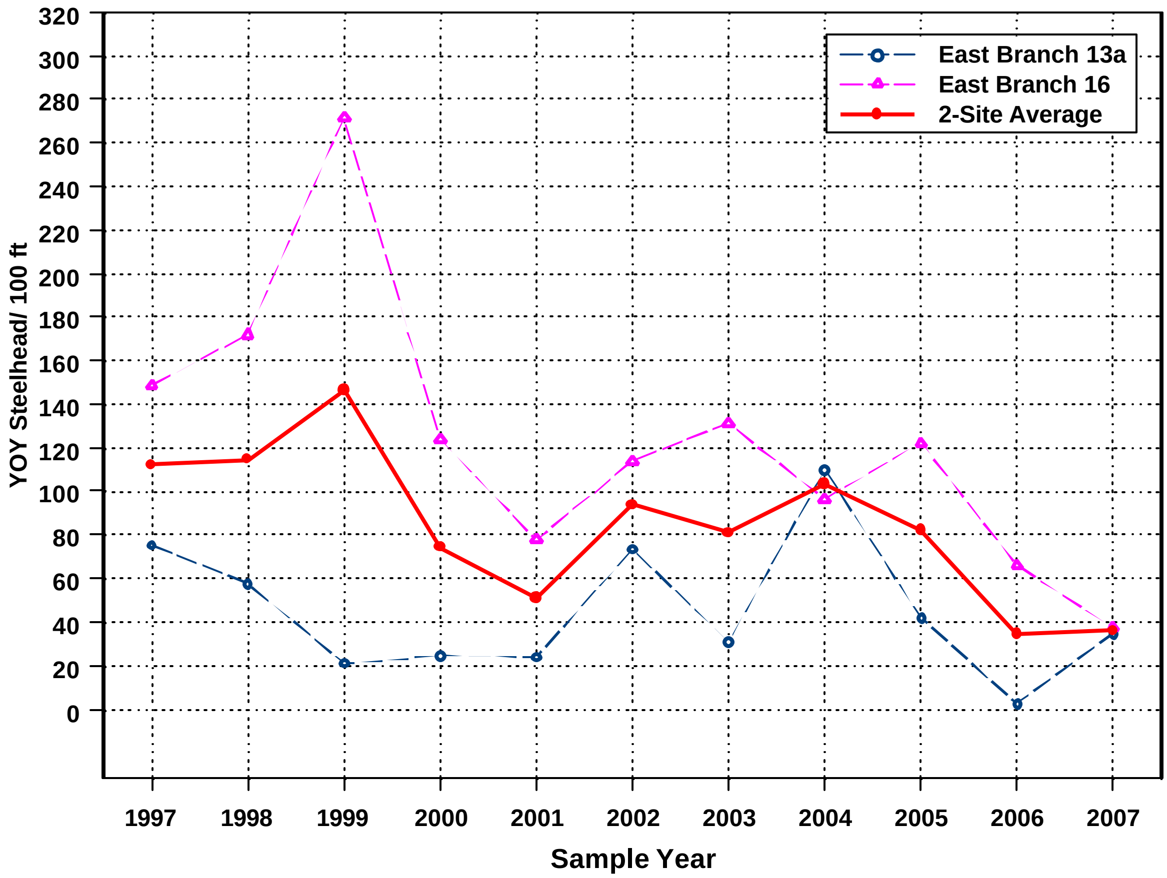


Figure 23. Plot of Annual Size Class II/ III Juvenile Densities at Soquel Mainstem Sites, 1997-2007.

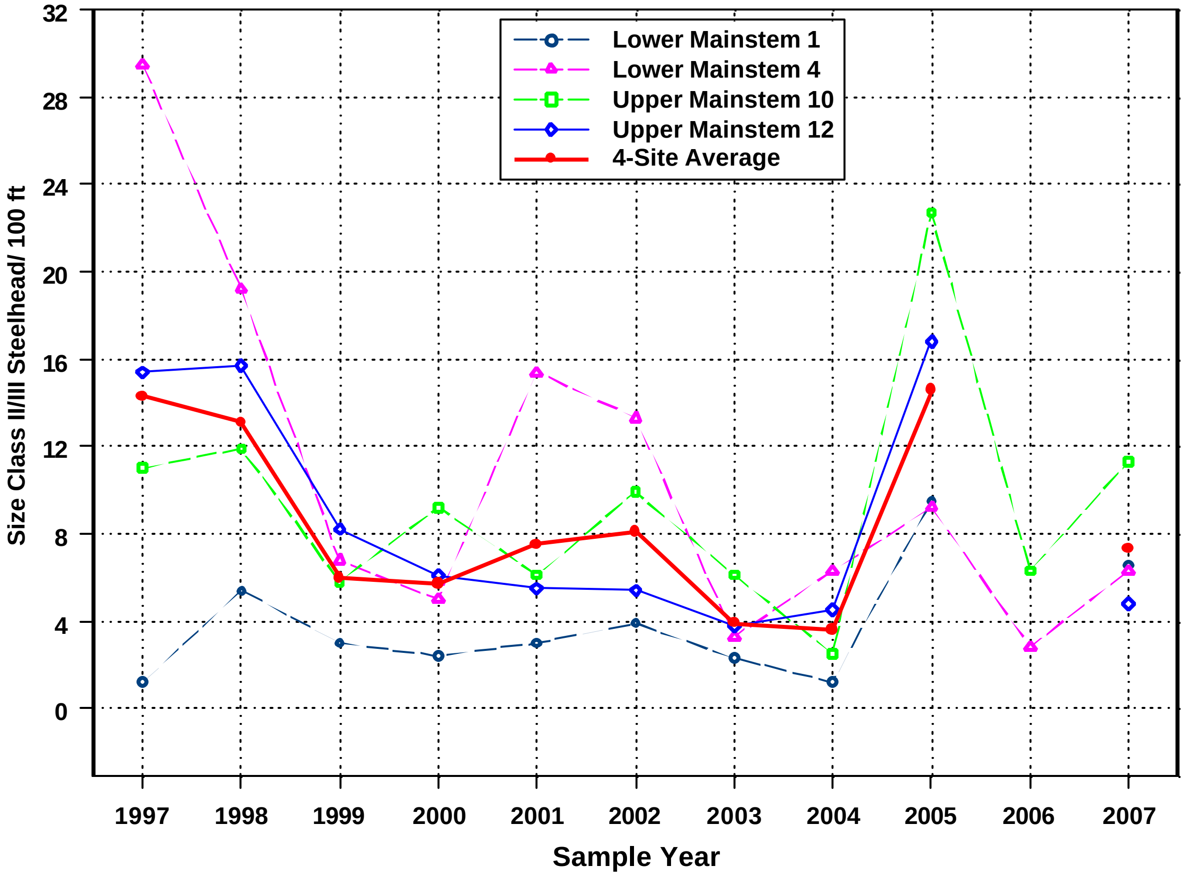


Figure 24. Plot of Annual Size Class II/ III Juvenile Densities at East Branch Soquel Creek Sites, 1997-2007.

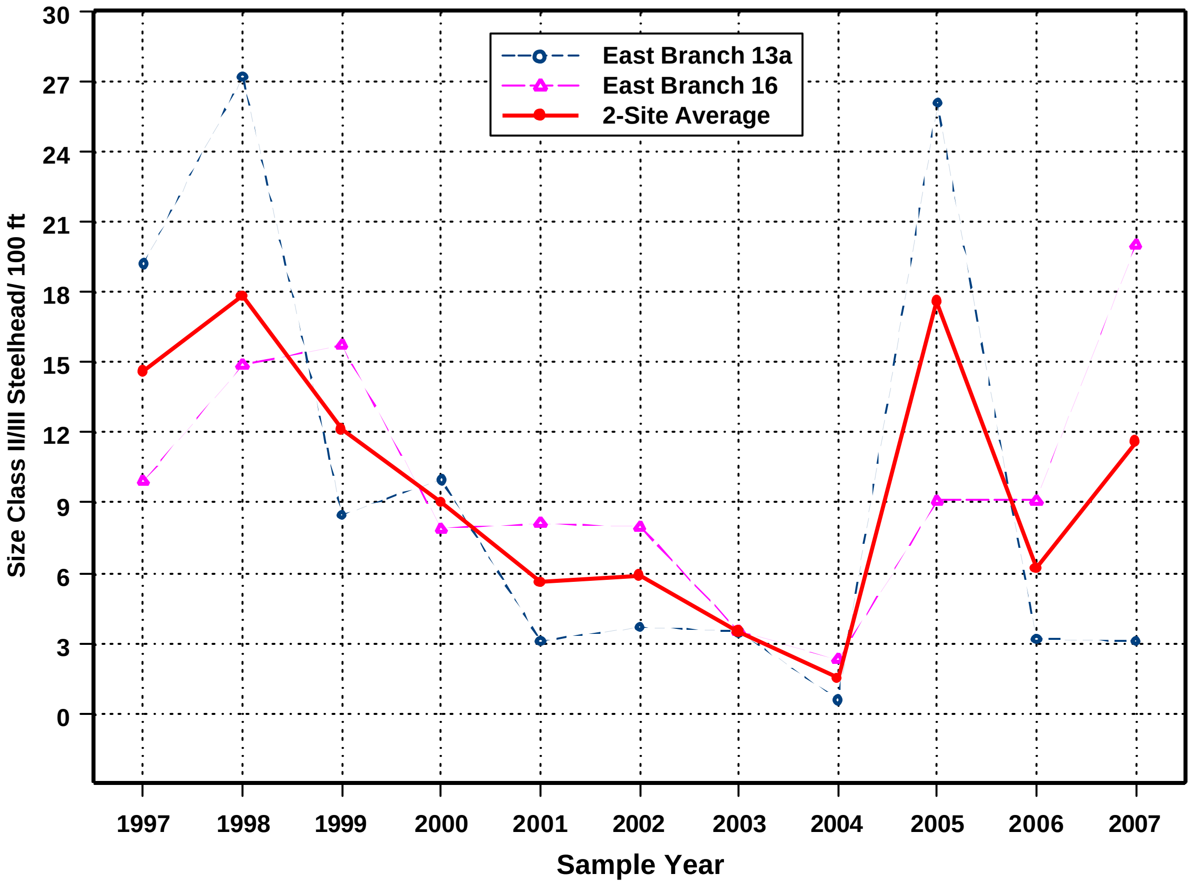


Figure 25. Averaged Mean Monthly Streamflow for May - September, 1997-2007 at the Big Trees Gage on the San Lorenzo River.

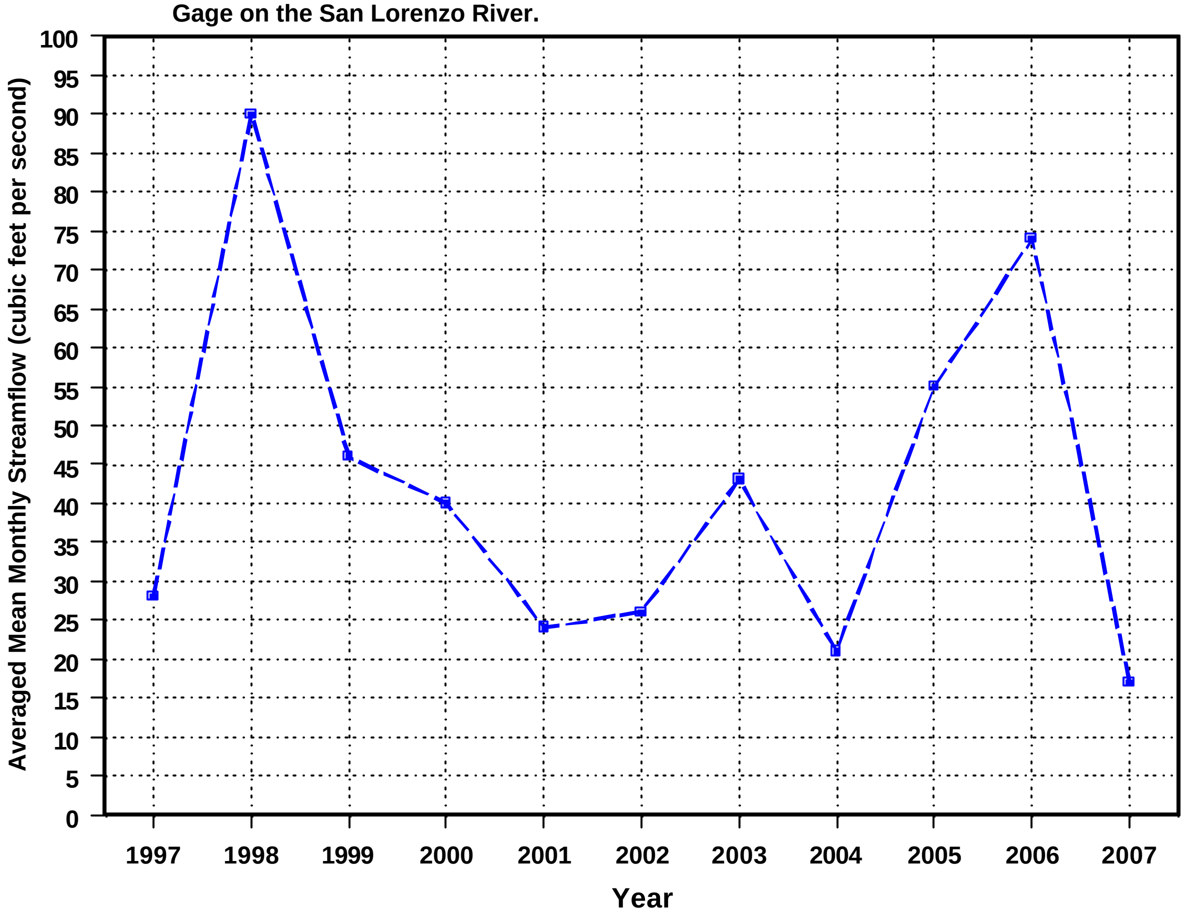


Figure 26. Averaged Mean Monthly Streamflow for May-September, 1997-2007 at the Soquel Village Gage on Soquel Creek.

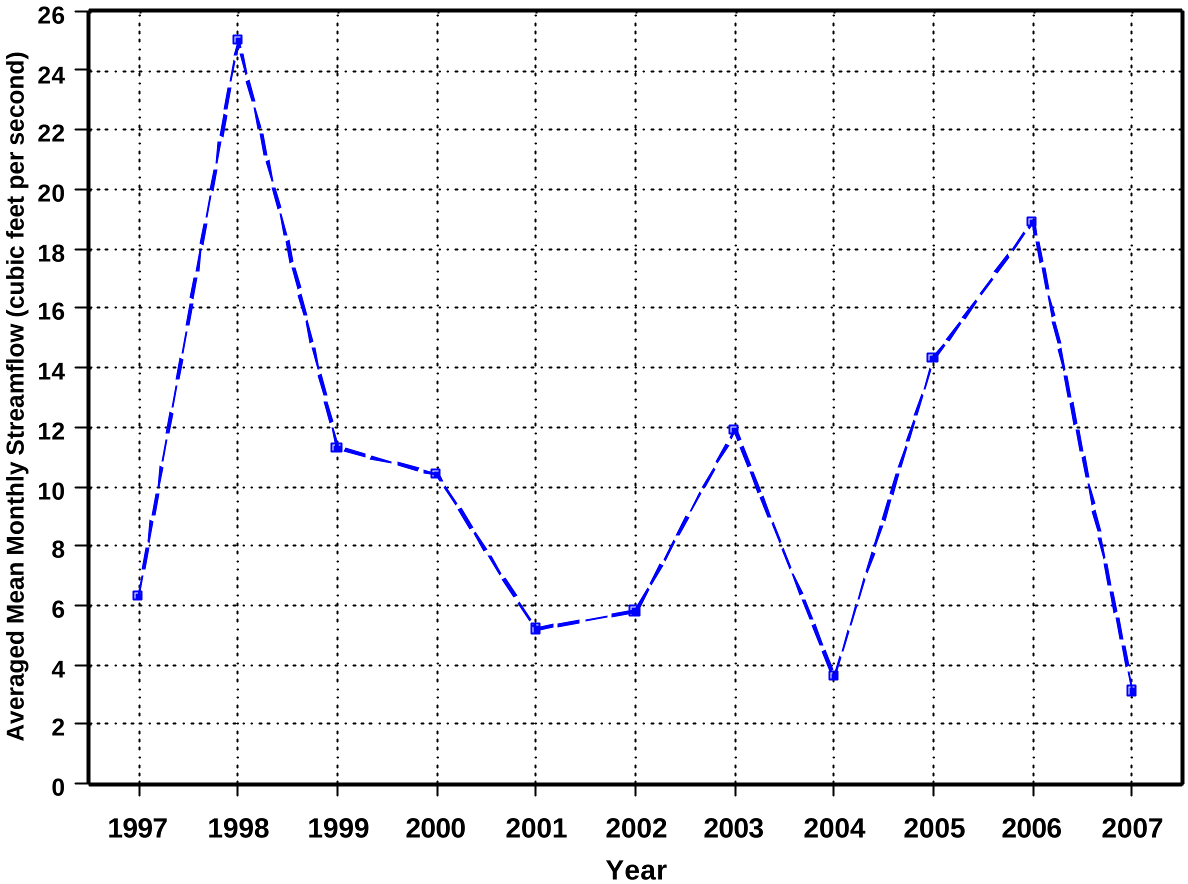


Figure 27. Averaged Maximum and Mean Riffle Depth in Reach 4 of the Lower Mainstem San Lorenzo River, 1997-2002 and 2006-2007.

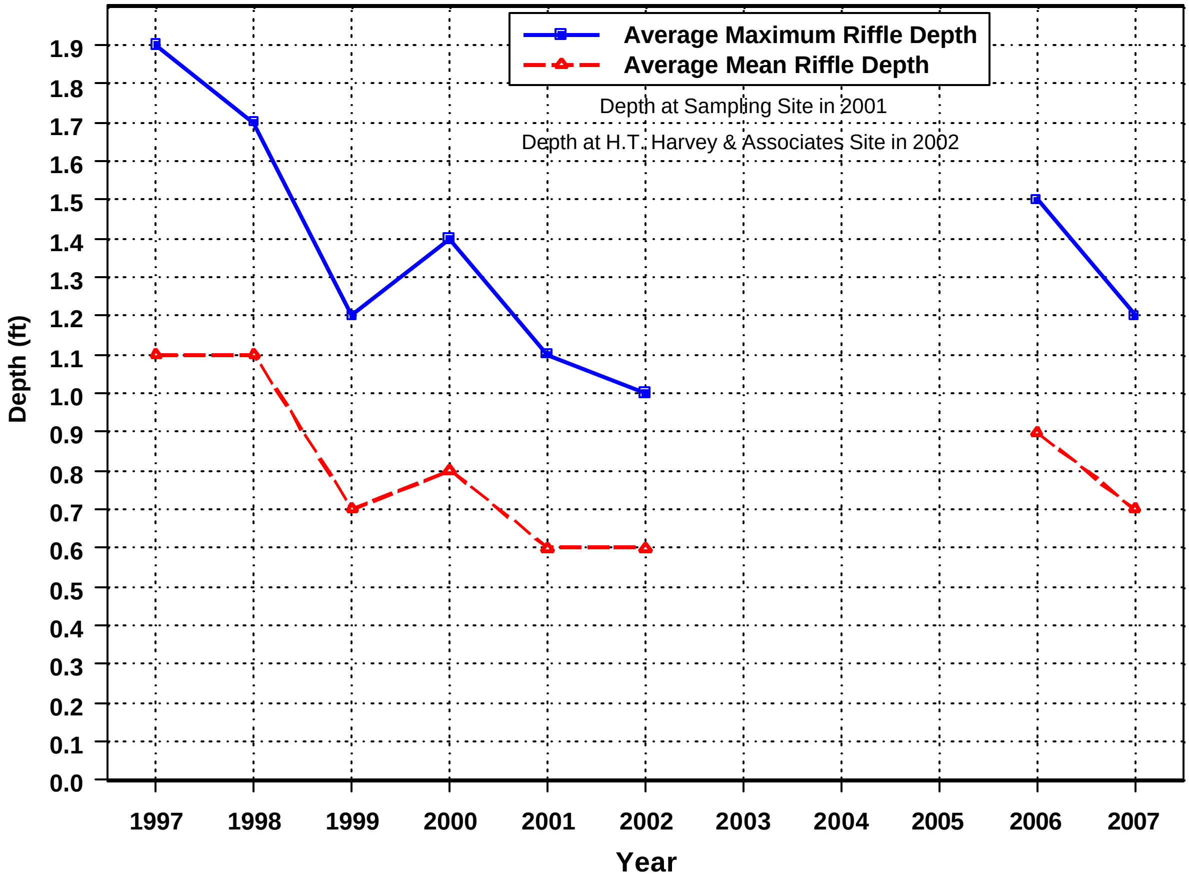


Figure 28. Escape Cover Index for Riffle Habitat in Reach 4 of the Lower Mainstem San Lorenzo River, 1998-2000 and 2006-2007.

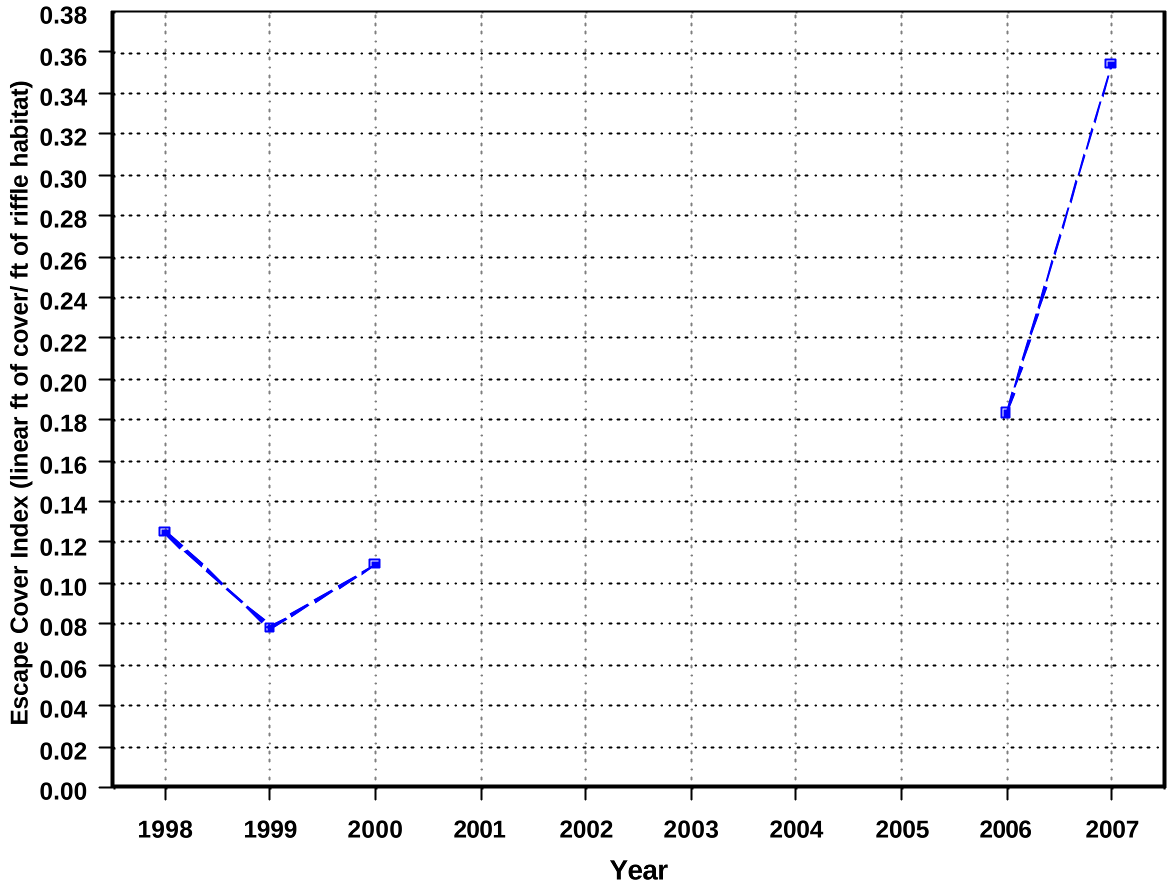


Figure 29. Averaged Percent Fines in Riffle Habitat in Reach 4 of the Lower Mainstem San Lorenzo River, 1997-2001 and 2006-2007.

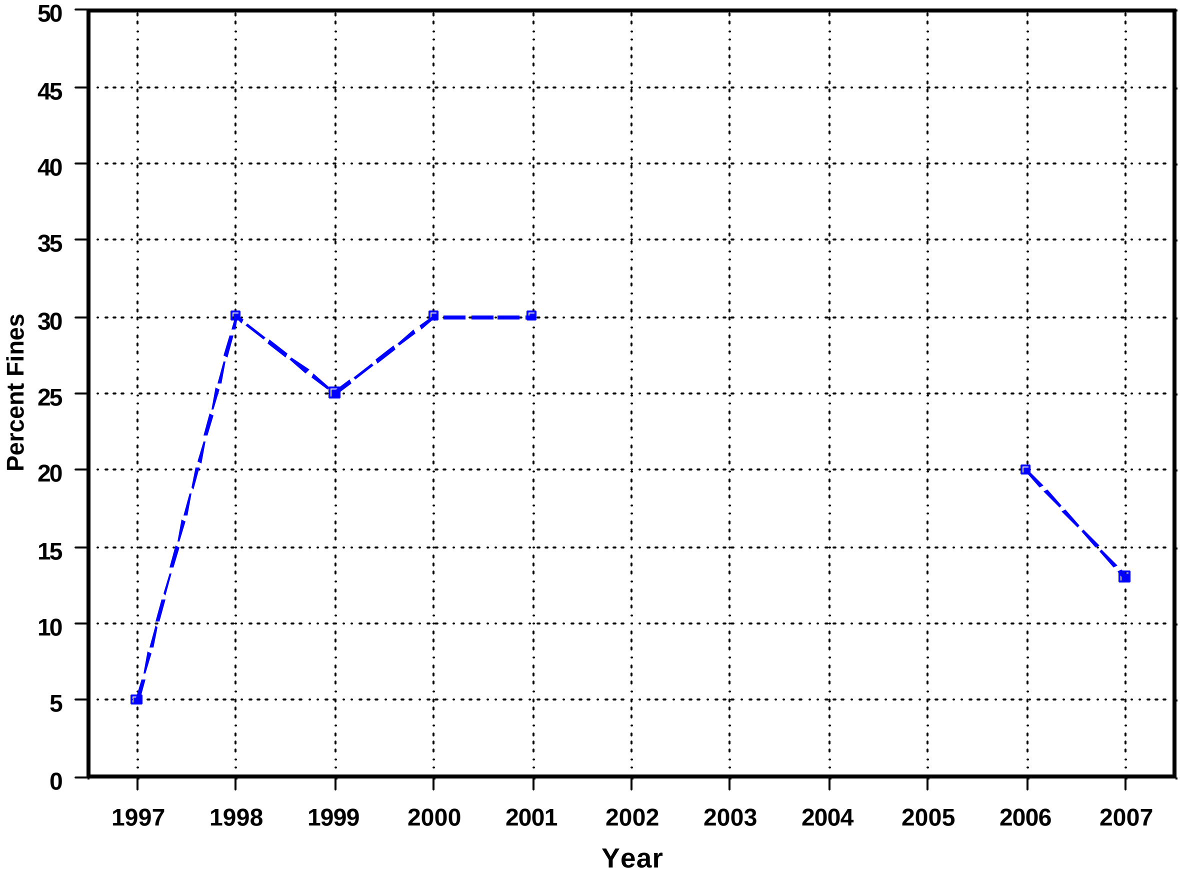


Figure 30. Averaged Maximum and Mean Riffle Depth in Reach 8 of the Middle Mainstem San Lorenzo River, 1997-2007.

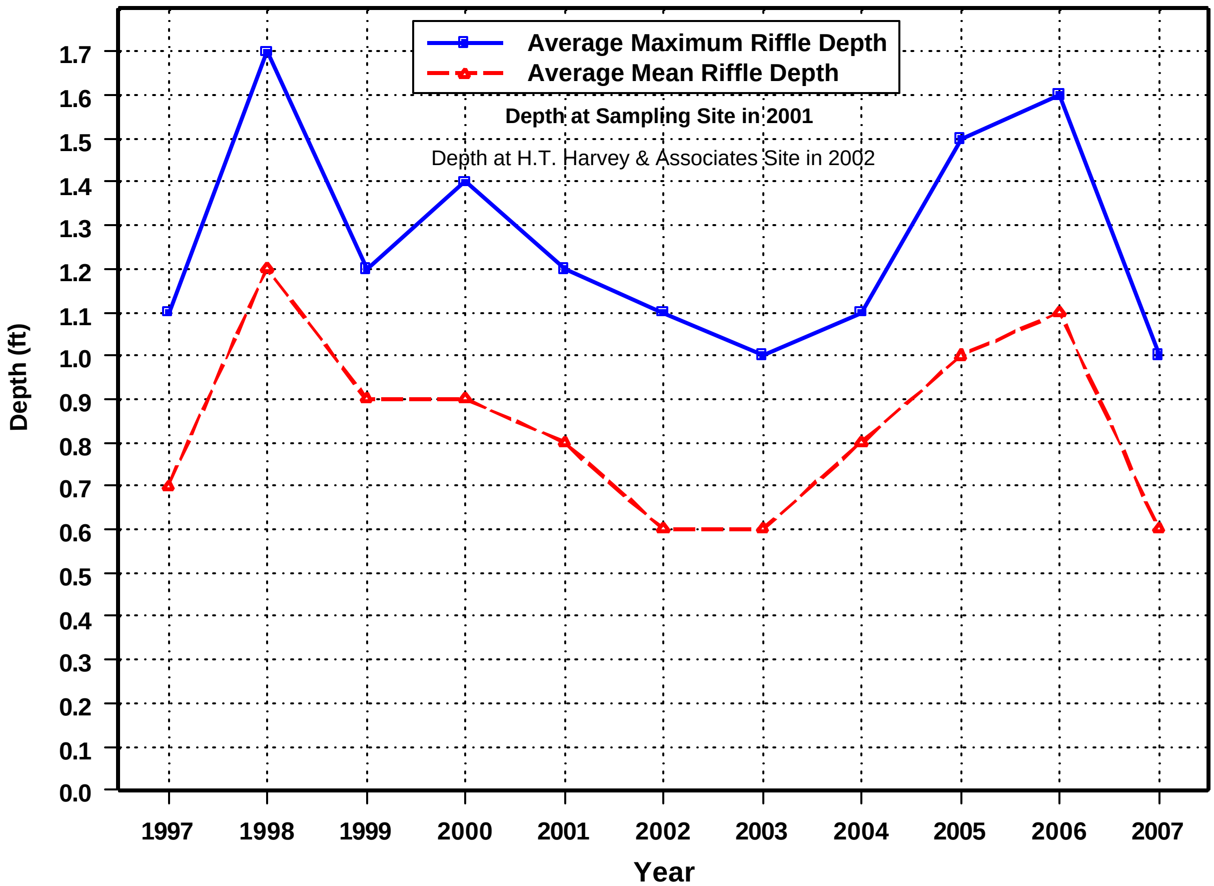


Figure 31. Escape Cover Index for Riffle Habitat in Reach 8 of the Middle Mainstem San Lorenzo River, 1998-2000, 2003 and 2005-2007.

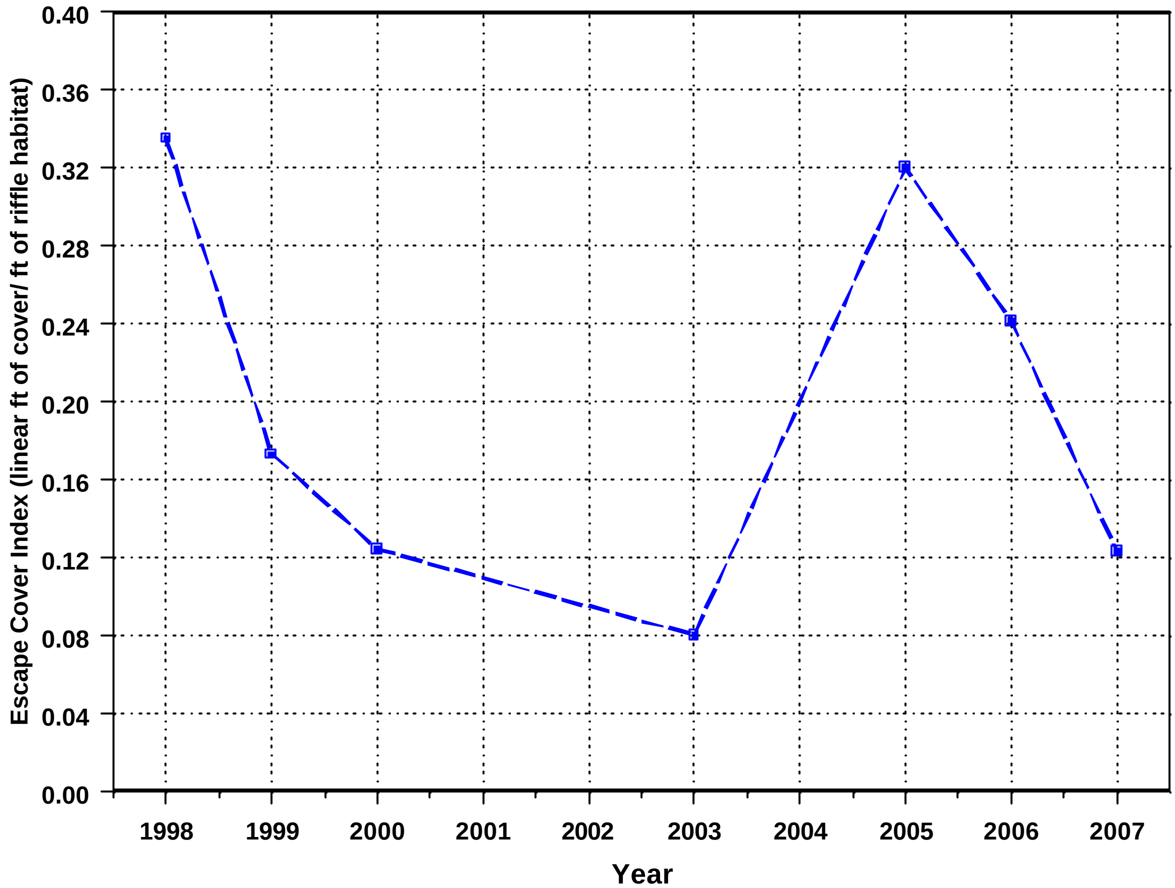


Figure 32. Averaged Percent Fines in Riffle Habitat in Reach 8 of the Middle Mainstem San Lorenzo River, 1997-2001, 2003 and 2005-2007.

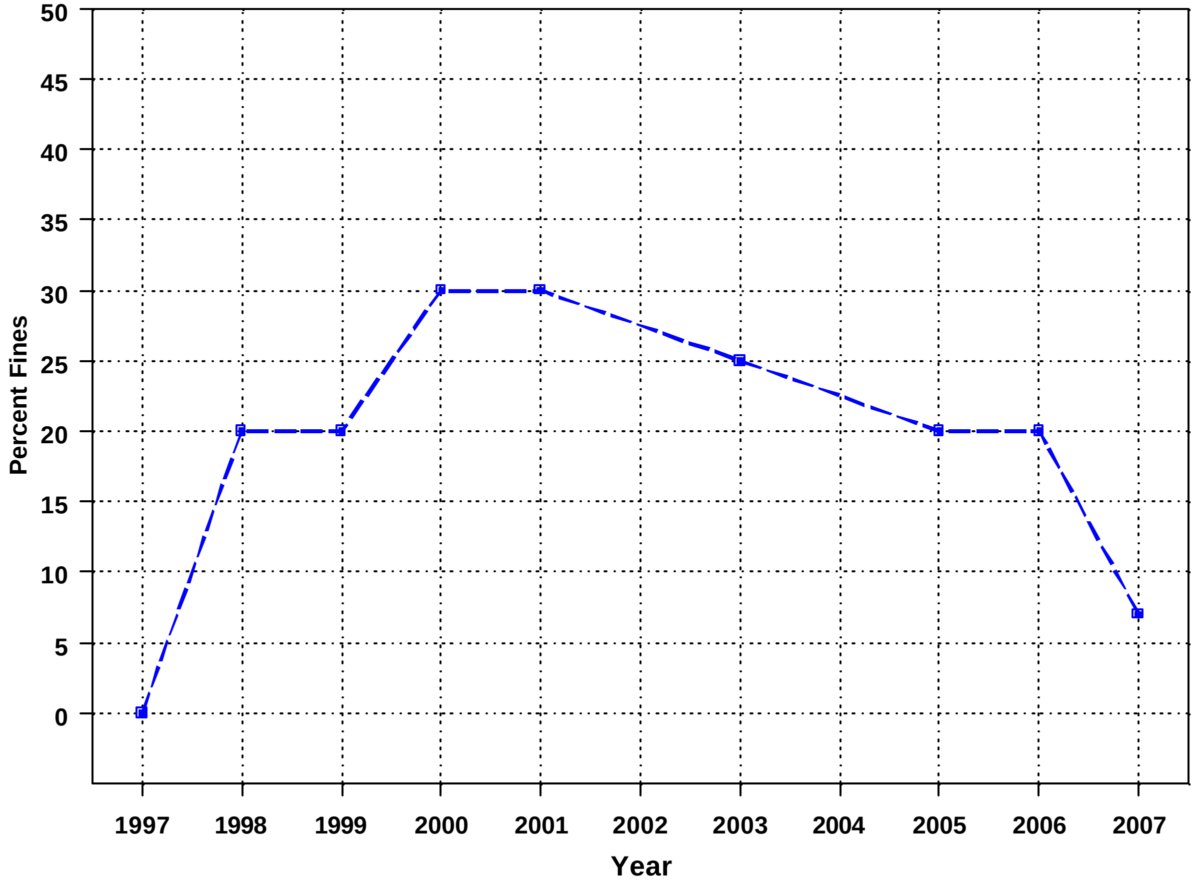


Figure 33. Averaged Maximum and Mean Pool Depth in Reach 13d of Zayante Creek, 1998-2000, 2003 and 2005-2007.

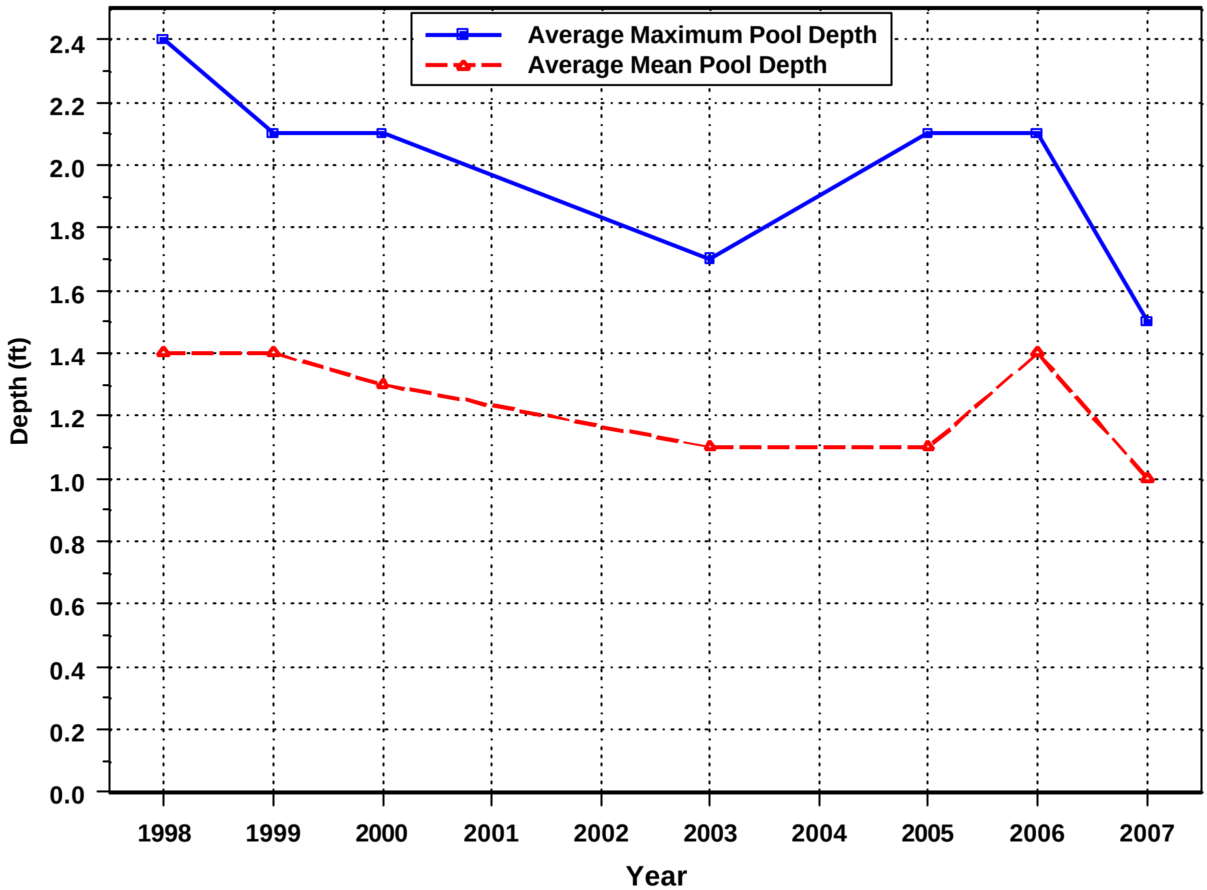


Figure 34a. Escape Cover Index for Pool Habitat in Reach 13d of Zayante Creek, 1998-2000, 2003 and 2005-2007.

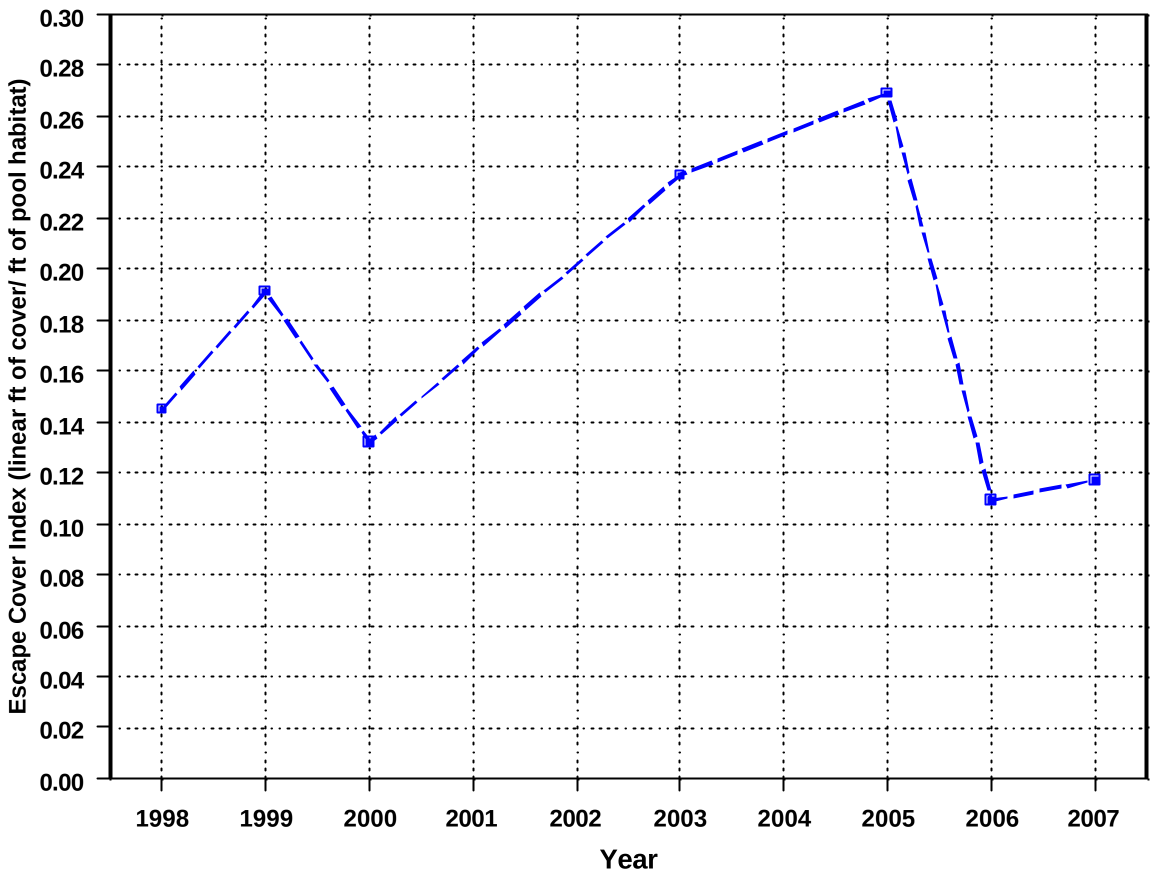


Figure 34b. Escape Cover Index for Pool Habitat at Site 13d in Zayante Creek, 1998-2001 and 2003-2007.

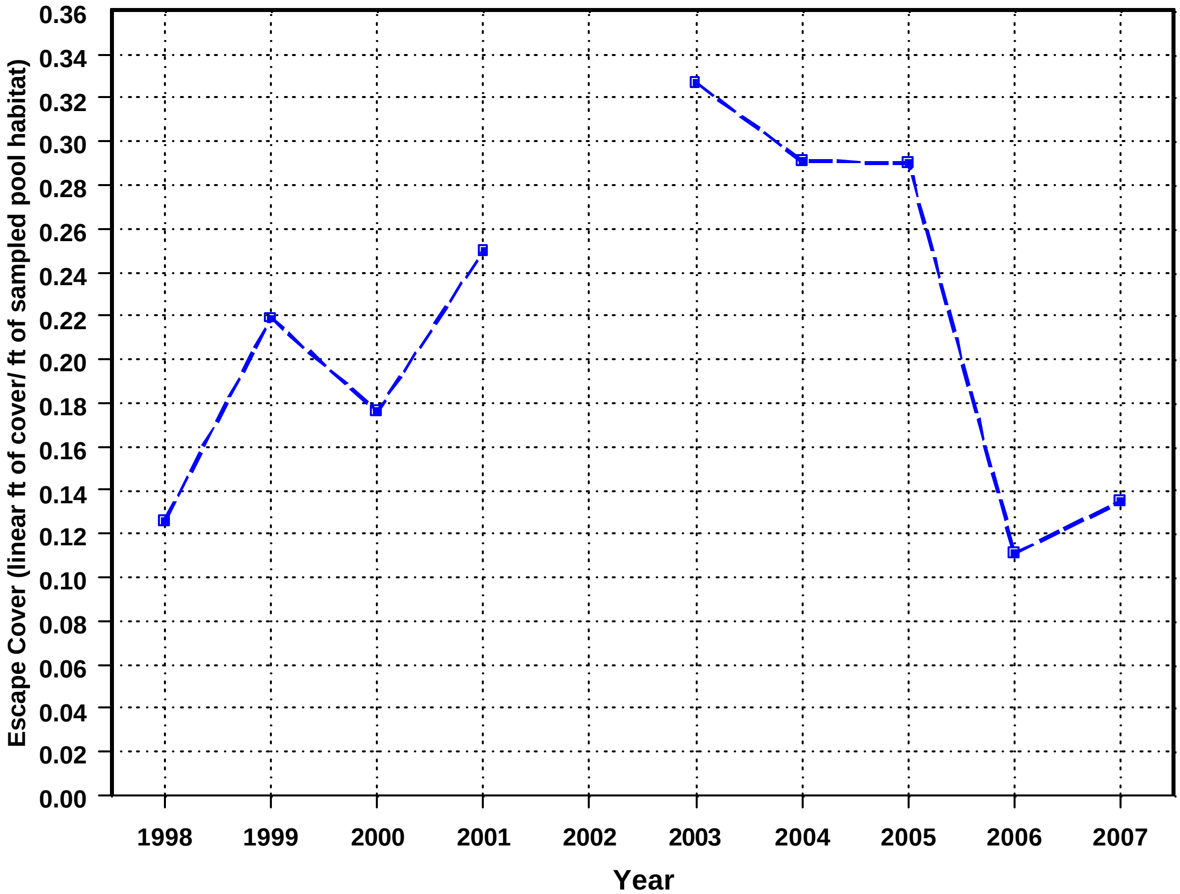


Figure 35. Averaged Percent Fines in Step-Run Habitat in Reach 13d of Zayante Creek, 1998-2001, 2003-2007.

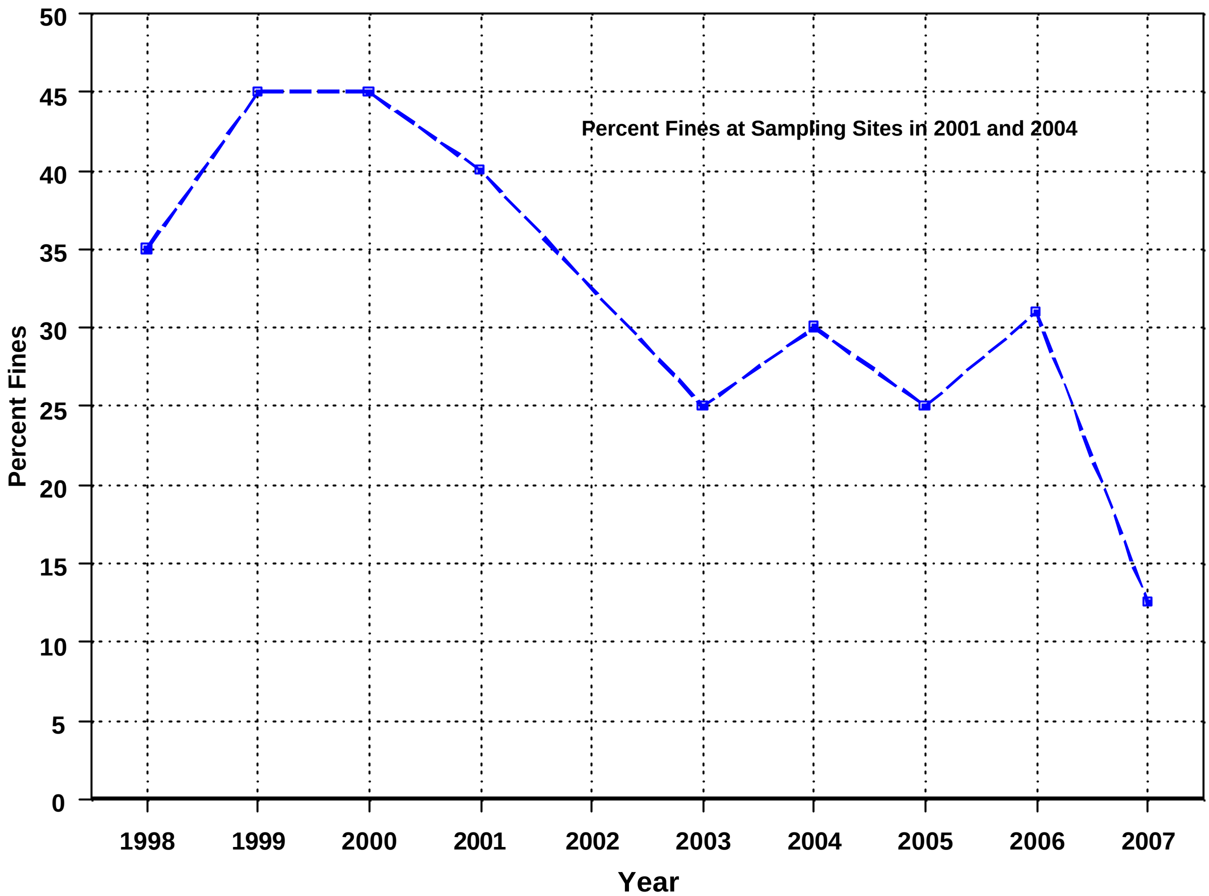


Figure 36. Averaged Maximum and Mean Pool Depth in Reach 17a of Boulder Creek, 1998-2000 and 2005-2007.

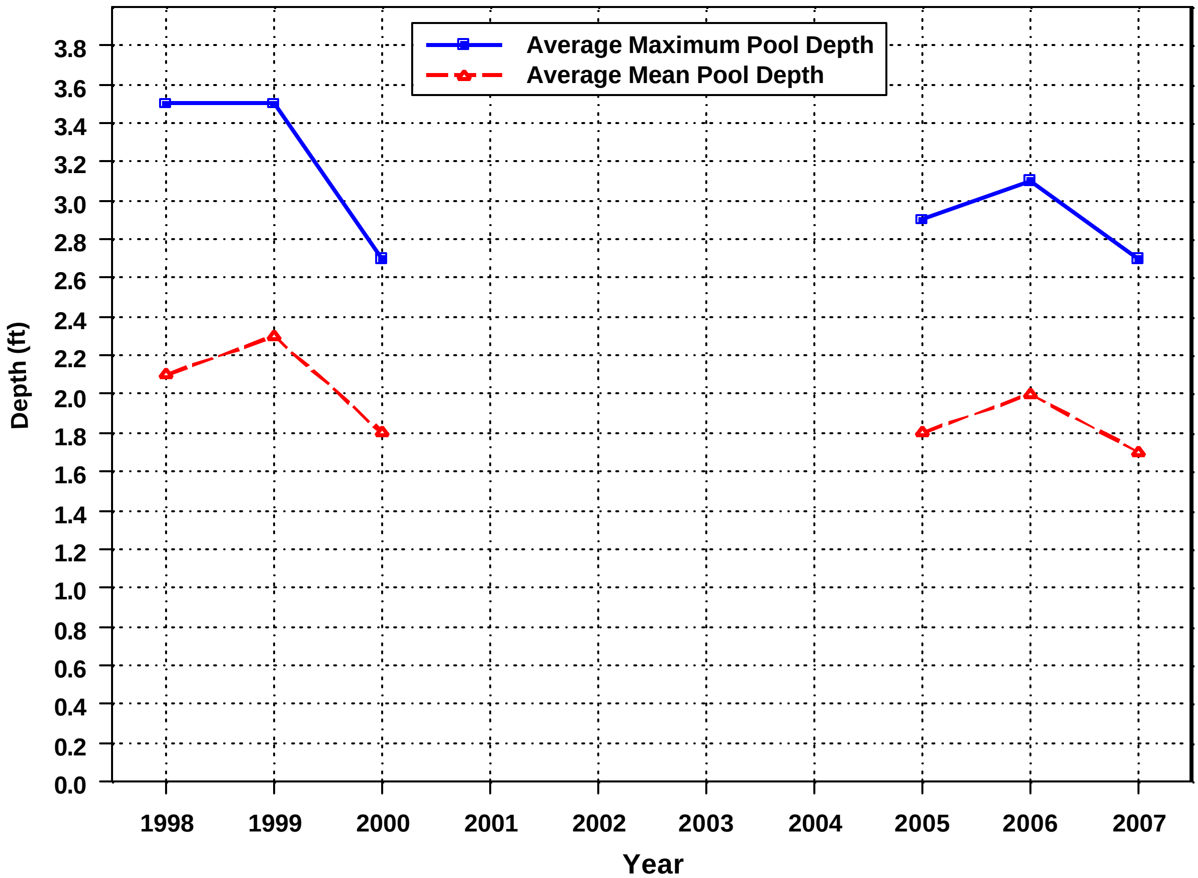


Figure 37a. Escape Cover Index for Pool Habitat in Reach 17a of Boulder Creek, 1998-2000 and 2005-2007.

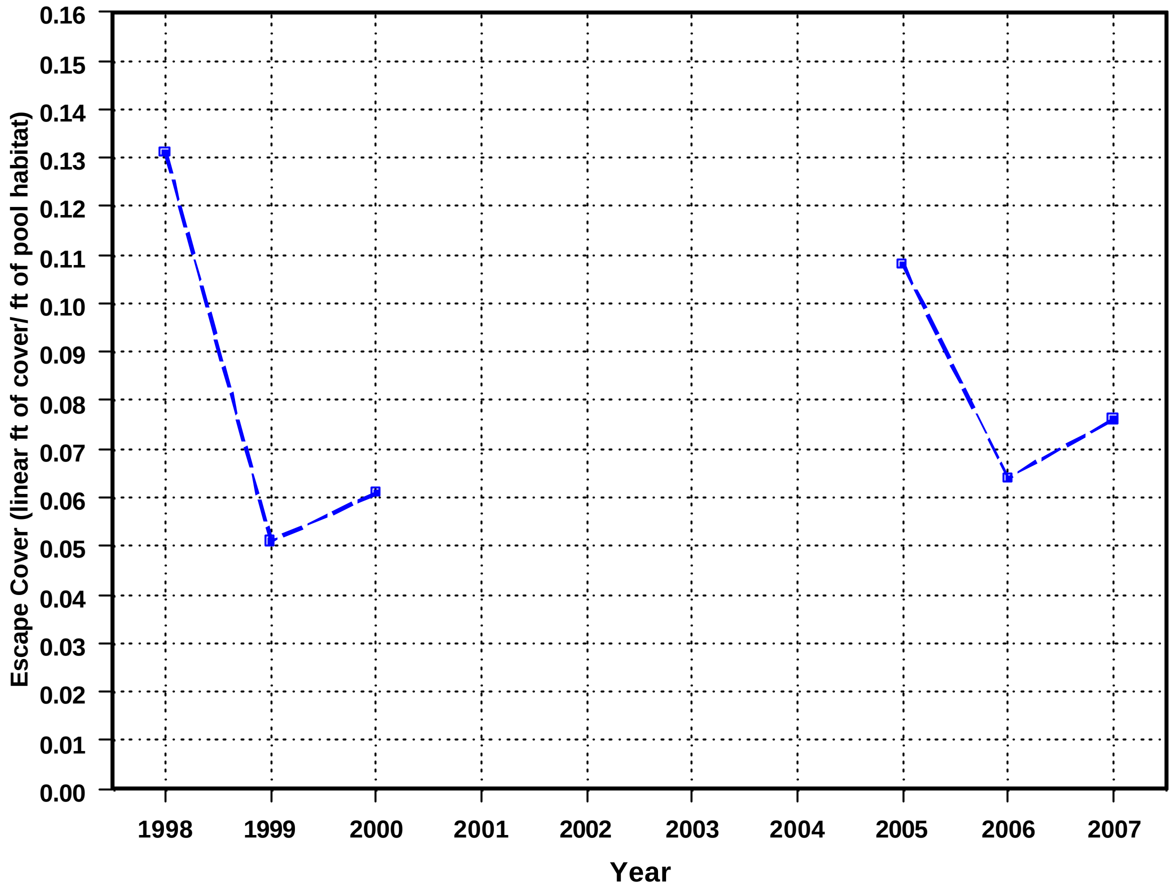


Figure 37b. Escape Cover Index for Pool Habitat at Site 17a in Boulder Creek, 1997-2001 and 2003-2007.

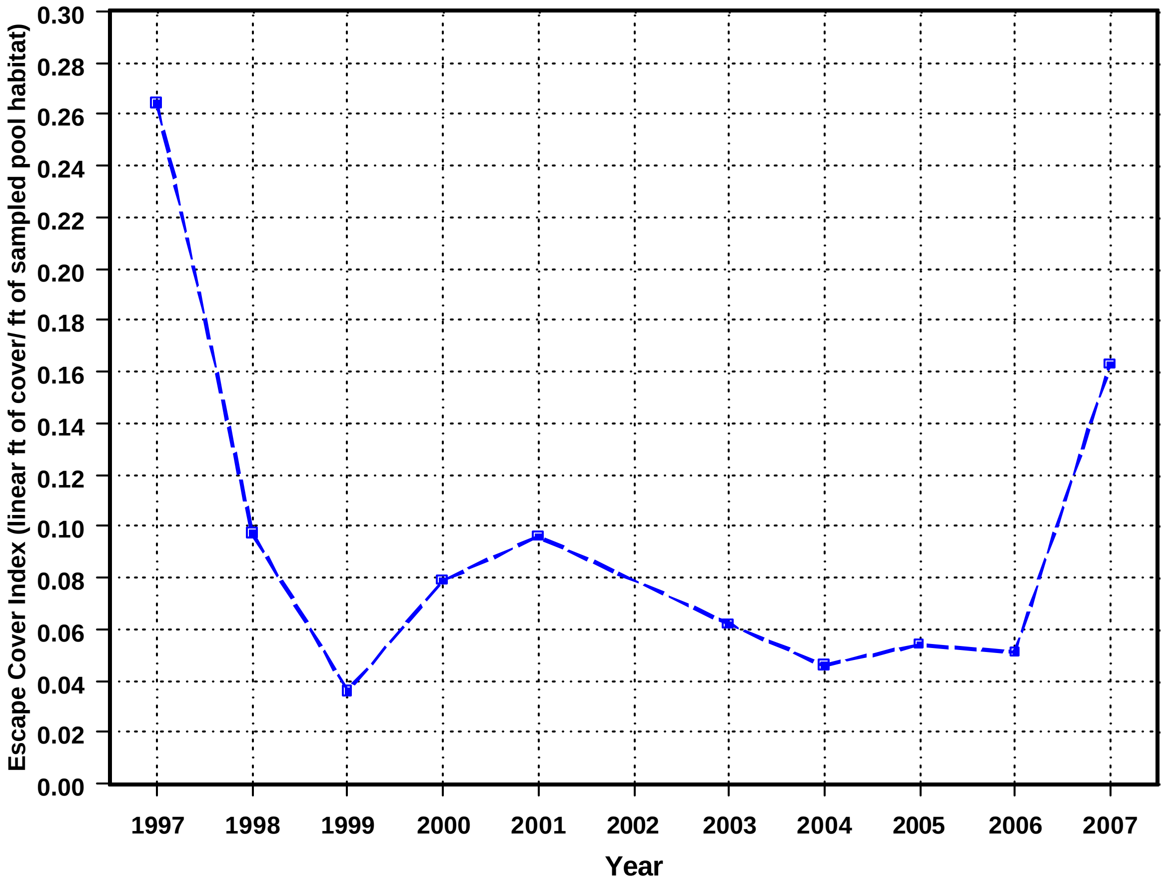


Figure 38. Averaged Percent Fines in Step-Run Habitat in Reach 17a of Boulder Creek, 1998-2001 and 2003-2007.

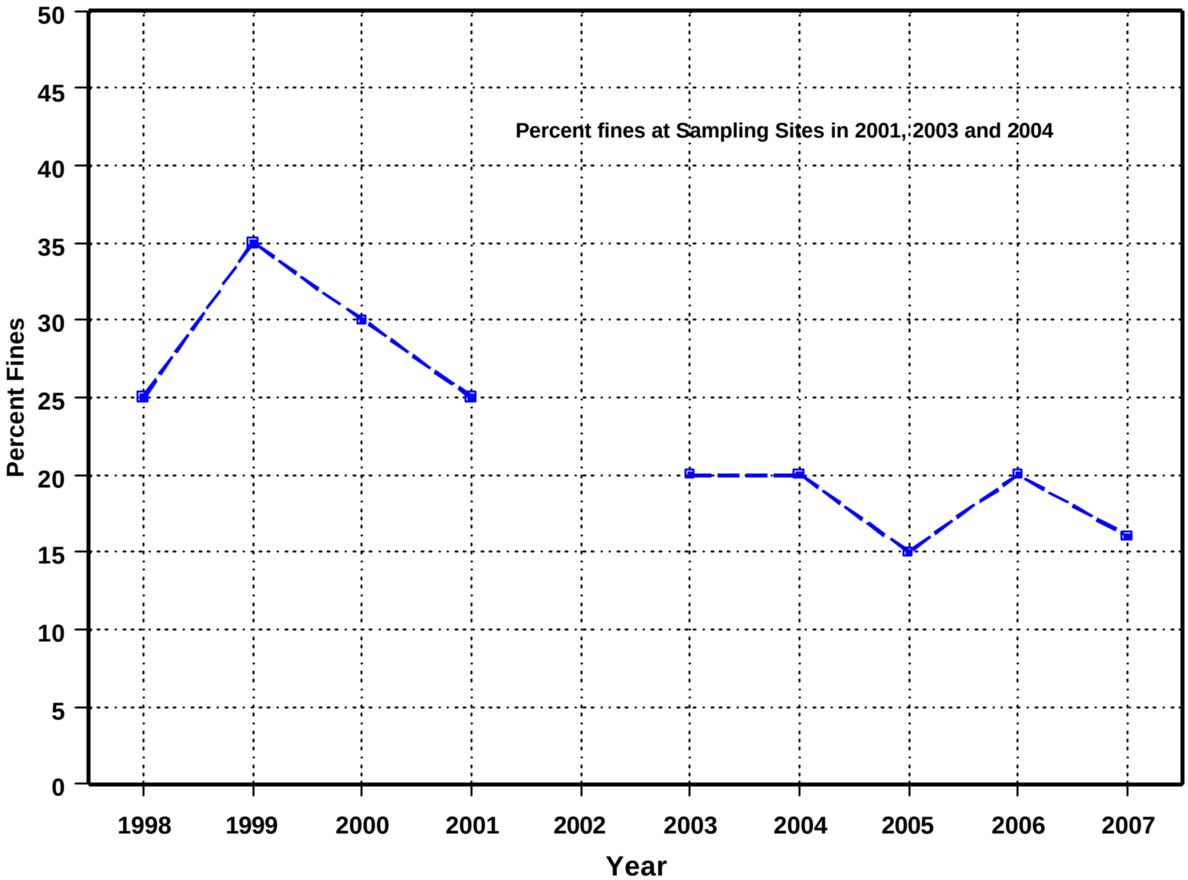


Figure 39. Averaged Maximum and Mean Pool Depth in Reach 1 of Soquel Creek, 1997-2007.

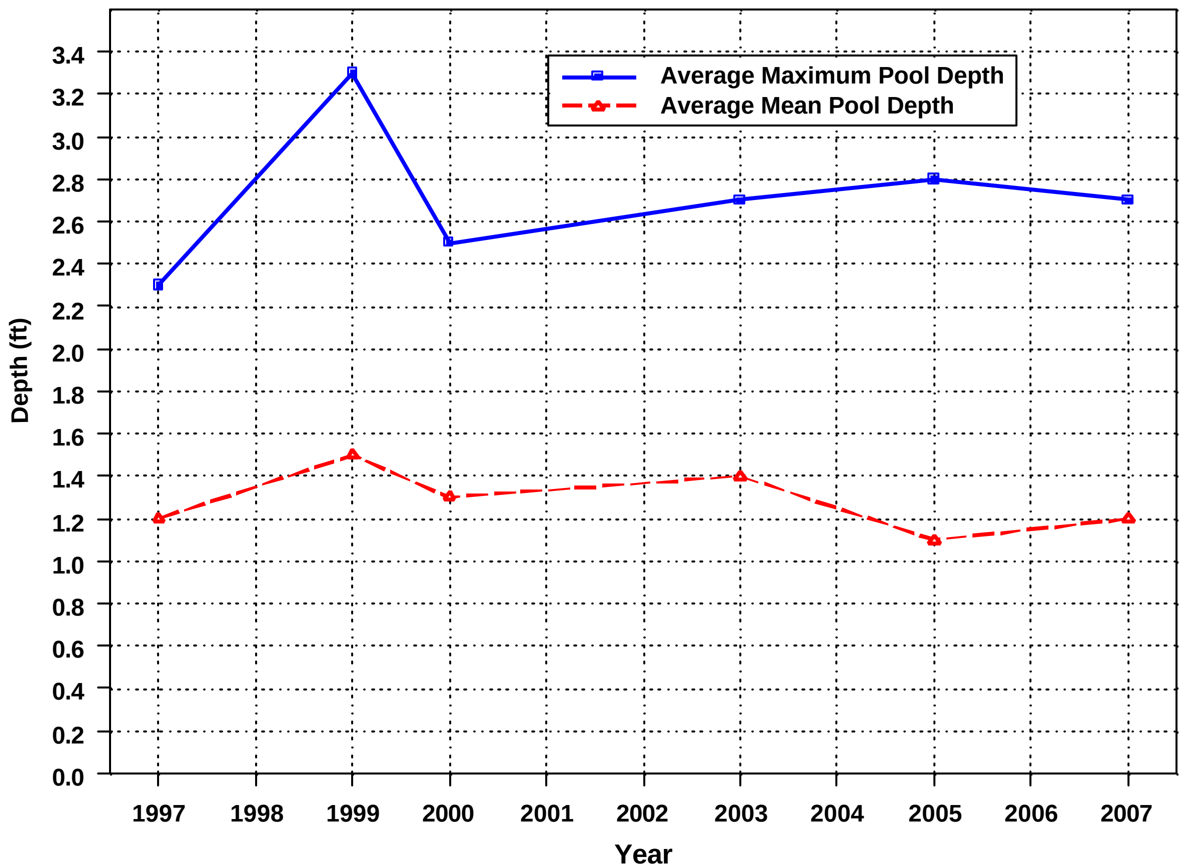


Figure 40a. Escape Cover Index for Pool Habitat in Reach 1 of Soquel Creek, 1997-2007.

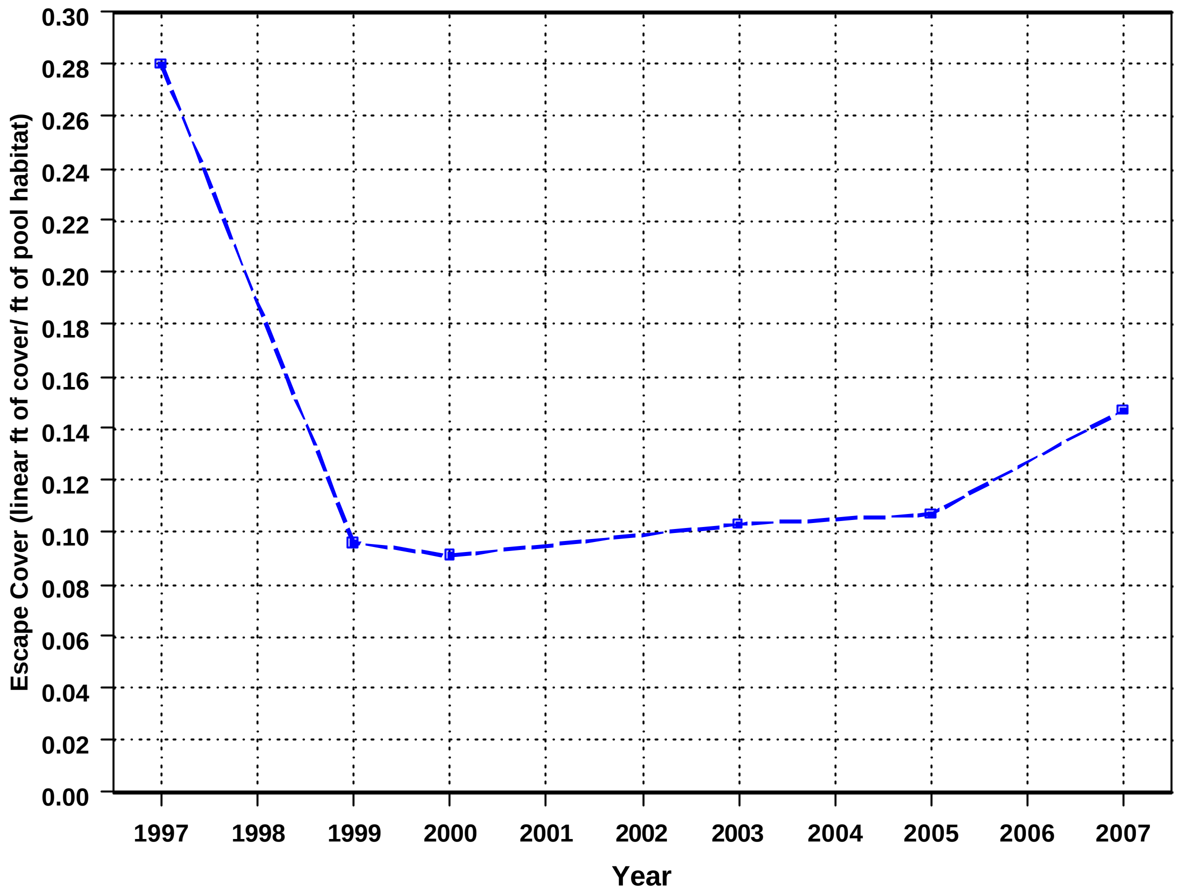


Figure 40b. Escape Cover Index for Pool Habitat at Site 1 in Soquel Creek, 1997-2006 and 2007.

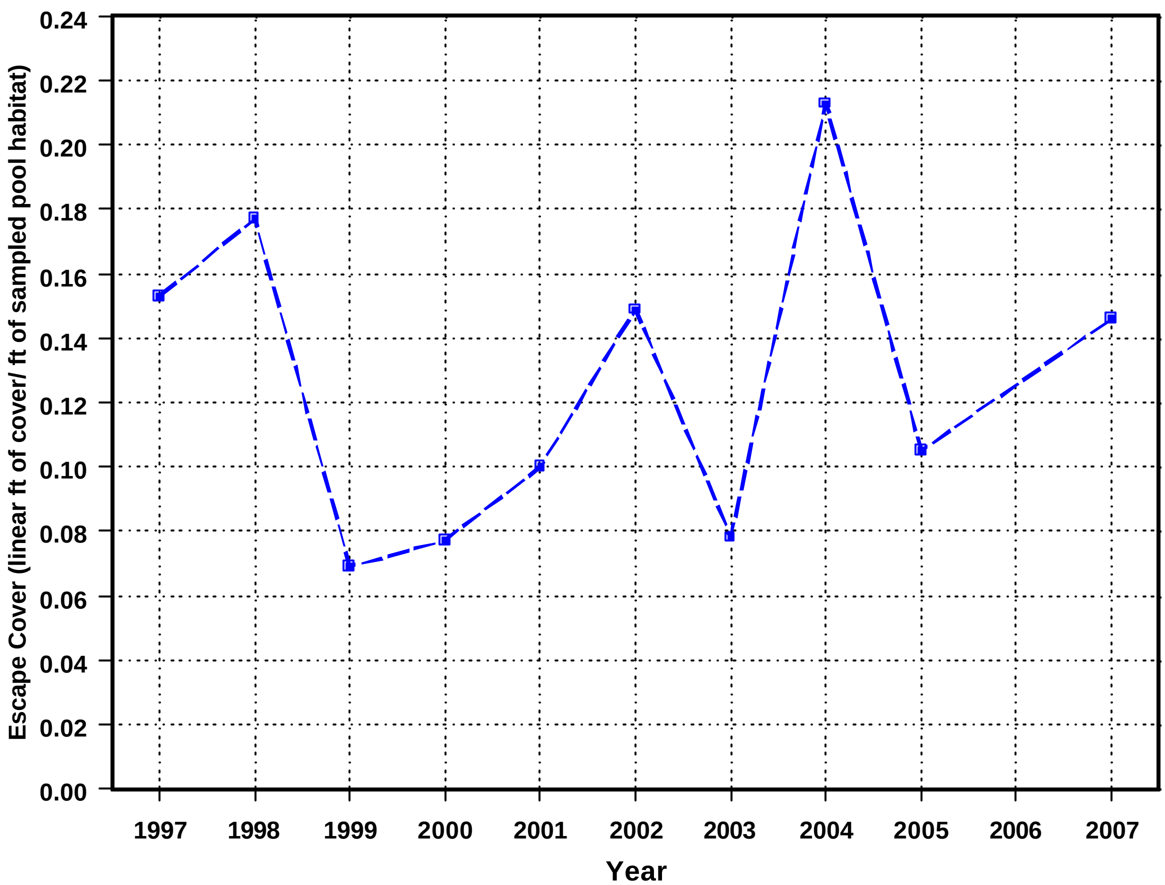


Figure 41. Average Embeddedness for Riffle and Run Habitat at the Sampling Site in Reach 1, of Soquel Creek, 1997-2007.

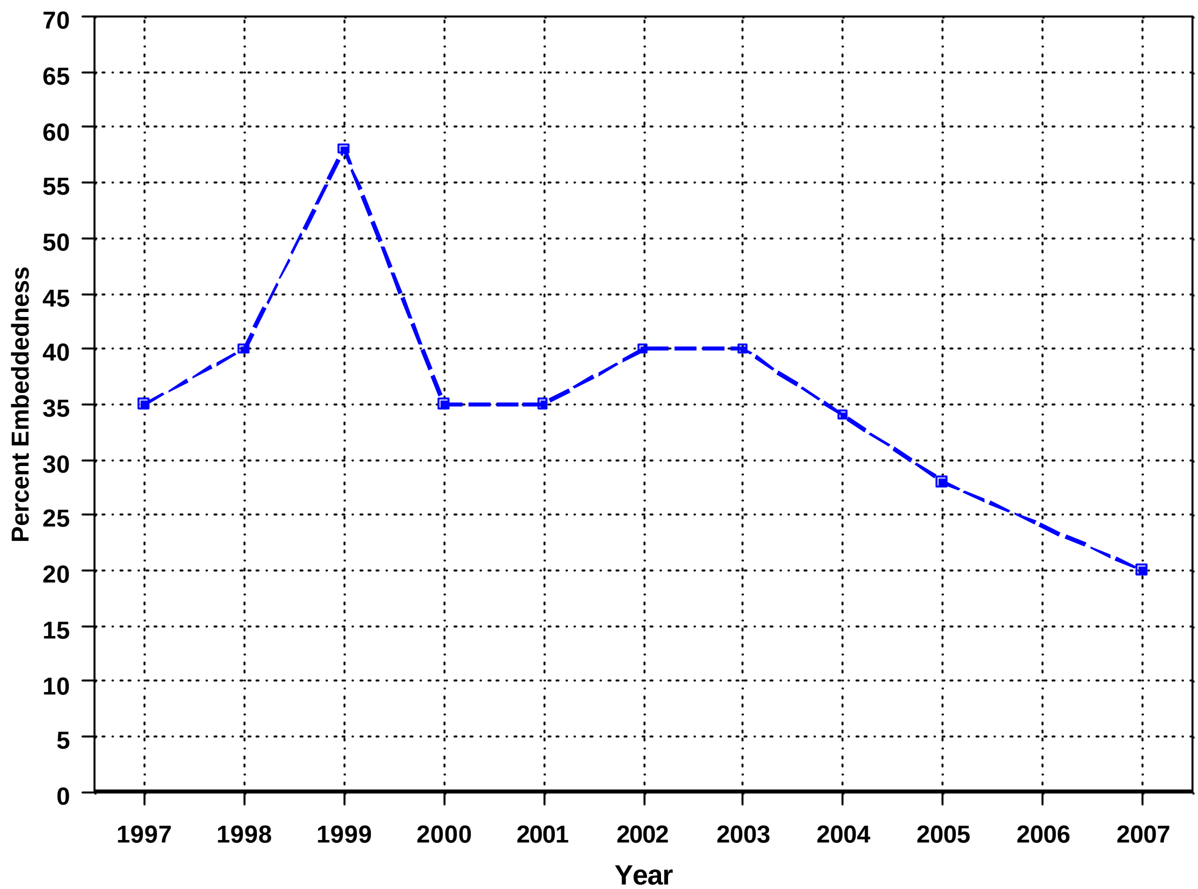


Figure 42. Averaged Maximum and Mean Pool Depth in Reach 7 (Above Moores Gulch) of Soquel Creek, 1997-2007.

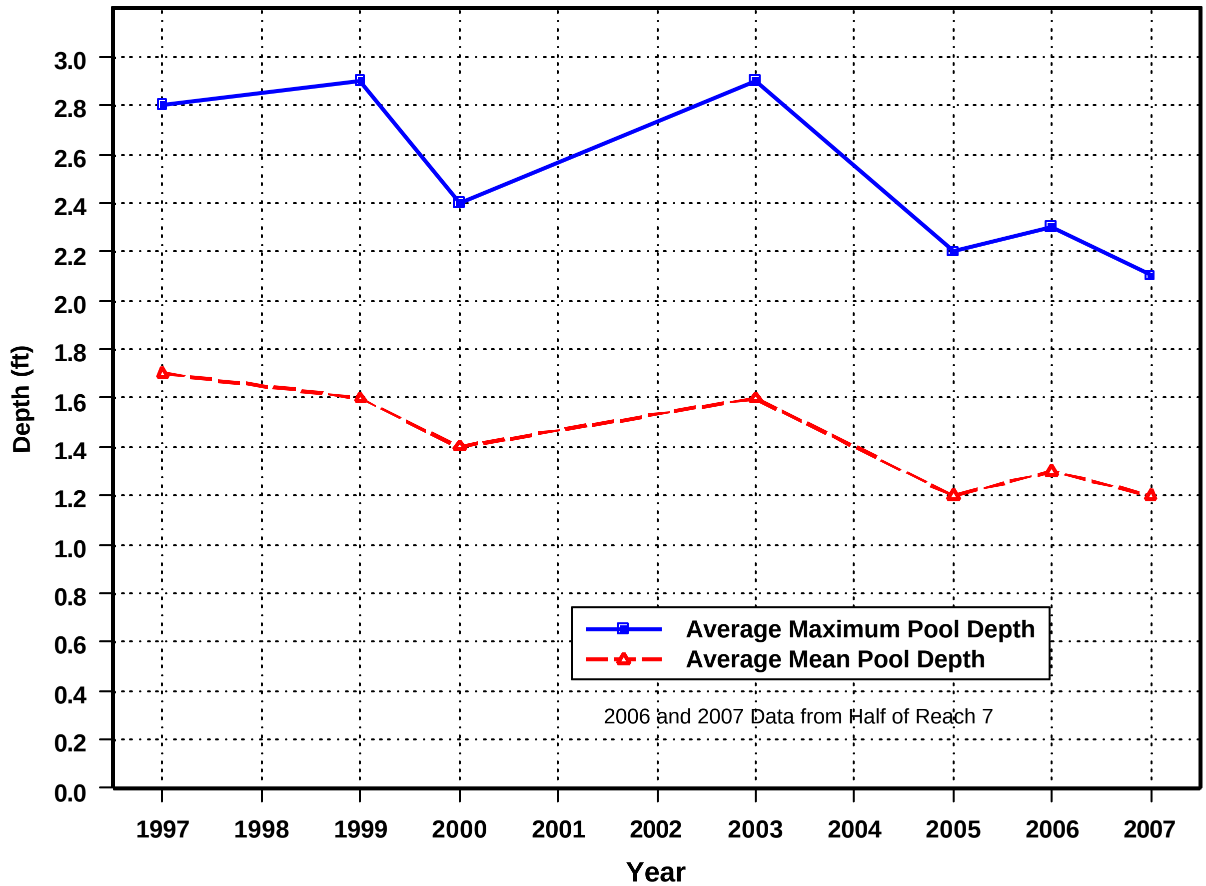


Figure 43a. Escape Cover Index for Pool Habitat in Reach 7 (Above Moores Gulch) of Soquel Creek, 1997-2007.

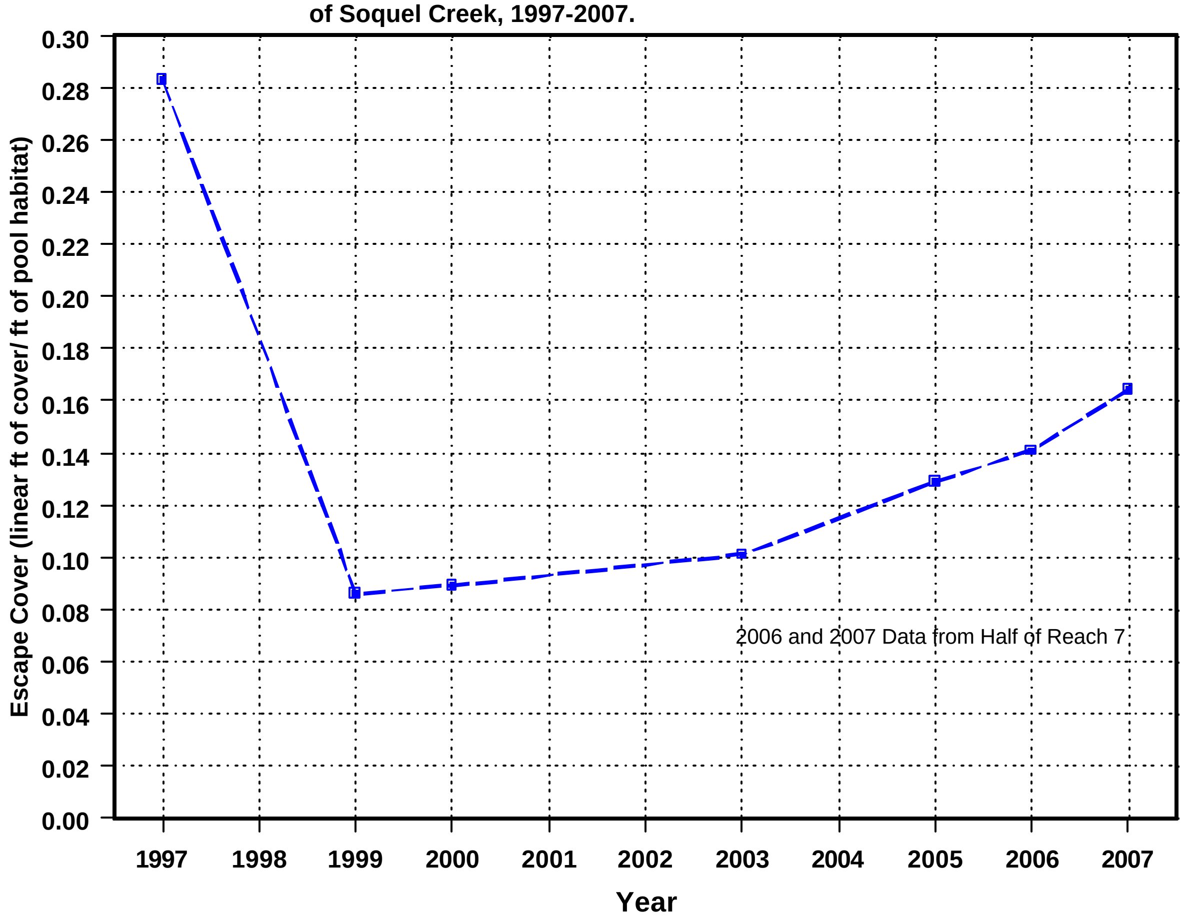


Figure 43b. Escape Cover Index for Pool Habitat at Site 10 (Reach 7 Above Moores Gulch) in Soquel Creek, 1997-2007.

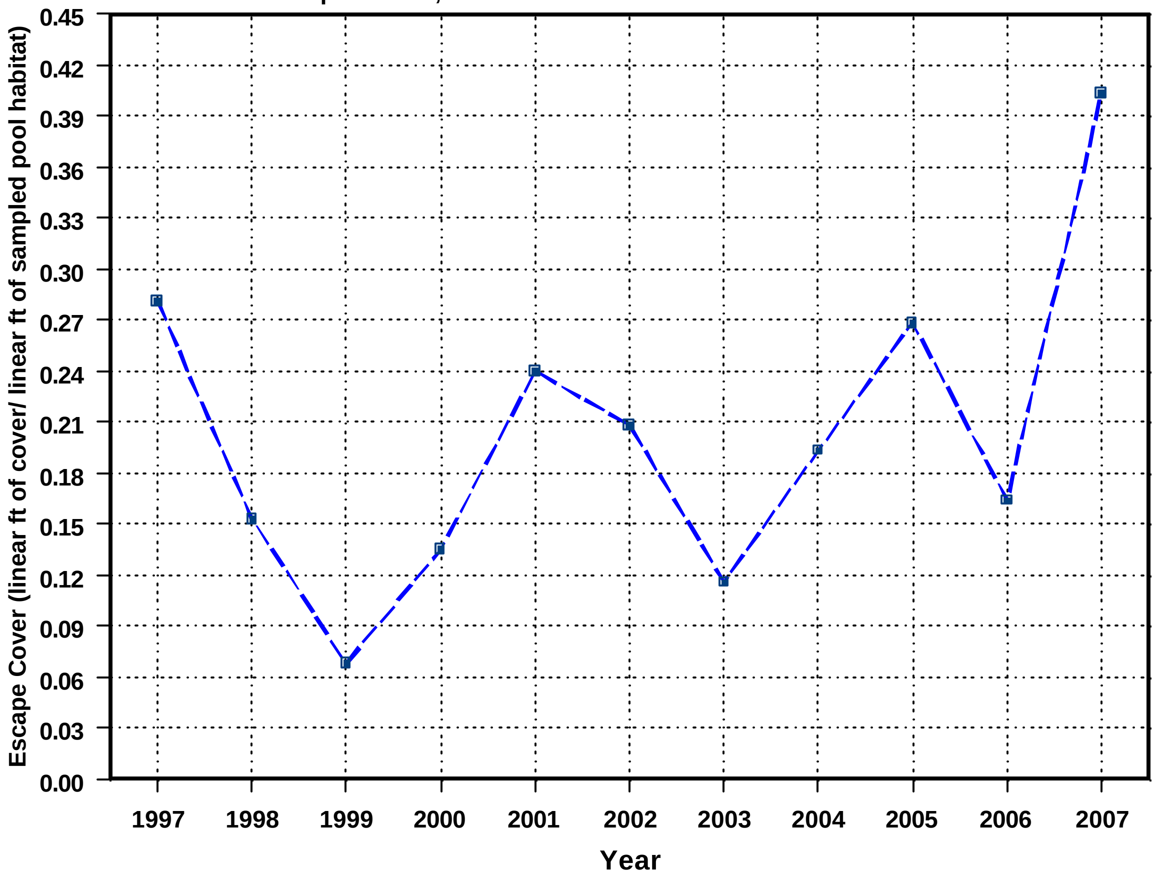


Figure 44. Average Embeddedness for Riffle and Run Habitat at Sampling Site 10 in Reach 7 (Above Moores Gulch) of Soquel Creek, 1997-2007.

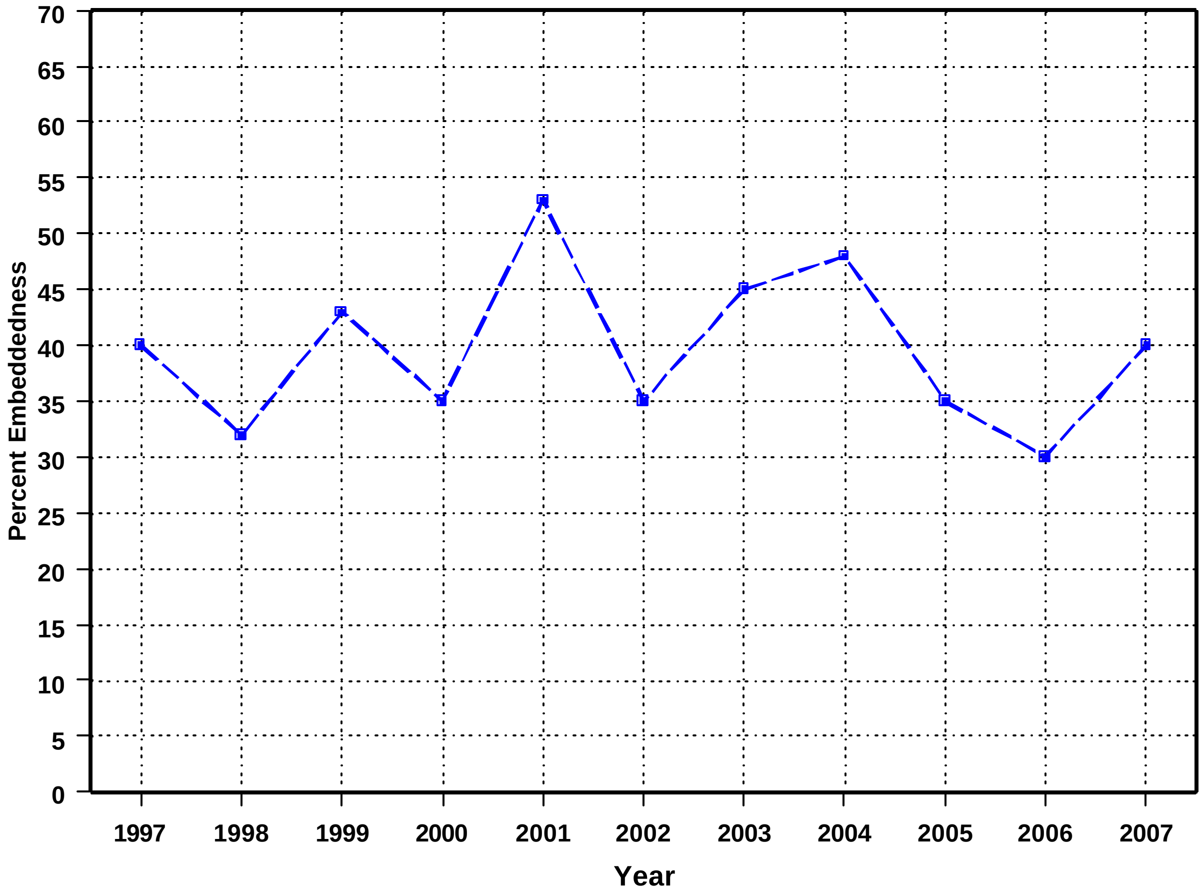


Figure 45. Average Maximum and Mean Pool Depth in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 2000 and 2005-2007.

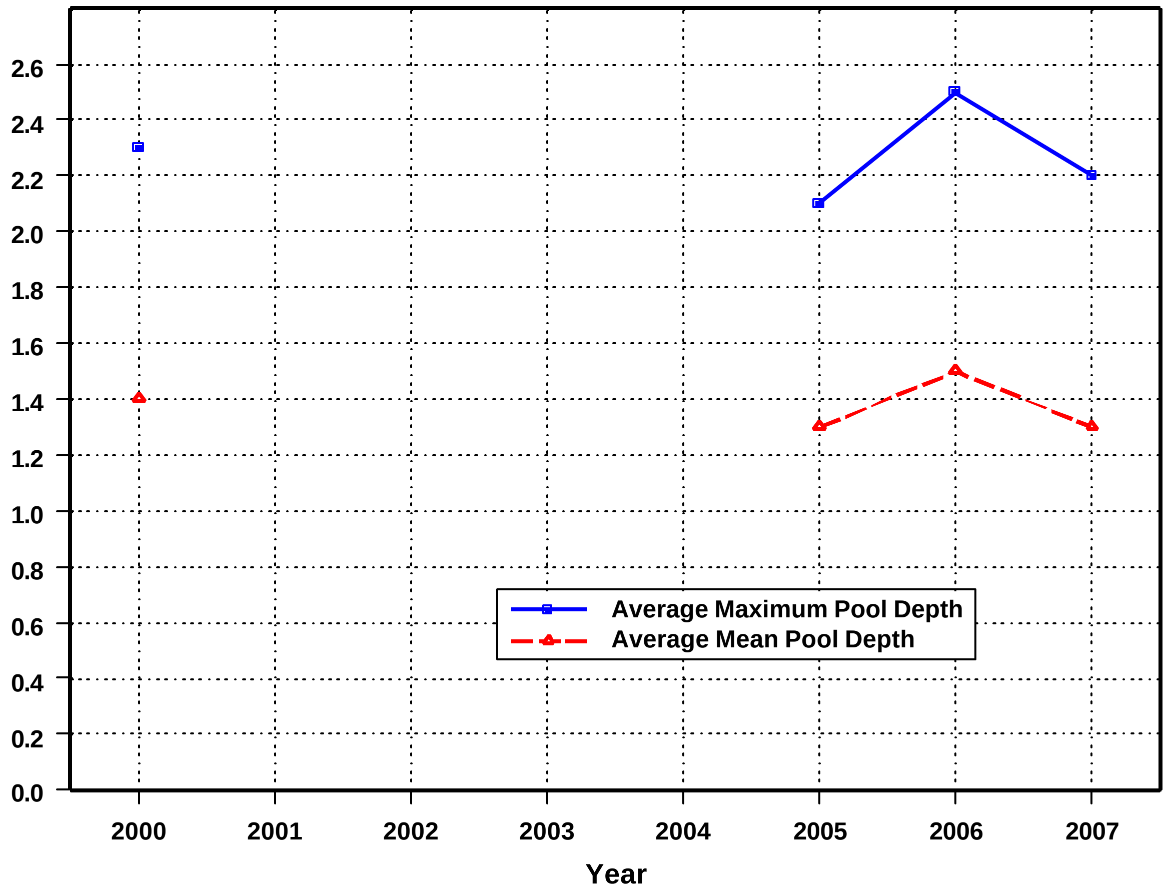


Figure 46a. Escape Cover Index for Pool Habitat in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 2000 and 2005-2007.

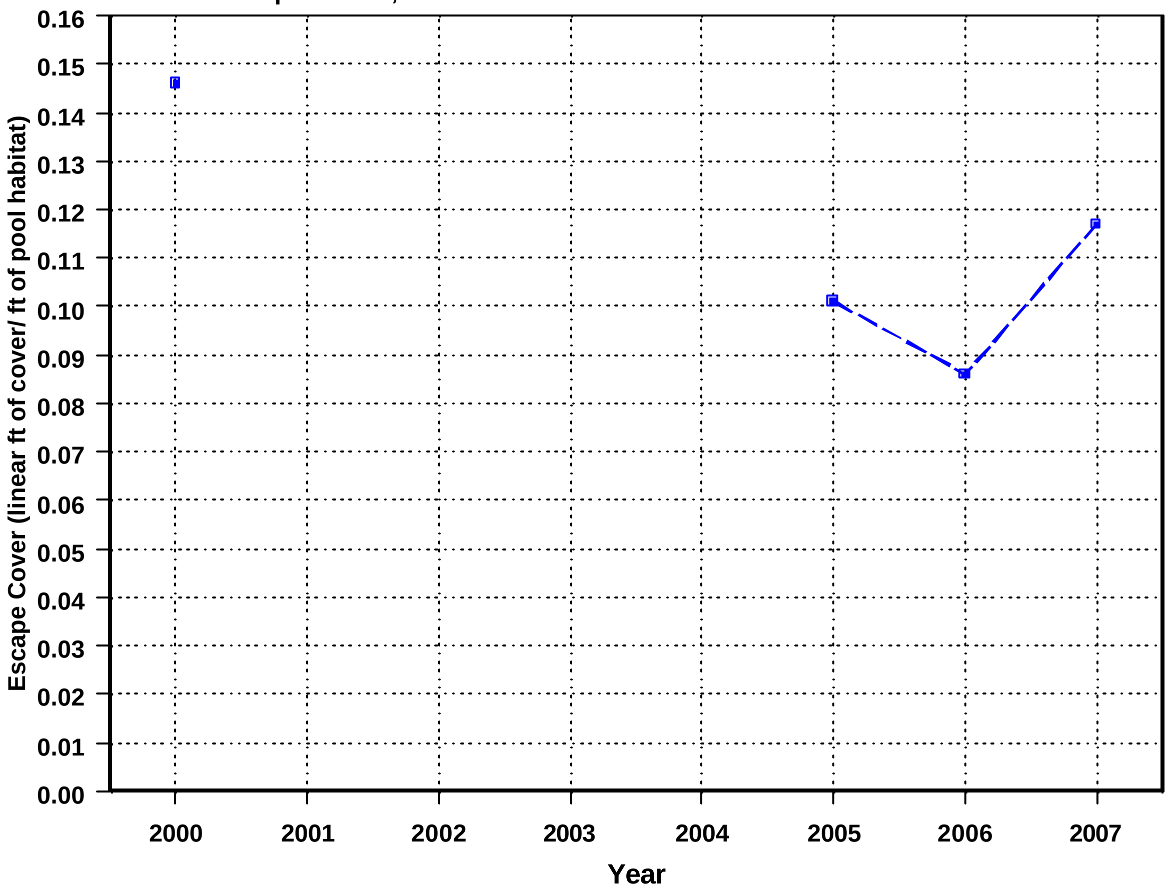


Figure 46b. Escape Cover Index for Pool Habitat at Site 13a (Reach 9a below Mill Pond) in East Branch Soquel Creek, 1997-2007.

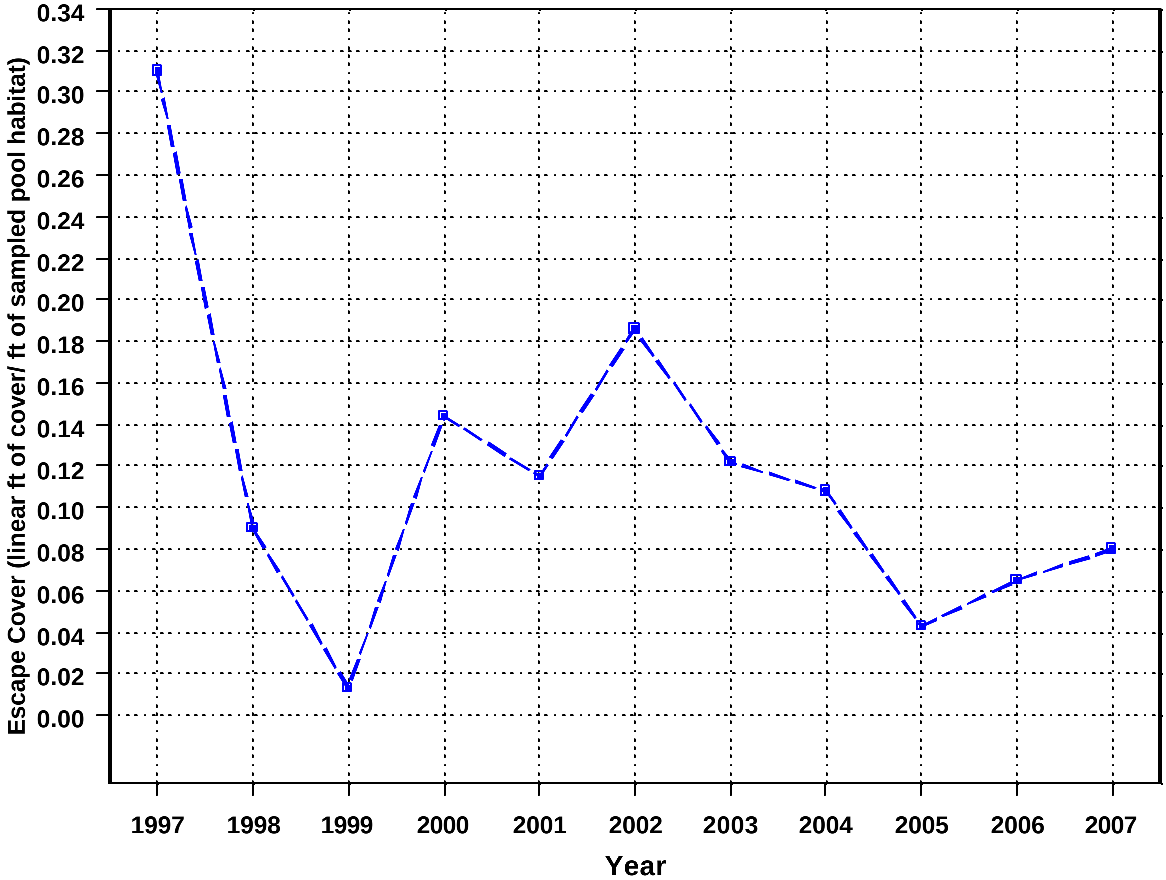


Figure 47. Averaged Percent Fines in Run and Step-Run Habitat in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 2000 and 2005-2007.

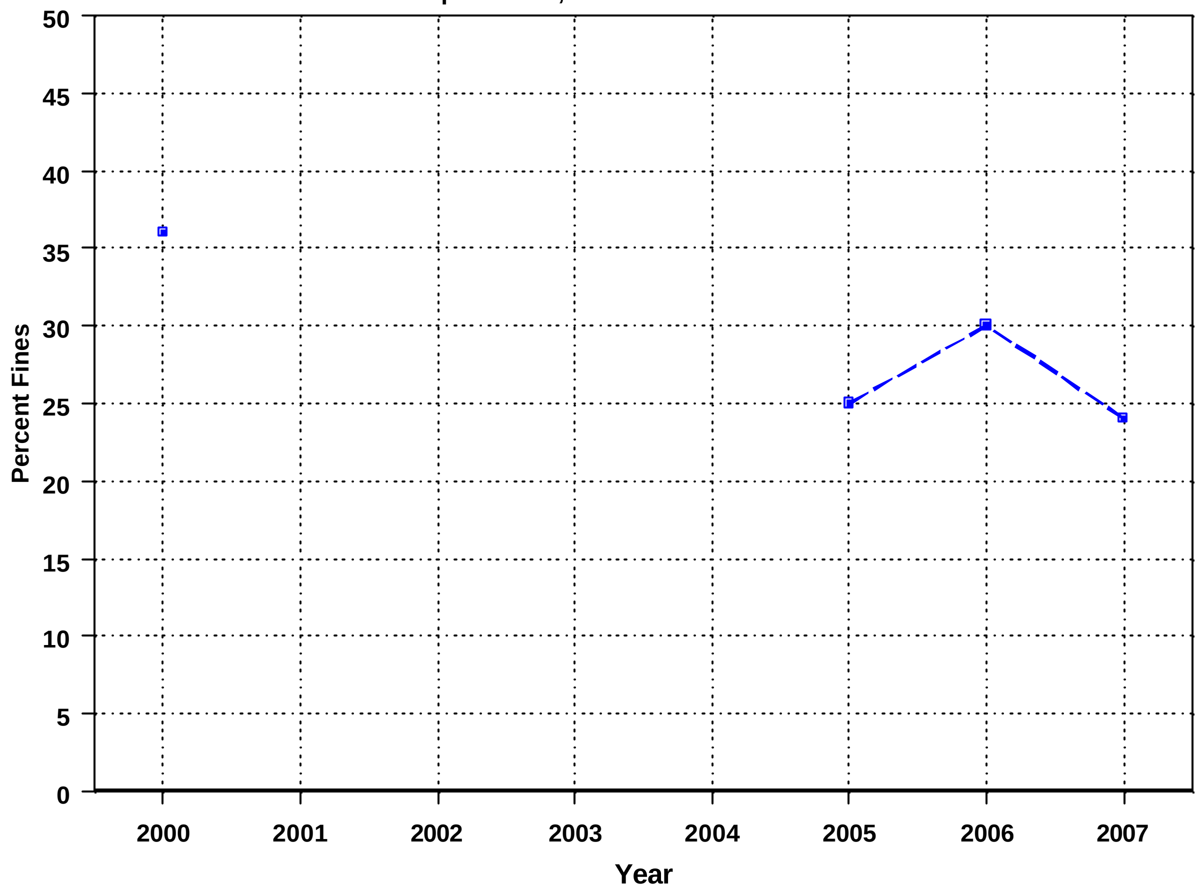


Figure 48. Average Embeddedness for Riffle and Run Habitat at the Sampling Site in Reach 9a (below Mill Pond) of East Branch Soquel Creek, 1997-2005.

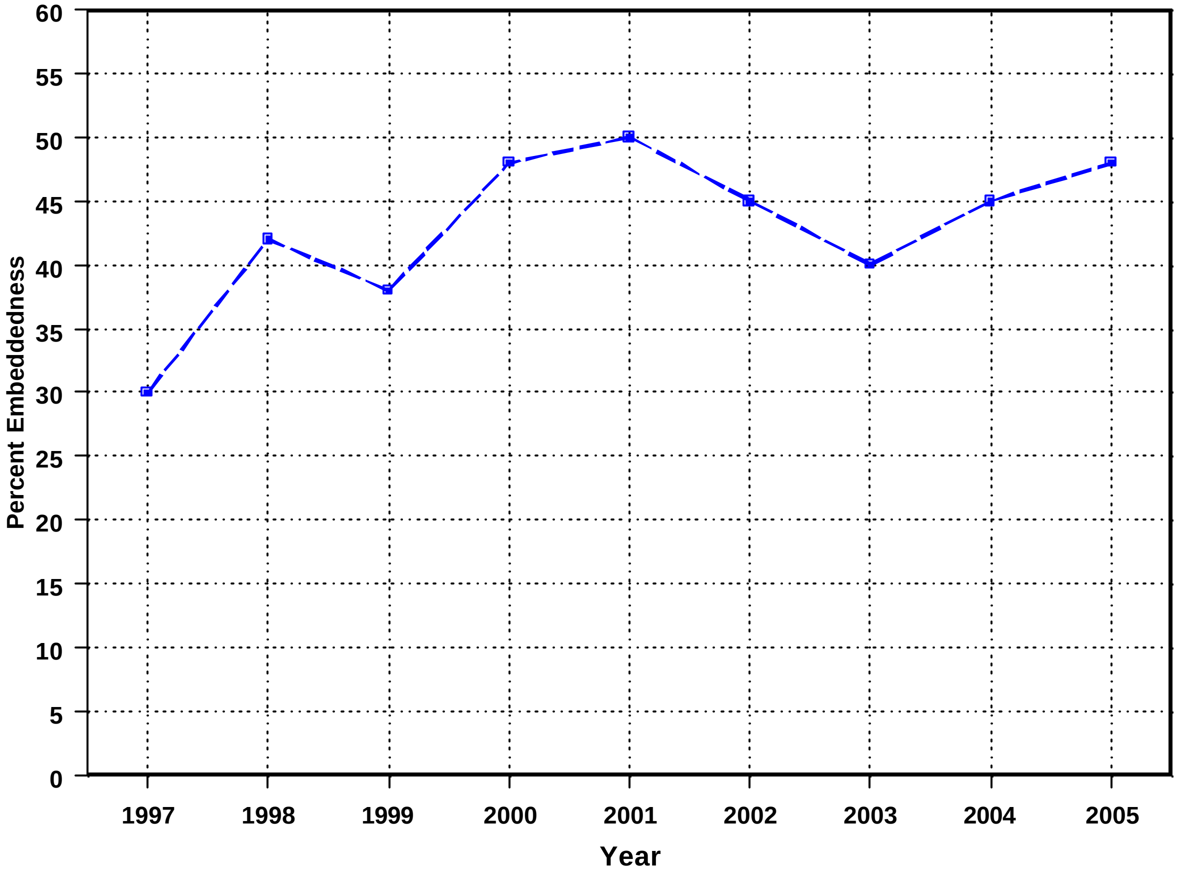


Figure 49. Averaged Maximum and Mean Pool Depth in Reach 12a (SDSF) of East Branch Soquel Creek, 2000 and 2005-2007.

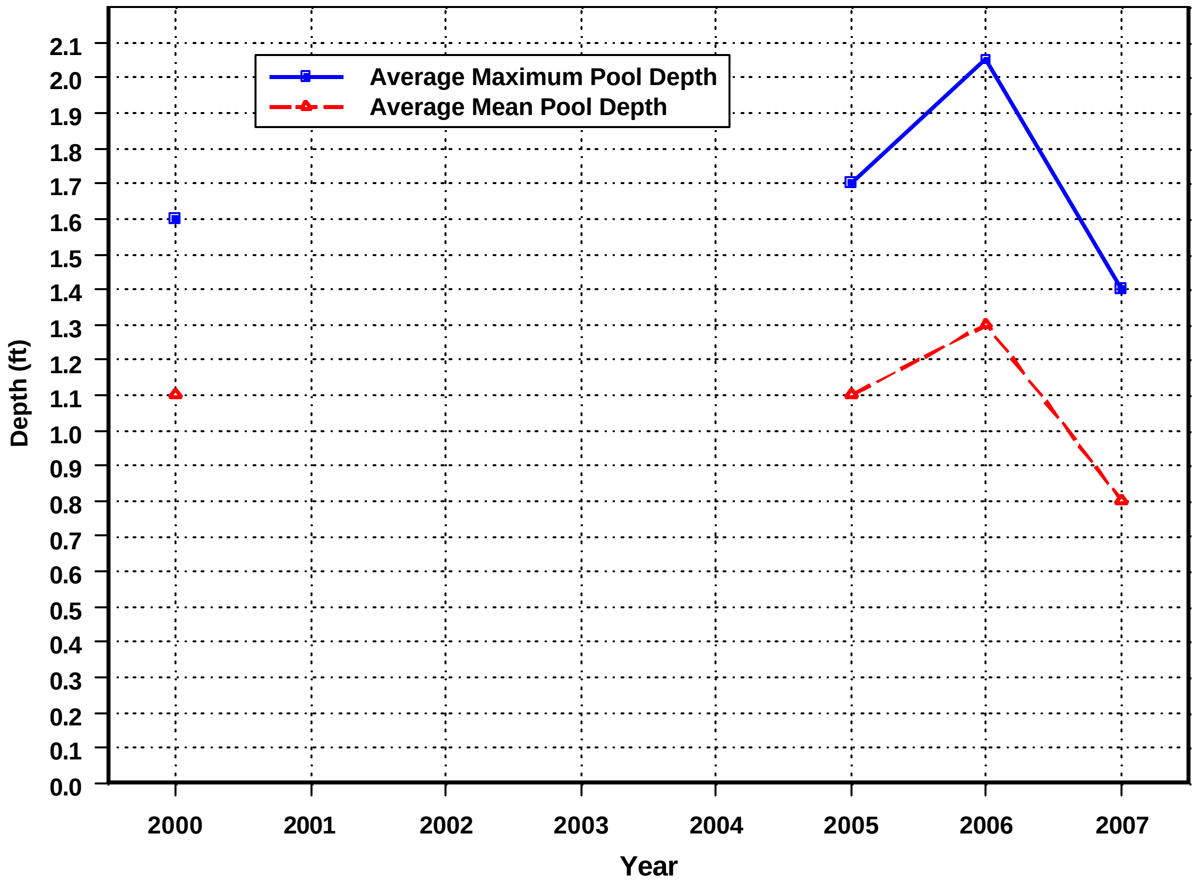


Figure 50a. Escape Cover Index for Pool Habitat in Reach 12a (SDSF) of East Branch Soquel Creek, 2000 and 2005-2007.

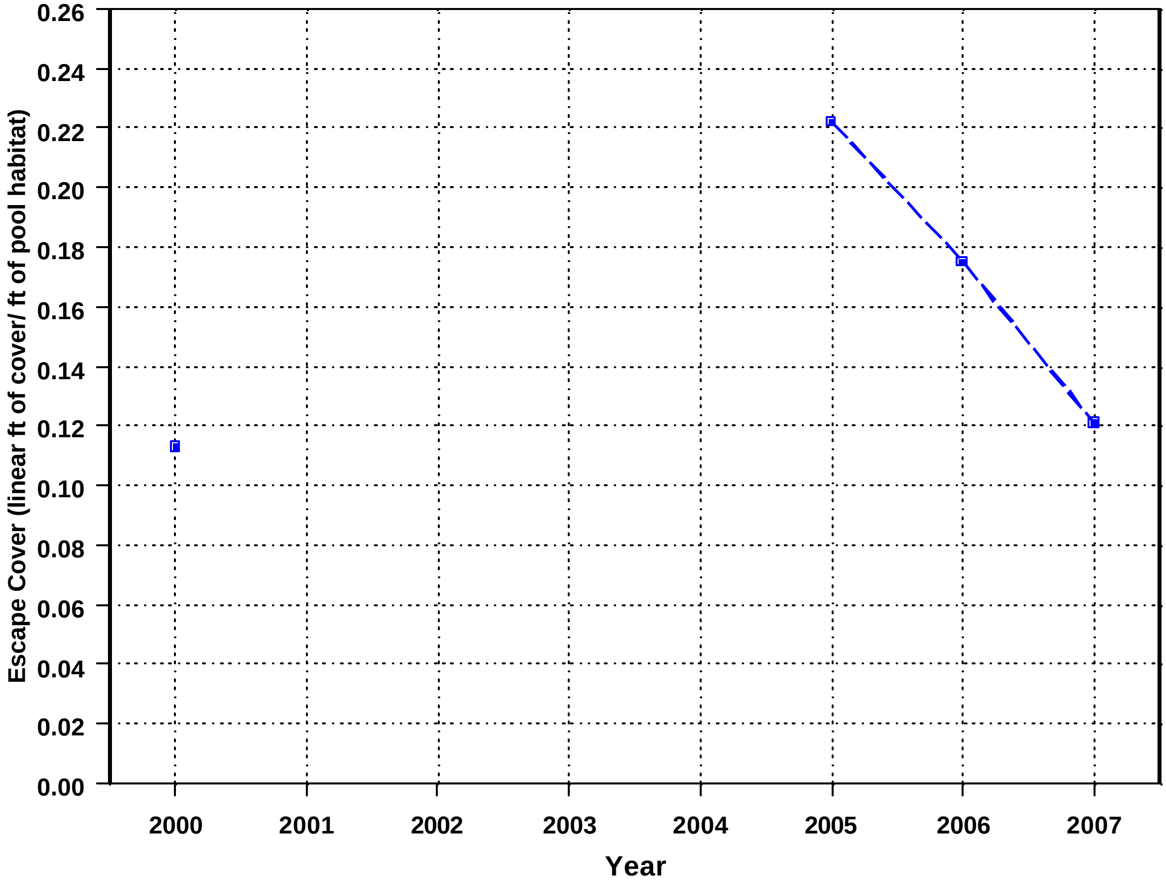


Figure 50b. Escape Cover Index for Pool Habitat at Site 16 (Reach 12a in SDSF) in East Branch Soquel Creek, 2000-2007.

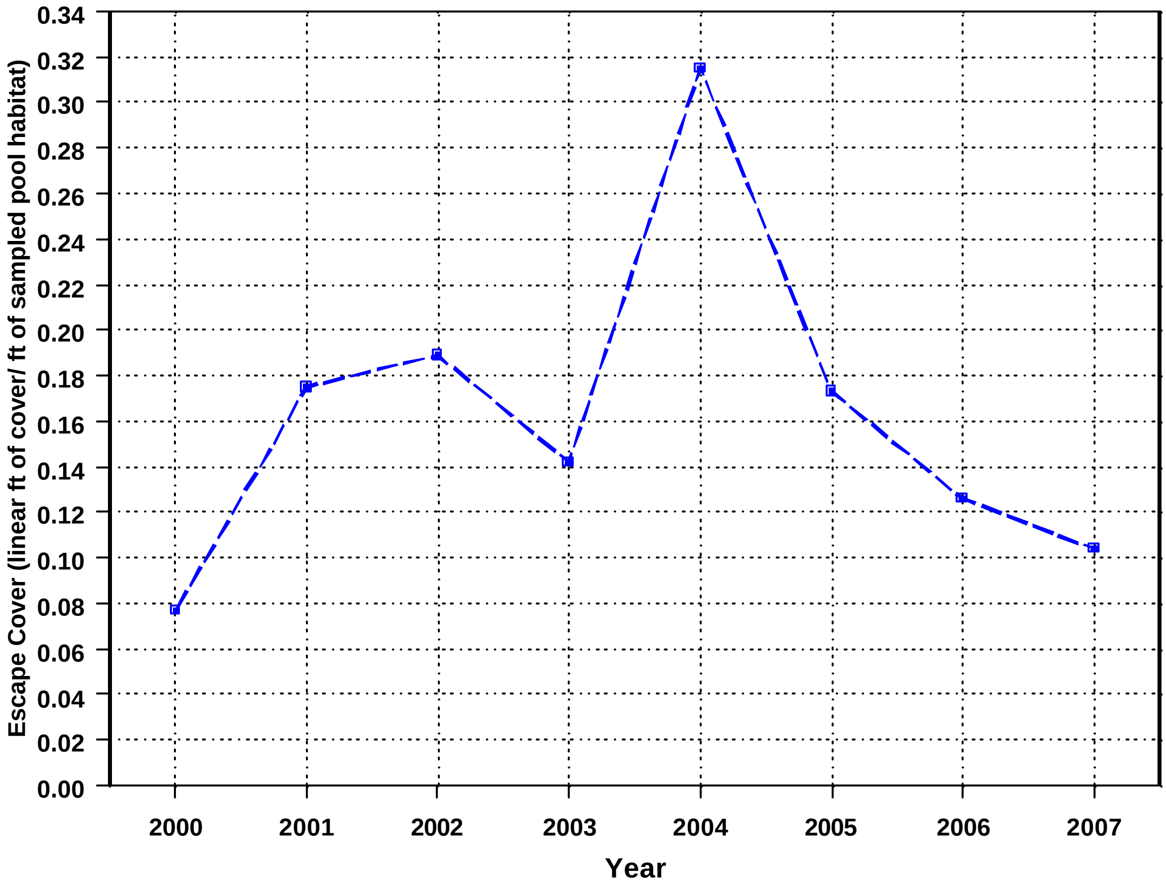


Figure 51. Averaged Percent Fines in Step-Run Habitat in Reach 12a (SDSF) of East Branch Soquel Creek, 2000 and 2005-2007.

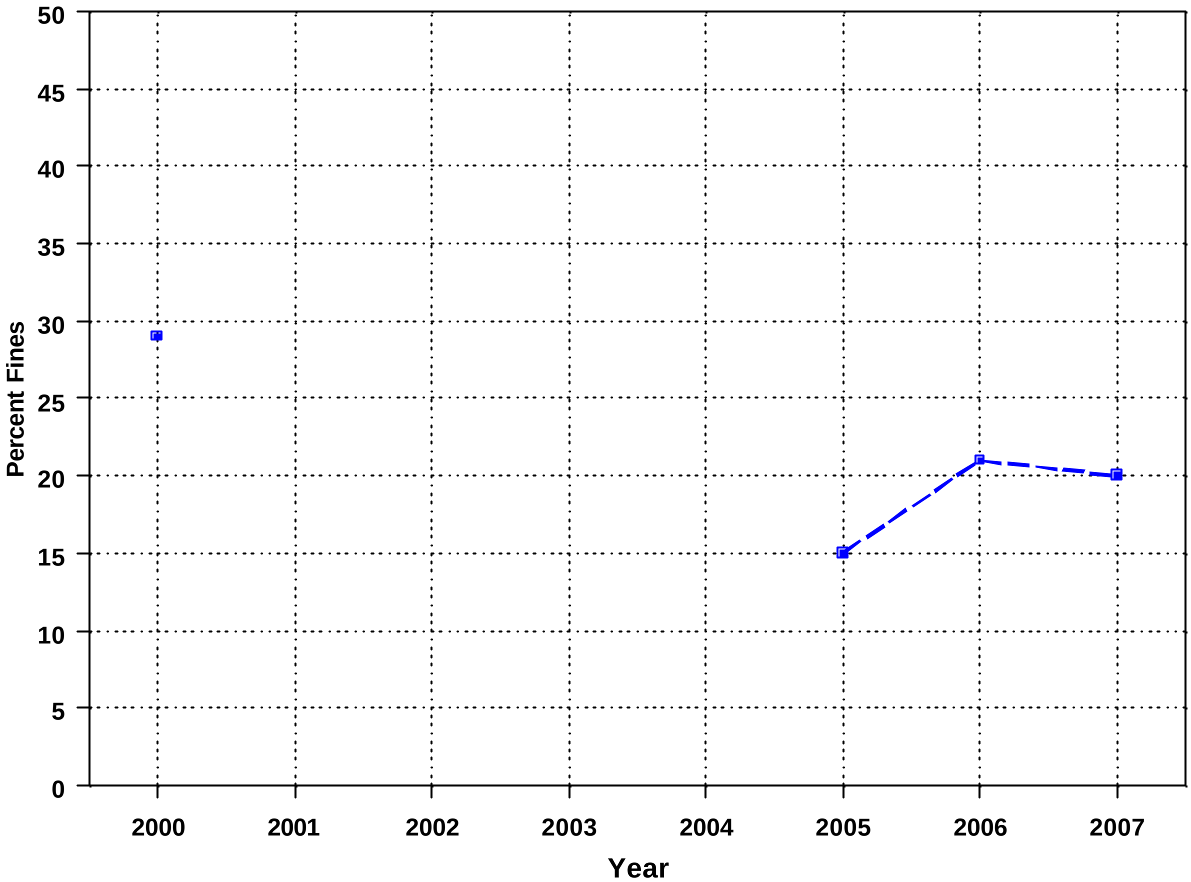


Figure 52. Average Embeddedness for Riffle and Step-run Habitat at the Sampling Site in Reach 12a (SDSF) of East Branch Soquel Creek, 2000-2007.

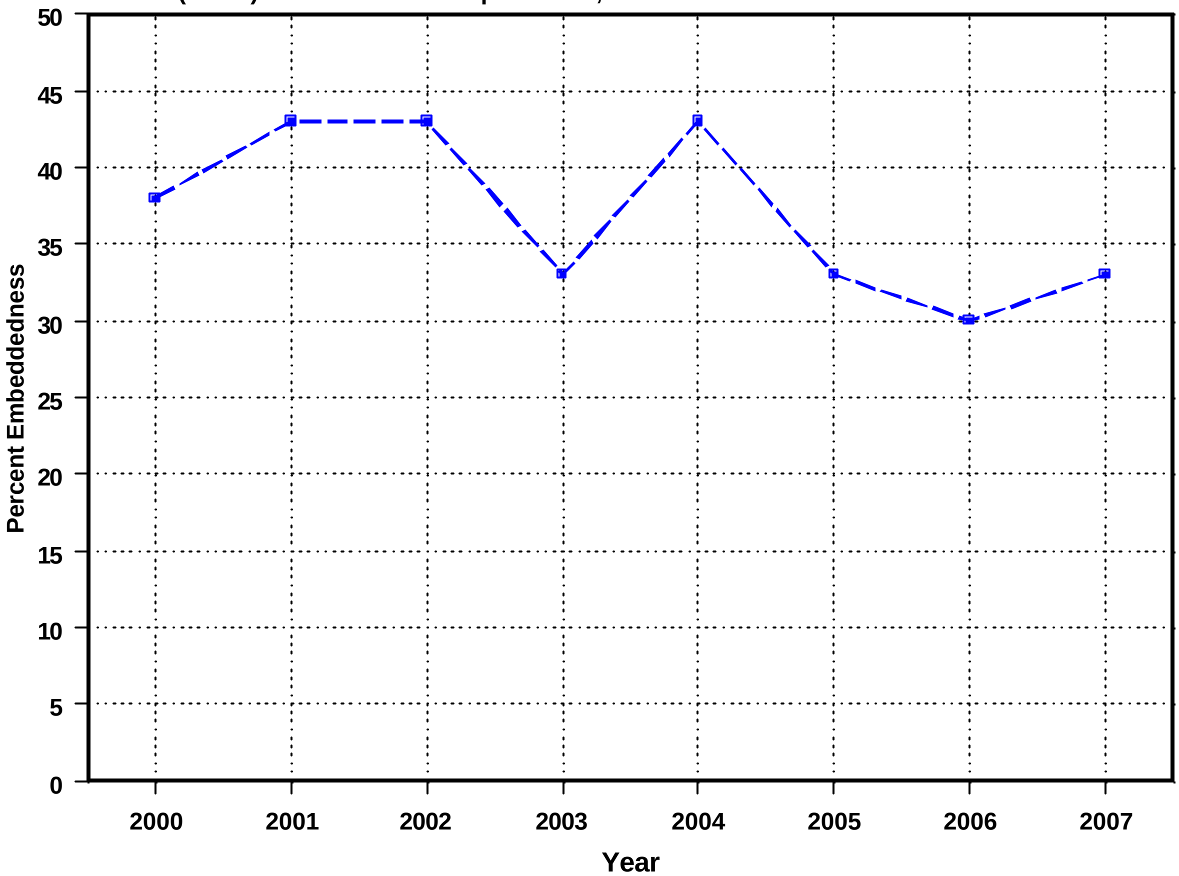


Figure 53. The 1994 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

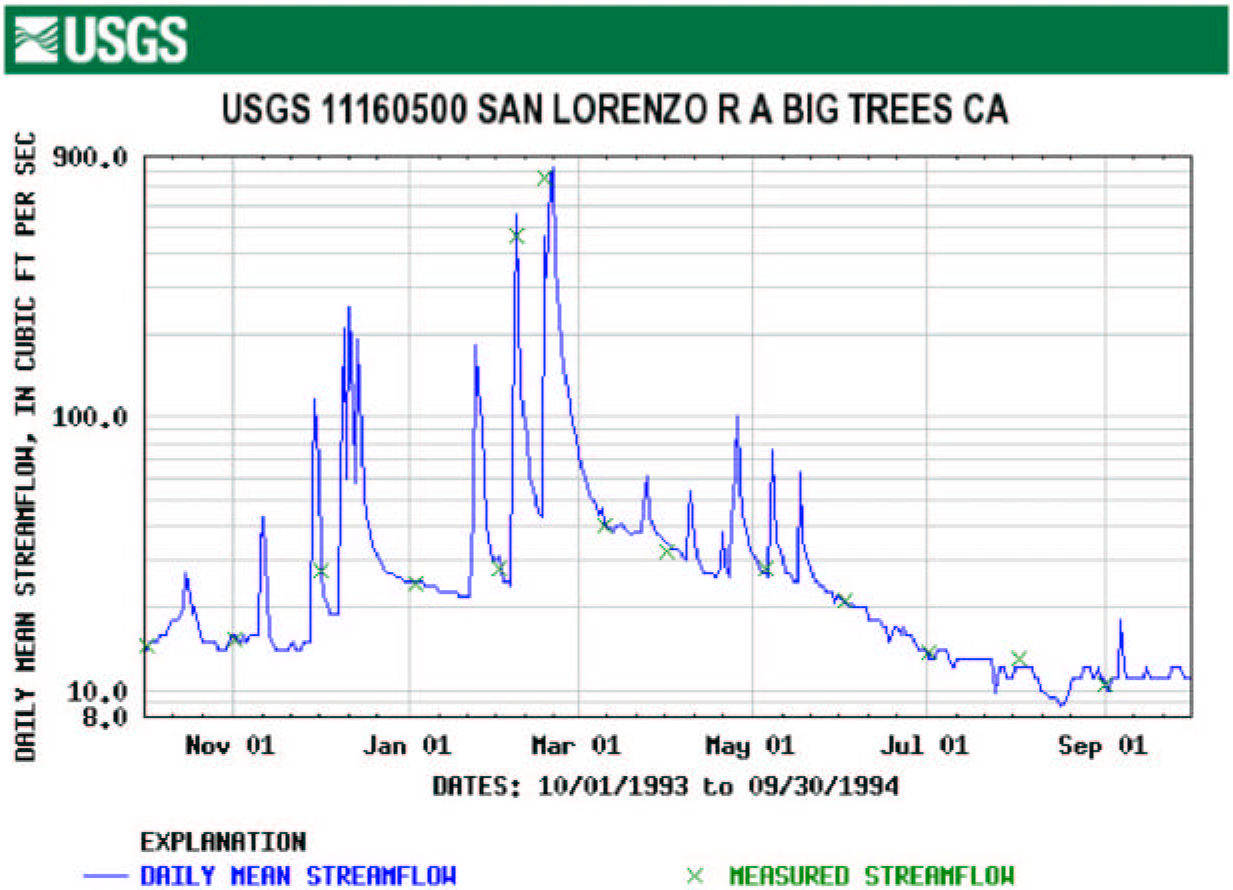


Figure 54. The 1997 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

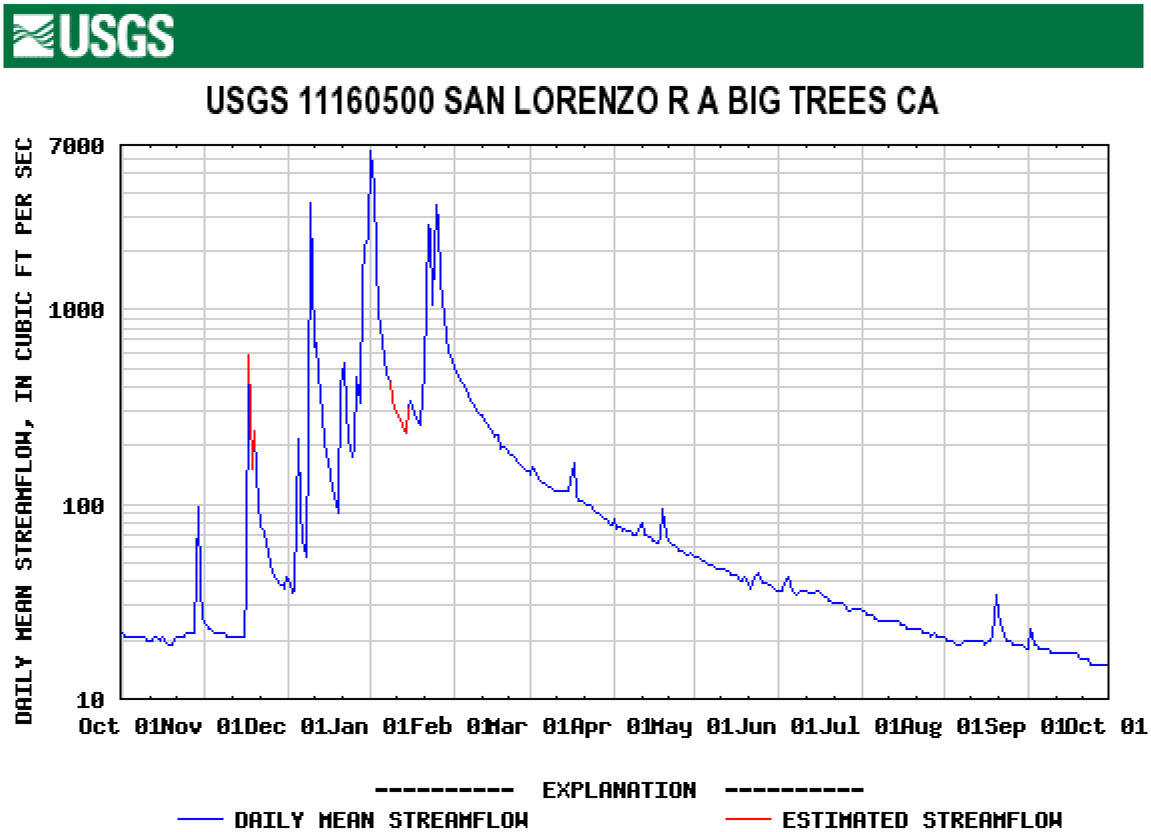


Figure 55. The 1998 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

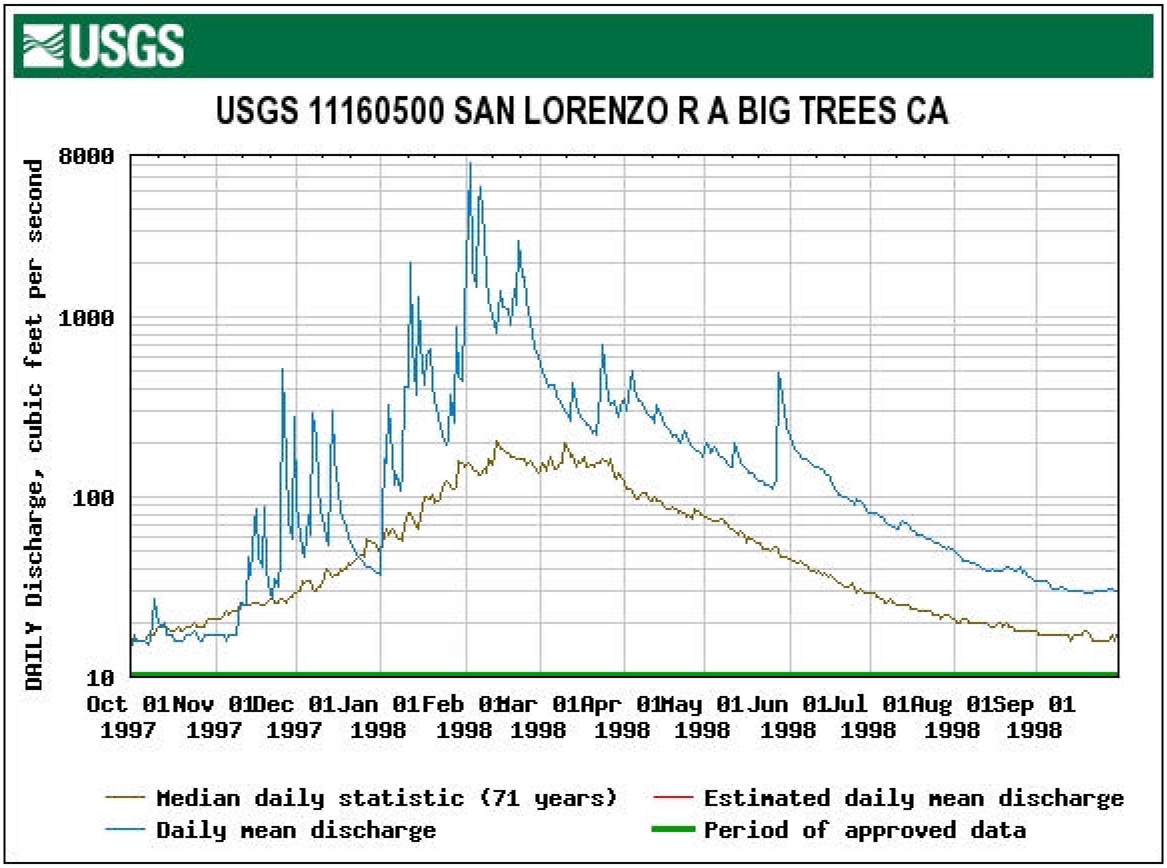


Figure 56. The 1999 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

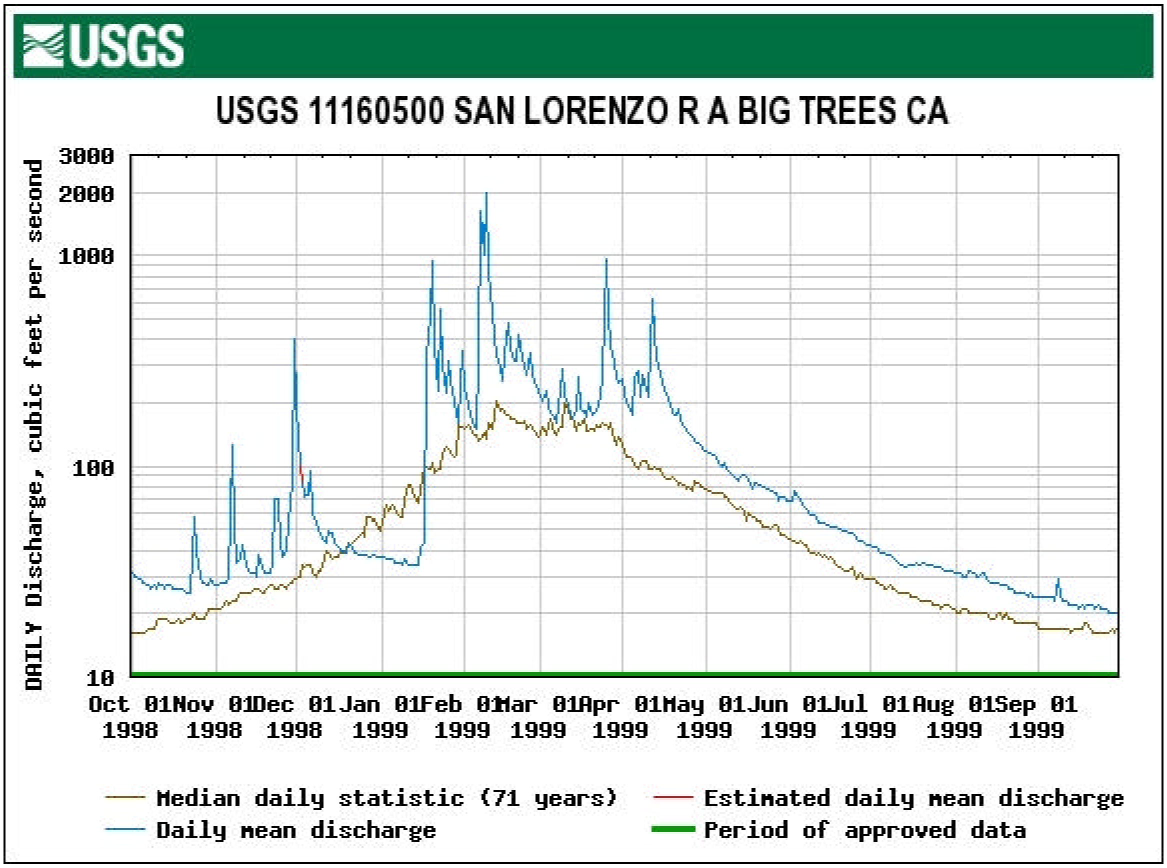


Figure 57. The 2000 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

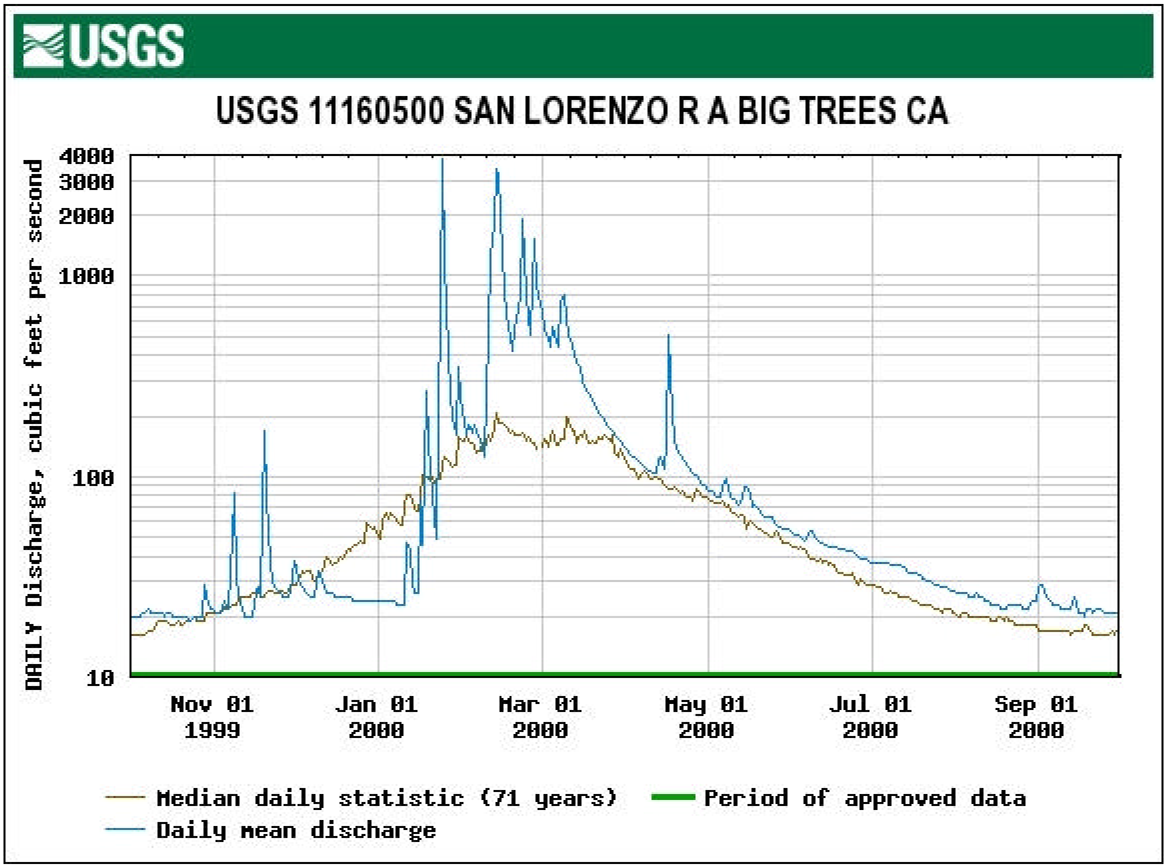


Figure 58. The 2001 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

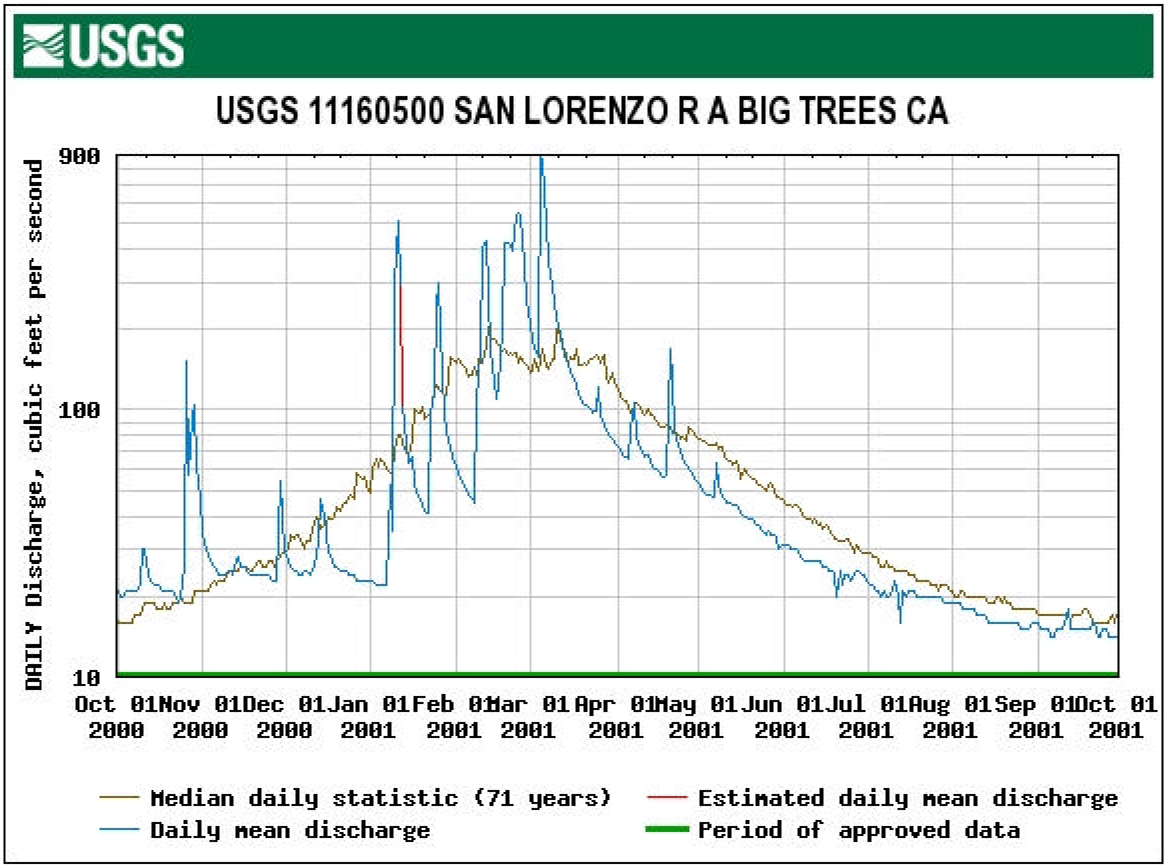


Figure 59. The 2002 Daily Average Discharge for the USGS Gage On the San Lorenzo River at Big Trees.

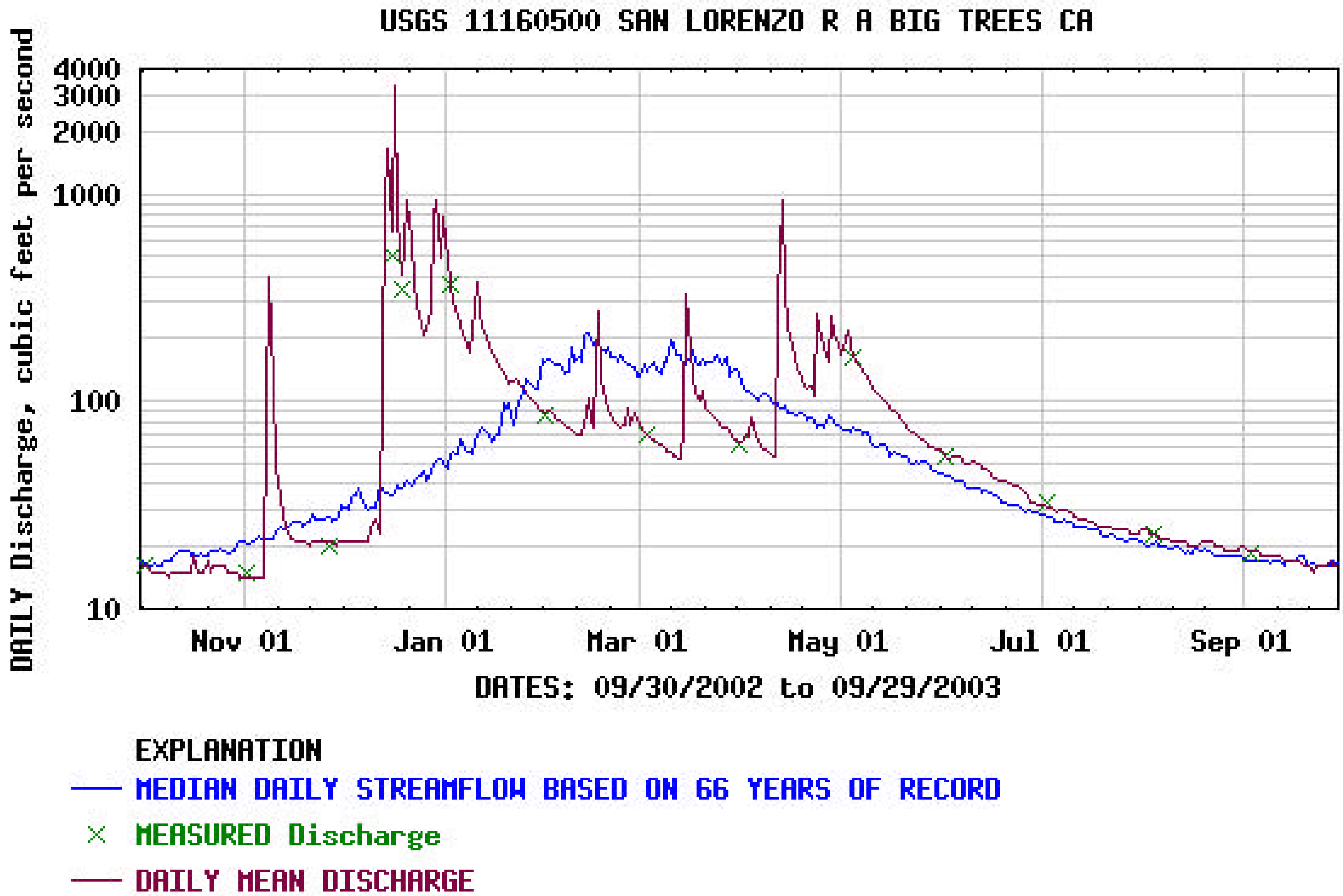


Figure 60. The 2003 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

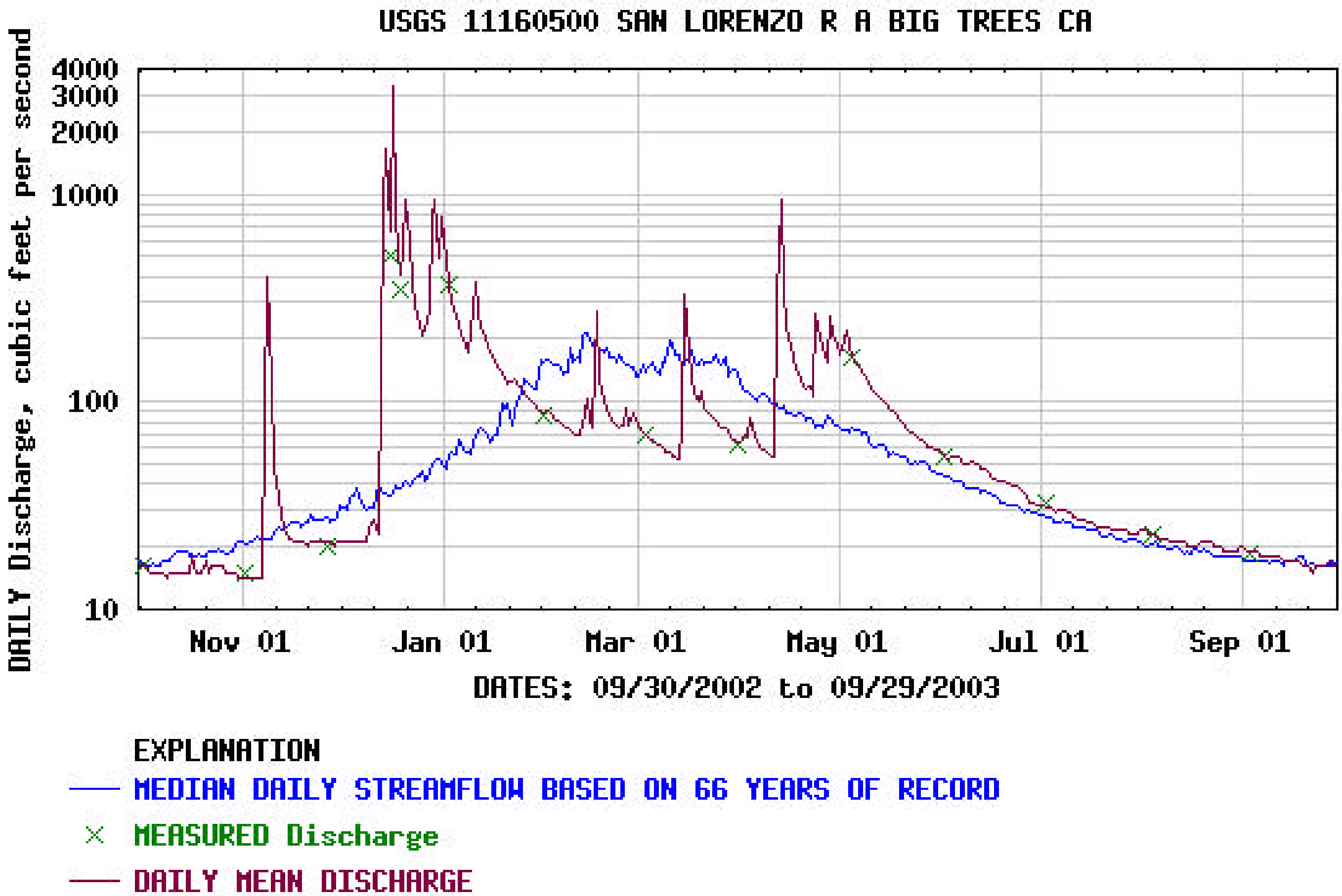


Figure 61. The 2004 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

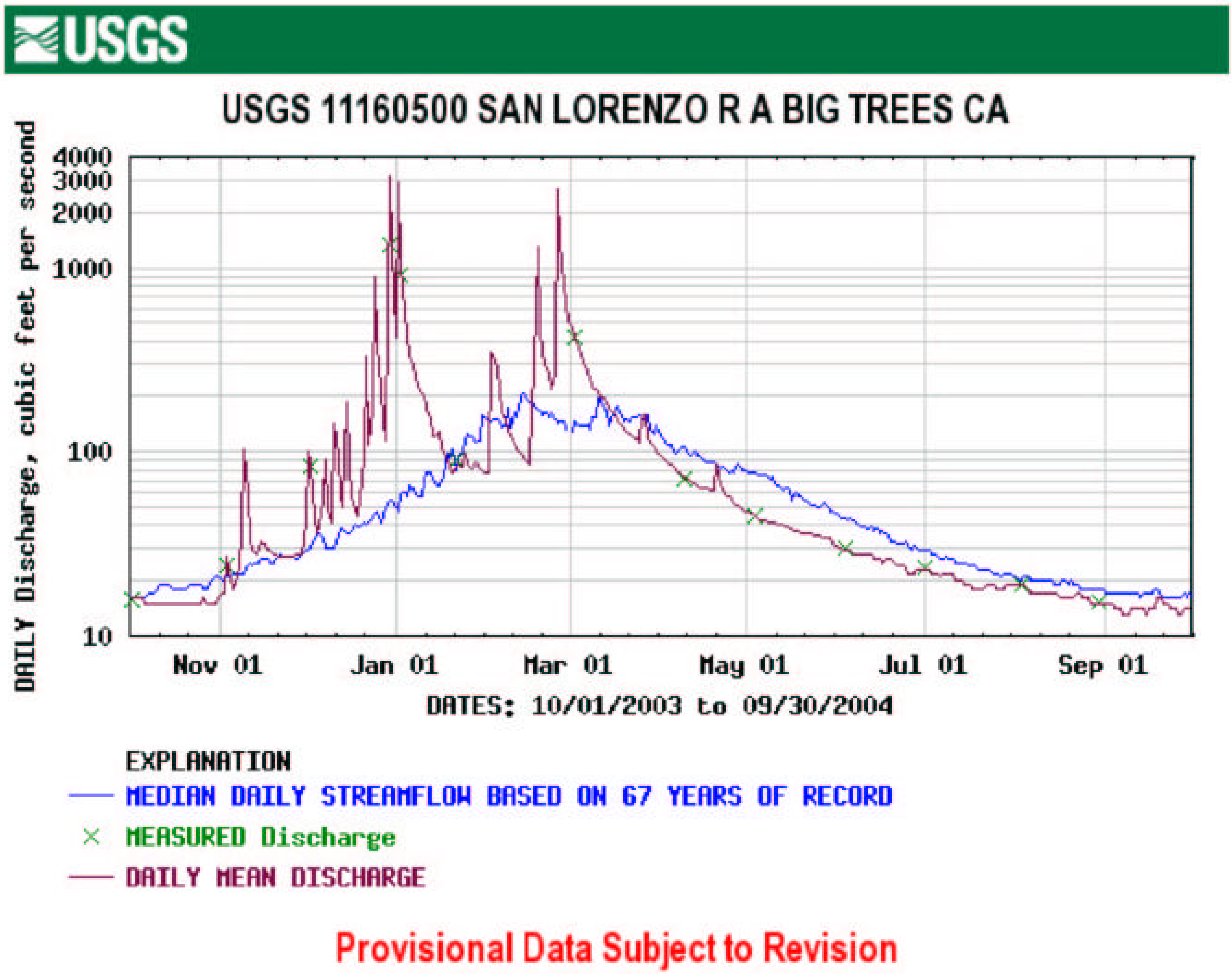


Figure 62. The 2005 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

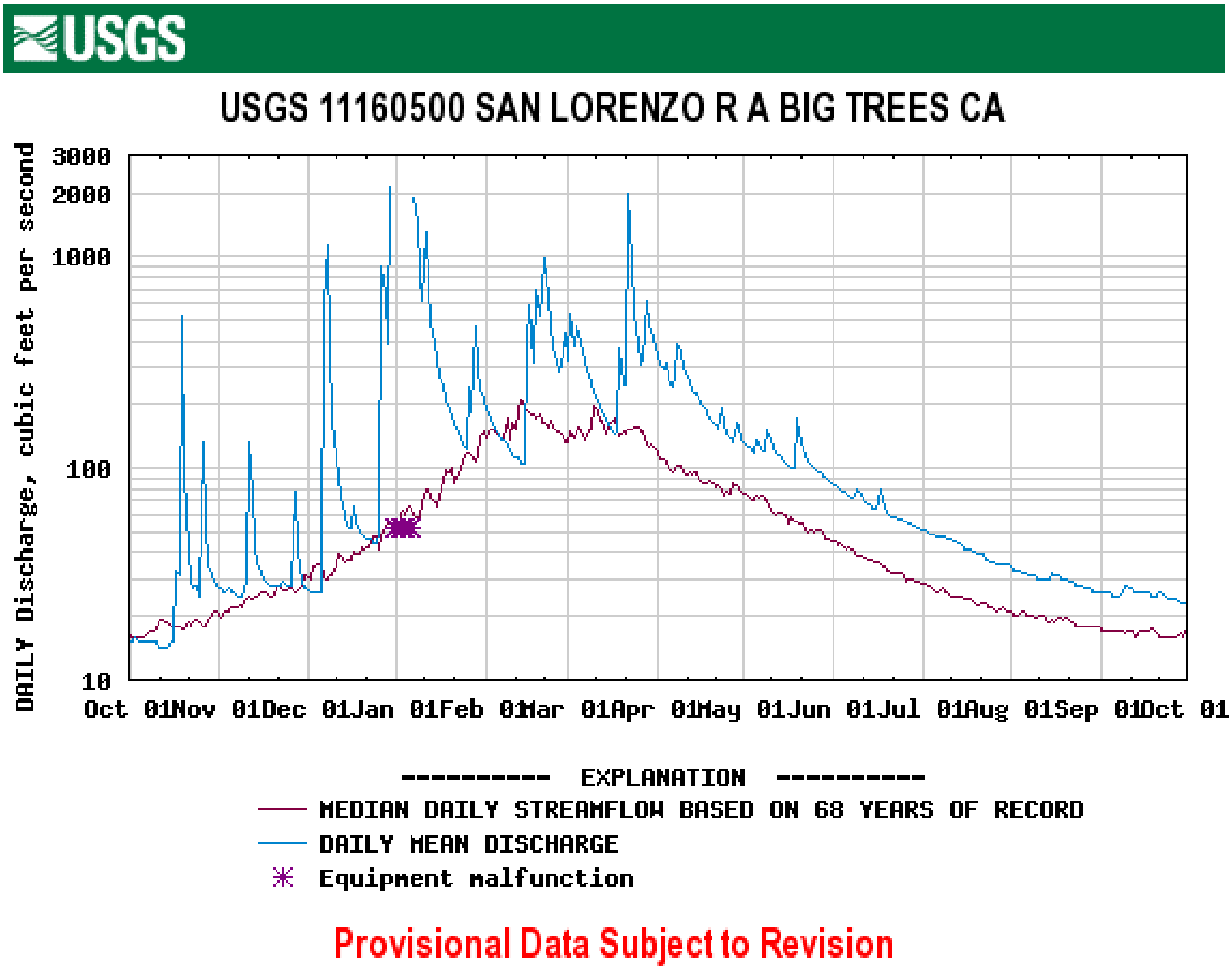


Figure 63. The 2005 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Santa Cruz. (Included because of equipment malfunction at the Big Trees Gage during a stormflow in early January.)

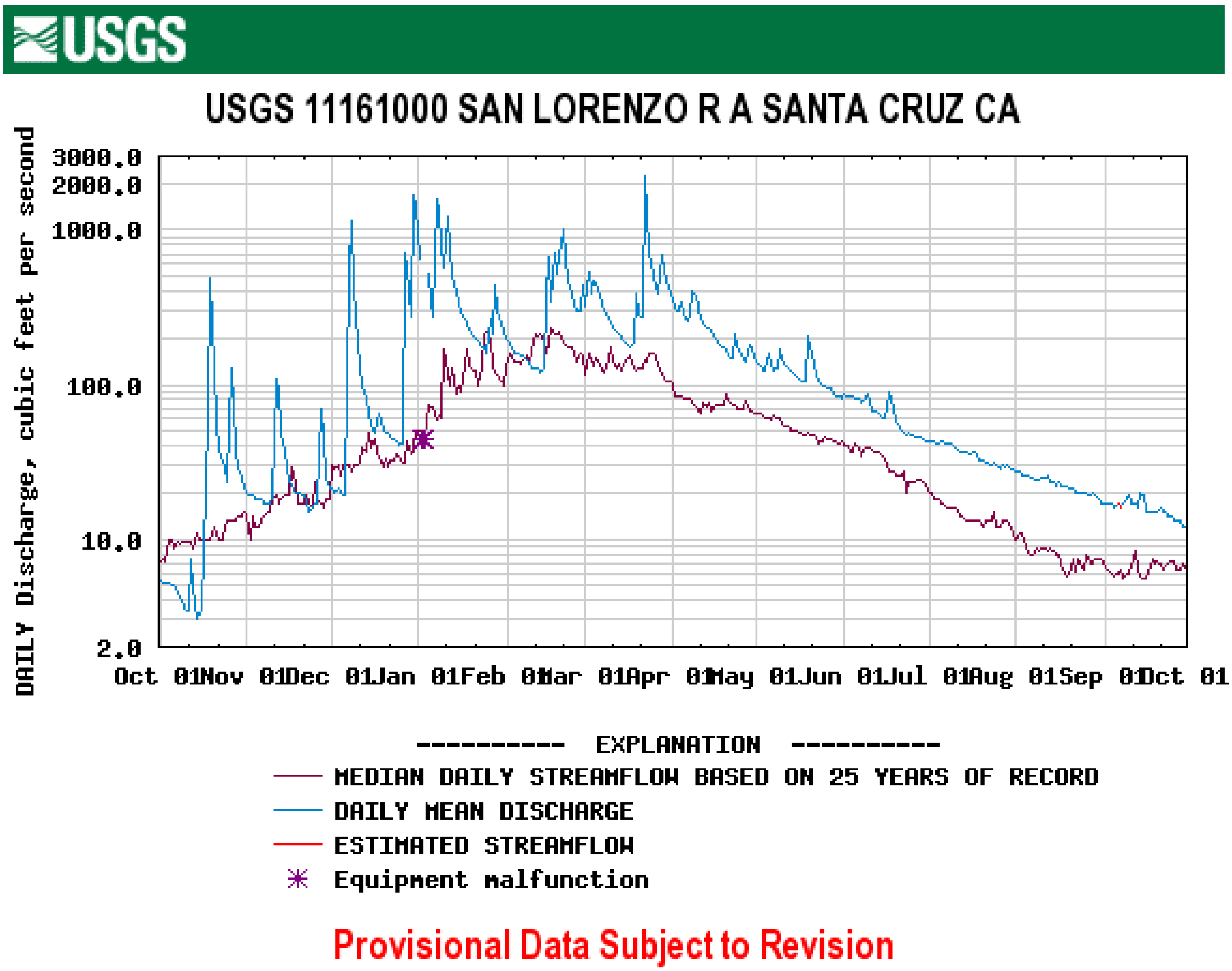


Figure 64. The 2006 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

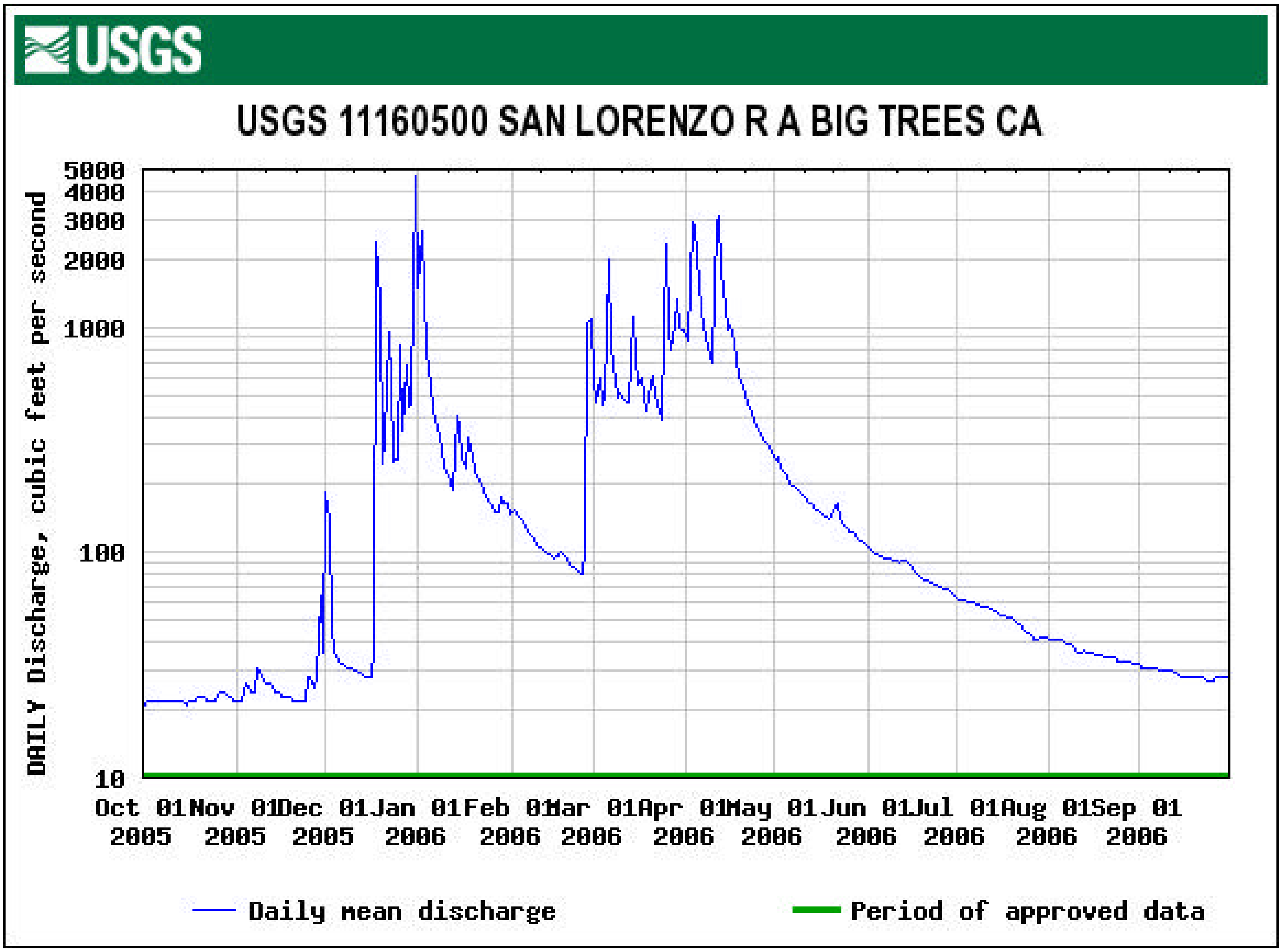


Figure 65. The 2007 Daily Average Discharge and Median Daily Flow on Record for the USGS Gage On the San Lorenzo River at Big Trees.

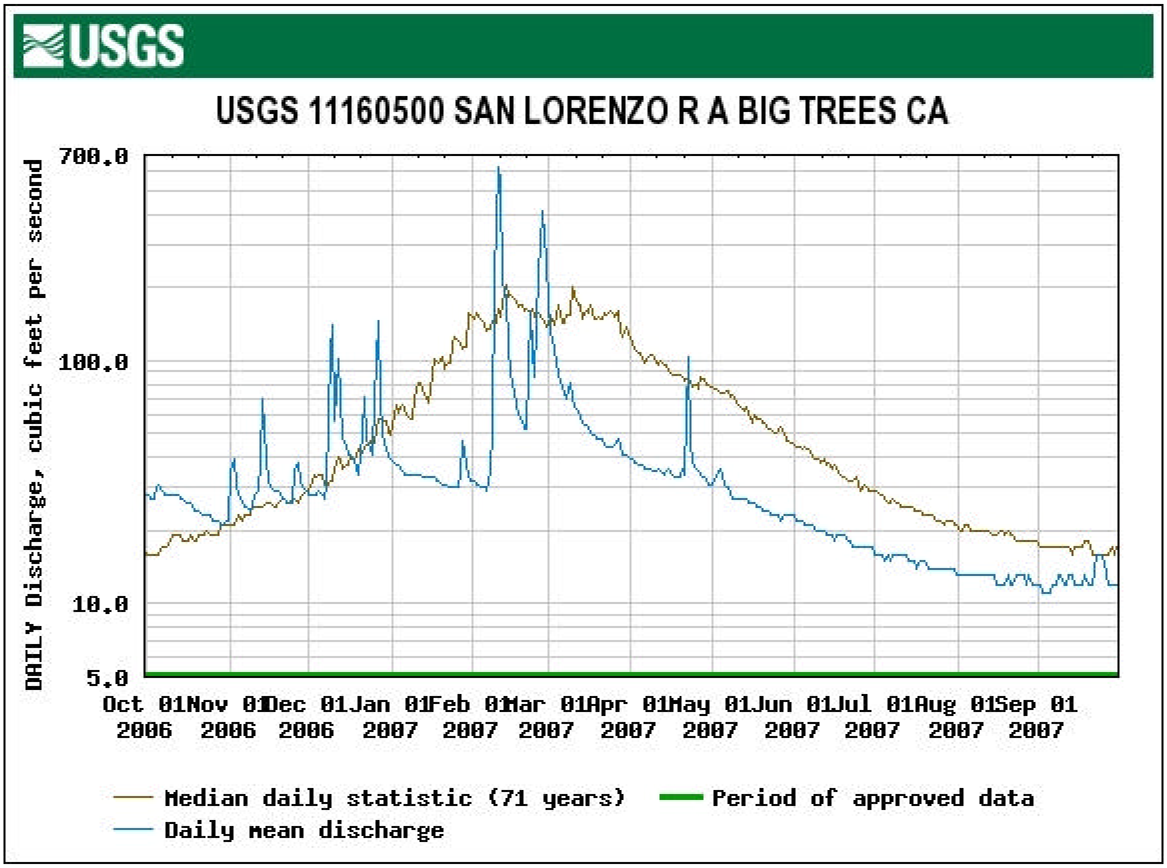


Figure 66. The 1995 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

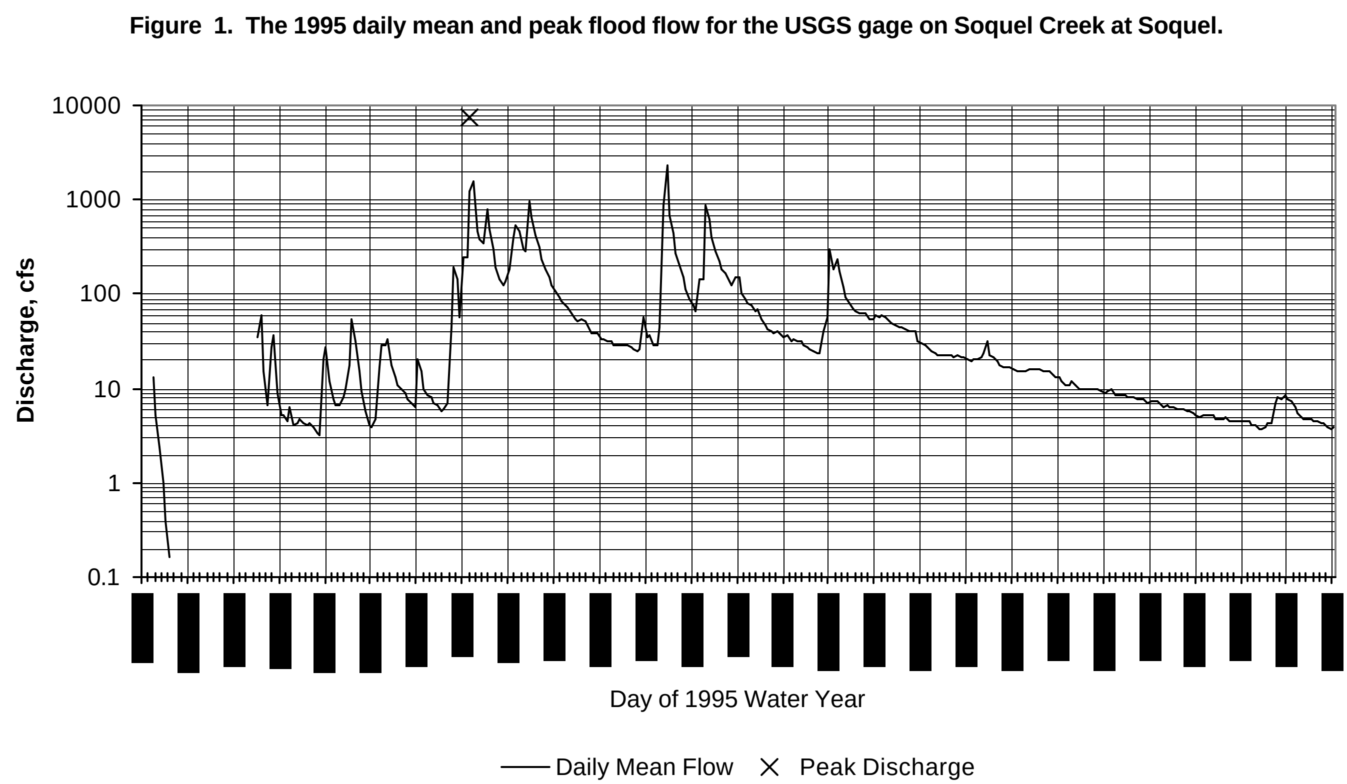


Figure 67. The 1996 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

Figure 2. The 1996 daily mean and peak flood flow for the USGS gage on Soquel Creek at Soquel.

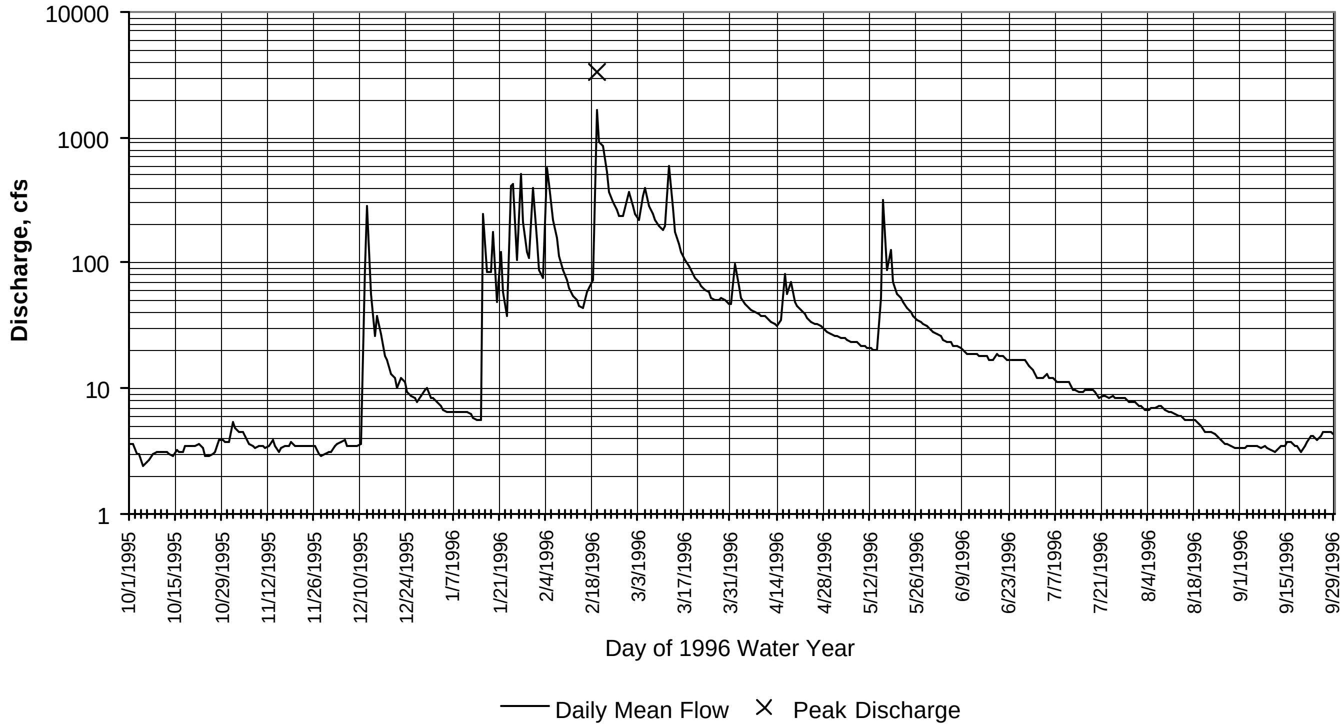


Figure 68. The 1997 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

Figure 3. The 1997 daily mean and peak flood flow for the USGS gage on Soquel Creek at Soquel.

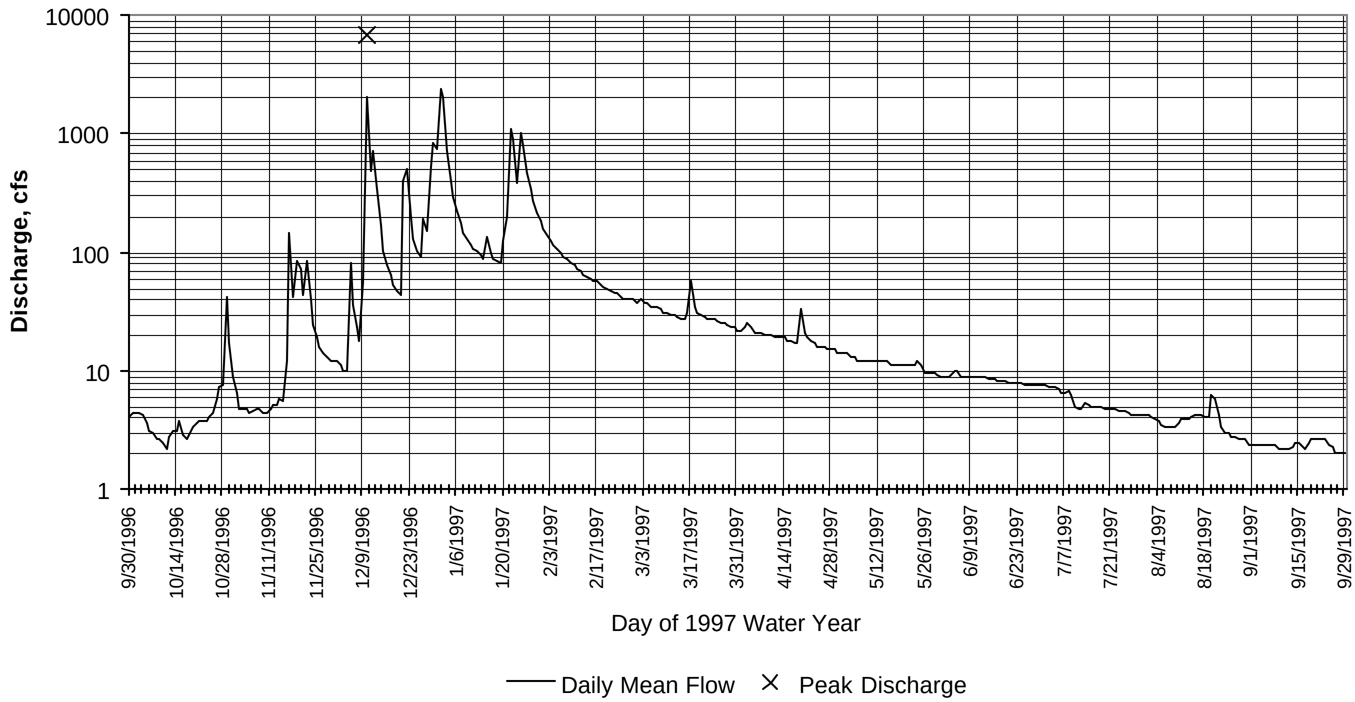


Figure 69. The 1998 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

Figure 4. The 1998 daily mean and peak flood flows for the USGS gage on Soquel Creek at Soquel.

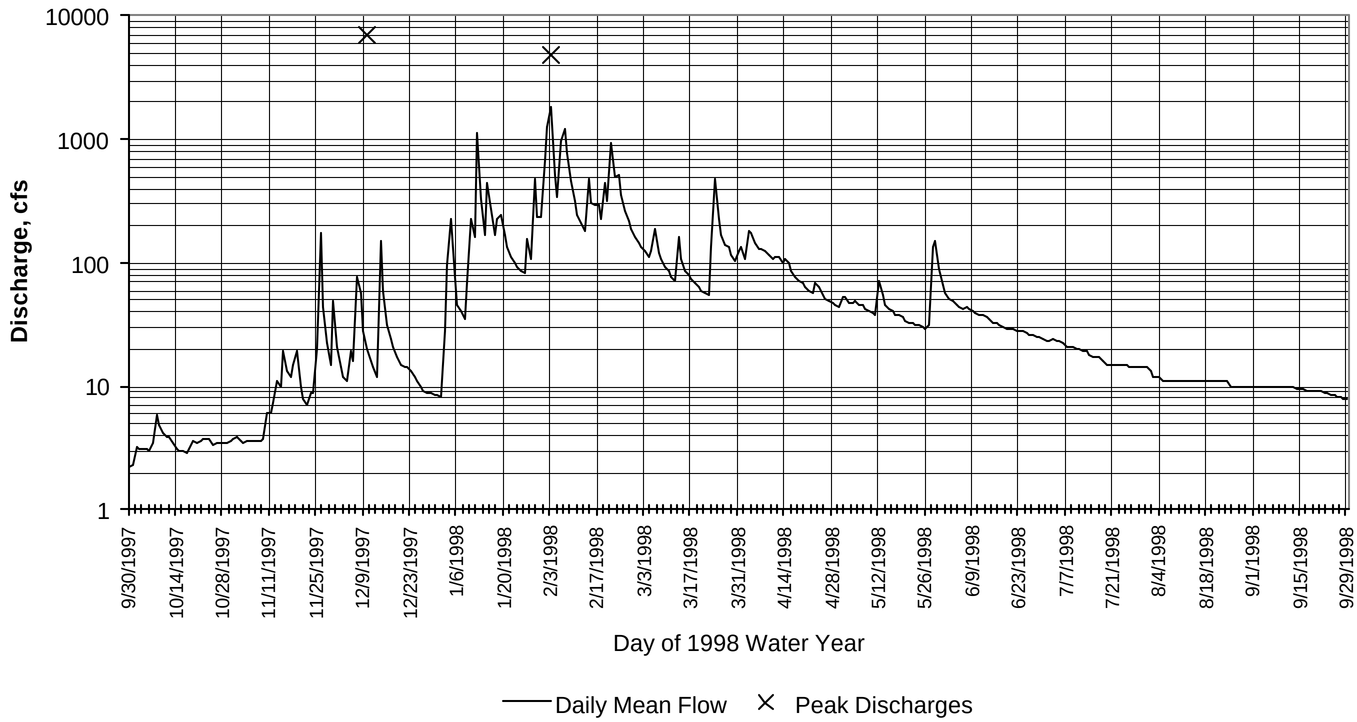


Figure 70. The 1999 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

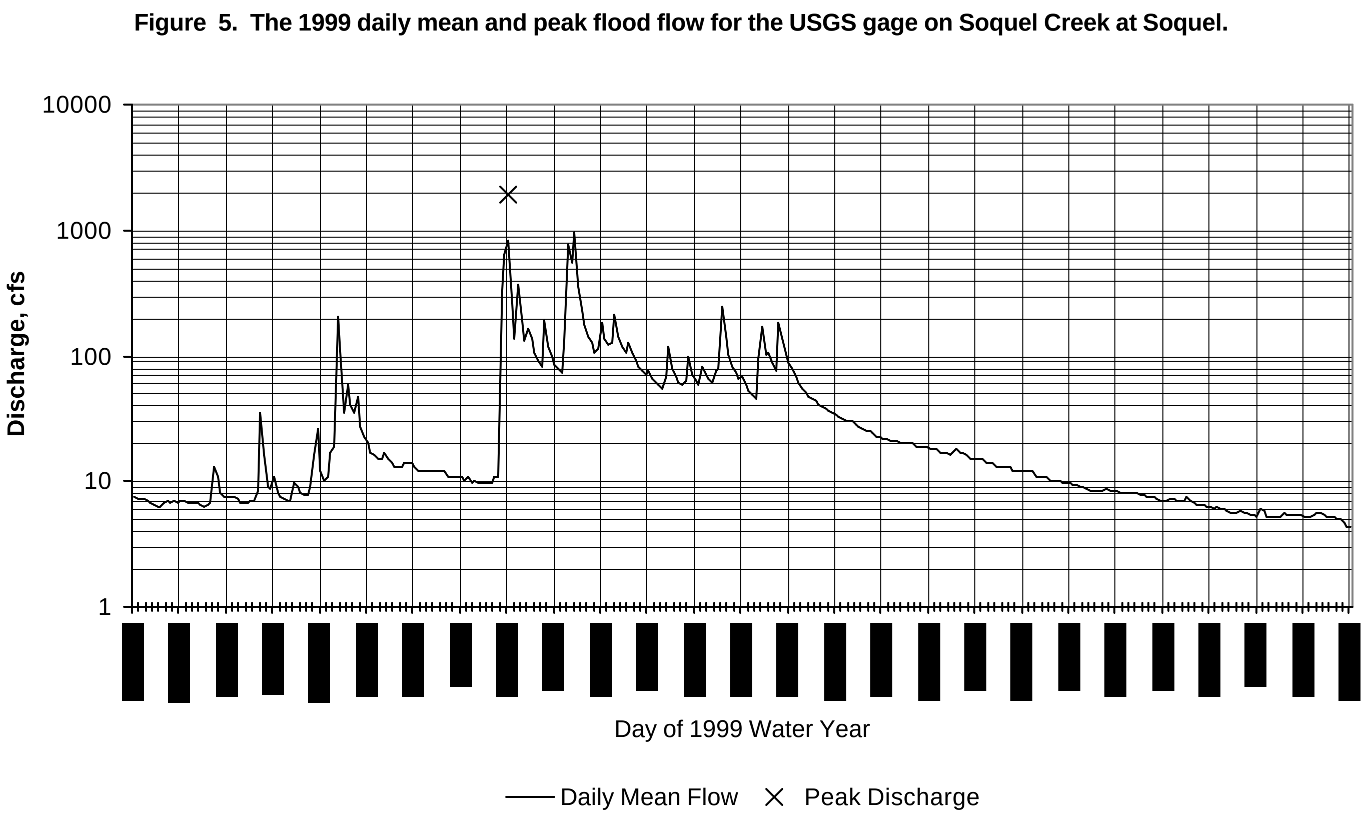


Figure 71. The 2000 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

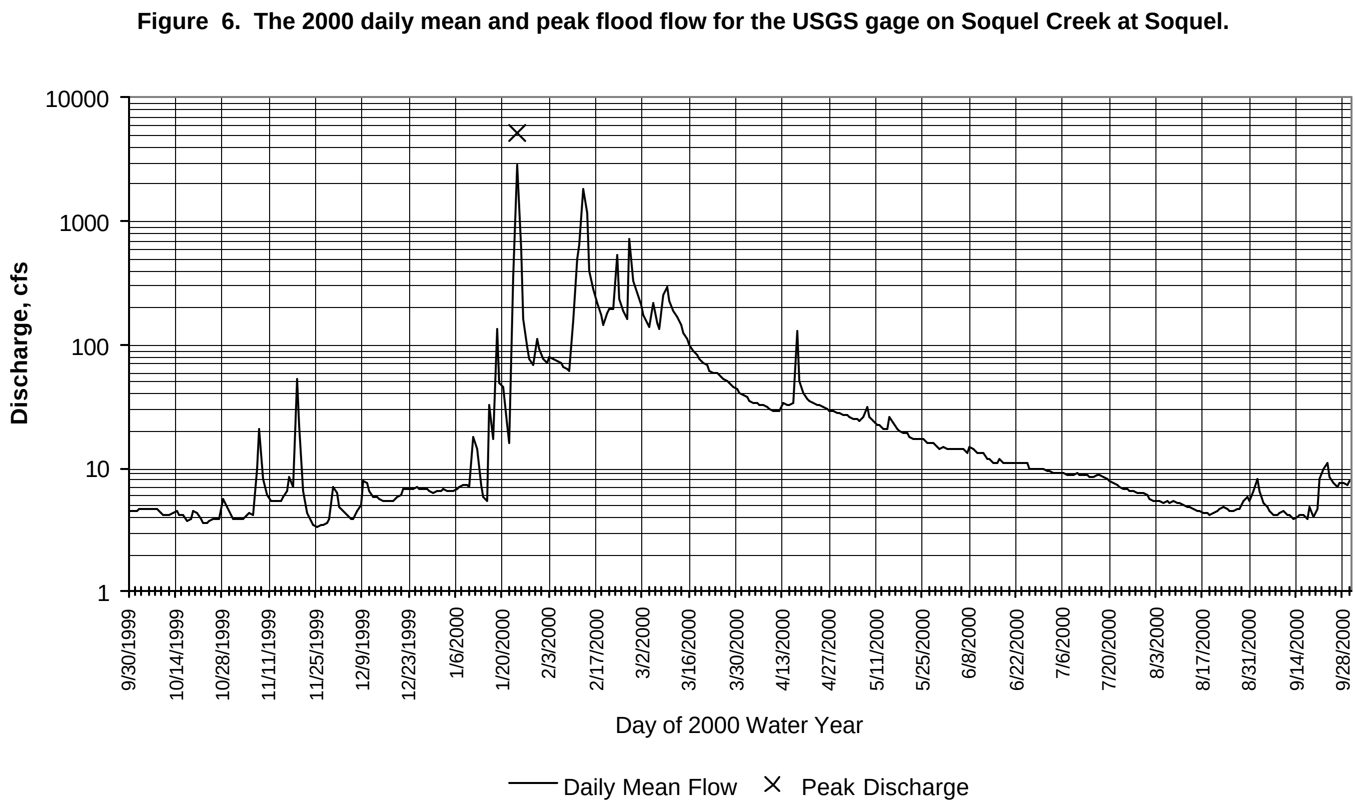


Figure 72. The 2001 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

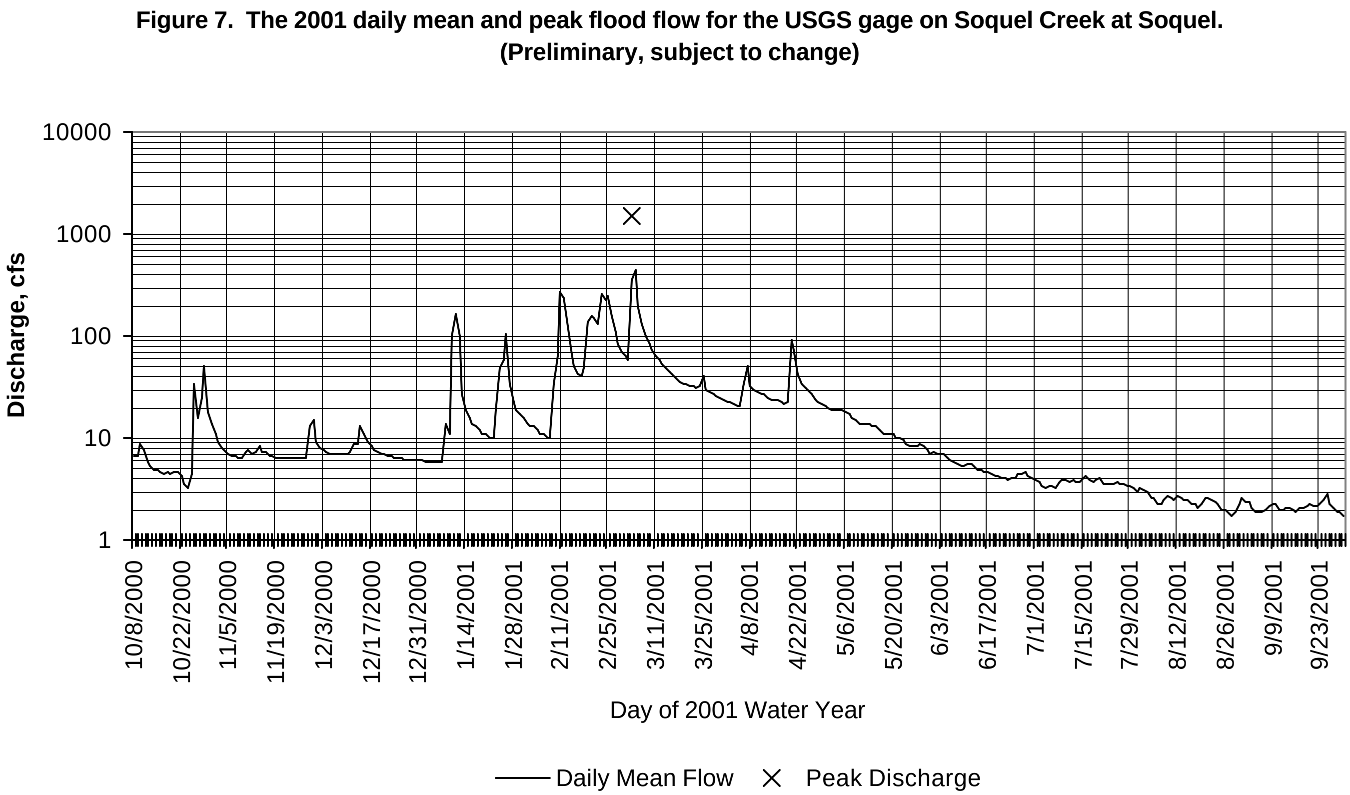


Figure 73. The 2002 Daily Mean and Peak Flood Flow at the USGS Gage on Soquel Creek at Soquel.

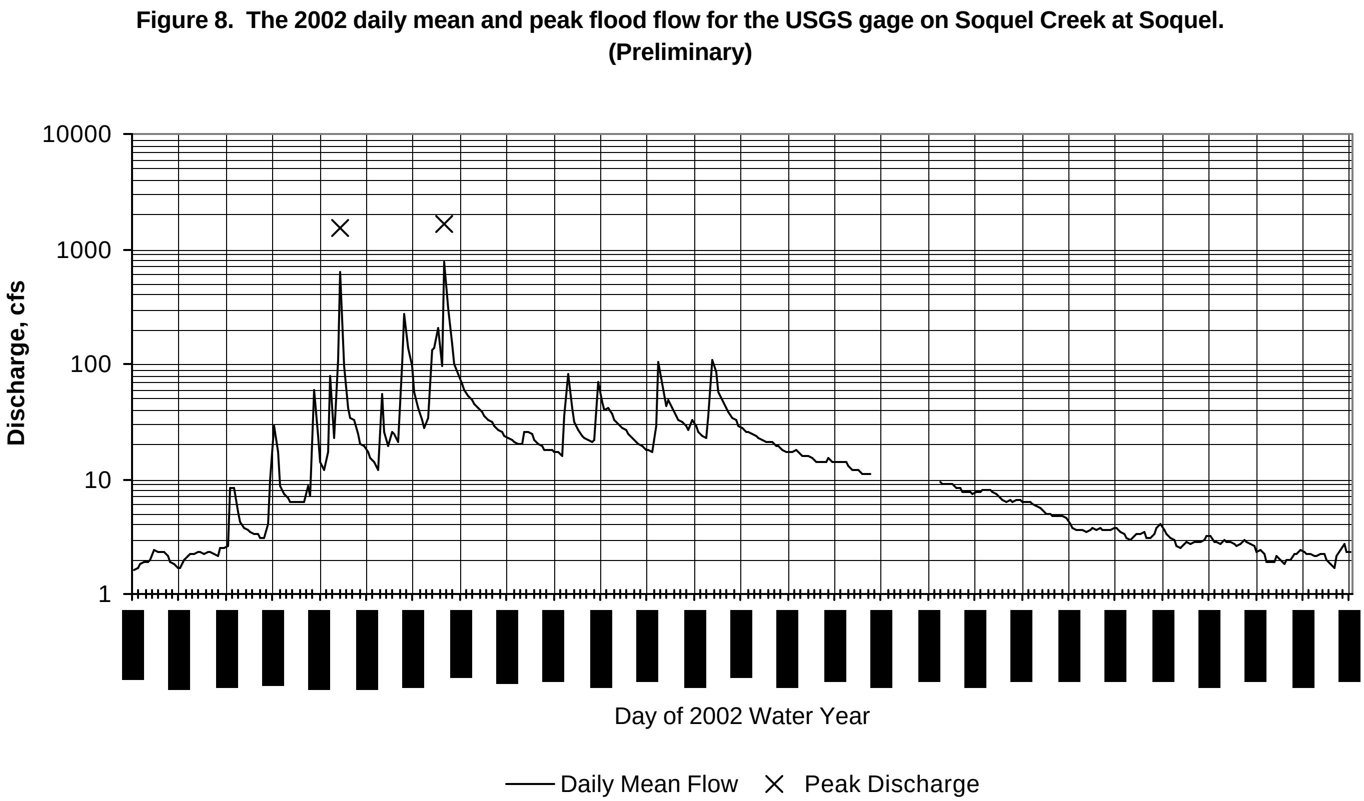


Figure 74. The 2003 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel.

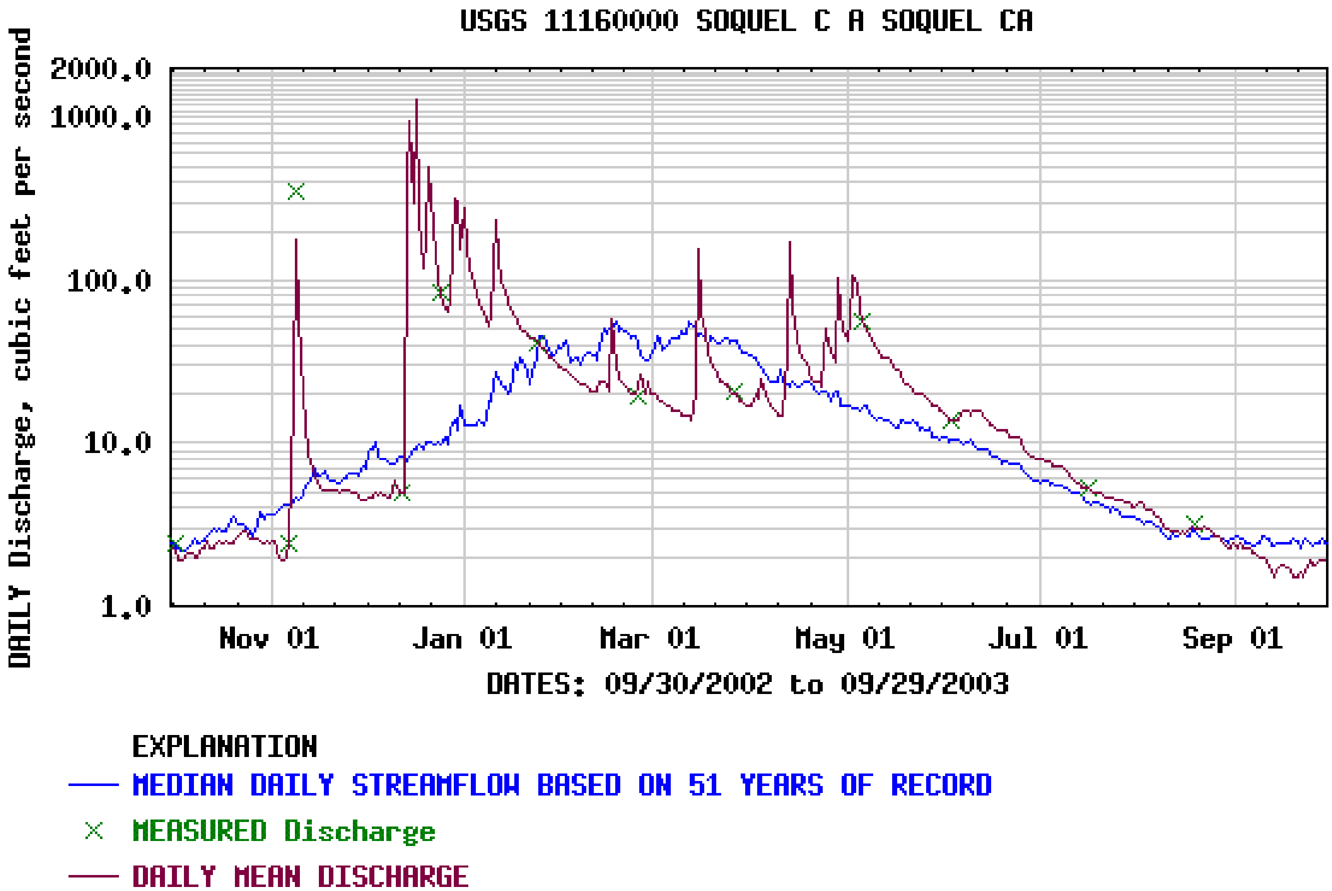


Figure 75. The 2004 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel.

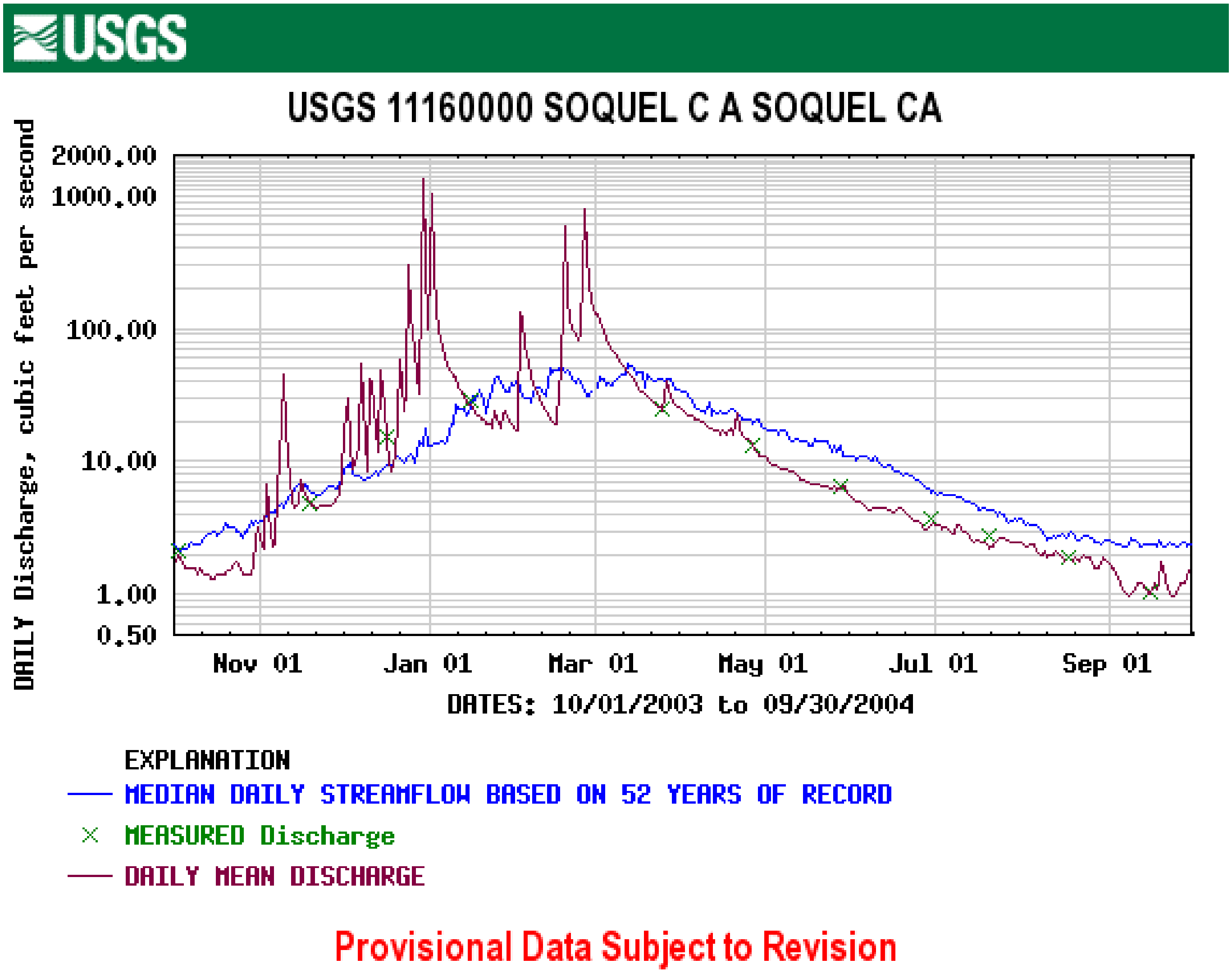


Figure 76. The 2005 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel.

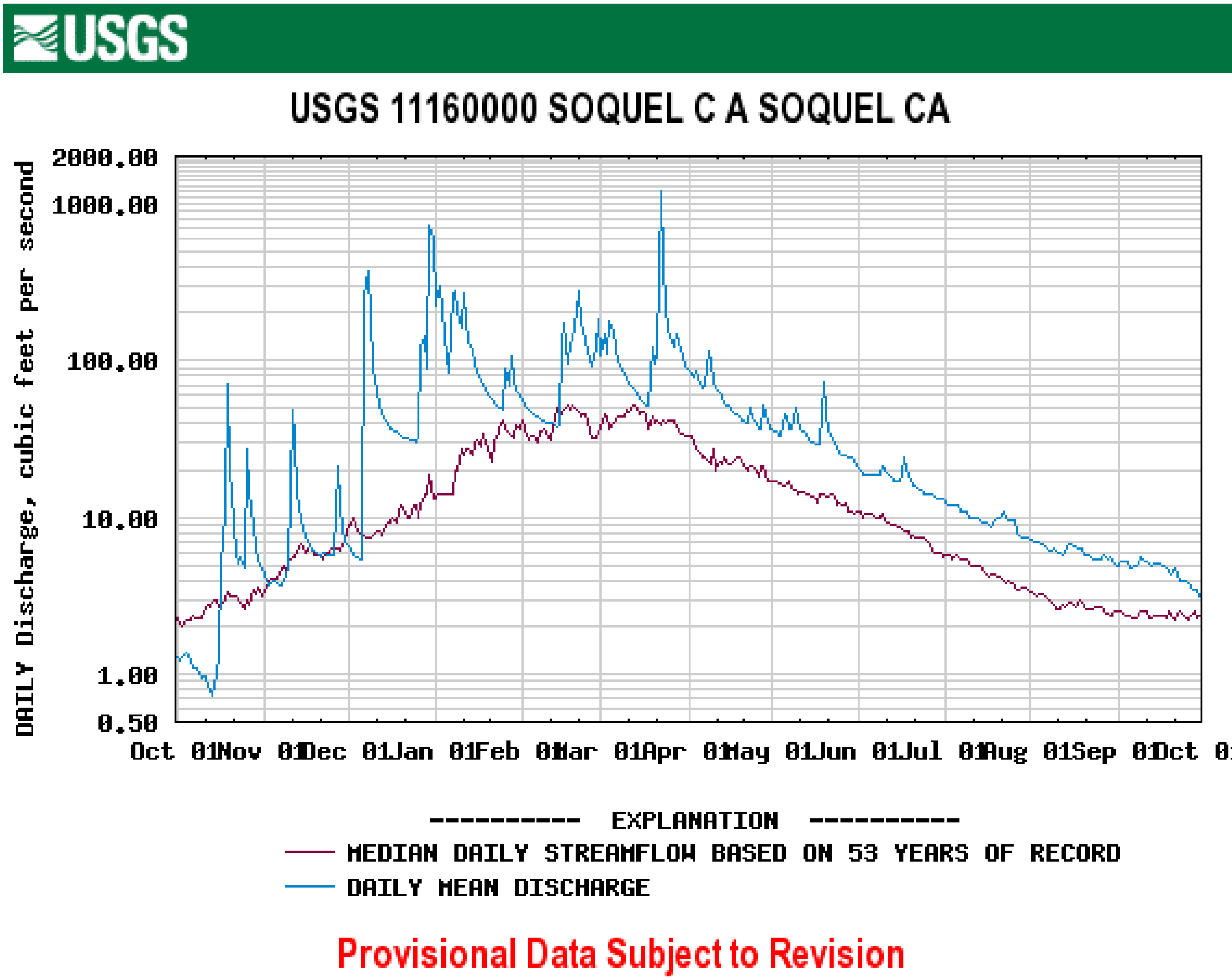


Figure 77. The 2006 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel.

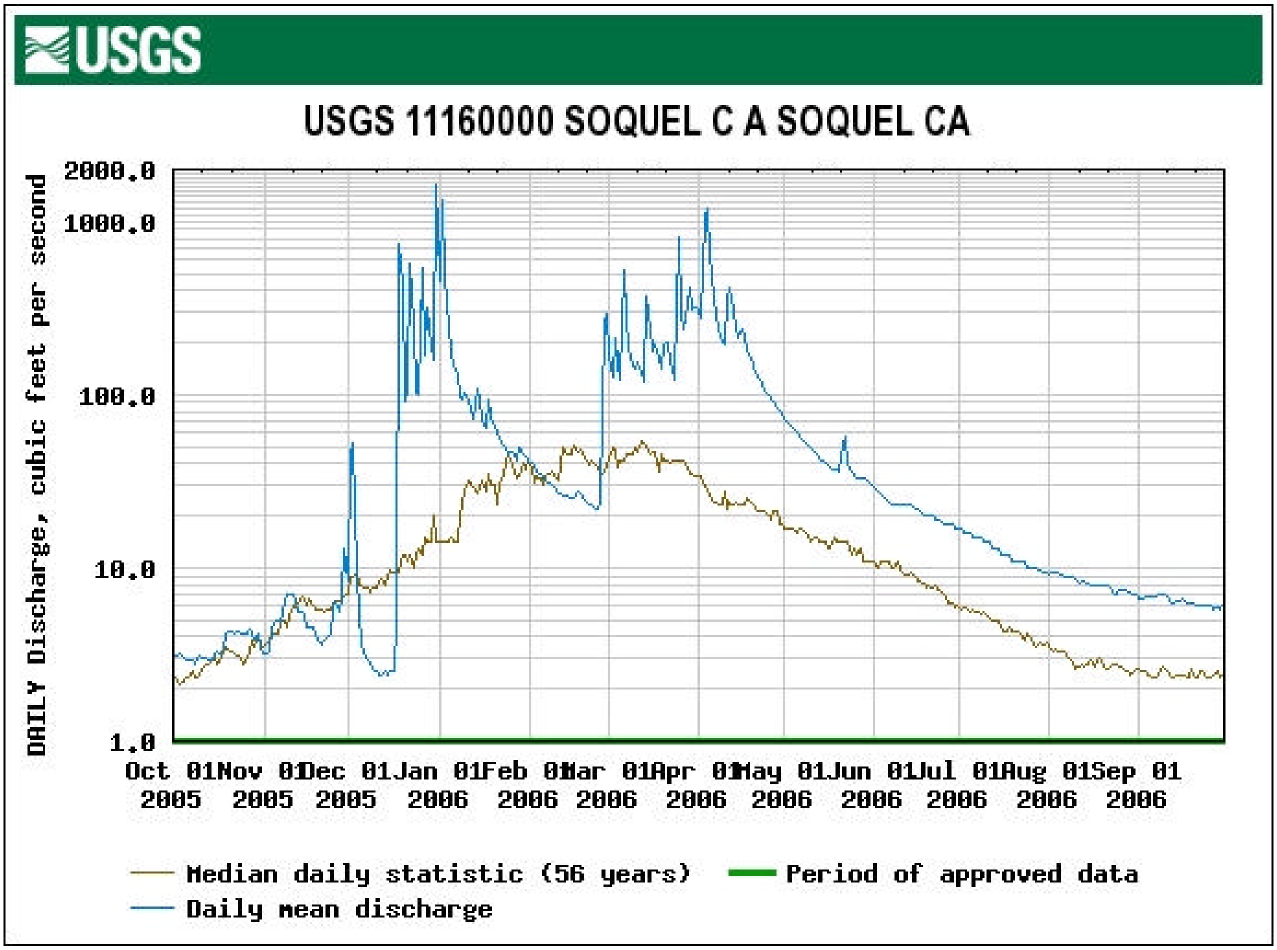


Figure 78. The 2007 Daily Mean and Median Flow at the USGS Gage on Soquel Creek at Soquel.

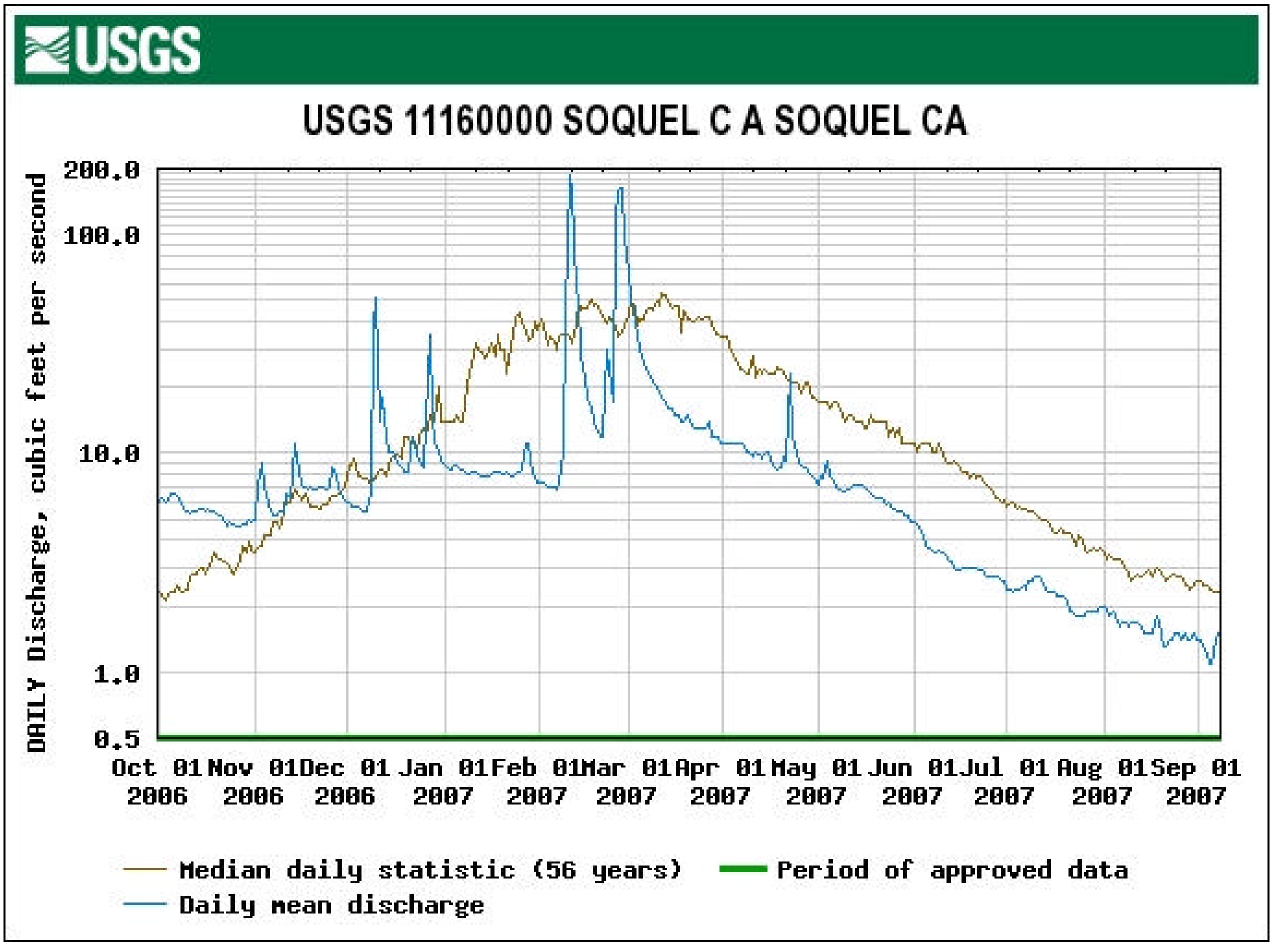


Figure 79. The 1981 Daily Mean Flow at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide logarithmic scale of discharge.)

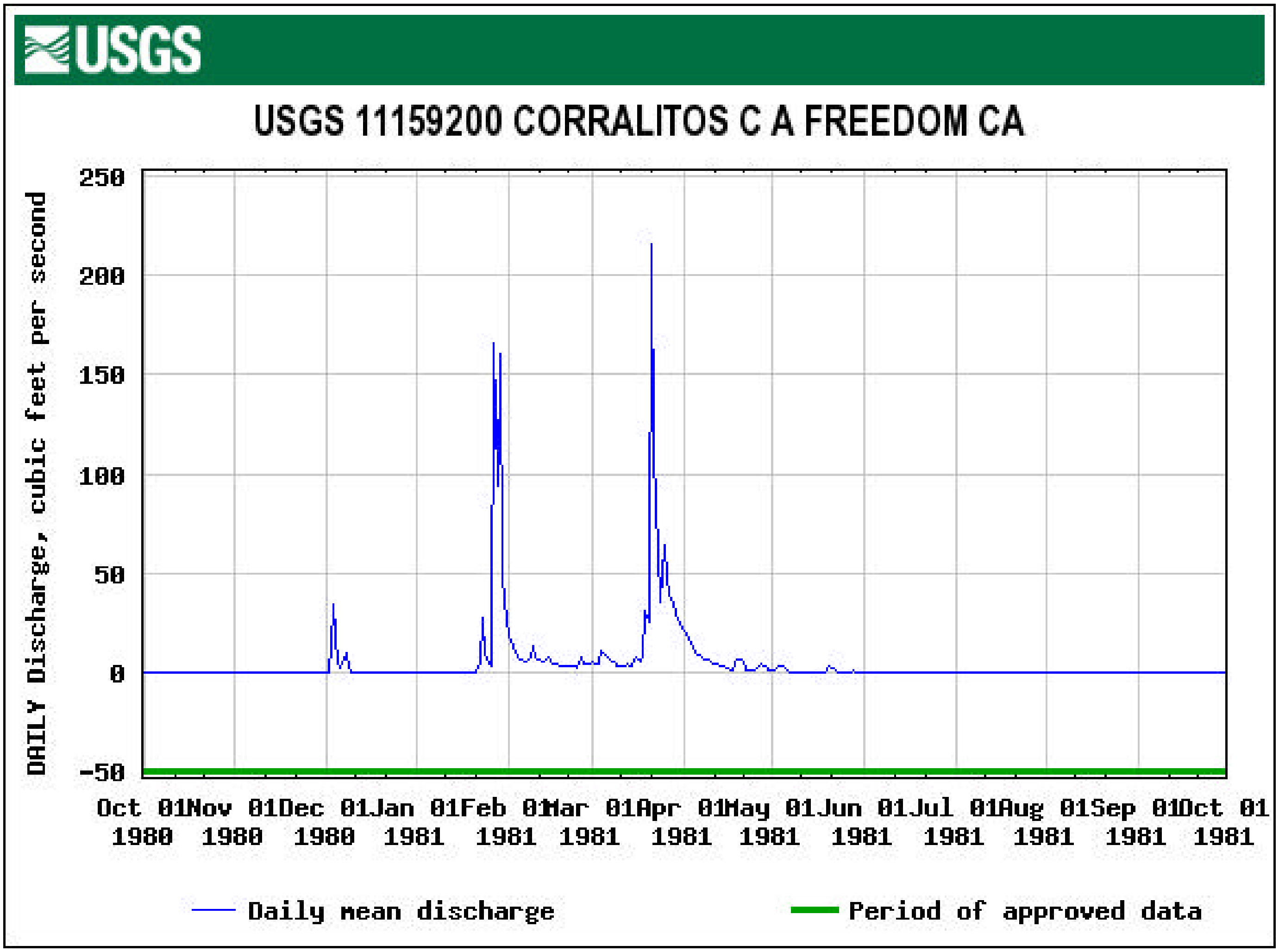


Figure 80. The 1994 Daily Mean Flow at the USGS Gage on Corralitos Creek at Freedom. (USGS website would not provide logarithmic scale of discharge.)

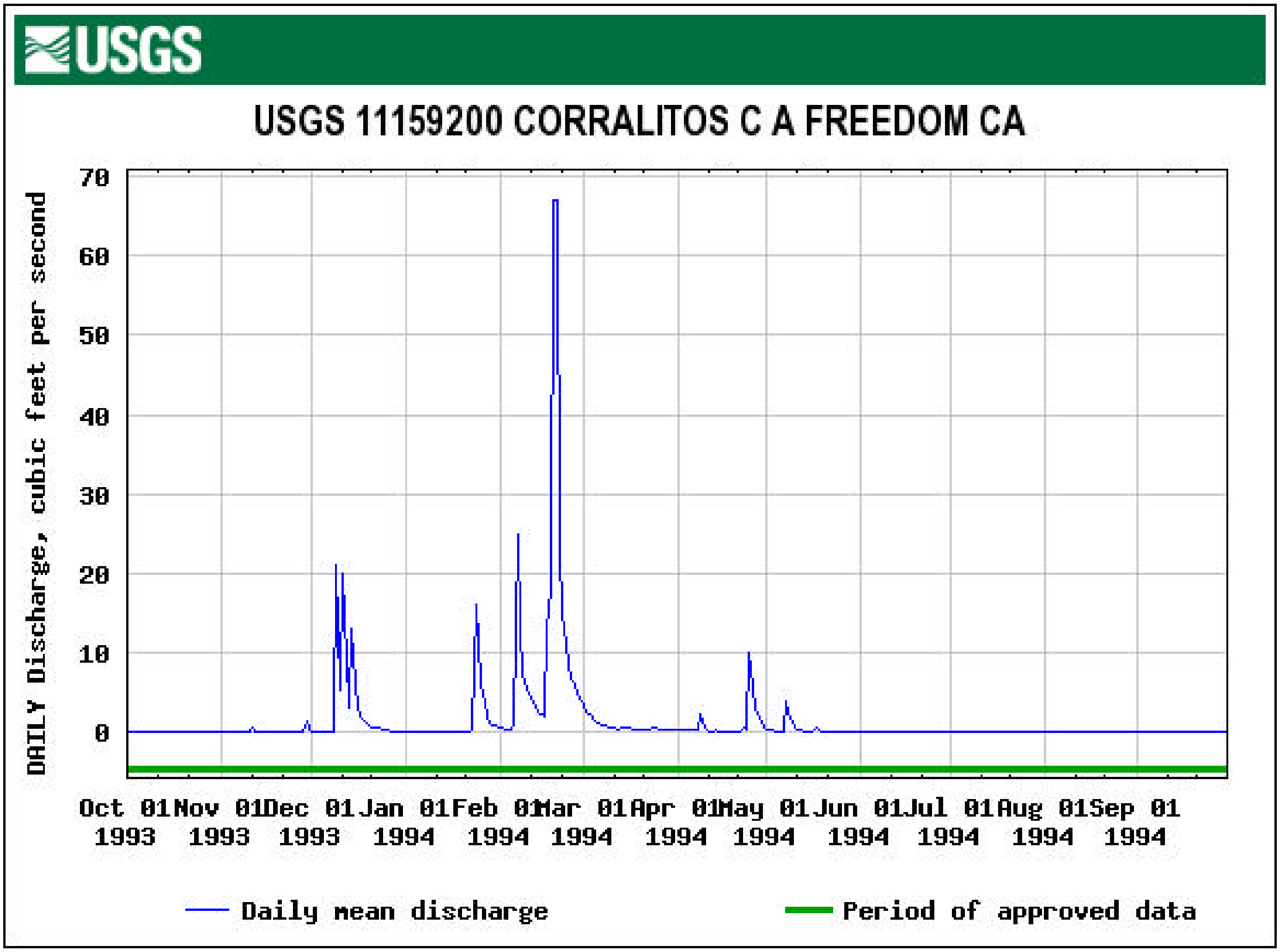


Figure 81. The 2006 Daily Mean Flow at the USGS Gage on Corralitos Creek at Freedom.

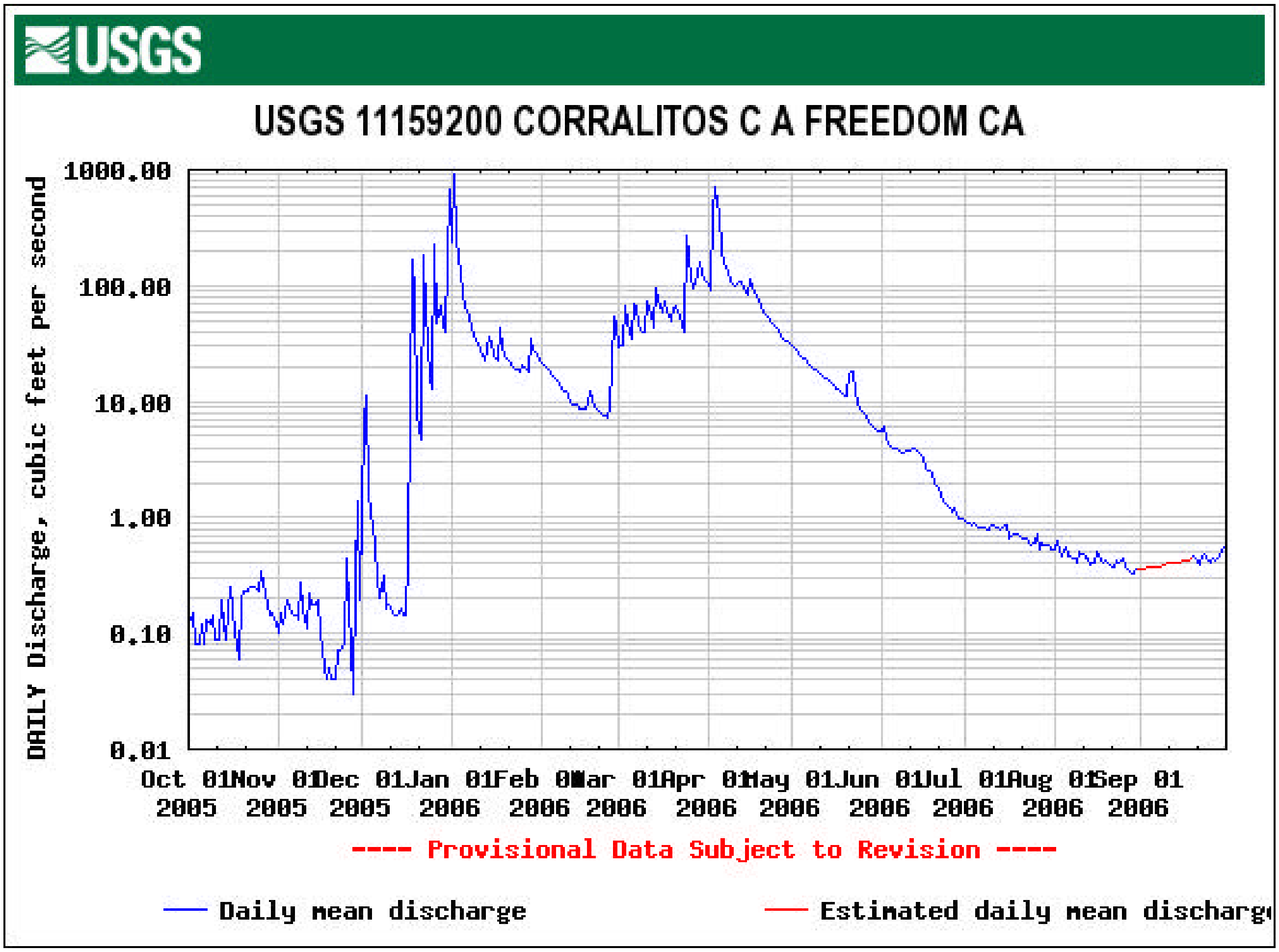
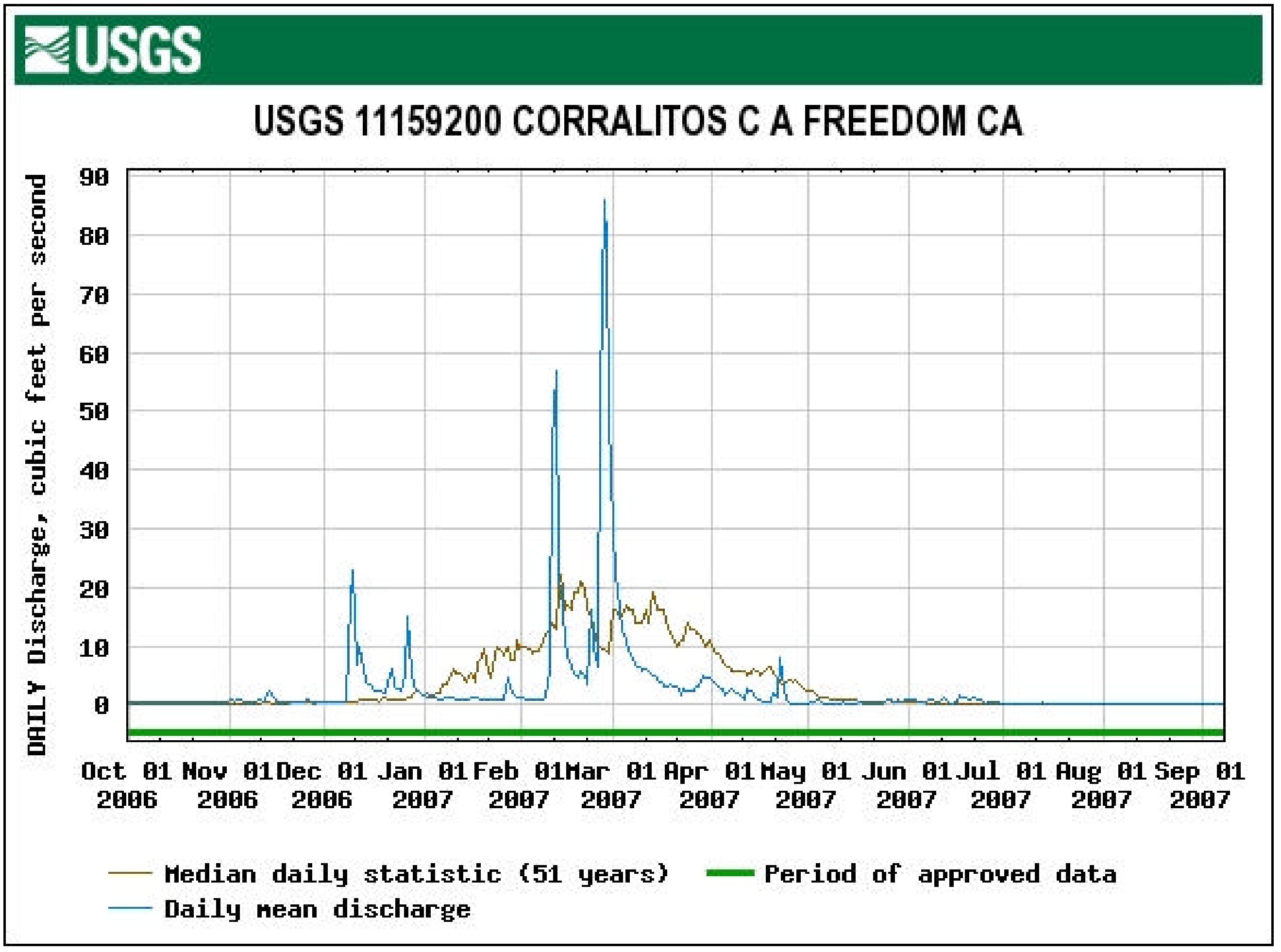


Figure 82. The 2007 Daily Mean and Median Flow at the USGS Gage on Corralitos Creek at Freedom.
(USGS website would not provide a logarithmic scale of discharge).



APPENDIX A. Maps of Sampling Sites.

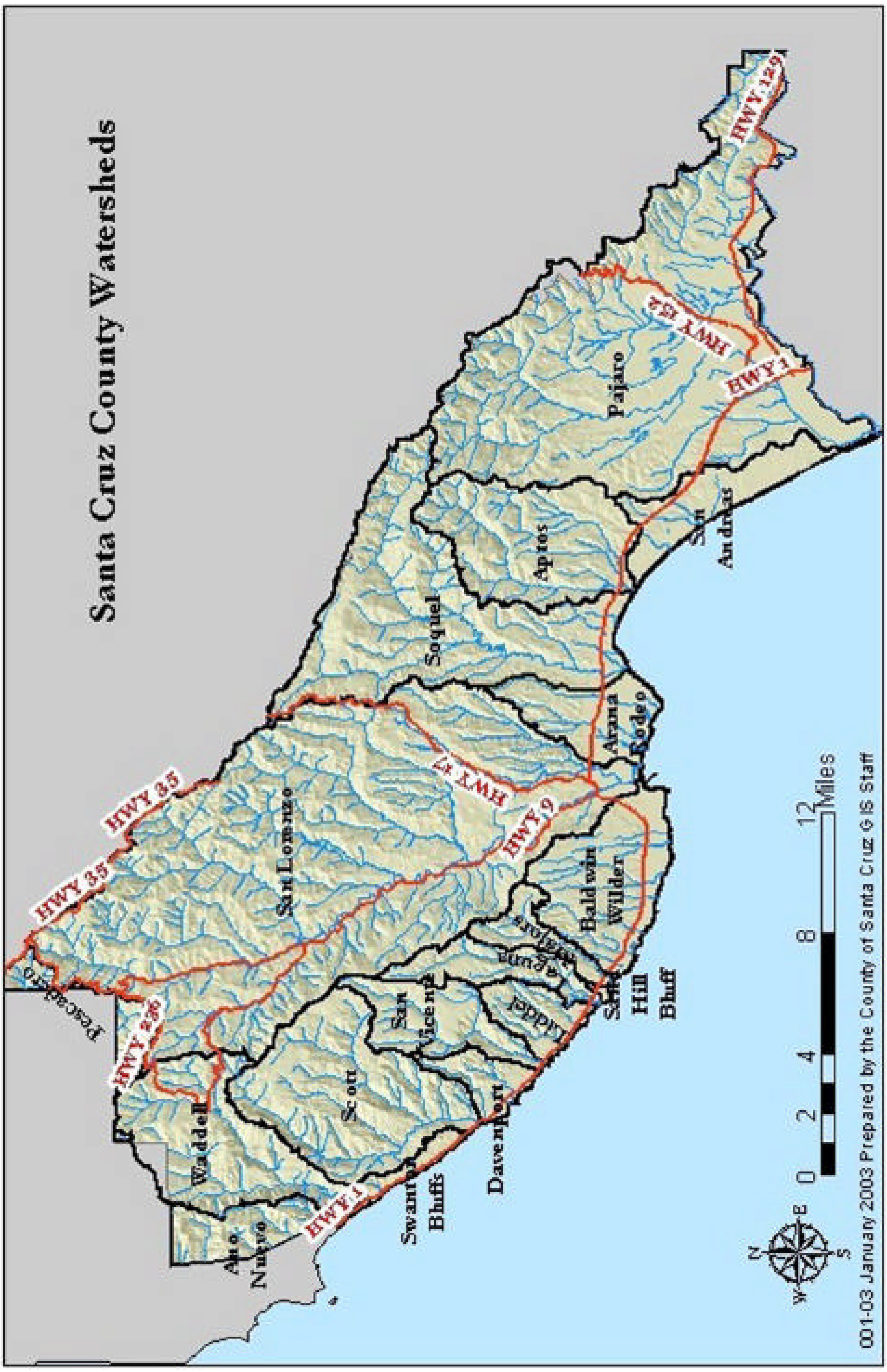


Figure 1. Santa Cruz County Watersheds.

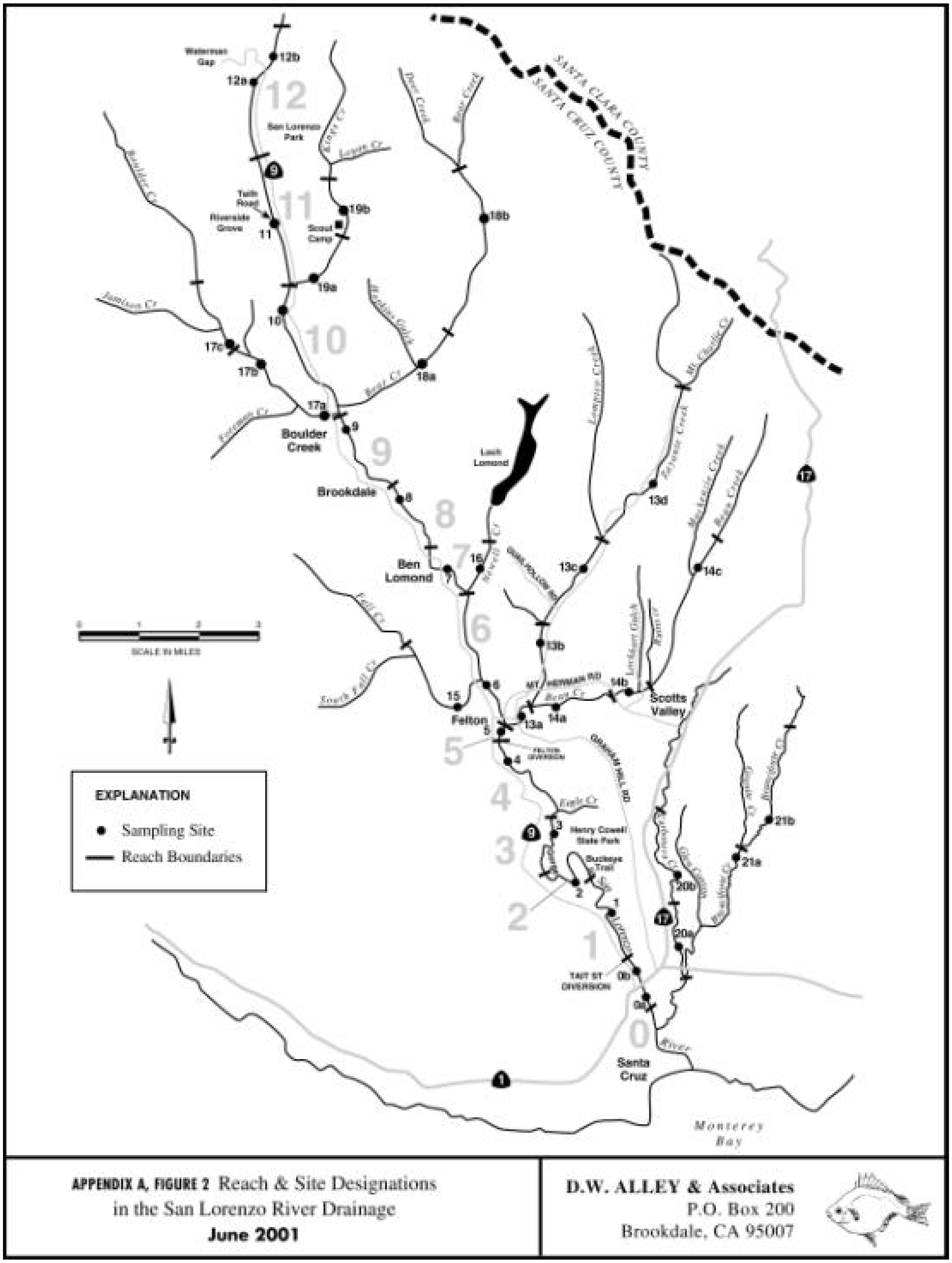
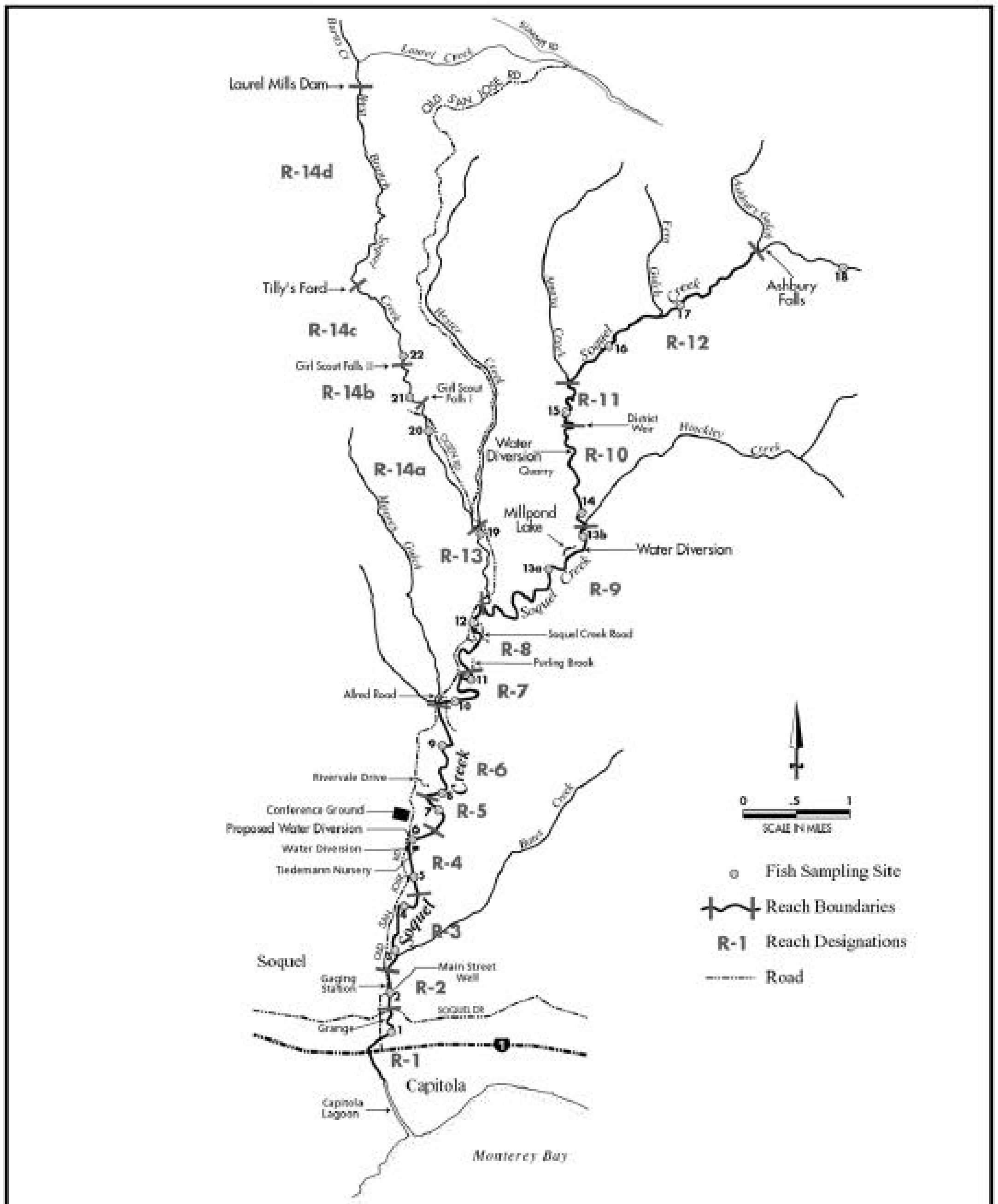


Figure 2. San Lorenzo River Watershed



APPENDIX A; FIGURE 2.
Reach Designations & Fish Sampling Sites
in the Soquel Creek Drainage

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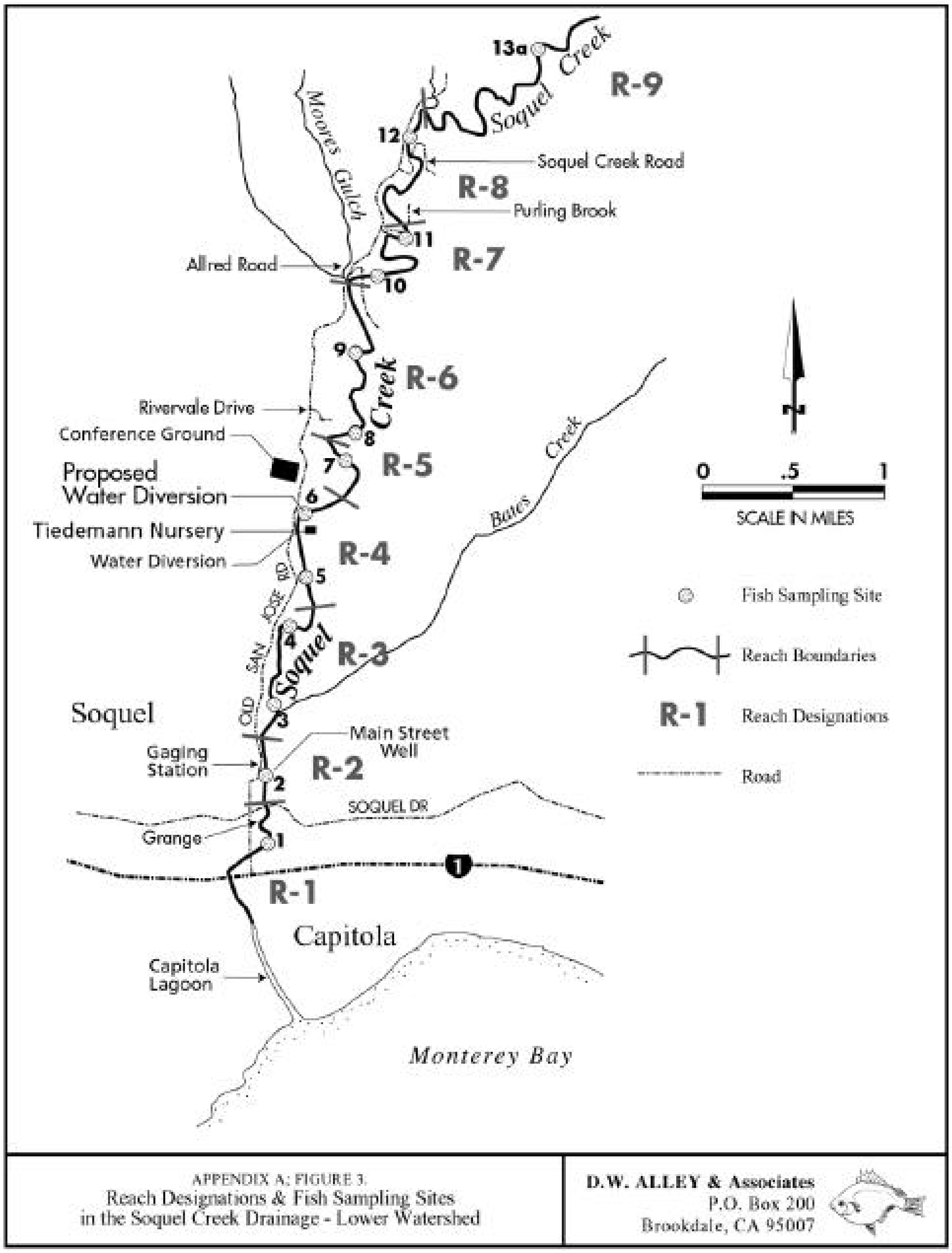
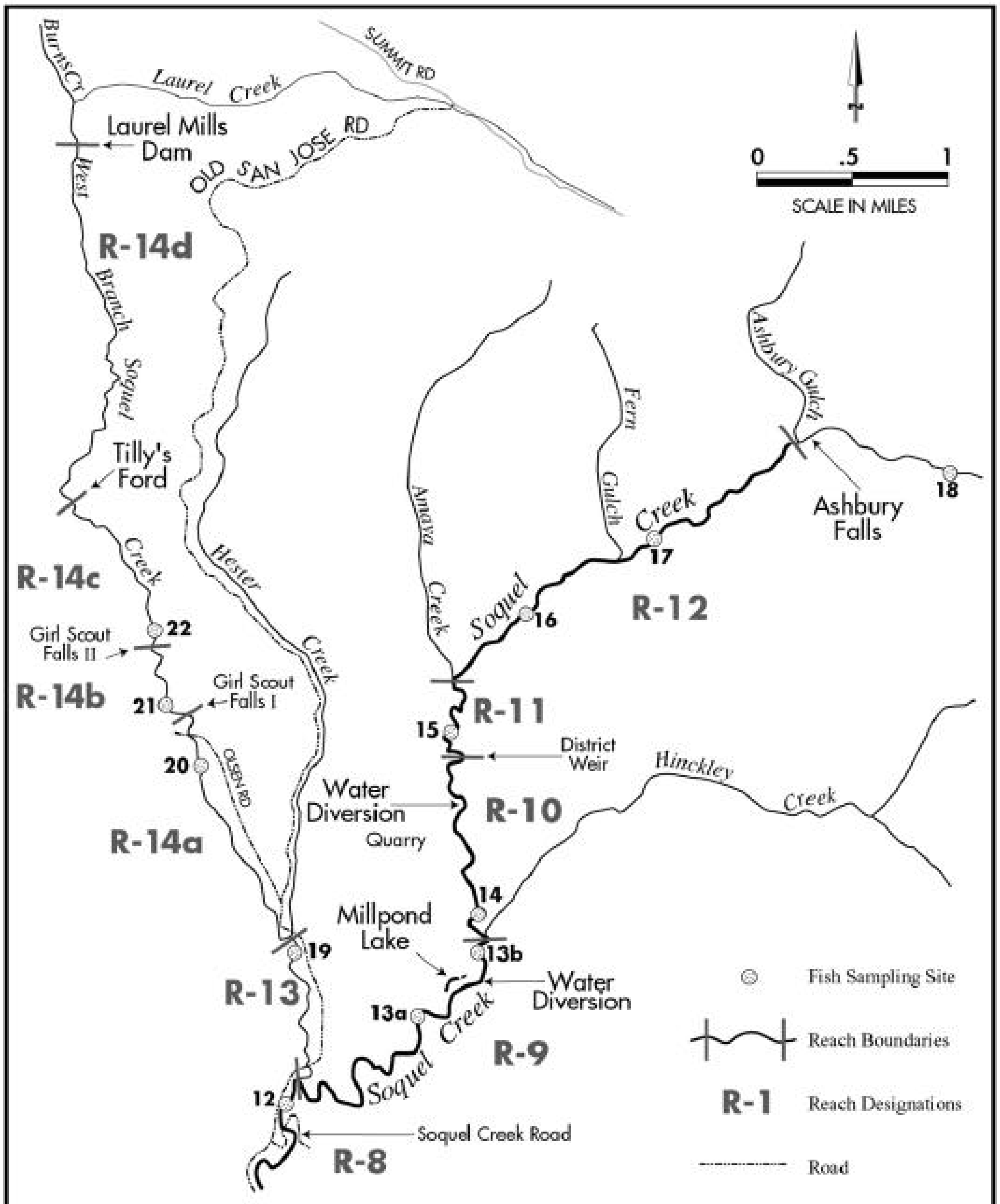
Brookdale, CA 95007

Figure 3. Soquel Creek Watershed.

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





APPENDIX A; FIGURE 4.
Reach Designations & Fish Sampling Sites
in the Soquel Creek Drainage - Upper Watershed

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Brookdale, CA 95007

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

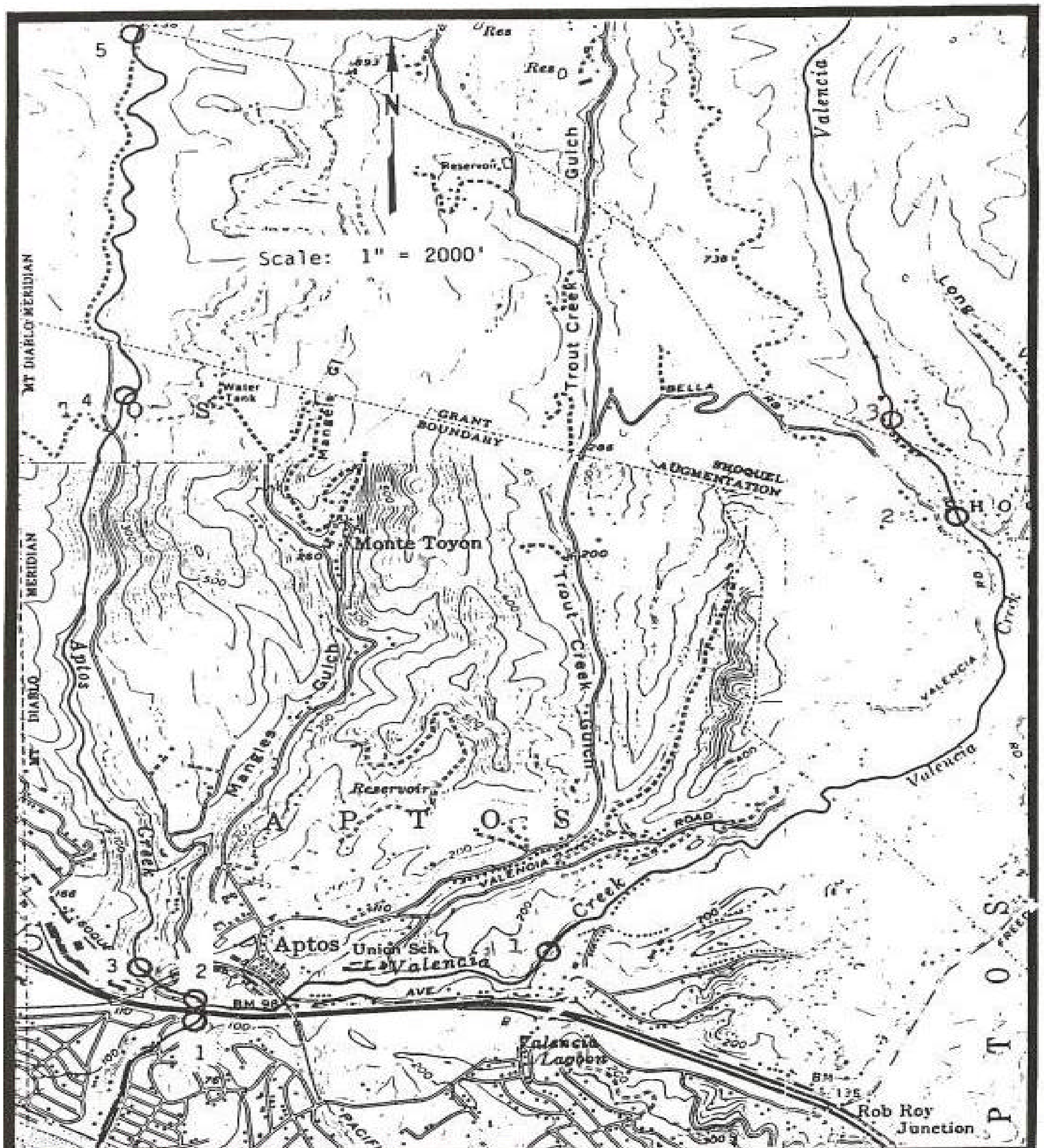

Figure 17. Fish sampling sites on Aptos Creek and Valencia Creek.

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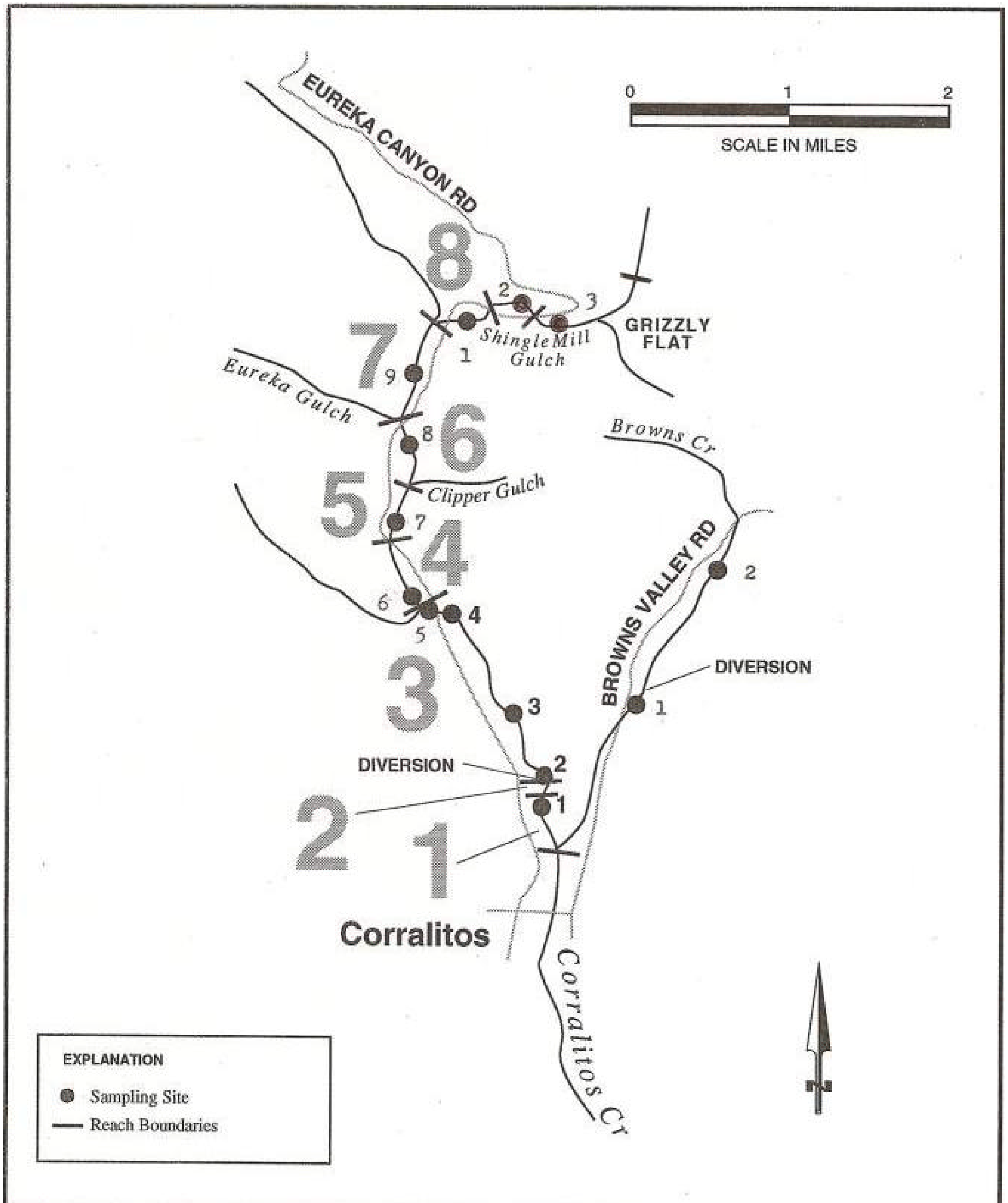
Figure 6. Map from Smith (1982) with Site #3 designation on Valencia Creek at 2006 location.



APPENDIX A, FIGURE 4 - Reach & Transect Designations in the Corralitos Creek Drainage
OCTOBER 1994

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Figure 7. Corralitos Sub-Watershed to the Pajaro River Watershed.

APPENDIX B. Summary of 2007 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 2007. 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 2007 were obtained by using the maximum number of steelhead seen per pass. Densities were so low in 2007 that there was little chance of counting the same fish twice, and it was very possible to miss fish on certain passes.

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: 24Sep07/15Sep07 Stream: SLR Sampled by: Alley, Steiner, Kittleson, Reis, Wheeler

Sampling Site: 1 (Paradise Park) Water Temperature and Times: 70.0 F @ 1535 hr, 24Aug07. (Air temp. 66 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
#13 Riffle 53 ft	4	1	2	4	2	1	0	1	0	0	0	0	6	2	1	4	1	7
#14 Run 91 ft	1	0	0	1	1	0	0	1	0	0	0	0	2	0	0	2	0	2
#11 Pool Snorkel 602 ft	4	0	1	5	4	0	1	5	4	0	1	5	4	0	1	4	1	5
All Habitats Combined 746 ft													10	2	2	10	2	14

Length of Stream Sampled (ft): 746 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0134/ 0.0027

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0027 /0.0161

Steelhead Sampling Results

Date: 25Sep07/23Sep07 **Stream:** SLR **Sampled by:** Alley, Steiner, Kittleson, Reis, Wheeler, Collins

Sampling Site: 2a (Rincon) **Water Temperature and Times:** 71.0 F @ 1537 hr, 25Aug07. (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
#22 Riffle 33 ft	31	7	1	25	9	5	1	5	6/4	0/3	0/6	0/1	50	15	2	35	2	52
#21 Run 55 ft	18	3	1	16	6	2	0	4	1	1	0	0	26	7.8	1	19.6	1	28.4
#13 Pool Snorkel 488 ft	4	1	3	6	6	1	3	9	13	2	3	14	13	2	3	14	0	16
#17 Pool Snorkel 170 ft	9	1	1	9	12	2	1	11	13	3	1	11	13	3	1	11	0	14
All Habitats Combined 746 ft													102	27.8	7	82.6	3	110.4

Length of Stream Sampled (ft): 746 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.1367/ 0.0373

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0094 /0.1147

Steelhead Sampling Results

Date: 24Sep07/15Sep07 **Stream:** SLR **Sampled by:** Alley, Steiner, Kittleson, Reis, Wheeler

Sampling Site: 4 (Henry Cowell Park) **Water Temperature and Times:** 70.0 F @ 1639 hr, 24Aug07. (Air temp. 69 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
#11 Riffle 67 ft	44	30	1	15	17	12	0	5	11/5	6/5	0	5/0	77	53	1	24	1	78
#13 Run 64 ft	22	20	0	2	9	6	0	3	6	5	0	1	41.2	38.1	0	6	0	44.1
#15 Pool Snorkel 469 ft	0	0	0	0	3	1	0	3	5	0	0	5	6	1	0	5	0	6
All Habitats Combined 600 ft													124.2	92.1	1	35	1	128.1

Length of Stream Sampled (ft): 600 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.207/0.1535

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0017/0.0600

Steelhead Sampling Results

Date: 18Sep07/30Sep07 Stream: SLR Sampled by: Alley, Steiner, Reis, Kittleson

Sampling Site: 6 (below Fall Creek) Water Temperature and Times: 64 F @ 1218 hr below Fall Creek confluence, 26Aug07. (Fall Creek Water Temperature: 61 F @ 1437 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 34 ft	21	21	0	0	9	9	0	0	6	6	0	0	40.7	40.7	0	0	0	40.7
#8 Run 126 ft	48	48	1	1	22	21	1	2	11	11	0	0	90.2	88.4	2	3	0	91.4
#15 Short Pool Snorkel 156 ft	8	6	2	4	8	6	1	3	8	6	0	2	8	6	2	4	0	10
#13 Long Pool Snorkel 277 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Habitats Combined 593 ft													138.9	135.1	4	7	0	142.1

Length of Stream Sampled (ft): 593 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2342/.2278

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0067/0.0118

Steelhead Sampling Results

<u>Date:</u> 18Sep07/30Sep07 <u>Stream:</u> SLR <u>Sampled by:</u> Alley, Steiner, Kittleson, Wheeler

<u>Sampling Site:</u> 8 (below Clear Creek) <u>Water Temperature and Times:</u> 66 F @ 1019hr, 29Aug07. (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
#12 Riffle 37 ft	16	14	0	2	3	2	0	1	0	0	0	0	19.3	16.2	0	3	0	19.2
#13 Run 49 ft	9	8	0	1	3	3	0	0	0	0	0	0	12.6	11.7	0	1	0	12.7
#17 Short Pool snorkel 162 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#29 Long Pool snorkel 327 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Habitats Combined 575 ft													31.9	27.9	0	4	0	31.9

Length of Stream Sampled (ft):_575 ft_____

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.0555/0.0485___________

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0000/ 0.0070__

Steelhead Sampling Results

Date: 2Sep06 Stream: SLR Sampled by: Alley, Steiner, Wheeler
Sampling Site: 11 (above Teihl Rd) Water Temp. and Times: 66 F @ 1630 hr, 23Aug07.(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
#29 Run- 22 ft	1	1	0	0	1	1	0	0	0	0	0	0	2	2	0	0	0	2
#32 Riffle 16 ft	3	3	0	0	1	1	0	0	0	0	0	0	4.2	4.2	0	0	0	4.2
#33 Pool 131 ft	15	15	0	0	9	9	0	0	1	1	1	1	28.8	28.8	1	1	0	29.8
All Habitats Combined 169 ft													35	35	1	1	0	36

Length of Stream Sampled (ft):_169 ft____

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.207/ 0.207__

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0059/ 0.0059__

Steelhead Sampling Results

Date: 13Sep07 **Stream:** Zayante **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 13a (below Bean Creek) **Water Temperature and Times:** 66 F @ 1414hr, 20Aug07. (Air temp. 84 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 Riffle 66 ft	30	30	1	1	14	14	1	1	6	6	1	1	55.3	55.3	3	3	0	58.3
#4 Pool 85 ft	26	26	6	6	10	10	0	0	4	4	0	0	42.5	42.5	6	6	0	48.5
#6 Pool 74 ft	14	14	2	2	7	7	0	0	3	3	0	0	27.1	27.1	2	2	0	29.1
#8 Run 42 ft	24	24	2	2	9	9	0	0	5	5	0	0	40.8	40.8	2	2	0	42.8
All Habitats Combined 267 ft													165.7	165.7	13	13	0	178.7

Length of Stream Sampled (ft):_267 ft___

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.6206/ .6206____

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0487/ 0.0487___

Steelhead Sampling Results

Date: 13Sep07 **Stream:** Zayante **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 13c (below Lompico Ck) **Water Temp. and Times:** 68 F @ 1546hr, 20Aug07. (Air temp. 83 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
#22 Riffle/ 19 ft	11	11	1	1	1	1	0	0	2/ 0	2/ 0	0/ 0	0/ 0	14	14	1	1	0	15
#24 Pool 80 ft	15	15	1	1	15	15	0	0	5	5	0	0	35	35	1	1	0	36
#26 Pool 34 ft	14	14	6	6	5	5	0	0	3	3	1	1	23.5	23.5	7.5	6.4	1.1	31
Pools Combined 114 ft													58.5	58.5	8.5	7.5	1.1	67
#28 Step-Run 52 ft	59	59	3	3	16	16	2	2	8	8	1	1	84.9	84.9	7.8	7.8	0	92.7
All Habitats Combined 185 ft													157.4	157.4	17.3	16.2	1.1	174.7

Length of Stream Sampled (ft):_185 ft___

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.8508/ 0.8508__

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0935/ 0.0935_

Steelhead Sampling Results

Date: 14Sep07 **Stream:** Zayante **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 13d (below Mountain Charlie Gulch) **Water Temp. and Times:** 61 F @ 1019hr, 22Aug07. (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
#42 Step-run (partial) 60 ft	27	27	10	10	11	11	0	0	6	6	0	0	48	48	10	10	0	58
#41 Pool 89 ft	21	21	10	10	9	9	4	4	8	8	1	1	46	46	15.9	15.9	0	61.9
All Habitats Combined 149 ft													94	94	25.9	25.9	0	119.9

Length of Stream Sampled (ft):_149 ft____

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.6309/ 0.6309_

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.1738/ 0.1738

Steelhead Sampling Results

Date: 14Sep07 **Stream:** Lompico **Sampled by:** Alley, Steiner, Wheeler, Collins
Sampling Site: 13e (below turnout) **Water Temp. and Times:** 62 F @ 1115hr, 21Aug07. (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
#43 Pool 54 ft	38	38	6	6	23	23	0	0	6	6	1	1	78.2	78.2	7.5	7.5	0	85.7
#38 Pool 46 ft	19	19	6	6	12	12	2	2	8	8	0	0	53.2	53.2	8.4	8.4	0	61.6
Pools Combined 100 ft													131.4	131.4	15.9	15.9	0	147.3
#44/45 Step-run/riffle 27 ft	5	5	2	2	5	5	0	0	0	0	0	0	10	10	2	2	0	12
#48 Step-run 42 ft	12	12	1	1	5	5	0	0	2	2	0	0	20.5	20.5	1	1	0	21.5
All Habitats Combined 169 ft													161.9	161.9	18.9	18.9	0	180.8

Length of Stream Sampled (ft):_169 ft___

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.9580/ 0.9580____

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.1118/ 0.1118

Steelhead Sampling Results

Date: 14Sep07 Stream: Bean Ck Sampled by: Alley, Steiner, Wheeler
Sampling Site: 14b (below Lockhart Gulch.) Water Temp. and Times: 65 F @ 1408hr, 21Aug07. (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
#49 Riffle 19 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#51 Pool 76 ft	0	0	7	7	0	0	0	0	0	0	0	0	0	0	7	6	1	7
#53 Pool 43 ft	0	0	7	7	0	0	0	0	0	0	1	1	0	0	8.4	7.4	1	8.4
Pools Combined 119 ft													0	0	15.4	13.4	2	15.4
#50 Run 35 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Habitats 173 ft													0	0	15.4	13.4	2	28.8

Length of Stream Sampled (ft): 173 ft
Young-of-the-Year/ Size Class 1 per Ft of Stream: 0.0000/ 0.0000
Yearlings and 2+/ Size Classes 2 and 3 per Ft of Stream: 0.0890/ 0.0890

Steelhead Sampling Results

Date: 17Sep07 **Stream:** Bean Ck **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 14c (above Mackenzie Gulch.) **Water Temp. and Times:** 67 F @ 1643hr, 22Aug07. (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
#13 Riffle 5 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#15 Riffle 24 ft	0	0	0	0	0	0	0	0					0	0	0	0	0	0
#12 Pool 39 ft	6	6	2	2	2	2	0	0	1	1	0	0	9.4	9.4	2	2	0	11.4
#14 Pool 25 ft	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
#26 Pool 51 ft	7	7	7	7	1	1	1	1	1	1	0	0	9	9	8.1	8.1	0	17.1
Pools Combined 115 ft													19.4	19.4	10.1	10.1	0	29.5
#27 Run 43 ft	2	2	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	2
All Habitats Combined 187 ft													21.4	21.4	10.1	10.1	0	31.5

Length of Stream Sampled (ft):_187 ft______
Young-of-the-Year / Size Class 1 per Foot of Stream:_0.1144/ 0.1144_
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0540/ 0.0540

Steelhead Sampling Results

Date: 18Sep07 Stream: Boulder Sampled by: Alley, Steiner, Wheeler
Sampling Site: 17a (above Highway 9) Water Temp. and Times: 60 F @ 1041hr. 17Aug07. (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
#18 Riffle 28 ft	6	6	0	0	1	1	0	0	0	0	0	0	7.1	7.1	0	0	0	7.1
#9 Pool 60 ft	17	17	2	2	9	9	0	0	3	3	0	0	32.8	32.8	2	2	0	34.8
#19 Pool 29 ft	12	12	6	6	7	7	0	0	0	0	0	0	21.9	21.9	6	6	0	27.9
Total Pools 89 ft													54.7	54.7	8	8		62.7
#8 Run 31 ft	12	12	2	2	9	9	0	0	0	0	0	0	21	21	2	2	0	23
All Habitats Combined 148 ft													82.8	82.8	10	10	0	92.8

Length of Stream Sampled (ft):_148 ft_______

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.5595/0.5595_____

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0676/ 0.0676_

Steelhead Sampling Results

Date: 19Sep07 Stream: Boulder Sampled by: Alley, Steiner, Reis
Sampling Site: 17b (Bracken Brae) Water Temp. and Times: 62 @ 1531 hr, 17Aug07. (Air temp. 74 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
#20 Step-run 42 ft	9	9	1	1	0	0	1	1	0	0	0	0	9	9	2	2	0	11
#26 Riffle 48 ft	7	7	2	2	3	3	0	0	1	1	0	0	11.8	11.8	2	2	0	13.8
#25 Pool 55 ft	16	16	9	9	6	6	1	1	6	6	1	1	33.2	33.2	11	11	0	44.2
#27 Pool 29 ft	5	5	1	1	0	0	1	1	2/0	2/0	0/0	0/0	7	7	2	2	0	9
Pools Combined 84 ft													40.2	40.2	13	13	0	53.2
All Habitats Combined 174 ft													61	61	17	17	0	78

Length of Stream Sampled (ft):_174 ft__

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.3506/0.3506___

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0977/ 0.0977_

Steelhead Sampling Results

Date: 19Sep07 **Stream:** Bear **Sampled by:** Alley, Steiner, Reis

Sampling Site: 18a (above and below Hopkins Gulch) **Water Temp. and Times:** 64 F @ 1422hr, 16Aug07.

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
#15 Riffle 19 ft	4	4	0	0	4	4	0	0	1	1	0	0	9	9	0	0	0	9
#12 Pool 137 ft	29	29	5	5	8	8	0	0	5	5	0	0	43.3	43.3	5	4	1	48.3
#14 Pool 18 ft	10	10	3	3	3	3	0	0	1	1	0	0	14.4	14.4	3	3	0	17.4
Pools combined 155 ft													57.7	57.7	8	7	1	65.7
#11 Run (partial) 55 ft	11	11	4	4	7	7	1	1	4	4	0	0	28.7	28.7	5.1	5.1	0	33.8
All Habitats Combined 229 ft													95.4	95.4	13.1	12.1	1	108.5

Length of Stream Sampled (ft): 229 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4166/ 0.4166

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0572/ 0.0572

Steelhead Sampling Results

Date: 17Sep07 **Stream:** Branciforte **Sampled by:** Alley, Steiner, Reis
Sampling Site: 21a-1 (below Granite Ck) **Water Temp. and Times:** 62 F @ 1340 hr, 07Sep07. (Air temp. 74 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
#32 Riffle 18 ft	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
#30-31 Pool 32 ft	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	2
#33 Pool 105 ft	2	2	3	3	1	1	3	3	0	0	0	0	3	3	6	4	2	9
Pools Combined 137 ft													4	4	7	5	2	11
#7 Run 26 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Habitats Combined 181 ft													5	5	7	5	2	12

Length of Stream Sampled (ft):_181 ft___

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.0276/ 0.0276_____

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0387/ 0.0387_

Steelhead Sampling Results

Date: 17Sep07 **Stream:** Branciforte **Sampled by:** Alley, Steiner, Reis
Sampling Site: 21a-2 (below Granite Ck) **Water Temp. and Times:** 60 F @ 1441 hr, 08Sep07. (Air temp. 66 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
#13 Riffle 15 ft	6	6	0	0	1	1	0	0	0	0	0	0	7.1	7.1	0	0	0	7.1
#16 Pool 125 ft	25	25	1	1	13	13	0	0	6	6	0	0	50.5	50.5	1	1	0	51.5
#12 Pool 33 ft	10	10	1	1	7	7	1	1	3	3	0	0	25.9	25.9	2	2	0	27.7
Pools Combined 158 ft													76.4	76.4	3	3	0	79.4
#10 Run 24 ft	7	7	0	0	2	2	0	0	1	1	0	0	10.3	10.3	0	0	0	10.3
All Habitats Combined 197 ft													93.8	93.8	3	3	0	96.8

Length of Stream Sampled (ft):_197 ft___

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.4761/ 0.4761_____

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0152 / 0.0152_

Steelhead Sampling Results

<u>Date:</u> 20Sep07 <u>Stream:</u> Soquel <u>Sampled by:</u> Alley, Steiner, Wheeler
<u>Sampling Site:</u> 1 Above Grange <u>Water Temp. and Times:</u> 66 F @ 1351 hr
<u>Air Temp.</u> 68 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
#33 Run 35 ft	0	0	0	0	2	2	0	0	0	0	0	0	2	2	0	0	0	2
#32 Riffle 59 ft	6	6	1	1	0	0	0	0	0	0	0	0	6	6	1	1	0	7
#34 Pool 219 ft	19	9	1	11	10	6	1	5	4	2	0	2	37.6	20.9	2	19.7	0	40.6
All Habitats Combined 313 ft													45.6	28.9	3	20.7	0	49.6

Length of Stream Sampled (ft):_<u>313 ft</u>_

Young-of-the-Year / Size Class 1 per Foot of Stream:_<u>0.1449/ 0.0923</u>
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__<u>0.0010/ 0.0661</u>

Steelhead Sampling Results

Date: 20Sep07 **Stream:** Soquel **Sampled by:** Alley, Steiner, Reis
Sampling Site: 4 Adjacent Flower Field. **Water Temp. and Times:** 67 F @ 1655 hr
Air Temp. 68 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
#9 Run 39 ft	2	2	0	0	2	2	0	0	0	0	0	0	4	4	0	0	0	4
#8 Riffle 65 ft	18	15	0	3	6	6	0	0	1	1	0	0	26	23.4	0	3	0	26.4
#7 Pool 114 ft	1	1	2	2	4	4	0	0	0	0	0	0	5	5	2	0	2	7
#10 Pool 98 ft	28	19	5	14	3	2	0	1	1	1	0	0	32	22	5	13	2	37
All Habitats Combined 316 ft													67	54.4	7	16	4	74.4

Length of Stream Sampled (ft): 316 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2120/ 0.1722
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0222/ 0.0633

Steelhead Sampling Results

Date: 20Sep07 **Stream:** Soquel **Sampled by:** Alley, Steiner, Reis
Sampling Site: 10 (Above Allred) **Water Temp. and Times:** 64 F @ 1101 hr, 31Aug07 (air temp. 68 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
#19 Run Partial 30 ft	4	3	0	1	1	1	0	0	0	0	0	0	5	4	0	1	0	5
#16 Pool 56 ft	34	29	2	7	11	8	0	3	4	3	0	1	50.8	40.8	2	11.8	0	52.6
#20 Pool 88 ft	14	13	4	5	9	6	2	5	3	3	0	0	31.4	24.6	6.7	6	4	34.6
#18 Riffle 28 ft	14	14	0	0	3	3	0	0	0	0	0	0	17.4	17.4	0	0	0	17.4
All Habitats Combined 202 ft													104.6	82.8	8.7	18.8	4	109.6

Length of Stream Sampled (ft): 202 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.5178/ 0.4099
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0431/ 0.1109

Steelhead Sampling Results

Date: 21Sep07 **Stream:** Soquel **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 12 Soquel Creek Rd **Water Temp. and Times:** 68 F @ 1749 hr.
31Aug07 **Air Temp.** 67 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 66 ft	18	17	0	1	7	7	0	0	4	4	0	0	31.4	30.7	0	1	0	31.7
#11 Riffle 60 ft	17	15	2	4	6	6	0	0	1	1	1	1	25.1	23.4	3	4	1	28.4
#12 Pool 205 ft	62	57	0	5	28	26	1	3	8	7	1	2	106.3	97.7	2	8	2	107.7
All Habitats Combined 331 ft													162.8	151.8	5	13	3	167.8

Length of Stream Sampled (ft): 331 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4918/ 0.4586

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0151/ 0.0483

Steelhead Sampling Results

Date: 03Oct07 Stream: E. Branch Soquel Sampled by: Alley, Steiner, Wheeler
Sampling Site: 13a (Below Millpond) Water Temp. and Times: 72 F @ 1309 hr, 1Sep07 (air temp. 75 F).

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
#26 Riffle (partial) 33 ft	13	12	9	1	4	3	0	1	2	1	0	0	19.7	16.2	0	2	0	18.2
#36 Run (Partial) 54 ft	21	21	0	0	3	3	0	0	1	1	0	0	25	25	0	0	0	25
#37 Pool 151 ft	27	25	0	2	4	4	1	1	1	0	0	1	32	29.3	1	4	0	33.3
#38 Pool 49 ft	16	14	1	3	5	5	0	0	1	1	0	0	22.7	20.9	1	3	0	23.9
Pools Combined 200 ft													54.7	50.2	2	7	0	57.2
All Habitats Combined 287 ft													99.4	91.4	2	9	0	100.4

Length of Stream Sampled (ft):_287 ft_

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.3463/ 0.3185__

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0070/ 0.0314_

Steelhead Sampling Results

Date: 03Oct07 **Stream:** E. Br. Soquel **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 16 (Below Long Ridge Rd) **Water Temp. and Times:** 75 F@ 1609 hr, 30Aug07; (air temp. 77 F).

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
#9 Pool 52 ft	25	25	14	14	7	7	1	1	4	4	0	0	37	37	15	15	0	52
#9 Pool 107 ft	24	24	19	19	10	10	6	6	0	0	1	1	36.6	36.6	26.9	26.9	0	63.5
Pools Combined 159 ft													73.6	73.6	41.9	41.9	0	115.5
#28 Step-run 52 ft	4	4	1	1	4	4	1	1	0	0	0	0	8	8	2	2	0	10
#10 Riffle 9 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Habitats Combined 220 ft													81.6	81.6	43.9	43.9	0	125.5

Length of Stream Sampled (ft): 220 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.3709/ 0.37-9
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.1995/ 0.1995

Steelhead Sampling Results

Date: 21Sep07 **Stream:** W. Br. Soquel **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 19 (below Hester) **Water Temp. and Times:** 62 F @ 1315hr, 05Sep07 (air temp. 71 F)

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
#8 Run 23 ft	7	7	0	0	1	1	0	0	0	0	0	0	8.1	8.1	0	0	0	8.1
#14 Riffle 12 ft	2	2	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	2
#9-10-11 Pool-run-pool 154 ft	27	21	3	9	2	2	0	0	4/4	4/4	0/0	0/0	37	31	3	9	0	40
All Habitat 189 ft													47.1	41.1	3	9	0	50.1

Length of Stream Sampled (ft): 189 ft
Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2492/ 0.2175
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0159/ 0.0476

Steelhead Sampling Results

Date: 03Oct06 **Stream:** W. Br. Soquel **Sampled by:** NOAA Fisheries (Sogard/ Swank)
Sampling Site: 21 (Above GS Falls I) **Water Temp. and Times:**

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
All Habitats* 328 ft	139	132	11	18	48	48	4	5	12	12	1	1	207.3	201.2	16.8	24.6	0	225.8
All Habitats Combined 328 ft													207.3	201.2	16.8	24.6	0	225.8

Length of Stream Sampled (ft):_328 ft_

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.6320/ 0.6134_

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0512/ 0.075__

*Location was 800 feet downstream of Girl Scout Falls II. The 100 m sampled segment included 4 pools (2 partial), 2 riffles and 2 runs. The boundaries of the segment were not at breaks in habitat types.

Steelhead Sampling Results

Date: 01Oct07 **Stream:** Aptos **Sampled by:** Alley, Wheeler, Reis
Sampling Site: 3 (Adj. County Park) **Water Temp. and Times:** 61 F@ 1310 hr, 31Aug07; (air temp. 66 F).

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
#30-31 Pool 114 ft	27	25	4	6	12	11	3	4	11/2	11/2	1/0	1/0	52	49	8	9	2	60
#38 Pool 65 ft	20	18	7	9	16	15	2	3	11/3	11/3	0/0	0/0	50	47	9	10	2	59
Pools Combined 179 ft													102	96	17	19	4	119
#32 Run 31 ft	11	11	1	1	1	1	0	0	1	1	0	0	13	13	1	1	0	14
#29 Riffle 28 ft	9	7	0	2	3	3	0	0	1	1	0	0	13.5	11.8	0	2	0	13.8
All Habitats Combined 238 ft													128.5	120.8	18	22	4	146.8

Length of Stream Sampled (ft):_238 ft_

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.5399/ 0.5076__
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0756/ 0.1092

Steelhead Sampling Results

Date: 02Oct07 **Stream:** Aptos **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 4 (Above Steel Bridge) **Water Temp. and Times:** 62 F@ 1415 hr, 01Sep07; (air temp. 75 F).

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
#36 Pool 131 ft	13	13	12	12	0	0	4	4	4/1	4/1	1/1	1/1	18	18	18	18	0	36
#39 Pool 70 ft	1	0	20	21	7	2	4	4	1	1	0	0	4	3	24.4	22.4	3	28.4
Pools Combined 201 ft													22	21	42.4	40.4	3	64.4
#34 Riffle 39 ft	3	2	1	2	0	0	1	1	0	0	0	0	3	2	2	3	0	5
#35 Run 26 ft	0	0	1	1	0	0	0	0	1	1	0	0	1	1	1	1	0	2
All Habitats Combined 266 ft													26	24	45.4	44.4	3	71.4

Length of Stream Sampled (ft): 266 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0977/ 0.0902
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.1707/ 0.1782

Steelhead Sampling Results

Date: 01Oct07 **Stream:** Valencia **Sampled by:** Alley, Wheeler, Reis
Sampling Site: 2 (below road crossing) **Water Temp. and Times:** 60 F@ 1305 hr, 03Sep07; (air temp. 74 F).

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
#44 Pool 39 ft	6	6	9	9	3	3	0	0	2	2	0	0	13.2	13.2	9	9	0	22.2
#48 Pool 113 ft	15	15	8	8	9	9	2	2	3	3	1	1	31.8	31.8	11.2	11.2	0	43
#51 Pool 41 ft	13	13	15	15	4	4	41	4	1	1	0	0	18.5	18.5	19.6	19.6	0	38.1
Pools Combined 193 ft													63.5	63.5	39.8	39.8	0	103.3
#46 Run 48 ft	4	4	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	4
#45 Riffle 8 ft	2	2	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	2
#47 Riffle 12 ft	0	0	3	3	0	0	0	0	0	0	0	0	0	0	3	3	0	3
All Habitats Combined 261 ft													69.5	69.5	42.8	42.8	0	112.3

Length of Stream Sampled (ft): 261 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2663/ 0.2663
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.1640/ 0.1640

Steelhead Sampling Results

Date: 02Oct07 Stream: Valencia Sampled by: Alley, Steiner, Wheeler
Sampling Site: 3 (Above road crossing) Water Temp. and Times: 61 F@ 1550 hr, 04Sep07; (air temp. 70 F).

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
#51 Pool 54 ft	0	1	10	9	0	0	1	1	0	0	1	1	0	1	12	10	1	12
#53 Pool 22 ft	2	3	6	5	0	0	1	1	0	0	0	0	2	3	7.1	6.1	0	9.1
#55 Pool 68 ft	1	1	12	12	1	1	1	1	0	0	0	0	2	2	13	13	0	15
Pools Combined 144 ft													4	6	32.1	29.1	1	36.1
#52 Run 41 ft	4	4	2	2	0	0	1	1	0	0	0	0	4	4	3	3	0	7
#54 Riffle 7 ft	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
All Habitats Combined 192 ft													9	11	35.1	32.1	1	44.1

Length of Stream Sampled (ft): 192 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0469/ 0.0573
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.1828/ 0.1724

Steelhead Sampling Results

Date: 25Sep07 Stream: Corralitos Sampled by: Alley, Steiner, Reis, Wheeler, Kittleson. Sampling Site: 1 (below dam) Water Temp. and Times:

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
#36 Pool 73 ft	7	7	3	3	1	1	3	3	2/1	2/1	1/0	1/0	11	11	7	6	1	18
#39 Pool 69 ft	4	4	6	6	3	3	1	1	3/4	3/4	2/0	2/0	14	14	9	9	0	23
Pools Combined 142 ft													25	25	16	15	1	41
#37 Step-run 43 ft	12	12	2	2	4	4	0	0	1	1	0	0	17.6	17.6	2	2	0	19.6
#38 Run (partial) 45 ft	15	15	3	3	4	4	0	0	0	0	0	0	19.6	19.6	3	3	0	22.6
All Habitats Combined 230 ft													62.2	62.2	21	20	1	83.2

Length of Stream Sampled (ft): 230 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.2704/ 0.2704
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0913/ 0.0913

Steelhead Sampling Results

Date: 26Sep07 **Stream:** Corralitos **Sampled by:** Alley, Steiner, Wheeler
Sampling Site: 3 (above Colinas Drive) **Water Temp. and Times:** 59 F@ 1040 hr, 06Sep07; (air temp. 61 F).

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 80 ft	16	16	6	6	3	3	5	5	3/3	3/3	2/0	2/0	25	25	13	13	0	38
#9 Pool 141 ft	22	22	12	12	11	11	5	5	5	5	1	1	43	43	19.2	14.9	4.3	62.2
Pools Combined 221 ft													68	68	32.2	27.9	4.3	100.2
#7 Riffle 21 ft	6	6	0	0	2	2	0	0	0	0	0	0	8.4	8.4	0	0	0	8.4
#8 Run (partial) 38 ft	8	8	0	0	0	0	0	0	1	1	0	0	9.3	9.3	0	0	0	9.3
All Habitats Combined 280 ft													85.7	85.7	32.2	27.9	4.3	117.9

Length of Stream Sampled (ft): 280 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.3061/ 0.3061
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.115/ 0.115

Steelhead Sampling Results

Date: 26Sep07 Stream: Corralitos Sampled by: Alley, Reis, Wheeler
Sampling Site: 8 (above Clipper Gulch) Water Temp. and Times: 60 F@ 1812 hr, 29Aug06; (air temp. 69 F).

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
#50 Pool 37 ft	11	11	6	6	4	4	0	0	3	3	0	0	19.8	19.8	6	5	1	25.8
#53 Pool 92 ft	37	36	9	10	7	7	1	1	5	5	0	0	49.2	48.3	10.1	9	2	59.3
Pools Combined 129 ft													69	68.1	16.1	14	3	85.1
#49 Step-run (partial) 54 ft	14	13	0	1	0	0	1	1	0	0	0	0	14	13	1	2	0	15
#51 Riffle 8 ft	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
All Habitats Combined 191 ft													84	82.1	17.1	16	3	101.1

Length of Stream Sampled (ft): 191 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4398/ 0.4298
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0895/ 0.0995

Steelhead Sampling Results

Date: 27Sep07 **Stream:** Corralitos **Sampled by:** Alley, Reis, Wheeler
Sampling Site: 9 (above Eureka Gulch) **Water Temp. and Times:**

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
#9 Pool 42 ft	10	10	4	4	2	2	3	3	2	2	0	0	14.3	14.3	8.8	7.5	1.3	23.1
#11 Pool 35 ft	5	5	3	3	1	1	0	0	1	1	0	0	7.2	7.2	3	2	1	10.2
Pools Combined 77 ft													21.5	21.5	11.8	9.5	2.3	33.3
#8 Step-run (partial) 48 ft	15	15	0	0	3	3	0	0	1	1	0	0	19.1	19.1	0	0	0	19.1
#10 Step-run 40 ft	6	6	1	1	3	3	0	0	1	1	0	0	11.1	11.1	1	1	0	12.1
All Habitats Combined 165 ft													51.7	51.7	12.8	10.5	2.3	64.5

Length of Stream Sampled (ft):_165 ft_

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.3133/ 0.3133__
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.0776/ 0.0776

Steelhead Sampling Results

Date: 27Sep07 **Stream:** Shingle Mill **Sampled by:** Alley, Wheeler, Reis

Sampling Site: 1 (below 2nd Road crossing) **Water Temp. and Times:**

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
#59 Pool 21 ft	0	0	4	4	0	0	0	0	0	0	0	0	0	0	4	4	0	4
#57 Pool 20 ft	0	0	4	4	1	1	0	0	0	0	0	0	1	1	4	2	2	5
Pools Combined 41 ft													1	1	8	6	2	9
#56 Riffle 15 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#58 Step-run 49 ft	2	2	3	3	0	0	3	3	0	0	0	0	2	2	6	6	0	8
All Habitats Combined 105 ft													3	3	14	12	2	17

Length of Stream Sampled (ft): 105 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0286/ 0.0286
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.1333/ 0.1333

Steelhead Sampling Results

Date: 27Sep07 Stream: Shingle Mill Sampled by: Alley, Reis, Wheeler

Sampling Site: 3 (above 3rd road crossing) Water Temp. and Times:

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
#56 Pool 34 ft	3	3	3	3	0	0	2	2	0	0	0	0	3	3	5	4	1	8
#58 Pool 33 ft	2	2	2	2	2	2	0	0	0	0	0	0	4	4	2	2	0	6
#60 Pool 42 ft	1	1	0	0	0	0	1	1	0	0	1	1	1	1	2	2	0	3
Pools Combined 109 ft													8	8	9	8	1	17
#57 Riffle 7 ft	0	0	0	0	0	0	0	0					0	0	0	0	0	0
#59 Run 18 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Habitats Combined 134 ft													8	8	9	8	1	17

Length of Stream Sampled (ft): 134 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.0597/ 0.0597

Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.0672/ 0.0672

Steelhead Sampling Results

<u>Date:</u> 28Sep07 <u>Stream:</u> Browns Valley <u>Sampled by:</u> Alley, Wheeler
<u>Sampling Site:</u> 1 (below diversion dam) <u>Water Temp. and Times:</u> 58 F@ 1203 hr, 05Sep07; (air temp. 67 F).

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 56 ft	4	6	15	13	7	7	5	5	0	0	0	0	11	13	21	18	1.1	32.1
#3 Pool 54 ft	6	8	12	10	2	3	3	2	1	1	0	0	9.4	12.6	15.4	12.2	0	24.8
Pools Combined 110 ft													20.4	25.6	36.4	30.2	1.1	56.9
#2 Run 20 ft	2	2	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	2
#4 Riffle-partial 56 ft	4	4	1	1	0	0	0	2/0	2/0	0/0	0/0	0/0	6	6	1	1	0	7
All Habitats Combined 186 ft													28.4	33.6	37.4	31.2	1.1	65.9

Length of Stream Sampled (ft):_186 ft_

Young-of-the-Year / Size Class 1 per Foot of Stream:_0.1527/ 0.1806__
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream:__0.2011/ 0.1737

Steelhead Sampling Results

Date: 28Sep07 **Stream:** Browns Valley **Sampled by:** Alley, Wheeler
Sampling Site: 2 (above diversion dam) **Water Temp. and Times:** 62 F@ 1450 hr, 05Sep07; (air temp. 72 F).

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
#30 Pool 67 ft	8	9	16	15	6	6	6	6	1	1	1	1	18.8	19.1	24.2	23.4	0	42.5
#35 Pool 38 ft	16	17	16	15	4	4	2	2	1	1	0	0	21.3	22.3	18.1	17.1	0	39.4
Pools Combined 105 ft													40.1	41.4	42.3	40.5	0	81.9
#29 Run 22 ft	10	10	4	4	5	5	0	0	3	3	0	0	21.1	21.1	4	4	0	25.1
#28 Riffle 27 ft	9	9	2	2	2	3	1	0	0	0	0	0	11.2	12.6	3	2	0	14.6
All Habitats Combined 154 ft													72.4	75.1	49.3	46.5	0	121.6

Length of Stream Sampled (ft): 154 ft

Young-of-the-Year / Size Class 1 per Foot of Stream: 0.4701/ 0.4877
Yearlings and 2+ / Size Classes 2 and 3 per Foot of Stream: 0.3201/ 0.3019

APPENDIX C. Habitat and Fish Sampling Data With Size Histograms.