Soquel Demonstration State Forest

by

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As we celebrate the 10th anniversary of electrofishing at Soquel Demonstration State Forest, we would like to thank all of the agency personnel and volunteers involved in making this year's survey a success. Biologists Susan Sogard, Ellen Freund, Heidi Fish, and David Rundio of the National Marine Fisheries Service (NMFS) provided invaluable leadership, expertise, and time during sampling as well as in the preparation of this report. John Field, Rebecca Fisher, Mark Gleason, Jeff Harding, Morgan Kilgour, Bruce MacFarlane, Noah Parker, Patty Perasso, Ryan Weidling, and Brian Wells, also with the NMFS, contributed generously to this sampling effort. We also greatly appreciate the interest, enthusiasm, and hard work of volunteers Anne Weidlich, Ron and Patricia Marland, and Annette Pennock, who participated in the study and helped it to be a success. Thank you.

Cover Photos: *Upper Left* - Injection of elastomer tagging material into a juvenile steelhead trout. *Center* - Ashbury Gulch electrofishing station. *Lower Right* - Examination of a recaptured steelhead for an elastomer tag, using short wavelength blue light.

Introduction

A fish population survey was conducted by the California Department of Forestry and Fire Protection (CDF) and the National Marine Fisheries Service (NMFS) in Soquel Demonstration State Forest (SDSF) from September 29, 2003 to October 3, 2003. Electrofishing (steelhead population sampling) was completed at five sites: four on the East Branch of Soquel Creek and one on Amaya Creek. (See Map 1.) These sites were revisited in October 2003 to assess their dynamic habitat values.

The purpose of this study was to add to previously accumulated baseline data of fish populations in the significant fish bearing creeks that run through SDSF. This is the tenth year of monitoring by CDF. (No independent monitoring by CDF occurred in 2000, as State Forest staff assisted with monitoring conducted by the Soquel Creek Water District.) This year's study was also conducted to support the research being performed by the National Marine Fisheries Service to monitor steelhead growth and migration. Electrofishing was performed independently of CDF staff at all five stations during the summer of 2003 by NMFS, and this re-sampling of the SDSF index reaches is an important part of their research. The participants in this year's study were: Thom Sutfin, Ed Orre, Jessica Malan, Gail Silliman, and Andy Morse (who are all with CDF); Susan Sogard, Ellen Freund, Heidi Fish, David Rundio, John Field, Rebecca Fisher, Mark Gleason, Jeff Harding, Morgan Kilgour, Bruce MacFarlane, Noah Parker, Patty Perasso, Ryan Weidling, and Brian Wells (NMFS); and volunteers Anne Weidlich, Ron and Patricia Marland, and Annette Pennock. Thom Sutfin, Susan Sogard, Jessica Malan, and Andy Morse revisited the survey reaches to evaluate habitat characteristics.

Methodology

Quantitative electrofishing surveys were completed at five sites: one on Amaya Creek (AC) and four on the East Branch of Soquel Creek, at Longridge Road Crossing (LR), Badger Springs Picnic Area (BS), Spanish Ranch Trail Crossing (SR), and approximately three-quarters of a mile above Ashbury Gulch (AG). Four of the sites used were the same as in previous quantitative surveys. Badger Springs is the first new station to be added since 1995. Only relatively small changes were made to the methodology used in the study.

Each electrofishing station was roughly 100 yards long and enclosed at both ends by seine nets. The nets were placed at stream channel habitat boundaries, resulting in a slight variation between station lengths. However, individual station lengths are fairly consistent from year to year because they are semi-permanently marked. This year’s sampling methodology was nearly identical to the methodology used in 2002. Changes in 2002 included the use of a third electrofishing pass on every reach, and also the introduction of a "back-pass" on each pass. Prior to 2002, stations were sampled with a third pass only when the second pass indicated that the rate of population depletion wasn’t high enough. Most of the time, this meant that only two passes were made in any given reach. This sampling protocol is based on the depletion method described by Seber and Le Cren (1967). The "back-pass," initiated by NMFS in 2002, is a sampling pass made downstream immediately following the upstream electrofishing pass. (The upstream pass is considered the standard in electrofishing, both by convention and because it allows those people sampling to use the flow of the water to push stunned fish into waiting nets.) The back-pass typically takes about half as much time as the upstream pass and does not net nearly as many fish. Fish caught on any given back-pass are included in the total number of fish attributed to the corresponding upstream pass (e.g., a fish netted on the first back-pass is included in "Pass 1").

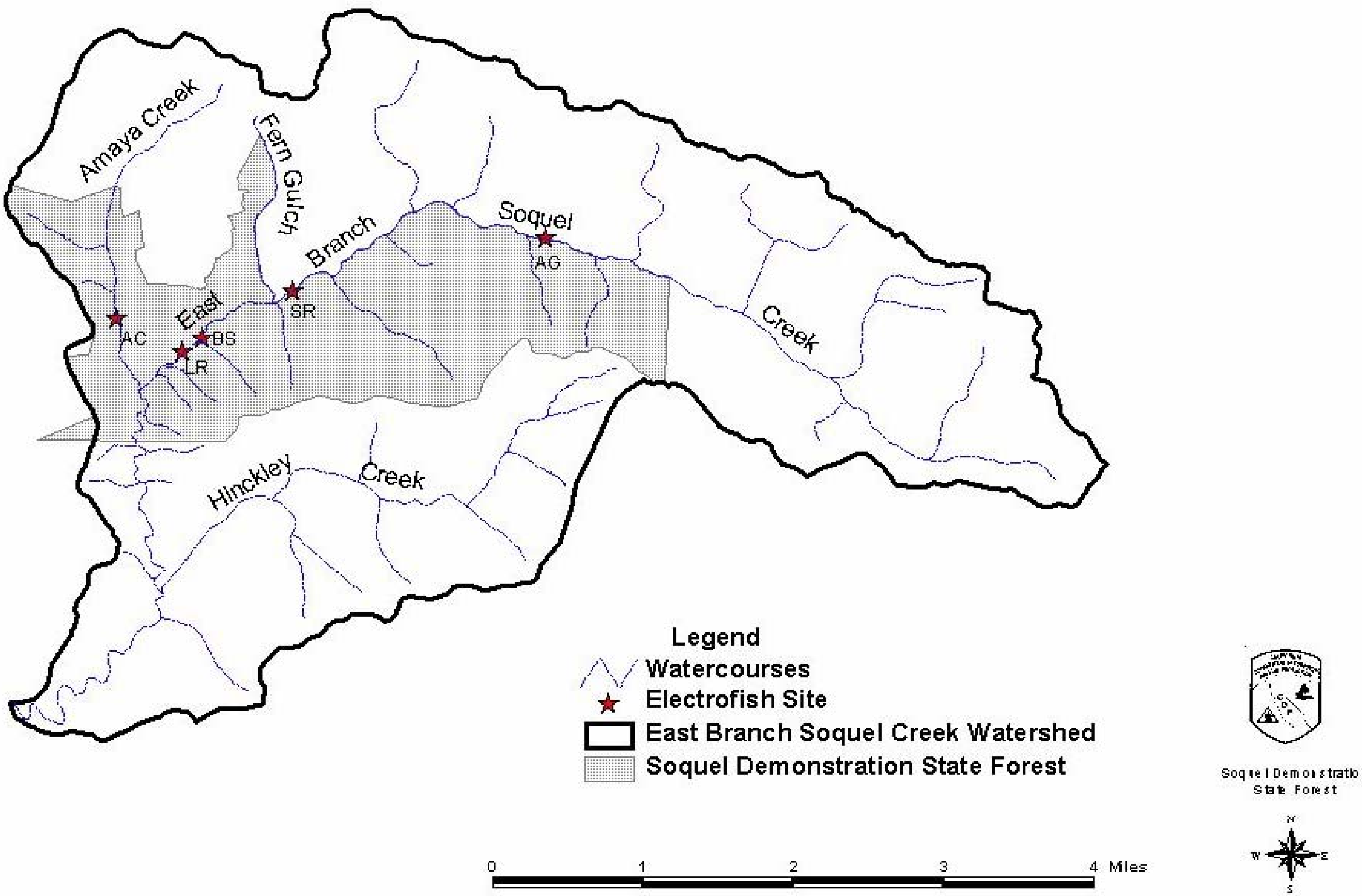
Electrofishing was completed in one day per station, being greatly facilitated by the simultaneous operation of two shocking units at the Longridge, Badger Springs, Spanish Ranch, and Ashbury Gulch locations. Amaya Creek electroshocking was performed by one unit. Electrofishing devices utilized DC power, generated by gasoline-powered backpack generator units. Fish were scooped out of the water by “netters” using both small aquarium-type nets (approximately 8 centimeters [cm] by 5 cm) and medium-sized nets (approximately 15 cm by 10 cm). In addition, a large number of fish were removed from the water using the nets strung across the ring at the end of the electrofishing anodes. Once fish were pulled from the water, they were placed into buckets carried by those people working alongside the electrofishing device(s).

The total number of seconds spent electroshocking and clock time for each pass were also monitored and recorded to ensure that effort was comparable between passes (see Appendix A). A considerable attempt was made to collect amphibians, including Pacific giant salamanders, yellow-legged frogs, and newts. Collections of non-steelhead fish, amphibians, and arthropods cannot, however, be considered reliable population estimates for these species. Consistent and concerted attempts at depletion were not made for these organisms, as is required for the establishment of a credible population estimate. Estimated steelhead populations and confidence intervals were calculated for each site using MicroFish software (Van Deventer and Platts, 1985). MicroFish outputs can be found in Appendix B.

The number of fish by species, individual fish fork lengths (nose to tail fork), and individual fish weights were recorded for each pass. In addition, scale samples were taken from about 17% of the steelhead collected, ranging from a minimum of two fish sampled for scales at the Amaya Creek station, up to a maximum of seventy-five fish sampled for scales at the Badger Springs station. These scale samples will be used by NMFS for research independent of the electrofishing sampling addressed in this report. For the collection of scale samples, weighing, and measuring, the fish were briefly anesthetized by being placed in a bucket of water to which the anesthetic Ms-222 (with a sodium bicarbonate buffer) was added. The most significant change made to the procedure for collecting information about individual fish was the addition of tagging the fish. Fish under 80 millimeters (mm) were tagged with a color-coded elastomer tag that allows researchers to group fish in 10 mm length classes. When tagged fish are recaptured during future sampling, growth estimates can then be made. Fish over 80 mm at the time of capture were tagged with Passive Integrated Transponder, or PIT, tags. Identifying numbers are assigned to each PIT tag, so that when a PIT-tagged fish is later recaptured, it can be scanned to learn the "identity" of the fish. This allows researchers to track the growth of a particular specimen in future sampling.

Water temperatures were taken at all stations on the day each was sampled. Habitat inventory data, in accordance with the methods outlined by the California Salmonid Stream Habitat Restoration Manual, Third Edition (Flosi et.al., 1998), was collected two to three weeks later. Stream flow was measured during electrofishing on Soquel Creek, and during habitat analysis on Amaya Creek and Soquel Creek, using the centroid method. Habitat analysis data can be found in Appendix C.

Map 1
Electrofishing Station Locations



Results

Total electroshocking time, time per pass, and volt settings are displayed in Appendix A. Estimated fish populations (as calculated by MicroFish) for each site are shown in Table 1 below. (See also Appendix B.)

Table 1. Estimated Steelhead Trout Population for 2003

Station	Number of Fish Caught			Total Fish Caught	**Estimated Population**
	Pass 1	Pass 2	Pass 3		
AC	6	0	0	6	**6**
LR	357	52	26	435	**438**
BS	251	61	28	340	**348**
SR	435	86	14	535	**538**
AG	84	23	3	110	**111**

As described above, prior to the sampling that occurred in 2002, electrofishing by SDSF staff in Soquel Creek and Amaya Creek was done using the depletion method described by Seber and Le Cren (1967). In practice, this usually meant that only two passes were necessary. In 2002 and 2003, however, the standard methodology for NMFS required three passes at all stations, without regard for second pass depletion. If the depletion method had been applied this year, no stations would have required a third pass, based on rates of depletion. For this reason, we ran MicroFish analyses for all stations after two passes and again after three passes, to compare differences in population estimates. The results of that process are displayed in Table 2 below. (See also Appendix B.)

Table 2. Comparison of MicroFish Outputs for Two and Three Pass Sampling

Station	Two Pass Population Estimate		Three Pass Population Estimate	
	Number	95% Confidence Interval	Number	95% Confidence Interval
AC	6	*	6	*
LR	417	±7.721	438	±4.464
BS	330	±14.169	348	±7.669
SR	541	±13.498	538	±4.17
AG	114	±9.508	111	±2.646

*The removal pattern observed at the Amaya Creek station would not allow for the calculation of population statistics.

Although the population estimates do not differ a great deal in absolute numbers, the three pass method did yield smaller confidence intervals and therefore greater accuracy in predicting the population of any given index reach that was sampled. For this reason, the three pass population estimates will be used throughout this report as the 2003 estimates of population.

Amaya Creek

The Amaya Creek station was electrofished on September 29, 2003. All fish collected were steelhead trout (*Oncorhynchus mykiss*). Amphibians collected included one rough-skinned newt (*Taricha granulosa*), seven Pacific giant salamanders (*Dicamptodon ensatus*), and one foothill yellow-legged frog (*Rana boylii*). No steelhead mortality occurred at this station. Fish lengths ranged from 110 mm to 189 mm with a median of 121 mm, and weight ranged from 16.3 grams to 78.7 grams with a median of 19.1 grams.

The structural habitat features of this area included two step run segments, two low gradient riffle segments, and a plunge pool, a run, and a glide segment. The most common features at this station were the two step run segments, accounting for 41% of the length of the Amaya Creek station, and the two low gradient riffle segments, adding up to nearly 40% of the station length. The deepest water was found in an 8 meter by 3 meter plunge pool, with an average depth of 17.7 cm and a maximum depth of 30 cm. Large woody debris plays an important role here, as it covers 40% of the plunge pool and 10% of the step run. Most of the remaining cover is provided by instream boulders. At the start of sampling, water temperature was 13°C.

Longridge Road Crossing

The Longridge Road Crossing station was electrofished on October 1, 2003. The most common fish caught were steelhead trout, although twenty-five Pacific lamprey (*Lampetra tridentata*) and one sculpin (*Cottus* spp.) were also collected at this location. In addition to fish, eighteen Pacific giant salamanders (*Dicamptodon ensatus*), forty-four foothill yellow-legged frogs (*Rana boylii*) and three rough-skinned newts (*Taricha granulosa*) were found at this station. Steelhead lengths ranged from 35 mm to 139 mm with a median of 55 mm, and weights ranged from 0.5 grams to 35.4 grams with a median of 2.1 grams. Steelhead mortality was eight fish, or 1.8%. (All deceased fish were retained by NMFS for research and autopsy purposes.) Some of the fish captured were suffering from black spot disease, a disorder evidenced by spots resulting from an infestation of young flukes of the larval trematode (*Neascus)*. This is the third year of significant observations of black spot disease at this station.

Habitat was comprised of two glides, a low gradient riffle, a high gradient riffle, and a step run segment. The riffles combined make up over 45% of the length of this station. The glides had the deepest water, with average depths of nearly 18 cm, and the station maximum of 29 cm. Instream cover is largely boulders, although there is an important undercut bank segment and some large woody debris. Another positive habitat attribute of this station is the substrate components, which are primarily cobbles, boulders, and gravel. On the day of sampling, water temperature was 13.5°C.

Badger Springs Picnic Area

The Badger Springs station was electrofished on October 3, 2003. In addition to steelhead, eighteen Pacific lamprey, eleven Pacific giant salamanders, five foothill yellow-legged frogs, three sculpin, two rough-skinned newts, and one lamprey were captured. Several signal crayfish (*Pacifasticus leniusculus*) were also collected, but they were not counted or measured, nor were they returned to Soquel Creek. Due to potentially negative effects on native species, these invasive arthropods were removed from the population.

Captured steelhead had a minimum length of 35 mm and a maximum length of 222 mm, the largest fish caught this year. Median steelhead length was 56 mm, and median weight was 2.1 grams. The most massive steelhead caught weighed 113.1 grams, while the lightest weighed only 0.4 grams. Steelhead mortality was kept to one fish, or just 0.2% of those fish counted.

The habitat types at this station were a run, a low gradient riffle, and a lateral scour pool (bedrock formed), along with two low gradient riffle side channels. The single most important habitat attribute here is the exposed bedrock stream bank, which has allowed the flow of the creek to scour out a deep pool. The pool's average depth is 49.2 cm, with a maximum of 90 cm. Overall, sand was the most common substrate element. The water temperature at the start of sampling was 14.3ºC.

Spanish Ranch

The Spanish Ranch station was electrofished on September 30, 2003. No non-steelhead fish were caught at this station. Eight Pacific giant salamanders, eight foothill yellow-legged frogs, five rough-skinned newts, and two signal crayfish were also collected. Steelhead lengths had a median of 53 mm and a range of 30 mm to 132 mm. Weights ranged from 0.4 grams to 28.0 grams with a median of 1.8 grams. Steelhead mortality was about 3.2%, or seventeen fish.

The habitat types at this site included two low gradient riffles, a run, a lateral scour pool (root wad enhanced) and a step run segment. The riffles and step run segments combined add up to 87% of the length of the station, while the lateral scour pool is less than 3%. In fact, the pool appears to be filling in with sand and gravel, which not only reduces the cool resting habitat that fish utilize in pools, but it is also reducing the accessibility of the root wad and undercut bank. The deepest point in this reach was actually found in the step run unit and was 30 cm. The highest average depth, however, was found in the scour pool, measuring 16.3 cm. Instream cover for young fish is largely absent, but the mostly gravel substrate is probably good spawning habitat. The water temperature at the beginning of the day of sampling was 13.8°C.

Ashbury Gulch

The Ashbury Gulch station was electrofished on October 2, 2003. All of the fish encountered here were steelhead trout. Six Pacific giant salamanders, two signal crayfish, and two rough-skinned newts were also caught. Steelhead lengths ranged from 49 mm to 198 mm with a median of 69.5 mm, and weights ranged from 1.3 grams to 82.6 grams with a median of 3.6 grams. One steelhead mortality occurred at this station, accounting for 0.9% of those fish captured.

Two step runs, a cascade, step pool, glide, run, and high gradient riffle were all found here, along with a step run side channel. At 47% of the length of this station, the three step run units were the most prevalent. Nonetheless, this station had the most heterogeneity of habitat of the five reviewed in this study. Water depth reached 45 cm in the glide unit, and the highest average depth was 24.4 cm in the step pools. This station also had the greatest occurrence of instream large and small woody debris, available for use as shelter in five of the eight units. On the day of sampling, water temperature was 13.6°C. Stream flow velocity was not measured at this station.

Fish length distribution for each station is displayed graphically in Figures 1 through

5 below.

Figure 1: Amaya Creek 2003 Fish Length Distribution

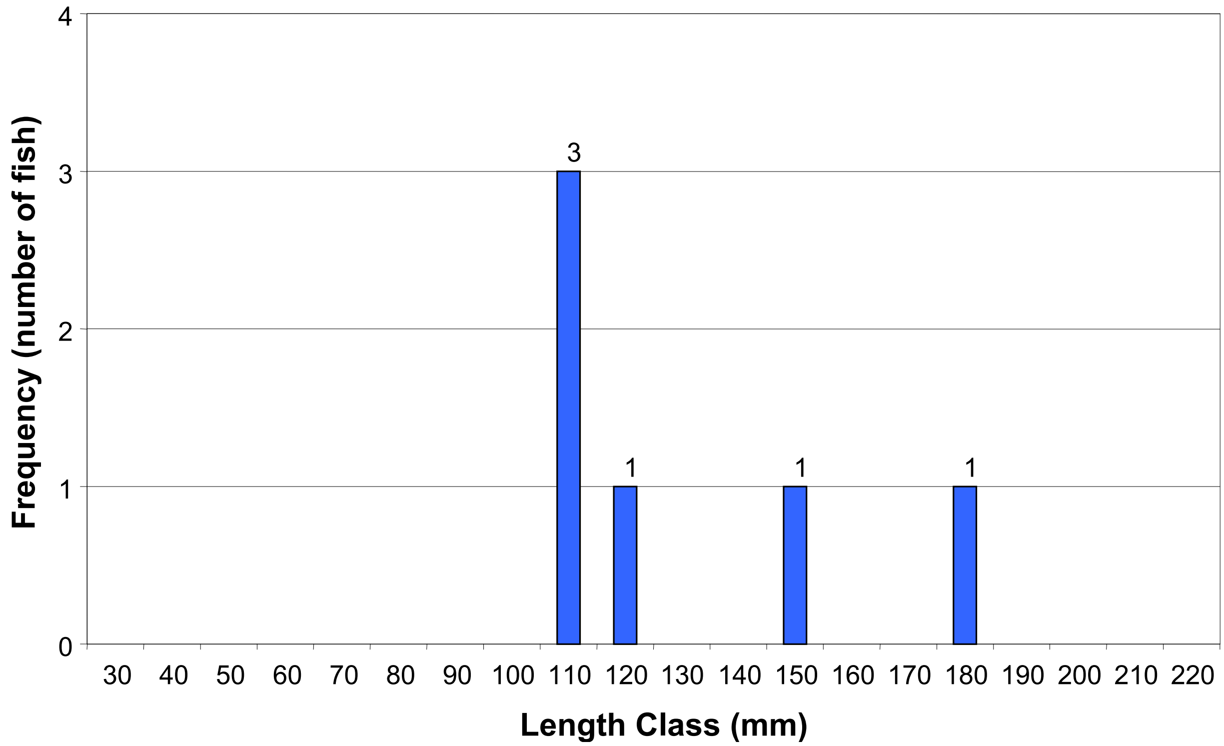


Figure 2: Longridge 2003 Fish Length Distribution

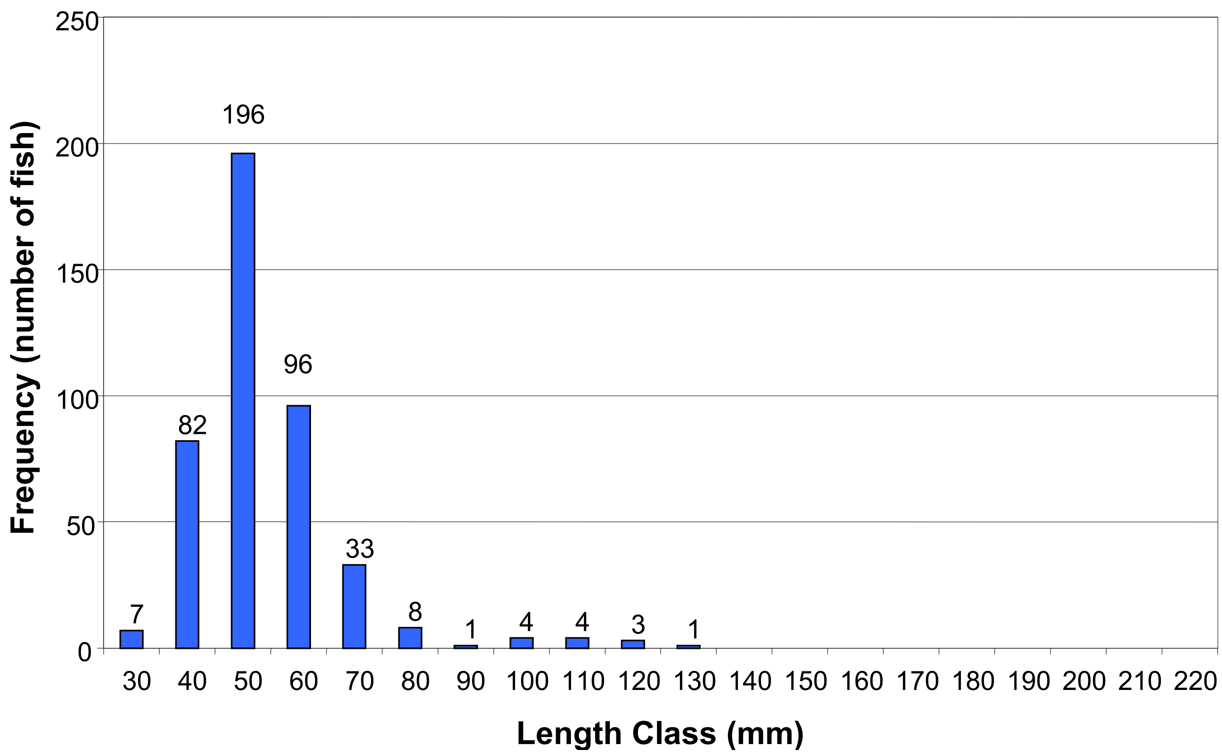


Figure 3: Badger Springs 2003 Fish Length Distribution

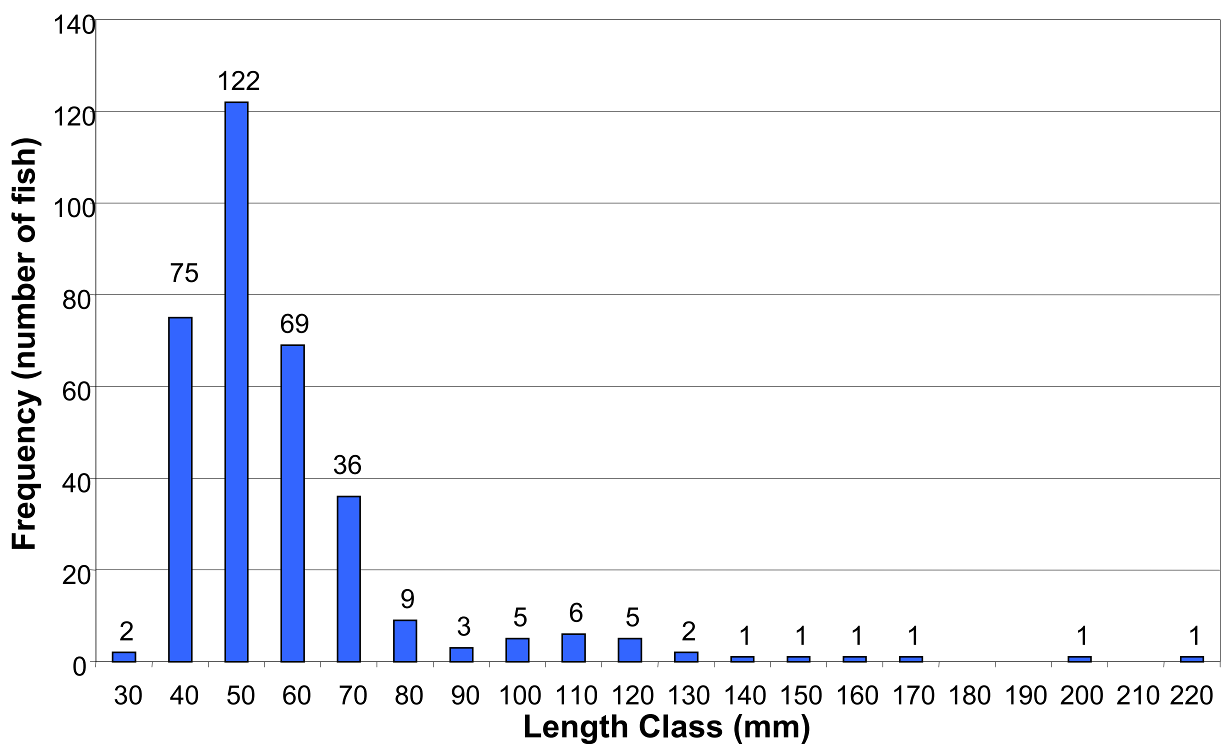


Figure 4: Spanish Ranch 2003 Fish Length Distribution

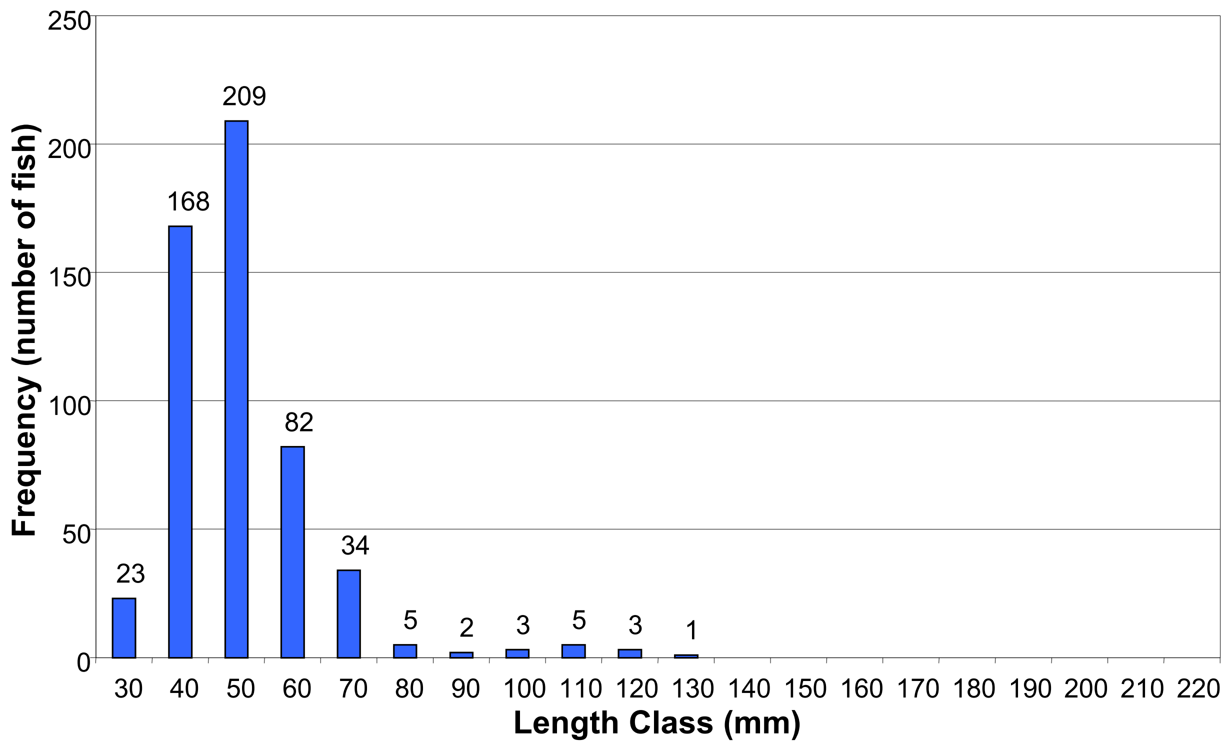
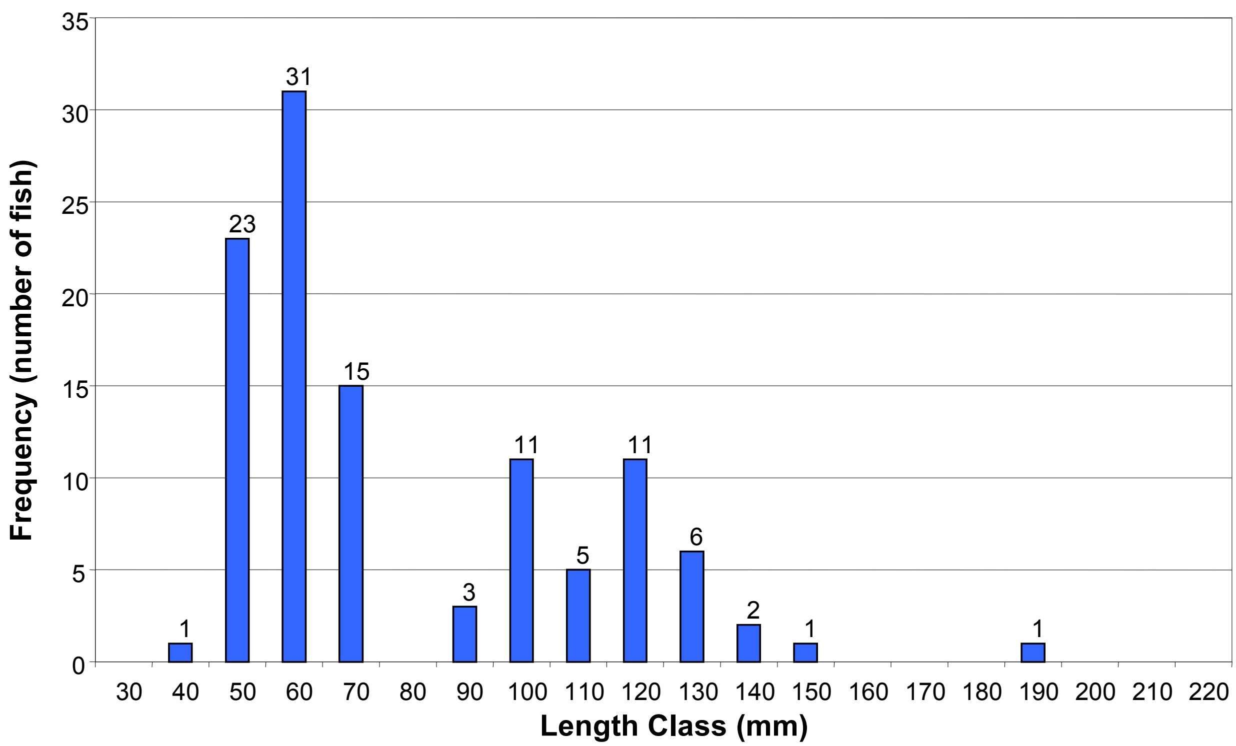


Figure 5: Ashbury Gulch 2003 Fish Length Distribution



Discussion

According to Flosi and Reynolds (1994), fish less than 80 mm are young-of-the-year (YOY), fish between 80 mm and 160 mm are one year old, and fish greater than 160 mm are two years of age or older. Based on this formula, Tables 3 through 6 show the relative age distribution for each station in the 2003, 2002, 2001, 1999, 1998, and 1997 catches.

Table 3. Age Distribution of Amaya Creek Catch

Year	YOY	1 Year	2+ Years	% YOY	% 1 Year	% 2+ Years
2003	0	5	1	0.0	83.3	16.7
2002	14	25	1	35.0	62.5	2.5
2001	0	30	1	0.0	96.8	3.2
1999	66	15	3	78.6	17.8	3.6
1998	2	28	0	6.7	93.3	0.0
1997	43	20	1	67.2	31.2	1.6

Table 4. Age Distribution of Longridge Catch

Year	YOY	1 Year	2+ Years	% YOY	% 1 Year	% 2+ Years
2003	414	21	0	95.2	4.8	0.0
2002	537	37	0	93.6	6.4	0.0
2001	430	58	1	87.9	11.9	0.2
1999	690	32	0	95.6	4.4	0.0
1998	374	58	1	86.4	13.4	0.2
1997	370	34	1	91.4	8.4	0.2

Table 5. Age Distribution of Badger Springs Catch

Year	YOY	1 Year	2+ Years	% YOY	% 1 Year	% 2+ Years
2003	304	32	4	89.4	9.4	1.2

Table 6. Age Distribution of Spanish Ranch Catch

Year	YOY	1 Year	2+ Years	% YOY	% 1 Year	% 2+ Years
2003	516	19	0	96.4	3.6	0.0
2002	378	34	0	91.7	8.3	0.0
2001	358	35	0	91.1	8.9	0.0
1999	395	35	0	91.9	8.1	0.0
1998	199	44	0	81.9	18.1	0.0
1997	308	22	1	93.1	6.6	0.3

Table 7. Age Distribution of Ashbury Gulch Catch

Year	YOY	1 Year	2+ Years	% YOY	% 1 Year	% 2+ Years
2003	70	39	1	63.6	35.5	0.9
2002	23	61	1	27.1	71.8	1.2
2001	135	59	0	69.6	30.4	0.0
1999	94	50	1	64.8	34.5	0.7
1998	49	39	0	55.7	44.3	0.0
1997	98	46	2	67.1	31.5	1.4

It is important to emphasize the scope of this report. This discussion of our findings will only attempt to present general trends in steelhead populations, their age distribution, and some of the ecological conditions that may influence steelhead behavior or survival. As stated in previous reports, it is difficult to make definitive conclusions about causality and the influence of environmental characteristics relative to population trends because of the limited number of sampling years and the inherent challenge in controlling for a wide range of natural variables. Furthermore, any forest-wide extrapolation of steelhead population estimates would be inappropriate due to the variability of habitat throughout the area. The index reaches used are only intended to give us an idea of population trends and demographics.

Nevertheless, increasing attempts are being made to understand, or possibly control for, some elements of steelhead life habits and SDSF sampling protocols. One topic of interest which has the potential to both add to the body of knowledge about steelhead, and to influence sampling methodology, is the issue of local migration (i.e., distances less than one kilometer up to several kilometers) of juvenile steelhead not yet mature enough for emigration to the ocean. The PIT tagging and elastomer tagging effort currently led by NMFS within SDSF will hopefully shed some light on month-to-month and year-to-year migration of young fish. This research may lead to a better understanding of the tolerance of steelhead for changes in microhabitats and falling water levels eliminating habitat. A better understanding of juvenile migration may also lead to improvements in electrofishing methodology and data analysis. For example, the current practice of assigning individuals to age classes (Tables 3 through 7) is intended to find out what age group is utilizing a particular reach, which then helps to determine if barriers to fish passage have developed or disappeared. Additional information about migration may allow us to draw new conclusions about what kinds of habitat fish prefer, and how far they will travel to reach that habitat.

Also, we currently have no expectation that significant numbers of individuals spend more than one season at any given station. Indeed, the age class data displayed in Tables 3 through 7 is not meant to suggest that this year's young-of-the-year will be next year's one year olds at any given station – there is simply too much opportunity for upheaval once winter storms arrive.

One adaptation made to reduce unnatural variability is the standardization of electrofishing timing in the fall. Recognizing that mortality and predation by other species can be very high for juvenile steelhead, it is logical that a sampling window of three or four weeks each year may have a large influence on population numbers and year over year population comparisons. For this reason, a concerted effort will be made to conduct electrofishing sampling every year in the last week of September. It must be noted, however, that this will not control for major swings in the end of the previous rainy season or the total amount of rainfall per year. All else being equal, Soquel Creek will have grossly different habitat characteristics by September if the last major storms come through in February versus late May. Additionally, Soquel Creek will have more available habitat following high rainfall winters than drought years.

Another topic for examination is that of primary productivity. In an effort to control for significant variation in stream channel characteristics between stations and from year to year, this report has begun to look at the number of steelhead in a given area of the water. This attempt at evaluating the primary productivity of each reach (Table 8) has been accomplished by dividing the population estimate by the estimate of water volume derived while examining the habitat types of each reach.

Table 8. Primary Productivity

Station	Population Estimate	Volume (m^3)	Primary Productivity ($fish/m^3$)
AC	6	14.75	0.41
LR	438	46.69	9.38
BS	348	108.11	3.22
SR	538	72.33	7.44
AG	111	51.40	2.16

Primary productivity did not turn out to be the equalizer that one might have expected. Though some aggregation did occur, these calculations of primary productivity lack the accuracy to make population predictions based on volume of water. Finally, it must be said that our attempt at calculating volume of water is incredibly crude, using only a handful of width and depth measurements.

Although non-continuous habitat altering events (e.g., landslides, floods, removal or addition of fish barriers, etc.) may have an important and ongoing effect on steelhead populations, these factors have not been addressed in this report if they occurred prior to the 2002 SDSF Steelhead Trout Population Survey. For a discussion of these events and the impact that they may continue to exert on current population conditions, please refer to previous SDSF Steelhead Trout Population Survey Reports.

<u>Amaya Creek</u>

The 2003 estimated population of six steelhead at the Amaya Creek sampling station is the all-time low for this location. This is a precipitous drop from the estimate of forty-one in 2002, and also far below the average of thirty-four for all years sampled. The 1999 estimate of eighty-six was the highest since sampling began in Amaya Creek in 1994.

With no known major changes in stream morphology at or around the Amaya Creek electrofishing station, and a 15% increase in rainfall over the prior year, it is difficult to know why the population estimate is so low. As in 2001, zero of the captured fish were considered YOY. When NMFS electrofished this station on June 17, 2003, they also observed a relatively small population (an estimated nine fish). This means that this low September population had nothing to do with high summer mortality or predation targeting these larger steelhead. Furthermore, the fact that five of the six fish caught at AC in September were already PIT tagged from June suggests that emigration is not a major issue. The only explanation that seems plausible is that the forty-one fish living at this station in 2002 have moved on or died, and that very few steelhead were hatched in this vicinity this year. No young-of-the-year were captured here, either in June or September (therefore, no fish were elastomer tagged). This low hatching level may have resulted from a fish barrier debris jam that prevented spawning adults from reaching this area, or from the larger-than-usual storms that this watershed experienced in November or December destroying redds. The one category in which this station is the leader is growth rate of PIT tagged fish between June and September. Average daily growth here was higher than for any other reach, based on recaptured PIT tagged fish. When viewed in terms of primary productivity of the reach, this makes sense. Primary productivity (Table 8) can be thought of much like population density – when primary productivity is low, as it was at the AC station, there is presumably less competition for resources. Accordingly, the small population of fish living here was able to grow more rapidly than its same-size counterparts elsewhere because of greater food availability.

<u>Longridge Crossing</u>

The 2003 estimated population of 438 steelhead at the Longridge station was down 24% from last year's estimate of 577, and also well below the high in 1999 of 829 fish. Further, this population estimate is about 13% below the average of 504 for all the years since 1993 that sampling has taken place at Longridge. Age distribution at this station has been fairly consistent since estimates of that attribute began in 1997. Young-of-the-year have always dominated this station, comprising between 86% and 96% of the population. The 2003 sampling was no different, with just over 95% of the population considered YOY.

When the Longridge station was sampled by NMFS on June 18, 2003, the population estimate was 520 steelhead. Due to expected high rates of juvenile mortality and changes in habitat caused by the falling water level, this drop of 17% over the course of the summer is not surprising. 394 fish were elastomer tagged at that time, along with 26 PIT tagged. 26% of the elastomer tagged fish (101 fish) were recaptured in October, as well as 38% of the PIT tagged fish (ten fish). Fish in the smallest size category in June (23-34 mm), grew the most, averaging 17.8 mm in growth by October. Growth rates decreased for fish in the larger size classes, with fish that were PIT tagged (at least 80 mm in June), showing almost no growth. This is consistent with the idea that as summer progresses, less food is available to steelhead. Because of their greater metabolic needs, larger fish do not grow as much because of the reduced food levels. Conversely, recapture rates were much lower for the smallest fish, ranging from 6% in the 23-34 mm size class, all the way up to 41% in the 70-79 mm size class (and 38% for PIT tagged fish, as stated above). We can assume much of this is due to summertime mortality. These high rates of mortality are also consistent with conventional thinking about steelhead populations. In summary, the smaller fish are able to grow at a much more impressive rate if they survive, but they are not nearly as resilient as the larger fish.

Some of the fish collected had signs of black spot disease, which is caused by an infestation of a parasitic fluke. The 2001 Steelhead Trout Population Survey Report was the first to mention black spot disease, so it is difficult to know when it first became such a widespread problem at this station or what its effects will be. During the 2001 electrofishing effort, black spot disease was observed in "over half" of the fish captured, and in 2002 it was reported that up to 80% of the steelhead captured were infected. However, because no formal sampling scheme was used to look for signs of this parasite it is difficult to know whether the disease is spreading, or at what rate. In 2003, less than 5% of the fish listed on the data sheets for Longridge were diagnosed and recorded as having black spot disease. This issue, however, was not discussed as a priority with the people responsible for observing the fish and recording information. For this reason, we cannot claim that the true incidence of black spot disease has decreased at all, much less nearly disappeared, based on what appears on the data sheets.

Mortality was back down to below 2% (eight steelhead), after being in the vicinity of 6% for the last two years. While some of this can rightfully be attributed to better oxygen, temperature, and anesthetic management in the buckets, some thought must be given to the effects of the June 2003 sampling. When this station was electrofished on that day, mortality was over 10%. If some juveniles are more susceptible to stress-induced mortality, they may have fallen victim to the earlier electrofishing effort leaving the more resilient individuals in the population. If this is in fact the case, these mortality figures may shed some light on the issue of juvenile migration – or lack thereof.

<u>Badger Springs Picnic Area</u>

In the first year of sampling at Badger Springs as part of the SDSF monitoring effort, the population estimate was 348 steelhead. At 90 cm deep, this station included the deepest pool in any of the State Forest reaches (by over 40 cm). By no coincidence, Badger Springs was also home to the two largest fish caught in 2003, both over 200 mm. The addition of this reach should be a great benefit to the monitoring program, as it will allow monitoring to occur in one of the few large bedrock formed pools with SDSF. As other pools are formed or filled over time, this one has a greater likelihood of longevity because of its proximity to a bedrock outcrop on a bend in Soquel Creek. This should ensure the continuation of the stream-bottom scouring that originally formed this pool. Also, in future drought years, this may be one of the only deep, coolwater refuges available to steelhead at the end of the summer. During those times, the chance to survey this reach and then compare the population with years of background data may be very valuable to understand the use of habitat and population dynamics during California's periodic droughts. Finally, monitoring the depth of this pool, especially relative to land use events such as stream restoration or road building, will give us some clues about how we can affect these features, and how they change on their own.

When this station was electrofished on July 28, 2003, the population estimate was 488. The 29% drop in population by October is within the range of what is expected. 54% of the steelhead that were PIT tagged in July were recaptured in October (twenty-two fish), along with 38% of the elastomer tagged fish (149 recaptured). The trends in growth by size class and recapture by size class were similar to those observed at Longridge (see above). Interestingly, one of the fish captured at Badger Springs in July was already elastomer tagged, having been caught and tagged in June at either Longridge or Spanish Ranch station. Also, two other fish recaptured during the electrofishing in October had been originally elastomer tagged at either Longridge or Spanish Ranch station in June. These three fish demonstrate why it will be advantageous to have this Badger Springs station for studying migration. As an intermediate between what are otherwise the two closest stations, relatively short distance migration will be traceable.

Spanish Ranch

The estimated steelhead population of 538 at Spanish Ranch in 2003 was an increase of 30% over last year, but also the new high for this station. The previous high of 499 was set in 1999. Even more interesting than the new record, though, is the fact that the population estimate for the sampling of this same station on June 19, 2003 was 11% lower, at 479 steelhead. This suggests that nearby reaches of Soquel Creek become so habitat-limited over the course of the summer that juveniles are forced to relocate.

The proportion of YOY also increased slightly compared to 2002, from around 91% of steelhead caught last year, to over 96%. This emphasizes the point seen at other stations, that young-of-the-year drive total population numbers throughout this study. At the other end of the size spectrum, according to recaptured PIT tagged steelhead, the average daily growth rate over the summer was actually negative at this station. (See Ashbury Gulch below for more on negative growth.) Looking to primary productivity (Table 8), which was relatively high here, we can assume the effects of elevated population density acted on these larger fish. That is, competition for food may not have been enough to lead to massive mortality, but the metabolic needs of the fish were not being met by their summertime diets, and growth was stagnant or even negative.

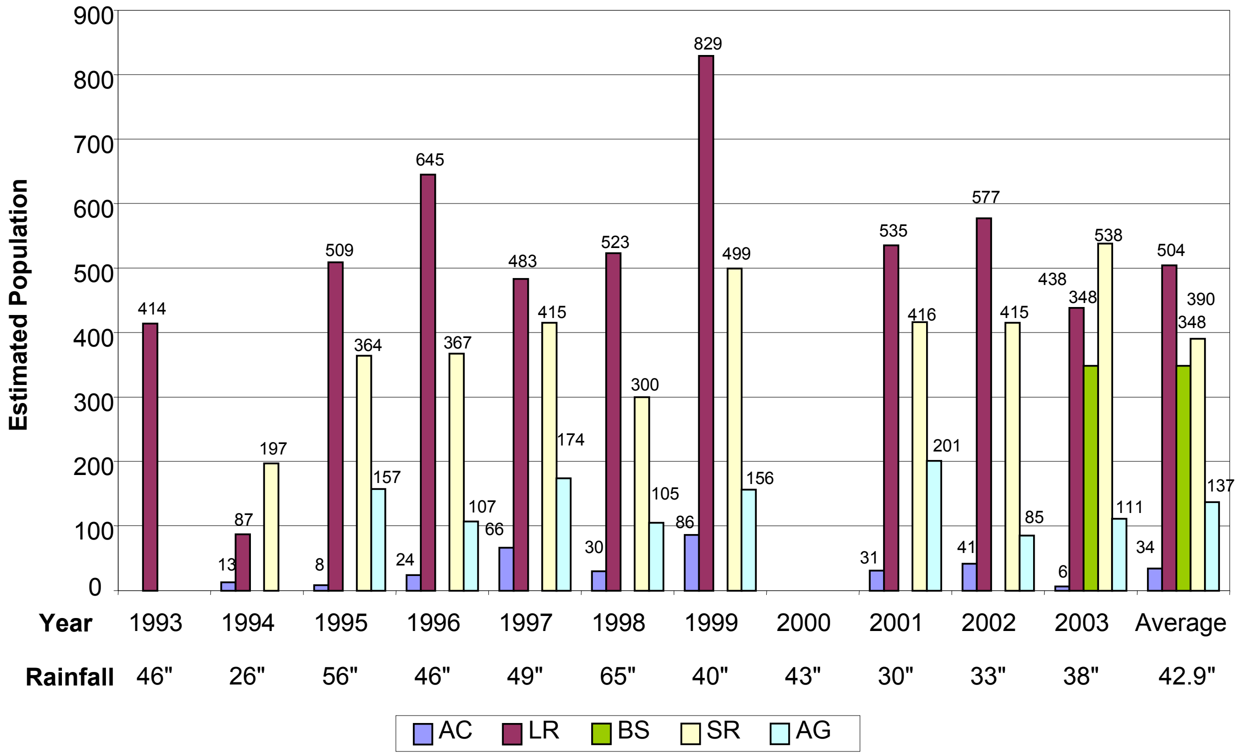
This station was again the site of two Hobo Temp data loggers that recorded air and water temperatures from early June to late October 2003. (Refer to the 2003 Instream Temperature Monitoring Report.)

Ashbury Gulch

Following the pattern of the other low stream order east end station, Spanish Ranch, this reach also saw an increase of about 30% in estimated population, from 85 in 2002 to 111 in 2003. The 2002 population estimate was, however, the lowest ever for this station. The increase in population this year corresponds to a restoration of the proportion of young-of-the-year to one year olds of about two to one, seen from 1997 through 2001. This year's population estimate is about 19% less than the ten-year average of 137 steelhead.

This station was first electrofished this year on July 30th. The population estimate then was 125, which fell about 11% in the two months leading up to Ashbury Gulch's October 2, 2003 sampling. Forty-eight fish were PIT tagged here during the summer sampling, the highest number of any station. Thirty-five of those steelhead (73%) were then recaptured in October, also the highest recapture rate of any station. The PIT tagged fish ranged from 90 mm to 199 mm in July, and 90 mm to 198 mm in October. Growth, however, averaged less than one millimeter for the entire group, with 15 individuals displaying negative growth. This negative growth was seen at other stations to varying degrees, and several explanations are possible. One is that sampling error of one or two millimeters in either direction caused these slow growing steelhead to appear to be shrinking following such a short window of time before resampling. Another explanation, which is based on observations in other studies, is that these one and two year old steelhead may actually lose several millimeters in fork length when they are living in conditions which do not satisfy their metabolic needs.

Figure 6: Estimated Steelhead Population Comparison
Index Reaches, Soquel Demonstration State Forest
1993-2003



Rainfall

At the bottom of Figure 6 is the total rainfall for each corresponding year measured at Soquel Forest Fire Station. The winter of 2002-2003 had approximately nine-tenths of average rainfall for recent years. Significant storm events occurred in November and December, with the largest storm of the season in mid-December registering about 5.5 inches of rain in one 24-hour period. January and February were unseasonably dry, followed by above average late-season precipitation in April and early May.

Mortality

Steelhead mortality did not occur at the Amaya Creek station. Mortality at Longridge Crossing was 1.8%, at Badger Springs 0.2%, at Spanish Ranch 3.2%, and at Ashbury Gulch 0.9%. Total mortality for the study was down from 4.9%, to 1.9% or 27 steelhead.

Watershed Land Use/Events

There were no particularly noteworthy watershed or land use events in 2003. Land use events prior to the 2002 steelhead survey are described in previous Population Survey Reports.

Suggestions for Future Surveys

1. One of the biggest improvements made during the 2002 sampling effort, and continued in 2003, was the addition of the "Fishmaster" position. Performed by Forest Manager Thom Sutfin, this person had the responsibility, and the flexibility, to coordinate all of the activities associated with the sampling effort once we left the office. This included ensuring that sufficient amounts of the appropriate equipment were loaded into the vehicles. The job's more important tasks had to do with the moving of buckets full of fish; the "working-up," or measuring and recording, of fish; the return of fish to the creek in a timely fashion; and the efficient distribution of labor. The Fishmaster also touched-up the flagging and paint that marks the top and bottom of each station, for future ease in finding all stations.

2. Have enough people working at all stations so that fish can be quickly caught, moved to the scales, processed, and placed in instream “live cars.” Sufficient personnel are even more critical now, with the added task of fish tagging. Twelve people are a good number at Longridge, Spanish Ranch, and Badger Springs. Ashbury Gulch requires ten to eleven people, and Amaya should have six people.

3. Continue to record the presence of black spot disease at all stations, especially Longridge, to begin to understand the effects of this larval fluke on State Forest steelhead populations. Carefully train data collectors on the identification of black spot disease.

4. Check the passability of Ashbury Falls and Amaya Creek each winter, if possible, to determine whether fish barriers exist that may influence migration and, therefore, age distribution at stations AG and AC.

5. Set survey dates and inform volunteers of these dates as far in advance as possible to facilitate obtaining adequate help each day.

6. Spend a few minutes clearing floating leaves from the sampling reach, especially at the Ashbury Gulch station, so that they don’t obstruct views of shocked fish.

7. Standardize the sampling dates each year. New information suggests differences in the dates that the electrofishing occurs from year to year can be a significant factor in fish sample estimates. Fish populations are declining over the fall months and as little as one to two weeks can result in a marked change. To minimize seasonal population variations, sampling will occur during the last full week of September each year.

8. Collect habitat type and stream flow information as close to the fish sampling dates as possible. Also, determine far in advance who will perform habitat typing and flow measurements to ensure that this gets done.

APPENDIX A

AMAYA CREEK **9/29/03**

	Air Temperature	Water Temperature
	No Record	13 C @ 1020 hrs

	Unit A (H. Fish/D. Rundio)	
Unit settings for Pass 1 (P1), Pass 2 (P2), and Pass 3 (P3)	200V	
Electroshocking Time (sec.)	P1	1618
	P2	1397
	P3	1374
	Total	4389
Total Time (min.)	P1	35
	P2	27
	P3	32
	Total	94
Number of Steelhead	P1	6
	P2	0
	P3	0
	Total	6

LONGRIDGE **10/1/03**

	Air Temperature	Water Temperature
	No Record	13.5 C @ 0959 hrs

	Unit A (H. Fish)		Unit B (D. Rundio)	
Unit settings for Pass 1 (P1), Pass 2 (P2), and Pass 3 (P3)	200V then 100V		200V then 100V	
Electroshocking Time (sec.)	P1	3776	P1	3920
	P2	3508	P2	3480
	P3	2815	P3	2640
	Total	10099	Total	10040

Total Time (min.)	P1	112
	P2	78
	P3	54
	Total	244
Number of Steelhead	P1	357
	P2	52
	P3	26
	Total	435

BADGER SPRINGS **10/3/03**

	Air Temperature	Water Temperature		
	No Record	14.3 C @ 0950 hrs		
		15.2 C @ 1640 hrs		
Unit settings for Pass 1 (P1), Pass 2 (P2), and Pass 3 (P3)	Unit A (D. Rundio) 200V		Unit B (M. Kilgour) 200V	
Electroshocking Time (sec.)	P1	5709	P1	4358
	P2	4810	P2	3644
	P3	3753	P3	2951
	Total	14272	Total	10953
Total Time (min.)	P1	130		
	P2	110		
	P3	90		
	Total	330		
Number of Steelhead	P1	251		
	P2	61		
	P3	28		
	Total	340		

SPANISH RANCH **9/30/03**

	Air Temperature	Water Temperature		
	No Record	13.8 C @ 0955 hrs		
		15.6 C @ 1600 hrs		
Unit settings for Pass 1 (P1), Pass 2 (P2), and Pass 3 (P3)	Unit A (H. Fish) 200V		Unit B (D. Rundio) 200V	
Electroshocking Time (sec.)	P1	3701	P1	3805
	P2	3394	P2	3255
	P3	2684	P3	2807
	Total	9779	Total	9867
Total Time (min.)	P1	122		
	P2	81		
	P3	60		
	Total	263		
Number of Steelhead	P1	435		
	P2	86		
	P3	14		
	Total	535		

ASHBURY GULCH **10/2/03**

	Air Temperature	Water Temperature
	No Record	13.6 C @ 1015 hrs

Unit settings for Pass 1 (P1), Pass 2 (P2), and Pass 3 (P3)	Unit A (H. Fish)		Unit B (D. Rundio)	
	100V		100V	
Electroshocking Time (sec.)	P1	2733	P1	2856
	P2	2865	P2	2470
	P3	2144	P3	2145
	Total	7742	Total	7471

Total Time (min.)	P1	77
	P2	67
	P3	50
	Total	194
Number of Steelhead	P1	84
	P2	23
	P3	3
	Total	110

APPENDIX B

Station: Amaya Creek
Species: Steelhead

Removal Pattern:	6	0			Removal Pattern:	6	0	0
Total Catch		=	6		Total Catch		=	6
Population Estimate		=	6**		Population Estimate		=	6**

**The removal pattern at this station will not allow for the output of a population estimate or summary statistics as seen at other stations. Due to the absence of fish caught in passes two and three, the population estimate for this station is 6.

Station: Longridge
Species: Steelhead

Removal Pattern:	357	52			Removal Pattern:	357	52	26
Total Catch		=	409		Total Catch		=	435
Population Estimate		=	417		Population Estimate		=	438
Chi Square		=	0.022		Chi Square		=	14.171
Pop Est Standard Error		=	3.919		Pop Est Standard Error		=	2.266
Lower Confidence Interval		=	409.279		Lower Confidence Interval		=	435.000*
Upper Confidence Interval		=	424.721		Upper Confidence Interval		=	442.464
Capture Probability		=	0.857		Capture Probability		=	0.794
Capt Prob Standard Error		=	0.021		Capt Prob Standard Error		=	0.020
Lower Confidence Interval		=	0.815		Lower Confidence Interval		=	0.755
Upper Confidence Interval		=	0.899		Upper Confidence Interval		=	0.833

*The population estimate lower confidence interval was set equal to the total catch. Actual calculated lower CI was 433.5362.

APPENDIX B (continued)

Station: Badger Springs
Species: Steelhead

Removal Pattern:	251	61	
Total Catch		=	312
Population Estimate		=	330
Chi Square		=	0.031
Pop Est Standard Error		=	7.192
Lower Confidence Interval		=	315.831
Upper Confidence Interval		=	344.169
Capture Probability		=	0.763
Capt Prob Standard Error		=	0.034
Lower Confidence Interval		=	0.696
Upper Confidence Interval		=	0.830

Removal Pattern:	251	61	28
Total Catch		=	340
Population Estimate		=	348
Chi Square		=	4.043
Pop Est Standard Error		=	3.893
Lower Confidence Interval		=	340.331
Upper Confidence Interval		=	355.669
Capture Probability		=	0.707
Capt Prob Standard Error		=	0.027
Lower Confidence Interval		=	0.654
Upper Confidence Interval		=	0.760

Station: Spanish Ranch
Species: Steelhead

Removal Pattern:	435	86	
Total Catch		=	521
Population Estimate		=	541
Chi Square		=	0.017
Pop Est Standard Error		=	6.852
Lower Confidence Interval		=	527.502
Upper Confidence Interval		=	554.498
Capture Probability		=	0.805
Capt Prob Standard Error		=	0.023
Lower Confidence Interval		=	0.760
Upper Confidence Interval		=	0.851

Removal Pattern:	435	86	14
Total Catch		=	535
Population Estimate		=	538
Chi Square		=	0.341
Pop Est Standard Error		=	2.117
Lower Confidence Interval		=	535.000*
Upper Confidence Interval		=	542.170
Capture Probability		=	0.813
Capt Prob Standard Error		=	0.017
Lower Confidence Interval		=	0.779
Upper Confidence Interval		=	0.847

*The population estimate lower confidence interval was set equal to the total catch. Actual calculated lower CI was 533.8298.

APPENDIX B (continued)

Station: Ashbury Gulch
Species: Steelhead

Removal Pattern:	84	23	
Total Catch		=	107
Population Estimate		=	114
Chi Square		=	0.079
Pop Est Standard Error		=	4.802
Lower Confidence Interval		=	107.000*
Upper Confidence Interval		=	123.508
Capture Probability		=	0.743
Capt Prob Standard Error		=	0.062
Lower Confidence Interval		=	0.621
Upper Confidence Interval		=	0.865

*The population estimate lower confidence interval was set equal to the total catch. Actual calculated lower CI was 104.4921.

Removal Pattern:	84	23	3
Total Catch		=	110
Population Estimate		=	111
Chi Square		=	1.152
Pop Est Standard Error		=	1.337
Lower Confidence Interval		=	110.000*
Upper Confidence Interval		=	113.646
Capture Probability		=	0.775
Capt Prob Standard Error		=	0.041
Lower Confidence Interval		=	0.693
Upper Confidence Interval		=	0.857

*The population estimate lower confidence interval was set equal to the total catch. Actual calculated lower CI was 108.3536.

APPENDIX C

Location: Amaya Creek

Date: 16 Oct 2003

Habitat Unit Number	1	2	3	4	5	6	7
Habitat Type	PLP	STEP RUN	RUN	LGR	GLIDE	STEP RUN	LGR
Length (m)	8	19	6.1	8.8	5	21.7	31
Width (m)	2.85	1.33	1.5	1.42	1.48	1.36	3
Avg. Depth (cm)	17.7	6.9	7.5	5.5	13.2	7	4.9
Max. Depth (cm)	30	16	13	9	28	15	11
Depth Pool Tail Crest (cm)	10						
Crest Substrate	Sm. Cob.						
% Embeddedness	25-50%						
Shelter Value	Good	Fair	Fair	Fair	Fair	Good	Good
% Unit Covered	10%	30%	10%	40%	5%	15%	30%
Boulders	20%	100%	100%	100%	100%	90%	55%
Terr. Veg.							40%
Aqua. Veg.							
WhiteWater							
SWD							10%
LWD	40%					10%	5%
Roots							
Undercut	40%						
Primary Substrate	Silt/Clay	Sm. Cob.	Silt/Clay	Lg. Cob.	Silt/Clay	Gravel	Gravel
Secondary Substrate	Sm. Cob.	Boulders	Sm. Cob.	Gravel	Lg. Cob.	Lg. Cob.	Lg. Cob.
% Exposed Substrate	5%	35%	5%	50%	5%	25%	60%
Canopy	60%	40%	25%	25%	35%	60%	40%
% Broadleaf	0%	10%	0%	0%	0%	5%	20%
% Evergreen	100%	90%	100%	100%	100%	95%	80%
Rt Bank Composition	Cob/Gravel	Cob/Gravel	Silt/Cly/Snd	Cob/Gravel	Boulder	Boulder	Cob/Gravel
Rt Bank Dominant Veg	Brush	Brush	Brush	Brush	Brush	Brush	Brush
% Rt Bk Vegetated	85%	90%	100%	100%	100%	100%	80%
Lft Bank Composition	Cob/Gravel	Silt/Cly/Snd	Silt/Cly/Snd	Silt/Cly/Snd	Silt/Cly/Snd	Silt/Cly/Snd	Silt/Cly/Snd
Lft Bank Dominant Veg	Brush	Conifers	Brush	Brush	Grass	Conifers	Brush
% Lft Bk Vegetated	85%	100%	100%	100%	100%	100%	100%
Surface Area (sq. meters)	22.8	25.3	9.2	12.5	7.4	29.5	93.0

Location: Longridge Crossing

Date: 16 Oct 2003

Habitat Unit Number	1	2	3	4	5
Habitat Type	STEP RUN	GLIDE	LGR	GLIDE	HGR
Length (m)	15.3	16.4	26.5	19.2	15.5
Width (m)	3.2	3	5.22	4.66	3.38
Avg. Depth (cm)	13.5	17.5	8.6	17.6	7.3
Max. Depth (cm)	23	29	16	26	12
Depth Pool Tail Crest (cm)					
Crest Substrate					
% Embeddedness					
Shelter Value	Fair	Good	Fair	Good	Good
% Unit Covered	10%	25%	25%	15%	40%
Boulders	100%	20%	85%	10%	100%
Terr. Veg.			15%		
Aqua. Veg.					
WhiteWater					
SWD					
LWD		50%			
Roots					
Undercut		30%		90%	
Primary Substrate	Sm. Cob.	Gravel	Boulder	Sand	Lg. Cob.
Secondary Substrate	Boulder	Sm. Cob.	Sm. Cob.	Lg. Cob.	Boulder
% Exposed Substrate	15%	10%	50%	10%	60%
Canopy	25%	40%	30%	85%	60%
% Broadleaf	70%	100%	80%	100%	100%
% Evergreen	30%	0%	20%	0%	0%
Rt Bank Composition	Cob/Gravel	Cob/Gravel	Silt/Cly/Snd	Boulder	Cob/Gravel
Rt Bank Dominant Veg	Decid. Trees	Decid. Trees	Decid. Trees	Decid. Trees	Brush
% Rt Bk Vegetated	100%	100%	100%	100%	100%
Lft Bank Composition	Boulder	Boulder	Cob/Gravel	Silt/Cly/Snd	Cob/Gravel
Lft Bank Dominant Veg	Brush	Brush	Decid. Trees	Decid. Trees	Decid. Trees
% Lft Bk Vegetated	100%	75%	90%	100%	100%
Surface Area (sq. meters)	49.0	49.2	138.3	89.5	52.4

Location: Badger Springs

Date: 16 Oct 2003

Habitat Unit Number	1	1.1	2	2.1	3
Habitat Type	RUN	LGR	LGR	LGR	LSBk
Length (m)	65.6	10.9	46.5	19.6	21.7
Width (m)	3.75	2	3	1.1	4.3
Avg. Depth (cm)	15.9	7.8	14.5	5.4	49.2
Max. Depth (cm)	31	13	46	10	90
Depth Pool Tail Crest (cm)					11
Crest Substrate					Sand
% Embeddedness					n/a
Shelter Value	Fair		Good		Good
% Unit Covered	10%		40%		10%
Boulders	80%		60%		50%
Terr. Veg.					
Bedrock Ledge					50%
WhiteWater					
SWD					
LWD					
Roots			10%		
Undercut	20%		30%		
Primary Substrate	Sand		Boulder		Gravel
Secondary Substrate	Lg. Cob.		Sand		Sand
% Exposed Substrate	15%		50%		5%
Canopy	80%		90%		90%
% Broadleaf	100%		95%		60%
% Evergreen	0%		5%		40%
Rt Bank Composition	Boulder		Boulder		Bedrock
Rt Bank Dominant Veg	Decid. Trees		Decid. Trees		Decid. Trees
% Rt Bk Vegetated	100%		100%		50%
Lft Bank Composition	Boulder		Boulder		Boulder
Lft Bank Dominant Veg	Decid. Trees		Decid. Trees		Decid. Trees
% Lft Bk Vegetated	90%		100%		100%
Surface Area (sq. meters)	246.0	21.8	139.5	21.6	93.3

Location: Spanish Ranch

Date: 22 Oct 2003

Habitat Unit Number	1	2	3	4	5
Habitat Type	LGR	RUN	LSR	SRN	LGR
Length (m)	14.6	10	2.8	38.3	30
Width (m)	5.36	1.8	2.3	6.5	6.38
Avg. Depth (cm)	15.4	9.5	16.3	15.8	9.5
Max. Depth (cm)	29	19	27	30	26
Depth Pool Tail Crest (cm)			2		
Crest Substrate			25-50%		
% Embeddedness			Gravel		
Shelter Value	Fair	None	Good	Good	Fair
% Unit Covered	20%	2%	20%	40%	35%
Boulders	100%	100%	30%	100%	95%
Terr. Veg.					
Aqua. Veg.					
WhiteWater					
SWD					
LWD					
Roots					
Undercut			70%		5%
Primary Substrate	Gravel	Gravel	Sand	Gravel	Gravel
Secondary Substrate	Lg. Cob.	Sm. Cob.	Gravel	Boulder	Lg. Cob.
% Exposed Substrate	20%	5%	0%	50%	50%
Canopy	60%	85%	100%	50%	40%
% Broadleaf	60%	70%	0%	100%	70%
% Evergreen	40%	30%	100%	0%	30%
Rt Bank Composition	Boulder	Boulder	Boulder	Boulder	Boulder
Rt Bank Dominant Veg	Conifers	Decid. Trees	Decid. Trees	Decid. Trees	Decid. Trees
% Rt Bk Vegetated	90%	100%	100%	95%	100%
Lft Bank Composition	Boulder	Cob/Gravel	Silt/Cly/Snd	Boulder	Boulder
Lft Bank Dominant Veg	Decid. Trees	Conifers	Conifers	Decid. Trees	Decid. Trees
% Lft Bk Vegetated	80%	40%	30%	90%	90%
Surface Area (sq. meters)	78.3	18.0	6.4	249.0	191.4

Location: Ashbury Gulch

Date: 22 Oct 2003

Habitat Unit Number	1	1.1	2	3	4	5	6	7
Habitat Type	CASCADE	STEP RUN	STEP POOL	STEP RUN	GLIDE	STEP RUN	RUN	HGR
Length (m)	7.5	20.5	10	9	7.1	22.9	11.9	21.8
Width (m)	1.2	1.85	3	2.47	2.3	4.1	2.6	2.2
Avg. Depth (cm)	17.5	12.4	24.4	15.4	24	18.8	15.5	16.7
Max. Depth (cm)	29	26	42	37	45	43	32	39
Depth Pool Tail Crest (cm)			6					
Crest Substrate			Sm. Cob.					
% Embeddedness			25-50%					
Shelter Value	Good	Good	Good	Good	Good	Fair	Good	Good
% Unit Covered	60%	50%	40%	30%	40%	20%	25%	25%
Boulders	95%	100%	35%	80%	60%	85%	75%	100%
Terr. Veg.								
Aqua. Veg.								
Bubble Curtain	5%							
SWD							25%	
LWD			65%	20%	20%	18%		
Roots								
Undercut					20%			
Primary Substrate	Gravel	Lg. Cob.	Sand	Sm. Cob.	Gravel	Sand	Boulder	Sm. Cob.
Secondary Substrate	Boulder	Silt/Clay	Sm. Cob.	Silt/Clay	Sand	Gravel	Gravel	Boulder
% Exposed Substrate	40%	60%	15%	30%	10%	35%	10%	10%
Canopy	20%	40%	30%	65%	50%	60%	60%	60%
% Broadleaf	50%	10%	0%	90%	100%	100%	80%	100%
% Evergreen	50%	90%	100%	10%	0%	0%	20%	0%
Rt Bank Composition	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder
Rt Bank Dominant Veg	Conifers	Conifers	Decid. Trees	Decid. Trees	Decid. Trees	Decid. Trees	Decid. Trees	Decid. Trees
% Rt Bk Vegetated	70%	70%	40%	85%	95%	20%	20%	70%
Lft Bank Composition	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder
Lft Bank Dominant Veg	Conifers	Conifers	Conifers	Decid. Trees	Brush	Decid. Trees	Decid. Trees	Decid. Trees
% Lft Bk Vegetated	40%	40%	30%	30%	60%	45%	95%	60%
Surface Area (sq. meters)	9.0	37.9	30.0	22.2	16.3	93.9	30.9	48.0

APPENDIX D

Electrofishing by the National Marine Fisheries Service within SDSF, independent of the SDSF Steelhead Monitoring program.

June & July 2003

Station: Amaya Creek
Species: Steelhead

Removal Pattern:	9	0	
Total Catch		=	9
Population Estimate		=	9**

**The removal pattern at this station will not allow for the output of a population estimate or summary statistics as seen at other stations. Due to the absence of fish caught in passes two and three, the population estimate for this station is 9.

Station: Longridge
Species: Steelhead

Removal Pattern:	335	120	
Total Catch		=	455
Population Estimate		=	520
Chi Square		=	0.010
Pop Est Standard Error		=	18.152
Lower Confidence Interval		=	484.240
Upper Confidence Interval		=	555.760
Capture Probability		=	0.645
Capt Prob Standard Error		=	0.038
Lower Confidence Interval		=	0.571
Upper Confidence Interval		=	0.720

Station: Badger Springs
Species: Steelhead

Removal Pattern:	270	110	62
Total Catch		=	442
Population Estimate		=	488
Chi Square		=	1.914
Pop Est Standard Error		=	12.633
Lower Confidence Interval		=	463.114
Upper Confidence Interval		=	512.886
Capture Probability		=	0.543
Capt Prob Standard Error		=	0.031
Lower Confidence Interval		=	0.482
Upper Confidence Interval		=	0.604

Station: Spanish Ranch
Species: Steelhead

Removal Pattern:	213	128	61
Total Catch		=	402
Population Estimate		=	479
Chi Square		=	1.045
Pop Est Standard Error		=	20.850
Lower Confidence Interval		=	437.925
Upper Confidence Interval		=	520.075
Capture Probability		=	0.455
Capt Prob Standard Error		=	0.036
Lower Confidence Interval		=	0.384
Upper Confidence Interval		=	0.527

Station: Ashbury Gulch
Species: Steelhead

Removal Pattern:	85	25	11
Total Catch		=	121
Population Estimate		=	125
Chi Square		=	0.678
Pop Est Standard Error		=	2.932
Lower Confidence Interval		=	121.000*
Upper Confidence Interval		=	130.806
Capture Probability		=	0.672
Capt Prob Standard Error		=	0.048
Lower Confidence Interval		=	0.577
Upper Confidence Interval		=	0.767

*The population estimate lower confidence interval was set equal to the total catch. Actual calculated lower CI was 119.1937.