



SALMON PROTECTION AND WATERSHED NETWORK

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Relocation of stranded native fishes from isolated pools on the tributaries of San Geronimo Creek (2000).

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Summary

The coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*) populations of the Lagunitas Watershed have suffered a 90% decline in the last 50 years. In an effort to protect and enhance the remaining salmonid populations, researchers commenced a program to relocate stranded juvenile salmonids from isolated pools on tributaries in the San Geronimo Creek system. Eight tributaries of San Geronimo Creek (Arroyo, Barranca, El Cerrito, Montezuma, Larsen, Deer Camp, Bates Canyon and Woodacre Creek) as well as two sites on San Geronimo itself (SG Creek in Woodacre and Roys Pools) were examined between May and October 2000 (Figure 1). Researchers noted presence of fish, stream flow and water temperature when possible. No fish were found on El Cerrito Montezuma, Deer Camp and Bates Canyon Creeks. The latter two maintained year-round flows. Researchers noted that the greatest risk to fish found in isolated pools was the rapid decline in water level as well as predation mostly from raccoons. Temperature did not appear to be of concern since pools generally remained between 11 and 15(C). At only one site (Roy's Pools) did temperatures reach 19(C). A total of 1716 salmonids, 1512 confirmed steelhead and 204 others that were likely steelhead, were relocated from isolated pools on tributaries. Few spawning adult coho returned to the tributaries of San Geronimo Creek during the winter 1999/2000. The late and irregular rainy season is likely the cause of this. Therefore, researchers feel that the few unidentified fish are likely steelhead. Several exotic species were also caught in Larsen Creek including 4 large mouth bass (*Micropterus salmoide*), 8 bluegill (*Lepomis macrochirus*), 17 mosquitofish (*Gambusia affinis*) and 2 bullfrog tadpoles (*Rana catesbeiana*). It is likely that the bass and bluegill originated in a pond where water from Larsen Creek is diverted through. While this program can potentially help to protect and enhance the remnant salmonid populations in the Lagunitas watershed, efforts by policy makers and agencies to protect these populations should focus on reducing the amount of sedimentation, water diversion and water impoundment.

Introduction

California salmonid populations have experienced a significant decline in the past 150 years. Throughout the state, their numbers have dramatically declined to a small remnant of what was originally noted in the 1850's when California's stream habitats and landscape were first heavily settled. Coho salmon (*Oncorhynchus kisutch*) were historically noted in at least 582 streams from the Smith River near the Oregon border to the San Lorenzo River on the central coast (Brown et al. 1994). Today there are probably less than 5000 native fishes remaining statewide. Many streams have populations of less than 100 individuals

Coho salmon and steelhead trout (*Oncorhynchus mykiss*) are commonly found in the Lagunitas watershed, Marin county. Both species in this region (Central California Evolutionary Significant Unit) are listed as threatened under the Endangered Species Act. The approximate 500 coho that return to this watershed annually are considered to be the healthiest population in the state. However, their numbers in this watershed are down 90% from 3000-6000 individuals indicated in historic records 50 – 100 years ago.

Reasons for the decline statewide include dam construction, which eliminated significant spawning and juvenile habitat, reduction of water quantity caused by water impoundment, removal of water from creeks by pumping. Other impacts include, overfishing, urbanization resulting in habitat degradation, increased sedimentation, pollution from pesticide use, septic systems and runoff from roads as well as livestock operations.

The spawning grounds of the San Geronimo creek and its tributaries are a vital component of coho and steelhead survival in the Lagunitas watershed. However, juvenile coho and steelhead in San Geronimo and its tributaries become stranded when rains cease and water flows become intermittent, causing some pools to become isolated. As summer progresses, water levels in these pools decrease often disappearing resulting in certain death for salmonids and some other species. High temperatures is also of concern, particularly in pools with little or no canopy cover above and high summer ambient temperatures. The upper lethal temperature for juvenile coho is 25 C (Sandercock, 1991). Optimum rearing temperatures for steelhead is between 7 and 15 C and the upper lethal limit is recorded to be 23.6 C (Barnhart, 1991).

SPAWN recognized that salmonid mortality in drying pools was jeopardizing the already fragile populations of coho and steelhead. Therefore fishes were relocated from isolated pools and transported to pools with steady flow. This report is a presentation of these rescue efforts from May to October 2000.

Methods

To determine the jeopardy of fish in tributaries, researchers surveyed stream habitats to determine presence and absence of salmonids and assessed water flow, water level and temperature in pools from May through October 2000. As the summer progressed and some tributaries began to break into isolated pools, the presence of trapped salmonids, water temperature and pool depth was periodically noted.

As water levels decreased, and based on last year's observation, it was apparent that pools would dry completely. Therefore, 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 in coolers were transported to a perennial flow section downstream on the tributary of capture or near the confluence of San Geronimo Creek and the tributary. The exact release location in San Geronimo Creek was dictated by issues of access on private property and the availability of pool habitat nearby. Nonetheless, all fish were re-located to San Geronimo Creek and always within 500 m of the confluence. Because the time between capture and release was short, and because the battery operated aerator seemed to cause significant agitation of fish, use of the aerator was eventually limited to occasions when holding time was >30 minutes or the density of fish in the cooler was high.

Upon capture of fish, individuals were identified and lengths measured. In some cases, measurements were done on a random sample of fish, especially if hundreds were caught. On occasion fish were captured, placed in coolers and rapidly relocated to a new site without identification. Researchers felt that this was important, particularly when fish appeared stressed and air temperature was 90⁰ or higher.

Every effort was made to minimize disturbance to fishes in isolated pools. Rescue efforts were conducted by trained staff and volunteers. Pools were netted for no more than 1 1/2 hours to minimize potential stress to fish. Netting was done by gently but swiftly sweeping a net through a pool in attempt of capturing stranded fishes. If fish mortalities occurred, they were collected. Notes were made of how each incident occurred and efforts were modified to prevent further mortalities.

Results

Nine tributaries were surveyed for salmonids between May and October 2000 (Figure 1). Eight of these creeks (Arroyo, Barranca, El Cerrito, Montezuma, Larsen, Deer Camp, Bates Canyon and Woodacre Creeks aka Redwood Creek) are tributaries that eventually drain into San Geronimo Creek. In addition, two locations on San Geronimo Creek itself (SG Creek in Woodacre and Roys Pools) were surveyed. Relocation efforts were conducted 22 times on all tributaries surveyed except El Cerrito and Montezuma, Deer Camp and Bates Canyon. Salmonids were not located on these four tributaries and the latter two maintained year-round flows.

Water temperatures in the streams remained relatively constant (11-15 C). In some locations, such as Roy's Pools, temperatures reached upwards of 19(C). Water temperature in a pond on Larsen Creek located in the San Geronimo Golf Course was 25(C). Water from this pond is occasionally pumped into the creek. Since temperatures were not as extreme as years past, temperature did not appear to be an imminent threat to fishes observed in isolated pools. In fact, temperatures remained moderate until the point that water disappeared.

A total of 1,716 salmonids were relocated from pools to flowing stretches of creek (Figure 2, Table 1). For surveys done on Woodacre Creek and San Geronimo Creek in Woodacre some fish were not identified. This composed of 204 of the 1,716 relocated fishes (~12%).

Three mortalities of steelhead resulted from relocation efforts on three separate occasions. This represents a fraction of a percent (0.002%) of total fish rescued. Examination of 2 of these fishes indicated that injury was likely caused by dip nets pinning fish to the substratum when nets were swept through pools. The third fish was found outside of the bucket on the ground. Two other dead fish were seen in one pool on Larsen Creek unrelated to netting activities. Water samples are being analyzed to determine if mortality was related to substances potentially introduced into the pool. All fishes were collected and sent to Bodega Bay Marine Lab (BBML) for genetic studies.

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

El Cerrito- This tributary was surveyed on 6/11/00. The creek passes through a culvert under Arroyo Road located 30m upstream of the confluence with Arroyo Creek. A second culvert under El Cerrito Road is located another 15m upstream. The stretch upstream of the culverts offers significant potential spawning habitat. Yet, the culvert appears to be a restriction to passage as fish would have to jump several feet to enter the culvert. Nevertheless, residents have reported seeing adult and juvenile salmonids above and below these culverts (Patty Krieglner and Henny Pers. comm.). Improvement of these fish passages would likely increase upstream migration and spawning on this creek.

Deer Camp - Deer Camp is located in a small steep canyon. The creek passes through a culvert under San Geronimo Valley Drive which appears to be a barrier to fish passage. While no fish were seen here and the stream did not go dry in 2000, steelhead and possibly coho have been sighted both north and south of the culvert in the past 40 years

(Willis Evans, Pers. comm.). Improvement of this fish passage would be beneficial for populations.

Bates Canyon – The creek in Bates Canyon is located in a small steep canyon and it also passes through a culvert under San Geronimo Valley Drive. This creek did not go dry nor were any fish seen in 2000. Unidentified juvenile salmonids have been sighted here, both north and south of the culvert, in previous years (Willis Evans, Pers. comm.).

Montezuma - No salmonids were sighted here. In recent years, coho salmon have been observed spawning in this tributary and juveniles have been seen at various locations along the first ~1,000 meters of this stream (Todd Steiner, Pers. obs.).

Larsen – This tributary passes through the Lagunitas School District and the San Geronimo Golf Course. Water temperatures in isolated pools remained cool (13-15 C) until the time that streams went dry. Rescue operations occurred between June 19 and August 26 all on school district property. A total of 993 steelhead were relocated from pools to the confluence with San Geronimo Creek. In addition, 4 large mouth bass (*Micropterus salmoides*), 8 bluegill (*Lepomis macrochirus*), 17 mosquitofish (*Gambusia affinis*) and 2 bullfrog tadpoles (*Rana catesbeiana*) were found in pools along this creek. Before winter rains resumed, some pools had gone completely dry in the lower reach where fish were rescued. Other pools reached low levels (<20cm) which warranted rescue. On 27 September, stream flow was noted to have briefly resumed and pools depths increased. Upon further investigation, it was determined that water from a pond on the golf course was being pumped into the creek. Water temperature in this pond on 17 August was found to be 25(C) along the edge. This water pumping effort is the likely explanation of introduced species such as large mouth bass and bluegill being observed in Larsen Creek.

Arroyo—A total of 134 steelhead were dip-netted from a series of drying pools located along 50 m of this creek between 18 June and 25 June. In previous years, over 500 salmonids have been rescued from pools. Water temperatures remained cool (11-13C). However, many pools went dry unusually early (end of June) before more fish could be rescued. Nearly all pools went completely dry before winter rains commenced.

Barranca- Fish were relocated on 25 June from this tributary. Water temperature remained around 15(C) until mid summer when pools went completely dry. A total of 305 steelhead were dip-netted from approximately 30 meters of creek in three pools.

Woodacre (Redwood)- Two separate pool sites were dip-netted between 29 May and 5 August. One site is located below a culvert near the tennis courts of the Woodacre Improvement Club. The other site was a pool located behind 253 Redwood Ave. These pools were completely dry by the end of August. Dip-netting efforts resulted in 29 steelhead and 105 unidentified salmonids being relocated. See discussion for further explanation.

San Geronimo, Roy's Pools – This site was formerly a dam with an adjacent fish ladder built over 40 years ago. However, in recent years the dam had degraded and was preventing fish from migrating upstream. The dam has since been restored and adults can now migrate up a series of three jump pools or through the adjacent fish ladder. Surveys were done between 29 May and 17 September. The 1999/2000 winter was the first time that water passed through the jump pools. While the upper pool and middle pools held water in the summer, the lower pool was slightly leaking resulting in a lower water level. Water temperatures in pools ranged between 15 and 19(C), the highest noted on any tributary during surveys. In addition, all pools had a high abundance of algae growth within them. In some cases algae covered 100% of the water surface as was most common in the lowest pool. Algal growth is often the result of increased sunlight and water temperature and photosynthetic respiration of algae can deplete O₂ resources in pools. Fish in the upper two pools appeared to be out of danger. However, the low water level and elevated temperature in the lowest pool in combination with algal blooms warranted rescue. A total of 51 fish were relocated from this pool on 5 May, 28 June and 5 August.

San Geronimo, Woodacre – Fish were relocated from two areas along this section of creek. One area was located across from the Woodacre Market. The second was just downstream of the confluence of San Geronimo and Woodacre Creeks. A total of 99 steelhead were relocated to a flowing section of San Geronimo on 19 and 28 June. As noted with other sites, water temperature remained low until water completely disappeared from these pools in late July.

Discussion

Relocation efforts for 2000 resulted in the rescue of hundreds of fish from certain death. While most fish rescued did not appear to be endangered by elevated water temperatures, a steady and early decline of water level in isolated pools, relative to years past, would have resulted in high mortality.

Rapid decline of water in pools may have been the result of natural causes. However, some residences and businesses along these tributaries actively pump water either directly from the creek or from wells nearby. This is an issue of great concern to researchers since these activities lower the water table especially during the summer months when flows are critical to juvenile salmonid survival. SPAWN and other organizations and agencies feel that every effort should be made to discourage and prevent this practice.

Very few spawning coho adults were seen in the upper tributaries during the winter rainy season (1999/2000). The low return may have been the result of irregular rain patterns for the season. Between 6 and 121 redds have been found in the entire San Geronimo Creek system from 1995-present (Eric Ettlenger, Pers. comm.). Last year 61 redds were found in the main stem of San Geronimo and very few in its upper tributaries. In fact, only 1 redd was found in Woodacre Creek, 1 in Larsen Creek and 2 in Arroyo Creek. Therefore, we feel confident that the majority of unidentified fishes from Woodacre Creek and San Geronimo Creek in Woodacre were steelhead. Interestingly, preliminary data from winter surveys of 2000/2001 indicate that the number of redds in San Geronimo is about the same as last year, still significantly down from historical numbers. Nevertheless, it appears that more fish moved into the upper tributaries of San Geronimo Creek relative to winter 1999/2000. It is likely that many stranded juvenile coho as well as steelhead will be found in isolated pools this summer. Rescue efforts could have a significant and positive impact on the integrity and genetic diversity of these populations.

The presence of exotic species on Larsen creek is of significant concern to researchers. Large mouth bass and bluegill in the riparian ecosystem are predatory and pose a serious threat to already fragile populations of salmonids. Moyle and Light (1996) assert that successful species invasions are more likely when native assemblages have been depleted or disrupted. The source of introduction into Larsen Creek is likely from the pond on San Geronimo Golf Course that the creek passes through. Every effort should be made to prevent further introduction of fishes into the ecosystem through removal of these species from the pond. Bass and bluegill have also been sighted in Lagunitas Creek just below Peter's dam and within S.P. Taylor Park this summer as well (Reuven Walder Pers. obs., Leslie Ferguson Pers. comm.). It is possible that these fishes spilled over Peter's, dam, passed through drainage pipes or migrated downstream from San Geronimo Creek. Apparently spillways and pipes on Seeger dam of Nicasio Reservoir were originally equipped with gear to prevent non-native fish introduction. They were removed because hundreds of tiny fish would clog screens preventing drainage (Willis Evans Pers. comm.). We recommend that all drain pipes be re-equipped with screens and spillways modified to prevent fish from passing through in the creek system.

While this program is in its second year, researchers have gained extensive experience in the assessment of stream conditions and capture and handling of fish. Through these efforts we envision further refinement to the project. In particular, we would like to experiment with different types of nets for capture of fishes. Currently, we are considering using a combination of dip-nets and a small seine-like net. This may result in a higher catch per unit effort which can minimize potential disturbances to stranded fishes. However, this would entail modification to our existing permit. We also would like to assess the impact of introducing fishes into new pools. We intend to do periodic surveys of pools where fish are translocated to before and after relocation efforts. Researchers will note fish abundance and behavior on surveys. Further improvements to our program include the deployment thermographs in all tributaries. We are in the process of acquiring these instruments through a partnership with the California Regional Water Quality Control Board. We are also going to establish a training program for volunteers to identify salmonids and learn how to safely capture and handle fishes. We also intend to expand the number of certified crew leaders for rescue efforts and will submit several resumes for addition to our permit.

We increased the number of streams monitored from the previous year and intend to cover all tributaries and relocate more stranded fish in the San Geronimo Creek system in 2001. To further assess the importance of each tributary, we are developing an out-migration trapping proposal. We feel these data will provide valuable insight into the distribution, habitat utilization, chronology and resource partitioning and effectiveness of fish rescue on salmonid populations. We are currently working on a modification of our permit to include this effort.

Through our fish relocation program, winter spawner survey program and restoration efforts, we have gained valuable data and insight into the riparian ecosystem pertaining to the juvenile salmonid and other fish populations of the San Geronimo Creek and its tributaries. We value sharing these data with other agencies and organizations since our collective knowledge and effort is a strong asset. We have developed partnerships in the watershed with several agencies including the Regional Water Quality Control Board, Marin Municipal Water District, California Department of Fish and Game, National Marine Fisheries Service, S.P. Taylor State Park, Point Reyes National Seashore, Tomales Bay Watershed Council, Wilderness Way and Bodega Bay Marine Laboratories and we serve on the Marin Municipal Water District Lagunitas Creek Technical Advisory Committee.

While we strive to protect and enhance the remaining salmonid populations in the San Geronimo Creek through this relocation effort, further steps must be taken to assure their long term survival. In order for these populations remain stable we must make every effort to provide sufficient water to the system to infiltrate into aquifers and flow down creeks particularly in the summer months when flows are crucial to survival of juvenile salmonids. Furthermore, we need to find solutions to reducing the amount of sediment washing into the riparian habitat as a result of our continued urbanization. These remedies will not only improve the health of salmonid populations, but all species within this fragile ecosystem.

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Table 1. Summary of SPAWN's Fish Relocation Program (2000).

<u>Location</u>	<u>Rescue Date</u>	<u>Average Size (mm)</u>	<u>Sample Size</u>	<u>Total Steel-head</u>	<u>Un-identified[†]</u>	<u>Temperature</u>
Arroyo	6/18/00	56	17	121		13
	6/25/00			13		11
	Total	56	17	134		
Barranca	6/25/00			305		13
	Total			305		
Larsen Creek	6/19/00	55	26	131		15
	6/20/00	122	6	91		15.5
	6/25/00	56	22	124		
	7/8/00	60	21	255		13.5
	7/15/00	57	21	77		13
	7/23/00			29		
	7/29/00	58	22	128		15
	8/5/00	55	22	102		14
	8/18/00			37		25**
	8/26/00	59	18	19		14.5
Total	60	158	993			
Woodacre Cr.	6/13/00				31	
	7/15/00			28		
	7/29/00			1	32	
	8/5/00				42	
	Total			29	105	
Roy's Pools	5/29/00	62	6	31		18.5
	6/28/00	69	8	19		17.5
	8/5/00			1		19
	Total	66	14	51		
SG Creek Woodacre	6/19/00				44	
	6/28/00				55	
	Total				99	
Total				1512	204	
Grand Total					1716	

* Unidentified fish were very likely steelhead (see discussion).

** Temperature recorded in pond upstream of Larsen Creek.

