

**JUVENILE SALMONID POPULATION MONITORING REPORT
LAGUNITAS CREEK
MARIN COUNTY, CALIFORNIA
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EXECUTIVE SUMMARY

Marin Municipal Water District (MMWD) staff conducted an electrofishing survey for coho salmon and steelhead trout in Lagunitas Creek and two of its main tributaries, San Geronimo Creek and Devil's Gulch, between 30-Sept-97 and 15-Oct-97. This survey is conducted annually and was performed in accordance with MMWD's *Aquatic Resources Monitoring Workplan for the Lagunitas Creek Drainage, Marin County, California: Final Report* (MMWD 1996). Sampling was conducted at twelve pre-established sample sites, seven in the mainstem of Lagunitas Creek, three in San Geronimo Creek and two in Devil's Gulch. Capture data from our sampling effort were used to compute population estimates as total abundance and densities (fish per unit length of stream) for coho and steelhead. Our results were compared to similar surveys conducted between 1970 and 1996 to track trends in the coho and steelhead populations over time.

Habitat conditions at the twelve sample sites was documented and found to be similar, but not necessarily identical, to the survey conducted in 1996. We determined that variations between survey results between 1996 and 1997 were not due to variations in habitat conditions at the sample sites. We also determined that a similar level of sampling effort was performed in 1997 as in 1996. Variations in the results were likely due to variations in the juvenile salmonid populations. However, we recommend an additional sample site be added to San Geronimo Creek, in the lower portion of the creek, to better represent salmonid utilization throughout San Geronimo Creek.

A total of 541 juvenile coho were captured from all sites during our survey and we estimate a population of 16,962 juvenile coho in the system. In 1997, coho were present in much higher numbers at the tributary sample sites than at the sites in the mainstem of Lagunitas Creek. This may have been due to a loss of coho eggs during a large winter storm in early January, 1997 which may have destroyed coho redds in the mainstem of Lagunitas Creek. Nonetheless, the 1997 juvenile coho population appears to be maintained as a strong year class, which occurs in three year cycles and is represented by the 1988 and 1994 juvenile coho populations (no data from 1991). The results from 1997 indicate that the tributary streams may be very important for survival of coho eggs and rearing of juvenile coho in the Lagunitas Creek system.

We captured 1,309 juvenile steelhead, consisting of 1,226 young-of-the-year (0+steelhead) and 83 older steelhead (1+steelhead, 1-3 years old). We also estimated between 47,000 and 53,000 juvenile steelhead in the Lagunitas Creek system. This year, the population of steelhead appeared to be much higher in the mainstem of Lagunitas Creek than in the tributaries, but this is not a consistent trend. The 1997 juvenile steelhead population estimate was the highest estimated in the period 1993 to 1997, although not dramatically higher than in most years in that period.

The juvenile coho and steelhead populations sampled in 1997 appear to be keeping with an overall upward trend of the salmonid populations in the Lagunitas Creek system. This trend has been noted over the past several years of monitoring, between 1993 and 1997. Certainly for coho, the year class represented by the 1994 and 1997 juveniles was a strong year class. While not as high as in 1994, the abundance and density of juvenile coho estimated in 1997 was the second highest in all the years of surveys since 1970.

1.0 INTRODUCTION

The Marin Municipal Water District (MMWD) is a public agency which diverts water from the Lagunitas Creek drainage in Marin County, California to provide a water supply for over 170,000 residents in southern and central Marin County. These diversions are permitted and regulated by the California State Water Resources Control Board (SWRCB). In its 1995 Order WR95-17, the SWRCB ordered MMWD to develop and implement a fisheries monitoring workplan as well as a sediment and riparian management plan for the Lagunitas Creek watershed (SWRCB 1995). In 1996, MMWD prepared the *Aquatic Resources Monitoring Workplan for the Lagunitas Creek Drainage, Marin County, California: Final Report* (MMWD 1996). In 1997, MMWD prepared the *Lagunitas Creek Sediment and Riparian Management Plan: Final* (MMWD 1997).

One element of MMWD's aquatic resources monitoring workplan is to conduct annual surveys for juvenile salmonids in Lagunitas Creek. These surveys are being conducted to monitor coho salmon and steelhead trout populations in the Lagunitas Creek system and have been an ongoing effort by MMWD for many years. Population sampling for coho salmon and steelhead trout was first conducted in the Lagunitas Creek system in 1970 at sites established by the California Department of Fish and Game (CDFG). Several of these sites were sampled nearly every year during the 1980's except for 1981 and 1989. Since 1993, juvenile salmonid sampling has been conducted annually by MMWD.

In 1983, MMWD began summer stream flow augmentation for the fishery resources downstream of Peters Dam. In addition to summer flow augmentation, MMWD has increased flows in Lagunitas Creek to aid in adult salmonid passage during the fall and winter spawning season. MMWD monitors stream flow at two gaging stations located in the mainstem of Lagunitas Creek and at a third gage located in San Geronimo Creek (a major tributary to Lagunitas Creek). MMWD also monitors water temperatures at one of the stream gages located on Lagunitas Creek.

Abundance of steelhead and coho salmon in the Lagunitas Creek system has fluctuated widely between 1970 and 1996 with an overall decline from historic populations. Throughout California and the Pacific Northwest coho salmon and steelhead have steadily declined. Reasons for the decline include droughts, floods, and habitat degradation due to man's influence. This decline resulted in the "threatened" listing for coho salmon and steelhead by the National Marine Fisheries Service under the Federal Endangered Species Act. However, the abundance of both coho and steelhead in Lagunitas Creek have shown recent increases. The increases may be due in part to stream flow releases being maintained by MMWD and due to efforts by MMWD and others to reduce sedimentation and improve habitat conditions in the Lagunitas Creek watershed.

This report covers the 1997 juvenile coho and steelhead population sampling effort. The survey was completed by MMWD staff during the Fall, 1997 at seven sampling sites in the mainstem of Lagunitas Creek as well as three sites in San Geronimo Creek and two sites in Devil's Gulch (another major tributary to Lagunitas Creek). The survey was conducted using electrofishing techniques, as have all past juvenile salmonid surveys.

There are different methods of estimating juvenile salmonid population numbers in a coastal stream such as Lagunitas Creek. Methods of acquiring population estimates used prior to 1995 relied on the assumption that sample sites were representative of stream or stream reaches. The estimating method used this year, as in 1995 and 1996, was based on habitat types so that more accurate estimates of coho and steelhead populations could be made. Habitat typing conducted in 1992, 1995, and 1997 allowed for a comparison of the habitat composition of the sample sites to the habitat composition of the stream or stream reach.

This report presents the results from our 1997 sampling effort and compares those results to population estimates from similar studies conducted in previous years. This year, we felt it was appropriate to continue to use the same method of estimating juvenile salmonid populations so as to be congruent with the previous years' methods. This will allow us to recognize population trends in the data to help develop future management actions and to help further the recovery of salmon and steelhead in the Lagunitas Creek watershed.

2.0 METHODS

Seven sites in Lagunitas Creek, three in San Geronimo Creek, and two in Devil's Gulch were sampled between September 30, 1997 and October 15, 1997. The sample sites in Lagunitas Creek were (in a downstream to upstream listing): LG-1, LG-3, LG-5, LG-7, LG-9, 15.86, and LG-12. The sites in San Geronimo Creek were: SG-2, SG-3, and SG-4. Sites in Devil's Gulch were DG-1 and DG-2. These are the sites that have been established for juvenile sampling in prior years. The sample site locations are shown on Figure 1.

Each sample site consisted of one or more riffle, run, or pool habitat units. Sampling was conducted by a team of between three and five people, depending on the size of the site. The team consisted of Gregory Andrew (fishery biologist), Mike Cronin, Andy Peri, and Kris Niffeneger (fishery biologist aides), and assistance from Ron Nerviani (water quality specialist). Prior to sampling the sites on National Park Service land (i.e., sites LG-3 and LG-5), Larry Serpa (aquatic entomologist) sampled each site for the presence of any California freshwater shrimp. Any shrimp that Mr. Serpa found were moved outside of the sample area.

Sampling was conducted using electrofishing techniques. Prior to sampling a designated site, block nets were erected at the downstream and upstream end of each habitat unit to prevent fish migration during sampling. A Smith-Root Type 12 backpack electrofisher, set at 100 to 300 volts and the appropriate programmable output wave, was used to make a minimum of three passes through each site. One or two electrofishers were used at each of the sample sites with one or two people following each electrofisher using dip-nets and buckets to capture stunned fish. As fish were stunned and netted, they were placed into the buckets which contained fresh stream water.

Habitat units were sampled from the downstream net to the upstream net and then back downstream again to complete one pass. After each pass, captured fish were anesthetized using Alka Seltzer tablets (CO₂) to reduce stress in handling. The captured fish were then identified to species and their length measured by placing the fish on a measuring board. The fish were then transferred to live cars (i.e., holding boxes consisting of a basket inside of an enclosed net) which had been placed in the stream, outside of the block

netted habitat unit. Once sampling was completed, captured fish were released back into the habitat unit from which they were sampled.

The lengths of coho salmon, steelhead and roach were measured in millimeters (mm) fork length (FL). The lengths of sculpin, stickleback and lamprey were measured in millimeters total length (TL). Juvenile lamprey were classified as smolts (if they had eyes, well-developed sucking mouths and silver coloring) or ammocoetes (if they were without the smolt features).

Each habitat unit within each sample site was habitat typed to compare with habitat that was present in 1994, 1995, and 1996. Habitat typing included an assessment of habitat quality based on depth, sediment composition, instream cover and undercut bank. Water temperatures were measured at each sample site using hand held mercury and digital thermometers. Water temperatures were also being recorded, independently, at the U.S. Geologic Survey (USGS) stream gage at Samuel P. Taylor State Park (upstream of the mouth of Devil's Gulch and upstream of sample site LG-7).

Steelhead were grouped into age classes of 0+ (young-of-the-year; <1 year old) or 1+ (one to three years old) based upon length and appearance of the fish at time of capture. Generally, steelhead under 100mm FL were considered to be 0+steelhead and those over 100mm were considered to be 1+steelhead. In the field, scale samples were taken from steelhead ranging from 86 millimeters to 115 millimeters. Scales were obtained by scraping the side of the fish above the lateral line and behind the dorsal fin. After the survey, the scales were mounted between two glass slides and analyzed with a microfiche reader. Those steelhead were then classified as either 0+ or 1+ depending on the absence or presence, respectively, of an annulus on the scale. The field data of individual fish lengths for steelhead were reviewed and compiled for all passes at each habitat unit and the size distributions were examined to determine age classes. Furthermore, histograms were made of all steelhead lengths per stream to assist in finding the size that appeared to divide 0+steelhead from 1+steelhead.

The catch by sample site, for all fish at all sites, was compiled in tabular form (Appendix A). Capture data on coho and steelhead only was entered into *Microfish*, a population estimation program designed for use with depletion data (Van Deventer & Platts 1989). Output from this program was used to calculate population estimates of coho, 0+steelhead, and 1+steelhead (Appendix B). Population estimates of coho, 0+ steelhead, and 1+ steelhead were made for individual habitat units and for each site.

The population estimates were then extrapolated for stream segments based on the available habitat within each stream segment (Appendix C). These extrapolated population estimates were expressed in two ways: a) as the number of fish per total length of stream within each stream segment; and b) as the number of fish per foot of particular habitat type within the same stream segment. For site based sampling, the population estimates were averaged for all sites within the stream reach and this average density was multiplied by the number of feet in the stream reach. For habitat based sampling, the population estimates were multiplied by the number of feet of the same habitat type in the applicable stream reach. The population estimates were also expressed as the density of coho or steelhead per 30 meters of stream.

These approaches were used so that the extrapolated population estimates from our 1997 survey could be compared to the annual juvenile salmonid surveys conducted between 1993 and 1996 and to track any trends in the coho and steelhead populations over time. The two methods of extrapolating salmonid

population estimates was employed so that estimates could be improved by considering the different habitat preferences of coho salmon and steelhead trout. Coho tend to utilize pools much more than runs or riffle while steelhead utilize all habitat types. Habitat typing data from 1992 (Trihey & Associates 1995a) and 1997 (MMWD 1998) was used to extrapolate population estimates for Lagunitas Creek and habitat typing data from 1995 (Trihey & Associates, Inc. 1995a) was used to extrapolate population estimates for San Geronimo Creek and Devil's Gulch.

3.0 RESULTS

3.1 HABITAT DESCRIPTIONS

Habitat descriptions of the juvenile sample sites are provided below and site locations are shown in Figure 1. Each site description includes the site number, site length, and habitat compositions by pool, riffle, and run. The sample sites and the habitats within each site are described in the order they occur moving in an upstream direction. References to the right or left bank are described looking in a downstream direction.

3.1.1 Lagunitas Creek

Site LG-1: Total length = 237 feet; pool-93 feet, riffle-38 feet, run-64 feet, run-42 feet;
(16% riffle, 45% run, 39% pool).

This site is located on the Gallagher ranch, downstream of Nicasio Creek. The downstream end of the site was located about 100 feet upstream from the private bridge to the Gallagher Ranch. The entire left bank of this site was a shallow gravel bar. The downstream pool was actually about 250 feet in length but only the top 93 feet of the pool was sampled due to depth constraints in the lower portion. The 93 feet of pool sampled had moderate depth (up to 3.4 feet in depth) with an undercut right bank and root masses being the dominant cover type. The first run upstream from the pool had willows and alders that had partially fallen into the water and an undercut right bank which extended in up to three feet. Between the first and second run was a riffle that was not sampled because of a large alder tree that had fallen into the channel and obstructed access over the entire riffle habitat; this riffle is not included in the data analysis. The most upstream run had an alder which had fallen into the water providing good shade and cover. The upstream end of the site was netted off at the downstream end of a broad pool. The mid-channel bar from 1996 had disappeared and the left bank of the site has remained a gravel bar which was open and unvegetated.

Site LG-3: Total length = 148 feet; pool-93 feet, run-55 feet;
(0% riffle, 37% run, 63% pool).

This site is located along the west side of Platform Bridge Road, immediately upstream from the Zenardi ranch barn and house complex (which is on the east side of the road). An eroded stream bank and an apple tree on the west side of the road are good markers to locate this site. The downstream boundary of the site was the tail of the downstream most pool visible from the road. The downstream pool was primarily sand and silt-bottomed with depths up to 3.2 feet. With the exception of some overhanging branches at the downstream end of the pool, there was no wood or boulders in the pool. The right bank was steep and eroded along most of the length of the pool. The upstream run had a few boulders but had no other cover due to lack of stream side vegetation and an eroded right bank. The site had a gravel bar along portions of

the left bank with a few willow trees that were set back from the stream edge. The total site length was essentially the same as in 1996 but there were not three distinct habitats (pool, run, pool) as in 1996.

Site LG-5: Total length = 127 feet; riffle-73 feet, run-54 feet;
(57% riffle, 43% run, 0% pool).

This site is located off of Sir Frances Drake Boulevard opposite the gate to the Cheda Ranch. The upstream boundary of this site was located immediately above the mouth of Cheda Creek located in a glide region of the upstream pool. The downstream boundary was in the middle of the transition from riffle to run, 127 feet downstream of Cheda Creek. The riffle sampled was bordered by a row of 10-15 foot willow trees on the right bank. A shallow gravel bar in the middle of the channel split the riffle and willow branches lay in the left side of the channel. The upstream run contained a side pool on the left bank, just above a fallen willow tree which provided shade and cover. The run had become more of a glide since 1996 but the left bank side pool, near the fallen willow, had remained.

Site LG-7: Total length = 228 feet; pool-118 feet, riffle-39 feet, run-71 feet;
(19% riffle, 30% run, 51% pool).

This site is located between Devil's Gulch and Deadman's Gulch and is downstream of the USGS gage station located in Samuel P. Taylor State Park. Access to this site is located off of Sir Frances Drake Boulevard opposite the entrance road into Devil's Gulch. The downstream net was approximately 800 feet upstream of the confluence of Devils Gulch and Lagunitas Creek, at the downstream end of a pool with bedrock ledge on the right bank. The upstream boundary was located just below (approximately 80 feet downstream) the footbridge on the right bank which crosses over the mouth of Deadman's Gulch. The downstream pool was dominated by bedrock in the streambed and on the stream margins. The riffle was also dominated by bedrock and had a large, downed alder providing good cover on the left side. The upstream run below Deadmans Gulch had less bedrock and more than 50% sand and silt in the stream bed. This run also had vegetation extending into the channel from both banks and some undercut on the right bank. This site had changed little since 1996.

Site LG-9: Total length = 173 feet; run-73 feet, riffle-100 feet;
(58% riffle, 42% run, 0% pool).

The site is located adjacent to the Samuel P. Taylor State Park campground entrance kiosk and picnic ground. The downstream end of the site was at a bedrock boulder at the tail end of a run, upstream of a pool and gravel bar at the picnic grounds. This downstream run tail was constrained by the outcropping of bedrock on the right bank. A 14-inch log spanned the channel, above the water surface, in the middle of the run, and a tree limb extended down into the channel from the left bank. The upstream riffle was netted off where a gravel bar extended into the channel from the right bank and a tree limb lay in the channel on the left bank. Each habitat had one tree limb in the water, providing some habitat, but the rest of the site had little or no cover for juvenile salmonids. This site had changed little from 1996. A backwater pool present at the upstream right bank of the run in 1996 was not as noticeable in 1997. There was some backwater with woody debris cover at the downstream right bank of the run in 1997. As in 1996, the pool downstream at the picnic grounds was not sampled due to the heavy foot traffic from park users.

Site 15.86: Total length = 146 feet; pool-146 feet;
(0% riffle, 0% run, 100% pool).

The site is located down the bank from the Marin County "15.86" mile marker along Sir Frances Drake Boulevard, about midway between Shafter and Irving bridges. This site was first sampled in 1994 because it was recognized that pool habitat was under sampled in this reach of Lagunitas Creek. In the summer of 1994, prior to being sampled, this site was also treated to improve cover in the pool. Medium and small sized woody material was placed in backwater areas on the right and left sides of the pool by Trout Unlimited. Some of the wood has washed downstream but the habitat has changed little since 1996. In addition to the woody debris that was still present, a deep undercut bank existed under the roots of a large redwood tree on the left bank. The woody debris around this undercut bank provided excellent cover and water depth up to 3.2 feet deep. A gravel bar on the right side of the channel provided a shallow backwater area along the right bank.

Site LG-12: Total length = 188 feet; pool-82 feet, riffle-35 feet, run-71 feet;
(18% riffle, 29% run, 43% pool).

The site is located along Sir Frances Drake Boulevard, a short distance downstream from Shafter Bridge. The upstream net for the site was about 50 feet downstream of the bridge, adjacent to the downstream end of the rip-rap along the left bank that protects Sir Frances Drake Boulevard. The downstream end of the site was netted off mid-stream through a pool just below four alder trees on the right bank (the pool continued downstream approximately 100 feet but only the upper 82 feet of this pool was sampled). The alders along the right bank of the pool habitat provided some root mass for cover. The upper part of the pool was more of a run than a pool. The riffle habitat was fast moving water through a narrow and steeper part of the stream the channel. The riffle and run habitat had little or no wood to provide cover and they had cobble substrate composition of 80% and 70%, respectively. The left bank of the site was a narrow gravel and cobble bar with willow and alder saplings. There was little change to the habitats since 1996.

3.1.2 San Geronimo Creek

Site SG-2. Total length = 161 feet; pool-53 feet, riffle-30 feet, pool-19 feet, run-59 feet;
(18% riffle, 36% run, 46% pool).

This site is located adjacent to MMWD's Lagunitas booster pump station on Sir Frances Drake Boulevard, across from the Lagunitas Post Office. The downstream end of the site was netted at the tail of the downstream pool, immediately downstream of an overflow release pipe from the booster station and upstream from a narrow bedrock section of the creek. The upstream end of the site was netted at the top of a shallow run and tail of a pool where there are some alder stumps on the right bank. The downstream habitat was a bedrock dominated pool with a bedrock wall along the left bank. A short and narrow riffle habitat extended upstream from the pool with gravel bars on the right and left banks. The upstream pool was circular, had a depth of 2.5 feet, and appeared to have been formed by the scouring effect of water plunging from a 12" culvert on the right bank (another overflow release pipe from the booster station). The upstream run averaged only 5 inches deep and had a gravel bar along the left bank. This site had very little cover in any of the habitat units. There was a small area of undercut bank from roots along the right bank of the run habitat but none in any of the other units. This site had changed little since 1996.

Site SG-3: Total length = 143 feet; pool-93 feet, riffle-50 feet;
(35% riffle, 0% run, 65% pool).

This site is located adjacent to MMWD's the San Geronimo Water Treatment Plant and adjacent to the fish rearing facility formerly operated by Trout Unlimited. The downstream end of the site was netted at the tail of a pool immediately upstream of the fish rearing facility and upstream of the pool that the treatment plant overflow culvert discharges into. The upstream end of the site was at the top of a shallow, cobble strewn riffle that is downstream of a rip-rap-and concrete stabilized left bank. The pool was up to 4.1 feet deep with very good cover on the left bank from an undercut root. The pool substrate was dominated by sand and silt and the water had a greenish tint to it, possibly from excess algae. The only cover in the riffle was from the cobbles and small boulders. The site appeared similar to 1996.

The excess algae in the pool made electrofishing difficult and prompted us to take water samples to analyze conductivity. The conductivity reading from the pool at site SG-3 was measured at 1,619 while conductivity measurements taken from water at sites SG-4, LG-3 and 15.86 were 679, 187, and 154, respectively. The pH of the water at sites SG-3 and SG-4 were also measured and recorded at 6.97 and 7.68, respectively.

Site SG-4: Total length = 143 feet; pool-105 feet, pool-38 feet;
(0% riffle, 0% run, 100% pool).

This site is also located at the San Geronimo Water Treatment Plant, at the plant's entrance road bridge over San Geronimo Creek. The downstream pool flows under the bridge with the downstream end about 20 feet below the bridge. The upstream boundary was netted at the top of the upper pool, about 120 feet upstream of the bridge. The lower pool had good shade provided by the bridge. There was no instream cover under or below the bridge but excellent cover provided by downed trees just above the bridge. The upstream habitat was absent of wood but had undercut bank along the left side which provided good cover. The downed tree in the lower pool was not present in 1996 and the upper pool was smaller in 1997 than in 1996.

3.1.3 Devils Gulch

Site DG-1: Total length = 161 feet; riffle-37 feet, pool-52 feet, run-72 feet;
(23% riffle, 45% run, 32% pool).

This site is located about 500 feet upstream of the horse camp area in Devil's Gulch. This site is accessed by hiking upstream along the stream side trail from the parking area, near the green gate at the end of the paved road. Downed alder and bay trees in the pool provided excellent instream cover. The upstream run had over 50% undercut bank with a large alder tree providing root structure and cover on the right side. The downstream riffle was more of a run in 1996 and the pool had enlarged since 1996 from 12 feet to 52 feet, probably due to the wood in the stream.

Site DG-2: Total length = 199 feet; riffle-29 ft., run-70 ft., pool-46 ft., riffle-10 ft., pool-44 ft.;
(20% riffle, 35% run, 45% pool).

This site is located about 0.5 mile upstream of the green gate mentioned above. The site is adjacent to the portion of the road that is well shaded and near the creek. A large buckeye tree between the road and creek is a good landmark for the downstream end of the site. The upstream end was at the base of a steep riffle strewn with cobbles and small boulders and immediately upstream of a large alder tree on the left bank.

Only five distinct habitats were identified in 1997, as opposed to six in 1996. Two middle pools identified in 1996 were a single shallow pool in 1997. This pool was dominated by a large ash tree root mass, providing an undercut bank and good cover. The downstream run had a large, fallen bay tree providing shade and cover. The upstream pool had a fallen log and a large, alder root mass. This site had high habitat complexity due to the wide variations of root masses and instream wood. The pools were bigger than they were in 1996 but habitat conditions in this had remained fairly similar to 1996.

3.2 STREAM HABITAT TYPES

The composition of habitats at the juvenile survey sample sites was compared to habitat composition for Lagunitas Creek, San Geronimo Creek and Devil's Gulch as a whole. For Lagunitas Creek, habitats were grouped into two segments of stream. Segment 1 of Lagunitas Creek extended from the mouth of Nicasio Creek upstream to the Tocaloma Bridge crossing at the junction of Sir Frances Drake Boulevard and Platform Bridge Road. Segment 2 of Lagunitas Creek extended from the Tocaloma Bridge upstream to Peters Dam. Habitat types for Segment 1 were taken from a 1992 habitat typing survey compiled for MMWD by Entrix, Inc. (Trihey & Associates 1995a). Habitat types for Segment 2 were taken from a 1997 habitat typing survey completed by MMWD. For San Geronimo Creek and Devil's Gulch, the entire stream lengths were considered as a whole. Habitat types in San Geronimo Creek and Devil's Gulch were taken from a 1995 habitat typing survey completed for MMWD by Trihey & Associates (Trihey & Associates, 1995b).

Segment 1 of Lagunitas Creek is represented by juvenile survey sample sites LG-1 and LG-3. Overall habitat composition of Segment 1, in 1992, was composed of 19% riffle, 50% run, and 31% pool while the habitat composition of sample sites LG-1 and LG-3, in 1997, was composed of 10% riffle, 42% run, and 48% pool (Figure 2). Segment 2 of Lagunitas Creek was represented by sample sites LG-5, LG-7, LG-9, 15.86, and LG-12. Overall habitat composition of Segment 2, in 1997, consisted of 9% riffle, 25% run, and 66% pool with the habitat composition of the sample sites, in 1997, composed of 29% riffle, 31% run, and 40% pool (Figure 3).

San Geronimo Creek is represented by sample sites SG-2, SG-3, and SG-4. Overall habitat composition of San Geronimo Creek, in 1995, was composed of 28% riffle, 38% run, and 34% pool with the sample sites, in 1997, consisting of 18% riffle, 13% run, and 69% pool (Figure 4). Devil's Gulch was represented by sample sites DG-1 and DG-2. Overall habitat composition of Devil's Gulch, in 1995, included 45% riffle, 28% run, and 27% pool with the composition of the sample sites, in 1997, being made up of 21% riffle, 40% run, and 39% pool (Figure 5).

Our analysis of habitat, with the resulting estimates of juvenile salmonid populations, varied in three ways from the 1995 and 1996 surveys (Trihey & Associates 1995b and 1996): 1) the dividing points between Segments 1 and 2 of Lagunitas Creek changed; 2) sample site LG-1 was included to represent habitat for Lagunitas Creek; and 3) we evaluated habitat for all of San Geronimo Creek as one long segment rather than two shorter segments which did not include the lower 4,100 feet of the stream. These variations are described in greater detail below. No variations were applied to Devil's Gulch.

In 1995 and 1996, the reach of Lagunitas Creek from Nicasio Creek to the National Park Service/State Park boundary, near Cheda Creek, was identified as a single segment and the reach from the National Park

Service/State Park boundary to Shafter Bridge identified as a separate segment. Habitat types for those surveys was based on data from a 1992 habitat mapping effort. For our survey, we considered the reach from Nicasio Creek to the Tocaloma Bridge as one segment (Segment 1) and the reach from the Tocaloma Bridge to Peters Dam as another segment (Segment 2). We did this since MMWD completed a habitat mapping survey along the stretch from Tocaloma to Peters Dam during July and August, 1997 and wanted to use this more current data in our analysis. Since the 1997 habitat mapping survey did not cover the stretch of Lagunitas Creek between Nicasio Creek and Tocaloma, we only had the 1992 data for that stretch. We decided to use the 1992 habitat data for the reach from Nicasio Creek to Tocaloma, which we identify as Segment 1, and to use the 1997 habitat data for the reach from Tocaloma to Peters Dam, which we identify as Segment 2.

Another variation for our survey was the application of data from sample site LG-1. The 1995 and 1996 surveys did not include sample site LG-1 in the analysis of extrapolated population estimates, indicating that site LG-1 was not representative of the habitat along that stretch of the creek (Trihey & Associates 1995a). For our survey, we did include sample site LG-1 as representing Segment 1 of Lagunitas Creek, along with sample site LG-3. We felt it was appropriate to use site LG-1 in the analysis and we see little value in continuing to sample site LG-1 if the data from that site is not used in the population analyses. As noted above (see Section 3.1), sample site LG-1 consisted of 16% riffle, 45% run, and 39% pool. This closely matched the overall habitat composition of Segment 1 (as measured in 1992) which consisted of 19% riffle, 50% run, and 31% pool (see Figure 2). The site provides useful information on the distributions and densities of coho and steelhead in the lower stretch of Lagunitas Creek. We believe site LG-1 is an important site to continue to sample and that data from the site should be used in the extrapolated population analyses.

For San Geronimo Creek, we considered the habitat of the entire length of the stream and did not break it down into two segments. Previous surveys have eliminated the lower 4,100 feet of San Geronimo Creek (from its mouth to the Lagunitas Street Bridge) and have divided the remainder of the creek into two segments (Trihey & Associates 1995a, 1995b, and 1996). We have considered San Geronimo Creek as a whole since the lower 4,100 feet is viable fish habitat and there does not appear to be a dramatic distinction in the habitat along the length of the stream.

In future years, it will be appropriate to reevaluate where along Lagunitas Creek lines should be established to divide the stream into segments. Segments should be established so that a segment is identified which includes sample site LG-1 at Gallagher's Ranch. Also, the stream segments should be divided in a way that they are representative of major distinctions in habitat composition along Lagunitas Creek. We believe it is appropriate to divide Lagunitas Creek into segments at the National Park Service/State Park Boundary but more recent habitat typing data should be applied to the segment downstream of Tocaloma Bridge. It is our expectation that habitat typing will be conducted downstream of Tocaloma during the summer 1998 and the habitat typing effort may also be conducted between Tocaloma and Peters Dam again to document any changes in habitat between 1997 and 1998. We believe sample site LG-1 should continue to be sampled and it should continue to be used in the data analysis. We also feel that San Geronimo should be considered as a single segment and not divided into two segments.

3.3 1997 FISH SAMPLING RESULTS

A compilation of the catch from each pass at each sample site is presented in Appendix A. Seven Species of fish were collected: coho salmon (*Oncorhynchus kisutch*), steelhead trout (*O. mykiss*), Pacific lamprey (*Lampetra tridentata*), sculpin (*Cottus sp.*), California roach (*Lavinia symmetricus*), threespine stickleback (*Gasterosteus aculeatus*), and Sacramento sucker (*Catostomus occidentalis*). The sculpin were not identified to species but were most likely prickly sculpin (*C. asper*), coast range sculpin (*C. aleuticus*), and riffle sculpin (*C. gulosus*). Only one Sacramento sucker was caught and it was at site 15.86. Two California freshwater shrimp (*Syncaris pacifica*) were inadvertently captured and released immediately, one at site LG-3 and one at site LG-7. Pacific giant salamander (*Dicamptodon ensatus*) were observed in Devil's Gulch at site DG-2. Bullfrog (*Rana catesbeiana*) adults and tadpoles were observed at site LG-1. No other amphibians were observed or captured.

A total of 541 coho and 1,309 steelhead were captured from all sample sites (Table 1). The steelhead capture by age class was: 0+steelhead = 1,226 and 1+steelhead = 83. At individual sample sites, the coho catch ranged from 0 to 154 and the steelhead catch ranged from 27 to 202 (the 0+steelhead catch ranged from 23 to 191 and the 1+steelhead catch ranged from 0 to 22).

The total number of mortalities experienced from our sampling effort were as follows: coho = 7 (1.3%), total steelhead = 36 (2.7%); 0+steelhead = 33 (2.7%), 1+steelhead= 3 (3.6%). These mortality rates are comparable to mortalities in recent years. During the sampling efforts between 1994 and 1997, the coho mortality rates have ranged from 0.5% to 3.9% of captured coho and the steelhead mortality rates have ranged from 1.0% to 3.1% of captured steelhead. The mortalities represent less than 0.1% of the total estimated populations.

During the sampling effort, stream flows as measured by MMWD at the Samuel P. Taylor gage station ranged between 8.07 and 26.97 cubic feet per second (cfs). The flows on most days were between 8 and 9 cfs, except for a flow of 26.97 cfs on 9-Oct-97 and 10.35 cfs on 10-Oct-97. During the same period, stream flows as measured at the gage station at Gallagher's ranch ranged between 7.14 and 33.6 cfs with the flows on most days ranging between 7 and 9 cfs, except for a flow of 33.6 cfs on 9-Oct-97 and 11.76 cfs on 10-Oct-97. Streamflow releases from Kent Lake during the sampling period were 8 cfs on all days.

Also during the sampling period, water temperatures ranged between 51.8 and 57.8 degrees Fahrenheit at the Lagunitas Creek sample sites, between 53.5 and 58.5 degrees Fahrenheit at the San Geronimo Creek sample sites, and between 51.6 and 58.7 degrees Fahrenheit at the Devil's Gulch sample sites. Water temperatures of Lagunitas Creek as measured at the Samuel P. Taylor gage station ranged between 52 and 57 degrees Fahrenheit during the same time period.

3.3.1 Coho and Steelhead Catch Summary

In Table 1, the total 1997 catch of coho and steelhead is compared to the catches from the annual surveys conducted between 1993 and 1996. These comparisons are made to look at trends in coho and steelhead abundance in recent years. Several important findings are apparent from these comparison as described below.

Coho

In 1997, coho were present in much higher numbers at the tributary sample sites (i.e., the San Geronimo Creek and Devil's Gulch sites) than at the mainstem Lagunitas Creek sample sites. We captured 411 coho at the six San Geronimo Creek and Devil's Gulch sample sites while we captured 130 coho from the seven Lagunitas Creek sample sites. Still, the pool at sample site 15.86, in Lagunitas Creek, has consistently supported a relatively large number of juvenile coho over the four years it has been sampled.

The coho catch at individual sample sites in Lagunitas Creek was generally similar in 1997 to the catch from 1996. Meanwhile, the 1997 coho catch at individual sample sites in San Geronimo Creek and Devil's Gulch was double the catch from 1996 (411 in 1997 versus 172 in 1996). Habitat conditions at all of the sample sites did not appear to have changed dramatically.

The 1997 and 1994 juvenile coho represent the same year class. While not as many coho were caught in 1997 as in 1994, the 1997 catch was higher in 1997 than in 1993, 1995 or 1996. This indicates that the 1994/97 year class is still relatively strong.

For coho in San Geronimo Creek, the juveniles appear to be more abundant in the upper portion of the stream than the lower; however, with a strong year class they spread through the system more so than with weaker year classes. Between 1993 and 1997, the coho catch at sample sites SG-3 and SG-4 was consistently higher than at site SG-2; but in 1994 and 1997, greater numbers of coho were present at site SG-2 than in 1993, 1995, or 1996. For Lagunitas Creek, it is more difficult to draw a similar conclusion since the catch data is less consistent between sample sites. For Devil's Gulch, juvenile coho appear to have spread through the system in all years between 1993 and 1997.

Steelhead

A total of 1,309 juvenile steelhead were caught in 1997, consisting of 1,226 young-of-the-year (0+steelhead) and 83 one to three years olds (1+steelhead). There were more steelhead caught in 1997 than in 1996 but not in all streams. For the sample sites in the mainstem of Lagunitas Creek, there was a large increase in number of steelhead caught (934 in 1997 versus 510 in 1996) while in San Geronimo Creek, there was a large decrease (225 in 1997 versus 409 in 1996) and in Devil's Gulch, there was a moderate increase (150 in 1997 versus 119 in 1996). The increase in the total steelhead catch from the Lagunitas Creek sites between 1996 and 1997 was made up of 0+steelhead and there was a decrease in 1+steelhead caught at all of the Lagunitas Creek sites in 1997 compared to 1996. The largest increase in the 0+steelhead catch in 1997 compared to 1996 was at sample sites LG-3, LG-9, and 15.86. The decrease in the total catch from the San Geronimo sites between 1996 and 1997 was for both 0+ and 1+ steelhead, with a decrease at all three sample sites.

3.3.2 Steelhead Age Classes

The size differences between 0+steelhead and 1+steelhead was determined for each sample site (all habitat units within each site combined) and for each stream (Lagunitas Creek, San Geronimo Creek, and Devil's Gulch). The length frequency of all steelhead captured from the mainstem of Lagunitas Creek, San Geronimo Creek, and Devil's Gulch sample sites is presented in Figure 6. The size class breaks between 0+steelhead and 1+ steelhead are summarized for each sample site in Table 2. Overall, we found the break

between 0+ and 1+ steelhead to occur at about 115 mm FL. The size break for steelhead captured from sample sites in the mainstem of Lagunitas Creek was more pronounced than for steelhead captured from the San Geronimo Creek or Devils' Gulch sites. In Lagunitas Creek, the maximum size for 0+steelhead ranged between 94 mm and 112 mm and the minimum size for 1+steelhead ranged between 120 mm and 186 mm. These ranges were comparable to the ranges identified in the 1996 juvenile survey (Trihey & Associates 1996). In San Geronimo Creek and Devil's Gulch, the maximum size for 0+steelhead ranged between 110 mm and 117 mm and the minimum size for 1+steelhead ranged between 120 mm and 133 mm. These ranges were higher than identified in 1996, which were between 66 mm and 99 mm for 0+steelhead and between 90 mm and 116 mm for 1+steelhead (Trihey & Associates 1996).

3.4 SALMONID POPULATION ESTIMATES

3.4.1 Juvenile Population Estimates

The coho and steelhead population estimates for each sample site, and the habitat units within each site, are presented in Appendix B. This represents the output of the catch data run through the population estimating program *Microfish*. In a few instances, the steelhead population estimates as determined by *Microfish* were not reliable; in these instances, we assumed the total catch was the total population for the particular habitat unit. For example, we captured 47 0+steelhead from the run habitat at site LG-5 after 4 passes, with catches of 13 in the first pass and 5 in the fourth pass; *Microfish* estimated the a population of 77 0+steelhead in that run but it seemed highly unlikely that there could have been another 30 0+steelhead in the run after the depletion we achieved in four passes through it, so we decided the *Microfish* estimate, in that case, was unreliable and we used the total catch in our extrapolated population estimate for 0+steelhead.

The population estimates for each sample site were then extrapolated for entire stream segments as presented in Appendix C. These total population estimates are compared to estimates between 1993 and 1996 as summarized in Table 3. The estimates were calculated in two ways: a) estimates based on the average density per channel segment length; and b) estimates based on average density per channel segment length and within habitat types (i.e., total riffle, run, and pool lengths within each stream segment). This dual method of estimating salmonid populations was used in 1995 and 1996 (Trihey & Associates 1995b and 1996). The results in Appendix C and Table 3 show that the population estimate can vary between the two methods of estimating. As mentioned above (see Section 3.2) Lagunitas Creek-Segment 1 extended from the mouth of Nicasio Creek upstream to the Tocaloma Bridge and Lagunitas Creek-Segment 2 extended from the Tocaloma Bridge upstream to Peters Dam. For Table 3, we combined Segments 1 and 2 of Lagunitas Creek for a tally along Lagunitas Creek from Nicasio Creek to Peters Dam. San Geronimo Creek extended from its mouth to the Dickson weir, and Devil's Gulch extended from its mouth upstream 6,925 feet.

The population estimates are a measure of coho and steelhead abundance in the system and reflect the catch at our sample sites relative to the habitat that is available within each stream segment. Another measure of the population can be expressed as the density of fish per unit of stream length. In Table 4, we have expressed coho and steelhead densities as the number of fish per 30 meters of stream for each of the sample sites between 1993 and 1997. Figures 7 and 8 display the densities of coho and steelhead (respectively) per 30 meters of stream combined for Lagunitas Creek, San Geronimo Creek, and Devil's

Gulch for each year between 1970 and 1997.

The juvenile salmonid surveys conducted in 1995 and 1996 estimated fish populations for two segments of San Geronimo Creek (Trihey & Associates 1995b and 1996). The segments were identified by Trihey & Associates during a 1995 habitat typing survey which excluded habitat in the lower 4,100 feet of the creek, and separated the remaining length of stream into two segments of 9,000 feet each (Trihey & Associates 1995a). We do not agree with Trihey's conclusion that the lower 4,100 feet of San Geronimo Creek (from its mouth to the Lagunitas Street bridge) was atypical habitat for the creek. Also, Trihey did not present any basis for separating the remaining stream habitat into two segments. Therefore, we evaluated San Geronimo Creek as a whole, from its mouth to the impassable fish barrier at the Dickson weir (upstream from the mouth of Woodacre Creek), and estimated the extrapolated population estimates for the entire length of the stream (see Table 3 and Appendix C). However, we did do a comparison of the extrapolated estimates by calculating estimates for San Geronimo Creek into segments as was done in 1995 and 1996. This comparison between extrapolated population estimates is presented in Appendix D. The results indicate a greater number of coho and steelhead in San Geronimo Creek when considering the entire length of the stream than when considering just the two 9,000 foot segments together. This result was expected since the entire stream length includes 4,100 feet of stream that was not included in the estimates for just the two 9,000 foot segments. Otherwise, the results are comparable between estimates (see Appendix D). We have concluded that future juvenile sampling efforts should add a sample site within the lower 4,100 feet of San Geronimo Creek (located at a representative site somewhere between the Inkwells and the Lagunitas Street bridge). We also have concluded that San Geronimo Creek should be evaluated as a whole and not divided into segments.

3.4.2 Juvenile Population Trends

For coho, the total 1997 juvenile population ranged between 16,962 and 21,410 fish, depending on the estimating method. The 1997 coho population was higher than in 1993, 1995, and 1996. While the population was not as high in 1997 as in 1994, these fish are in the same year class and the results indicate the year class is still the strongest observed in recent years. The strong year class is evident in San Geronimo Creek and Devil's Gulch as well as in the mainstem of Lagunitas Creek.

Over the 27 year period that juvenile sampling has been conducted in Lagunitas Creek (recognizing that sampling was not conducted in all years) the 1997 coho population estimate was second only to the 1994 population estimate. Except for 1988, total coho abundance between 1970 and 1993 has been estimated at below 10,000 juveniles with as few as 400 juvenile coho estimated from 1986 (Trihey & Associates 1995a). It is interesting to note that the 1988 juvenile coho population is in the same year class as the 1994 and 1997 juvenile coho populations.

When viewed as the number of fish per 30 meters of stream, juvenile coho clearly appear to do better in the tributaries than in the mainstem of Lagunitas Creek. Since 1993, the density of juvenile coho per 30 meters of stream has been higher in San Geronimo Creek and Devil's Gulch than in the mainstem of Lagunitas Creek.

For steelhead, the 1997 juvenile steelhead population ranged between 47,847 and 52,427 fish, depending on the estimating method. The 1997 steelhead population was the highest estimated in the period 1993-1997, although not dramatically higher than in most other years in that period. The total steelhead population this year was significantly higher than in 1996, made up largely of 0+steelhead in the mainstem of Lagunitas Creek.

This year, the populations of 0+steelhead and 1+steelhead appear to be much higher in the mainstem of Lagunitas Creek than in the tributaries (both in terms of total numbers of fish and fish per 30 meters of stream) but this is not a consistent trend since 1993. It is more difficult to draw any meaningful trends for steelhead since there is more variation between years and streams. Overall, however, it appears that the juvenile steelhead population has stayed relatively high since 1993. It appears that 1997 was a particularly good year for steelhead in the mainstem of Lagunitas Creek. It also appears that the 1997 steelhead did much better in the mainstem of Lagunitas Creek, both in terms of total abundance and density, than they did in the tributaries.

4.0 DISCUSSION AND CONCLUSIONS

The juvenile coho and steelhead populations sampled in 1997 appear to be keeping with an overall upward trend of the salmonid populations in the Lagunitas Creek system. This trend has been noted over the past several years of monitoring, between 1993 and 1997. Certainly for coho, the year class represented by the 1994 and 1997 juveniles was a strong year class. While not as high as in 1994, the abundance and density of juvenile coho estimated in 1997 was the second highest in all the years of surveys since 1970.

We believe the estimate of 16,962 juvenile coho in Lagunitas Creek, San Geronimo Creek, and Devil's Gulch (as based on the average density within each habitat type) is the more accurate of the two estimates of coho in the system. Juvenile coho tend to occupy pools much more than they utilize runs or riffles and they are not found in all habitats along the length of stream. The estimate of 21,410 juvenile coho (as based on average density per channel length) probably overestimated the actual number of coho in the system since this assumes equal densities of coho in all habitats.

The differences in the juvenile salmonid catch between 1996 and 1997 appear to reflect variations in the populations more so than the result of changes in habitat types at the sample sites. While there were some changes in the habitats at the various sample sites between 1996 and 1997, these changes were not dramatic. Also, the differences do not appear to be from any variations in the level of sampling effort since identical sampling techniques were used in both years.

For coho, the tributary streams (i.e., San Geronimo Creek and devil's Gulch) are important for egg survival and as rearing streams for juveniles. Coho redds and egg survival in the mainstem of Lagunitas Creek may be at greater risk than in the tributaries. While coho numbers in the mainstem of Lagunitas Creek were greater in 1997 than in 1996, they were not nearly as high as in the tributaries. Winter storms during January, 1997 may have scoured some redds and covered others with sediment. A coho spawner survey during the 1996-1997 winter found that most coho spawned during the month of December, 1996 (Trihey & Associates 1997). This spawning period was followed by a large winter storm that started on January 1,

1997 and raised stream flows in Lagunitas Creek to well above 2,500 cfs. Previous studies of redd scour in Lagunitas Creek indicate that the high flows in Lagunitas Creek may destroy some of redds and eggs. Between 1982 and 1984, D.W. Kelley & Associates investigated the effects of streamflow on scour of salmonid redds (Bratovich and Kelley 1988). They found that redd scour was most severe during two separate storm events which increased stream flows from 25 to 925 cfs in the first storm and from 130 to 500 cfs during the second storm. They concluded that, given the streambed conditions in Lagunitas Creek, salmonid redds can tolerate one or two moderate sized storms without suffering from the effects of scour, but more than two storms, or one storm of great magnitude, places most redds at risk of scour and increases egg mortality. They also found that deposition of fine sediments on redds, with intrusion of the sediments into the redd, can cause high egg mortality by reducing oxygen concentrations. During the January, 1997 storm, egg survival in the mainstem of Lagunitas Creek may have suffered from the combination of redd scour and intrusion of fine sediments into redds.

Despite the large number of coho estimated for San Geronimo Creek, the lower portion of the stream may be under utilized. We recommend that a fourth sample site be added in San Geronimo Creek, in the lower portion of the creek, between the Inkwells and the Lagunitas Street bridge. This will help understand salmonid abundance and density throughout the San Geronimo system. As it is now, the single sample site at SG-2 is probably not sufficient to represent the entire lower portion of the stream.

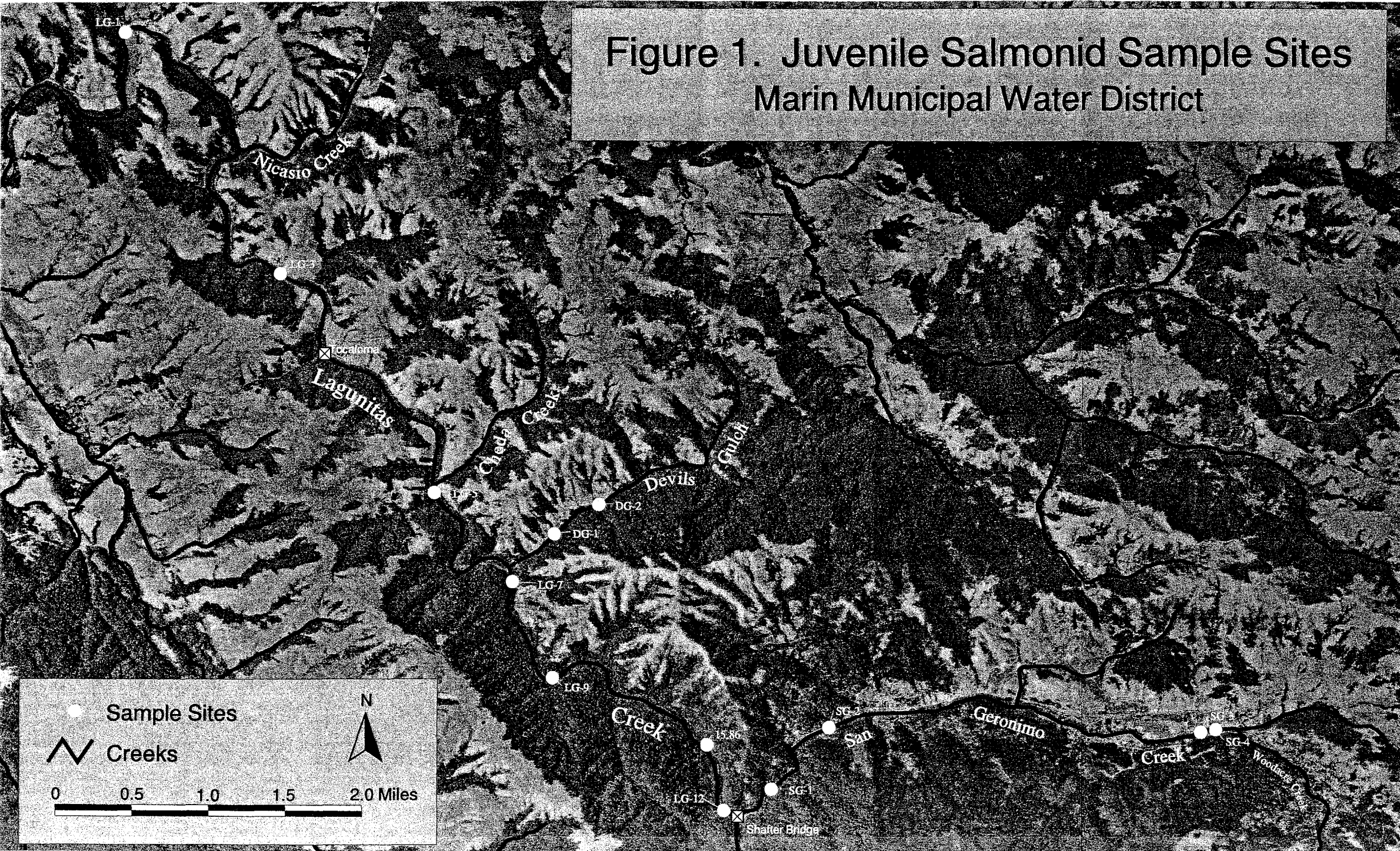
In contrast to coho, the comparison of juvenile steelhead between 1996 and 1997 indicate the numbers of steelhead were higher in the mainstem of Lagunitas Creek and not as high in the tributaries. The high numbers in the mainstem may also be at least partially a result of the storm patterns during the 1996-1997 winter. Steelhead are known to spawn later in the winter than coho with most spawning occurring between January and March. After the January 1, 1997 storm, there were no major storm events through the rest of the winter. Stream flows in Lagunitas Creek between mid-January and early March, 1997 were below 1,000 cfs with many days of stream flow below 100 cfs. So while some coho redds may have been destroyed during the early January storm, most steelhead redds created after that storm may have stayed intact.

5.0 REFERENCES

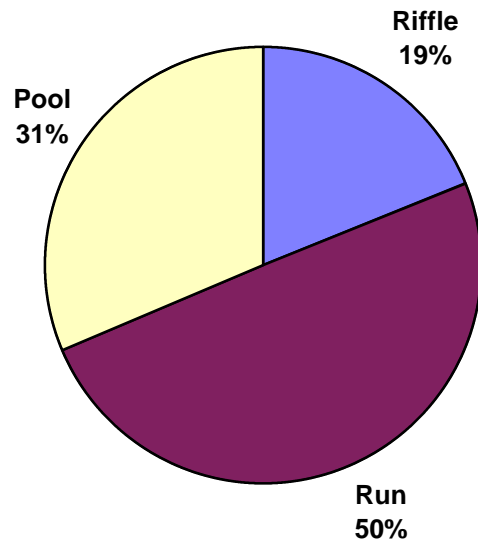
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FIGURES AND TABLES

Figure 1. Juvenile Salmonid Sample Sites
Marin Municipal Water District



Overall Habitat Composition



Fish Population Survey Habitat Composition Sample Sites-LG-1 and LG-3

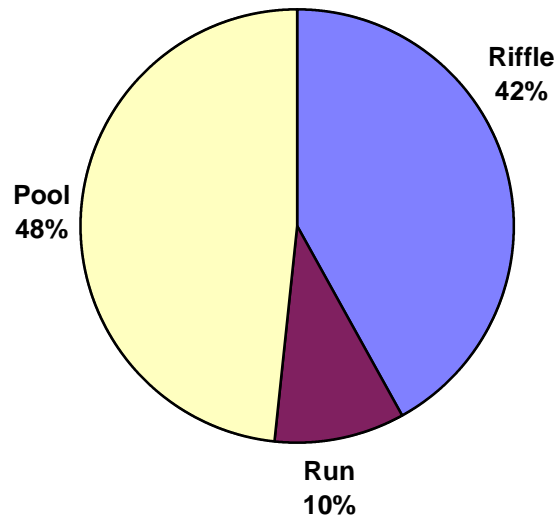
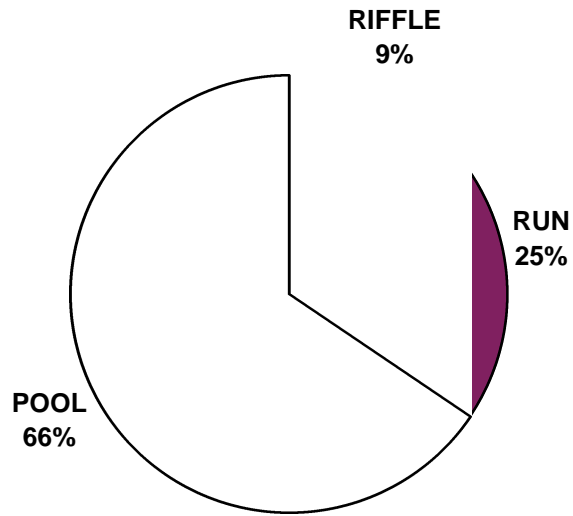


Figure 2. Overall habitat composition and percentage of habitat surveyed in Lagunitas Creek - Segment 1 (Nicasio Creek to Tocaloma Bridge).

Overall Habitat Composition



Fish Population Survey Habitat Composition
Sample Sites-LG-5, LG-7, LG-9, LG-15.86, and LG-12

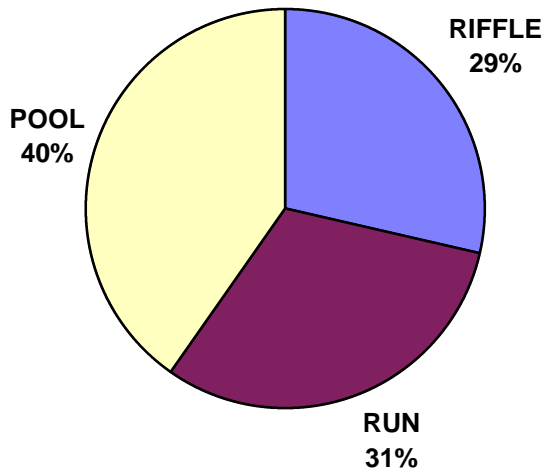
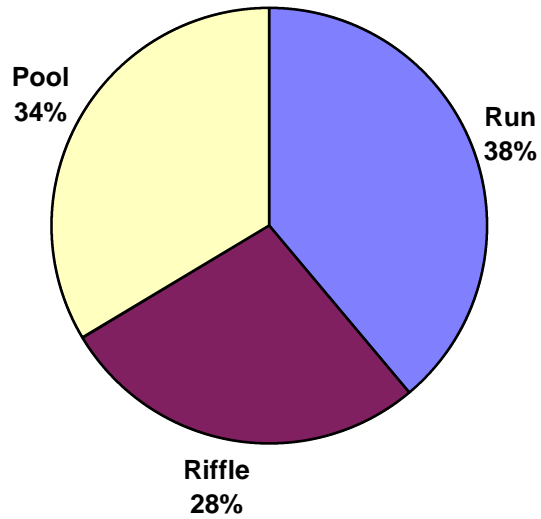


Figure 3. Overall habitat composition and percentage of habitat surveyed of Lagunitas Creek - Segment 2 (Tocaloma Bridge to Peter's Dam).

Overall Habitat Composition



Fish Population Survey Habitat Composition Sample Sites-SG-2, SG-3, SG-4

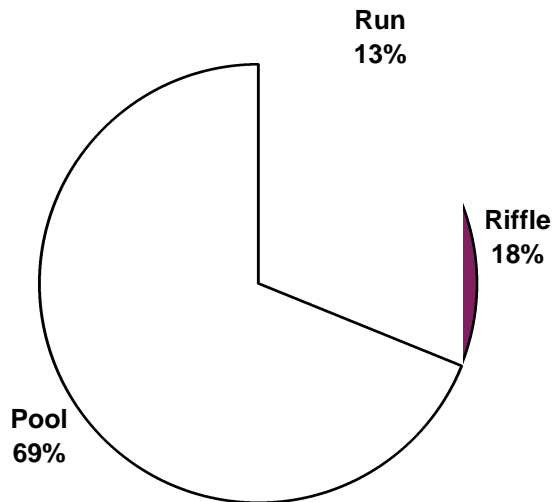
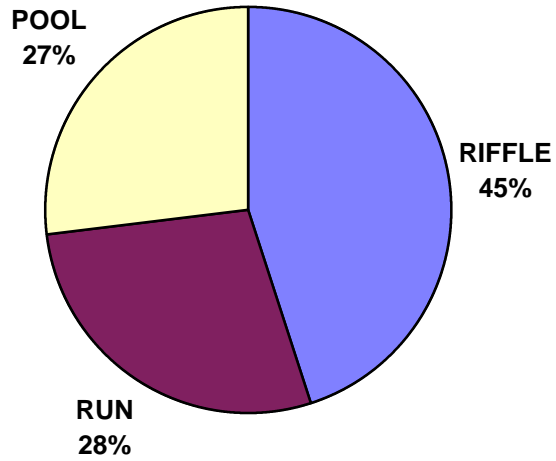


Figure 4. Overall habitat composition and percentage of habitat surveyed in San Geronimo Creek (Mouth to Dickson weir).

Overall Habitat Composition



Fish Population Survey Habitat Composition Sample Sites_DG-1 and DG-2

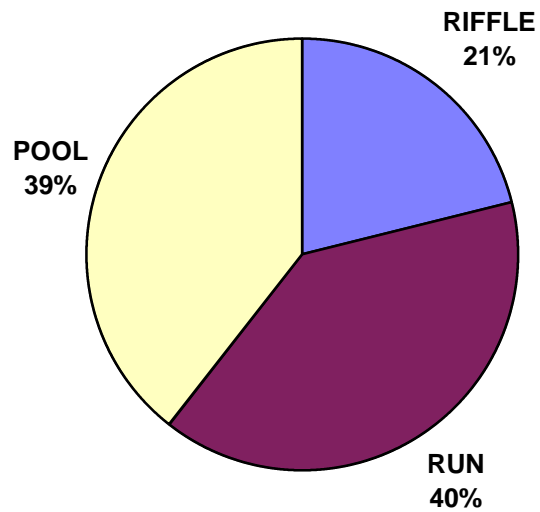
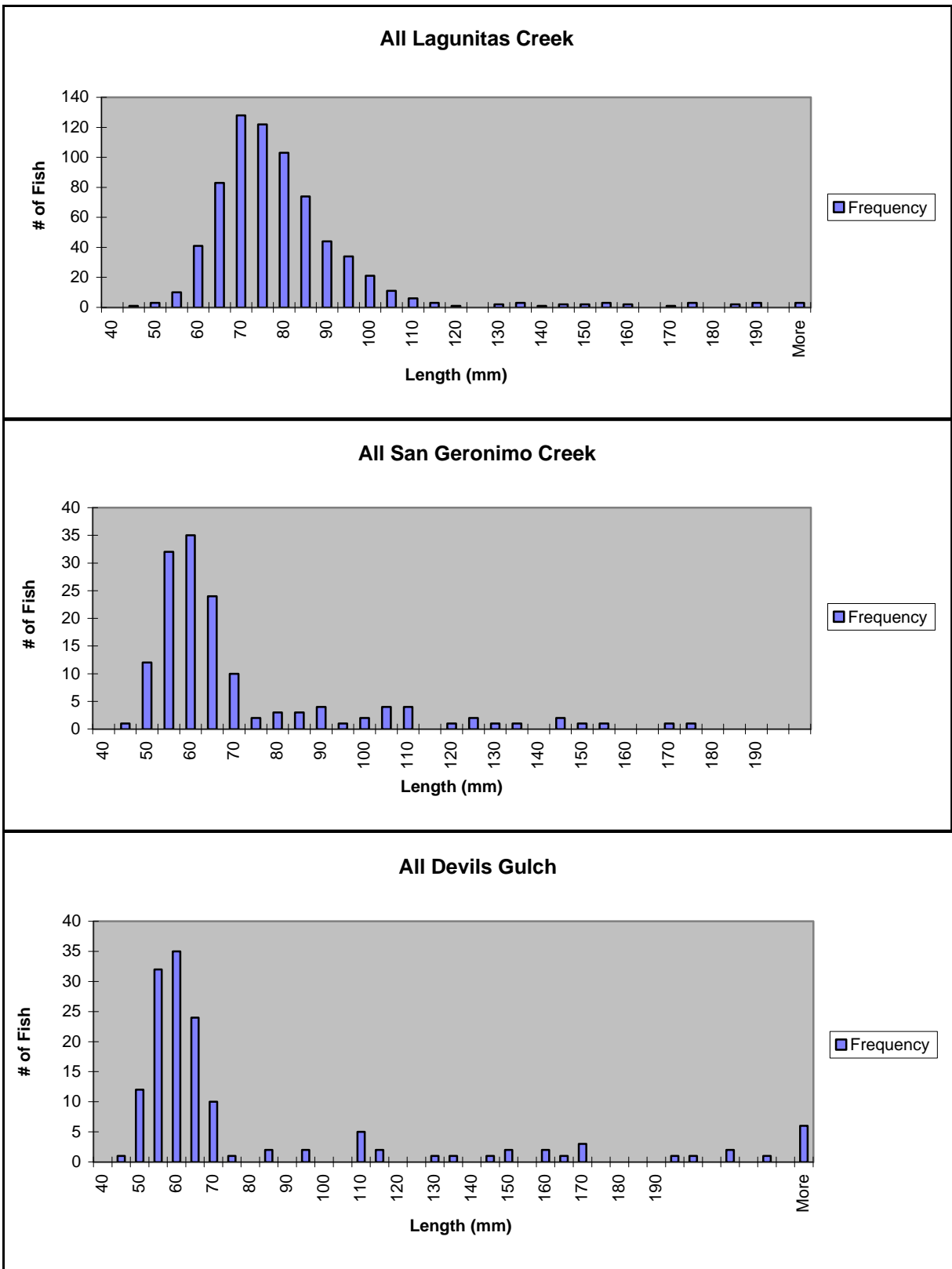


Figure 5. Overall composition of habitat and percentage of habitat surveyed in Devils Gulch (Mouth to 6,925 feet upstream).

Figure 6. Length frequency of all steelhead captured at juvenile sample sites in Lagunitas Creek, San Geronimo Creek, and Devil's Gulch.



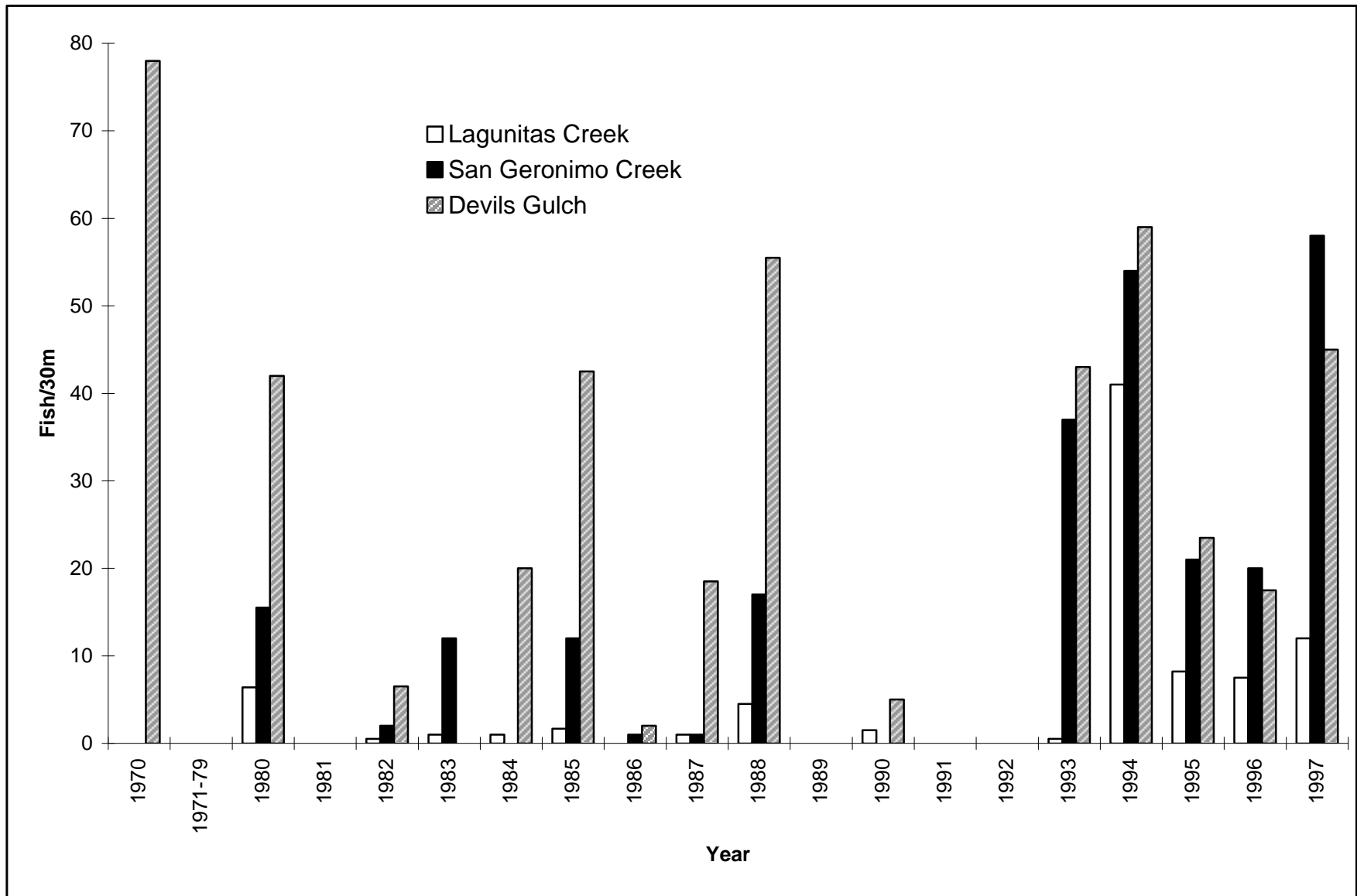


Figure 7. Coho Density in Lagunitas Creek, San Geronimo Creek, and Devils Gulch by Year.

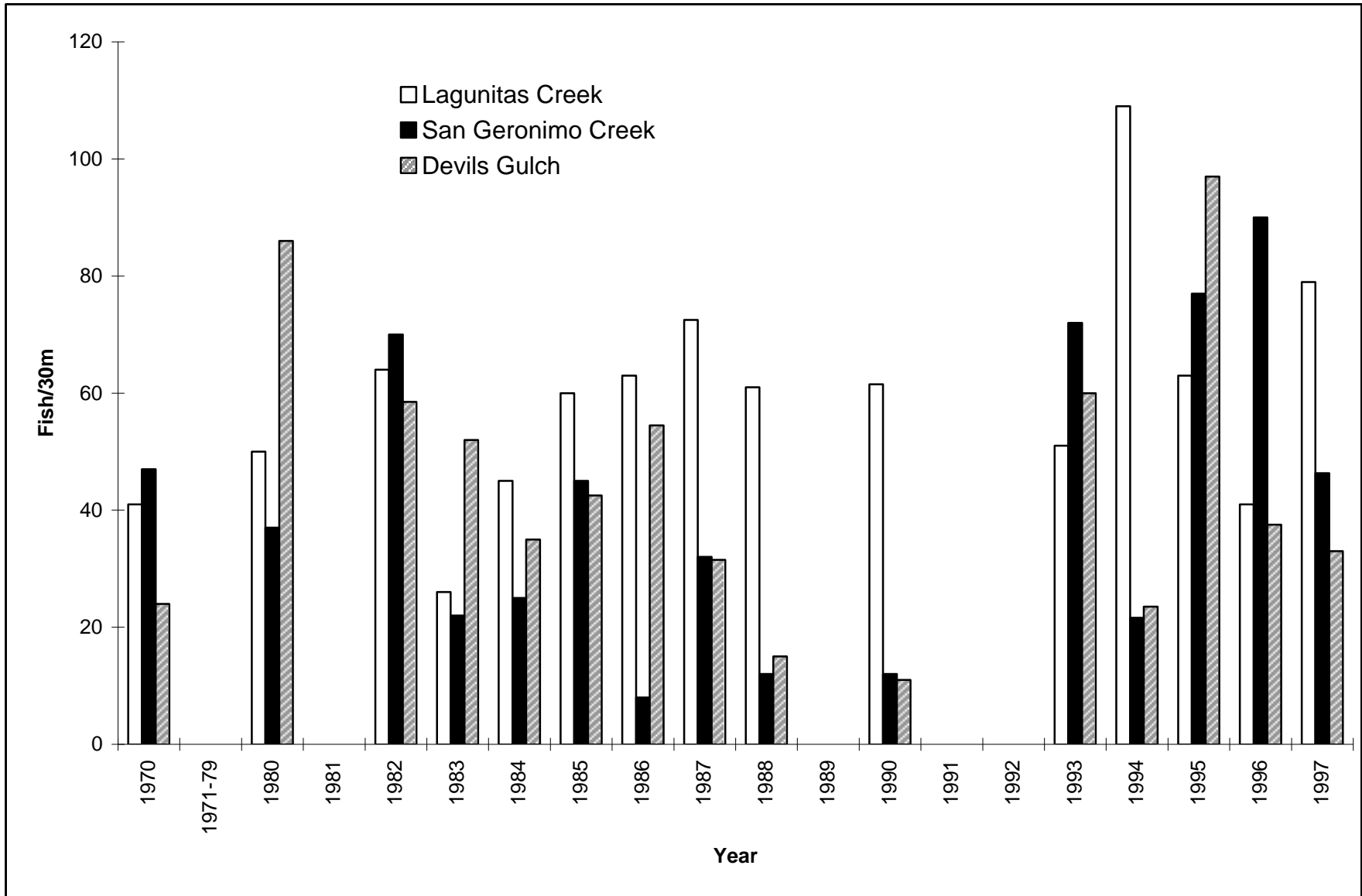


Figure 8. Steelhead Density in Lagunitas Creek, San Geronimo Creek, and Devils Gulch by Year.

Table 1. Comparison of Total Catch at Juvenile Salmonid Sample Sites for 1993 - 1997.

<u>Site #</u>	<u>Year</u>	<u>Coho</u>	<u>0+ SH</u>	<u>1+SH</u>	<u>All SH</u>
<u>LG 1</u>	1993	0	30	0	30
	1994	2	123	16	139
	1995	0	21	1	22
	1996	0	129	35	164
	1997	0	104	6	110
<u>LG 3</u>	1993	0	88	2	90
	1994	31	184	25	190
	1995	0	107	7	114
	1996	19	77	25	102
	1997	1	191	11	202
<u>LG 5</u>	1993	0	101	1	102
	1994	14	215	3	218
	1995	8	213	5	218
	1996	0	59	8	67
	1997	3	107	2	109
<u>LG 7</u>	1993	0	30	0	30
	1994	1	36	5	41
	1995	N/S	N/S	N/S	N/S
	1996	14	14	63	77
	1997	39	114	7	121
<u>LG 9</u>	1993	0	38	1	39
	1994	7	78	0	78
	1995	1	74	2	76
	1996	0	35	2	37
	1997	1	170	0	170
<u>LG 15.86</u>	1993	N/S	N/S	N/S	N/S
	1994	156	57	10	67
	1995	48	54	7	61
	1996	41	30	13	43
	1997	86	146	6	152
<u>LG 12</u>	1993	1	47	0	47
	1994	51	83	8	91
	1995	0	27	6	33
	1996	0	20	3	23
	1997	0	65	5	70
<u>SG 2</u>	1993	4	187	2	189
	1994	11	18	9	27
	1995	1	157	6	163
	1996	2	226	13	239
	1997	25	117	9	126
<u>SG 3</u>	1993	3	35	11	46
	1994	46	15	21	36
	1995	1	19	1	20
	1996	41	48	23	71
	1997	69	23	4	27
<u>SG 4</u>	1993	96	58	13	71
	1994	104	17	0	17
	1995	85	169	10	179
	1996	73	61	38	99
	1997	154	50	22	72
<u>DG 1</u>	1993	82	68	0	68
	1994	114	16	7	23
	1995	58	123	3	126
	1996	22	37	9	46
	1997	84	58	5	63
<u>DG 2</u>	1993	30	93	4	97
	1994	41	35	6	41
	1995	8	164	0	164
	1996	34	62	11	73
	1997	79	81	6	87
Total	1997	541	1226	83	1309

N/S = Not Surveyed
 SH = Steelhead
 0+SH = <1year old
 1+SH = 1-3 years old

Table 2. Size Breaks Between 0+ and 1+ Steelhead in Each Sample Site.

Sample Site	Steelhead Age Classes		Size Difference (mm)
	0+ max (mm)	1+ min (mm)	
LG-1	112	132	20
LG-3	110	128	18
LG-5	94	186	92
LG-7	112	120	8
LG-9	96	None	n/a
LG-12	103	130	27
LG 15.86	115	133	18
SG-2	117	120	3
SG-3	116	122	6
SG-4	115	133	18
DG-1	110	122	12
DG-2	110	120	10

Notes:

0+ are young-of-the-year steelhead (<1 year old); max represents the maximum length of the age class.

1+ are one to three year old steelhead; min represents the minimum length of the age class.

Sizes are measured as fork length (FL).

Table 3: Comparison of 1993 - 1997 total juvenile salmonid population estimates based on two methods of estimating.

ESTIMATE A (See Explanation Below):

ESTIMATE B (See Below):

Lagunitas Creek (Nicasio Creek to Peter's Dam)

Type	1993	1994	1995	1996	1997
0+SH	30,002	43,536	24,106	14,118	36,987
1+SH	246	3,345	1,724	1,864	1,062
Coho	82	20,171	3,212	3,694	5,714

1995	1996	1997
24,547	11,411	33,717
1,583	2,395	1,404
1,535	2,468	8,678

San Geronimo Creek (Mouth to Dixon Weir upstream from Woodacre Creek)

Type	1993	1994	1995	1996	1997
0+SH	14,158	2,390	14,574	17,771	9,742
1+SH	1,149	1,351	652	2,966	1,730
Coho	4,886	7,150	2,995	10,076	12,560

1995	1996	1997
9,449	13,160	9,563
464	1,426	842
1,286	4,295	6,112

Devils Gulch Creek (Mouth to 6,925 feet)

Type	1993	1994	1995	1996	1997
0+SH	4,079	1,360	6,549	2,270	2,694
1+SH	101	327	67	450	212
Coho	2,820	4,029	1,510	2,360	3,136

1995	1996	1997
6,484	1,827	2,242
39	358	79
1,192	1,717	2,172

Total for All Streams

Type	1993	1994	1995	1996	1997
0+SH	48,239	47,286	45,229	34,159	49,423
1+SH	1,496	5,023	2,443	5,280	3,004
Coho	7,788	31,350	7,717	16,130	21,410

1995	1996	1997
40,480	26,398	45,522
2,086	4,179	2,325
4,013	8,480	16,962

Notes:

Estimate A = Estimates based on extrapolations from average density per channel length.

Estimate B = Estimates based on extrapolations from average density within each habitat type (riffle, run, pool); estimates based on this method were not made in 1993 or 1994.

0+SH = Young-of-the-year steelhead (<1 year old); **1+SH** = One to three year old steelhead .

Table 4. Fish per 30 meters of stream for Lagunitas, San Geronimo, and Devil's Gulch.

Stream and Site	Species	1993	1994	1995	1996	1997
Lagunitas Creek						
LG1	Coho	0	1	0	0	0
	0+SH	30	91	8	50	50
	1+SH	0	7	1	14	2
	Total SH	30	98	9	64	53
LG-3	Coho	0	22	0	12	1
	0+SH	63	140	58	50	136
	1+SH	1	9	4	16	7
	Total SH	64	149	62	66	144
LG-5	Coho	0	13	7	0	2
	0+SH	96	205	187	41	95
	1+SH	1	3	7	3	2
	Total SH	97	208	194	45	97
LG-7	Coho	0	1	-	6	20
	0+SH	29	34	-	6	57
	1+SH	0	5	-	26	3
	Total SH	29	39	-	32	60
LG-9	Coho	0	7	1	0	1
	0+SH	38	78	30	27	132
	1+SH	1	0	1	0	0
	Total SH	39	78	31	29	132
15.86	Coho	-	193	41	34	60
	0+SH	-	70	46	25	113
	1+SH	-	12	6	11	4
	Total SH	-	82	52	36	117
LG-12	Coho	1	51	0	0	0
	0+SH	47	104	26	14	39
	1+SH	0	6	6	2	3
	Total SH	47	110	32	16	42
Average	Coho	0	41	8	7	12
	0+SH	51	103	59	30	89
	1+SH	1	6	4	10	3
	Total SH	51	109	63	41	92
San Geronimo Creek						
SG-2	Coho	2	6	1	1	15
	0+SH	98	13	85	124	76
	1+SH	1	2	3	7	6
	Total SH	99	15	88	131	81
SG-3	Coho	3	40	1	4	50
	0+SH	30	13	14	45	16
	1+SH	10	18	1	22	3
	Total SH	40	31	15	67	19
SG-4	Coho	107	116	61	54	108
	0+SH	64	19	121	45	34
	1+SH	14	0	7	28	15
	Total SH	78	19	128	73	50
Average	Coho	37	54	21	20	58
	0+SH	64	15	73	71	42
	1+SH	8	7	4	19	8
	Total SH	72	22	77	90	50
Devils Gulch						
DG-1	Coho	66	91	42	16	51
	0+SH	55	18	90	27	36
	1+SH	0	2	2	7	3
	Total SH	55	20	92	34	39
DG-2	Coho	20	27	5	19	39
	0+SH	62	26	102	35	40
	1+SH	3	1	0	6	3
	Total SH	65	27	102	41	43
Average	Coho	43	59	24	18	45
	0+SH	59	22	96	31	38
	1+SH	2	2	1	7	3
	Total SH	60	24	97	38	41

SH = Steelhead.
 0+SH = <1 year old.
 1+SH = 1-3 years old.

APPENDIX A

1997 FISH CATCH BY SAMPLE SITE

Lagunitas Creek: Site LG-1

Downstream Pool	Pass			Total
	1	2	3	
Species	1	2	3	Total
0+ Steelhead	7	2	6	15
1+ Steelhead	1	2	0	2
Coho Salmon	0	0	0	0
Sculpin	8	1	4	13
California Roach	41	32	24	97
Stickleback	3	0	0	3
Pacific Lamprey	3	1	0	4

Downstream Riffle	Pass				Total
	1	2	3	4	
Species	1	2	3	4	Total
0+ Steelhead	5	10	4	2	21
1+ Steelhead	0	0	0	0	0
Coho Salmon	0	0	0	0	0
Sculpin	3	0	1	0	4
California Roach	14	5	2	3	24
Stickleback	0	0	0	0	0
Pacific Lamprey	0	0	0	0	0

Upstream Run	Pass				Total
	1	2	3	4	
Species	1	2	3	4	Total
0+ Steelhead	8	10	10	4	32
1+ Steelhead	1	2	0	0	3
Coho Salmon	0	0	0	0	0
Sculpin	5	0	1	1	7
California Roach	0	1	3	2	6
Stickleback	0	0	0	0	0
Pacific Lamprey	1	0	0	0	1

Upstream Run	Pass			Total
	1	2	3	
Species	1 <td>2 <td>3 <td>Total</td> </td></td>	2 <td>3 <td>Total</td> </td>	3 <td>Total</td>	Total
0+ Steelhead	14	17	5	36
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	7	1	1	9
California Roach	0	0	0	0
Stickleback	0	2	0	2
Pacific Lamprey	1	1	0	2

Lagunitas Creek: Site LG-3

Downstream Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	74	29	15	118
1+ Steelhead	3	2	1	6
Coho Salmon	0	1	0	1
Sculpin	10	4	4	18
California Roach	151	31	12	194
Stickleback	4	15	2	21
Pacific Lamprey	20	13	19	52
Ca. Freshwater Shrimp	1	0	0	1

Upstream Run	Pass			Total
Species	1	2	3	
0+ Steelhead	45	19	9	73
1+ Steelhead	4	1	0	5
Coho Salmon	0	0	0	0
Sculpin	12	2	1	15
California Roach	15	0	0	15
Stickleback	0	1	0	1
Pacific Lamprey	11	11	5	27

Lagunitas Creek: Site LG-5

Downstream Riffle	Pass			Total
Species	1	2	3	
0+ Steelhead	30	18	12	60
1+ Steelhead	1	1	0	2
Coho Salmon	0	0	0	0
Sculpin	1	0	1	2
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	1	1

Upstream Run	Pass				Total
Species	1	2	3	4	
0+ Steelhead	13	14	15	5	47
1+ Steelhead	0	0	0	0	0
Coho Salmon	1	2	0	0	3
Sculpin	0	0	0	0	0
California Roach	0	0	0	0	0
Stickleback	0	1	0	0	1
Pacific Lamprey	0	0	0	1	1

Lagunitas Creek: Site LG-7

Downstream Pool	Pass				Total
Species	1	2	3	4	
0+ Steelhead	15	22	7	4	48
1+ Steelhead	3	0	0	4	7
Coho Salmon	12	1	8	4	25
Sculpin	3	3	4	1	11
California Roach	0	0	0	0	0
Stickleback	1	6	2	2	11
Pacific Lamprey	2	2	2	4	10

Upstream Run	Pass			Total
Species	1	2	3	
0+ Steelhead	21	13	7	41
1+ Steelhead	0	0	0	0
Coho Salmon	9	2	2	13
Sculpin	5	0	2	7
California Roach	0	0	0	0
Stickleback	2	0	1	3
Pacific Lamprey	0	8	2	10
Ca. Freshwater Shrimp	1	0	0	1

Upstream Riffle	Pass			Total
Species	1	2	3	
0+ Steelhead	14	9	2	25
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	1	1
Sculpin	3	1	0	4
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Lagunitas Creek: Site LG-9

Downstream Run	Pass			Total
Species	1	2	3	
0+ Steelhead	24	19	5	48
1+ Steelhead	0	0	0	0
Coho Salmon	1	0	0	1
Sculpin	3	0	0	3
California Roach	0	0	0	0
Stickleback	1	0	0	1
Pacific Lamprey	0	2	0	2

Upstream Riffle	Pass			Total
Species	1	2	3	
0+ Steelhead	54	43	25	122
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	5	0	1	6
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Lagunitas Creek: Site 15.86

Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	87	32	27	146
1+ Steelhead	5	0	1	6
Coho Salmon	60	17	9	86
Sculpin	8	0	9	17
California Roach	3	4	4	11
Stickleback	0	0	1	1
Pacific Lamprey	25	27	29	81
Sacramento Sucker	0	0	1	1

Lagunitas Creek: Site LG-12

Downtown Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	10	10	4	24
1+ Steelhead	1	1	0	2
Coho Salmon	0	0	0	0
Sculpin	7	3	2	12
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Upper Riffle	Pass				Total
Species	1	2	3	4	
0+ Steelhead	11	11	4	2	28
1+ Steelhead	1	2	0	0	3
Coho Salmon	0	0	0	0	0
Sculpin	12	1	0	1	14
California Roach	0	0	0	0	0
Stickleback	0	0	0	0	0
Pacific Lamprey	0	1	1	0	2

Upstream Run	Pass			Total
Species	1	2	3	
0+ Steelhead	3	6	4	13
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	12	8	1	21
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	3	1	1	5

San Geronimo Creek: Site SG-2

Downstream Pool	Pass				Total
Species	1	2	3	4	
0+ Steelhead	24	12	6	7	49
1+ Steelhead	5	2	1	1	9
Coho Salmon	8	6	8	3	25
Sculpin	0	0	0	0	0
California Roach	0	0	0	0	0
Stickleback	7	6	9	9	31
Pacific Lamprey	4	1	3	11	19

Downstream Riffle	Pass			Total
Species	1	2	3	
0+ Steelhead	1	1	0	2
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Upstream Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	18	11	2	31
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	4	2	5	11
Pacific Lamprey	1	0	0	1

Upstream Run	Pass			Total
Species	1	2	3	
0+ Steelhead	25	8	2	35
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	38	32	22	92
Pacific Lamprey	1	0	1	2

San Geronimo Creek: Site SG-3

Downstream Pool	Pass			
Species	1	2	3	Total
0+ Steelhead	9	4	1	14
1+ Steelhead	4	0	0	4
Coho Salmon	45	17	7	69
Sculpin	4	1	0	5
California Roach	8	2	1	11
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Upstream Riffle	Pass			
Species	1	2	3	Total
0+ Steelhead	7	2	0	9
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

San Geronimo Creek: Site SG-4

Downstream Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	27	5	2	34
1+ Steelhead	17	3	0	20
Coho Salmon	89	28	6	123
Sculpin	1	1	0	2
California Roach	18	11	3	32
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Upstream Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	12	2	2	16
1+ Steelhead	2	0	0	2
Coho Salmon	22	5	4	31
Sculpin	1	1	1	3
California Roach	4	2	0	6
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Devils Gulch: Site DG-1

Upstream Riffle	Pass			Total
Species	1	2	3	
0+ Steelhead	7	2	1	10
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Downstream Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	16	5	0	21
1+ Steelhead	1	0	0	1
Coho Salmon	43	8	0	51
Sculpin	8	1	0	9
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Upstream Run	Pass			Total
Species	1	2	3	
0+ Steelhead	18	5	4	27
1+ Steelhead	4	0	0	4
Coho Salmon	25	5	3	33
Sculpin	7	0	0	7
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Devils Gulch: Site DG-2

Downstream Riffle	Pass				Total
Species	1	2	3	4	
0+ Steelhead	1	2	0	0	3
1+ Steelhead	0	0	0	0	0
Coho Salmon	0	0	0	0	0
Sculpin	0	0	0	0	0
California Roach	0	0	0	0	0
Stickleback	0	0	0	0	0
Pacific Lamprey	0	0	0	0	0

Downstream Run	Pass				Total
Species	1	2	3	4	
0+ Steelhead	41	6	1	0	48
1+ Steelhead	1	0	0	0	1
Coho Salmon	14	7	0	0	21
Sculpin	0	1	0	0	1
California Roach	0	0	0	0	0
Stickleback	0	0	0	0	0
Pacific Lamprey	0	0	0	0	0

Downstream Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	15	2	0	17
1+ Steelhead	1	0	0	1
Coho Salmon	16	1	1	18
Sculpin	6	1	1	8
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Devils Gulch: Site DG-2 (Continued)

Upstream Riffle	Pass			Total
Species	1	2	3	
0+ Steelhead	0	0	0	0
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

Upstream Pool	Pass			Total
Species	1	2	3	
0+ Steelhead	12	1	0	13
1+ Steelhead	4	0	0	4
Coho Salmon	34	5	1	40
Sculpin	13	3	1	17
California Roach	0	0	0	0
Stickleback	0	0	0	0
Pacific Lamprey	0	0	0	0

APPENDIX B

1997 POPULATION ESTIMATES BY SAMPLE SITE FOR SALMONIDS

LAGUNITAS CREEK**SITE: LG-1****Station: Pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	15	3	0
Population Estimate	28	3	0
Lower Confidence Interval	15	3	0
Upper Confidence Interval	79.256	6	0

Station: Riffle

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	21	0	0
Population Estimate	26	0	0
Lower Confidence Interval	21	0	0
Upper Confidence Interval	39.133	0	0

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	32	3	0
Population Estimate	57	3	0
Lower Confidence Interval	32	3	0
Upper Confidence Interval	117.362	4.454	0

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	36	0	0
Population Estimate	48	0	0
Lower Confidence Interval	36	0	0
Upper Confidence Interval	71.197	0	0

TOTAL: Site LG-1

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	104	6	0
Population Estimate	121	6	0

SPECIAL NOTE:

The 0+Steelhead population estimates from the Pool and first Run stations are not reliable; the total catch from these stations were used in the total population estimate for 0+Steelhead.

LAGUNITAS CREEK**SITE: LG-3****Station: Pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	118	6	1
Population Estimate	127	6	1
Lower Confidence Interval	118	6	1
Upper Confidence Interval	137.375	8.577	1

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	73	5	0
Population Estimate	78	5	0
Lower Confidence Interval	73	5	0
Upper Confidence Interval	85.966	5.466	0

TOTAL: SITE LG-3

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	191	11	1
Population Estimate	205	11	1

SPECIAL NOTE: None.

LAGUNITAS CREEK**SITE: LG-5****Station: Riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	60	2	0
Population Estimate	76	2	0
Lower Confidence Interval	60	2	0
Upper Confidence Interval	99.034	6.884	0

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	47	0	3
Population Estimate	77	0	3
Lower Confidence Interval	47	0	3
Upper Confidence Interval	132.14	0	4.454

TOTAL: SITE LG-5

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	107	2	3
Population Estimate	123	2	3

SPECIAL NOTE:

The 0+Steelhead population estimate from the Run station is not reliable; the total catch from the Run station was used in the total population estimate for 0+Steelhead.

LAGUNITAS CREEK**SITE: LG-7****Station: Pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	48	7	25
Population Estimate	57	33	33
Lower Confidence Interval	48	7	25
Upper Confidence Interval	71.283	380	51.537

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	41	0	13
Population Estimate	49	0	13
Lower Confidence Interval	41	0	13
Upper Confidence Interval	63.193	0	14.907

Station: Riffle

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	25	0	1
Population Estimate	26	0	1
Lower Confidence Interval	25	0	1
Upper Confidence Interval	30.053	0	1

TOTAL: SITE LG-7

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	114	7	39
Population Estimate	132	7	47

SPECIAL NOTE:

The 1+Steelhead population estimate from the Pool station is not reliable; the total catch from the Pool station was used in the total population estimate for 1+Steelhead.

LAGUNITAS CREEK**SITE: LG-9****Station: Run**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	48	0	1
Population Estimate	54	0	1
Lower Confidence Interval	48	0	1
Upper Confidence Interval	64.492	0	1

Station: Riffle

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	122	0	0
Population Estimate	178	0	0
Lower Confidence Interval	122	0	0
Upper Confidence Interval	236.854	0	0

TOTAL: SITE LG-9

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	170	0	1
Population Estimate	232	0	1

SPECIAL NOTE: None.

LAGUNITAS CREEK**SITE: LG-12****Station: Pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	24	2	0
Population Estimate	31	2	0
Lower Confidence Interval	24	2	0
Upper Confidence Interval	47.986	2	0

Station: Riffle

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	28	3	0
Population Estimate	30	3	0
Lower Confidence Interval	28	3	0
Upper Confidence Interval	35.701	3	0

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	13	0	0
Population Estimate	13	0	0
Lower Confidence Interval	13	0	0
Upper Confidence Interval	13	0	0

TOTAL: SITE LG-12

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	65	5	0
Population Estimate	74	5	0

SPECIAL NOTE: None.

LAGUNITAS CREEK**SITE: 15.86****Station: Pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	146	6	86
Population Estimate	167	6	89
Lower Confidence Interval	146	6	86
Upper Confidence Interval	186.241	6.967	94.263

TOTAL: SITE 15.86

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	146	6	86
Population Estimate	167	6	89

SPECIAL NOTE:

This site is only one habitat so the total catch and total population estimate is the same as the catch and population estimate from the Pool station.

SAN GERONIMO CREEK SITE: SG-2

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	49	9	25
Population Estimate	55	9	37
Lower Confidence Interval	49	9	25
Upper Confidence Interval	65.002	10.83	66.171

Station: Riffle

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	2	0	0
Population Estimate	2	0	0
Lower Confidence Interval	2	0	0
Upper Confidence Interval	2	0	0

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	31	0	0
Population Estimate	32	0	0
Lower Confidence Interval	31	0	0
Upper Confidence Interval	35.878	0	0

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	35	0	0
Population Estimate	35	0	0
Lower Confidence Interval	35	0	0
Upper Confidence Interval	36.92	0	0

TOTAL: SITE SG-2

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	117	9	25
Population Estimate	124	9	37

SPECIAL NOTE: None.

SAN GERONIMO CREEK SITE: SG-3

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	14	4	69
Population Estimate	14	4	72
Lower Confidence Interval	14	4	69
Upper Confidence Interval	15.767	4	77.673

Station: Riffle

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	9	0	0
Population Estimate	9	0	0
Lower Confidence Interval	9	0	0
Upper Confidence Interval	9.602	0	0

TOTAL: SITE SG-3

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	23	4	69
Population Estimate	23	4	72

SPECIAL NOTE: None.

SAN GERONIMO CREEK SITE: SG-4

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	34	20	123
Population Estimate	34	20	125
Lower Confidence Interval	34	20	123
Upper Confidence Interval	35.319	20.47	128.994

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	16	2	31
Population Estimate	16	2	32
Lower Confidence Interval	16	2	31
Upper Confidence Interval	17.544	2	35.281

TOTAL: SITE SG-4

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	50	22	154
Population Estimate	50	22	157

SPECIAL NOTE: None.

DEVIL'S GULCH**SITE: DG-1****Station: Riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	10	0	0
Population Estimate	10	0	0
Lower Confidence Interval	10	0	0
Upper Confidence Interval	11.419	0	0

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	21	1	51
Population Estimate	21	1	51
Lower Confidence Interval	21	1	51
Upper Confidence Interval	21.916	1	51.766

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	27	4	33
Population Estimate	28	4	33
Lower Confidence Interval	27	4	33
Upper Confidence Interval	31.756	4	34.796

TOTAL: SITE DG-1

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	58	5	84
Population Estimate	59	5	84

SPECIAL NOTE: None.

DEVIL'S GULCH**SITE: DG-2****Station: Riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	3	0	0
Population Estimate	3	0	0
Lower Confidence Interval	3	0	0
Upper Confidence Interval	4.545	0	0

Station: Run

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	48	1	21
Population Estimate	48	1	21
Lower Confidence Interval	48	1	21
Upper Confidence Interval	48.811	1	22.468

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	17	1	18
Population Estimate	17	1	18
Lower Confidence Interval	17	1	18
Upper Confidence Interval	17.311	1	18.54

Station: Riffle

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	0	0	0
Population Estimate	0	0	0
Lower Confidence Interval	0	0	0
Upper Confidence Interval	0	0	0

Station: Pool

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	13	4	40
Population Estimate	13	4	40
Lower Confidence Interval	13	4	40
Upper Confidence Interval	13.153	4	40.797

TOTAL: SITE DG-2

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	81	6	79
Population Estimate	81	6	79

SPECIAL NOTE: None.

APPENDIX C

1997 EXTRAPOLATED POPULATION ESTIMATES BY REACH FOR SALMONIDS

Lagunitas Creek - Segment 1: Nicasio Creek to Tocaloma Bridge

Total Habitat:

Total Reach Length=8,724 ft.

Riffle=19%(1,645 ft.) Run=50%(4,346 ft.) Pool=31%(2,733 ft.)

Fish Habitat - Sites LG1 and LG3:

Total Length of Habitats Sampled=385 ft.

Riffle=10%(38 ft.) Run=42%(161 ft.) Pool=48%(186 ft.)

Percentage of Total Reach Sampled:

385 ft/8,724 ft = 4.81%

Fish Population Estimates from Sites Sampled: (see Appendix A)

0+SH=326 1+SH=11 Coho=1

Population Estimate Based on Average Density Per Channel Length:

Extrapolation Multiplier for Total Reach Length:

8,724 ft/385 ft = 22.66

Fish Population Extrapolation for Total Reach:

0+SH=326 x 22.66=7,387 1+SH=11 x 22.66=249 Coho=1 x 22.66=22

Population Estimate Based on Average Density Per Channel Length and Within Habitat Types:

Number of Fish per Habitat Type in the Stream Segment:

0+SH

Riffle=26 fish/38ft=0.68 fish/ft x 1,645 ft of riffle = 1,125

Run=156 fish/163ft=0.96 fish/ft x 4,346 ft of run = 4,159

Pool=142 fish/186 ft=0.76 fish/ft x 2,733 ft of pool = 2,086

7,370

1+SH

Riffle=0 fish/38ft=0.00 fish/ft x 1,645 ft of riffle = 0

Run=8 fish/163ft=0.05 fish/ft x 4,346 ft of run = 213

Pool=9 fish/186 ft=0.05 fish/ft x 2,733 ft of pool = 132

345

Coho

Riffle=0 fish/38ft=0.00 fish/ft x 1,645 ft of riffle = 0

Run=8 fish/163ft=0.00 fish/ft x 4,346 ft of run = 0

Pool=1 fish/186 ft=0.005 fish/ft x 2,733 ft of pool = 14

14

Lagunitas Creek - Segment 2: Tocaloma Bridge to Peter's Dam

Total Habitat:

Total Reach Length=35,051 ft.

Riffle=9%(3,237 ft.)

Run=25%(8,869 ft.)

Pool=66%(22,945 ft.)

Fish Habitat - Sites LG5, LG7, LG9, LG12, and 15.86:

Total Length of Sites Sampled=862 ft.

Riffle=29%(247 ft.)

Run=31%(269 ft.)

Pool=40%(346 ft.)

Percentage of Total Reach Sampled:

862 ft./35,051 ft. = 2.46%

Fish Population Estimates from Sites Sampled: (see Appendix A)

0+SH=728

1+SH=20

Coho=140

Population Estimate Based on Average Density Per Channel Length:

Extrapolation Multiplier for Total Reach Length:

35,051 ft./862 ft. = 40.66

Fish Population Extrapolation for Total Reach:

0+SH=728 x 40.66=29,600

1+SH=20 x 40.66=813

Coho=140 x 40.66=5,692

Population Estimate Based on Average Density Per Channel Length and Within Habitat Types:

Number of Fish per Habitat Type in the Stream Segment:

0+SH

Riffle=310 fish/247ft=1.25 fish/ft x 3237 ft of riffle = 4,062

Run=163 fish/269ft=0.61 fish/ft x 8,869 ft of run = 5,374

Pool=255 fish/346 ft=0.74 fish/ft x 22,945 ft of pool = 16,910

26,347

1+SH

Riffle=5 fish/247ft=0.22 fish/ft x 3237 ft of riffle = 65

Run=0 fish/269ft=0.00 fish/ft x 4,346 ft of run = 0

Pool=15 fish/346 ft=0.04 fish/ft x 22,945 ft of pool = 994

1,059

Coho

Riffle=1 fish/247ft=0.02 fish/ft x 3237 ft of riffle = 13

Run=17 fish/269ft=0.06 fish/ft x 4,346 ft of run = 560

Pool=122 fish/346 ft=0.32 fish/ft x 22,945 ft of pool = 8,090

8,664

San Geronimo - Mouth to Dickson Weir (Upstream of Woodacre Creek)

Total Habitat:

Total Reach Length=22,106 ft.

Riffle=28%(6,114 ft.)

Run=39%(8,579 ft.)

Pool=34%(7,413 ft.)

Fish Survey Habitat-San Geronimo (Mouth to Dixon Weir)

Total Length of Sites Sampled=447 ft.

Riffle=18%(80 ft.)

Run=13%(59 ft.)

Pool=69%(308 ft.)

Percentage of Total Reach Sampled:

447 ft./22,106 ft. = 2.02%

Fish Population Estimates from Sites Sampled:

0+SH=197

1+SH=35

Coho=254

Population Estimate Based on Average Density Per Channel Length:

Extrapolation Multiplier for Total Reach Length:

22,106 ft./447 ft. = 49.45

Fish Population Extrapolation for Total Reach:

0+SH=197 x 49.45=9,742

1+SH=35 x 49.45=1,730

Coho=254 x 49.45=12,560

Population Estimate Based on Average Density Per Channel Length and Within Habitat Types:

Number of Fish per Habitat Type in the Stream Segment:

0+SH

Riffle=11 fish/80ft=0.14 fish/ft x 6,114 ft of riffle = 840

Run=35 fish/59ft=0.59 fish/ft x 8,579 ft of run = 5,089

Pool=151 fish/308 ft=0.49 fish/ft x 7,413 ft of pool = 3,634

9,563

1+SH

Riffle=0 fish/80ft=0.00 fish/ft x 6,114 ft of riffle = 0

Run=0 fish/59ft=0.00 fish/ft x 8,579 ft of run = 0

Pool=35 fish/308 ft=0.11 fish/ft x 7,413 ft of pool = 842

842

Coho

Riffle=0 fish/80ft=0.00 fish/ft x 6,114 ft of riffle = 0

Run=0 fish/59ft=0.00 fish/ft x 8,579 ft of run = 0

Pool=254 fish/308 ft=0.82 fish/ft x 7,413 ft of pool = 6,112

6,112

Devils Gulch (Mouth to 6,925 feet)

Total Habitat:

Total Reach Length=6,925 ft.

Riffle=45%(3,116 ft.) Run=28%(1,939 ft.) Pool=27%(1,870 ft.)

Fish Survey Habitat-Devils Gulch

Total Length of Sites Sampled=360 ft.

Riffle=22%(76 ft.) Run=39%(142 ft.) Pool=39%(142 ft.)

Percentage of Total Reach Sampled:

360 ft./6,925 ft. = 0.05%

Fish Population Estimates from Sites Sampled:

0+SH=140 1+SH=11 Coho=163

Population Estimate Based on Average Density Per Channel Length:

Extrapolation Multiplier for Total Reach Length:

6,925 ft./360 ft. = 19.24

Fish Population Extrapolation for Total Reach:

0+SH=140 x 19.24=2,694 1+SH=11 x 19.24=212 Coho=163 x 19.24=3,136

Population Estimate Based on Average Density Per Channel Length and Within Habitat Types:

Number of Fish per Habitat Type in the Stream Segment:

0+SH

Riffle=13 fish/76ft=0.17 fish/ft x 3,116 ft of riffle = 533
Run=76 fish/142ft=0.54 fish/ft x 1,939 ft of run = 1,038
Pool=51 fish/142 ft=0.40 fish/ft x 1,870 ft of pool = 672

2,242

1+SH

Riffle=0 fish/76ft=0.00 fish/ft x 3,116 ft of riffle = 0
Run=0 fish/142ft=0.00 fish/ft x 1,939 ft of run = 0
Pool=5 fish/142 ft=0.04 fish/ft x 1,870 ft of pool = 79

79

Coho

Riffle=0 fish/76ft=0.00 fish/ft x 3,116 ft of riffle = 0
Run=54 fish/142ft=0.38 fish/ft x 1,939 ft of run = 737
Pool=109 fish/142 ft=0.71 fish/ft x 1,870 ft of pool = 1,435

2,172

APPENDIX D

COMPARISON OF 1997 EXTRAPOLATED POPULATION ESTIMATES FOR SAN GERONIMO CREEK INTO TWO SEGMENTS

Appendix D. Comparison of Extrapolated Population Estimates for San Geronimo Creek Into Two Segments.

Estimate 1.

<i>All of San Geronimo Creek</i>	<i>Total</i>
Total Length (ft)	22,106
0+Steelhead Population Estimate	9,563
1+Steelhead Population Estimate	842
Coho Population Estimate	6,112

Estimate 2.

<i>San Geronimo Creek (Segment 1)</i>	<i>Total</i>
Total Length (ft)	9,000
0+Steelhead Population Estimate	6,001
1+Steelhead Population Estimate	337
Coho Population Estimate	937
<i>San Geronimo Creek (Segment 2)</i>	<i>Total</i>
Total Length (ft)	9,000
0+Steelhead Population Estimate	1,435
1+Steelhead Population Estimate	366
Coho Population Estimate	3,231
<i>San Geronimo Creek (Segment 1 and 2)</i>	<i>Total</i>
Total Length (ft)	18,000
0+Steelhead Population Estimate	7,436
1+Steelhead Population Estimate	703
Coho Population Estimate	4,168

Estimate 3.

<i>All San Geronimo Creek (minus the lower 4100 ft)</i>	<i>Total</i>
Total Length	18,000
0+Steelhead Population Estimate	7,871
1+Steelhead Population Estimate	663
Coho Population Estimate	4,945

APPENDIX E

1997 FIELD SURVEY DATA

[The field survey data is not included in this KRIS edition of this document]