

**JUVENILE SALMONID POPULATION MONITORING REPORT**

**LAGUNITAS CREEK, MARIN COUNTY, CALIFORNIA**

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**Prepared By:**

Eric Ettlinger, Aquatic Ecologist  
Gregory Andrew, Fishery Biologist  
and  
Aviva Rossi, Fisheries Watershed Aide

Marin Municipal Water District  
220 Nellen Avenue  
Corte Madera, CA 94925  
(415) 945-1191

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## EXECUTIVE SUMMARY

Marin Municipal Water District (MMWD) staff conducted a capture and release electrofishing survey for coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*) in Lagunitas Creek and two of its main tributaries, San Geronimo Creek and Devil's Gulch, between October 2 and October 31, 2000. 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 thirteen pre-established sample sites, seven in Lagunitas Creek, four in San Geronimo Creek and two in Devil's Gulch. Capture data from our sampling effort were used to compute total abundance (population size) and densities (number of fish per unit length of stream) for coho and steelhead. Our results were compared to similar surveys conducted between 1970 and 1999 to track trends in the coho and steelhead populations over time.

Habitat conditions at the thirteen sample sites were documented and generally found to be similar to the conditions documented in 1999, with one exception. At sample site LG-5 a large bay tree had fallen into the pool habitat and helped to form a large debris jam. The large number of coho observed at this site represented 30% of this year's catch of coho and significantly influenced the coho population estimate. We found that the proportion of habitats surveyed at the juvenile sample sites was representative of the creeks as a whole. We also determined that a similar level of sampling effort was performed this year as compared with surveys conducted since 1996. In general, the trends observed are likely due to variations in the juvenile salmonid populations and not the result of changes in habitat or methodology.

A total of 157 juvenile coho were captured from all sites during our survey and we estimate a population of 4,684 juvenile coho in the system. Disregarding the section of creek from Gallagher Cascade to Nicasio Creek (which was not included in the population analysis prior to 1999), the coho population estimate is 4,281. This is the lowest estimate in the past eight years. For this year class, which includes the populations surveyed in 1982, 1985, 1988, 1994 and 1997, this year's coho density (the average for all surveyed streams) was the lowest recorded since 1982. The population estimate for Devil's Gulch was the lowest in eight years and the estimate for San Geronimo Creek was also near an eight-year low. The 1999/2000 coho spawning run was of average size, so the low juvenile population was surprising. We have no evidence of unusually high juvenile mortality during the spring and summer, but an alternative explanation may be the destruction of redds due to high winter stream flows. A high proportion of coho redds were built in the main stem of Lagunitas Creek in 1999/2000. Relatively high stream flows in Lagunitas Creek in February 2000 may have scoured many of these redds. Whatever the cause, it appears that that this year class has experienced a sharp decline.

We captured 1,913 juvenile steelhead, consisting of 1,748 young-of-the-year (0+steelhead) and 165 older steelhead (1+steelhead, 1-3 years old). We estimate a population of 59,196 juvenile steelhead in the system. This is one of the highest estimates to date, with only the estimates of 1998 and 1999 being higher. Unlike the coho, the later-spawning steelhead had access to tributaries and many may have spawned after the highest winter stream flows. The steelhead population appears to be robust and growing in all of the surveyed creeks.

## 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 185,000 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. Stream flow is monitored at two U.S. Geological Survey (USGS) gaging stations located in Lagunitas Creek and at a third gage operated by MMWD in San Geronimo Creek (a major tributary to Lagunitas Creek). MMWD also monitors water temperatures at one of the stream gages located in Lagunitas Creek.

Abundance of steelhead and coho salmon in the Lagunitas Creek system has fluctuated widely between 1970 and 1999 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, overfishing, hatcheries and habitat degradation due to human influence. This decline resulted in the listing of coho salmon and steelhead as "threatened" by the National Marine Fisheries Service under the Federal Endangered Species Act. Steelhead in Lagunitas Creek have shown recent increases while the trend for coho is not as clear.

This report covers the 2000 juvenile coho and steelhead population sampling effort. The survey was completed by MMWD staff during the Fall of 2000 at seven sampling sites in Lagunitas Creek as well as four 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. This year we also snorkeled each site and compared those counts to our electrofishing results.

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 streams or stream reaches. The estimating method used since 1996

is based on fish densities within habitat types so more accurate estimates of coho and steelhead populations can be made. Habitat typing conducted in 1998 and 1999 allowed for a comparison of the habitat composition of the sample sites to the habitat composition of the streams or stream reaches.

This report presents the results from our 2000 sampling effort and compares those results to population estimates from previous years. The population trends produced by our analysis will help us to evaluate juvenile coho and steelhead abundance in relation to MMWD management practices and/or SWRCB-ordered mitigation measures.

## **2.0 METHODS**

Seven sites in Lagunitas Creek, four in San Geronimo Creek, and two in Devil's Gulch were sampled between October 2, 2000 and October 31, 2000 (Figure 1). The sample sites in Lagunitas Creek were (in a downstream to upstream listing): LG-1, LG-3, LG-5, LG-7, LG-9, LG-15.86, and LG-12. The sites in San Geronimo Creek were: SG-1, SG-2, SG-3, and SG-4. Sites in Devil's Gulch were DG-1 and DG-2. These sites have been sampled annually for juvenile salmonids since 1993, with the exception of SG-1, which was added in 1998 to better represent salmonid utilization throughout San Geronimo Creek.

Each sample site consisted of one or more riffle, run, or pool habitat units. A team of three to five people, depending on the size of the site, conducted sampling. The team consisted of Gregory Andrew (Fishery Biologist), Eric Ettlinger (Aquatic Ecologist) and Aviva Rossi (Watershed Aide), with assistance from John Fuche, Krista Hodson, Wendy Ralston, Leslie Ferguson and Reuven Walder. Prior to sampling the two sites on National Park Service land (sites LG-3 and LG-5), Larry Serpa (Aquatic Entomologist, National Park Service) sampled each site for the presence of California freshwater shrimp. Shrimp were removed from the sample area until completion of salmonid sampling.

This year we surveyed every pool and run habitat unit in Lagunitas Creek and Devil's Gulch by snorkeling prior to electrofishing. In San Geronimo Creek we snorkeled site SG-1, but did not snorkel the other sites due to concerns over water quality. Pairs of snorkelers swam from the downstream end to the upstream end of each habitat unit. The snorkelers divided the habitat units into left and right sides and indicated to each other which steelhead or coho he or she was counting to avoid double-counting fish. We counted all coho, 0+ steelhead, 1+ steelhead and large steelhead, which we called 2+ steelhead. Tallies were written on a slate during the survey. Each habitat was snorkeled once, twice or three times, depending on how difficult it was to count fish accurately (e.g., large numbers of fish or complex habitat). When units were snorkeled multiple times we averaged counts greater than 15 fish or used the greatest count when less than 15 fish. This data was compared to our electrofishing results to develop a correlation between these methods.

Prior to electrofishing 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 habitat. The initial electrofisher voltage and output wave were set based on water conductivity, expressed as microSiemens/cm ( $\mu\text{S}$ ), which was measured prior to electrofishing. One or two electrofishers were used at each of the sample habitats (depending on the width of the site) 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 (CO<sub>2</sub>) to reduce stress in handling. The captured fish were then identified to species and measured on a measuring board. The fish were then transferred to live cars (i.e., holding pen consisting of a basket lined with netting) 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, roach, and Sacramento sucker 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 classified by habitat type to compare with habitat that was present in 1994-1999. Habitat typing included an assessment of habitat quality based on width, depth, substrate composition, shelter ratings, and bank vegetation. Water temperatures were measured at each sample site using hand held mercury and digital thermometers. Water temperatures were also being recorded, independently, at the 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 captured in Lagunitas Creek under 110mm FL were considered to be 0+ steelhead and those 110mm or over were considered to be 1+ steelhead. Steelhead captured in San Geronimo Creek and Devil's Gulch that were under 90mm FL were considered to be in the 0+ age class. In the field, scale samples were taken from steelhead ranging from 94 millimeters to 112 millimeters. Scales were obtained by scraping the side of the fish above the lateral line and behind the dorsal fin. At some future date we intend to definitively determine the ages of these fish by viewing the scales under a microscope and counting their annuli (yearly rings). In the meantime steelhead have been grouped into age classes by identifying the largest appropriate gap in a histogram of lengths for each site.

The catch by sample site, for all fish at all sites, was compiled in tabular form (Appendix A). Capture data on coho and steelhead 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.

Total fish population sizes were estimated by extrapolating from individual habitats to entire streams based on the proportions of habitat within those streams (Appendix C). Population estimates for individual habitats were multiplied by the number of feet of the same habitat type in the applicable stream. Population estimates were also expressed as the density of coho or steelhead per 30 meters of stream. The extrapolated population estimates from this year's survey can be compared to the annual juvenile salmonid surveys

conducted between 1995 and 1999 while the density estimates can be compared to surveys conducted as early as 1970.

The stream segments used in estimating the juvenile salmonid populations of Lagunitas Creek have changed multiple times over the years. For the 1993 and 1994 juvenile surveys, Trihey (1995a) estimated salmonid abundance in three segments of Lagunitas Creek: Highway 1 to Nicasio Creek (Segment 1), Nicasio Creek to the western boundary of Samuel P. Taylor State Park (Segment 2) and the park boundary to Shafter Bridge (Segment 3). For the 1995 and 1996 surveys, Trihey (1995b, 1995c, 1996) only considered Segments 2 and 3 because they determined that sample site LG-1 in Segment 1 did not accurately reflect the habitat composition of that section of creek, although habitat typing surveys were not conducted in that segment until 1999. For the 1997 and 1998 surveys, we changed the extent of the two creek segments. Segment 1 extended from Nicasio Creek to Tocaloma Bridge and Segment 2 extended from Tocaloma Bridge to Peters Dam (MMWD 1998). We did this because MMWD completed a habitat mapping survey along the stretch from Tocaloma Bridge to Peters Dam in 1997 and we wanted to use this more current data in our analysis. We also started using sample site LG-1, in addition to site LG-3, to extrapolate the salmonid population of Lagunitas Creek Segment 1, even though this sample site is downstream of this stretch of creek. Sampling has occurred annually at site LG-1 since 1993 and we felt this data should be included in our population estimates.

Starting in 1999 and continuing this year, we began considering Lagunitas Creek as one segment, extending from sample site LG-1 (at the upstream margin of a small cascade we call Gallagher Cascade) to Peters Dam. Combining the two creek segments reflects our belief that the Tocaloma Bridge boundary between creek segments does not represent a boundary in creek habitats as much as it represents a convenient landmark and historical survey boundary. We also believe that sample sites LG-1 and LG-3 underestimate the coho population of the downstream section of creek (based on the available habitat) and using an average coho density from all of the Lagunitas Creek sample sites more accurately describes this section. We extended the area of analysis downstream to the Gallagher Cascade because it is appropriate to use the sampling data from site LG-1 to estimate the salmonid population in this section of creek. Habitat typing data collected in 1998 and 1999 indicates that the sample sites slightly over-represent run habitat while under-representing riffle habitat, but are generally representative of this lower section of creek.

For San Geronimo Creek, we considered the habitat of the entire length of the stream and did not divide it into segments. Surveys prior to 1997 eliminated the lower 4,100 feet of San Geronimo Creek (from its mouth to the Lagunitas Street Bridge) and 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.



## 3.0 RESULTS

### 3.1 HABITAT AND SAMPLE SITE DESCRIPTIONS

Juvenile survey sample sites were selected to be representative of the creeks in which they are located. All of these sites have been sampled annually since 1994 and some of the sites were first sampled as early as 1970. 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 = 329 feet; pool-191 feet, run-138 feet;  
(0% riffle, 42% run, 58% pool).

Conductivity = 199  $\mu$ S

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 left bank of this site was a blackberry bramble, giving way to a shallow gravel bar upstream. The downstream pool was actually about 250 feet in length but only the top 191 feet of the pool was sampled due to depth constraints in the lower portion. The 191 feet of pool sampled had moderate depth (up to 3.2 feet in depth) with an undercut right bank and terrestrial vegetation being the dominant cover type. The upstream run had willows growing out from the right bank which provided good shade and cover. The upstream end of the site was netted off slightly below the downstream end of a broad pool. The net was placed downstream of the top of the riffle to avoid a small redd that we believed could have been a coho redd.

**Site LG-3:** Total length = 184 feet; pool-184 feet  
(0% riffle, 0% run, 100% pool).

Conductivity = 195  $\mu$ S

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, an apple tree on the west side of the road and a culvert under the road are good markers to locate this site. This site consisted of a single pool along the eroded stream bank. The downstream half of the pool was primarily sand and silt-bottomed with depths up to 3.4 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 half of the pool had a few boulders and a small, submerged log but had no other cover due to lack of streamside vegetation and the eroded right bank. The site had a gravel bar along portions of the left bank with a few willows that were set back from the stream edge. The upstream net was set at the upstream margin of a small riffle emptying into the pool.

**Site LG-5:** Total length = 340 feet; run-171 feet; pool-169 feet.  
(0% riffle, 50% run, 50% pool).

Conductivity = 188  $\mu$ S

This site is located off of Sir Francis Drake Boulevard, opposite the gate to the Cheda Ranch. The downstream boundary of the site was at the transition from riffle to run, roughly 160 feet downstream from the mouth of Cheda Creek. In 1999 the channel was split by a gravel bar and willows but the flow this year only occupied the left channel. The long run had a small area of riffle splitting the run into

upstream and downstream sections (although we did not call these distinct habitat units). The upstream half of the run contained a side pool on the left bank, just above a fallen willow tree that provided shade and cover. The boundary between the downstream run and upstream pool habitats was located immediately above the mouth of Cheda Creek. Just upstream of the habitat boundary was a massive woody debris jam spanning the channel and covering the lower portion of the pool. The channel here had scoured beneath the debris jam to a maximum depth of 3.2 feet. The long pool first widened and then became narrower upstream, ending at a small, steep riffle. The left bank was generally covered by blackberry while the right bank was a gravel bar with a few willows set back from the water's edge.

**Site LG-7:** Total length = 274 feet; pool-169 feet, run-105 feet.  
(0% riffle, 38% run, 62% pool).

Conductivity = 194  $\mu$ S

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 Francis Drake Boulevard opposite the entrance road into Devil's Gulch. The downstream net was approximately 800 feet upstream of the confluence of Devil's Gulch and Lagunitas Creek, at the downstream end of a pool with bedrock ledge on the right bank. The downstream pool was dominated by bedrock in the streambed and on the stream margins. A riffle at the upstream margin was also dominated by bedrock and had a large, downed alder providing good cover on the left side. The upstream run, below Deadman's Gulch, had less bedrock and mostly cobble and gravel substrate. This run also had vegetation extending into the channel from the left bank and some undercut and small woody debris on the right bank that provided good cover. The upstream boundary was located immediately downstream of the footbridge on the right bank which crosses over the mouth of Deadman's Gulch.

**Site LG-9:** Total length = 247 feet; run-132 feet, riffle-115 feet;  
(47% riffle, 53% run, 0% pool).

Conductivity = 195  $\mu$ S

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 an outcropping of bedrock on the right bank, which also created a backwater upstream and along the right bank. The right bank was largely bedrock, with some willows and sedges providing cover. Cover on the left bank was limited to a tree limb extending down into the channel from the upper end of the habitat. The upstream habitat had both shallow run and riffle components with riffle habitat slowly yielding to run upstream. The upstream net was hung between an ash on the right bank and a small alder on the left bank. The net was placed here based more on ease of anchoring than on a clear habitat boundary.

**Site 15.86:** Total length = 161 feet; pool-161 feet;  
(0% riffle, 0% run, 100% pool).

Conductivity = 192  $\mu$ S

The site is located down the bank from the Marin County "15.86" mile marker along Sir Francis 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. During this year's survey the site had a large amount of woody debris along the left bank and a large log spanning the channel above the water surface. In addition to the woody debris, the bank was

deeply undercut around a large redwood tree on the left bank. The water reached a maximum depth of 3.0 feet near this bank. Willows along the right bank provided additional cover. A gravel bar provided a shallow backwater area along the right bank.

**Site LG-12:** Total length = 272 feet; pool-172 feet, run-63 feet, riffle-37 feet;  
(14% riffle, 23% run, 63% pool). Conductivity = 192  $\mu$ S

The site is located along Sir Francis 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 riprap that protects Sir Francis Drake Boulevard. A long log spans the downstream pool, above the water surface. The downstream end of the site was netted off downstream of this log, between an alder on the right bank and a maple on the left bank. The pool continued downstream of the net for approximately 100 feet. The alders along the right bank of the pool provided some root mass for cover. The pool slowly transitioned to run habitat upstream where willows along the left bank provided most of the cover for this habitat. The short riffle, in the middle of the site, was fast flowing and relatively steep, with cobble and small boulder substrate. Sedges along the right bank and a few willows on the left bank provided cover. The upstream run was a straight and shallow channel with sedges along both banks providing the dominant, although minimal cover. A small backwater existed along the left bank, just downstream of the upstream net.

### 3.1.2 San Geronimo Creek

**Site SG-1.** Total length = 249 feet; pool-85 feet, run-88 feet, pool-76 feet;  
(0% riffle, 35% run, 65% pool). Conductivity = 422  $\mu$ S

This site is located just upstream of the Sir Francis Drake bridge over San Geronimo Creek and downstream of the town of Lagunitas. The downstream end of the site was across from the first house upstream of the bridge, at the top of a narrow riffle. Boulders at the downstream end of the shallow pool and along the left bank provided most of the fish cover, along with roots from a double-stemmed alder on the left bank. The pool substrate consisted of gravel and fines and reached a maximum depth of 1.8 feet. The net separating the downstream pool from the middle run habitat was strung across a small riffle between a bay on the right bank and an ash on the left bank. The run was adjacent to the second house upstream of the bridge, with a riprapped right bank and a gravel left bank. An undercut log at the base of the riprapped bank provided most of the cover in this unit. Limbs from a few ash trees provided additional cover upstream along the left bank. The net separating the run from the upstream pool was hung from a multiple-stem maple on the right bank, next to the third house upstream of the bridge. A culvert high on the left bank is a good landmark for this unit. The upstream portion of the pool has abundant cover from alder roots and limbs and is the deepest part of the unit, at 1.1 feet.

**Site SG-2.** Total length = 326 feet; pool-66 feet, riffle-77 feet, pool-183 feet;  
(24% riffle, 0% run, 76% pool). Conductivity = 439  $\mu$ S

This site is located adjacent to MMWD's Lagunitas booster pump station on Sir Francis 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 of a narrow bedrock section of the creek. The upstream end of the site was netted at the top of a long pool, where a steep and narrow riffle enters the pool. The downstream habitat was a bedrock-dominated pool with a bedrock wall along the left bank where the water was up to 3.5 feet deep. The riffle

habitat was very shallow except for two small pools formed by plunging water from outflow pipes on the right bank. Little cover existed in this unit except for small woody debris caught among the cobbles. The upstream pool extended upstream past the booster station and included a large alder rootmass along the right bank and an undercut bank at the upstream end of the unit, where the pool reached a maximum depth of 2.4 feet.

**Site SG-3:** Total length = 148 feet; pool-111 feet, riffle-37 feet;  
(25% riffle, 0% run, 75% pool). Conductivity = 447  $\mu$ S

This site is located adjacent to MMWD's San Geronimo Water Treatment Plant and adjacent to the abandoned 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 riprap-and-concrete stabilized left bank. The pool was up to 4.4 feet deep with very good cover on the left bank from an undercut ash rootmass. Sand and silt dominated the pool substrate and as this silt was stirred up the water gave off a faint putrid smell. The only cover in the riffle was from the cobbles and small boulders.

**Site SG-4:** Total length = 166 feet; pool-166 feet;  
(0% riffle, 0% run, 100% pool). Conductivity = 467  $\mu$ S

This site is also located at the San Geronimo Water Treatment Plant, at the plant's entrance bridge over San Geronimo Creek. The downstream portion of the 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 end of the pool, about 120 feet upstream of the bridge. The lower portion of the pool had good shade provided by the bridge. There was little cover downstream of the bridge while undercut bank along the left side and willows along the right bank provided good cover upstream of the bridge. The substrate throughout the unit was extremely silty.

### 3.1.3 Devils Gulch

**Site DG-1:** Total length = 208 feet; riffle-59 feet, run-39 feet, pool-110 feet,;  
(28% riffle, 19% run, 53% pool). Conductivity = 380  $\mu$ S

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. The downstream riffle was extremely shallow with ferns along the bank providing nearly all of the shelter. The upstream end of the riffle was split into two channels by a gravel bar that also extended through most of the run habitat upstream. A small net was placed at the top of the gravel bar to block fish movement between the two run channels. Downed alder and bay trees at the upstream end of the run provided excellent cover. Two undercut alder root masses provided cover along the left bank while a few ferns provided cover along the right bank, near where the channels split. The upstream pool extended upstream to a small footbridge over a tributary entering from the right side. The left bank was a long gravel bar while the right bank was undercut bank and alder roots, giving way to bedrock outcrops upstream.

**Site DG-2:** Total length = 176 feet; riffle-47 ft., pool-82 ft., riffle-10 ft., pool- 37ft.;  
(32% riffle, 0% run, 67% pool). Conductivity = 418  $\mu$ S

This site is located about 0.5 miles 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. Four habitats were identified this year, compared with five in 1997 and six in 1996. The long middle pool was identified as a run and two separate pools in 1996, although the total length of the site has not changed significantly. The downstream riffle had some root cover provided by an alder on the right bank. The middle pool had two large fallen trees spanning the channel and a debris jam against the upstream tree. The pool here was scoured to a depth of 2.7 feet. A large rootmass provided additional cover at the upstream end of the pool. The tiny riffle had no cover and mostly gravel substrate. The upstream pool had a fallen log and a large, alder root mass. Overall, this site had high habitat complexity due to the large amount of root masses and fallen wood.

### 3.2 STREAM HABITAT TYPES

We compared the habitat composition at the juvenile survey sample sites to the habitat composition of Lagunitas Creek, San Geronimo Creek and Devil's Gulch as a whole. In Lagunitas Creek, the habitats downstream of Gallagher Cascade were not included in our analyses because the juvenile sample sites were not intended to represent this section of creek. For San Geronimo Creek and Devil's Gulch, the entire stream lengths were considered as a whole. Habitat typing surveys in San Geronimo Creek and Devil's Gulch were undertaken in 1998 and surveys in Lagunitas Creek were begun in 1998 and completed in 1999.

Lagunitas Creek is represented by juvenile survey sample sites LG-1, LG-3, LG-5, LG-7, LG-9, LG-12 and LG-15.86. Overall habitat composition of Lagunitas Creek, in 1998 and 1999, was composed of 8% riffle, 30% run, and 62% pool while the habitat composition of the seven sample sites, in 2000, was composed of 8% riffle, 34% run, and 58% pool (Figure 2).

San Geronimo Creek is represented by sample sites SG-1, SG-2, SG-3, and SG-4. Site SG-1 was first surveyed in 1998. Overall habitat composition of San Geronimo Creek, when last surveyed in 1998, was composed of 12% riffle, 14% run, and 74% pool with the sample sites, in 2000, consisting of 13% riffle, 10% run, and 77% pool (Figure 2).

Devil's Gulch is represented by sample sites DG-1 and DG-2. Overall habitat composition of Devil's Gulch, in 1998, included 37% riffle, 7% run, and 57% pool with the composition of the sample sites, in 2000, being made up of 30% riffle, 10% run, and 60% pool (Figure 2).

### 3.3 2000 FISH SAMPLING RESULTS

Seven species of fish were collected: coho salmon (*Oncorhynchus kisutch*), steelhead trout (*O. mykiss*), Pacific lamprey (*Lampetra tridentata*), sculpin (*Cottus spp.*), California roach (*Lavinia symmetricus*), threespine stickleback (*Gasterosteus aculeatus*), and Sacramento sucker (*Catostomus occidentalis*).

Appendix A presents the catch from each electrofishing pass at each sample site. The sculpin were not identified to species but were most likely prickly sculpin (*C. asper*). Other, less common, sculpin species include coast range sculpin (*C. aleuticus*), and riffle sculpin (*C. gulosus*) (Page and Burr 1991). Three Sacramento suckers were caught, all at site LG-5. In addition to the many juvenile lamprey caught, for the first time we caught four adult lamprey, measuring between 498 and 560 mm. A pair of lamprey was caught at site LG-12 and another pair at site SG-2. Three Pacific giant salamanders (*Dicamptodon ensatus*) were observed at site LG-7, two at SG-1, three at DG-1 and four at DG-2. No other amphibians were observed or captured. Fifty-one California freshwater shrimp (*Syncaris pacifica*) were inadvertently captured and released, forty-five at site LG-1, five at site LG-3 and one at site LG-5.

A total of 157 coho and 1,913 steelhead were captured from all sample sites (Table 1). The steelhead captured by age class were: 0+ steelhead = 1,747 and 1+ steelhead = 166. At individual sample sites, the coho catch ranged from 0 to 47 and the steelhead catch ranged from 36 to 365 (the 0+ steelhead catch ranged from 34 to 263 and the 1+ steelhead catch ranged from 0 to 44).

The total number of mortalities experienced from our sampling effort were as follows: coho = 2 (1.3%), total steelhead = 26 (1.4%); 0+ steelhead = 24 (1.4%), 1+ steelhead = 2 (1.2%). These mortality rates are comparable to mortalities in recent years. During the sampling efforts between 1994 and 1997, the coho mortality rates ranged from 0.5% to 3.9% of captured coho and the steelhead mortality rates ranged from 1.0% to 3.1% of captured steelhead. This year's mortalities represent less than 0.05% of the total estimated populations.

During the sampling effort, stream flows as measured by MMWD at the Samuel P. Taylor gage station ranged between 8.1 and 12.2 cubic feet per second (cfs). The flows on most days were between 8 and 9 cfs. Water releases from Kent Lake during the sampling period were 8 cfs on all days.

Also during the sampling period, water temperatures ranged between 52.0 and 60.6 degrees Fahrenheit at the Lagunitas Creek sample sites, between 51.3 and 55.6 degrees Fahrenheit at the San Geronimo Creek sample sites, and between 48.6 and 56.8 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 50.1 and 57.3 degrees Fahrenheit during the same time period.

### **3.3.1 Coho and Steelhead Electrofishing Summary**

In Table 1, the total 2000 catch of coho and steelhead is compared to the catches from the annual surveys conducted between 1993 and 1999. These comparisons are made to look at trends in coho and steelhead abundance in recent years. Several important findings are apparent from these comparisons as described below.

#### Coho

The total catch for 2000 was the second-lowest catch of coho in the past eight years of sampling. Only the catch of 1998 was lower. The 21 coho caught in Devil's Gulch was the lowest recorded, while the 51 caught catch in San Geronimo Creek was the second-lowest recorded. By contrast, the 85 coho caught in

Lagunitas Creek was the third-greatest catch in eight years, accounting for 54% of all coho caught this year. Most of the coho caught in Lagunitas Creek were at site LG-5, where we captured 47 coho, representing 30% of all coho caught.

The coho catch at individual sample sites in Lagunitas Creek was generally similar to the catches of previous years, with the notable exceptions of sites LG-5 and LG-15.86. During the winter of 1999/2000 a large bay tree fell into the upper habitat of site LG-5, creating a large woody debris jam and deepening the pool. When this site was snorkeled, we counted 81 coho, nearly double the number caught through electrofishing. Many coho presumably escaped into the woody debris during electrofishing. Site 15.86, which also has a good and increasing amount of woody debris, has shown consistent declines in the number of coho caught each year. The 24 coho caught this year is less than half the average over the seven years this site has been surveyed. We observed 73 coho while snorkeling, which demonstrates that the increasing amount of woody debris has made catching coho through electrofishing difficult at this site.

The catch at sites in San Geronimo Creek varied dramatically in 2000. Site SG-4, which has consistently had the greatest catch of coho in the creek, this year had an all-time low of only 7 coho. By contrast, site SG-2 had a record 29 coho caught.

The low coho catch at the Devil's Gulch sample sites is also likely the result of poor spawning conditions in 1999/2000 (MMWD 2001). Given that National Park Service staff counted only 3 redds in the entire creek during the 1999/2000 spawning season, the 21 juvenile coho caught was actually more than we expected.

Looking at trends in coho year classes, the year class represented by the 2000 juvenile coho is vastly diminished since 1994 and 1997. In 1994 a total of 578 coho were caught, while in 1997 this number declined only slightly to 541 captured coho.

### Steelhead

In contrast to the decline in coho numbers, the catch of steelhead has consistently increased since 1993 (Table 1). The 2000 juvenile steelhead catch was the second-highest catch in eight years. The increase has occurred in all of the sampled creeks, but has been greatest in San Geronimo Creek where the number of steelhead caught this year was nearly double the average of the previous 7 years.

In 2000 we caught more steelhead than in 1999 at most of the sample sites in Lagunitas Creek. An interesting exception was site LG-5, where we caught far fewer steelhead (146 in 2000, versus 256 in 1999). This may be related to the large increase in coho observed at this site. At site LG-15.86 we caught half as many steelhead this year as in 1999 (36 versus 72), the lowest number of steelhead caught at that site to date. However, we observed 103 steelhead while snorkeling at this site. The electrofishing catch trend for both coho and steelhead is down at this site, while the number of fish observed while snorkeling is much higher. This may indicate that catching fish at this site is becoming more difficult owing to the increasingly complex habitat, and may not indicate a decline in the population, at least for steelhead.

Site SG-1 had the greatest number of steelhead caught (365), comprising 44% of the catch in San Geronimo Creek. This is up sharply from the 233 steelhead caught in 1999, but down from the 435 caught in 1998. The other sample sites all had above average catches, but did not show dramatic increases. In Devil's Gulch, the catch at DG-1 was lower than in 1999 (98 versus 132) while the catch at DG-2 was higher (129 versus 87). The total catch was above average for this creek, but not dramatically so.

The percentage of one- to three-year-old (1+) steelhead increased from 5.9% last year to 8.6% this year. This is roughly the average for the past eight years. In Lagunitas Creek the percentage of 1+ steelhead increases as one moves downstream. Site LG-1 had 22.1% 1+ steelhead, while Sites LG-12 and LG-15.86 (the most upstream sites) had no 1+ steelhead. Within San Geronimo Creek and Devil's Gulch we did not observe this spatial trend in the numbers of one- to three-year-old steelhead, but both creeks had higher percentages of 1+ steelhead than Lagunitas Creek as a whole (Lagunitas Creek = 4.7%; San Geronimo Creek = 11.1%; Devil's Gulch = 14.1%).

### **3.3.2 Steelhead Age Classes**

The size differences between 0+ steelhead and 1+ steelhead were determined for each sample site (Table 2). 0+ steelhead in Lagunitas Creek were found to be considerably larger than in either San Geronimo Creek or Devil's Gulch. For Lagunitas Creek, the largest 0+ steelhead were between 102 and 115 millimeters in fork length, depending on sample site. In San Geronimo Creek, the largest 0+ steelhead were between 81 and 86 mm. In Devil's Gulch, the largest 0+ steelhead were between 79 and 87 mm. The size breaks between the largest 0+ steelhead and the smallest 1+ steelhead varied from 3 mm at site SG-2 to 21 mm at site SG-3. Only three sites, LG-1, SG-1 and SG-2, had size breaks of less than 10 mm. Scales were collected for 14 steelhead, ranging in size from 94 to 112 mm. These scales have not yet been analyzed.

### **3.3.3 Coho and Steelhead Snorkeling Summary**

A total of 206 coho, 1258 0+ steelhead and 77 1+ steelhead were observed during snorkeling surveys. Pool and run habitats at all sites except SG-2, SG-3 and SG-4 were snorkeled (Table 3). More fish were observed snorkeling than were caught through electrofishing at most of the sample sites, particularly in Lagunitas Creek.

#### Coho

A total of 185 coho were observed in Lagunitas Creek during snorkeling surveys. This compares with 85 coho caught at the same sample sites. Of the seven habitats where coho were observed, more were counted through snorkeling in five habitats, while a few more coho were caught using electrofishing in two habitats (Figure 4). At site LG-3, one coho was caught during electrofishing while none were observed snorkeling. In the upstream run habitat of site LG-7, seven coho were observed while snorkeling while nine were caught during electrofishing. The most dramatic differences in counts occurred at sites LG-5 and LG-15.86, where only 56% and 33%, respectively, of the coho observed through snorkeling were later caught using electrofishing. Coho appear to seek refuge in the woody debris at these sites during electrofishing, but not during snorkeling. Leslie Ferguson snorkeled site LG-15.86 immediately after we completed



electrofishing but before the captured fish were returned to the habitat unit. She observed approximately 30 coho, which is more than we had captured during four electrofishing passes.

In Devil's Gulch, a total of 23 coho were observed during snorkeling and 21 coho were caught during electrofishing. The riffles at these sites were too shallow to snorkel, but no coho were caught in riffle habitats during electrofishing. Of the four habitats where coho were observed, more coho were observed during snorkeling in two habitats, and more were caught during electrofishing at two sites, but the counts were close in all habitats (Figure 4).

At site SG-1, the only habitat snorkeled in San Geronimo Creek, two coho were observed during snorkeling, compared with eight caught during electrofishing. Shallow, turbid water made snorkeling difficult at this site.

### Steelhead

A total of 921 0+ steelhead and 70 1+ steelhead were observed during snorkeling surveys in Lagunitas Creek, compared with 784 0+ steelhead and 40 1+ steelhead caught at the same sites. Of the 12 habitats where 0+ steelhead were observed, more 0+ steelhead were observed during snorkeling in 9 habitats, while more 0+ steelhead were caught during electrofishing in 3 habitats (Figure 5). We observed 1+ steelhead in every habitat unit except the two habitats at site LG-12. Of the remaining 10 habitat units, more 1+ steelhead were caught using electrofishing in three habitats (Figure 6). Electrofishing was more effective than snorkeling at counting 0+ steelhead in Lagunitas Creek only at site LG-9, where electrofishing caught over twice as many fish. Electrofishing was more effective than snorkeling at counting 1+ steelhead at site LG-9 and the upstream habitat of site LG-1. The likely reason for this discrepancy at site LG-9 is the shallow depth of the site, where the maximum depth is only 1.1 feet. A possible explanation for the discrepancy at LG-1 may be that fish moved between September 19 (when we snorkeled) and October 24 (when we electrofished). Between those dates we counted 9 additional fish in the upstream habitat and 8 fewer fish in the downstream habitat. Aside from these discrepancies, snorkeling seems to have been at least as effective as electrofishing in Lagunitas Creek.

In Devil's Gulch and San Geronimo Creek snorkeling was not effective at counting either 0+ or 1+ steelhead (Figures 5 and 6). Electrofishing caught more fish at every habitat in these two creeks. The primary reason for this is the large numbers of steelhead using riffles and shallow runs, where snorkeling was impossible. Snorkeling was more effective at counting coho because they congregate in the deeper pools and runs, and rarely use shallow areas.

## **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. These estimates were determined using the population estimating program *Microfish*. 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 1995 and

1999 in Table 4. The estimates were calculated based on the average fish density, expressed as the number of fish per foot, for each habitat type (i.e., riffle, run, and pool). This year we extended our study area in Lagunitas Creek downstream to the Gallagher Cascade, as described above (Section 2.0). By extrapolating the average fish density to a longer section of creek we increased the population estimate for Lagunitas Creek. In order to compare this year's population estimates with those from previous years, Table 4 also includes a population estimate for the section of Lagunitas Creek from Nicasio Creek to Peters Dam.

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. Another measure of the population can be expressed as the density of fish per unit of stream length. In Table 5, 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 2000. Fish per 30 meters has been a statistic calculated since 1970 and we continue to use it to produce a long-term trend in fish densities. Figures 7 and 8 display the densities of coho and steelhead (respectively) per 30 meters of stream for Lagunitas Creek, San Geronimo Creek, and Devil's Gulch for each year between 1970 and 2000.

### **3.4.2 Juvenile Population Trends**

We estimated the 2000 juvenile coho population at 4,684 coho for our study area, including the section of Lagunitas Creek between Gallagher Cascade and Nicasio Creek. This is the lowest estimate in eight years and much lower than the 16,962 coho estimated in 1997, which represent the same coho year class. In 1994, we estimated a population of 31,350 coho, although we used an estimation method that assumed a constant coho density across habitat types and is not directly comparable to later estimates. This year class has been the strongest of the three year classes since the mid-1980's, as demonstrated by the high coho densities recorded in 1985, 1988, 1994 and 1997 (Figure 7). This decline occurred despite the near doubling of the coho population at site LG-5. The record catch of coho at this site, which accounted for 30% of this year's coho catch, may have partly offset the observed decline in the coho population.

Steelhead, unlike coho, were plentiful in 2000. We estimated the steelhead population at 59,196. This is the third highest population estimate in eight years, with only 1998 and 1999 having higher estimates. We estimated the population of 0+ steelhead at 54,871 and the 1+ steelhead at 4,325. In 2000 the density of steelhead was close to a 30-year record in San Geronimo Creek and one of the highest densities recorded in Devil's Gulch (Figure 8). The density of steelhead in Lagunitas Creek was 46 fish per 30 meters, one of the lowest densities recorded since 1970. However, since steelhead density has not tended to vary greatly in Lagunitas Creek, this year's density was not far below the 30-year average of 58 fish per 30 meters. Overall the steelhead population throughout the Lagunitas Creek drainage seems robust and growing.

## **4.0 DISCUSSION AND CONCLUSIONS**

The juvenile steelhead population sampled in 2000 continued to show an overall upward trend while the coho population appears to have declined this year. The coho population in 2000 appears particularly low when compared to the high densities (averaged for all surveyed streams) observed in 1985, 1988, 1994 and 1997, which represent the same year class.

While it is difficult to be certain that our population estimates are accurate, we believe the trends in population estimates since 1995 accurately reflect trends in the juvenile salmonid populations. We found habitat conditions at almost all sample sites to be similar to those found in previous years and our level of effort has remained relatively constant. The only dramatic habitat change between 1999 and 2000 occurred at site LG-5, where a large bay tree fell and helped form a large debris jam that deepened the pool. The 47 coho caught this year were nearly double the number caught last year, and the 81 coho observed during snorkeling were the most coho observed in any habitat sampled. This habitat change appears to have benefited coho, but did not make up for the declines in coho numbers observed at most of the other sample sites.

Coho densities were uniformly low in all of the surveyed streams. In San Geronimo Creek and Devil's Gulch, access by coho was hindered by low stream flows through much of the 1999/2000 spawning season, which resulted in below average numbers of redds in these creeks. By contrast, the number of coho redds built in Lagunitas Creek in 1999/2000 was the highest in five years, but apparently this did not translate into large numbers of juvenile coho in Lagunitas Creek. This may indicate high mortality during egg incubation or juvenile rearing. We have no data to indicate high juvenile mortality during the spring and summer, but high stream flows may have caused redd scour and egg mortality during incubation. On February 13, 2000, the stream flow at the Samuel P. Taylor gage peaked at 1,729 cubic feet per second (cfs). Based on work in Lagunitas Creek by Bratovich and Kelley (1988), this flow may have been high enough to scour coho redds in Lagunitas Creek. In addition to scouring redds, high flows can deposit fine sediments on redds which can limit intragravel water flow and oxygen delivery to the eggs.

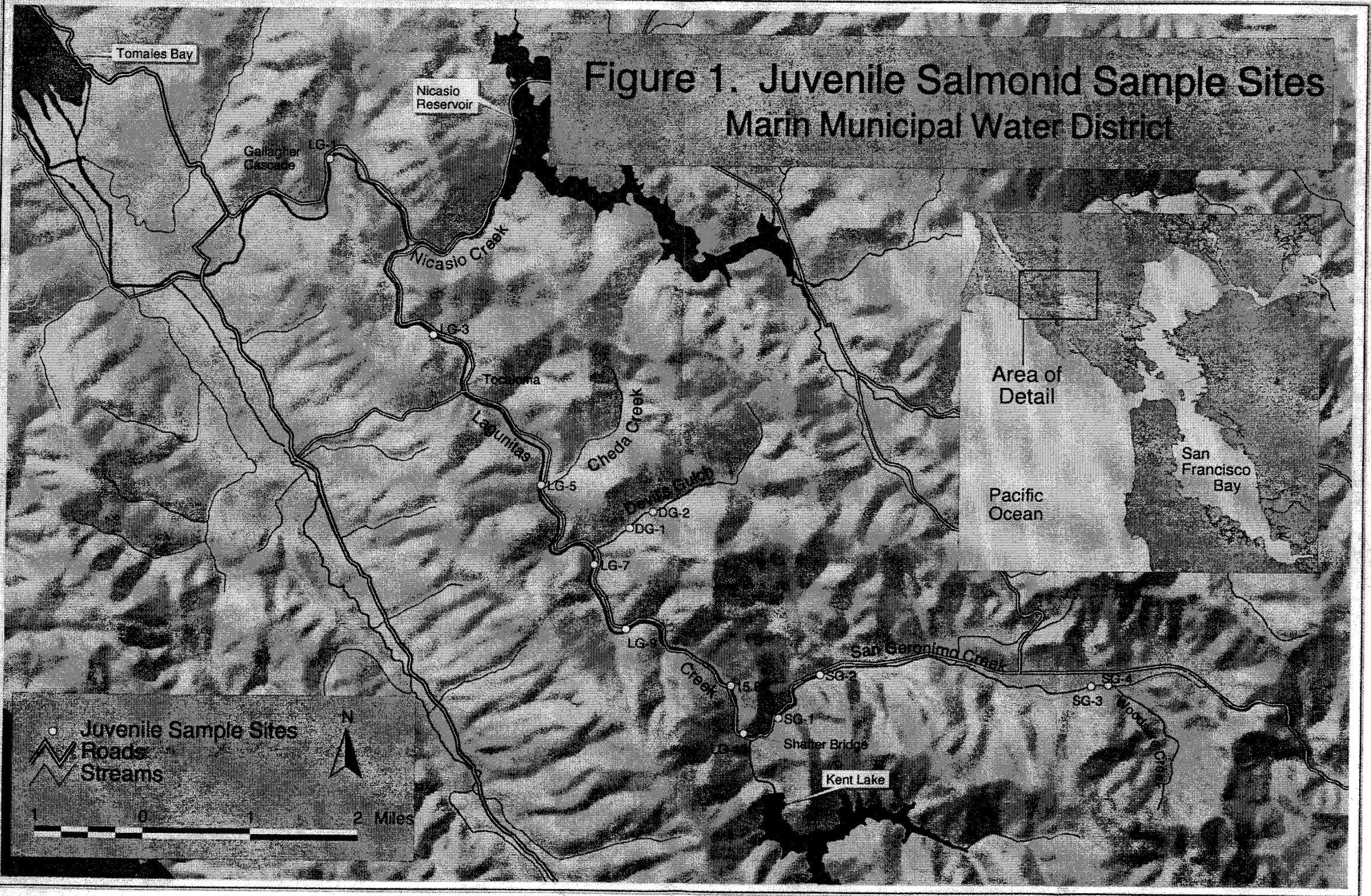
We observed the highest steelhead densities at site LG-9 and SG-1, both of which are characterized by riffles and long, shallow runs. The number of 1+ steelhead increases as one moves downstream in Lagunitas Creek, possibly due to the downstream migration of fish as they age. Moving downstream is more difficult in San Geronimo Creek and Devil's Gulch, where summer flows are very low, which may explain the more random distribution of 1+ steelhead in these creeks. The lower numbers of 1+ steelhead in Lagunitas Creek relative to San Geronimo Creek and Devil's Gulch may mean that larger steelhead are using the deep pools in lower Lagunitas Creek which are not represented by our sample sites.

The distribution of coho in the Lagunitas Creek drainage demonstrates the importance of complexity in pools for coho habitat. Sites LG-5 and LG-15.86 had the most coho of the sample sites, and both of these sites had deep pools with lots of large woody debris and/or undercut banks. The number of steelhead caught at these sites declined between 1999 and 2000, which may indicate that coho can out-compete steelhead in this type of habitat. The high proportion of coho at these sites offer hope that habitat enhancement efforts aimed at increasing woody debris in the creek will help to improve the trend in the coho population.

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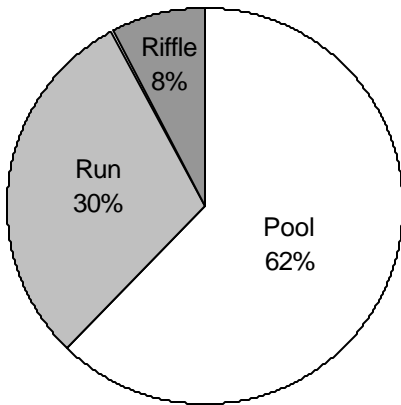
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Figure 1. Juvenile Salmonid Sample Sites  
Marin Municipal Water District

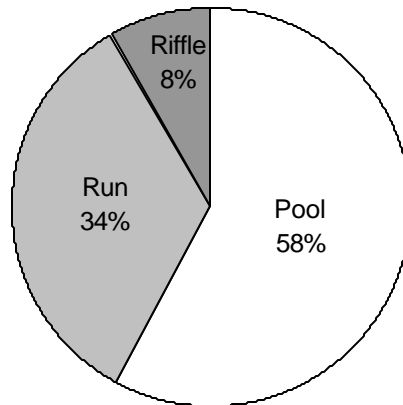


**Lagunitas Creek**

Overall Habitat Composition

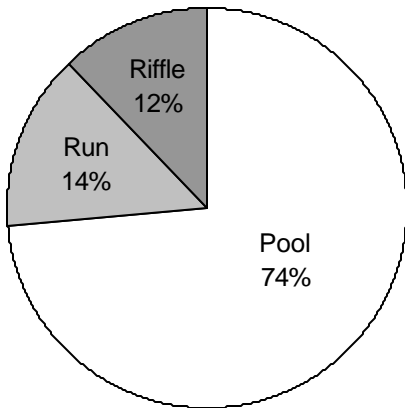


Lagunitas Creek Sample Sites

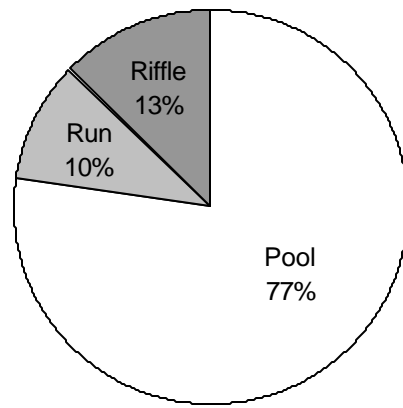


**San Geronimo Creek**

Overall Habitat Composition

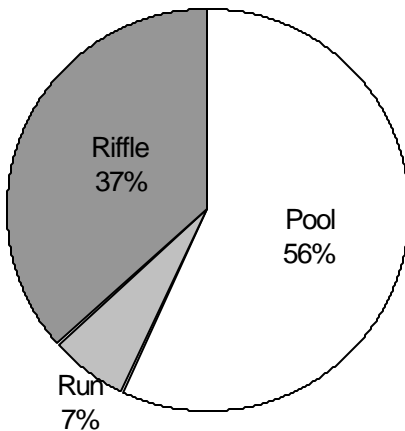


San Geronimo Creek Sample Sites



**Devil's Gulch**

Overall Habitat Composition



Devil's Gulch Sample Sites

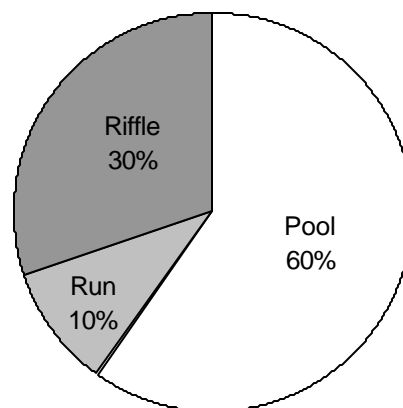
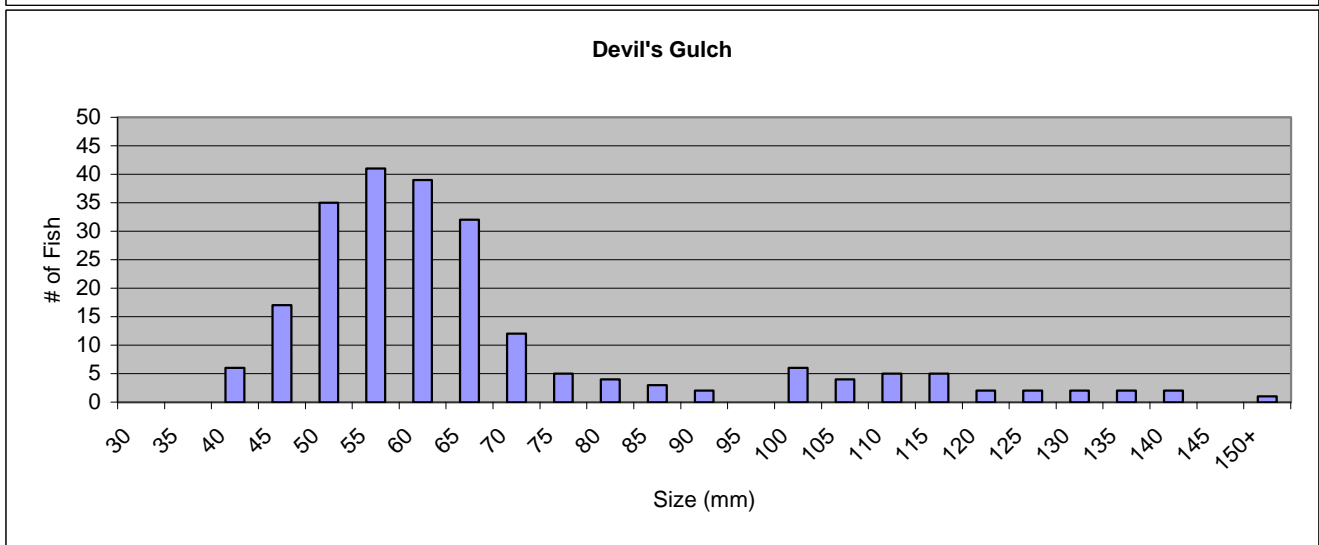
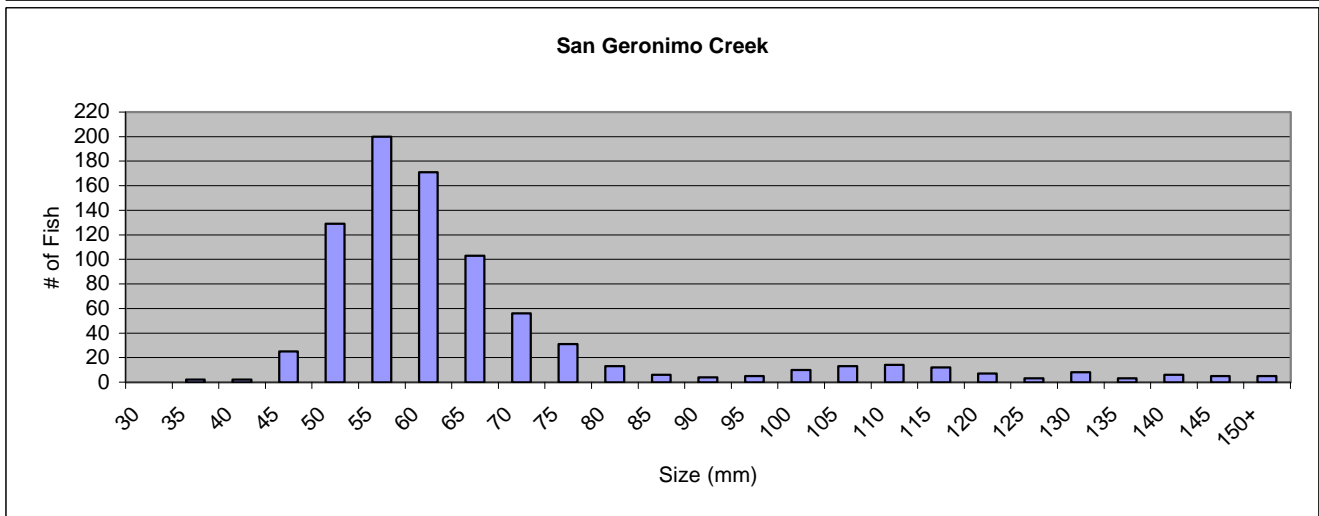
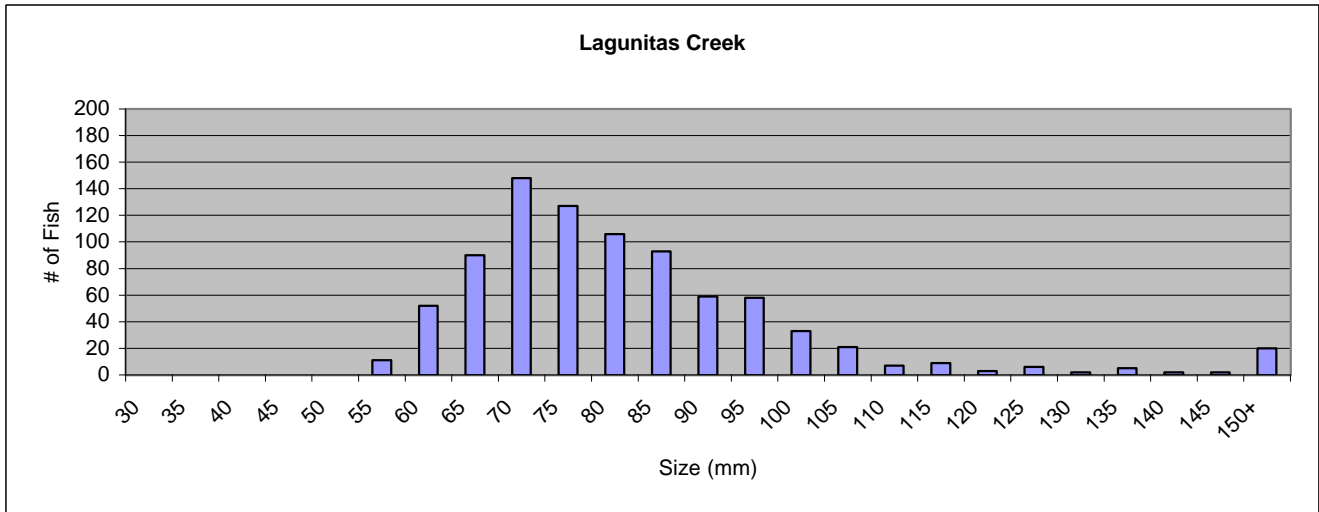


Figure 2. Habitat composition of surveyed creeks and sample sites, 2000 juvenile salmonid survey.



**Figure 3. Frequency histograms of steelhead sizes for Lagunitas Creek, San Geronimo Creek and Devil's Gulch, 2000 juvenile salmonid survey.**

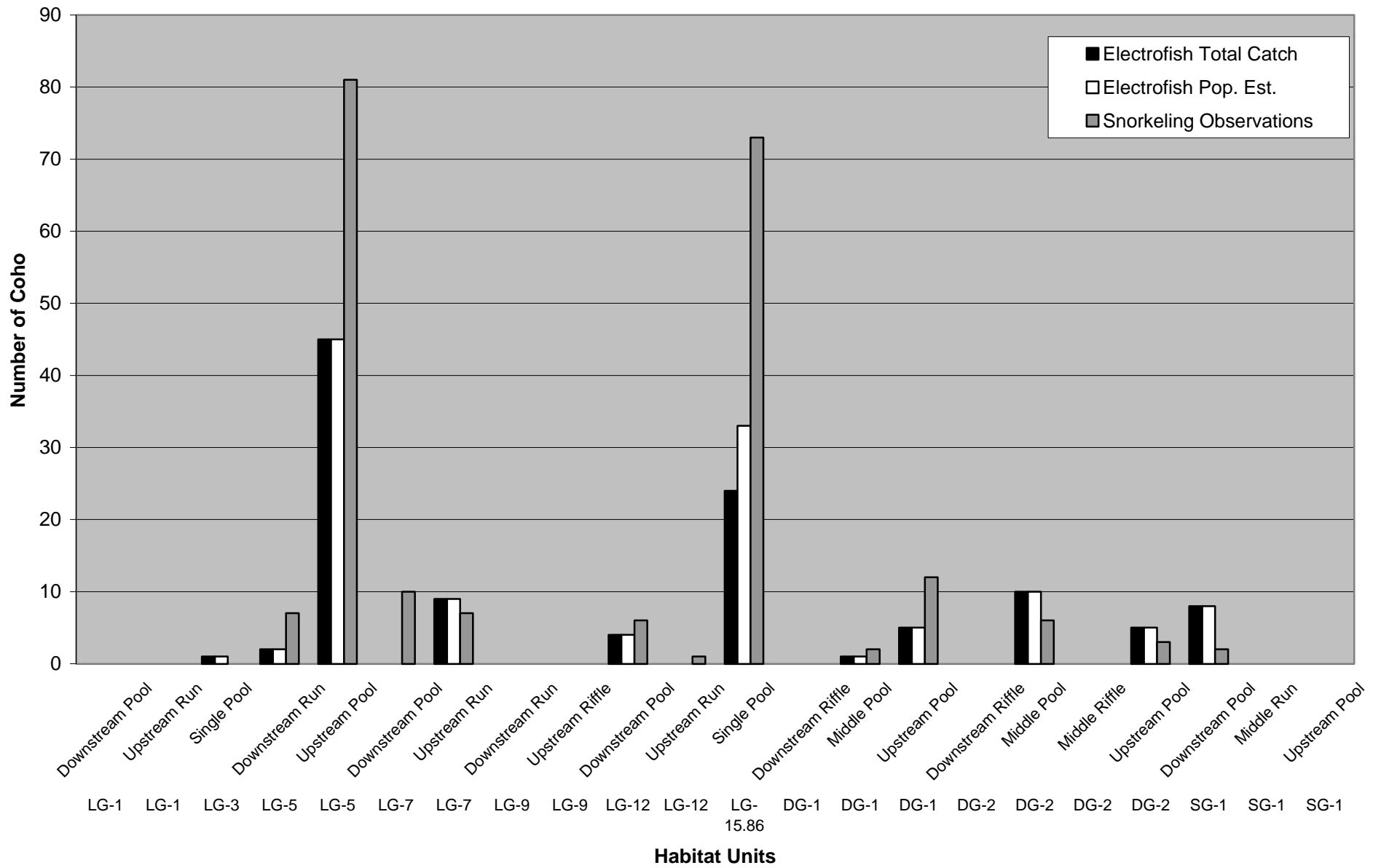


Figure 4. Comparison of snorkeling and electrofishing results for coho, 2000 juvenile salmonid survey.



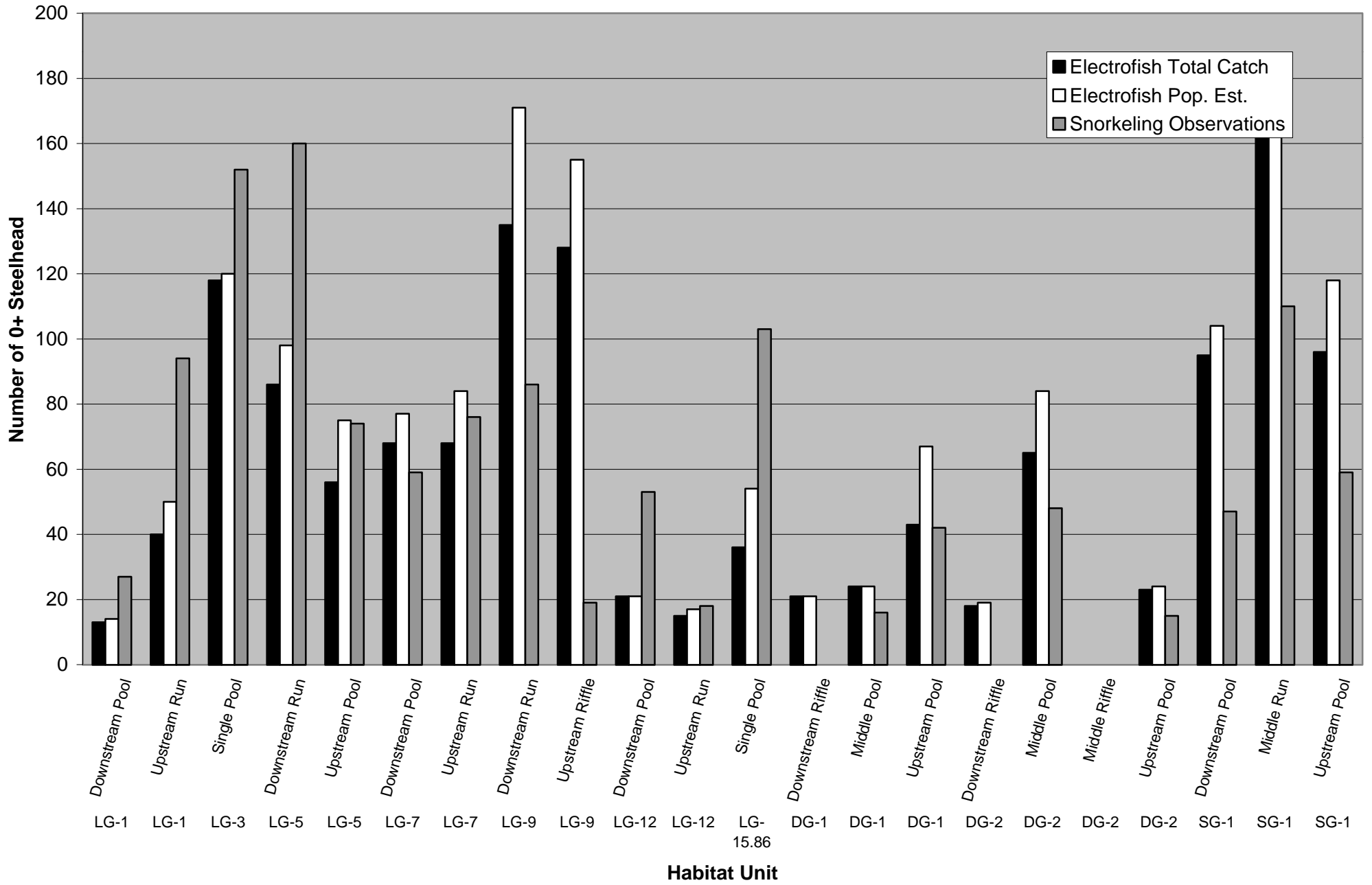


Figure 5. Comparison of snorkeling and electrofishing results for 0+ steelhead, 2000 juvenile salmonid survey.

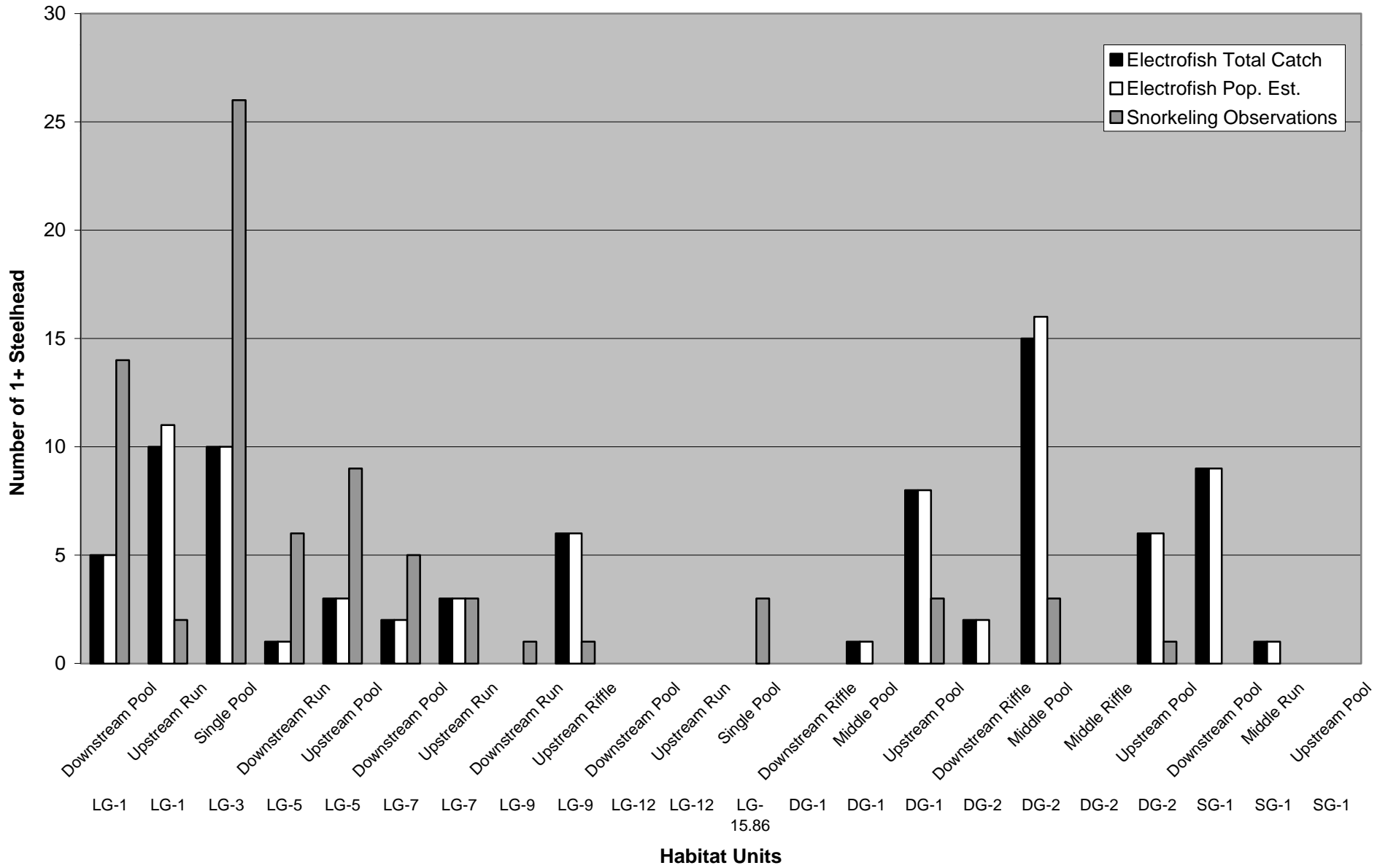


Figure 6. Comparison of snorkeling and electrofishing results for 1+ steelhead, 2000 juvenile salmonid survey.

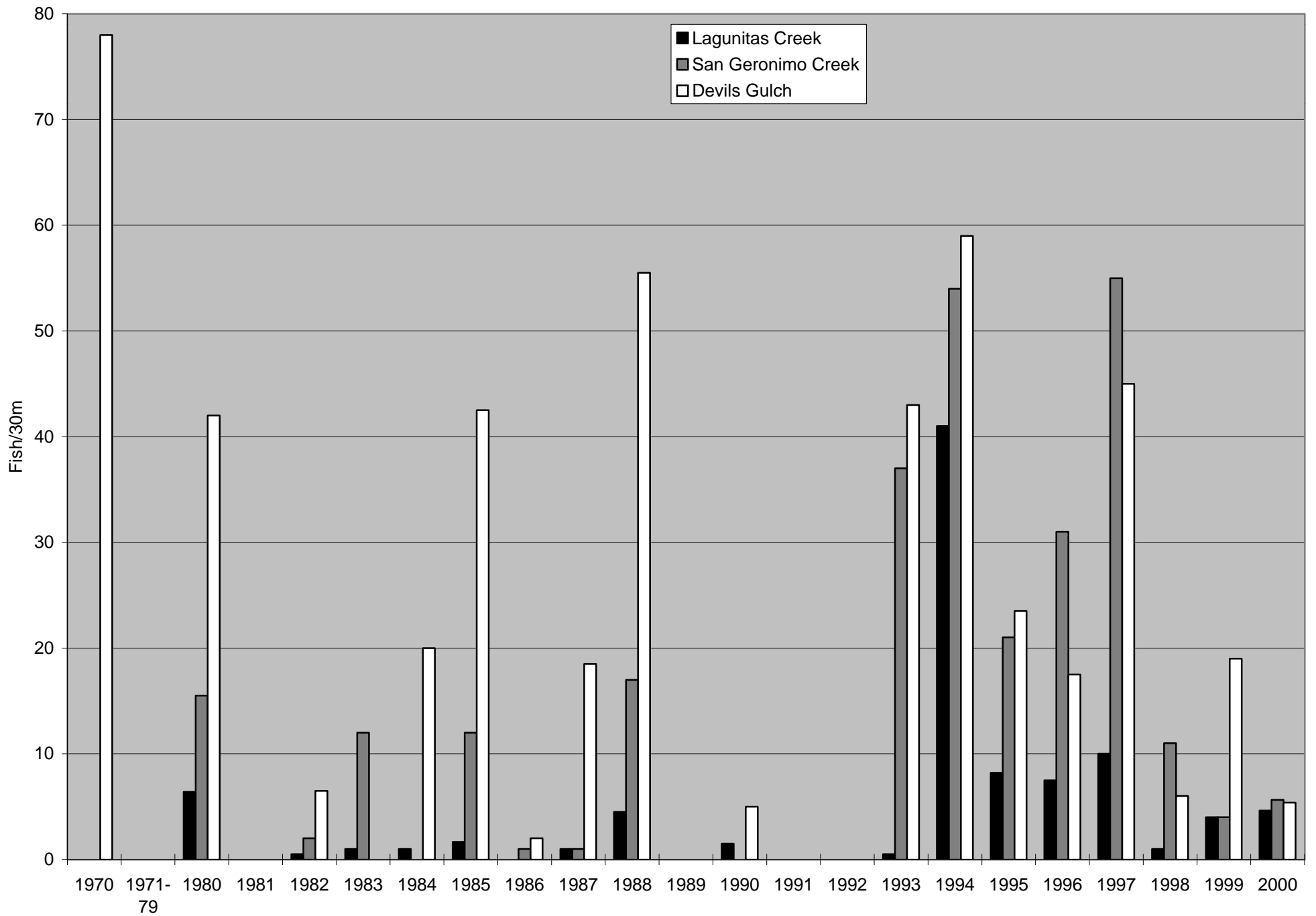


Figure 7. Coho Density in Lagunitas Creek, San Geronimo Creek, and Devils Gulch by Year.

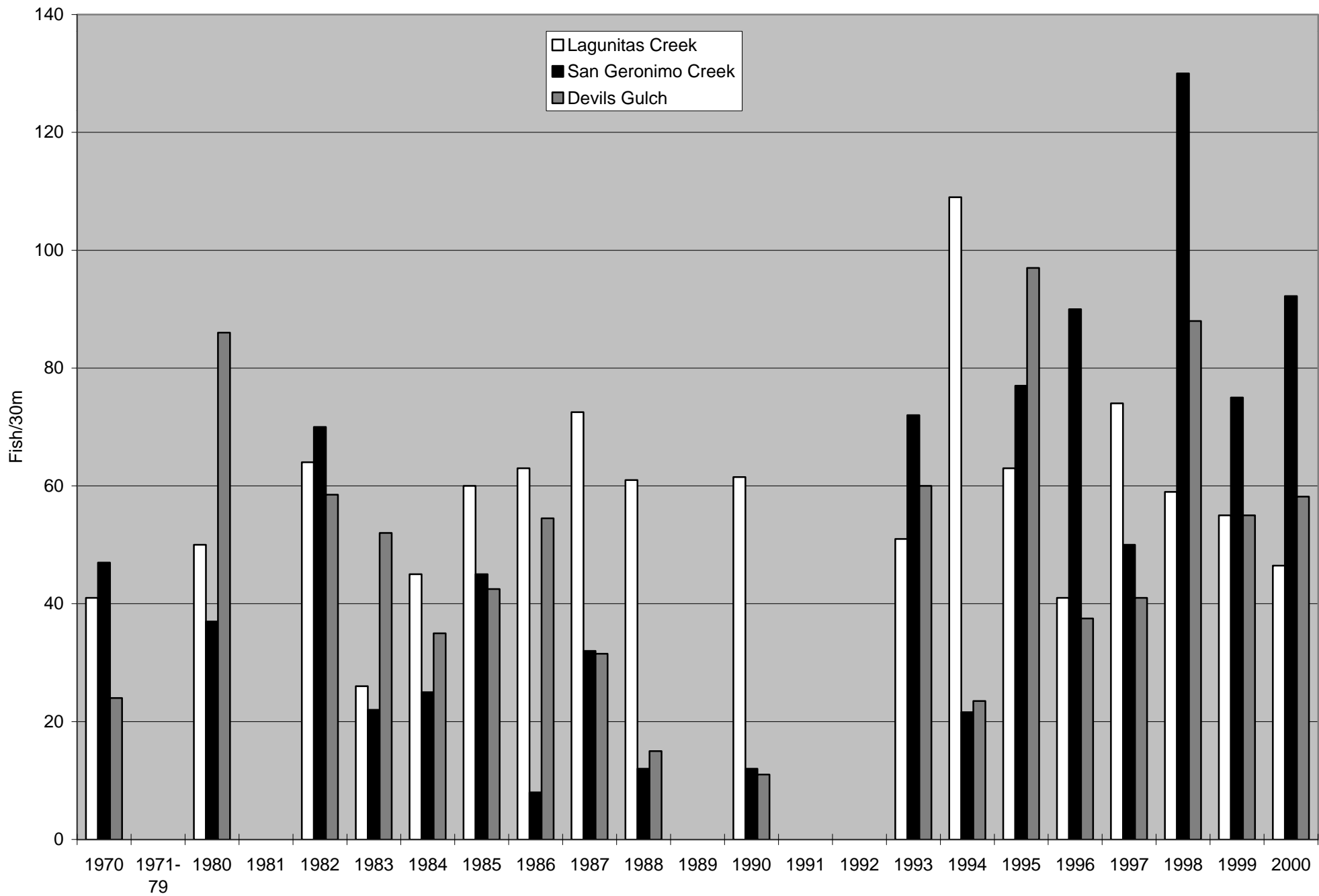
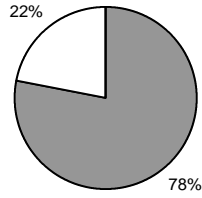


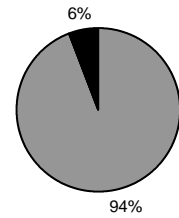
Figure 8. Steelhead Density in Lagunitas Creek, San Geronimo Creek, and Devils Gulch by Year.

**Table 1. Comparison of Total Catch at Juvenile Salmonid Sample Sites for 1993-2000.**

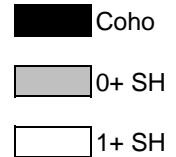
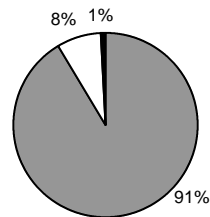
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>LG 1</b>	1993	30	0	30	0
	1994	123	16	139	2
	1995	21	1	22	0
	1996	129	35	164	0
	1997	104	6	110	0
	1998	21	11	32	1
	1999	27	18	45	0
	<b>2000</b>	<b>53</b>	<b>15</b>	<b>68</b>	<b>0</b>



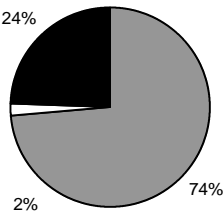
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>LG 12</b>	1993	47	0	47	1
	1994	83	8	91	51
	1995	27	6	33	0
	1996	20	3	23	0
	1997	65	5	70	0
	1998	21	1	22	0
	1999	44	5	49	0
	<b>2000</b>	<b>65</b>	<b>0</b>	<b>65</b>	<b>4</b>



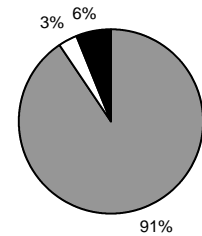
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>LG 3</b>	1993	88	2	90	0
	1994	184	25	190	31
	1995	107	7	114	0
	1996	77	25	102	19
	1997	191	11	202	1
	1998	269	17	286	0
	1999	84	17	101	0
	<b>2000</b>	<b>118</b>	<b>10</b>	<b>128</b>	<b>1</b>



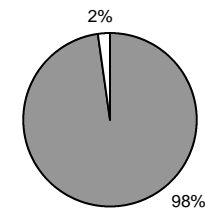
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>LG 5</b>	1993	101	1	102	0
	1994	215	3	218	14
	1995	213	5	218	8
	1996	59	8	67	0
	1997	107	2	109	3
	1998	93	6	99	4
	1999	253	3	256	26
	<b>2000</b>	<b>142</b>	<b>4</b>	<b>146</b>	<b>47</b>



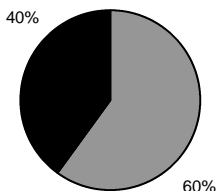
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>LG 7</b>	1993	30	0	30	0
	1994	36	5	41	1
	1995	N/S	N/S	N/S	N/S
	1996	14	63	77	14
	1997	114	7	121	39
	1998	113	7	120	0
	1999	109	4	113	7
	<b>2000</b>	<b>136</b>	<b>5</b>	<b>141</b>	<b>9</b>



Site #	Year	0+ SH	1+SH	All SH	Coho
<b>LG 9</b>	1993	38	1	39	0
	1994	78	0	78	7
	1995	74	2	76	1
	1996	35	2	37	0
	1997	170	0	170	1
	1998	154	1	155	0
	1999	260	4	264	0
	<b>2000</b>	<b>263</b>	<b>6</b>	<b>269</b>	<b>0</b>



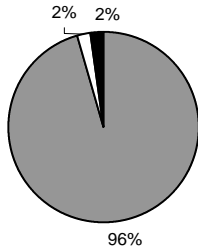
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>15.86</b>	1993	N/S	N/S	N/S	N/S
	1994	57	10	67	156
	1995	54	7	61	48
	1996	30	13	43	41
	1997	146	6	152	86
	1998	56	7	63	14
	1999	68	4	72	26
	<b>2000</b>	<b>36</b>	<b>0</b>	<b>36</b>	<b>24</b>



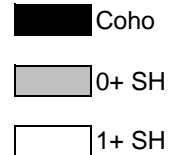
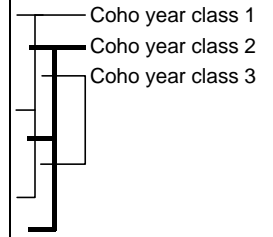
N/S = Not Surveyed; SH = Steelhead;  
 0+SH = <1year old; 1+SH = 1-3 years old

**Table 1. Comparison of Total Catch at Juvenile Salmonid Sample Sites for 1993-2000.**

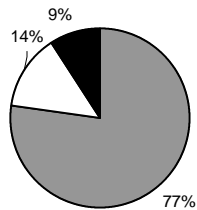
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>SG 1</b>	1993	N/S	N/S	N/S	N/S
	1994	N/S	N/S	N/S	N/S
	1995	N/S	N/S	N/S	N/S
	1996	N/S	N/S	N/S	N/S
	1997	N/S	N/S	N/S	N/S
	1998	428	7	435	8
	1999	226	7	233	2
<b>2000</b>	<b>356</b>	<b>9</b>	<b>365</b>	<b>8</b>	



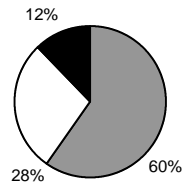
Site #	Year	0+ SH	1+SH	All SH	Coho
<b>Totals</b>	1993	775	34	809	216
	1994	877	110	968	578
	1995	1128	48	1176	210
	1996	798	243	1041	246
	1997	1226	83	1309	541
	1998	1977	101	2078	124
	1999	1657	104	1761	168
<b>2000</b>	<b>1748</b>	<b>165</b>	<b>1913</b>	<b>157</b>	



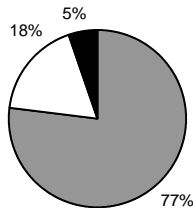
<b>SG 2</b>	1993	187	2	189	4
	1994	18	9	27	11
	1995	157	6	163	1
	1996	226	13	239	2
	1997	117	9	126	25
	1998	364	3	367	1
	1999	271	16	287	9
<b>2000</b>	<b>247</b>	<b>44</b>	<b>291</b>	<b>29</b>	



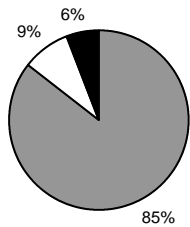
<b>SG 3</b>	1993	35	11	46	3
	1994	15	21	36	46
	1995	19	1	20	1
	1996	48	23	71	41
	1997	23	4	27	69
	1998	44	10	54	18
	1999	8	3	11	0
<b>2000</b>	<b>34</b>	<b>16</b>	<b>50</b>	<b>7</b>	



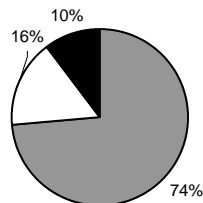
<b>SG 4</b>	1993	58	13	71	96
	1994	17	0	17	104
	1995	169	10	179	85
	1996	61	38	99	73
	1997	50	22	72	154
	1998	69	9	78	53
	1999	104	7	111	23
<b>2000</b>	<b>103</b>	<b>24</b>	<b>127</b>	<b>7</b>	



<b>DG 1</b>	1993	68	0	68	82
	1994	16	7	23	114
	1995	123	3	126	58
	1996	37	9	46	22
	1997	58	5	63	84
	1998	182	7	189	8
	1999	128	4	132	44
<b>2000</b>	<b>89</b>	<b>9</b>	<b>98</b>	<b>6</b>	



<b>DG 2</b>	1993	93	4	97	30
	1994	35	6	41	41
	1995	164	0	164	8
	1996	62	11	73	34
	1997	81	6	87	79
	1998	163	15	178	17
	1999	75	12	87	31
<b>2000</b>	<b>106</b>	<b>23</b>	<b>129</b>	<b>15</b>	



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, 2000 Juvenile Salmonid Survey**

Sample Site	Steelhead Age Classes		Size Difference (mm)
	0+ max (mm)	1+ min (mm)	
LG-1	115	119	4
LG-3	114	125	11
LG-5	111	122	11
LG-7	110	129	19
LG-9	110	120	10
LG-12	104	No 1+	Unknown
LG-15.86	102	No 1+	Unknown
SG-1	86	95	9
SG-2	85	88	3
SG-3	81	102	21
SG-4	86	98	12
DG-1	79	98	19
DG-2	87	97	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. Fish Observations During Snorkeling, 2000 Juvenile Salmonid Survey**

Site	Habitat	Pass	Coho	0+ SH	1-2 SH	2+ SH	Other Species
<b>LG-1</b>	Downstream Pool	1	0	27	11	3	
	Upstream Pool	1	0	94	2	0	
<b>LG-3</b>	Single Pool	1	0	125	12	6	
		2	0	178	28	6	
		<i>Average*</i>	0	152	20	6	
	Downstream Run	1	0	70	0	0	Stickleback
<b>LG-5</b>	Downstream Run	2	0	77	1	0	
		<i>Average*</i>	0	74	1	0	
		Middle Run	1	7	86	2	3
	Upstream Pool	1	81	74	7	2	Sucker
<b>LG-7</b>	Downstream Pool	1	10	47	0	0	Stickleback
		2	6	71	5	0	
		<i>Average*</i>	10	59	5	0	
	Upstream Pool	1	4	77	1	1	
		2	7	75	0	2	
		<i>Average*</i>	7	76	1	2	
<b>LG-9</b>	Downstream Run	1	0	73	1	0	Bass?
		2	0	103	1	0	
		<i>Average*</i>	0	86	1	0	
	Upstream Riffle	1	0	15	1	0	
		2	0	22	1	0	
		<i>Average*</i>	0	19	1	0	
<b>LG-15.86</b>	Single Pool	1	72	100	1	2	Roach
		2	74	105	1	1	Roach
		<i>Average*</i>	73	103	1	2	
	<b>LG-12</b>	Downstream Pool	1	6	42	0	0
2			0	64	0	0	Stickleback
<i>Average*</i>			6	53	0	0	Crayfish
Upstream Run		1	1	18	0	0	
		2	0	18	0	0	
		<i>Average*</i>	1	18	0	0	
<b>DG-1</b>	Middle Pool	1	2	16	0	0	Giant salamander
		2	2	16	0	0	
		<i>Average*</i>	2	16	0	0	
	Upstream Pool	1	4	32	1	0	Sculpin
		2	12	52	2	1	Giant salamander
		3	8	43	2	1	
<i>Average*</i>	12	42	2	1			
<b>DG-2</b>	Downstream Pool	1	6	49	2	1	Crayfish
		2	3	47	1	1	
		<i>Average*</i>	6	48	2	1	
	Upstream Pool	1	3	12	1	0	
		2	2	18	1	0	
		<i>Average*</i>	3	15	1	0	
<b>SG-1</b>	Downstream Pool	1	2	45	0	0	
		2	1	49	0	0	
		<i>Average*</i>	2	47	0	0	
	Middle Run	1	0	110	0	0	Stickleback
	Upstream Pool	1	0	59	0	0	Stickleback
<b>Totals</b>			210	1258	57	20	

SH = Steelhead; 0+ SH = <1 year old; 1-2 SH = 1-2 years old; 2+ SH = >2 years old

\* Counts were averaged for multiple passes when more than 15 fish were observed. Otherwise the greatest count was used.



**Table 4. 1995 - 2000 Total Juvenile Salmonid Population Estimates**  
(based on extrapolations from average density within each habitat type)

**ESTIMATE**

**Lagunitas Creek**

Type	1995*	1996*	1997**	1998**	1999***	2000***
0+ SH	24,547	11,411	33,717	25,104	29,748 (26,304)	25,173 (21,312)
1+ SH	1,583	2,395	1,404	1,652	1,748 (1,200)	1,091 (863)
Coho	2,686	2,468	8,678	727	2,920 (2,553)	2,676 (2,273)

**San Geronimo Creek**

Type	1995^	1996^	1997	1998	1999	2000
0+ SH	9,449	13,160	9,563	32,186	22,132	23,354
1+SH	464	1,426	842	985	819	2,351
Coho	1,286	4,295	6,112	3,026	1,189	1,458

**Devil's Gulch**

Type	1995^^	1996^^	1997^^	1998	1999	2000
0+ SH	6,484	1,827	2,242	9,275	5,611	6,344
1+ SH	39	358	79	555	373	883
Coho	1,192	1,717	2,172	641	2,012	550

**Total for All Streams**

Type	1995	1996	1997	1998	1999	2000
0+ SH	40,480	26,398	45,522	66,565	57,491 (54,047)	54,871 (51,010)
1+SH	2,086	4,179	2,325	3,192	2,940 (2,392)	4,325 (4,097)
Coho	5,164	8,480	16,962	4,394	6,091 (5,724)	4,684 (4,281)

**Notes:**

0+ SH = Young-of-the-year steelhead (<1 year old)

1+ SH = One to three year old steelhead

Numbers in parentheses are based on the Lagunitas Creek estimates for the section of creek from Nicasio Creek to Peters Dam, for comparison with previous years.

Estimates are 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.

**Lagunitas Creek**

\* Estimates are based on the distance from Nicasio Creek to Shafter Bridge (39,906 ft).

\*\* Estimates are based on the distance from Nicasio Creek to Peters Dam (42,291 ft).

\*\*\* Estimates are based on the distance from Gallagher Cascade to Peters Dam (48,774 ft).

**San Geronimo Creek**

^ Estimates are based on the distance from Lagunitas Bridge to Dixon Weir, upstream of Woodacre Creek (18,000 ft).

Estimates since 1997 are based on the distance from the creek mouth to Dixon Weir (~23,000 ft).

One sample site was added starting in 1998.

**Devil's Gulch**

^^ Estimates are based on the distance from the mouth to 6,925 feet upstream.

Estimates since 1998 are based on the distance from the mouth to 10,889 feet upstream.

**Table 5. Fish per 30 meters of stream for Lagunitas Creek, San Geronimo Creek, and Devil's Gulch.**

Stream and Site	Species	1993	1994	1995	1996	1997	1998	1999	2000
<b>Lagunitas Creek</b>									
LG1	Coho	0	1	0	0	0	1	0	0
	0+SH	30	91	8	50	43	13	8	16
	1+SH	0	7	1	14	2	7	5	4
	Total SH	30	98	9	64	46	19	13	20
LG-3	Coho	0	22	0	12	1	0	0	1
	0+SH	63	140	58	50	127	154	45	63
	1+SH	1	9	4	16	7	10	9	5
	Total SH	64	149	62	66	134	164	55	68
LG-5	Coho	0	13	7	0	2	2	13	14
	0+SH	96	205	187	41	83	45	130	41
	1+SH	1	3	7	3	2	3	2	1
	Total SH	97	208	194	45	84	48	132	42
LG-7	Coho	0	1	-	6	17	0	3	3
	0+SH	29	34	-	6	49	44	40	49
	1+SH	0	5	-	26	3	3	1	2
	Total SH	29	39	-	32	52	47	42	51
LG-9	Coho	0	7	1	0	1	0	0	0
	0+SH	38	78	30	27	97	83	107	105
	1+SH	1	0	1	0	0	1	2	2
	Total SH	39	78	31	29	97	83	109	107
15.86	Coho	-	193	41	34	58	10	16	15
	0+SH	-	70	46	25	98	39	41	22
	1+SH	-	12	6	11	4	5	2	0
	Total SH	-	82	52	36	102	44	44	22
LG-12	Coho	1	51	0	0	0	0	0	1
	0+SH	47	104	26	14	34	12	19	24
	1+SH	0	6	6	2	3	1	2	0
	Total SH	47	110	32	16	37	12	21	24
Average	Coho	0	41	8	7	10	1	4	5
	0+SH	51	103	59	30	71	56	52	44
	1+SH	1	6	4	10	3	4	3	2
	Total SH	51	109	63	41	74	59	55	46

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

**Table 5. Fish per 30 meters of stream for Lagunitas Creek, San Geronimo Creek, and Devil's Gulch.**

Stream and Site	Species	1993	1994	1995	1996	1997	1998	1999	2000
<b>San Geronimo Creek</b>									
SG-1	Coho	NA	NA	NA	NA	NA	4	1	3
	0+SH	NA	NA	NA	NA	NA	212	103	141
	1+SH	NA	NA	NA	NA	NA	3	3	4
	Total SH	NA	NA	NA	NA	NA	215	107	144
SG-2	Coho	2	6	1	1	15	0	3	9
	0+SH	98	13	85	124	72	165	83	75
	1+SH	1	2	3	7	6	1	5	13
	Total SH	99	15	88	131	77	166	88	88
SG-3	Coho	3	40	1	4	47	12	0	5
	0+SH	30	13	14	45	16	29	5	23
	1+SH	10	18	1	22	3	7	2	11
	Total SH	40	31	15	67	19	36	7	33
SG-4	Coho	107	116	61	54	106	36	15	4
	0+SH	64	19	121	45	34	47	69	61
	1+SH	14	0	7	28	15	6	5	14
	Total SH	78	19	128	73	50	53	73	75
Average	Coho	37	54	21	20	55	11	4	6
	0+SH	64	15	73	71	42	126	71	82
	1+SH	8	7	4	19	8	4	4	10
	Total SH	72	22	77	90	50	130	75	92
<b>Devils Gulch</b>									
DG-1	Coho	66	91	42	16	51	4	21	3
	0+SH	55	18	90	27	35	91	60	42
	1+SH	0	2	2	7	3	3	2	4
	Total SH	55	20	92	34	39	94	62	46
DG-2	Coho	20	27	5	19	39	8	17	8
	0+SH	62	26	102	35	40	76	40	59
	1+SH	3	1	0	6	3	7	6	13
	Total SH	65	27	102	41	43	83	47	72
Average	Coho	43	59	24	18	45	6	19	5
	0+SH	59	22	96	31	38	83	51	50
	1+SH	2	2	1	7	3	5	4	8
	Total SH	60	24	97	38	41	88	55	58

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

**APPENDIX A**

**2000 FISH CATCH BY SAMPLE SITE**

Appendix A. 2000 Fish Catch by Sample Site.

<b>LG-1 upstream run</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	24	4	12	40	
1+ Steelhead	5	3	2	10	
Coho Salmon	0	0	0	0	
Sculpin	7	2	2	11	
California Roach	11	16	1	28	
Stickleback	1	12	0	13	
Pacific Lamprey	0	0	0	0	

<b>LG-1 downstream, pool</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	6	5	2	13	
1+ Steelhead	5	0	0	5	
Coho Salmon	0	0	0	0	
Sculpin	0	0	0	0	
California Roach	0	1	1	2	
Stickleback	16	10	5	31	
Pacific Lamprey	3	7	2	12	

<b>LG-3 single, pool</b>		Pass				
Species	1	2	3	4	Total	
0+ Steelhead	81	16	13	8	118	
1+ Steelhead	6	2	2	0	10	
Coho Salmon	0	0	1	0	1	
Sculpin	10	1	1	0	12	
California Roach	24	1	11	3	39	
Stickleback	38	13	13	6	70	
Pacific Lamprey	9	18	11	17	55	

<b>LG-5 downstream run</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	46	29	11	86	
1+ Steelhead	1	0	0	1	
Coho Salmon	2	0	0	2	
Sculpin	2	0	0	2	
California Roach	0	0	0	0	
Stickleback	2	3	2	7	
Pacific Lamprey	4	7	2	13	

<b>LG-5 upstream pool</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	29	13	14	56	
1+ Steelhead	3	0	0	3	
Coho Salmon	39	3	3	45	
Sculpin	1	0	0	1	
California Roach	7	5	3	15	
Stickleback	3	0	1	4	
Pacific Lamprey	0	0	2	2	

<b>LG-7 downstream pool</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	41	14	13	68	
1+ Steelhead	0	0	2	2	
Coho Salmon	0	0	0	0	
Sculpin	4	0	1	5	
California Roach	0	0	0	0	
Stickleback	4	2	0	6	
Pacific Lamprey	1	2	1	4	

Appendix A. 2000 Fish Catch by Sample Site.

<b>LG-7 upstream run</b>		Pass			
Species	1	2	3	4	Total
0+ Steelhead	29	14	18	7	68
1+ Steelhead	2	1	0	0	3
Coho Salmon	2	2	3	2	9
Sculpin	0	0	0	1	1
California Roach	0	0	0	0	0
Stickleback	1	1	0	0	2
Pacific Lamprey	1	5	4	5	15

<b>LG-9 upstream riffle</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	70	33	25	128	
1+ Steelhead	5	0	1	6	
Coho Salmon	0	0	0	0	
Sculpin	3	1	1	5	
California Roach	0	0	0	0	
Stickleback	0	2	0	2	
Pacific Lamprey	3	5	1	9	

<b>LG-9 downstream run</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	66	46	23	135	
1+ Steelhead	0	0	0	0	
Coho Salmon	0	0	0	0	
Sculpin	2	3	2	7	
California Roach	0	0	0	0	
Stickleback	0	1	0	1	
Pacific Lamprey	2	5	2	9	

<b>LG-12 downstream pool</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	17	3	1	21	
1+ Steelhead	0	0	0	0	
Coho Salmon	4	0	0	4	
Sculpin	19	8	5	32	
California Roach	0	0	0	0	
Stickleback	1	2	1	4	
Pacific Lamprey	14	9	8	31	

<b>LG-12 middle riffle</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	21	7	1	29	
1+ Steelhead	0	0	0	0	
Coho Salmon	0	0	0	0	
Sculpin	11	2	2	15	
California Roach	0	0	0	0	
Stickleback	0	0	0	0	
Pacific Lamprey	5	4	1	10	

<b>LG-12 upstream run</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	7	6	2	15	
1+ Steelhead	0	0	0	0	
Coho Salmon	0	0	0	0	
Sculpin	7	5	2	14	
California Roach	0	0	0	0	
Stickleback	0	0	0	0	
Pacific Lamprey	19	7	11	37	

Appendix A. 2000 Fish Catch by Sample Site.

<b>LG-15.86 pool</b>	Pass				
Species	1	2	3	4	Total
0+ Steelhead	11	12	7	6	36
1+ Steelhead	0	0	0	0	0
Coho Salmon	7	9	4	4	24
Sculpin	3	1	3	0	7
California Roach	0	1	1	0	2
Stickleback	10	3	5	0	18
Pacific Lamprey	23	22	34	9	88

<b>SG-1 downstream pool</b>	Pass			
Species	1	2	3	Total
0+ Steelhead	56	28	11	95
1+ Steelhead	6	2	0	8
Coho Salmon	3	5	0	8
Sculpin	0	0	0	0
California Roach	0	1	1	2
Stickleback	16	10	5	31
Pacific Lamprey	3	7	2	12

<b>SG-1 middle run</b>	Pass			
Species	1	2	3	Total
0+ Steelhead	108	38	17	163
1+ Steelhead	1	0	0	1
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	5	12	0	17
Pacific Lamprey	2	6	0	8

<b>SG-1 upstream pool</b>	Pass			
Species	1	2	3	Total
0+ Steelhead	50	30	18	98
1+ Steelhead	0	0	0	0
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	7	6	7	20
Pacific Lamprey	1	4	4	9

<b>SG-2 downstream pool</b>	Pass			
Species	1	2	3	Total
0+ Steelhead	48	26	16	90
1+ Steelhead	11	2	2	15
Coho Salmon	7	5	3	15
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	3	9	4	16
Pacific Lamprey	9	17	13	39

<b>SG-2 middle riffle</b>	Pass			
Species	1	2	3	Total
0+ Steelhead	20	7	4	31
1+ Steelhead	2	0	0	2
Coho Salmon	0	0	0	0
Sculpin	0	0	0	0
California Roach	0	0	0	0
Stickleback	2	2	2	6
Pacific Lamprey	2	0	0	2

Appendix A. 2000 Fish Catch by Sample Site.

<b>SG-2 upstream pool</b>				Pass	
Species	1	2	3	Total	
0+ Steelhead	73	38	15	126	
1+ Steelhead	21	5	1	27	
Coho Salmon	10	4	0	14	
Sculpin	0	0	0	0	
California Roach	3	4	2	9	
Stickleback	52	31	21	104	
Pacific Lamprey	12	5	2	19	

<b>SG-3 downstream pool</b>						Pass	
Species	1	2	3	4	5	Total	
0+ Steelhead	8	6	3	6	4	27	
1+ Steelhead	10	3	1	2	0	16	
Coho Salmon	0	3	1	3	0	7	
Sculpin	5	5	0	0	0	10	
California Roach	3	5	2	0	1	11	
Stickleback	0	0	0	0	0	0	
Pacific Lamprey	0	0	0	0	0	0	

<b>SG-3 upstream riffle</b>					Pass	
Species	1	2	3	4	Total	
0+ Steelhead	4	1	1	1	7	
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	

<b>SG-4 single pool</b>				Pass	
Species	1	2	3	Total	
0+ Steelhead	52	35	16	103	
1+ Steelhead	17	6	1	24	
Coho Salmon	4	2	1	7	
Sculpin	5	10	4	19	
California Roach	3	4	3	10	
Stickleback	0	0	0	0	
Pacific Lamprey	0	0	0	0	

<b>DG-1 downstream riffle</b>						Pass	
Species	1	2	3	4	5	After all passes	Total
0+ Steelhead	13	1	1	2	1	3	21
1+ Steelhead	0	0	0	0	0	0	0
Coho Salmon	0	0	0	0	0	0	0
Sculpin	0	0	0	0	0	0	0
California Roach	0	0	0	0	0	0	0
Stickleback	0	0	0	0	0	0	0
Pacific Lamprey	0	0	0	0	0	0	0

<b>DG-1 middle run/pool</b>				Pass	
Species	1	2	3	Total	
0+ Steelhead	15	7	2	24	
1+ Steelhead	1	0	0	1	
Coho Salmon	1	0	0	1	
Sculpin	0	0	0	0	
California Roach	0	0	0	0	
Stickleback	0	0	0	0	
Pacific Lamprey	0	0	0	0	



**Appendix A. 2000 Fish Catch by Sample Site.**

<b>DG-1 upstream pool</b>		Pass			
Species	1	2	3	4	Total
0+ Steelhead	12	15	13	4	44
1+ Steelhead	5	2	1	0	8
Coho Salmon	2	3	0	0	5
Sculpin	4	0	0	0	4
California Roach	0	0	0	0	0
Stickleback	0	0	0	0	0
Pacific Lamprey	0	0	0	0	0

<b>DG-2 downstream riffle</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	10	5	3	18	
1+ Steelhead	1	1	0	2	
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	

<b>DG-2 middle riffle</b>		Pass			
Species	1	2	3	Total	
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	

<b>DG-2 middle pool</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	32	20	13	65	
1+ Steelhead	9	3	3	15	
Coho Salmon	6	3	1	10	
Sculpin	1	1	0	2	
California Roach	0	0	0	0	
Stickleback	0	0	0	0	
Pacific Lamprey	0	0	0	0	

<b>DG-2 upstream pool</b>		Pass			
Species	1	2	3	Total	
0+ Steelhead	14	6	3	23	
1+ Steelhead	5	0	1	6	
Coho Salmon	3	0	2	5	
Sculpin	0	0	0	0	
California Roach	0	0	0	0	
Stickleback	0	0	0	0	
Pacific Lamprey	0	0	0	0	

**APPENDIX B**

**2000 SALMONID POPULATION ESTIMATES BY SAMPLE SITE**

**LAGUNITAS CREEK****SITE: LG-1****Station: downstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	13	5	0
Population Estimate	14	5	0
Lower Confidence Interval	13	5	0
Upper Confidence Interval	19.281	5	0

**Station: upstream run**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	40	10	0
Population Estimate	50	11	0
Lower Confidence Interval	40	10	0
Upper Confidence Interval	67.936	16.422	0

**TOTAL: Site LG-1**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	53	15	0
Population Estimate	64	16	0

**SITE: LG-3****Station: single pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	118	10	1
Population Estimate	120	10	1
Lower Confidence Interval	118	10	1
Upper Confidence Interval	124.078	11.253	1

**TOTAL: Site LG-3**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	118	10	1
Population Estimate	120	10	1

**SITE: LG-5****Station: downstream run**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	86	1	2
Population Estimate	98	1	2
Lower Confidence Interval	86	1	2
Upper Confidence Interval	112.663	1	2

**Station: upstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	56	3	45
Population Estimate	75	3	45
Lower Confidence Interval	56	3	45
Upper Confidence Interval	103.723	3	46.015

**TOTAL: Site LG-5**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	142	4	47
Population Estimate	173	4	47

**SITE: LG-7****Station: downstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	68	2	0
Population Estimate	77	2	0
Lower Confidence Interval	68	2	0
Upper Confidence Interval	89.554	2	0

**Station: upstream run**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	68	3	9
Population Estimate	84	3	9
Lower Confidence Interval	68	3	9
Upper Confidence Interval	104.957	3.504	95.875

**TOTAL: Site LG-7**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	136	5	9
Population Estimate	161	5	9

**SITE: LG-9****Station: upstream riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	128	6	0
Population Estimate	155	6	0
Lower Confidence Interval	129.048	6	0
Upper Confidence Interval	180.952	6.967	0

**Station: downstream run**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	135	0	0
Population Estimate	171	0	0
Lower Confidence Interval	137.448	0	0
Upper Confidence Interval	204.552	0	0

**TOTAL: Site LG-9**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	263	6	0
Population Estimate	326	6	0

**SITE: LG-12**

**Station: downstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	21	0	4
Population Estimate	21	0	4
Lower Confidence Interval	21	0	4
Upper Confidence Interval	21.916	0	4

**Station: middle riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	29	0	0
Population Estimate	29	0	0
Lower Confidence Interval	29	0	0
Upper Confidence Interval	30.532	0	0

**Station: upstream run**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	15	0	0
Population Estimate	17	0	0
Lower Confidence Interval	15	0	0
Upper Confidence Interval	24.044	0	0

**TOTAL: Site LG-12**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	65	0	4
Population Estimate	67	0	4

**SITE: 15.86**

**Station: single pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	36	0	24
Population Estimate	54	0	33
Lower Confidence Interval	36	0	24
Upper Confidence Interval	89.925	0	54.794

**TOTAL: Site 15.86**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	36	0	24
Population Estimate	54	0	33

**SAN GERONIMO CREEK****SITE: SG-1****Station: downstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	95	8	8
Population Estimate	104	8	8
Lower Confidence Interval	95	8	8
Upper Confidence Interval	114.937	8.686	10.496

**Station: middle run**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	163	1	0
Population Estimate	172	1	0
Lower Confidence Interval	163	1	0
Upper Confidence Interval	181.256	1	0

**Station: upstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	96	0	0
Population Estimate	118	0	0
Lower Confidence Interval	96	0	0
Upper Confidence Interval	142.554	0	0

**TOTAL: Site SG-1**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	354	9	8
Population Estimate	394	9	8

**SITE: SG-2****Station: downstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	90	15	15
Population Estimate	108	15	18
Lower Confidence Interval	90	15	15
Upper Confidence Interval	128.76	16.648	27.99

**Station: middle riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	31	2	0
Population Estimate	32	2	0
Lower Confidence Interval	31	2	0
Upper Confidence Interval	35.878	2	0

**Station: upstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	126	27	14
Population Estimate	139	27	14
Lower Confidence Interval	126	27	14
Upper Confidence Interval	152.523	28.153	15

**TOTAL: Site SG-2**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	247	44	29
Population Estimate	279	44	32

**SITE: SG-3****Station: downstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	27	16	7
Population Estimate	42	16	11
Lower Confidence Interval	27	16	7
Upper Confidence Interval	77.722	17.047	33.896

**Station: upstream riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	7	0	0
Population Estimate	7	0	0
Lower Confidence Interval	7	0	0
Upper Confidence Interval	8.997	0	0

**TOTAL: Site SG-3**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	34	16	7
Population Estimate	49	16	11

**SITE: SG-4****Station: single pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	103	24	7
Population Estimate	125	24	7
Lower Confidence Interval	103	24	7
Upper Confidence Interval	148.573	25.556	9.127

**TOTAL: Site SG-4**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	103	24	7
Population Estimate	125	24	7

**DEVIL'S GULCH****SITE: DG-1****Station: downstream riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	21	0	0
Population Estimate	21	0	0
Lower Confidence Interval	21	0	0
Upper Confidence Interval	21.975	0	0

**Station: middle run/pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	24	1	1
Population Estimate	24	1	1
Lower Confidence Interval	24	1	1
Upper Confidence Interval	26.436	1	1

**Station: upstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	44	8	5
Population Estimate	65	8	5
Lower Confidence Interval	44	8	5
Upper Confidence Interval	102.231	8.875	6.088

**TOTAL: Site DG-1**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	89	9	6
Population Estimate	110	9	6



**SITE: DG-2**

**Station: downstream riffle**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	18	2	0
Population Estimate	19	2	0
Lower Confidence Interval	18	2	0
Upper Confidence Interval	23.675	2	0

**Station: middle 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: middle pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	65	15	10
Population Estimate	84	16	10
Lower Confidence Interval	65	15	10
Upper Confidence Interval	110.21	20.531	11.944

**Station: upstream pool**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	23	6	5
Population Estimate	24	6	5
Lower Confidence Interval	23	6	5
Upper Confidence Interval	28.02	6.967	8.3

**TOTAL: Site DG-2**

	0+ Steelhead	1+ Steelhead	Coho
Total Catch	106	23	15
Population Estimate	127	24	15

**APPENDIX C**

**2000 EXTRAPOLATED SALMONID POPULATION ESTIMATES BY STREAM**

**Lagunitas Creek - Total:** Gallagher Cascade to Peters Dam

**Total Habitat:**

Total Reach Length=48,774 ft. \*Note: does not include 1198 ft. of cascades and plunge pools

Riffle=8% (3,858 ft.) Run=30% (14,506 ft.) Pool=62% (30,420 ft.)

**Fish Habitat - Sites LG1, LG3, LG5, LG7, LG9, LG12, and LG15.86:**

Total Length of Habitats Sampled=1807ft.

Riffle=8% (152 ft) Run=34% (609 ft.) Pool=58% (1046 ft.)

**Fish Population Estimates from Sites Sampled:** (see Appendix B)

	<u>0+ SH</u>	<u>1+ SH</u>	<u>Coho</u>
Riffle	184	6	0
Run	420	15	11
Pool	361	20	59
Total	965	41	70

**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 = 184 fish/152 ft = 1.211 fish/ft x 3858 ft of riffle = 4670  
 Run = 420 fish/609 ft = 0.69 fish/ft x 14506 ft of run = 10004  
 Pool= 361 fish/1046ft= 0.345 fish/ft x 30420 ft of pool = 10499  
25173

1+ SH

Riffle = 6 fish/152 ft = 0.039 fish/ft x 3858 ft of riffle = 152  
 Run = 15 fish/609 ft = 0.025 fish/ft x 14506 ft of run = 357  
 Pool= 20 fish/1046ft= 0.019 fish/ft x 30420 ft of pool = 582  
1091

Coho

Riffle=0  
 Run = 11 fish/609 ft = 0.018 fish/ft x 14506 ft of run = 262  
 Pool= 59 fish/1046ft= 0.056 fish/ft x 30420 ft of pool = 1716  
1978

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

**Total Habitat:**

Total Reach Length=23,477 ft.      \*Note: does not include 1341 ft. of cascades and plunge pools

Riffle=12% (2845 ft.)    Run=14% (3358 ft.)      Pool=74% (17,274 ft.)

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

Total Length of Sites Sampled=889 ft.

Riffle=13% (114 ft.)    Run=10% (88 ft.)      Pool=77% (687 ft.)

**Fish Population Estimates from Sites Sampled:** (see Appendix B)

	<u>0+ SH</u>	<u>1+ SH</u>	<u>Coho</u>
Riffle	32	2	0
Run	172	1	0
Pool	636	90	58
Total	840	93	58

**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 = 32 fish/114 ft = 0.281 fish/ft x 2845 ft of riffle = 799  
 Run = 172 fish/88 ft = 1.955 fish/ft x 3358 ft of run = 6563  
 Pool= 636 fish/687ft= 0.926 fish/ft x 17274 ft of pool = 15992  
23,354

1+ SH

Riffle = 2 fish/114 ft = 0.018 fish/ft x 2845 ft of riffle = 50  
 Run = 1 fish/88 ft = 0.011 fish/ft x 3358 ft of run = 38  
 Pool= 90 fish/687ft= 0.131 fish/ft x 17274 ft of pool = 2263  
2,351

Coho

Riffle=0  
 Run=0  
 Pool= 58 fish/687ft= 0.084 fish/ft x 17274 ft of pool = 1458  
1,458

**Devils Gulch** (Mouth to 11,078 feet)

**Total Habitat:**

Total Reach Length=10,889 ft.      \*Note: does not include 189 ft. of cascades  
and plunge pools

Riffle=37% (3915 ft.)      Run=7% (699 ft.)      Pool=57% (6086 ft.)

**Fish Survey Habitat-Devils Gulch**

Total Length of Sites Sampled=384 ft.

Riffle=30% (116 ft.)      Run=10% (39 ft.)      Pool=60% (229 ft.)

**Fish Population Estimates from Sites Sampled:** (see Appendix B)

	<u>0+ SH</u>	<u>1+ SH</u>	<u>Coho</u>
Riffle	39	2	0
Run	24	1	1
Pool	173	30	20
Total	236	33	21

**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 = 39 fish/116 ft = 0.336 fish/ft x 3915 ft of riffle = 1316  
Run = 24 fish/39 ft = 0.615 fish/ft x 699 ft of run = 430  
Pool= 173 fish/229ft= 0.755 fish/ft x 6086 ft of pool = 4598  

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6344

1+ SH

Riffle = 2 fish/116 ft = 0.017 fish/ft x 3915 ft of riffle = 68  
Run = 1 fish/39 ft = 0.026 fish/ft x 699 ft of run = 18  
Pool= 30 fish/229ft= 0.131 fish/ft x 6086 ft of pool = 797  

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883

Coho

Riffle=0 fish  
Run = 1 fish/39 ft = 0.026 fish/ft x 699 ft of run = 18  
Pool= 20 fish/229ft= 0.087 fish/ft x 6086 ft of pool = 532  

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550

## **APPENDIX D**

### **2000 SURVEY DATA**

(not included in the KRIS edition of this document in interest of saving memory space)