Horse Creek Dam Removal Project
Salmonid Habitat Survey

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Background

The Santa Barbara based Community Environmental Council retained Stoecker Ecological to conduct a site analysis of the Horse Creek Dam, an assessment of upstream salmonid habitat conditions, and to assistance Los Padres National Forest personnel with stakeholder-based dam removal plan development. The dam was built in 1969 and is located on Horse Creek approximately 850 feet upstream from the Sisquoc River confluence within the Los Padres National Forest, San Rafael Wilderness Area, and Sisquoc River Wild and Scenic River Corridor. The obsolete dam was identified as an impassable barrier to fish migration and recommended for removal in *Steelhead Migration Barrier Assessment and Recovery Opportunities for the Sisquoc River, California* (Stoecker 2003). The removal of Horse Creek Dam has been identified as a desirable restoration project by the Forest Service as part of their Sisquoc River Wild and Scenic River management planning process.

Horse Creek Dam

In coordination with Los Padres National Forest personnel, Community Environmental Council received a grant from American Rivers/NOAA Fisheries to further assess removal of Horse Creek Dam. The Forest Service has agreed to act as the lead agency for permitting and actual dam removal coordination. The Forest Service also provided an administrative pass and gate keys for vehicle access close to Horse Creek Dam near the Manzana Schoolhouse at the Manzana Creek and Sisquoc River confluence. Mike Love and Associates was contracted to oversee the dam site survey and to characterize the existing physical channel conditions, evaluate anticipated channel response associated with removal of the dam, and characterize the streams hydrology through estimation of peak flows and associated recurrence intervals. Matt Stoecker and Mike Love conducted the dam site survey June 14-15, 2005. Mike Love and Associates produced a technical memorandum titled *Stream Channel Assessment for Horse Creek Dam Removal Project* dated September 7, 2005 that details the dam site analysis findings. Los Padres Forest Service personnel have conducted non-fishery related biological surveys at the dam site during the spring and summer of 2005 and visited Stoecker and Love during the June 15, 2005 dam site survey. The following report summarizes salmonid habitat conditions observed on Horse Creek during two days of surveying on June 19-20, 2005 by Stoecker and Allen.

Scope of Work

The objectives of the survey were to identify the natural limits to upstream steelhead migration that would be encountered with the removal of the Horse Creek Dam, to assess basic salmonid habitat conditions, and to document any fish species observed. The habitat survey extended from the Horse Creek confluence at the Sisquoc River upstream and included the upper mainstem of Horse Creek and both the Middle and East Forks of Horse Creek.

Survey Results

Survey results are summarized below for the mainstem of Horse Creek, the East Fork Horse Creek, and the Middle Fork Horse Creek. Within these reaches the habitat description and photographs are organized in the order they were observed from the downstream end of the reach to the upstream survey limit. For the purposes of this report, the mainstem of Horse Creek extends from the Sisquoc River upstream along "Horse Canyon" as defined on USGS 7.5 minute quad maps. The East Fork Horse Creek confluence with the mainstem occurs approximately 6.1 miles upstream of the Sisquoc River. The Middle Fork Horse Creek confluence with the mainstem occurs approximately 7.15 miles upstream of the Sisquoc River. Both East and Middle Forks are unnamed tributaries on the USGS 7.5 minute quad maps. The mainstem of Horse Creek was surveyed for approximately 8.7 miles upstream of the Sisquoc River. The East Fork of Horse Creek was surveyed for 1.1 miles upstream of Horse Creek. The Middle Fork of Horse Creek was surveyed for 1.0 mile upstream of Horse Creek. A total of 10.8 miles of stream were ground surveyed within the Horse Creek drainage.

Horse Creek Drainage Map

Mainstem of Horse Creek

Downstream of the dam, Horse Creek provides limited salmonid rearing habitat of poor to fair quality due to the lack of pools, maximum water depth of less than 2 feet, low riparian canopy cover, and low instream cover. Adequately sized spawning substrate occurs in moderate abundance downstream of the dam with substrate embeddedness averaging 50%.

Looking downstream of the dam

Upstream of the dam, the wetted stream width measured between 5-12 feet and small pools up to 2 feet 6 inches in depth were observed. Shallow runs and riffles are the dominant habitat type with pocket water and small pools occurring to a lesser extent. The substrate consists mainly of cobbles and small boulders. Riparian canopy cover increases upstream of the dam and emergent vegetation also increases the available instream cover. Salmonid rearing habitat conditions are mostly fair upstream of the dam with several smaller pools that would provide good salmonid rearing habitat. Fair spawning substrate conditions occur with moderate substrate embeddedness and a moderate amount of adequately sized substrate.

Scour pool 950 feet upstream of dam

Bedrock scour pool approximately 1 mile upstream of dam

Stream habitat approximately 2.5 miles upstream of dam

Surface flow of approximately 2.0 c.f.s. was observed to occur continuously from the Sisquoc River confluence upstream for 5.0 miles to near the 1800-foot elevation. At this location a prolific groundwater source occurs and appears to supply all summer surface flows to lower Horse Creek.

Groundwater resurfacing and dry channel upstream

Upstream of the groundwater source, Horse Creek was observed to be dry for 1.1 miles to 100 feet upstream of the East Fork Horse Creek confluence. Approximately 100 feet upstream of the East Fork Horse Creek confluence, a short reach of Horse Creek was observed to have trickling flows mixed with short dry reaches and several small pools. This wetted reach extended for only 0.05 miles and contained one bedrock scour pool measuring 2 feet 6 inches deep. Water temperature measured 67 degrees Fahrenheit. The pool and adjacent wetted reaches would provide adequate, but limited summer rearing habitat for salmonids.

Habitat approximately 250 feet upstream of the East Fork

The Horse Creek channel remained dry for 0.9 miles upstream to 250 feet downstream of the Middle Fork where surface flows of 1 c.f.s were observed upstream to the Middle Fork. The Middle Fork supplied all surface flows into this portion of Horse Creek. Water temperature was measured at 65 degrees Fahrenheit and fair spawning and rearing habitat was observed. Beginning immediately upstream of the Middle Fork, the mainstem of Horse Creek was dry for 1.15 miles upstream to near the 2400-foot elevation.

Dry channel upstream of the Middle Fork

Upstream of the previously mentioned dry stream reach, trickling flow of less than 0.1 c.f.s was observed along with isolated pockets of shallow water and short dry reaches. Salmonid rearing habitat conditions were poor in this upper reach of Horse Creek due to sporadic surface flows, and shallow water depth. These variable surface flow conditions continued upstream to the upper extent of the survey approximately 8.7 miles upstream from the Sisquoc River.

Isolated pool in upper Horse Creek

Streambed substrate embeddedness on the mainstem of Horse Creek was observed to average 50% and varied from a low of 40% to a high of 60%. Substrate embeddedness values observed were not optimal for salmonid spawning in many locations, but several reaches associated with scour pools or confined reaches with accelerated water velocities contained adequate embeddedness values for spawning. In addition, embeddedness values observed during this mid-June survey are expected to be higher than substrate conditions encountered during ideal late winter and spring salmonid spawning season. By mid June, percent substrate embeddedness has likely increased significantly due to increased fine sediment deposition and incremental algal growth. Adequately sized spawning substrate was present in low to moderate abundance throughout the Horse Creek drainage and overall spawning conditions during late winter

and spring are expected to be fair. Spawning conditions in a given year are likely variable and highly dependant upon natural events such as fire, erosion, and rainfall patterns.

Southern steelhead (*Oncorhynchus mykiss*) were not observed in the Horse Creek drainage. Arroyo Chub (*Gila orcutti*) ranging from 1.5 to 4 inches in total length were observed sporadically in low densities from the Sisquoc River upstream 4.0 miles. One Arroyo Chub was observed downstream of the dam. No fish species were observed upstream of the lower 4 miles of Horse Creek.

Arroyo Chub downstream of Horse Creek Dam

Along the 8.7 miles of the mainstem Horse Creek that were surveyed, no physical features within the stream channel were observed that would prevent upstream adult steelhead migration with adequate surface flows present. It is difficult to estimate the natural upstream limit of migration for steelhead on the mainstem of Horse Creek due to the lack of surface flows observed in several reaches and presence of thick vegetation in the channel of the uppermost surveyed reaches. While obvious waterfall or steep gradient type barriers were not present in the 8.7 miles of the mainstem surveyed, upstream migration may be limited by inadequate surface flows in multiple reaches. The dry reaches observed downstream of the East Fork and between the East Fork and Middle Fork appear to carry sufficient surface flow for upstream migration during winter flows, as determined by the extent of substrate scour, waterline marks observed on adjacent bedrock and channel banks, and debris caught in adjacent vegetation. The dry reach upstream of the Middle Fork, however, appears to convey low winter flows and chaparral-type vegetation was observed growing in the channel. Riparian vegetation associated with perennial reaches was absent and streambed substrate appeared highly permeable. The upper Horse Creek drainage is small upstream of the Middle Fork and adequate surface flows for upstream migration may be lacking during some years. Especially wet years may provide sufficient flow and limited upstream migration. The stream channel becomes a very small gully by mile 8.7 and is densely vegetated with thick brush limiting upstream survey access. It was determined based on USGS 7.5 minute topographic maps that steelhead migration could not extend past mile 9.7, where excessive stream gradient occurs.

East Fork Horse Creek

The lower 0.6 miles of the East Fork Horse was dry. Upstream of the dry reach, variable stream flow conditions occurred for 0.1 mile with trickling flow less than 0.1 c.f.s mixed with dry reaches.

Dry channel on East Fork upstream of Horse Creek

Surface flow of less than 0.2 c.f.s was observed 0.7 miles upstream of the mainstem of Horse Creek and continued past the upstream limit of the survey 1.0 mile upstream of Horse Creek. Water temperature was measured at 64 degrees Fahrenheit. Poor to fair rearing habitat was observed due to the shallow water depth, low instream cover, and highly limited habitat size. Adequate spawning substrate was present in low abundance and substrate embeddedness was moderate. No fish species were observed in the 1.0 mile of stream surveyed on the East Fork.

Near upper survey limit of the East Fork

Dry channel conditions along the lower 0.6 miles of the East Fork limit fish passage during most or all of a given year, depending on stream flows. Approximately 0.5 miles upstream from the mainstem of Horse Creek a 6-foot tall bedrock and boulder cascade was observed. This cascade would likely limit upstream fish passage depending on the amount of surface flow encountered during a given flow year. Waterlines suggest the downstream pool may fill 2 to 3 feet in depth leaving a 3 to 4-foot jump for fish. Such a scenario is near the upper limitation of adult steelhead jump capabilities, but may be possible during high stream flows when the downstream pool is at it's deepest.

6-Foot bedrock drop 0.5 mile upstream on the East Fork

With adequate surface flows and migration over the 6-foot cascade, steelhead may be able to migrate upstream of the upper survey limit 1.0 mile upstream of the mainstem of Horse Creek. The stream channel becomes densely vegetated with thick brush 1.0 mile upstream from Horse Creek, limiting upstream survey access. It was determined based on USGS 7.5 minute topographic maps that steelhead migration could not extend more than 4.6 miles upstream on the East Fork due to excessive stream gradient observed near the 3600-foot elevation.

Middle Fork Horse Creek

The Middle Fork of Horse Creek was observed to have the greatest surface flow upstream from flows observed on the lower 5 miles of Horse Creek. At the confluence with the mainstem, the Middle Fork was discharging approximately 1.0 c.f.s of stream flow with a temperature of 65 degrees Fahrenheit. The surface flow only continued upstream for 0.15 miles before abruptly ending. Fair to good salmonid rearing habitat was observed in this reach with moderate instream cover, 50-75% riparian canopy cover, and pool depth to 2 feet. Adequately sized spawning substrate was moderately abundant and substrate embeddedness measured 45%.

Middle Fork flow immediately upstream of Horse Creek

Dry channel conditions were observed upstream of the reach with surface flow for approximately 0.25 miles. Trickling flows of approximately 0.1 c.f.s combined with dry reaches were observed upstream to the upper survey limit. No fish species were observed on the Middle Fork.

Near the upper survey limit on the Middle Fork

The stream channel becomes densely vegetated with thick brush 1.1 miles upstream from Horse Creek, limiting upstream survey access. With adequate surface flows, steelhead may be able to migrate upstream of the upper survey limit 1.1 miles upstream of the mainstem of Horse Creek. It was determined based on USGS 7.5 minute topographic maps that steelhead migration could not extend more than 3.1 miles upstream on the mainstem of the Middle Fork due to excessive stream gradient observed near the 3240-foot elevation. Two smaller tributaries that enter the Middle Fork from the east may also be accessible. The downstream, unnamed tributary may provide 1.1 miles of accessible habitat before excessive gradient prevents upstream passage near the 2880-foot elevation and the second unnamed tributary may provide an additional 0.4 miles of habitat before excessive gradient prevents upstream passage near the 3040-foot elevation.

Salmonid Habitat and Population Recovery Conclusions

Adequate rearing and spawning habitat to support *O. mykiss* was observed in the Horse Creek drainage. With the removal of Horse Creek Dam it is anticipated that fish populations will be able to naturally recolonize all historically accessible habitat within the Horse Creek basin. Of the 10.5 stream miles surveyed, 5.2 miles were observed to have surface flow, 1.3 miles were observed to have variable stream flow conditions, and 4.0 miles were dry. The highest quality salmonid habitat was observed in the lower 5.0 miles of Horse Creek, the lower 0.15 miles of the Middle Fork of Horse Creek, and the 0.05 miles of Horse Creek upstream of the East Fork Horse Creek. These reaches provide fair to good summer rearing habitat conditions for salmonids. Adequate spawning substrate occurs throughout the surveyed reaches in low to moderate abundance and provide sufficient habitat conditions during spawning season.

It is possible that adequate migration conditions during wet years could allow *O. mykiss* to migrate upstream of the upper survey limits of this project. An additional 8.4 miles of stream were identified upstream of the upper survey limits to the estimated upstream natural barriers to steelhead migration. This potential additional habitat could increase the total quantity of habitat available for steelhead to 18.9 miles. Upstream natural limits were estimated by locating where the stream sustains a slope of 10-15% using CDFG barrier estimation methods and based on stream slope assessment of USGS 7.5 minute topographic maps.

The presence of a diversity of age classes of Arroyo Chub in the lower 4.0 miles of Horse Creek suggest the occurrence of perennial stream habitat over the last several years. Due to the presence of the impassable Horse Creek Dam, this Arroyo Chub population could not have migrated upstream from the Sisquoc River without human transplantation. It is assumed that the Arroyo Chub population has likely occurred in Horse Creek for many years and was likely present before the dam was built. Adequate habitat conditions for Arroyo Chub were observed in the lower 4 miles of Horse Creek where they were observed.

O. mykiss coexist with Arroyo Chub in the Sisquoc River and tributaries such as Manzana Creek and both species likely occurred in Horse Creek upstream of the dam before it was built. It is possible that following the construction of the dam, factors such as fire-related erosion and elevated sediment transportation in the stream, prolonged drought, excessive water temperatures, and possibly fishing pressure could have

eliminated the *O. mykiss* population. With the impassable dam near the mouth of the creek, *O. mykiss* have likely not been able to recolonize the drainage since that time. It is expected that following the removal of Horse Creek Dam, *O. mykiss* and other aquatic species prevented from upstream migration, will naturally recolonize this drainage. It should be noted that natural events such as fires and prolonged droughts may have historical eliminated fish populations from all or parts of Horse Creek in the past and similar conditions will surely occur in the future. However, with the removal of Horse Creek Dam, unrestricted migration from the Sisquoc River to the natural upstream limits of Horse Creek will allow fish populations to naturally recolonize the tributary when conditions are adequate.

Successful steelhead recovery to Horse Creek, the Sisquoc River, and the Santa Maria River watershed is highly dependant on improving steelhead migration conditions on the Santa Maria River downstream. Unfavorable flow releases from Twitchell Dam on the Cuyama River, increased groundwater pumping near Santa Maria, and gravel extraction operations in the river channel have all negatively impacted the now endangered Santa Maria/Sisquoc River steelhead population (Stoecker 2003). Improved stream flow conditions for steelhead migration between the ocean and the Sisquoc River are needed to ensure successful steelhead recovery to Horse Creek, the Sisquoc River, and Santa Maria River watershed.

References

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