GROUP PROJECT BRIEF

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STEELHEAD PASSAGE RESTORATION OPTIONS FOR CAÑADA DE SANTA ANITA, SANTA BARBARA COUNTY, CALIFORNIA

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ON THE WEB AT HTTP://fiesta.bren.ucsb.edu/~santaanita/ SPRING 2008

INTRODUCTION

The recovery of viable populations of steelhead (*Oncorhynchus mykiss*) in southern California and elsewhere in the western United States is currently a high priority for local, tribal, state, and federal interests. The southern California steelhead (Figure 1) was once abundant in coastal streams and rivers. Over the past few decades however, steelhead populations in southern California have declined to roughly one percent of their historical numbers. As a result, the southern California steelhead has been listed as endangered under the Endangered Species Act. Obstacles that impede upstream migration to spawning habitat pose the most significant threat to steelhead populations within Santa Barbara County.

Figure 1. Southern steelhead spawning in Mission Creek, Santa Barbara. Photograph by Mark Capelli, 2008.

The Hollister Ranch Owners' Association (HROA) and its subcommittee, the Hollister Ranch Conservancy (HRC), have designated steelhead restoration as one of their top priorities. Hollister Ranch (HR) is located on central California's Gaviota Coast, 40 km west of Santa Barbara. Cañada de Santa Anita (Santa Anita Creek), an 8.4 km creek, has been identified as having the highest potential for steelhead recovery within HR (Figure 2). However, a 4.5 m high dam and seven culverts have been identified as potential threats to the upstream migration of steelhead. The restoration of fish passage to Santa Anita will require not only the removal of the dam and culverts, but also the management of a large volume of sediment impounded behind the dam. Various options exist for removing the barriers and sediment and improving habitat along Santa Anita Creek.

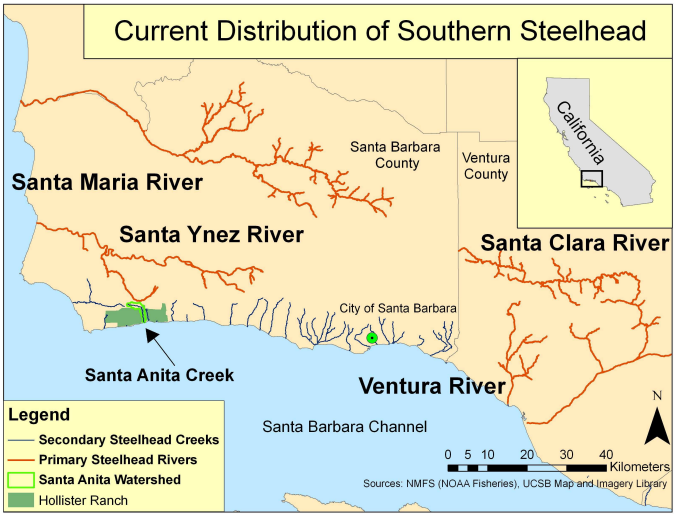

Figure 2. The four main rivers occupied by southern steelhead relative to the studied creek, Cañada de Santa Anita.

Voluntary restoration of steelhead passage to Santa Anita Creek will require a substantial amount of effort and resources from our client, Hollister Ranch. As such, a careful evaluation of potential payoffs associated with various restoration options is necessary. With generous monetary support from the Hollister Ranch Conservancy, Hollister Ranch Owners' Association, and the Coastal Ranches Conservancy we answered the following research questions:

1) *What is the feasibility of removing barriers to steelhead migration in Cañada de Santa Anita?*

2) *If the barriers are removed, what is the quantity and quality of steelhead habitat that will become available?*

APPROACH

To answer the above research questions, we took the following approach:

1) Using surveying and sampling techniques, we characterized the sediment impounded behind the dam by estimating its volume and grain size composition. We then calculated the potential fate and transport of released sediment and assessed its potential effects on habitat and infrastructure downstream of the dam. These results, in combination with a review of relevant literature, allowed us to develop four dam removal and sediment management options for the HROA.

2) We assessed the impact each of the creek's barriers had on the upstream migration of steelhead using California Department of Fish and Game protocols and the modeling software FishXing. Barrier removal was then prioritized based on geographic location. A literature review informed suggestions for retrofitting each barrier.

3) We conducted field surveys to assess the creek's current ability to support steelhead. Water temperature, canopy cover, pools, and spawning gravel were evaluated. The quantity and quality of steelhead habitat found within Santa Anita Creek was then determined.

RESULTS

Dam Removal and Sediment Management

From the results of the dam and impounded sediment survey we estimated the impounded sediment volume to be 100,000 m^3. Soil samples taken from the impounded sediment consisted of 62% silt and clays, 35% sands and 3% gravels, as illustrated in Figure 3.

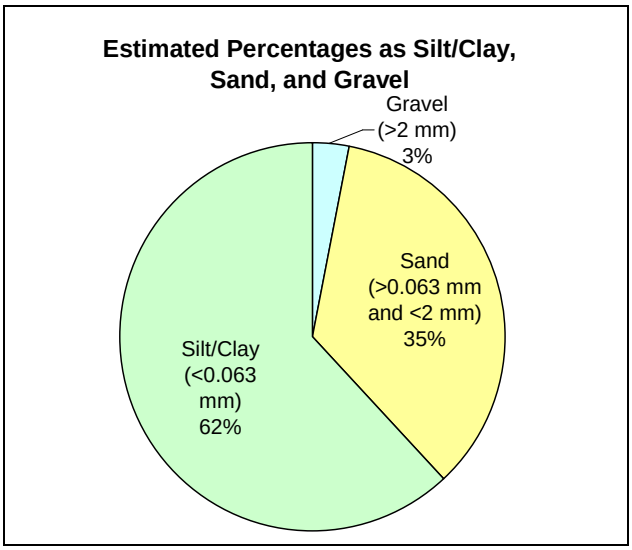

Figure 3. The grain size distribution of the samples taken from the impounded sediment.

Overall, release of sediment from behind the dam (Figure 4) as a result of dam removal is expected to impact downstream reaches of Santa Anita Creek for approximately 8 to 19 years. Sediment transport calculations revealed that the majority of impounded sediment, consisting of silt and clays, would be temporarily deposited in the estuary or washed to the ocean when the estuary's mouth is open. Under frequently occurring flow conditions the remaining sediment (16,000 m^3), consisting of coarser sands, gravels, and cobbles, would deposit between the dam and the creek's railroad crossing. See Figure 5 for a stream profile of Santa Anita Creek including the locations of each barrier.

Figure 4. The Santa Anita Creek Dam.

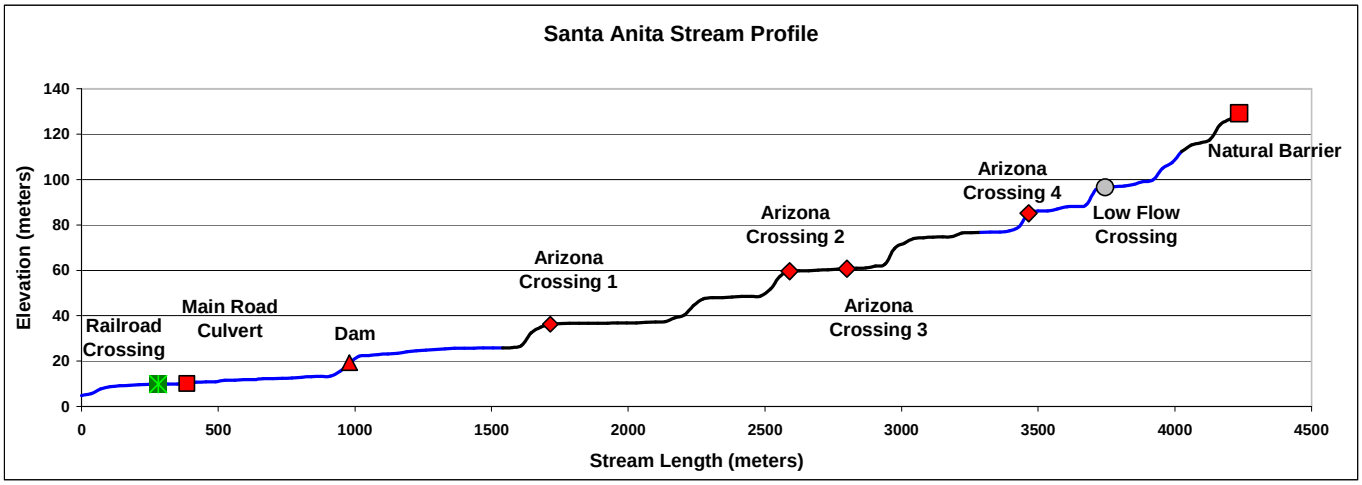

Figure 5. The stream profile of Santa Anita Creek calculated from the National Elevation Dataset. Stream crossings are identified up to the creek's natural steelhead migration barrier.

One of the primary risks associated with the release of sediment from behind the dam is the deposition of sands that would occur downstream. These sands could negatively impact the quality of the migration corridor and reduce the culverts' conveyance capacity.

Once the potential effects of the creek's sediment transport patterns were understood, we were able to identify four dam removal and sediment management options for the HROA. These options and their associated levels of risk and cost are outlined in the following table.

Dam Removal and Sediment Management Options for Santa Anita Creek
Complete dam removal with natural sediment transport *High risk, low cost*
Complete dam removal with partial sediment excavation and bank stabilization *Moderate risk, moderate cost*
Complete dam removal with complete sediment excavation *Low risk, high cost*
Incremental dam removal with natural sediment transport *Moderate risk, high cost over an extended time period*

Barrier Analysis

While removal of the dam and the impounded sediment will be the largest and most costly undertaking on Santa Anita Creek, the creek's other barriers must also be considered if steelhead passage is to be restored. Only one of Santa Anita Creek's seven barriers, the railroad crossing, was expected to provide passage for all steelhead age classes at all times. One additional crossing, the low flow crossing, was predicted to facilitate the migration of adult steelhead on a limited basis. This crossing was expected to have 28, 17, and 0 days of passable flow for adult steelhead during the wettest, average and driest years on record, respectively. It was not predicted to be passable by younger steelhead age classes. The main road culvert and Arizona Crossings Two, Three, and Four were predicted to completely block fish passage and Arizona Crossing One was not analyzed due to a lack of access.

Based on California Department of Fish and Game (CDFG) protocol, we recommended the redesign of the main road culvert to a natural-bottom arch culvert. We recommended replacing Arizona Crossings Two, Three, and Four with pre-cast bridges and improving the low flow crossing by replacing it with a larger culvert partially embedded with the creek's natural substrate.

Habitat Assessment

Overall, Santa Anita Creek was found to have suitable spawning and rearing habitat as well as a useful migration corridor.

The reach of Santa Anita Creek upstream of the impounded sediment was evaluated to have suitable quality spawning and rearing habitat. Water temperatures remained well below lethal ranges for steelhead throughout the summer and canopy cover was dense. Two out of nine pools contained adequate spawning gravels. In addition, trout were observed in two pools during our study, indicating the stream's current ability to support steelhead.

The reach of Santa Anita Creek from the dam to the railroad crossing was assessed to be a supportive environment for the upstream migration of steelhead. On the other hand, the reach flowing through the impounded sediment just upstream of the dam was determined to be of lesser quality due to a lack of canopy cover and a lack of complex in-stream habitat. However, we predict that by removing the dam, allowing the channel to return to its natural gradient, and replanting riparian vegetation, 0.8 km of current migration corridor would be transformed into suitable spawning and rearing habitat.

Results of our assessment of the estuary's capacity to rear steelhead demonstrate the occurrence of high water temperatures that create potentially lethal conditions during summer months. In addition, dissolved oxygen levels dropped below lethal limits for steelhead and 0% canopy cover was observed near the estuary mouth. However, temperature and dissolved oxygen can vary with location, time of day, and water depth. The extent of our analyses may not accurately depict the degree of environmental variability within the estuary. Therefore, a more detailed biological analysis of the estuary is needed to determine its level of suitability for steelhead rearing in the summer. While our initial analysis of the estuary suggests poor quality summer rearing habitat, it does not discount Santa Anita Creek's utility as a source of habitat for southern steelhead.

Based on an extrapolation of our habitat observations to inaccessible reaches of the creek, we estimate that Santa Anita Creek currently provides a total of 2.4 km of suitable southern steelhead spawning and rearing habitat. In total, Santa Anita Creek is predicted to have a total of 43 pools with ten pool tail-outs that would support spawning. Upon dam removal, an additional 0.8 km of spawning and rearing habitat is predicted to become available for a total of 3.2 km. This 3.2 km is predicted to contain a total of 53 pools and 13 pool tail-outs with patches of gravel for steelhead spawning.

RECOMMENDATIONS AND CONCLUSIONS

Restoration of fish passage to Santa Anita Creek may benefit the southern California steelhead by contributing to the currently limited amount of accessible spawning habitat available to steelhead, including those that stray from the major rivers of the region. Six of the seven stream crossings found on Santa Anita Creek currently impede upstream fish passage. We recommend that these barriers be replaced based on DFG protocols for fish passage restoration. In addition to the creek's six impassable stream crossings, the 4.5 m high dam would need to be removed in order for steelhead to access the suitable spawning and rearing habitat observed during our field assessment. Management of the 100,000 m^3 of sediment impounded behind the dam is the largest impediment to restoration because of its cost and potential for adverse effects downstream. We define and analyze four dam removal and sediment management options for the HROA to consider, each with an associated level of risk and cost. Ultimately, it will be up to Hollister Ranch to weigh the various risks and costs in order to decide which, if any, they will pursue to restore steelhead passage to Santa Anita Creek.