UPPER BASIN ACTIONS FOR THE PROTECTION AND ENHANCEMENT OF SOUTHERN STEELHEAD IN THE SANTA YNEZ RIVER

Appendix E

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1.1 INTRODUCTION

The Santa Ynez River Fisheries Technical Advisory Committee (SYRTAC) was formed in 1993 to:

1. investigate steelhead and rainbow trout use of the Santa Ynez River,
2. identify actions that could benefit steelhead and rainbow trout within the drainage, and
3. develop plans to implement those actions that have a high potential for promoting the recovery of steelhead populations from their low current levels.

Various management actions to benefit steelhead were developed through a consensus-based process including local, state and federal agencies, environmental groups, landowners and other interested parties. Among these actions were several measures that would allow steelhead to access the area above Bradbury Dam (the upper basin). Before the construction of Bradbury Dam (completed in 1953), this area provided most of the suitable spawning and rearing habitat in the Santa Ynez River basin. These actions were identified in recognition that opportunities to provide mainstem habitat below Bradbury Dam were limited because of rapid warming of water released from the dam and the high percolation rate of water into the groundwater basins.

Through this process, various actions in the Santa Ynez River upstream of the Bradbury Dam have been identified that may benefit rainbow trout/steelhead populations throughout the basin. These actions were first described in the 1998 Management Alternatives Plan (SYRTAC 1998). In order to evaluate actions that could potentially benefit steelhead populations in the basin, the SYRTAC created the Upper Basin Work Group.

The Upper Basin Work Group was responsible for assessing the benefits, impacts and feasibility of potential actions that could be taken in the portion of the Santa Ynez River above Bradbury Dam (upper basin) to enhance steelhead populations within the basin. Bradbury Dam is currently the lowermost impassable barrier to steelhead migration on the Santa Ynez River. The objective of the technical appendix is to evaluate the potential actions being considered for the upper basin and decide whether these actions should be pursued further. Two aspects were considered to be of primary importance in evaluating these alternatives: (1) the probability that the action would result in benefit to the steelhead population, and (2) the technical and institutional feasibility of the action. Only those actions technically and institutionally feasible and which have a high likelihood of successfully benefiting the rainbow trout/steelhead population have been included in the Management Plan.

1.2 RAINBOW TROUT/STEELHEAD LIFE HISTORY

Coastal rainbow trout exhibit two distinctive life history strategies: freshwater residency or anadromy. Resident rainbow trout live their entire lives in freshwater. Anadromous steelhead are born in freshwater, emigrate to the ocean as smolts to rear to maturity, and then return to freshwater to spawn. It is common to find populations exhibiting both life history strategies within the same river system. As members of the same species, they can interbreed within a given aquatic system and form a single cohesive population. Some mature resident rainbow trout have been documented downstream of impediments (Shapovalov and Taft 1954) and some proportion of the offspring of resident populations may exhibit the anadromous life history. Individuals exhibiting one life history strategy can produce offspring that exhibit the other strategy (J. Nielsen, pers. comm., 1998a). Due to the extreme environmental cycles of Southern California, it is common for one life history strategy or the other within a population to have poor success or be extirpated periodically. This life history pattern can potentially be restored by the progeny of the other life history pattern. The Southern California steelhead may have adapted to the unpredictable climate by being able to remain landlocked for many years or generations before returning to the ocean when flow conditions allow (Titus *et al*., 1994).

In many historical steelhead streams, passage barriers have blocked migration to and from upper stream reaches and resulted in residualization of steelhead populations, forcing them to adopt a resident life history strategy (resident rainbow trout). On the Santa Ynez River, there are natural and man-made impediments (*e.g*,. dams and road crossings) to upstream migration that separate populations of steelhead and resident rainbow trout. In addition, impediments exist upstream of habitat accessible to steelhead trout which separate the populations of resident rainbow trout (*i.e.,* Gibraltar Dam and Juncal Dam).

1.3 ENHANCEMENT OPPORTUNITIES

The Upper Basin Work Group evaluated three actions for the upper basin that could benefit the anadromous steelhead population. These actions are:

1. ***Genetic Protection*** **–** The rainbow trout planted to support the put-and-take fishery in Lake Cachuma and below Gibraltar Dam are derived from non-native stocks. These stocks evolved under different environmental conditions than those present in Southern California, and thus are likely less adapted to survive the extreme environment. While most of these fish are caught by fishermen, some fish survive and may be washed over the dam in spill years. These fish may then interbreed with native stocks and thereby reduce the fitness of the resulting progeny in the Santa Ynez River. The Work Group evaluated opportunities to prevent the introgression of non-native stocks into the native steelhead population, while protecting the recreational fishery in Lake Cachuma and below Gibraltar Dam.

2. ***Increase Habitat Availability*** **–** Prior to the construction of Bradbury Dam, the tributaries upstream of Bradbury Dam provided the majority of the quality spawning and

rearing habitat for steelhead. The upper basin tributaries historically maintained perennial flow and cooler water temperatures than areas in the lower basin. The Work Group evaluated opportunities to provide steelhead access to historical habitat above the dam.

3. ***Increased Smolt Production*** – Since the division of the basin as a result of dam construction, the only successful life history form upstream of Bradbury Dam has been resident rainbow trout. However, a portion of the progeny of the upper basin resident rainbow trout exhibit anadromous tendencies. The Upper Basin Work Group evaluated the feasibility of trapping juveniles migrating downstream (smolt) above the dam and transporting those juveniles by truck downstream of the dam to increase the number of smolt reaching the ocean.

This appendix provides a complete discussion and evaluation of these actions. Section 2 provides background on the historic usage of the upper basin by steelhead and rainbow trout prior to the development of the watershed as well as the current status of habitat and stocking practices within the upper basin. Section 3 describes and evaluates the genetic protection measures considered. Section 4 covers measures to provide steelhead access to areas above Bradbury Dam. Section 5 describes how juveniles produced by the resident rainbow trout population in the upper basin might be used to supplement the endangered steelhead stocks in the lower basin.

The upper basin is defined as the portion of the Santa Ynez River watershed upstream of Bradbury Dam (Figure 2-1). Currently, the upper basin of the Santa Ynez River is divided into three isolated sub-basins by three dams. Gibraltar Dam was completed in 1920, Juncal Dam was completed in 1930, and Bradbury Dam was completed in 1953. The three sub-basins are:

1. ***Lower sub-basin*** – Mainstem Santa Ynez River from Bradbury Dam to Gibraltar Dam, including Lake Cachuma. Some of the major tributaries include Cachuma, Santa Cruz, Oso, Tequepis, Los Laureles and Devil's Canyon creeks.

2. ***Middle sub-basin*** – Mainstem Santa Ynez River from Gibraltar Dam (including the reservoir) to Juncal Dam. The major tributaries include Blue Canyon, Mono, Indian, Gidney, Camuesa, Agua Caliente Canyon, Fox and Alder creeks.

3. ***Upper sub-basin*** – Mainstem Santa Ynez River from Juncal Dam eastward into the headwaters of the Santa Ynez River. The major tributaries include Juncal, and North Fork Juncal creeks.

In order to evaluate the management alternatives, it is necessary to understand (1) the historic use of the upper basin by anadromous steelhead, and (2) the current conditions in the upper basin. This section provides an overview of these issues.

2.1 HISTORIC USE OF THE UPPER BASIN

The Santa Ynez River is typical of many Southern California streams in that streamflow in the lower reaches often declines to zero during summer and fall months. During the summer and fall when both streamflow and wave energy are low, a sandbar forms across the mouth of the river. This bar prevents adult steelhead from entering the river until high flows associated with winter storms and winter wave energy are sufficient to breach the sandbar. During dry years, streamflows sufficient to breach the bar and allow access into the river are of relatively short duration (possibly only one to two weeks in duration). During exceptionally dry years, streamflow may never be sufficient to breach the bar and thus, adult steelhead are prevented from migrating up and spawning in the Santa Ynez River (Lantis 1967).

Once adult steelhead were able to enter the river, they migrated to the area upstream of Solvang and particularly to the tributaries to spawn (Shapavolov 1944). Access to the tributaries above the current location of Gibraltar Dam was blocked by the construction

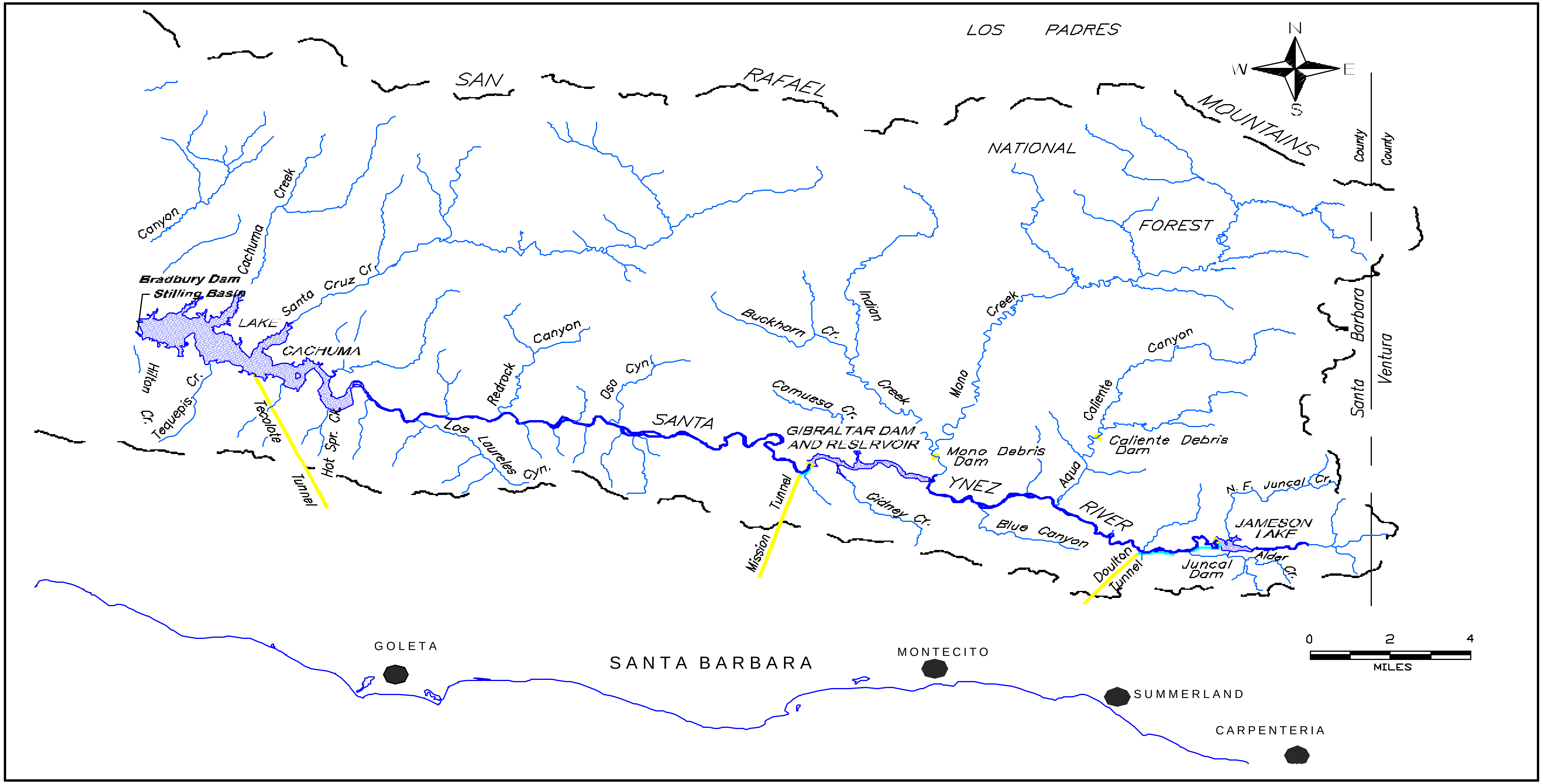

Figure 2-1. Upper Santa Ynez River Above Bradbury Dam.

of that facility in 1920. The completion of Bradbury Dam in 1953 blocked access to much of the remaining historic habitat.

Prior to the development of these projects, the upper basin provided spawning, summer rearing, and over-wintering habitat as many of the upper tributaries have perennial flow. However, during years of high rainfall, suitable habitat extended into the lower portion of the basin. California Department of Fish and Game (CDFG) documents from the 1940's (prior to construction of Bradbury Dam) confirm that migration and spawning in the Santa Ynez River were highly dependent upon rainfall (ENTRIX 1995a). The upper basin is believed to have historically contained at least 60% of the spawning and rearing habitat in the Santa Ynez River (Chubb 1997).

During the winter of 1943 to 1944, Shapovalov (1944) reported that steelhead were spawning in "practically all accessible tributaries below Gibraltar Dam." Spawning tributaries mentioned included Alisal, Santa Cota, Cachuma, Tequepis Canyon, and Santa Cruz creeks. In 1946, Shapovalov (1946) observed that flows in the tributaries were insufficient to allow migration of steelhead, even though a rainstorm had increased the flows in the mainstem Santa Ynez River to the point where they were "quite favorable" for steelhead migration and spawning. This situation may have been common, as the upper basin receives substantially more rainfall than the lower basin.

Based on review of the records prior to 1946, Chubb (1997) concluded that the best historical spawning habitat was concentrated in the mid- to upper-third of the Santa Ynez basin. After the completion of Gibraltar Dam, the best mainstem spawning habitat extended from the Solvang area up to Oso Creek (Shapovalov 1946). Cachuma and Santa Cruz creeks were noted as significant spawning tributaries. Steelhead populations began to decline in the 1940's, subsequent to the construction of Gibraltar and Juncal dams, but prior to the construction of Bradbury Dam.

Shapovalov (1944) identified Indian and Alamar creeks as historical steelhead spawning areas until the construction of Gibraltar Dam blocked access to these creeks in the 1920's. Subsequent to the construction of Gibraltar Dam, landlocked salmon (rainbow trout) living in Gibraltar Reservoir were reported to spawn in Gidney Creek, the mainstem Santa Ynez River above the reservoir, and Mono Creek below Mono Debris Dam (Shapovalov 1944).

Since the construction of Bradbury Dam, anadromous steelhead have been prevented from migrating upstream into the upper basin. Soon after the construction of Bradbury Dam, a "landlocked" run of steelhead continued to run up and out of the Cachuma Reservoir, utilizing the lower reaches of Cachuma Creek to spawn. Due to concerns with poaching and predators on Cachuma Creek, a fish impediment apparently was constructed at the outlet (Chubb 1997). This population of landlocked rainbow trout/steelhead are believed to be the ancestors of the current resident rainbow trout population. These resident rainbow trout have similar spawning and rearing habitat requirements as that of the anadromous steelhead. Consequently, the resident trout migrate from the reservoirs upstream into the Santa Ynez and its tributaries to spawn in the habitat historically used by the steelhead.

The resident rainbow trout population has been "augmented" with the planting of non-native rainbow trout. Stocking non-native rainbow trout into the Santa Ynez River and its tributary streams has taken place since at least the 1930's. While native stock may persist in some areas (*e.g.*, above Juncal Dam), CDFG has planted a variety of different strains including Whitney, Coleman, Hot Creek, Whitney and Kamloop crosses and Hot Creek-Wyoming throughout the basin above Bradbury Dam (Adams, CDFG Fillmore Hatchery, pers. comm.). Stocking above Gibraltar Dam was discontinued at least twenty years ago as was the stocking of Cachuma Creek. Additionally, Santa Cruz and Coche creeks have not been stocked in over ten years. Since approximately 1980, stocking has been primarily confined to Lake Cachuma and the mainstem below Gibraltar Dam (near the Los Prietos Ranger District Office) (Adams, 1999, CDFG Fillmore Hatchery, pers. comm.).

2.2 CURRENT CONDITIONS

Each of the three dams in the upper basin prevents upstream migration. Downstream migration can occur only during years when the reservoirs spill. This results in an unknown amount of gene-flow in a downstream direction. As a result of these impediments, native rainbow trout populations above Gibraltar Dam are less affected by introgression with stocked rainbow trout, as most stocking has occurred below Gibraltar Dam. The resident rainbow trout in these sub-basins use habitat in the same way as steelhead did historically. Some fish remain stream resident throughout their life, while other fish likely migrate downstream into the reservoirs and rear to adulthood there. These lake adults then return to the tributary streams to spawn.

Many of the tributary streams have passage impediments (natural and man-made) which prevent these resident fish from reaching suitable habitat in some areas. These impediments, in addition to the major dams on the mainstem, reduce gene flow among the various sub-populations. Some of these impediments, like the Mono debris dam, prevent lake fish from reaching much of the suitable habitat on the tributary streams, and may limit the amount of suitable spawning and rearing available to lake resident fish.

Stocking to supplement resident rainbow trout populations began in the 1930's and continues today. Today the majority of stocking occurs between Bradbury and Gibraltar dams. Currently, Lake Cachuma is stocked with approximately 54,000 pounds of non-native trout between three to five fish per pound each year. Additionally, the section of mainstem Santa Ynez River between Lake Cachuma and the Gibraltar Dam is stocked with 8,000 pounds of trout similar in size to those used to stock Lake Cachuma (M. Haynie, CDFG, pers. comm.). This stocking supports a valuable put-and-take fishery managed by CDFG.

3.1 BACKGROUND

The rainbow trout fishery in Lake Cachuma and the mainstem below Gibraltar Dam are the predominant recreational fisheries for the citizens of Santa Barbara County. These areas provide fishing opportunities for bass, sunfish and catfish as well as trout. The rainbow trout fishery is supported by the stocking of rainbow trout. Current stocking practices include the release of rainbow trout derived from genetically northern stocks into the Santa Ynez River between Bradbury Dam and Gibraltar Dam. These rainbow trout currently come from two sources, neither of which is derived from southern stocks. CDFG annually supplies 31,000 pounds (three to five fish per pound) of fish from the Fillmore Hatchery each year. The County of Santa Barbara matches this volume with fish from the Mt. Lassen Hatchery, although in the past, fish from Idaho hatcheries were also released (A. Kvaas, Santa Barbara Co. Fish and Game Commission pers. comm.). These stocked fish have the potential to breed with the native trout in the basin. Genetic sampling indicates that a large proportion of the rainbow trout in Lake Cachuma have genetic patterns suggestive of a strong northern stock influence (ENTRIX 1995b).

While introgression resulting from stocking is primarily affecting the population above Bradbury Dam, the possibility of migration downstream exists during spill events and releases from the reservoir. Hatchery rainbow trout that end up downstream of the dam could potentially breed with native steelhead, resulting in genetic introgression within the protected population. It seems that the southern steelhead are better adapted to survival in the highly variable climate and flow conditions of Southern California streams (National Marine Fisheries Service [NMFS] 1996, Matthews 1996, Chubb pers. comm.). As a result, interbreeding of northern stocks with southern steelhead could result in a decrease in fitness of the resultant progeny, leading to a further decline in the population.

3.1.1 GENETICS OF STEELHEAD AND RAINBOW TROUT IN SANTA YNEZ RIVER BASIN

Genetic analyses have been conducted of rainbow trout and steelhead throughout the Santa Ynez basin (ENTRIX 1995b, Nielsen 1998). Dr. Jennifer Nielsen analyzed both mitochondrial DNA (mtDNA) and nuclear microsatellite DNA (microsatellites) using samples collected recently by the SYRTAC and earlier collections from the lower and upper basin, as well as those from other watersheds (Malibu Creek and Northern California). The following is a summary of the key points of Dr. Nielsen's report and a discussion of their relevance to management of Santa Ynez rainbow trout/steelhead. (Dr. Nielsen's report is provided in *Appendix F*).

MtDNA is DNA from the mitochondria, which is maternally-inherited and does not undergo recombination. Only one segment of this DNA strand (the d-loop) was examined. Ten different forms (haplotypes) of this segment have been found in Santa Ynez basin fish, the most common being mtDNA haplotypes 1, 3, 5, and 8. All four haplotypes can be found throughout the California coast, although haplotypes 1 and 3 are more common in northern populations and hatchery trout, and haplotypes 5 and 8 are more common in the south (Nielsen *et al*., 1994). A wild-caught fish cannot be determined to be hatchery-derived simply by examination of the mtDNA. Haplotypes 1 and 3 do not necessarily indicate hatchery-derived fish in Southern California streams, although there is a higher probability that hatchery rainbow trout will possess this haplotype rather than haplotype 5 or 8.

Microsatellites are short repeated units of DNA from the nucleus (inherited from both male and female), which can be highly variable. Dr. Nielsen examined ten different microsatellite locations (ten loci). Microsatellite analysis is a more recently-developed tool, and one that is showing great promise. For example, recent microsatellite work by Dr. Nielsen (pers. comm., 1998b) has found that hatchery fish in Southern California are more similar to Central Valley stocks. Using these markers, Dr. Neilsen has also found high levels of genetic diversity in southern steelhead (Malibu Creek and Santa Ynez River) (J. Nielsen 1998 manuscript).

The mtDNA data from the Santa Ynez River indicated an upper and lower basin substructure, with the notable exception of Salsipuedes Creek which grouped with the upper basin fish populations (Figure 2 in Neilsen 1998, *Appendix F*). The lower basin mtDNA group included Hilton Creek, Alisal Creek (from above the small reservoir), Long Pool, and Cachuma Reservoir (mtDNA haplotypes 1 and 3 most common). The upper basin mtDNA group included Salsipuedes/El Jaro creeks, and upper basin creeks such as Alder, Fox, Franklin, and Devil's Canyon (mtDNA haplotypes 5 and 8 most common). Jameson Reservoir data showed close similarities and gene flow with these upper basin creeks.

The microsatellite data provided slightly different information from the mtDNA data (Figure 3 in Neilsen 1998, *Appendix F*). There were two main groupings of the Santa Ynez based on microsatellites. Alisal Creek, San Miguelito Creek (only one fish), and Devil's Creek (three fish) made up one group, while Hilton Creek, Salsipuedes Creek, the Long Pool, and Malibu Creek made up the other. It is interesting to note that the samples in the first group came from above passage impediments, while the samples from the other group came from streams with access to the ocean. All Santa Ynez and Malibu Creek samples were more similar to each other than samples from Whale Rock Reservoir (a hatchery near Morro Bay that is thought to be derived from steelhead landlocked in the reservoir) or Northern California coast steelhead. Our ability to draw further conclusions about basin population structure is limited due to the lack of microsatellite data from the upper basin (only three fish from Devil's Creek), and variable and small sample sizes in our samples. Small sample sizes are especially problematic for microsatellite data, since there is more variation to contend with (ten different loci that can vary, as opposed to one locus for mtDNA). Microsatellites have proven to be valuable markers that can make finer discriminations among steelhead when samples sizes are larger.

Additional data from the upper headwaters would be very helpful to determine if resident fish harbor relic gene pools that would be appropriate for supplementation of anadromous native

Santa Ynez stocks. Dr. Neilsen recommended more samples (sample sizes 30 to 40 per location), collected systematically to answer genetic questions, and coordination among the groups conducting genetic studies in the basin.

The results of these genetic studies indicate that native southern steelhead haplotypes persist in the Santa Ynez River basin. The mtDNA data suggests some sub-basin structure for above and below Bradbury Dam, although Salsipuedes/El Jaro fish grouped more closely with fish from the upper basin than with fish from other lower basin streams. Hilton Creek fish were similar to fish from the Long Pool and Lake Cachuma. Inferences based on the limited available microsatellite data suggest that fish from streams with ocean access may be more similar to each other than to fish above passage impediments (Neilsen *et al.*, 1997). It is worth noting that the microsatellite tree grouped Hilton Creek and Long Pool fish (which were predominantly mtDNA haplotypes 1 and 3) with Salsipuedes fish (which were predominantly mtDNA haplotypes 5 and 8) and Malibu Creek fish (other work has indicated that Malibu fish are dominated by mtDNA haplotypes 5, 8 and 4 [Nielsen *et al*. 1997]); all were more similar to each other than to northern steelhead. The similarity of the mtDNA between the upper basin fish and Salsipuedes fish suggests that these upper basin fish may be appropriate source stocks if stocking or trap-and-truck measures are considered for the lower basin, although additional microsatellite studies of upper basin rainbow trout are recommended to further investigate this.

3.1.2 PROPOSED ACTION

Two measures have been identified to offset the potential genetic effects of stocking northern rainbow trout in Lake Cachuma and the mainstem below Gibraltar Dam, while continuing the current recreational fishery. The first proposed action is to replace the northern-origin rainbow trout currently used for stocking in Lake Cachuma and any other upper basin localities with an equal quantity of rainbow trout with a genetic profile more typical of Southern California steelhead. The second action would be to replace the fish currently stocked with an equal quantity of sterile rainbow trout or a sterile brown trout-rainbow trout hybrid. The current stocking program contributes to a valuable recreational fishery, and one of the objectives of this action is to continue the fishery's current level of success. The objective of this option is to preserve the genetic integrity of the local steelhead and rainbow trout population by minimizing introgression by foreign stocks.

3.2 ESTABLISHMENT OF A SOUTHERN STEELHEAD HATCHERY

3.2.1 BROODSTOCK DEVELOPMENT

The Southern California rainbow trout/steelhead broodstock would be developed from trout collected in the upper basin above Gibraltar or Jameson reservoirs. Creation of a broodstock begins with identifying a population of rainbow trout with genetic profiles similar to Southern California steelhead. Within the Santa Ynez watershed, this can potentially be found in the populations above Gibraltar and Juncal Dam (mid and upper sub-basins). Genetic studies of fish from Jameson Reservoir and tributaries such as Fox, Alder, Franklin, Indian and Devil's Canyon creeks support this conclusion (reviewed in *Appendix III* of Nielsen 1998).

In order to be assured enough genetic material to begin the broodstock, eggs and sperm must be collected from at least 500 females and 500 males (M. Haynie, CDFG, pers. comm.). Typically, the adults are captured in tributaries as they are migrating upstream to spawn. They are either spawned immediately or kept in live pens on site for several days until they are ready to spawn. Once all the adults are spawned, they are released back into the tributaries.

Field investigations and/or review of existing data will be needed to determine which tributaries to target and the appropriate locations for trapping operations on these tributaries. The selected tributaries will need to contain a population of genetically desirable adults large enough to withstand the removal of genetic material from 1,000 individuals. These fish would likely need to be collected from more than a single location (S. Chubb, pers. comm.). Additionally, the tributaries must be accessible during the spawning season and suitable for the operation of traps and holding facilities for individuals.

Prior to collection of spawning material, a hatchery facility must be available for fertilizing eggs and rearing the fish (potential facilities are discussed in the next section). The hatchery would require an appropriate water supply, method of aeration, backup system and manpower. In addition, any water quality issues relating to hatchery wastewater will need to be negotiated with the Regional Water Quality Board, particularly if a new facility is constructed.

It is anticipated that it will take eight to ten years to establish a suitable broodstock. The resulting progeny would need to be raised to a size of between three to five fish per pound in order to meet the needs of the stocking program. In order to obtain fish of this size, it currently takes the domestic stocks seven to eight months of rearing. It may take as long as two years for a wild stock to reach this size at the hatchery, depending on how the new broodstock responds.

3.2.2 HATCHERY FACILITIES

3.2.2.1 Existing Hatchery Facilities

The Upper Basin Work Group explored the possibility of developing and maintaining a broodstock in one of the existing hatcheries, as discussed below.

- ***Fillmore Hatchery*** – The Fillmore Hatchery is currently supplying half of the fish used to stock the Santa Ynez River. It is currently a rearing facility and lacks the capabilities and capacity for the development and maintenance of a broodstock. In addition, its remaining capacity may be used by the Department of Water Resources for reservoir stocking programs. For this facility to be used, a water treatment system would have to be developed to provide water of suitable temperature and quality for spawning and rearing rainbow trout. Systems and protocols would have to be developed to maintain strict separation between fish derived from southern stocks and the northern stocks currently employed. The capacity of the Fillmore Hatchery would need to be increased to maintain the southern broodstock.

- ***Whitney Hatchery*** **–** The Whitney Hatchery is currently involved in the Golden Trout stocking program. The golden trout is also a listed species, so the Whitney hatchery has substantial experience in dealing with the issues of rearing a listed species. The Whitney golden trout program includes the development and maintenance of a wild golden trout broodstock. The broodstock is kept in five different ponds in Northern California rather than on site. The trout are captured and spawned annually in order to rear the stock. Use of the Whitney Hatchery, however, has several problems that make it unlikely that it could be used for the proposed program. First, it has an ongoing problem with whirling disease, which is difficult to eradicate and could endanger the existing steelhead and rainbow trout populations in the Santa Ynez River if infected fish were released. Second, Whitney Hatchery is located in the Owens River basin, which has a substantially different climate than the Santa Ynez River. The difference in climate would likely result in different selective pressures. Over time, the fish reared there would become more adapted to the conditions and climate of the hatchery rather than of the Santa Ynez River, which would not meet the program objectives.

- ***Several other hatcheries*** were discussed, including Whale Rock, Hot Creek, Shasta-Pit and Lassen. These facilities seemed unlikely to serve the purposes of the *Santa Ynez River Fish Management Plan*. In most cases, the problems of hatchery size, climate and distance from the river seemed too great to warrant further investigation.

3.2.2.2 Construction of a New Hatchery Facility

Due to the difficulties associated with using an existing hatchery, it is likely that the construction of a new hatchery facility would be required to pursue this action. Ideally, a southern steelhead hatchery would be developed within the ESU to best emulate the environmental conditions of the Santa Ynez basin. A new facility would require a substantial investment to design and construct. The location of such a facility would require a water source with appropriate temperature, quality and reliability for spawning rainbow trout and rearing them to release size. Additional issues will involve obtaining the appropriate permits for the construction of such a facility and the resulting water discharge of its operation.

3.2.3 Additional Information and Monitoring

Several monitoring programs should be conducted to determine the success of the program. These include:

- population surveys of rainbow trout populations in the upper basin to determine appropriate locations where broodstock might be obtained;
- genetic monitoring of the fish used for stocking in order to maintain a genetic profile similar to Southern California rainbow trout/steelhead;

- creel surveys to determine if the fish are returning to the creel; and
- genetic monitoring of the fish within Lake Cachuma to determine whether there is a beneficial genetic shift.

3.2.4 EVALUATION

3.2.4.1 Technical Feasibility

The development and maintenance of a broodstock from Santa Ynez resident rainbow trout is, apparently, technically feasible. Based on the review of existing information, populations above Gibraltar and Juncal dams can likely provide 1,000 spawners without serious adverse affects on the resident population (S. Chubb, U.S. Forest Service [USFS], pers. comm.). However, it would be difficult to get the number of fish needed from a single tributary. A review of the existing hatcheries indicates that they have significant problems which would likely prevent their use. Therefore, it will probably be necessary to build a new hatchery for this purpose. If this program is pursued, it will be necessary to:

- acquire access to hatchery facilities suitable to the needs of the program or research the feasibility of building a new hatchery, including supporting the hatchery for eight to ten years during the development of the broodstock; address environmental issues regarding water supply and discharge involved with the construction of a hatchery facility;
- confirm the genotype of all fish collected for the purpose of developing a broodstock; and
- monitor the genetics of the hatchery stock in order to maintain genetic integrity.

3.2.4.2 Biological Concerns

It will be necessary to remove spawning material from 500 females and 500 males in order to create the broodstock. Sara Chubb (USFS) has indicated that the trout populations above Gibraltar and Juncal dams are likely sufficiently large and healthy enough to support this effort, although there would be difficulty in capturing such numbers in only a few locations without excessively depleting the population. Surveys should be conducted to identify areas where rainbow trout could be captured and spawned.

Once broodstock have been collected, founder effects and the selective forces in the hatchery environment will begin pushing the genetics of this hatchery population toward those individuals with the greatest fitness for conditions in the hatchery. As the purpose of this hatchery population is to serve the recreational fishery (not to supplement the wild population) a reasonable amount of "genetic drift" may be acceptable. However, in order to prevent excessive genetic drift, it will be necessary each year to collect additional spawning material from wild trout for combination with the hatchery broodstock. This infusion of new genetic material will help maintain genetic similarity with the southern genotype. The proportion of wild fish that would need to be incorporated each year to offset genetic drift must be determined.

The fish produced by this program will likely be more adapted to conditions in the Santa Ynez River than the northern fish currently stocked. These fish would therefore have a higher probability of survival if they avoid the creel, and they may compete more strongly with wild fish. These fish may interbreed with wild fish and introduce their hatchery-influenced genome into the wild population, to the extent that the genetic drift cannot be offset. The greater number of survivors (compared to northern derived fish) may result in a higher degree of mixing, and therefore the protection of downstream populations may not be complete. However, this mixing is less likely to reduce the fitness of the native stock than the current practice because of the genetic similarity of the southern steelhead hatchery fish, and therefore it will have a beneficial impact on the protected population over the current stocking practice.

3.2.4.3 Institutional Concerns

The proposed action is consistent with the management objectives of the CDFG and the Santa Barbara County Fish and Game Commission (County) for both steelhead management and the recreational fishery in the upper basin. CDFG has indicated that restoration of native and wild stocks is the highest priority for steelhead management, including maintaining genetic variability in wild stocks (Farley 1997). CDFG has also stated that artificial production, rearing, and stocking programs shall be managed to have minimal interference with natural salmonid stocks. The proposed action supports both goals. CDFG and the County also manage a valuable recreational fishery in Lake Cachuma and the Santa Ynez River between Bradbury and Gibraltar dams. Recreational fishing will not be hindered since stocking programs will be continued, albeit with southern-origin fish substituted for northern origin. This substitution will protect the genetic integrity of the native rainbow trout/steelhead stocks in the upper basin, consistent with CDFG's steelhead management objectives.

NMFS should have no objection to this action because stocks above Bradbury Dam are not included in the listed population. Additionally, the action has significant potential to protect the listed population below Bradbury Dam.

3.2.5 CONCLUSIONS

The proposed measure has the potential to preserve the genetic integrity of Southern California steelhead in the Santa Ynez basin by reducing or eliminating the potential for introgression from the northern derived stocks currently being planted in the river, although the influence of hatchery pressures could not be completely removed from the broodstock. The genetic analyses indicate that populations of rainbow trout exist in the Santa Ynez River basin with genetic profiles similar to southern steelhead and are available for use in the development of a broodstock.

This action, while technically feasible, would entail a long-term investment of effort to bring it to fruition. Existing hatcheries are at or near capacity or face other problems that would eliminate them from consideration for use. Constructing a new hatchery would also be a lengthy process, and would likely be quite expensive given land and water values in Southern California. The group recommends that development of a southern steelhead hatchery to support the put-and-take fishery in Lake Cachuma and the mainstem below Gibraltar Dam be put aside pending further investigation of population size and genetics of resident rainbow trout populations in the upper basin.

3.3 STOCKING STERILE TROUT

The second action that might be implemented to avoid the genetic introgression of native steelhead and rainbow trout with exotic strains would be to replace the rainbow trout currently planted in the lake and mainstem below Gibraltar Dam with sterile rainbow trout or sterile brown trout-rainbow trout hybrids.

DFG is currently working on the development of a brown trout-rainbow trout hybrid (brown-bows) at their Mt. Whitney Hatchery (M. Seefeldt, pers. comm.). While this program has met with only partial success to date, Mr. Seefeldt feels it will be successful in the long run. According to Mr. Seefeldt, hybrid stocking programs are in place in several other states using a brook trout-brown trout hybrid known as a "tiger trout." This strain is very aggressive and cannibalistic and thus would be unsuitable for use in the Santa Ynez River. CDFG is currently considering using this strain only in areas where a controlled predator is needed, such as in alpine lakes where fish growth is stunted by over-population. The brown-bow trout hybrid is less aggressive and will likely be more suitable in situations with sensitive species.

These programs would require larger numbers of eggs to produce the same number of fish, as the hybridization process is less viable than standard single species reproduction. The extra effort involved would require additional funds provided to the hatcheries implementing the program.

The third option in developing a sterile trout for planting would be to use a process which produces triploid fish. These fish have an extra set of chromosomes (the material on which genes are coded) that makes these fish sterile. The process which produces triploidy is simple, but success is highly variable (M. Seefeldt, pers. comm.). In some batches of fish, nearly 100% the fish will be triploid, while in the next batch only 50% will be triploid. Until the reliability of this process can be improved, it would not be suitable for use in this program, as there is not a simple way of determining whether a given fish is diploid or triploid.

3.3.1 EVALUATION

3.3.1.1 Technical Feasibility

The proposed stocking of sterile trout does not appear to be technically feasible at this time, although the development of brown-bow hybrid may be feasible in the near future (M. Seefeldt, pers. comm.). Once the technology has been adequately developed, there will be an additional delay involved in getting this technology geared up to a production level capable of producing the desired number of fish. The hybridized eggs are not as viable as single species eggs, and therefore a greater starting pool of eggs will be required to obtain a similar number of fish. There will be additional cost associated with producing these hybrid fish.

3.3.1.2 Biological Concerns

The tiger trout are highly aggressive and predatory and therefore do not meet the objective of this action. The brown-bow strain is believed to be less aggressive and may be more suitable for use in this application, but their behavior has not been well studied. Either of these strains may exhibit spawning behavior even if they are sterile. There is a possibility they may compete with native rainbow trout and steelhead for suitable spawning sites. However, the brown-bow are the progeny of fall spawning brown trout and fall spawning rainbow trout. Therefore the hybrids would likely exhibit fall spawning behavior, and the competitive pressure for suitable spawning sites would be alleviated.

The brown-bow hybrids are being developed at the Mt. Whitney Hatchery which has a whirling disease problem. If brown-bows were to be planted in Lake Cachuma and the Santa Ynez River, these fish should be produced at a facility without this parasite, to avoid infestation in this watershed, where it currently does not occur.

3.3.1.3 Institutional Concerns

There are no known institutional constraints to this program. The brown-bow hybrids are being developed by CDFG. The fish are sterile, so they pose no genetic threat to native trout stocks. However the behavioral characteristics of this hybrid are poorly understood.

3.3.2 CONCLUSION AND RECOMMENDATIONS

This measure, while still technically infeasible, has the potential to avoid possible genetic introgression with steelhead and support the continuation of the Lake Cachuma fishery. This measure would also avoid any potential adverse genetic effects associated with the development of a broodstock program. Based on the likely need to construct a new hatchery for southern steelhead if a southern steelhead broodstock were to be developed, the brown-bow hatchery program could likely be attained at a considerable cost savings. There may also be a substantial time savings involved depending on the progress of the hybrid development and the actual time needed to adapt this process into a production mode facility. It is recommended that the

SYRTAC keep abreast of the progress of this research and consider implementation of this option if it proves technically feasible.

3.4 SUMMARY OF GENETIC PROTECTION

The current practice of stocking northern rainbow trout strains into Lake Cachuma and the mainstem below Gibraltar Dam has the potential to adversely affect the protected steelhead population below Bradbury Dam. However, this practice supports a unique and valuable fishery, the likes of which cannot be found elsewhere in Santa Barbara County. This fishery should be continued and enhanced. The upper basin work group recommends that CDFG pursue stocking practices that will not jeopardize the genetics of the protected steelhead population. Two options have been investigated, each of which presents substantial biological and technical challenges. Based on feasibility of the development of a new hatchery and the potential problems associated with any hatchery, the work group recommends that the development of a southern steelhead hatchery stock be shelved. The work group further recommends that the SYRTAC and DFG stay abreast of current research on the development of sterile trout strains for use in put-and-take fisheries, and as this research becomes applicable, use it to replace the current stocking practice in Lake Cachuma and the upper mainstem below Gibraltar Dam.

4.1 BACKGROUND

As discussed in Section 2, the area above Bradbury Dam historically provided much of the good steelhead spawning and rearing habitat in the basin. Due to the current passage barriers, steelhead do not have access to this area of the basin.

The actions evaluated are intended to provide steelhead access to the historical spawning and rearing habitat in the upper basin. In order for the progeny of steelhead transported into the upper basin to complete their life history cycle, however, it will also be necessary to provide smolts downstream passage around Bradbury Dam so that they can reach the ocean. Section 5 addresses trap-and-truck operations for downstream transport of smolts from the upper basin.

Four alternatives were considered to provide passage around Bradbury Dam: (1) a fish ladder at Bradbury Dam, (2) a fish ladder from Hilton Creek to Lake Cachuma, (3) a bio-engineered fish passage channel that would pass fish around or into Lake Cachuma, and (4) trap-and-truck operations to move returning adult steelhead from below Bradbury Dam into the upper basin. Each of these actions are described in more detail in the following sections.

4.2 LADDER AT BRADBURY DAM

4.2.1 PROPOSED ACTION

Fish ladders are often used to allow upstream migrating fish to travel over a dam or other passage barrier and gain access to spawning and rearing habitat in the portion of a watershed above that barrier. Fish ladders also allow outmigrating fish downstream passage around a barrier to gain access to the ocean. This option discusses the construction of a fish ladder from the mainstem Santa Ynez River over Bradbury Dam. The type of ladder proposed for this action is an Alaska Steeppass ladder, which is a style of Denil fishway. Implementation of this style of fish passageway involves not only the construction of the ladder portion, but also modifications to the dam for the necessary outlet structure.

According to guidelines suggested by Bates (1997), an Alaska Steeppass can achieve a slope of about 25%, and they have been tested up to a slope of 33%. The standard length of ladder sections is 30 feet, with a 10-foot-long resting pool between sections. Thus, for every 40 feet of ladder and pool, a rise of 7.5 to 10 feet would be achieved. Bradbury Dam, therefore, would require a total ladder length of 1,116 to 1,488 feet. The ladder would need to be a self-supporting structure that is connected to Bradbury Dam. It must be capable of withstanding seismic activity and must not jeopardize the stability of the dam itself. The outlet structure at the ladder's upstream end would need to be designed to accommodate variable lake levels so that a continuous flow from the lake to the ladder could be maintained.

4.2.2 Technical Feasibility

Constructing a ladder from the mainstem presents serious technological challenges, according to fish passage experts (G. Heise [CDFG] and J. Pisamente, pers. comm. to C. Fusaro; W. Trihey, ENTRIX pers. comm.). Bradbury Dam is a 279-foot tall earthen dam. This is more than twice as high as the highest locations where successful ladders have been constructed. The outlet structure at the top would need to accommodate variable lake levels. Such an outlet structure would require flow control gate structures and would represent a major engineering modification to the dam. This would greatly increase the complexity and cost of the fish ladder. Because this action is technically infeasible, it has been dropped from further consideration.

4.3 Fish Ladder from Hilton Creek to Lake Cachuma

4.3.1 Proposed Action

Some of the technological problems of constructing a fish ladder at Bradbury Dam (Section 4.2) would be reduced by constructing the ladder from the top of Hilton Creek. Hilton Creek is a small tributary located just below Lake Cachuma. During winter flows, rainbow trout/steelhead swim up Hilton Creek to spawn (SYRTAC 1997a). The portion of the creek on U.S. Bureau of Reclamation (Reclamation) property extends approximately 2,980 feet from the Santa Ynez River (elevation approximately 550 feet) up to the Reclamation property boundary (elevation 680 feet). Under this action, Hilton Creek would be used to gain some elevation, and a fish ladder would be constructed from the upper end of Hilton Creek near the property boundary to Lake Cachuma.

Currently, a partial passage obstruction exists on the creek at an elevation of 625 feet, approximately 1,380 feet upstream from the confluence with the Santa Ynez River. Plans are currently underway to correct this impediment (*Appendix D - Hilton Creek Enhancement*). Modification of this passage impediment would allow fish to reach an elevation of 680 feet (Reclamation property boundary).

Passage into Lake Cachuma would then require a fish ladder 86 feet high and approximately 349 to 459 feet in length. As discussed earlier, the type of ladder proposed for this action is an Alaska Steeppass ladder, which is a style of Denil fishway. Implementation of a fish ladder would require an appropriate outlet structure to address the variable water surface elevation within the lake, as discussed above, so that a continuous flow from the lake to the ladder could be maintained.

4.3.2 Technical Feasibility

Although this approach is technologically more feasible than a larger ladder from the mainstem Santa Ynez River, it would still be a long ladder that may be difficult for adults to successfully negotiate. Furthermore, the ladder would require an appropriate outlet structure to address the variable water surface elevation within the lake which, as discussed above, would require substantial modifications to the dam. Such an outlet structure would require flow control gate structures and would represent a major engineering modification to the dam. This would greatly increase the complexity and cost of the fish ladder.

4.3.3 Biological Concerns

A fish ladder alone would not allow steelhead to complete their life cycle because it would likely be ineffective at providing downstream passage for outmigrating smolts and for any adults that may be returning to the ocean. Outmigrating smolts would have to navigate through Lake Cachuma in order to find the entrance to the fish ladder. Lake Cachuma is a large reservoir (3,000+ acres) which has negligible flow throughout most of the year. As a result, it is unlikely that smolts would be able to negotiate a way through the reservoir to find the relatively small outlet into the fish ladder. Also, the numerous warmwater predatory fishes in Lake Cachuma would prey on the smolts during their migration. The only other way for juvenile fish to migrate downstream would be to go over the face of the spillway in large storm events. These opportunities occur in about one out of three years, and the trip down the spillway would likely result in injury and possible mortality.

Because juvenile fish would likely be unsuccessful in migrating through Lake Cachuma to the lower basin, any plan to get upstream migrants into the upper basin would have to be accompanied by a downstream migrant trapping program, like the one described in Section 5.

4.3.4 Institutional Concerns

Allowing the federally listed steelhead to enter Lake Cachuma by any means would have serious regulatory consequences for the recreational fishery in the lake. CDFG currently manages the lake as a fishery for bass, catfish and stocked rainbow trout. Lake Cachuma is the largest lake in the area available to local fishermen. The presence of steelhead would essentially prohibit fishing in the lake and in the mainstem and tributaries between Bradbury and Gibraltar dams, thus significantly impacting the opportunity for recreational fishing within the county. Therefore, allowing steelhead above the dam would raise institutional conflicts with the County.

Allowing steelhead above Lake Cachuma would also impact private landowners in this area. The land management practices of these owners may be restricted by the presence of an endangered species.

These concerns could be mitigated if NMFS designated the translocated fish an experimental population and therefore not subject to ESA protections.

4.4 Bio-Engineered Fish Passage Channel

4.4.1 Proposed Action

This option would construct a bio-engineered fish channel to allow steelhead to pass around the dam and the lake. This would be a structure with a lower gradient than a fish ladder, but would likely be several miles in length. Continuous water flow would have to be maintained throughout the entire channel to allow fish to swim upstream. Based on a review of topographic maps, the most likely course for such a canal would be up Santa Aqueda Creek to the headwaters of Happy Canyon Creek and then into Lake Cachuma in the vicinity of Cachuma Creek.

4.4.2 Technical Feasibility

This option would be technically infeasible because the headwaters of Happy Canyon Creek are over 90 feet above the elevation of Lake Cachuma. Thus continuous "downstream" flow could not be maintained through the constructed channel. Due to the technical infeasibility of this option, the biological and institutional concerns are not discussed.

4.5 Trap-and-Truck Transport of Adult Steelhead

4.5.1 Proposed Action

This option would trap adult upstream migrant steelhead below Bradbury Dam and release them into suitable spawning habitat in the upper basin. An advantage of a trap-and-truck operation over a fish ladder is that it has the potential to allow steelhead access to habitat throughout the upper basin, depending on the selected release site. The ladder or fish channel would allow fish to pass over Bradbury Dam, but these fish would be blocked at Gibraltar Dam and thus would not have access to habitat available above this point. Steelhead would also be limited to habitat on the tributaries below any passage barriers.

Trapping of adult steelhead would be conducted using the same methods as the current SYRTAC studies of the lower basin. For several years, the SYRTAC has been conducting trapping operations in the lower Santa Ynez River and its tributaries as part of a migration monitoring program. The program has trapped both upstream and downstream migrating adults and juveniles.

A fyke trap with a weir portion constructed after the Alaskan style A-frame weir would be placed across the stream to collect fish migrating upstream. Monitoring of traps and transport of steelhead would occur daily throughout the operation period. Trapping can be conducted only at relatively low flows. During high flows, the trapping equipment must be removed from the river or stream to prevent its loss. More permanent trapping stations able to withstand higher flows could be designed and constructed. Possible trapping sites include Hilton Creek, which is on Reclamation property, or the mainstem or Salsipuedes Creek, which would require permission from the landowner.

Captured adults would be transported in an aerated tanker truck to the upper basin. The fish would be released in Los Padres National Forest above Gibraltar Dam or Juncal Dam, and/or suitable tributary habitat above Gibraltar Dam. Access to this area would be difficult with a tanker truck. Once accessible areas have been identified, habitat data will need to be reviewed to determine the best spawning areas to release adults. Potential release sites include Blue Canyon, Indian, Mono, Fox, and Alder creeks in the middle sub-basin, and Juncal Creek in the upper sub-basin.

4.5.2 TECHNICAL FEASIBILITY

Trapping in the lower basin would likely be technically feasible, although the number of fish captured would be limited by the inability to operate the traps during high-flow events. The primary technical issue in upstream transport is vehicular access in the upper basin to suitable release sites. The roads that currently exist are not passable during the winter and spring months when transport would occur. It would be necessary to improve existing roads so that they are passable by a medium-sized tanker truck during these months.

4.5.3 BIOLOGICAL CONCERNS

Trap-and-truck operations involve a substantial amount of fish handling which can result in stress and in some cases mortality of individuals. Specific points of stress include the transfer of fish from the trap to the truck, transport (truck ride) to the upper basin, and release into the upper tributaries. Measures will need to be incorporated in order to minimize the amount of handling and therefore stress of steelhead.

Biologically, it may be desirable to move some adult steelhead into the upper basin to keep the anadromous life history strategy alive in this area of the Santa Ynez River. The current population has been landlocked for many generations; and fish exhibiting an anadromous tendency would tend to be selected against, as they may pass over the dams and be lost to the upstream population. By introducing adult steelhead into the upper basin and keeping the anadromous tendency alive in this area, a buffer may be provided that could be used as a source for anadromous southern steelhead genome, even if no assistance were provided to allow outmigrant juveniles to reach the sea.

In order for the progeny of steelhead transported into the upper basin to complete their life history pattern, it will be necessary to provide them access to the ocean. This would likely be accomplished with a trap-and-truck operation of outmigrating smolts from the upper basin tributaries to below Bradbury Dam (discussed in detail in Section 5). Such an operation would need to be conducted every year during the outmigration season (about March to June). It will be necessary to identify suitable trapping sites and construct traps in the upper basin tributaries. Additionally, suitable release sites in the lower basin will need to be identified in order to increase the likelihood of smolts reaching the ocean.

In the short-term, trapping-and-trucking adult steelhead could have negative impacts on the population below Bradbury Dam. It would move the production of any fish transported from the lower basin to the upper basin. Given their relatively low numbers, this would likely have a significant effect on the population. In addition, as steelhead can spawn more than once, adult steelhead moved over the dam would not be able to return to the ocean; and once moved above the dam, these fish would be forced to reside in one of the reservoirs or tributaries unless successfully recaptured and transported back downstream (see Section 5 below). This would likely reduce their potential lifetime production. However, other enhancement measures currently being pursued by the SYRTAC are designed to increase the population of steelhead in the lower basin. The success of these additional measures would result in a "surplus" of adult steelhead returning to the lower basin to spawn. A surplus of fish is a number of fish larger than the appropriate habitat to support them, or a larger number of fish than needed to fully saturate the available habitat for subsequent life stages. As these populations increase, the biological impacts of moving adults to the upper basin will be reduced and, therefore, its feasibility will increase.

4.5.4 INSTITUTIONAL CONCERNS

Proposed trap-and-truck operations raise serious concerns for state and federal agencies. CDFG policies state, "trap-and-truck operations, because of their history of failure to fully mitigate for loss of habitat, will not be considered as mitigation for proposed water projects, except where already approved." (T. Farley CDFG 1997). NMFS has recommended that other options be considered and implemented before trap-and-truck proposals be pursued, due to the lack of success achieved in other regions (Hogarth 1998). NMFS would prefer to see if conservation measures in the lower basin are successful at enhancing steelhead production before engaging in trap-and-truck measures.

Transporting federally listed steelhead into the upper basin would potentially have consequences for recreational fishing and private landowners, but not to the degree that a fish ladder would, as discussed earlier in Section 4.2.4. This is because the adults could be selectively released above Gibraltar Dam in Los Padres National Forest. A fish ladder would release steelhead into Lake Cachuma, where they could create regulatory conflicts with the existing fishery. Again, the concerns about endangered species regulations could be mitigated if NMFS designated the translocated fish an experimental population and therefore not subject to ESA protections.

Trap-and-truck operations could potentially affect other protected species in the upper basin, principally California red-legged frog (federally listed as threatened) and the southwestern arroyo toad (federally listed as endangered). Both species move around and are present on roadways in the winter. Increased vehicular traffic during this time of year could result in increased mortality to these species. If a trap-and-truck operation were put into place, measures would need to be taken to prevent harming these species during their spring movements. Consultation with the U.S. Fish and Wildlife Service (USFWS) would be required to develop appropriate mitigation measures and to obtain an incidental take permit.

4.6 CONCLUSIONS AND RECOMMENDATIONS

The Work Group reviewed several options for getting adult steelhead into the available habitat in the upper basin. The options of a fish ladder from the mainstem Santa Ynez River or a bio-engineered fish channel are technically infeasible and do not warrant further investigation. A fish ladder from upper Hilton Creek is technically questionable, very expensive and presents serious biological concerns. This measure would also endanger the valuable recreational fishery in Lake Cachuma and the upper mainstem below Gibraltar Dam. Trapping adults in the lower basin and transporting them via truck to the upper basin is the most feasible option for upstream passage. All of these options fail to provide adequate passage for outmigrating smolts from the upper basin, therefore, a trap-and-truck operation for outmigrants is a necessary complementary measure for any upstream passage measure. Simply providing adult steelhead passage in an upstream direction may help keep the anadromous life history pattern alive in the upper basin, which may provide a source of suitable genes for supplementing the population of southern steelhead at a later date should it become necessary.

The Upper Basin Work Group recommends that a fish ladder over Bradbury Dam not be considered because of the lack of certainty that the ladder would be successful, the difficulty of getting juvenile fish back downstream of the dam, and the presence of the valuable fishery of Lake Cachuma and the mainstem below Gibraltar Dam, which is the single most important freshwater fishing opportunity in Santa Barbara County.

Trap-and-truck operations for upstream migrants still face several technical and institutional challenges to implementation, including:

- access to suitable release sites in the upper basin over poor roads in winter;
- permission for establishing trapping sites on tributaries in the lower basin (not an issue if trapping is conducted at Hilton Creek on Reclamation property);
- measures to minimize take of red-legged frogs and Arroyo toads during transport;
- providing downstream access for outmigrating smolts to the ocean (discussed further in Section 5);
- short-term loss of steelhead production in the lower basin due to transport of adults into the upper basin for spawning; and
- resistance by CDFG and NMFS to trap-and truck operations.

In the face of these challenges, the upper basin work group recommends that the proposed habitat rehabilitation and enhancement efforts below Bradbury Dam be carried out and monitored to see how the population responds. The Adaptive Management Committee will continue to investigate opportunities to provide passage for steelhead around Bradbury Dam.

5.1 BACKGROUND

As described earlier, steelhead and resident rainbow trout are members of the same species but with different life history strategies. Steelhead are anadromous (fish mature in the sea, and return as adults to spawn in freshwater), while resident rainbow trout spend their entire lives in freshwater. As members of the same species they can interbreed within a given aquatic system and form a single cohesive population. Adults exhibiting either life history pattern may produce offspring exhibiting either life history pattern. Since the construction of Bradbury Dam, anadromous steelhead have been prevented from migrating upstream into the upper basin. Furthermore, the only life history strategy that the population upstream of Bradbury Dam can express is freshwater residency.

Some proportion of resident rainbow trout progeny are expected to exhibit anadromous traits by becoming smolts and attempting to migrate downstream to the ocean. Currently, smolts from the upper basin cannot migrate downstream past the dams. One way to enhance the anadromous population of the lower basin would be to provide a mechanism by which these "anadromous" progeny could successfully reach the ocean. These fish, if they successfully smolt, would grow to maturity and return to the Santa Ynez River, thereby boosting the population.

The objective of the proposed action is to enhance steelhead production in the lower basin by providing additional outmigrants with access to the ocean.

5.2 PROPOSED ACTION

This action will provide passage around Bradbury Dam for outmigrating smolts that are produced in the upper basin, thereby providing access to the ocean. Fish that are migrating downstream from the tributaries in the middle or upper sub-basins will be trapped, transported downstream via an aerated tanker truck, and released in the river near the upper end of the estuary. This location was selected for release to minimize the chance that any of these fish might residualize (remain in freshwater) and out compete an individual that might eventually exhibit an anadromous life history strategy.

Trapping would likely be conducted using the same methods as currently used in the SYRTAC studies of the lower basin. A fyke trap with a weir portion constructed after the Alaskan style A-frame weir would be placed across the stream to collect fish migrating downstream. Monitoring of traps and transport of young fish would occur daily throughout the operation period. Trapping can be conducted only at relatively low flows. During high flows, the trapping equipment must be removed from the river or stream to prevent its loss. More permanent trapping stations able to withstand higher flows could be designed and constructed. Possible trapping sites include Blue Canyon, Indian, Mono, Fox, and Alder creeks in the middle sub-basin, and the mainstem above Juncal Dam, Juncal Creek and North Fork Juncal Creek in the upper sub-basin.

Another potential type of downstream migrant trap is a "fish gulper." The fish gulper facility would require a reasonably stable channel reach that could be completely screened, probably with removable screens. The collection mechanism involves placing a screen (1/4-inch mesh or smaller) diagonally across the stream channel, which will funnel fish down into the narrow apex. The "fish gulper" is a pipe at the apex of the funnel. Water velocity increases as the water is funneled down, so the fish are sucked into the gulper and carried through a pipe to a holding tank. The water is then bypassed or pumped back to the river. The collected fish would then be transported via a tanker truck to a release site downstream of Bradbury Dam.

Prior to implementing trap-and-truck operations, review of existing data and/or surveys would be necessary to identify likely trapping sites in the upper basin. The issues to consider in selecting suitable trapping sites include juvenile production of the tributary, manageable flow rates, debris loads, and vehicle accessibility. In order to obtain fish of southern steelhead genetic lineage, trapping would occur only in tributaries in the middle or upper sub-basins.

5.3 EVALUATION

5.3.1 TECHNICAL FEASIBILITY

As discussed in Section 4.5, trapping of downstream migrants would likely be technically feasible, although the number of fish captured would be limited by the inability to operate the traps during high-flow events. Since steelhead and rainbow trout juveniles generally move during these high flows, only a small portion of the available migrants is likely to be captured. In addition, during high flows, the trapping equipment must be removed from the river or stream to prevent its loss.

A fish screen and fish gulper would be most applicable and likely to succeed where the streamflow and debris load is very predictable (*e.g.,* in a water diversion facility). Such a facility is not well suited for the flashy debris-laden flows of the Santa Ynez River. The approach velocity of fish screens is typically less than .5 feet/second, which means that any appreciable flow would require a great length of screen. A rough cost estimate is $1,000 per linear foot of screen (4 to 5 feet tall). High-flow events and debris would seriously damage the screens. One solution to this problem would be to remove screens when flows are high. However, anadromous fish like steelhead typically use the high flows to migrate downstream. Therefore, the fish gulper would be most effective in years with low or moderate flow, but not in years of high flow. A fish gulper facility would require continuing maintenance during the spring migration season for the removal, cleaning, and installation of screens, as well as supervision of fish capture and transfer. Information to be sought if the feasibility of a fish gulper is to be considered further would be the duration and magnitude of high flows, typical debris loads, and a survey of the channel to find a suitable site.

Another technical challenge is vehicular access in the upper basin. The roads that currently exist are not passable during the winter and spring months when transport would occur. It would be necessary to improve existing roads so that they are passable by a medium-sized tanker truck during these months.

5.3.2 Biological Concerns

Some of the juveniles translocated downstream of Bradbury Dam may remain resident within the system. These individuals may displace young steelhead already present. This may have a detrimental effect on these young fish. To reduce this possibility, the traps would be placed so that they capture only fish that are actively moving downstream out of a tributary (*i.e.,* outmigrants), this being a sign of potential anadromy. To further reduce the risk of residualization, juveniles moved downstream would be placed near the upstream end of the estuary so that they are less likely to enter a tributary stream where they might displace native fish.

It is currently unknown how many juveniles might be actively migrating downstream in the upper basin, or how important these individuals are to the local populations. These factors should be investigated before this action is implemented.

Trapping and transport activities could result in stress and mortality of the captured juveniles. Additional stress and mortality may be experienced in the receiving stream due to low flows, poor habitat conditions and/or unsuitable temperatures in the receiving stream. These problems can be addressed through proper transport procedures and release site selection.

5.3.3 Institutional Concerns

Proposed trap-and-truck operations raise serious concerns for state and federal agencies. The CDFG policies state, "trap-and-truck operations, because of their history of failure to fully mitigate for loss of habitat, will not be considered as mitigation for proposed water projects, except where already approved." (T. Farley CDFG 1997). NMFS has recommended that other options be considered and implemented before trap-and-truck proposals be pursued, due to the lack of success achieved in other regions (Hogarth 1998). NMFS would prefer to see if conservation measures in the lower basin are successful at enhancing steelhead production before engaging in trap-and-truck measures.

Trap-and-truck operations could potentially affect other protected species in the upper basin, principally California red-legged frog (federally listed as threatened) and the southwestern arroyo toad (federally listed as endangered). Both species move around and are present on roadways in the winter. Increased vehicular traffic during this time of year could result in increased mortality to these species. If a trap-and-truck operation were put into place, measures would need to be taken to prevent harming these species during their spring movements. Consultation with USFWS would be required to develop appropriate mitigation measures and to obtain an incidental take permit.

5.4 CONCLUSIONS AND RECOMMENDATIONS

The objective of this option is to supplement the steelhead population in the lower basin. In at least some wet years, there appears to be sufficient production of juveniles. In other years, production in the lower basin may be reduced and it may be desirable to increase the number of smolt going out to sea. However, other enhancement measures currently being pursued by the SYRTAC are designed to increase the habitat available in the lower basin. It may be advisable to evaluate the need for supplementing production in the lower basin after we see the results of planned actions there.

This action appears to be feasible from a technical basis. Impacts to rainbow trout populations would likely not be a concern because the rainbow trout in the upper basin, while genetically similar to southern steelhead, are not part of the protected population under the ESA. There may be adverse impacts to the steelhead population downstream of Bradbury Dam, however, if some of these fish residualize and occupy habitat that otherwise could be used by juveniles that will become anadromous steelhead. The juvenile rainbow trout trapped for this program, however, would be in a migratory phase which will increase the likelihood that they would smoltify and go to sea. Additionally, these fish would be released near the upper end of the estuary where they are unlikely to enter the tributary stream and displace local rainbow trout or steelhead.

Based on the lack of knowledge about the need for the action, the potential benefit of the action (how many additional smolt would be produced), and the potential effects of the action on steelhead populations in the protected reach below Bradbury Dam and the rainbow trout populations in the area where the juveniles would be collected, the Upper Basin Work Group recommends that these questions be investigated and that this action be revisited when more is known.

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