



SALMON PROTECTION AND WATERSHED NETWORK

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Relocation of Stranded Native Fishes from Isolated Pools in the San Geronimo Creek System in 2002

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Summary

In 2002, the fourth year of SPAWN's salmonid rescue and relocation program, a total of 2,631 salmonids (2,084 coho, 547 steelhead) in imminent danger of mortality were relocated to flowing water downstream in the San Geronimo Creek system within the Lagunitas Creek Watershed. Fish were relocated from drying pools in Arroyo Creek, Barranca Creek, Larsen Creek, Evans (formerly Bates) Canyon Creek, Woodacre Creek, North Fork of San Geronimo Creek, and the lowest Pool of Roy's Pools on San Geronimo Creek. No juvenile salmonids were relocated from El Cerrito, Montezuma, Creamery and Deer Camp Creeks. Stranded salmonids were observed in Montezuma creek but they perished before crews were able to relocate them. Two dead fish were found (one on Larsen and one on Woodacre Creek). Two steelhead with bent spines were documented on North Fork San Geronimo Creek. One coho was noted with 2 tumors posterior of its pectoral fins. Since all three of these individuals were alive, video documentation was recorded and the individuals were released downstream. Additional native species relocated included 16 california roach (*Hesperoleucus symmetricus*), 11 sculpin (*Cottus* sp.), 1 three spine stickleback (*Gasterosteus aculeatus*). In addition, one exotic large mouth bass (*Micropterus salmoides*) was again discovered in Larsen creek as well. Temperature in isolated pools ranged from 11-23° C in all tributaries. The highest temperature was at Roys' Pools, a site where a re-vegetation project will address this problem. Since this program began in 1999 under permits from the National Marine Fisheries Service (NMFS) and California Department of Fish and Game (DFG)¹, a total of 7,727 salmonids have been relocated.

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¹ NMFS permit #1162 and a CDFG permit

Introduction

Coho salmon and steelhead trout (*Oncorhynchus mykiss*) are found in the Lagunitas Creek Watershed, Marin County (LCW). Both species in this region (Central California Coast Evolutionary Significant Unit) are listed as 'threatened' under the Endangered Species Act. The National Marine Fisheries Service (NMFS) is presently considering uplisting the coho to 'endangered' in this unit. Coho are also considered 'endangered' by the State of California. The approximate 500 coho that return to this watershed annually are considered to be one of the more robust populations in the state. However, their abundance in this watershed are estimated to be a fraction of historical numbers. Chinook salmon (*Oncorhynchus tshawytscha*) and chum salmon (*Oncorhynchus keta*) have also been documented in the LCW in recent years. However neither of these species have been documented in the tributaries to San Geronimo Creek.

This report is a documentation of relocation efforts for the 2002 season within the San Geronimo Valley. Background and information on the populations and motivation for conducting this effort are described in previous reports (See Walder, R.K. and Steiner T. 2001. Relocation of stranded native fishes from isolated pools in the San Geronimo Creek system - 2001).

Methods

Streams were surveyed to determine presence and absence of salmonids and monitored to determine water flow, depth and temperature in pools from April - October 2002. As it became apparent that pools would dry completely and based on current and previous years observations at known sites, relocation efforts were begun. Crews would delay efforts as long as possible in an effort to maximize resident time in their natal stream habitat. Relocation began in Mid July (in part due to administrative processing of our permit).

Fish were dip-netted out of pools and placed in insulated coolers equipped with a battery operated aerator. Approximately every 15-45 minutes, captured fish were transported to a perennial flow section downstream on their natal tributary or to San Geronimo Creek at or downstream of the confluence where they would have passed had they not become stranded. The exact release location was dictated by the availability of nearby pool habitat and issues of access on private property. To assure that pools where fish were relocated to were not overstocked, researchers relocated fish to several pools along stretches and made sure to release into pools where connectivity would allow fish to migrate both upstream and downstream.

Upon capture of fish, individuals were identified and lengths measured and stream conditions recorded. In some cases, measurements were done on a random sample of fish, especially if hundreds were caught at a site. On occasion, particularly when air temperature was 32° C or higher, fish were identified but not measured in order to rapidly relocate them with minimal stress.

To further minimize disturbance and stress to fish, pools were netted for no more than 30 minutes. Netting was done by gently but swiftly sweeping a net through the water. If fish mortalities occurred, individuals were collected and frozen for delivery to NMFS. Notes were made of how each incident occurred and efforts were modified to prevent further mortalities.

Results

Ten tributaries to San Geronimo Creek were surveyed for salmonids and habitat conditions between April and October 2002 (Arroyo, Barranca, El Cerrito, Montezuma, Larsen, Creamery, Deer Camp, Bates Canyon, Woodacre Creek, and North Fork San Geronimo) as well as Roy's Pools on San Geronimo Creek itself (Figure 1). Relocation efforts were conducted on all tributaries surveyed except El Cerrito, Montezuma, Creamery and Deer Camp. Coho were located on Montezuma Creek near the confluence with San Geronimo Creek but fish perished before relocation efforts commenced.

Water temperatures in creeks ranged from 8 –23° C, reaching their highest in Roy's Pools (Table 1). This high temperature exceeded threshold temperatures reported necessary to maintain growth for coho and approached or exceeded sub-lethal temperatures reported in some studies (Hines and Ambrose unpublished data, Welsh et al. 2001). The combination of the high temperatures with direct sunlight exposure caused alga and aquatic plant blooms inundating available habitat. As the algae and plants decayed, oxygen levels likely dropped potentially compromising salmonid survival. Temperatures in all other creeks remained moderate until the point they went dry.

A total of 2,631 salmonids (2,084 coho, 547 steelhead) were successfully relocated (**Figure 2**) and included 302 coho and 289 steelhead in Arroyo Creek, 0 coho and 43 steelhead in Barranca Creek, 874 coho and 0 steelhead in Larsen Creek, 0 coho and 4 steelhead in Evans (formerly Bates) Canyon Creek, 461 coho and 15 steelhead in Woodacre Creek and 432 coho and 195 steelhead in North Fork of San Geronimo Creek, as well as 15 coho and 1 steelhead from the lowest Pool of Roy's Pools on San Geronimo Creek. Two dead fish were found (one on Larsen and one on Woodacre Creek). Additional native species relocated included 16 california roach (*Hesperoleucus symmetricus*), 11 sculpin (*Cottus* sp.), 1 three spine stickleback (*Gasterosteus aculeatus*). In addition, one exotic large mouth bass (*Micropterus salmoides*) was again discovered in Larsen creek as well.

Specific description of relocation efforts for each site are listed below:

Arroyo - 591 salmonids (302 coho and 289 steelhead) as well as 7 sculpin and 1 stickleback were relocated from the lower 400 meter stretch of this creek before most of it went dry in mid October. We noted that some sections in the this stretch were dry by the end of September. Most of the upper stretch remained flowing throughout the summer. However, a 150 meter section in this stretch was not surveyed due to inability to access. Temperatures ranged from 11.5 - 21° C.

Barranca - The lower 50 meter stretch of this creek was noted to cease flowing by approximately late April. By early July, there were 2-3 isolated pools in this stretch where salmonids were relocated from. By October, 2 isolated pools were noted in a section 50-100 meters upstream of the confluence where relocation efforts were conducted. In total, 43 steelhead were relocated. Temperatures ranged from 10.5-20° C.

El Cerrito - No fish were located from this tributary in 2002. In previous years, only steelhead have been located in this creek, probably due to culvert migration barriers that favor limited steelhead passage. A woody debris jam located on the lower stretch of this creek in combination with low rainfall during steelhead migration may explain the lack of activity this year (see discussion). By early June the lower 300 m of this creek went dry. Flow continued in the upper portion throughout the summer.

Montezuma – No fish were relocated, though coho juveniles were seen in the lower reach of this tributary (45 m upstream of the confluence with San Geronimo Creek), just below the first culvert. However, the lower 600 m of this tributary went dry in late May before crews could relocate these individuals. Temperatures remained cool on this tributary until it went dry.

Larsen – Prior to the lower 450 meter stretch of this tributary going completely dry in late August, 874 coho and no steelhead were relocated while the upper stretch maintained flow throughout the summer. One exotic large mouth *bass* (*Micropterus salmoides*) was noted in a drying pool. This exotic species was not removed and did not survive when the pool went dry 2 days later. One coho was discovered with a tumor posterior of the pectoral fins. The tumor was 5-8 mm in diameter and was noted to have some fine material protruding from at least 2 locations. Video footage was taken of this fish and it was released downstream. In addition, 1 dead coho (68mm) was discovered in a pool prior to relocation activities. The individual was collected for delivery to the NMFS laboratory for genetic analysis. Temperatures ranged from 12.5 to 16.5° C.

Creamery - No fish were located. The culvert at the Creamery and the San Geronimo Creek confluence is likely a complete barrier to upstream migration.

Roy's Pools, San Geronimo Creek– Water continued to flow year-round through the adjacent fish ladder at this site but ceased cascading through the pools in late May isolating fish in all three pools. The upper and middle pools maintained sufficient water level all summer, while the lowest pool lost more than 75 percent of its water volume by June. Crews relocated 15 coho, 1 steelhead and 16 roach from the lowest pool in October.

Visual surveys in the upper 2 pools indicated that hundreds of steelhead (Young of the Year - YOY through 2+), coho (YOY and smolts), roach and stickleback were once again trapped within them. Water temperatures in pools ranged between 9.5 and 23° C which was recorded within a algae mat on the surface of the middle pool. This temperature, was the highest recorded from all creeks surveyed. However, researchers noted that temperatures at the bottom of pools only reached a maximum of 19° C.

Algae was again removed from the pools every 2-3 weeks to allow for salmonids to feed and prevent anoxic conditions which would result from their decay.

Deer Camp - No salmonids were relocated from this tributary in summer 2002 and the creek maintained flow throughout the year. A creek diversion on the lower stretch likely prevents all stages of salmonids from migrating upstream at present.

Evans Canyon – This creek maintained flow throughout the summer except for a short 20 foot section in the upper stretch which went dry in late August from which 4 steelhead were relocated. A more imminent threat to salmonids was their inability to migrate downstream through a cement box culvert where researchers noted, as in the previous 2 summers, that water flow was passing underneath the cement box culvert that passes under San Geronimo Valley Drive. Apparently the culvert has eroded such that water flow percolates underground and re-surfaces on the other side of the culvert. Temperatures ranged from 8-11° C. Funding has been secured to remove and replace this culvert in summer 2004 through a collaborative project of the County of Marin and SPAWN.

Woodacre - Flow continued year-round in the lower 500 meters of this tributary (between San Geronimo Valley Drive and Carson Road) and no relocation occurred there. The upper two forks (East Fork and West Fork of Woodacre Creek) ceased flowing by May. Rescue of 461 coho and 15 steelhead occurred exclusively in these upper forks, particularly within the east fork adjacent the Woodacre Improvement Club. One very decomposed juvenile steelhead was noted in a pool prior to relocation efforts for one of the relocation days. Since relocation efforts had been occurring in this area for several days prior, it is possible that this mortality may be related to the past efforts. However, natural mortalities do occur in conditions such as this. The specimen was not collected since it was so badly decomposed and would not have provided sufficient genetic material. All pools on both forks were noted to be completely dry by late August. Temperatures throughout the creek remained between 8 and 12° C.

North Fork San Geronimo (Upstream of Woodacre - San Geronimo Confluence) – Fish were again relocated from the stretch between the confluence of Woodacre Creek a 10' tall dam located ~400m upstream on Dixon Ranch. Before the entire stretch went dry in September, SPAWN crews relocated 432 coho, 195 steelhead and 4 sculpin. Temperatures ranged from 9-13.5° C.

Discussion

In 2002, the vast majority of juvenile salmonids relocated were coho (78 percent), and the remainder steelhead, a reversal of trends from previous years. In comparison, in 2001, only 13 percent of relocated salmonids were coho. Not surprisingly, these numbers reflect a doubling in the number of spawning salmon located in these tributaries and an all time high for counts in the entire watershed in recent years in the 2001/02 spawning season (Walder and Steiner, 2002; Ettliger and Andrew, 2001). In addition, 579 more individual salmonids (~ 27 percent) were relocated than the previous year. Yet this increase likely reflects an increase in effort rather than a reflection of actual population size.

In addition, light and irregular rainfall allowed for some smolt and young of the year (YOY) to migrate downstream before flows cease on these tributaries. However, greater numbers of salmonids may have been stranded due to the irregular pattern. In effort to understand out-migration patterns and ecological processes related to their movement, SPAWN has submitted a permit request to the NMFS and CDFG to conduct out-migrant studies on some of these tributaries. If these studies proceed, they will provide necessary data to determine how many juveniles are able to migrate downstream in spring prior tributaries losing connectivity with San Geronimo Creek and allow a better understanding of the relative importance of productivity of these tributaries to salmonid reproduction and survival.

The relative increase in individuals relocated is most likely explained by rainfall patterns during the winter spawning season that allowed coho access to tributaries, most of which require navigating through culverts that impede migration under most water flow conditions. The majority of rainfall occurred October through January, coinciding with the peak coho migration. Much less rainfall occurred in January through March, when presumably the peak steelhead migration occurs and juvenile downstream migration occurs..

Improvement of fish passage at these culverts and other migration barriers would likely result in an increase of available spawning habitat for coho particularly in years when rainfall patterns do not prove to be ideal for upstream or downstream juvenile and adult migration. SPAWN has completed a study of select migration barriers in the San Geronimo Valley and is developing plans for repair of high priority sites (Walder et al., 2002)

We have noted exotic fish (Large mouth bass and or bluegill) on Larsen creek for the third consecutive year. We are most certain that these fish are entering the system from a pond that Larsen creek is diverted through on the San Geronimo Golf Course. The large mouth bass, in particular, is piscivorous and will prey on smaller fishes (McGinnis, 1984) including salmonids. Bluegill are varied in their food source consumption (McGinnis, 1984), and, it is assumed that they will also consume juvenile salmonids. Both species are quite fecund and each female can produce up to 100,000 and 50,000 eggs per nest respectively (McGinnis, 1984). In October, SPAWN crews installed 1/4" mesh screen on the drain outlet to prevent further non-natives introductions. However, the mesh caused clogging and drainage problems and was subsequently removed. SPAWN is working with the owners of the pond (San Geronimo Golf Course) to design and install a screen that will not clog, while preventing exotics from reaching the creek system.

The presence of deformities found in three fish has never been documented in the 4 years of this effort. Since these individuals were all alive when discovered they were released downstream. Researchers from the Marin Municipal Water District have noted salmonids with bent spines in past years (E. Ettlinger, Pers. comm.) that may be present in the San Geronimo Creek system. SPAWN will discuss the issue of collection on any other deformed fish located in the future with proper agencies to determine if these individuals would be useful for additional study. Yet, no record of tumors has been noted before. Deformities in salmonids have been linked to

an array of pesticides and other chemicals (See Ewing, 1999) researchers should assure to collect individuals who exhibit similar symptoms regardless of whether they are dead or alive.

During relocation efforts, salmonids were relocated to several pools rather than depositing all individuals into one pool. This was done to minimize over-stocking pools with too many fish. In addition, effort was made to assure that relocation sites were not near sites near those of other researchers (e.g. UC Davis and MMWD) who are conducting juvenile salmonid population estimate studies. SPAWN will continue to coordinate with these and other researchers in the watershed.

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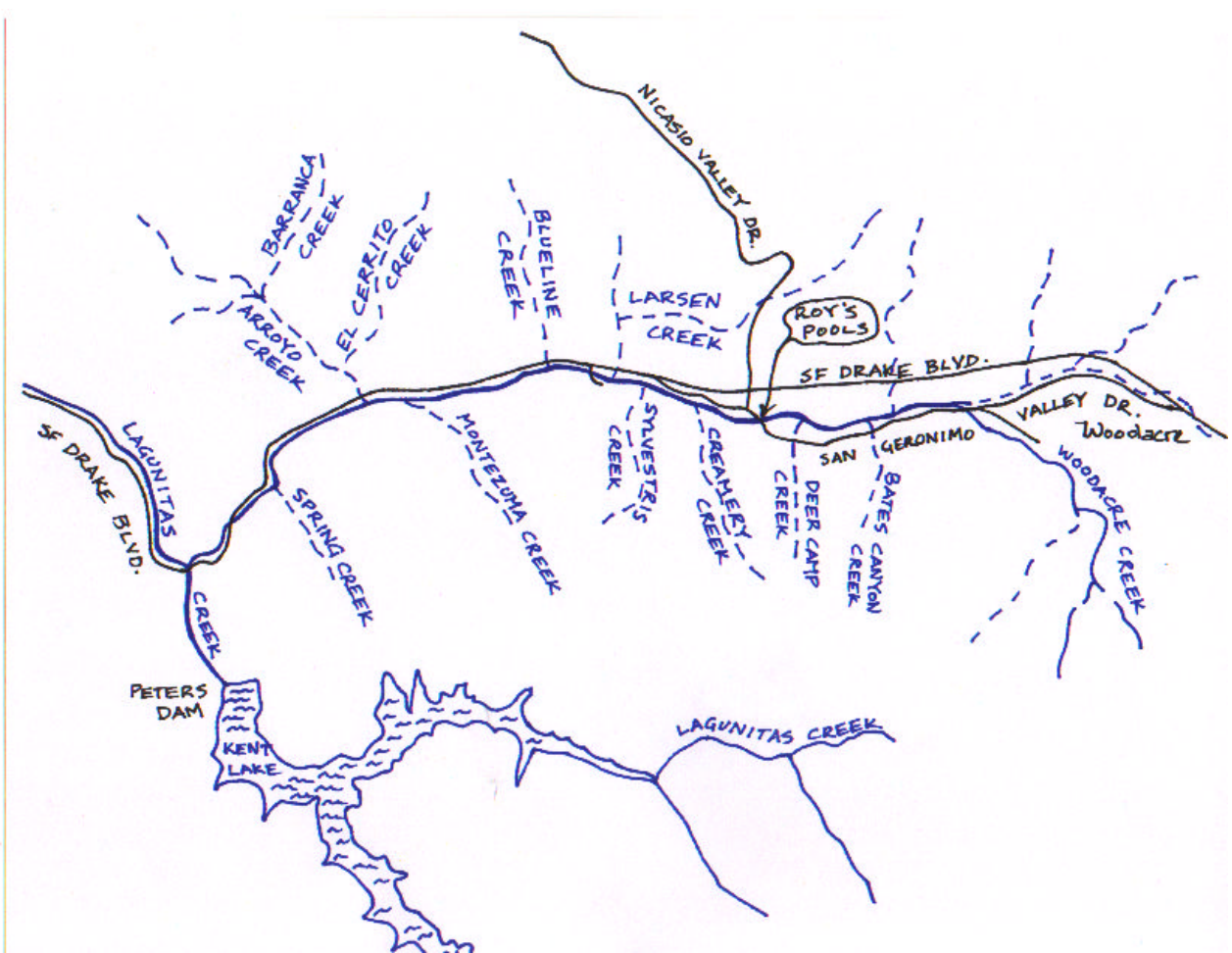
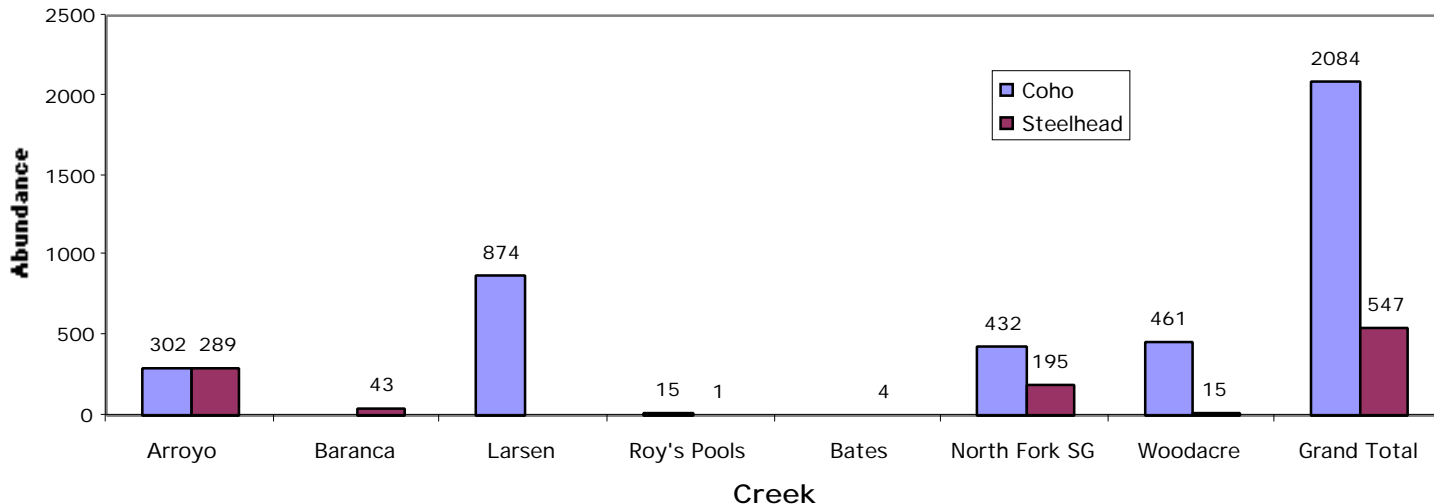


Figure 1. Map of San Geronimo Creek and it tributaries.

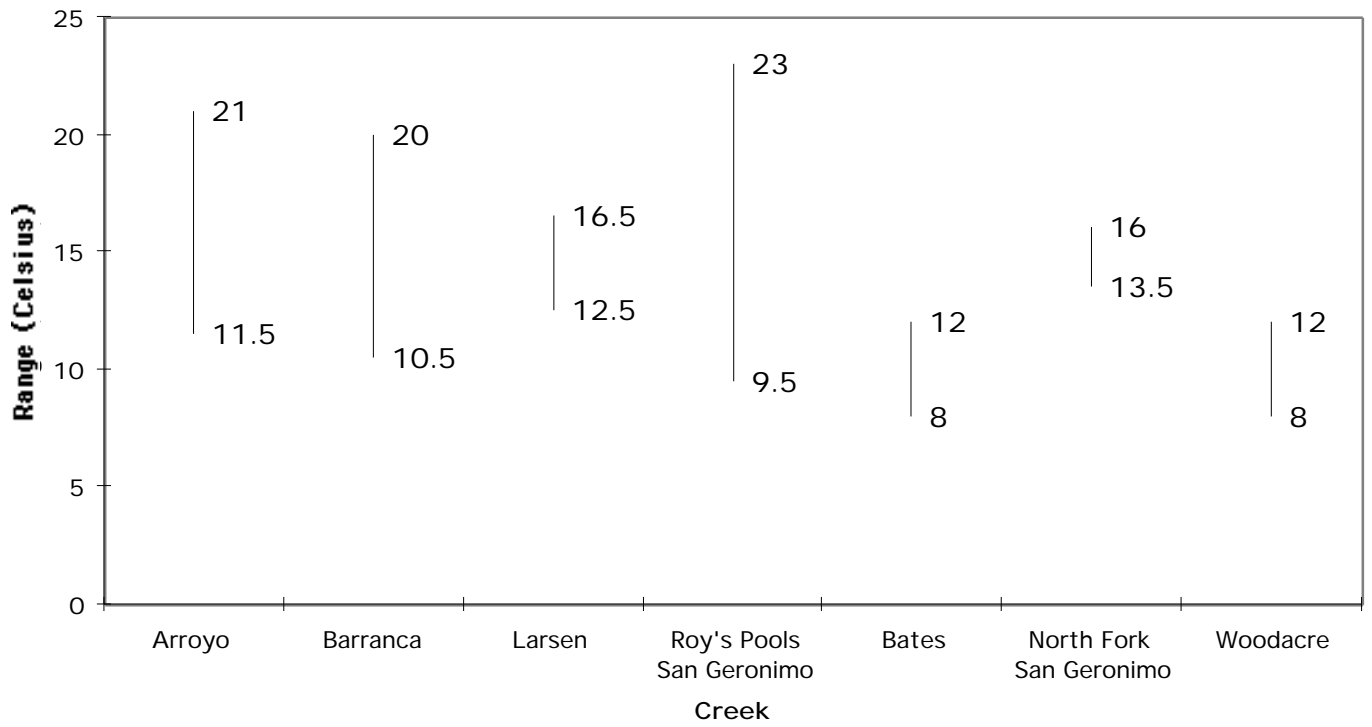
Juvenile Salmonid Relocation Effort - Summer 2002



Range and Average Size

Creek	Average Coho (mm)	Range (mm)	Average Steelhead (mm)	Range (mm)
Arroyo	62	40-94	50	35-131
Barranca	*	*	75	56-122
Larsen	60	40-94	80	80-80
Roy's Pools	86	78-100	186	186-186
Bates	*	*	119	102-159
North Fork SG	63	40-134	60	48-80
Woodacre	57	42-80	65	20-67

Figure 2. Relocation efforts were conducted between 7/15/02 and 10/15/02. A total of 2631 juvenile salmonids (2084 coho, 547 Steelhead) were relocated during this period. * Indicates species not relocated.



Temperature Ranges