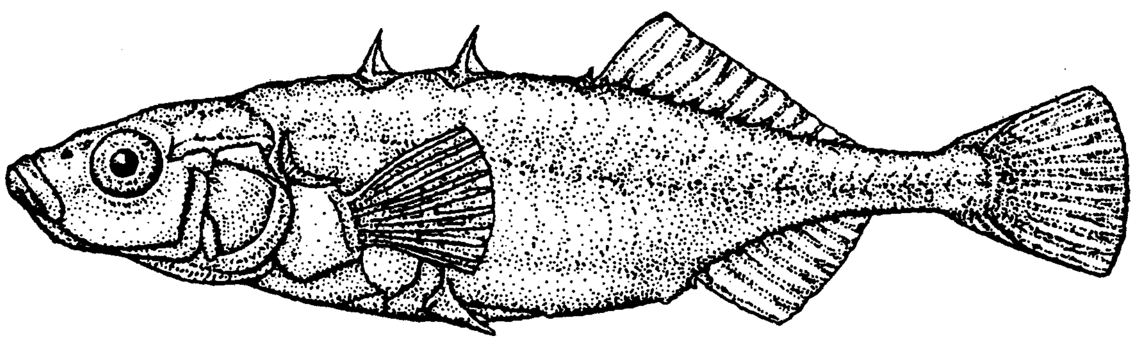
Recovery Plan



UNARMORED THREESPINE STICKLEBACK

REVISED

UNARMORED THREESPINE STICKLEBACK

RECOVERY PLAN

U.S. Fish and Wildlife Service

Portland, Oregon

Revision Approved: David L. McMullen

Acting Regional Director, Region 1
U.S. Fish and Wildlife Service

12/26/85

Date

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ACKNOWLEDGEMENTS

The Unarmored Threespine Stickleback Recovery Plan was revised from the original Recovery Plan prepared by the Unarmored Threespine Stickleback Recovery Team in 1977. At the time the original plan was prepared the Recovery Team consisted of: Shoken Sasaki, Team Leader, California Department of Fish and Game, Jonathan N. Baskin, California State Polytechnic University, Pomona, Ben Beall, U.S. Forest Service, James A. St. Amant, California Department of Fish and Game, and Camm Swift, Los Angeles County Natural History Museum. Input into the revised plan was provided by the current Recovery Team members and advisors and the agencies cooperating in the recovery effort. The final revisions were incorporated into the plan by Jack Williams and Edward Lorentzen of the Sacramento Endangered Species Office, U.S. Fish and Wildife Service. Cover drawing by Sara Wilkinson.

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Unarmored Threespine Stickleback

Recovery Plan Executive Summary

1. At what point or condition can the species be considered recovered?

When habitat conditions for each of the known remnant popualtions have been stabilized at or near historical carrying capacities, when the other known threats have been addressed in a manner that assures the continued existence of these populations, and when at least five self-sustaining populations have been maintained within the historical range of *G. a. williamsoni* for a period of five consecutive years without significant threats to their continued existence.

2. What must be done to reach recovery?

The known extant populations must be preserved and protected, additional populations will need to be successfully reintroduced into historical habitats, the spread of exotic organisms will need to be controlled, and degraded habitats will need to be restored and maintained.

3. What specifically must be done to meet needs of #2?

Adequate instream flows must be maintained in all essential habitats, land uses must be regulated to maintain good water quality, the introduction of additional exotic organisms must be prevented, the spread of established populations of exotic organisms controlled, suitable reintroduction sites within the historical range must be found, and habitat conditions must be monitored to insure that satisfactory conditions for *G. a. williamsoni* are being maintained.

4. What management/maintenance needs have been identified to keep species recovered?

Removal (take) of species will be closely regulated; habitat conditions will be monitored and appropriately managed; contingency plans will be implemented to protect the species from natural or man-made disasters, and additional populations will be established in suitable reintroduction sites as needed.

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PART I

INTRODUCTION

Brief Overview

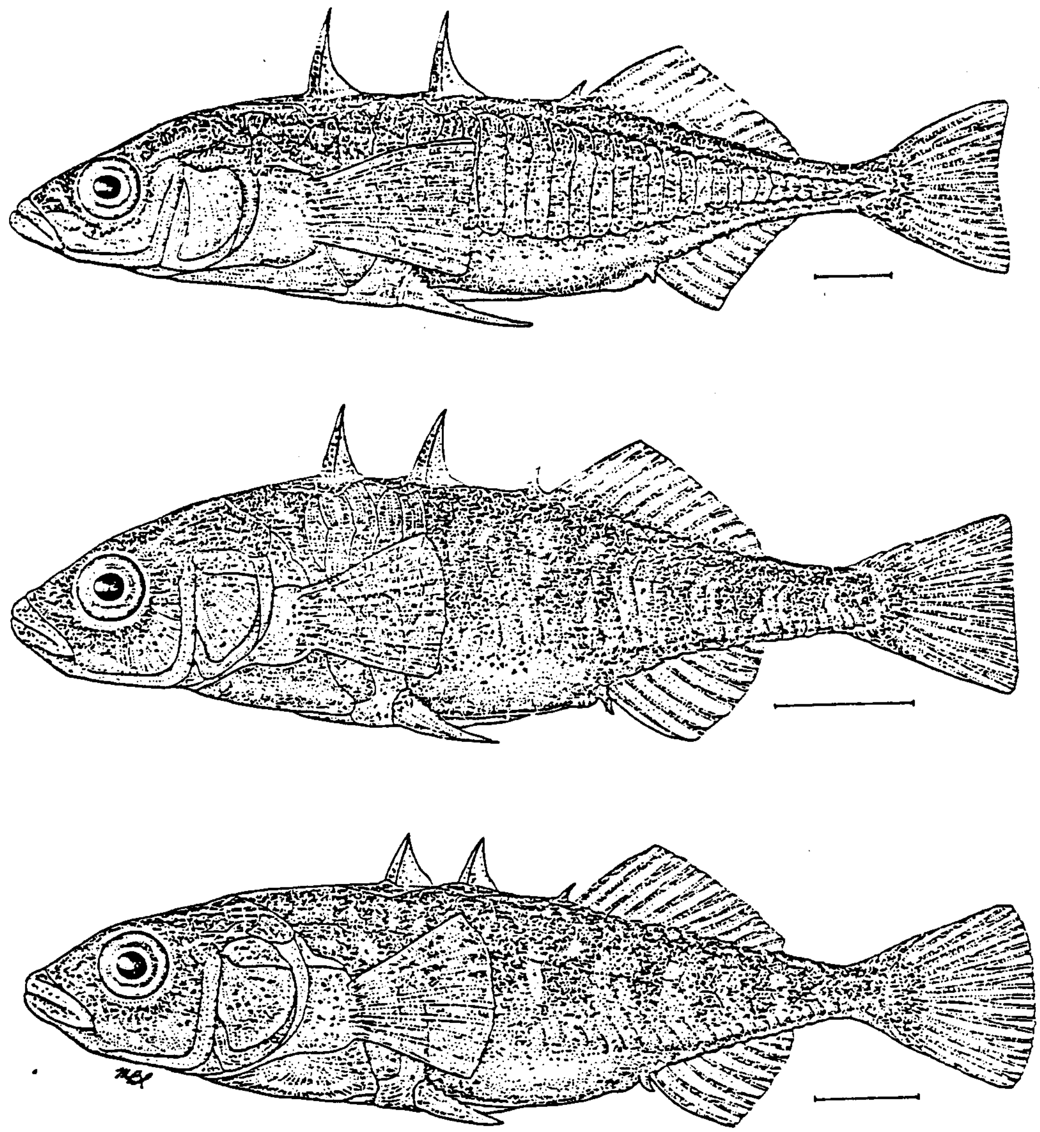
This is a plan for the recovery and eventual delisting of the endangered unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*). This fish is currently restricted to the Santa Clara River drainage in Los Angeles County and the San Antonio Creek drainage in Santa Barbara County, but previously was more widespread in southern California (Miller and Hubbs 1969). The U.S. Fish and Wildlife Service listed the unarmored threespine stickleback as an endangered species in 1970 (Federal Register 35: 16047). Critical habitat was proposed in 1980 (Federal Register 45: 76012) and is still pending.

Description and Diagnosis

Threespine sticklebacks (*Gasterosteus aculeatus*) are found throughout much of the Northern Hemisphere. They are streamlined fish, usually not exceeding six cm standard length (i.e., from the tip of the snout to the base of the caudal fin). The dorsal fin consists of two isolated spines anteriorly, with a third smaller spine at the front edge of the more posterior, soft rayed portion of the fin. The most striking features, however, are the unusual pelvic girdle with a denticulated spine on either side (Nelson 1971) and large, lateral bony plates of varying number (zero to about 35). Threespine sticklebacks also are known for the brilliant male nuptial coloration of red on the head which sometimes extends back to the origin of the anal fin. Miller and Hubbs (1969) recognized three subspecies of Gasterosteus aculeatus on the Pacific Coast of North America: G. a. aculeatus (fully plated), G. a. microcephalus (low plated) and G. a. williamsoni (unplated) (Figure 1). The minor problems with this terminology have been pointed out by Hagen and McPhail (1970) and reviewed by Bell (1976a).

G. a. williamsoni is readily distinguished from the other two subspecies on the basis of lateral plate counts alone, provided that at least 25 morphologically mature specimens [i.e., individuals of at least 32 mm in standard length (SL), Bell (1981)] are available. Samples of G. a. williamsoni generally average 0.06 to 0.55 lateral plates per individual and G. a. microcephalus average more than six lateral plates per individual (Bell 1976b). However, rare individuals of G. a. williamsoni may have as many as six lateral plates (Miller and Hubbs 1969, Bell 1976b) and occasional specimens of G. a. microcephalus have none. It is necessary to have several individuals to recognize a population of G. a. williamsoni, as is usually the case with subspecies (Mayr 1969).

Although lateral plate counts are the easiest way to separate G. a. williamsoni from other subspecies, they also may be distinguished from other California sticklebacks by using additional characters: short dorsal pelvic spines, rounded pectoral and caudal fins, less streamlined body (Miller and Hubbs 1969), reduced denticulation of the spines, and reduced size of the ascending branch of the pelvic girdle (Bell 1976b). Ross (1973) devised a character index with a 96% joint nonoverlap between typical G. a. williamsoni and G. a. microcephalus. Miller and Hubbs (1969) mention characters which separate G. a. williamsoni from Old World analogs.



The three subspecies of *Gasterosteus aculeatus* in western North America. All specimens drawn are from California; the scale for each figure represents 0.5 mm. Above: *G. a. aculeatus*, UMMZ 66025, a female 62 mm SL, from Humboldt Bay. Middle: *G. a. microcephalus*, UMMZ 131725, a juvenile (♂?) 33 mm SL, from Arroyo Grande Creek (Fig. 1, loc. 8). Below: *G. a. williamsoni*, UMMZ 159243, a topotypic male 42 mm SL, from the headwaters of Santa Clara River (see Miller, 1960).

Figure 1. Illustrates physical characteristics of three subspecies of Gasterosteus aculeatus. Taken from COPEIA 1969, No. 1. March 6, Stickleback Systematics, Robert Rush Miller and Carl L. Hubbs.

Bell's (1975, 1976b) results indicate that there has been a low rate of gene flow from G. a. microcephalus to G. a. williamsoni within some populations. The rate of gene flow has been so low that it has had little impact on lateral plate counts in G. a. williamsoni under existing conditions. At present, the dry portion of the Santa Clara River from Lang to Interstate 5 appears to be a major barrier to upstream gene flow. For the reasons discussed below in the section on introgression, an increase in the rate of gene flow might cause a significant increase in lateral plate counts in G. a. williamsoni. G. a. williamsoni could eventually become indistinguishable from G. a. microcephalus if the historical barriers to gene flow are not maintained.

Taxonomic Status and Distribution

Girard (1854) was the first to describe low or zero plated sticklebacks in California when he named the population in Soledad Canyon Gasterosteus williamsoni. Since then, other low or zero plated Gasterosteus have been reported from California (Regan 1909, Miller and Hubbs 1969) and elsewhere (Regan 1909 - Italy; Boulenger 1916 - Algeria; Moodie and Reimchen 1973, Hagen and McPhail 1970, Bell 1974 - British Columbia; Francis et al. 1985 - Alaska). The southern California unarmored sticklebacks have been considered to be G. a. williamsoni, which formerly had a widespread distribution including the headwaters of the Santa Clara and low gradient parts of the Los Angeles, San Gabriel, and Santa Ana rivers. Recently, Baskin and Bell (1976) documented the distribution of populations of sticklebacks from the Santa Maria River system and San Antonio Creek (Santa Barbara County) with an average number of lateral plates intermediate between G. a. williamsoni and G. a. microcephalus. The San Antonio Creek unarmored threespine stickleback population is considered to be G. a. williamsoni.

This problem of recognition and taxonomic status is compounded because (1) armored or partially armored sticklebacks are widespread and can interbreed with unarmored sticklebacks to produce intermediate forms and (2) sticklebacks may be widely introduced unwittingly with trout introductions.

At present the only recognized G. a. williamsoni populations are confined to the headwaters of the Santa Clara River and its tributaries, in northern Los Angeles County, and to the San Antonio Creek drainage, and possibly Honda Creek, on Vandenberg Air Force Base, Santa Barbara County. The areas in the Los Angeles basin which formerly supported G. a. williamsoni now harbor no sticklebacks and few, if any, other native fishes. The historic range of G. a. williamsoni and the location of the known surviving populations are depicted in Figure 2.

In 1984, G. a. williamsoni from San Antonio Creek were introduced into Honda Creek, a tributary to the Pacific Ocean. These fish have reproduced and survived to the present. However, it will be some time before it is known whether a self-sustaining population has become established in this marginal habitat. A small transplanted population may also exist outside the native range in upper San Felipe Creek, San Diego County. That population was established from a 1973 transplant of sticklebacks taken from Soledad Canyon. A population of low-plated

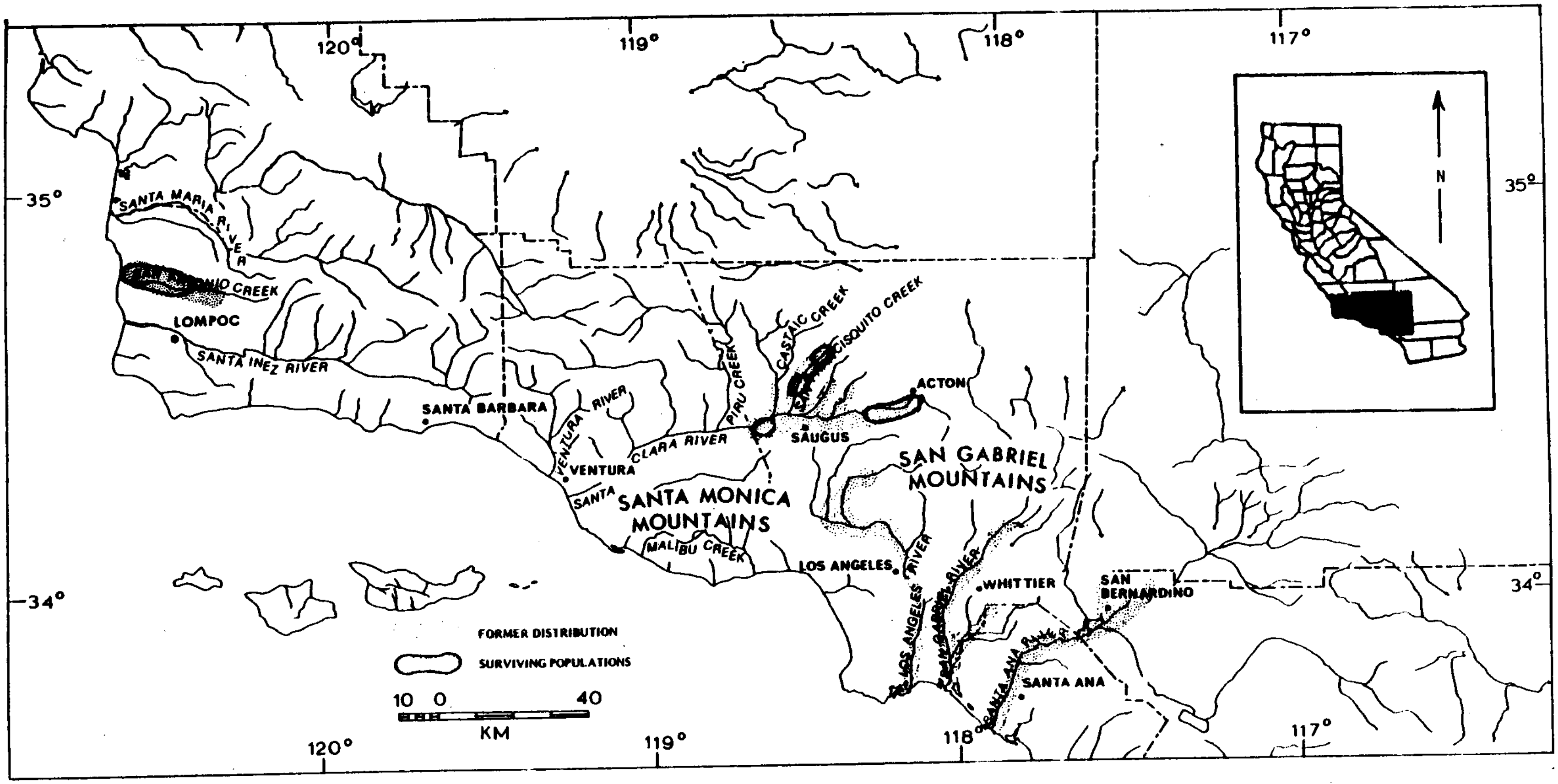


Figure 2. Historic range and present distribution of Gasterosteus aculeatus williamsoni.

sticklebacks that is possibly a remnant population of *G. a. williamsoni* was recently discovered in Shay Creek, a tributary to Baldwin Lake, San Bernardino County. Efforts are underway to examine the genetic characteristics of this population to determine if it properly should be considered *G. a. williamsoni*.

Essential habitat for the unarmored threespine stickleback consists of two disjunct stream reaches of the Santa Clara River in Los Angeles County, a short reach of San Francisquito Canyon in Los Angeles County, and the lowermost 8.4 miles of San Antonio Creek in Santa Barbara County. The essential habitat coincides with the area proposed as critical habitat for *G. a. williamsoni* on November 17, 1980 (*Federal Register*, 45:76012-76015) (see Appendices A and B). Essential habitat within the Santa Clara River proper consists of the following two sections: the river near Del Valle downstream of Interstate 5 and the river at the head of Soledad Canyon. The lower portion is separated from the upper portion by a dry section of river bed from Lang to Interstate 5. The upper portion is in Soledad Canyon from Lang to Arrastre Canyon, the type locality, which is subdivided during the dry season by intermittent dry sections of river bed. Essential habitat in San Francisquito Canyon is located from the southern boundary of the Angeles National Forest upstream approximately 8.4 miles to San Francisquito Powerhouse No. 1 near the junction with Clearwater Canyon. Essential habitat in the San Antonio Creek drainage consists of approximately an 8.4 mile section from the mouth of the creek at the Pacific Ocean upstream into Barka Slough. This creek section is entirely within the boundary of Vandenberg Air Force Base.

Reasons for Decline

In 1917, Culver and Hubbs found *G. a. williamsoni* to be abundant throughout the Los Angeles basin. By 1942 it was extinct there, and Miller (1961) attributed this extinction to habitat destruction (channelization and drying of streams caused by groundwater pumping) and the introduction of mosquitofish (*Gambusia affinis*). Baskin (1974) found that *G. a. williamsoni* builds its nests only in a microhabitat with a slow or negligible water flow. He also found it sympatric with *Gambusia* in parts of the upper Santa Clara River. Stomach content analysis indicated that *Gambusia* may be competing with *G. a. williamsoni* for some food items. Thus, *Gambusia* may have contributed to the disappearance of *G. a. williamsoni* in the Los Angeles basin. However, this basin has become thoroughly urbanized since 1917 and most of the streams have been channelized, destroying the quiet backwaters and side streams required by sticklebacks.

Miller and Hubbs (1969) reported that populations of *G. a. williamsoni* from the Santa Maria River drainage had been introgressed by *G. a. microcephalus* that were inadvertently included with introductions of trout. These plate counts were confirmed by Baskin and Bell (1976).

Thus all of the known natural populations of *G. a. williamsoni* except those from the upper Santa Clara River drainage (Baskin 1974, Bell 1975) and San Antonio Creek, have either been extirpated or become introgressed. The extant populations of *G. a. williamsoni* in the upper Santa Clara River system and San Antonio Creek have been spared extinction by the relative lack of urbanization. The upper Santa Clara River population apparently has not been introgressed by G. a. microcephalus because natural barriers prevent substantial gene flow into the upper Santa Clara River drainage and G. a. microcephalus has not been introduced. G. a. microcephalus is not known from San Antonio Creek.

Natural History and Habitat Requirements

The Santa Clara River populations of G. a. williamsoni spend all of their life in fresh water in the upper portions of that basin (Baskin 1974, 1975). The following fishes also are found there and have probably been introduced:

Arroyo chub	Gila orcutti
Santa Ana sucker	Catostomus santaanae
Mosquitofish	Gambusia affinis
Green sunfish	Lepomis cyanellus
Black bullhead	Ictalurus melas

Young sticklebacks hatch in a nest from eggs which have been brooded for several days by the adult male, which fans the eggs and guards the nest and surrounding territory from possible predators (Baskin 1974, 1975; Baskin and Bell 1976). This parental care is essential for successful reproduction. The exact amount of time the young stay in the nest is not known, but the smallest specimens captured outside a nest were about 10 mm SL. These young fish were observed at the shallow edge of the stream in areas of dense vegetation. The water temperature here is a few degrees higher than the surrounding stream, which may help speed development through the vulnerable early juvenile stages. The larger juveniles and sub-adults (less than about 20 mm SL) also tend to be found in the protection of vegetation, in slow moving or standing water.

Adults (32 mm SL or longer) are found in all areas of the stream. They tend to gather in areas of slower moving or standing water. In places where water is moving rapidly, adults tend to be found behind obstructions, or at the edge of the stream, especially under the edge of algal (Cladophora) mats. In small artificial pond situations, the sticklebacks tend to be concentrated at the upstream end of the pond where the water is flowing in. In larger ponds they are only found in such places, not in the areas of standing water. No adults have been found to be living permanently in ponds isolated from the main stream.

Population size estimates (Baskin 1975, Baskin and Bell 1976) indicate that the best habitat is a small clean pond in the stream with a constant flow of water through it. A pond such as this once located at Thousand Trails in Soledad Canyon supported between 2.0 and 3.4 fish/m^2. The pond encompassed about 475 m^2. The cleanliness of the water in Soledad Canyon is indicated by the 2.49 diatom diversity index found there by Riznyk (in Baskin 1974).

Stickleback populations tend to decline because of natural mortality and low recruitment during the winter. Fish apparently live for only one year.

Examination of gonads, size-frequency studies, and field observations of young and nesting adults show that there is some reproduction during almost every month. A large increase in reproductive activity occurs in the spring, about March, and continues at a lower level throughout the summer and fall.

Breeding takes place when the male develops nuptial coloration (bright red throat, blue sides, green eyes), establishes a territory, and builds a nest of aquatic vegetation on the bottom. These nests are located in places were there is ample vegetation and a gentle flow of water. After the female lays the eggs, the male fertilizes and guards them. He also uses his pectoral fins to pass a current of water over the eggs. This "fanning" behavior is essential for the proper development of the eggs.

The number of suitable nesting sites may be a limiting factor for the population. Some natural mortality probably occurs from flooding, causing sticklebacks to be washed out of favorable habitat. Also, predation by males on eggs may be a major mortality factor. None of the fishes occurring sympatrically with G. a. williamsoni have been found to be egg predators. However, stomach contents of Ictalurus and Lepomis have not been examined. These species are certainly capable of taking sticklebacks of all sizes, but they are not abundant and tend to be small in the upper Santa Clara River drainage.

Two other predators, belostomatid bugs (Belostoma) and garter snakes, (Thamnophis), occur in the essential habitat and are known to prey on sticklebacks. Belostomatids are very abundant and may be a major predator, especially on the younger individuals.

G. a. williamsoni feeds mostly on insects, most of which are benthic, but some are nectonic or terrestrial. Snails are also common in the diet, but flat worms and nematodes comprise only a very small percentage. Stickleback eggs were found in 12% of the stickleback stomachs examined. All of these stickleback eggs were in males.

In general, _G. a. williamsoni_ appears to be an opportunistic feeder and takes a wide variety of food items. However, during the dry season of 1973, when these samples were taken, _G. a. Williamsoni_ relied mostly on mayfly larvae, which are characteristic of clean flowing fresh water.

Our knowledge of the San Antonio Creek population of _G. a. williamsoni_ is sparse but was recently expanded by the work of Irwin and Soltz (1982). The unarmored threespine stickleback was found throughout most of San Antonio Creek downstream of Barka Slough. Irwin and Soltz (1982) also found the following fishes in San Antonio Creek:

Tidewater goby	_Eucyclogobius newberryi_
Prickly sculpin	_Cottus asper_
Arroyo chub	_Gila orcutti_
Carp	_Cyprinus carpio_
Mosquitofish	_Gambusia affinis_

With the exception of the tidewater goby, these fish appear to be introduced. Suitable stickleback habitat in San Antonio Creek consists of shallow areas of moderate current with copious quantities of aquatic vegetation (Irwin and Soltz 1982). Periodic flood events are an integral feature of San Antonio Creek and radically alter the physical habitat. Irwin and Soltz (1982) found that some reproduction occurred throughout the year, but that the highest recruitment of young occurs from May through September. No population estimates are available for the San Antonio creek population.

Primary food items of _G. a. williamsoni_ in San Antonio Creek consist of chironomid larvae, amphipods and ostracods. Feeding is largely opportunistic, with consumption of the above mentioned foods highly correlated with their abundance in the habitat (Irwin and Soltz 1982).

Threats

The management of _G. a. williamsoni_ presents some unusual problems not typically encountered in endangered species management. In addition to the usual problems of maintaining the essential habitat and sufficient numbers of individuals, _G. a. williamsoni_ is a subspecies and is susceptible to introgression (see below) by _G. a. microcephalus_. Lateral plate counts also have been shown to be strongly influenced by selective predation (Bell 1976a, b) and the introduction of predators to the essential habitat might selectively eliminate zero-plated sticklebacks, obliterating the unique features by which _G. a. williamsoni_ is recognized. Each of these problems must be recognized and taken into account in the management of _G. a. williamsoni_. Many of the threats to _G. a. williamsoni_ discussed below have been examined elsewhere (Baskin 1974; Baskin and Bell 1976, Bell 1975, 1976a, b).

Stream Channelization.--Stream channelization presents a number of problems. One major consequence of channelization of the essential habitat of G. a. williamsoni is that it might allow continuous flow of water across the dry area between Interstate 5 and Lang (Stations 16 and 17 of Bell 1975). Continuous flow across this area might allow introgression of G. a. williamsoni by G. a. microcephalus. Continuous flow might also allow prickly sculpin (Cottus asper), which have been reported to feed on stickleback eggs and fry (Moodie 1972), to move upstream.

Channelization increases water velocity in pools, eliminates shallow backwaters, and reduces aquatic vegetation. Baskin (1974) showed that G. a. williamsoni nest in the calm water of pools with well-developed vegetation and a slow, gentle current. Furthermore, Baskin (1974, 1975) found that G. a. williamsoni is far more abundant in pools (with some flow) and shallow backwaters than in stream channels. Thus, pools along the upper Santa Clara River should not be channelized but should be maintained or even increased in number.

Stream channelization also increases peak flows during floods. The stickleback populations in Soledad Canyon and San Antonio Creek have both been drastically reduced in recent years in response to major flood events. Post flood surveys conducted by the Forest Service after the flood of 1977 documented the almost complete disappearance of G. a. williamsoni from Soledad Canyon in the year following the flood. Only a handful of sticklebacks were collected in Soledad Canyon in 1978 in spite of intensive survey efforts (Nichols 1978). Major floods completely scoured the stream channels of both San Antonio Creek and the upper Santa Clara River again in the spring of 1983 causing stickleback numbers to decline to low levels once again. Any action that increases peak flood flows over natural conditions would increase the potential for a flood to cause the complete extirpation of a stickleback population.

Urbanization.--Urbanization presents a large number of threats to *G. a. williamsoni*. Included among these is increased public pressure for stream channelization and subsequent destruction of essential habitat. Urbanization also increases the chance of introducing *G. a. microcephalus* or predators of *G. a. williamsoni*. However, the greatest threat of urbanization is the degradation of water quality. Presently, the upper Santa Clara River and San Antonio Creek watersheds are relatively undeveloped, though some housing exists on the former stream. Intensive development would increase runoff, siltation, nutrients (which would cause cultural eutrophication, see below), pesticides, and other pollutants in the river. The consequences of other pollutants are difficult to foresee, but they are likely to be adverse.

Bell (unpublished data)[1] has discovered drastic deformities of *G. a. microcephalus* associated with pollution in the Ventura and lower Santa Clara rivers. Sticklebacks from Santa Clara River immediately downstream of the Fillmore State Fish Hatchery (station 11 of Bell 1975)

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[1]Present Address: Department of Ecology and Evolution, State University of New York at Stony Brook, Stony Brook, New York 11794

commonly have deformities such as pug nose (truncated snout and protruding lower jaw), incomplete gill covers, and increased lateral plate count asymmetry compared to sticklebacks from other parts of the drainage. Increased bilateral asymmetry of fishes has been correlated with increased water pollution (Valentine et al. 1973). Water immediately downstream of the Fillmore Hatchery is relatively turbid and there are thick deposits of detritus, presumably derived from uneaten food and trout feces. Although the pollutant in the Ventura River is unidentified, collections made downstream of petrochemical plants in 1974 consistently contained foreshortened fish (i.e., reduced length relative to body depth). This deformity was entirely absent upstream of the petrochemical plants in 1974. Foreshortened sticklebacks have also been recorded from an agricultural area in British Columbia (McPhail, pers. comm.). While these deformities have thus far been detected only in other subspecies of Gasterosteus aculeatus, it is reasonable to expect that G. a. williamsoni would be affected similarly.

Introduction of Predators and Competitors.--Predators may adversely affect G. a. williamsoni by removing individuals either randomly or selectively or by restricting them to habitats that the predators cannot enter. Random or selective removal may cause extinction, but selective removal also may cause a change in the appearance of G. a. williamsoni to more closely resemble G. a. microcephalus. Restriction to habitats that the predators cannot enter will reduce population size. Bell (1976a, b) has shown that predators remove sticklebacks with different plate counts at different rates. This can produce a shift in the frequency of individuals with different numbers of plates (Hagen and

Gilbertson 1973, Moodie et al. 1973). Larson (1976) found that predation by Coho salmon (*Oncorhynchus kisutch*) caused lacustrine sticklebacks to occupy a limnetic habitat to which they were poorly adapted.

Competitors also may cause extirpation or morphological change of *G. a. williamsoni* populations. *G. aculeatus* is rare in eastern North America streams apparently because fish species diversity is high and, hence, there are many potential competitors. Ross (1973) believed that low gill raker counts of sticklebacks for Arroyo Trabuco Creek, a tributary of San Juan Creek, Orange County, was caused by the unusual presence of California killifish (*Fundulus parvipinnis*). Thus, introductions could have unforeseeable effects on *G. a. williamsoni*.

Introductions of predators and competitors can come from a number of sources. Channelization may provide a route for invasion by fathead minnows (*Pimephales promelas*) and *Cottus asper*, which was recently introduced into the Santa Clara River drainage (Bell 1975, 1976a). Urbanization also increases the probability that predators and competitors will be introduced. The African clawed frog (*Xenopus laevis*), which was popular in the pet trade until it was prohibited, was introduced into Agua Dulce Canyon, a tributary of the Santa Clara River sometime in the 1970's. *Xenopus* is regarded as a threat to native fishes (St. Amant et al. 1973) and a severe threat to *G. a. williamsoni* (Baskin 1974). In 1984, *X. laevis* was discovered in Soledad Canyon zone of essential habitat (S. Sasaki, pers. comm.)[2]. This stream reach is now being monitored to determine how severe an impact this fish predator is having on G. a. williamsoni reproduction and survival. Efforts to control its spread in the Santa Clara River drainage are also underway. The introduction of other exotic species into the essential habitat of G. a. williamsoni should be prevented to avoid the unforeseeable effects of predators and competitors.

Introgression.--Introgression results from hybridization and is the flow of genes from members of one population into members of a second population. The result of introgression is that the population receiving intensive gene flow will come to resemble the other population. Increased gene flow may be caused by stream channelization, releases of water containing G. a. microcephalus into the upper Santa Clara River and San Antonio Creek, or the introduction of G. a. microcephalus into the habitat of G. a. williamsoni. The latter may occur when game fishes are introduced, or may be done intentionally. Introduction by private parties becomes increasingly likely as the human population in the upper Santa Clara River basin grows.

Agricultural Impacts.--Possible impacts of agriculture are varied, depending on the kind of agriculture and techniques used. Increased flow of silt from the watershed can cause habitat destruction by

[2] Present Address: California Department of Fish and Game, 110 Salisbury Avenue, Goleta, California 93117

covering the bottom of pools with fine sediment or completely filling in pools. Increased siltation may be caused by overgrazing or by irrigation. Irrigation of citrus orchards in the lower Santa Clara River, downstream of the essential habitat of *G. a. williamsoni*, has already caused siltation of certain reaches of the stream. *G. a. williamsoni* is not found in even slightly turbid water (Baskin 1974).

Cultural eutrophication is the excessive growth of aquatic vegetation resulting from the input of nutrients, particularly phosphate and nitrate (Odum 1971). The flow of these nutrients into the essential habitat of *G. a. williamsoni* probably will be increased by urbanization as well as agriculture. Agricultural sources of such nutrients include runoff from crop fields containing dissolved synthetic fertilizers and runoff from areas containing large concentrations of livestock feces.

Oxygen Reduction.--Excessive growth of aquatic vegetation may reduce oxygen by two different means. During the night, photosynthesis (which produces oxygen) ceases, but aquatic plants continue to utilize oxygen by respiration. If the vegetation is dense, oxygen levels may be depressed sufficiently to cause fish kills. During winter, aquatic vegetation dies, and its decomposition also requires oxygen. If aquatic vegetation is overly dense, the winter die-off may depress dissolved oxygen to lethal levels.

Feldmeth and Baskin (1976) and Baskin (1975) showed that *G. a. williamsoni* has a moderate tolerance to oxygen reduction (to 2.0 ppm).

They pointed out that as oxygen concentration approaches 2.0 ppm, G. a. williamsoni must increase the amount of energy put into respiration, detracting from somatic growth, reproduction, and activity. Thus, sublethal reductions of dissolved oxygen may reduce growth and reproduction of G. a. williamsoni, possibly placing it at a competitive disadvantage with sympatric fishes. Cultural eutrophication thus could eliminate G. a. williamsoni directly by reducing dissolved oxygen to lethal levels or indirectly by reducing dissolved oxygen to disadvantageous levels.

Groundwater Removal.--The Santa Clara River flows over a sandy surface that is easily permeated by water. Therefore, there is a continuous exchange of water between the surface and groundwater. As water is pumped from wells along the Santa Clara River, it presumably is replaced by water moving from the surface into the ground. The aquatic habitat of G. a. williamsoni tends to expand and contract following a daily and annual cycle (Baskin 1974). If too much water were removed by pumping, all remaining stream segments might become desiccated. Any reduction of essential habitat is likely to cause a reduction of the population size. Feldmeth and Baskin (1976) and Baskin (1975) found that G. a. williamsoni has a moderate temperature tolerance (critical thermal maximum of 30.5°C when acclimated at 8°C and a critical thermal maximum of 34.6°C when acclimated at 22.7°C). As the volume and flow of water in the essential habitat declines, pools become shallower and water temperature increases. Pumping of groundwater, especially during dry years, is a severe threat to G. a. williamsoni. Such problems already exist in the upper San Antonio Creek drainage because of domestic and agricultural use.

Transpiration.--Transpiration is the release of water from the leaves of plants. It seems unlikely that transpiration could remove a significant amount of water from the essential habitat of G. a. williamsoni except possibly in portions of San Antonio Creek. Increased plant growth and associated water loss by transpiration around one spring habitat of the warm springs pupfish (Cyprinodon nevadensis pectoralis) in Nevada, probably caused the near complete desiccation of this habitat (Soltz pers. comm.)[3].

Off-road Vehicles.--The use of off-road vehicles (motorcycles, dirt bikes, dune buggies, jeeps, and four wheel drive trucks) is a popular sport in southern California. The ecological effects of off-road vehicle (ORV) use can be drastic resulting in vegetation destruction, increased erosion, and increased water flow. As the sport has grown, the land area which ORVs are allowed to use has declined. Formerly, ORVs were used extensively along two reaches of the essential habitat, Soledad Station (U.S. Forest Service) and Thousand Trails (privately owned) (Baskin 1974). ORV use has been substantially reduced near the former Soledad Station site by means of a Forest Service order closing the area to such use. A potentially significant amount of illegal use continues, however. Ongoing law enforcement activity will be necessary to protect the habitat. ORVs indirectly affect G. a. williamsoni by destroying riparian vegetation and removing obstacles to stream flow which in turn cause pools to form. It also was common for dirt bikes

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for dirt bikes to race through the stream beds and destroy nesting areas of *G. a. williamsoni*. Dirt bike racers have been observed driving through a pool (Baskin 1974) that had contained twelve stickleback nests.

Drinkwater Reservoir.--San Francisquito Canyon contains a small population of *G. a. williamsoni* at its juncture with Drinkwater Canyon in Angeles National Forest. This habitat is only about 100 m long during the summer but extends to a length of about 1.5 km in the winter. A reservoir in Drinkwater Canyon releases water that maintains the small habitat in San Francisquito Canyon. According to local Los Angeles Department of Water and Power personnel, a one cfs water release is maintained throughout the year to satisfy the rights of private property owners downstream of the reservoir. The flow, however, is temporarily terminated when pipes are cleaned. Positive action should be taken to insure the continuous supply of suitable quality water to this population. Many of the threats to *G. a. williamsoni* in the Santa Clara River also apply to the population in San Francisquito canyon.

Toxic Spills and Discharges.--The floodplain of the Santa Clara River is crossed by the Southern Pacific Railroad tracks, Soledad Canyon Road, and several commercial campgrounds. The possibility exists that a toxic chemical spill from private land, railroad, or highway accident could destroy the entire Santa Clara River population of *G. a. williamsoni* leaving only the San Antonio Creek population and the small populations in San Francisquito Canyon. The discharge of chlorine into the essential habitat is also a potential problem because of the large number of recreational lakes and pools in Soledad Canyon. The Los Angeles County Health Department currently requires property owners to chlorinate or otherwise treat these recreational water bodies. When they are drained, chlorine or other chemicals may be discharged into the Santa Clara River. Thus, while G. a. williamsoni is currently seasonally abundant in most years, its restricted distribution renders it vulnerable to catastrophic extirpation. This situation necessitates consideration of transplants to other drainages for security.

Addition of Water.--The addition of water to the Santa Clara River basin can be beneficial or harmful depending on the amount and contents of the water. Tertiary treated sewage water, if released into the upper Santa Clara River, would probably be of sufficient quality to increase the size and productivity of the G. a. williamsoni habitat.

Both the increase in size and productivity of habitat would tend to increase the population size. However, if too much water is released, increased flow rates might wash out barriers (e.g., dams, fallen logs, emergent vegetation, etc.) that keep flow at an appropriate velocity for G. a. williamsoni. If sewage water contained a high concentration of nutrients, cultural eutrophication (discussed above) might occur, or the decomposing nutrients might cause oxygen depletion thereby adversely affecting G. a. williamsoni. In addition, waters polluted with excessive concentrations of nutrients have been observed to contain unusually high frequencies of deformed fish (unpublished data[4]). If addition of treated sewage water into the upper Santa Clara River were sufficient to establish continuous flow of water between Lang and Interstate 5, introgression between G. a. williamsoni and G. a. microcephalus might occur.

Water imported from another drainage into the Santa Clara River basin also might increase the size of the G. a. williamsoni habitat. However, the importation of out-of-basin water has already resulted in the introduction of Catostomus fumeiventris and Cottus asper into the Santa Clara River drainage (Bell 1978). Imported water may contain a variety of predators, competitors, and parasites detrimental to G. a. williamsoni.

Any source of water that increases the habitat of G. a. williamsoni and the dependability of the water supply should be considered on its merits. However, any potential addition of water to the upper Santa Clara River should be preceded by careful analysis of its chemical and biological contents. Initial addition of water should be on a trial basis, with continuation contingent upon its ecological benefit to the Santa Clara River system, not on the basis of economic benefit. Disposal of water into the Santa Clara River would be a privilege, and parties interested in utilizing this privilege should be prepared to demonstrate that their water is safe and that they could immediately halt water disposal if necessary.

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[4] See footnote 1.

Impoundment of Waters.--Baskin (1974) found that impoundments may benefit or adversely affect sticklebacks. Small impoundments (e.g., Pond 1, 456 m^2., Baskin and Bell 1976) with well-circulated water and abundant aquatic vegetation along the edges have the highest density of sticklebacks (Baskin 1974, 1975). However, large impoundments without aquatic vegetation are unsuitable for sticklebacks. Baskin (1974) found that White Rock Pond, which is large and lacks vegetation, contained abundant mosquitofish, but *G. a. williamsoni* was virtually absent. It seems likely that White Rock Pond, as it is presently managed, has reduced the carrying capacity of *G. a. williamsoni* in the segment of essential habitat that it occupies.

Conservation Efforts

The agencies cooperating in the recovery effort have undertaken several actions to conserve the unarmored threespine stickleback. These activities include: (1) surveys to discover additional populations, (2) transplants to establish *G. a. williamsoni* in other waters, (3) surveys to discover exotic organisms, (4) eradication programs to remove or control exotic species, (5) contingency plans to establish response procedures in case of oil or toxic chemical spills, (6) rescue efforts to maintain the gene pool of populations threatened by stream desiccation, (7) genetic studies to ascertain taxonomic relationships, and (8) installation of water conveyance facilities to provide emergency supplemental flows.

These conservation efforts have resulted in the discovery of a potential remnant population of G. a. williamsoni in Shay Creek, San Bernardino County, (J. Malcolm, pers. comm.)[5], the possible establishment of another stickleback population in Honda Creek, Santa Barbara County, and a potential change in the taxonomic status of one or more of the recognized extant populations (D. Buth, pers. comm.)[6]. Fish and Wildlife Service policy with respect to proposed taxonomic revisions is to await acceptance and publication in a reputable scientific journal before initiating changes in the management of listed species.

Recently the Air Force added a discharge valve to an existing water line over San Antonio Creek to provide capability for releasing emergency supplemental flows into that stream in the event it becomes dewatered as a result of increased groundwater pumping in the upper part of the basin. In response to another emergency situation, the Big Bear City Community Services District has agreed to protect the recently discovered stickleback population in Shay Creek by providing supplemental flows from a nearby water line through the summer and fall of 1985. Some sticklebacks from that stream were also rescued and placed in a laboratory at the University of Redlands as a precautionary measure. Flows in Shay Creek had declined to perilously low levels by August, 1985, and it appeared likely that the short reach of stickleback habitat in this stream might completely dry up before the genetic

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composition of this population could be ascertained. By preparing a contingency plan (see Appendix D) and acquiring the equipment needed to rescue and hold sticklebacks during an emergency situation, the Forest Service is prepared to respond to a toxic chemical spill in the Soledad Canyon zone of essential habitat.

PART II

RECOVERY

Objectives

The primary objective of this recovery plan is to prevent the extinction of the unarmored threespine stickleback and to improve and maintain its status at a point where it can be safely delisted. This objective will be achieved when: (1) the factors responsible for threatening the integrity of the known remaining habitats have been identified and actions have been taken to stabilize habitat conditions, (2) the other known threats to extant populations have been addressed in a manner that assures the continued existence of these remnant populations, and (3) at least five self-sustaining populations have been maintained within the historical range of *G. a. williamsoni* for a period of five consecutive years without significant threats to their continued existence. The latter criterion can be satisfied by successfully reintroducing *G. a. williamsoni* into sufficient numbers of suitable historical habitats to reach a total of five secure populations, by discovering additional remnant populations in secure historical habitats, or by some combination of reintroductions and new discoveries.

It will be appropriate to consider reclassification of *G. a. williamsoni* from endangered to threatened when criteria 1 and 2 have been met and at least three self-sustaining populations have been maintained within the historical range of *G. a. williamsoni* for a period of five consecutive years without significant threats to their continued existence.

Step-down Outline

1. Restore and maintain UTS essential habitat at optimum conditions.
   - 11. Maintain existing habitat.
     - 111. Determine, monitor and regulate water use.
     - 112. Determine, monitor and regulate land use.
     - 113. Develop management agreement with Los Angeles Department of Water and Power.
     - 114. Maintain essential stream characteristics.
   - 12. Restore degraded habitat.
     - 121. Determine appropriate methods to restore degraded habitat.
     - 122. Develop procedures to supplement instream flows.
       - 1221. Determine supplemental flow capacity needed to maintain UTS if natural flows interrupted.
       - 1222. Acquire water rights if necessary.
       - 1223. Install needed pumping or water conveyance facilities.
     - 123. Implement procedures to restore degraded habitat and supplement instream flows.
   - 13. Protect existing and restored habitat.
     - 131. Identify and investigate potential land sites needing protection.
     - 132. Establish priorities for protection as needed.
     - 133. Secure appropriate parcels.

2. Restore and maintain UTS populations at optimum conditions.

21. Protect existing populations.

211. Prevent introduction of exotic organisms.

212. Remove exotic organisms as needed.

213. Establish contingency plan.

2131. Determine UTS contingency procedures.

2132. Establish temporary holding facility to maintain rescued UTS.

214. Implement contingency plan as appropriate.

22. Establish additional populations as appropriate.

221. Determine need for establishing additional populations.

222. Select suitable sites.

223. Restore habitat as necessary.

224. Obtain transplant stock.

225. Perform transplants.

23. Monitor UTS populations.

231. Monitor existing populations through established census techniques.

232. Monitor transplanted individuals.

233. Investigate possible existence of additional populations of UTS.

3. Determine UTS life history and obtain needed ecological and genetic information.

31. Determine natural habitat conditions.

32. Assess effects of exotic predators.

33. Determine biological needs for nesting, reproduction and rearing young.

34. Determine food requirements.

35. Determine water quality and quantity requirements of UTS.

36. Establish determinants of water distribution and abundance within essential habitat.

37. Determine optimum size of UTS population necessary to be self-sustaining.

38. Determine genetic composition of populations of unknown origin.

4. Inform the public of UTS status and recovery effort.

41. Publicize UTS distribution, identification and legal status.

42. Provide relevant organizations with advice to preserve UTS.

43. Inform public of transplant efforts.

5. Utilize laws and regulations to protect fish and habitat.

51. Enforce existing laws and regulations.

52. Designate critical habitat as provided for by the Endangered Species Act.

53. Determine need for and propose additional laws and regulations.

54. Review permits for research projects.

Narrative

The primary objective of this recovery plan is to prevent the extinction of the unarmored threespine stickleback and to improve and maintain its status at a point where it can be safely delisted. This objective will be achieved when: (1) the factors responsible for threatening the integrity of the known remaining habitats have been identified and actions have been taken to stabilize habitat conditions, (2) the other known threats to extant populations have been addressed in a manner that assures the continued existence of these remnant populations, and (3) at least five self-sustaining populations have been maintained within the historical range of *G. a. williamsoni* for a period of five consecutive years without significant threats to their continued existence. The latter criterion can be satisfied by successfully reintroducing *G. a. williamsoni* into sufficient numbers of suitable historical habitats to reach a total of five secure populations, by discovering additional remnant populations in secure historical habitats, or by some combination of reintroductions and new discoveries.

It will be appropriate to consider reclassification of *G. a. williamsoni* from endangered to threatened when criteria 1 and 2 have been met and at least three self-sustaining populations have been maintained within the historical range of *G. a. williamsoni* for a period of five consecutive years without significant threats to their continued existence.

1. Restore and maintain UTS essential habitat at optimum conditions. Restoration of the essential habitat in Soledad Canyon, Angeles National Forest, is under way. The use of off-road vehicles (ORV)

within the essential habitat on public lands in Soledad Canyon has been reduced, but continuing law enforcement efforts will be necessary to prevent significant habitat destruction by unauthorized users. In San Francisquito Canyon, efforts to stop ORV use are continuing. Efforts also are being made to improve the quality of the existing habitat on public land (see Habitat Requirements). Further modifications will await determination of more precise habitat requirements and may include the creation of small pools within the stream by the use of small dams and deflectors.

All the Angeles National Forest was closed to target shooting in November of 1981, except for 16 designated areas. None of these areas are in essential habitat, but shooter debris remains from past activity in certain areas and should be cleaned up.

Restoration of the essential habitat on private land involves problems similar to those on public land, but in addition the cooperation of the owner must be obtained. This is a critical problem because most of the essential habitat in Soledad Canyon where the most important populations occur (see Description and Diagnosis) and downstream of Interstate 5 are privately owned.

11. Maintain existing habitat. *G. a. williamsoni* must be able to survive in the areas that it now occupies to have a good chance of recovery. Maintenance of suitable habitat requires that instream flows and vegetation be protected. Recently

individuals have been harvesting watercress and other aquatic vegetation from the essential habitat for private and commercial use. Watercress harvest may be especially detrimental to the stickleback population in years following major floods when instream vegetation is scarce.

111. Determine, monitor and regulate water use. The amount and quality of water is the primary environmental parameter that must be monitored and regulated. Flowing surface water is essential to stickleback populations as was shown in 1976 when the amount of essential habitat in the dry season was reduced to levels that constituted a threat to *G. a. williamsoni* (see Threats). It is necessary to regulate the removal of groundwater and the diversion of streams into lakes and large pools, which form unfavorable habitat for *G. a. williamsoni*.

The chemical composition of the water will have to be monitored and the various possible sources of chemical pollution must be regulated (e.g., human waste, agricultural runoff, chemical spills). Also, a drastic increase in flow rate as a result of artificial addition of water must be avoided because this also can reduce the suitability of habitat for sticklebacks.

112. Determine, monitor and regulate land use. The use of land in and adjacent to the essential habitat must be regulated to avoid deleterious modifications such as pollution.

Of the two essential habitat crossings in San Francisquito Canyon, one has an approved concrete low water crossing. The other crossing just below Power House #2 should be improved.

Private landowners of habitat occupied by *G. a. williamsoni* should be informed of the fish's presence and the status of their property as essential habitat for the UTS. Efforts should be made to control the harvest of watercress if this activity results in the take of *G. a. williamsoni*.

113. Develop management agreement with Los Angeles Department of Water and Power. The essential habitat in San Francisquito Canyon (Angeles National Forest) depends on release of water from Drinkwater Reservoir by the Los Angeles Department of Water and Power (LADWP). A management agreement with LADWP should be pursued to insure the continued release of suitable quality water from Drinkwater Reservoir.

Another segment of essential habitat in San Francisquito Canyon, also in Angeles National Forest, flows through a small community occupied by LADWP workers. The USFS should notify LADWP that this segment of essential habitat is not to be disturbed.

114. Maintain essential stream characteristics. Major floods in the Santa Clara River and San Antonio Creek drastically modify the configuration of the stream channel and scour away aquatic vegetation. Such events also typically cause precipitious declines in stickleback abundance. Because of the current restricted distribution of *G. a. williamsoni*, some seasonal pool restoration work may be required following flood events to increase stickleback carrying capacity and to accelerate the recovery of populations that are adversely affected by floods. Rish (1982) described the types of stream restoration activities that have been most successful to date in accelerating habitat recovery. A population that declined to a low level after a winter flood and did not recover in the following summer would be vulnerable to extirpation in the event major floods occurred in successive years.

12. Restore degraded habitat. Continuing habitat degradation necessitates restoration efforts in certain sections of essential habitat to insure survival of UTS populations.

121. Determine appropriate methods to restore degraded habitat. Areas of essential habitat that have been degraded should be examined to determine the most appropriate methods of restoration.

122. Develop procedures to supplement instream flows. Groundwater pumping for agricultural, military, and residential use may soon desiccate portions of San Antonio Creek, at least seasonally. The same threat also applies to Soledad Canyon and the recently discovered population in Shay Creek, San Bernardino County. One potential means of maintaining surface flows during periods when heavy groundwater pumping would otherwise cause stream desiccation is through the release of surface or groundwater back into the stream. When it is not possible to preserve essential habitat by regulating the removal of groundwater (see #111), an emergency flow maintenance system should be developed that is capable of sustaining the stickleback population through critical dry periods.

1221. Determine supplemental flow capacity needed to maintain UTS if natural flows interrupted. It will be necessary to determine the minimum flow levels needed to maintain UTS populations. This volume may vary because of season (e.g., high evaporation rates in summer) or differing requirements of the fish (e.g., enough water for reproduction and survival of young or only enough water for adult survival). After the stickleback's minimum flow needs are determined, the amount of supplemental flow capacity needed for emergency situations can be calculated.

1222. Acquire water rights if necessary. It may be necessary to acquire water rights for instream flow preservation or for groundwater pumping.

1223. Install needed pumping or water conveyance facilities. Any pumps or related equipment and conveyance facilities that are needed to maintain instream flows during critically dry periods should be installed before the need for their use arises.

123. Implement procedures to restore degraded habitat and supplement instream flows. The methods identified in task 121 for restoring degraded habitats should be implemented as needed. Supplemental instream flows should also be provided as needed during prolonged periods of drought or when surface diversions or groundwater pumping have diminished or eliminated natural flows. The groundwater pumping or water

conveyance facilities needed to maintain flows during an emergency should be ready in advance.

13. Protect existing and restored habitat. Suitable existing or restored habitat must be protected by conservation easements, memoranda of understanding, management agreements, land exchange, or acquisition. These efforts should be restricted to critical parcels of private land and Forest Service inholdings that are available on a willing seller basis or for which mutually acceptable management agreements can be negotiated.

131. Identify and investigate potential land sites needing protection. Land downstream of Interstate 5 has not been investigated for possible protection. Its ownership, availability, and appropriate method of protection should be investigated. An area near San Martinez Canyon is a candidate for habitat protection.

132. Establish priorities for protection as needed. Lands containing essential habitat should be identified and priorities for protection determined on a periodic basis. Protection of needed essential habitat land in Soledad Canyon should have priority over land downstream of Interstate 5 because (1) sticklebacks in the latter area are introgressed by *G. a. microcephalus*, (2) it is farthest upstream and

therefore easiest to manage, (3) it contains high quality habitat, (4) it has sticklebacks with the lowest average lateral plate number, and (5) it has the most abundant population of sticklebacks.

133. Secure appropriate parcels. Those lands identified as most important for UTS preservation should be secured by the most appropriate method (e.g., cooperative agreements, memoranda of understanding, conservation easements, land exchange, or fee purchase).

2. Restore and maintain UTS populations at optimum conditions. Population levels of *G. a. williamsoni* can be enhanced by protecting existing populations from threats such as exotic species and pollution as well as by establishing additional populations. A regular program of population monitoring is necessary to determine the need for further actions.

21. Protect existing populations. The first priority of the recovery plan must be to preserve and protect existing populations of *G. a. williamsoni* while achieving the primary objective.

211. Prevent introduction of exotic organisms. Even if the essential habitat remains physically intact the possible introduction of several species of exotic organisms remains a constant threat to UTS survival.

Exotic organisms may be introduced into essential habitat in a variety of ways. Water imported from other areas or released from upstream may contain exotic species. The fish fauna of Bouquet Reservoir, Drinkwater Reservoir, Lake Piru, and Castaic Lake may include exotic species that would be detrimental to survival of G. a. williamsoni.

No exotic fishes, either predators or competitors of G. a. williamsoni, should be introduced into the essential habitat. Exotic predators that cannot reproduce in the Santa Clara River (e.g., Salmo gairdneri) may be permitted in private ponds, but those that may reproduce (e.g., Xenopus and Centrarchidae) should be excluded. Plants of game fish should be carefully scrutinized to assure the absence of unwanted exotics. Exotics may be introduced by bait fishermen. Therefore, laws prohibiting the use of small fish as bait should be strictly enforced.

The introduction of G. a. microcephalus should also be prevented. If G. a. microcephalus is introduced to the essential habitat of G. a. williamsoni, interbreeding could cause lateral plate counts and other distinctive features of G. a. williamsoni (see Description and Diagnosis) to approach the condition in _G. a. microcephalus_. The result could be that _G. a. williamsoni_ would cease to exist as a distinct taxon.

212. Remove exotic organisms as needed. The African clawed frog, _Xenopus laevis_, was introduced into Agua Dulce Canyon, which drains into the essential habitat, sometime in the early 1970's. In 1984, this exotic predator was discovered in the Soledad Canyon reach of essential habitat. Measures should be implemented to eradicate or control this fish predator and other exotics that are found to be detrimental to _G. a. williamsoni_.

213. Establish contingency plan. One justification for considering _G. a. williamsoni_ to be endangered is that it is restricted to the Santa Clara River basin and San Antonio Creek and that most individuals might be eliminated by a single catastrophic event such as a drought, chemical spill or forest fire. Until UTS is well established in other locations, a contingency plan should be prepared to save surviving individuals in case of catastrophe.

2131. Determine UTS contingency procedures. Step by step procedures to follow in case of an emergency should be established and made available to local wardens and resource managers.

2132. Establish temporary holding facility to maintain rescued UTS. Temporary facilities to maintain rescued *G. a. williamsoni* should be established in case of catastrophe. It may be desirable to establish mobile holding facilities that can be moved rapidly to the appropriate site in case of a catastrophe. The larger the number of sticklebacks rescued, the greater will be the probability of preserving genetic variation in the population.

214. Implement contingency plan as appropriate. As soon as a catostrophe has been detected, the contingency plan should be implemented. Responsible personnel from the California Department of Fish and Game, Forest Service, Fish and Wildlife Service, and Air Force should be notified immediately.

22. Establish additional populations as appropriate. Establishment of new, viable populations of *G. a. williamsoni* by transplants into its former range or at adjacent sites will reduce the possibility of its extinction. In addition, this action should improve its status and be cause to consider removing this fish from the endangered species list.

221. Determine need for establishing other populations. To delist the subspecies, it will be necessary to establish additional self-sustaining populations. The number, size and location of the populations can only be determined on the basis of historic distribution, current distribution, and potential transplant sites.

Populations of *G. a. williamsoni* should be established in habitats that it previously inhabited, provided that they will now support such populations. Reintroduction into suitable habitat also will help restore damaged ecosystems.

222. Select suitable sites. Suitable transplant sites should be selected on the basis of the best available criteria. Important criteria include absence of predatory fishes and other sticklebacks, the presence of suitable habitats and evidence that the habitat will remain suitable.

223. Restore habitat as necessary. Restoration of habitat may be necessary. Ideally, habitat should be restored to near historical condition. Instream flows may need to be supplemented (see #122). If exotic predators are present, their removal may be needed.

224. Obtain transplant stock. Specimens for transplants should be collected by seining. All size classes (i.e., age classes) should be used and individuals should be transplanted without regard to lateral plate count. All *G. a. williamsoni* populations contain some individuals with plates (Miller and Hubbs 1969, Bell 1974) and it is not desirable, and probably not possible, to eliminate them from introduced populations.

The number of sticklebacks introduced will affect the likelihood of the introduced fish finding each other for reproduction. The probability of encountering an appropriate mate depends on the size of the suitable habitat and the tendency of sticklebacks to disperse or aggregate. The tendency to disperse is not known for *G. a. williamsoni*. Thus, the number of sticklebacks used for transplants should be relatively large (500 to 1000 individuals).

225. Perform transplants. Specimens for transplants south of Vandenberg AFB should come from the headwaters of the Santa Clara River in Soledad Canyon because sticklebacks from this area are least introgressed (Bell 1976b) and this apparently is the type locality of the subspecies (Miller and Hubbs 1969). Specimens for transplants within or north of Vandenberg AFB should come from San Antonio Creek.

23. Monitor UTS populations. All populations should be monitored annually. Habitat condition, especially quality and quantity of water flow, should be monitored periodically throughout the year.

231. Monitor existing populations through established census techniques. Existing populations should be monitored annually. Additional monitoring may be necessary following major floods or during drought.

232. Monitor transplanted individuals. The stickleback population in the immediate vicinity of the transplant site should be monitored at fixed periods following the transplant to note the presence of fry, stickleback nests, and sticklebacks in reproductive condition.

233. Investigate possible existence of additional populations of UTS. The existence of other *G. a. williamsoni* populations also should be determined. Preliminary surveys to determine the range of *G. a. williamsoni* within and to the north of the Santa Clara River system have already been carried out. There have been reports of unarmored sticklebacks to the south of the Santa Clara River system. These reports should be investigated, and all other streams that might contain UTS should be surveyed.

3. Determine UTS life history and obtain needed ecological and genetic information. Several studies have addressed habitat requirements and/or distribution of the UTS, however, much remains to be learned about the life history, ecology, and genetics of *G. a. williamsoni* that will aid in its recovery and eventual delisting. Important aspects of UTS biology that are poorly known should be identified and evaluated so that research can be initiated on the most essential items. Future research may provide data that will increase our ability to manage the habitat and thus increase the survival probability of *G. a. williamsoni* within its essential habitat. Clarification is also needed concerning the genetic composition of some populations, including the ones in Del Valle zone of the Santa Clara River and San Antonio Creek.

The ecology of various species of sticklebacks is an active area of research. Much is being published on resource utilization, the effects of predation on morphological variation, and habitat preference. This information may provide insights into the proper management of the essential habitat.

31. Determine natural habitat conditions. Although a great deal of time has been spent in the field observing *G. a. williamsoni*, it still is impossible to predict that a habitat within the range of the subspecies will contain abundant *G. a. williamsoni*. It is possible, however, to recognize unsuitable habitats. Research to determine measurable

ecological parameters that are indicators of habitat suitability for *G. a. williamsoni* are needed. Emphasis should be placed on determining historic, natural habitat conditions.

32. *Assess effects of exotic predators*. It is known that certain predators selectively feed on sticklebacks with a low number of lateral plates (Bell 1976a, b; Moodie and Reimchen 1973; Moodie et al. 1973). Thus, it seems likely that predators may cause an increase in lateral plate counts if they prey on *G. a. williamsoni*. The actual effects of known or potential predators on *G. a. williamsoni* should be assessed, particularly the impact of *X. laevis* on the population in Soledad Canyon.

33. *Determine biological needs for nesting, reproduction and rearing young*. Information concerning reproduction, nesting, and rearing of young is needed so that optimum habitat for these activites can be determined.

34. *Determine food requirements*. The feeding ecology of *G. a. williamsoni* should be investigated. Knowledge of the relationship between food habits and food supply in the UTS ecosystem can furnish some answers to the fish's life history and assist in management.

35. Determine water quality and quantity requirements of UTS. We presently do not know much about the quality and quantity of water necessary to maintain existing populations of G. a. williamsoni. It is known that the Santa Clara River has relatively clean water (Baskin 1974), but the amount of turbidity and water quality degradation that can be tolerated by G. a. williamsoni is unknown. Until water-quality requirements are determined, the threat posed by pollution will be difficult to assess. Bioassays can help determine water quality requirements.

36. Establish determinants of water distribution and abundance within essential habitat. The amount of water necessary to maintain the essential habitat and many of the factors that control the distribution and abundance of water within the essential habitat are unknown. Knowledge of these factors will allow maximal utilization of groundwater in the upper part of the Santa Clara River without destroying essential habitat. This knowledge also may allow anticipation of habitat loss by drought.

37. Determine optimum size of UTS population necessary to be self-sustaining. It is important to know what constitutes optimal population size for G. a. williamsoni so that self-sustaining populations can be maintained. The criteria for reclassifying to threatened consists of maintaining self-sustaining populations of UTS in three historic habitats

without significant threats to their existence for a period of five consecutive years.

38. <u>Determine genetic composition of populations of unknown origin</u>. The Forest Service recently funded an electrophoretic study that examined the biochemical characteristics of 17 southern California stickleback populations. The preliminary results suggest that the populations in San Antonio Creek and the Del Valle reach of the Santa Clara River may be derived from *G. a. microcephalus* and should not be assigned to *G. a. williamsoni* (see section on Conservation Efforts). The findings of that study have not yet been published. A morphological and meristic study is needed to supplement the data obtained by electrophoresis to determine whether the San Antonio and Del Valle populations should continue to be treated as *G. a. williamsoni*, described as new subspecies, assigned to *G. a. microcephalus* without protection under the Endangered Species Act, or considered a uniquely distinctive population of *G. a. microcephalus* that qualifies for protection under the Endangered Species Act.

4. <u>Inform the public of UTS status and recovery effort</u>. The success of the UTS recovery effort will depend on a carefully coordinated program of public education and support.

41. Publicize UTS distribution, identification and legal status. A conservation education and public information program should be conducted. It should be recognized that the recovery of *G. a. williamsoni* depends ultimately upon public support and understanding. The public should, therefore, be made aware of the existence and endangered status of the fish, and public sympathies solicited for its preservation. The facts to be emphasized are the uniqueness of the fish, its being one of southern California's very few native freshwater fishes, its role in the ecosystem, the potentially disasterous effect that man's modification of the habitat can have on this unique fish, and that the first recovery step is the preservation of its habitat.

The public relations objectives can be furthered by several means: through media, by the installation of informational signs in the essential habitat areas and at nearby places where people gather (e.g., campsites, picnic areas and shopping centers), by audiovisual programs and brochures made available to the public (e.g., at schools), by establishing a natural history exhibit on the UTS essential habitat area (e.g., in the Thousand Trails area), or displays at schools.

42. Provide relevant organizations with advice to preserve UTS. Both public and private organizations whose activities affect the stickleback populations and their habitat should be made

aware of the existence and endangered status of the stickleback. Such organizations should be offered advice concerning the way in which their activities may degrade UTS habitat and be informed of things that can be done to improve habitat conditions. Much additional support for the recovery program could be generated through a positive informational program.

43. Inform public of transplant efforts. Details of transplants should be made public by inclusion in CDFG archives in Long Beach and Sacramento, publication in *California Fish and Game*, press releases, and informational signs. This information should include at a minimum: source of introduced fish, place of introduction, date of introduction, description of the habitat into which the transplant was made, and the number of sticklebacks introduced.

5. Utilize laws and regulations to protect fish and habitat. Existing laws should be strictly enforced and periodically examined as to their effectiveness.

51. Enforce existing laws and regulations. Applicable laws and regulations should be strictly enforced to protect *G. a. williamsoni* and its habitat. Transplanted populations should receive the same protection as native populations unless they have been designated as experimental pursuant to Section 10(j) of the Endangered Species Act.

52. Designate critical habitat as provided for by the Endangered Species Act. Final determination of those lands designated in Appendix A as critical habitat would benefit the Forest Service and County governments in their planning efforts by identifying the areas most vulnerable to land use changes.

53. Determine need for and propose additional laws and regulations. Current laws and regulations should be examined to determine the need for additional protective measures. Such measures, as needed, should be proposed.

54. Review permits for research projects. Proposals to study *G. a. williamsoni* should be screened and permits granted expeditiously for needed studies. Permits should be granted on the basis of the effect on the total stickleback population.

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PART III

IMPLEMENTATION SCHEDULE

Table 1 that follows is a summary of scheduled actions and costs for the unarmored threespine stickleback recovery program. It is a guide to meet the objectives of the Unarmored Threespine Stickleback Recovery Plan, as elaborated upon in Part II, Narrative section. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform tasks, a time table for accomplishing these tasks, and lastly, the estimated costs to accomplish these tasks. Implementing Part III is the action of the recovery plan that, when accomplished, will bring about the recovery of this endangered species. Initiation of these actions is subject to the availability of funds.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

RECOVERY ACTION PRIORITIES

1 = An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.
2 = An action that must be taken to prevent a significant decline in the species' population or habitat quality, or some other significant negative impact short of extinction.
3 = all other actions necessary to provide for full recovery of the species.

Table 1. Implementation Schedule

General Category	Plan Task	Task Number	Priority Number	Duration[1/] of Task (Yrs.)	Cooperating Agencies FWS Region	Cooperating Agencies FWS Program	Cooperating Agencies Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments/Notes
M7	Determine, monitor and regulate water use	111	1	Ongoing			USFS* USAF* SWRCB* CDFG	1 1 0.5 0.5	1 1 0.5 0.5	1 1 0.5 0.5	USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands; SWRCB has jurisdiction over issuance of water rights
03	Determine, monitor and regulate land use	112	1	Ongoing			USFS* USAF* CDFG*	3 1 0.5	3 1 0.5	3 1 0.5	USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands; CDFG is lead agency on private lands
A3	Develop management agreement with Los Angeles Department of Water and Power	113	2	1			USFS* LADWP	0.5			Agency costs largely administrative
M3	Maintain essential stream characteristics	114	1	Ongoing			USFS* USAF* CDFG*	1 0.5 0.5	1 0.5 0.5	1 0.5 0.5	USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands; CDFG is lead agency on private lands
M3	Determine appropriate methods to restore degraded habitat	121	1	2			USFS* USAF*	1 1	1 1		USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands

General Category	Plan Task	Task Number	Priority Number	Duration[1/] of Task (Yrs.)	Cooperating Agencies FWS Region	Cooperating Agencies FWS Program	Cooperating Agencies Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments/Notes
M3	Determine supplemental flow volume necessary to maintain UTS	1221	2	1			USFS* USAF* CDFG*	1 1 1			USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands CDFG is lead agency on private lands
M3	Acquire water rights if necessary	1222	1	As needed			USFS* USAF* SWRCB* CDFG	To Be Determined			USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands; SWRCB has jurisdiction over issuance of water rights
M3	Install apparatus for maintaining supplemental flows	1223	2	1			USFS* USAF*			10 10	USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands
M3	Implement procedures to restore degraded habitat and supplement instream flows	123	2	As Needed			USFS* USAF*	To Be Determined			USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB lands
A7	Identify and investigate potential land sites needing protection	131	2	2			CDFG USFS*	2 2	2 2		
A7	Establish priorities for protection as needed	132	2	1	1	SE	CDFG* USFS*	0.5 1 1			USFS is lead agency within Angeles N.F.; CDFG is lead agency on other lands

General Category	Plan Task	Task Number	Priority Number	Duration[1/] of Task (Yrs.)	Cooperating Agencies FWS Region	Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments/Notes
A7	Secure appropriate parcels	133	2	5			CDFG USFS*		5 10	10 50	USFS will secure parcels as funding permits after priorities established
M4	Prevent introduction of exotic organisms	211	1	Ongoing	1	LE	CDFG* USFS	0.5 0.5 0.5	0.5 0.5 0.5	0.5 0.5 0.5	FY85 PA 4a
M4	Remove exotic organisms as needed	212	1	Ongoing	1	SE	CDFG*	To Be Determined			CDFG has undertaken action to remove catfish and tilipia from Soledad Canyon.
M7	Establish contingency plan	213	1	1	1	SE	CDFG* USAF	1 1 1			Includes 2131-2132 USFS has completed plan for Angeles N.F.
M7	Implement contingency plan	214	1	Continuous			CDFG* USFS USAF	To Be Determined			USFS has obtained necessary equipment for Angeles N.F.
M2	Determine need for establishing additional populations	221	2	1	1	SE	CDFG*	1 1			
M2	Select suitable sites	222	2	1	1	SE	CDFG* USFS* USAF*		0.5 0.5 2 2		USFS is lead agency for sites on Forest Service lands; USAF is lead agency on Vandenberg AFB; CDFG is lead agency in other areas
M2	Restore habitat as necessary	223	2	Ongoing			CDFG* USFS* USAF*	To Be Determined			Same division of responsibilities as described for #222

General Category	Plan Task	Task Number	Priority Number	Duration[1/] of Task (Yrs.)	Cooperating Agencies: FWS Region	Cooperating Agencies: FWS Program	Cooperating Agencies: Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments/Notes
M2	Obtain transplant stock	224	2	Ongoing			CDFG*	To Be Determined			Stock from San Antonio Creek was transplanted into Honda Creek on Vandenberg AFB in 1984.
M2	Perform transplants	225	2	Ongoing			CDFG*	To Be Determined			See Notes 224
R1	Monitor existing populations through established census techniques	231	1	Ongoing			CDFG* USFS* USAF*	0.5 0.5 0.5	0.5 0.5 0.5	0.5 0.5 0.5	CDFG is lead agency on private lands; USFS is lead agency on Forest Service lands; USAF is lead agency on Vandenberg AFB
M2	Monitor transplanted individuals	232	3	Ongoing			CDFG* USFS* USAF*	To Be Determined			Same division of responsibilities as described for #231 - Monitoring indicates some reproduction in both 1984 and 1985.
R1	Investigate possible existence of additional populations of UTS	233	1	1	1	SE	CDFG*	12.5 12.5			Several populations south of the Santa Clara River need to be examined
M3	Determine natural habitat conditions	31	2	3	1	SE	USFS* USAF* CDFG*	1 3 2 1	1 3 2 1	1 3 2 1	Same divisions of responsibilities as described for #231
R9	Assess effects of exotic predators	32	2	1	1	SE	CDFG*	4 4			Evaluating impact of African clawed frog invasion is highest priority [illegible]

General Category	Plan Task	Task Number	Priority Number	Duration[1/] Duration (Yrs.)	Cooperating Agencies FWS Region	Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments/Notes
R14	Determine biological needs for nesting, reproduction and rearing young	33	2	3	1	SE	UNIV LACM CDFG*	1 1 1 1	1 1 1 1	1 1 1 1	Current knowledge needs refining
R14	Determine food requirements	34	2	1	1	SE	UNIV LACM CDFG*		1 1 1 1		Current knowledge needs refining
R14	Determine water quality and quantity requirements of UTS	35	2	1	1	SE	CDFG*		2 2		Some requirements are known, but additional information is needed
R2	Establish determinants of water distribution and abundance within essential habitat	36	1	1	1	SE	CDFG USFS* USAF*	1 1 2 2			USFS is lead agency on Forest Service lands, USAF is lead agency on Vandenberg AFB lands
R1	Determine optimum size of UTS population necessary to be self-sustaining	37	2	1	1	SE	CDFG*		1 2		
R1	Determine genetic composition of populations of unknown origin	38	1	1	1	SE	CDFG*	10 10			Highest priority research needs are resolving taxonomic questions associated with Shay Creek and San Antonio Creek populations

General Category	Plan Task	Task Number	Priority Number	Duration[1/] Duration (Yrs.)	Cooperating Agencies FWS Region	Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments/Notes
01	Publicize UTS distribution, identification and legal status	41	3	Contin-uous	1	SE		1	1	1	USFS to maintain on-site Santa Clara River displays, USAF to complete on-site San Antonio Creek display; CDFG to develop informational brochures
							CDFG*	2	2	2	
							USFS*	3	3	3	
							USAF*	1	1	1	
01	Provide relevant organizations with advice to preserve UTS	42	3	Contin-uous	1	SE		0.5	0.5	0.5	
							CDFG*	0.5	0.5	0.5	
							USFS	0.5	0.5	0.5	
							USAF	0.5	0.5	0.5	
01	Inform public of transplant efforts	43	3	Continuous			CDFG*	To Be Determined			
02	Enforce existing laws and regulations	51	1	Ongoing	1	LE		0.5	0.5	0.5	FY 85 PA 4a
							CDFG*	1	1	1	
							USFS	5	5	5	
							USFS	0.5	0.5	0.5	
04	Designate critical habitat as provided for by the Endangered Species Act	52	2	1	1	SE*			1		Critical habitat has been proposed and should be finalized

General Category	Plan Task	Task Number	Priority Number	Duration[1/] of Task (Yrs.)	Cooperating Agencies FWS Region	Program	Other	Estimated Costs ($1,000's) FY 1	FY 2	FY 3	Comments/Notes
02	Determine need for and propose additional laws and regulations	53	2	Continuous		1	LE CDFG* USAF USFS	To Be Determined			
02	Review permits for research projects	54	2	Ongoing		1	SE* CDFG	To Be Determined			FY 85 PA 3d

* = lead agency

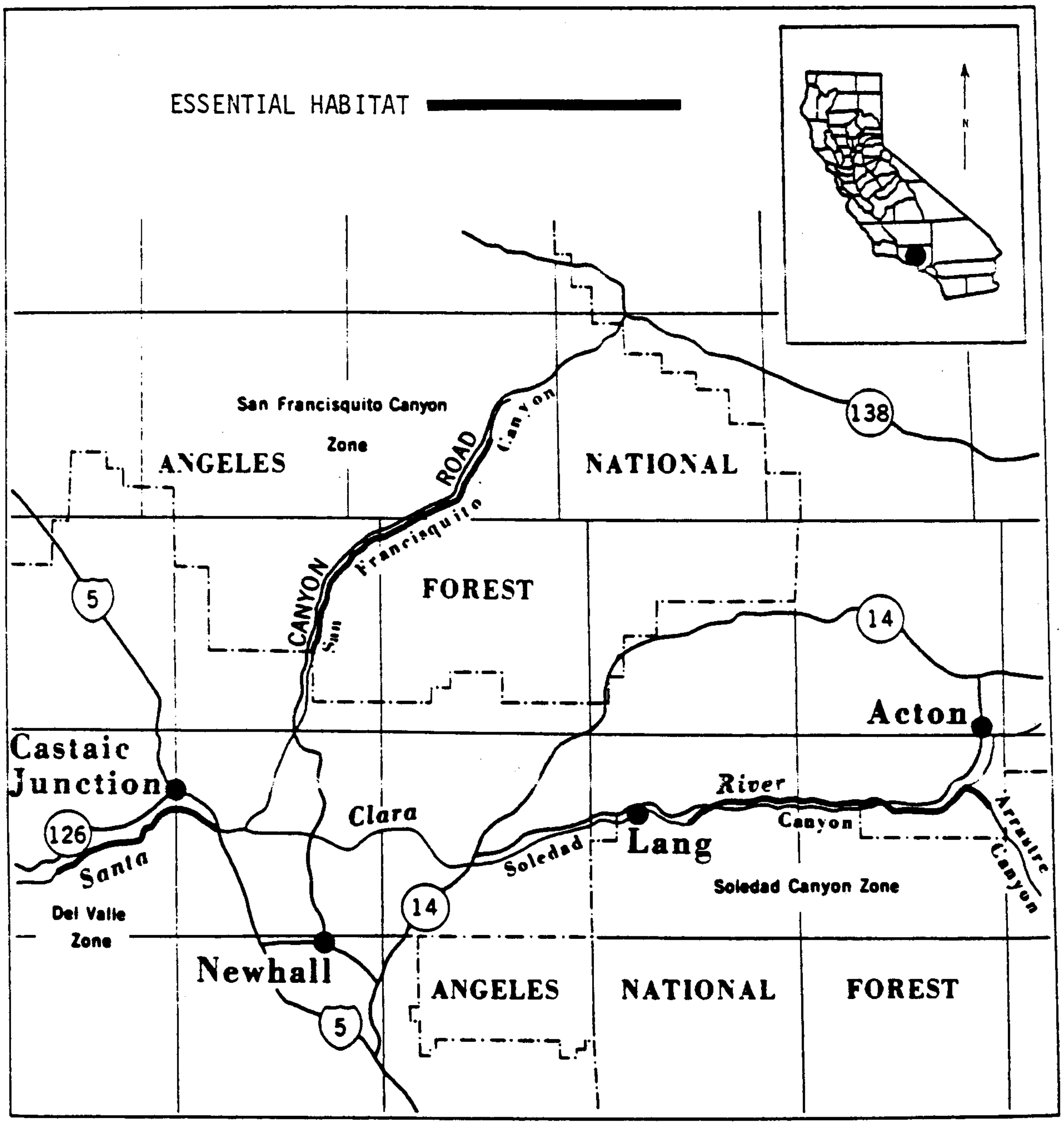
1/ Ongoing = The action is now being implemented and will continue on an annual basis, or as needed.
Continuous = The action will be implemented on an annual basis once the action is begun, or as needed.

Abbreviations

CDFG = California Department of Fish and Game
USAF = U.S. Air Force
SWRCB = State Water Resources Control Board
USFS = U.S. Forest Service
UNIV = Universities
LACM = Los Angeles County Museum
LADWP = Los Angeles Department of Water and Power

APPENDIX A

Essential habitat for the unarmored threespine stickleback in Los Angeles County, California.



Del Valle, San Francisquito Canyon and Soledad Canyon Zones

Los Angeles County, CALIFORNIA

Description of the three zones of essential habitat for the unarmored threespine stickleback in Los Angeles County.

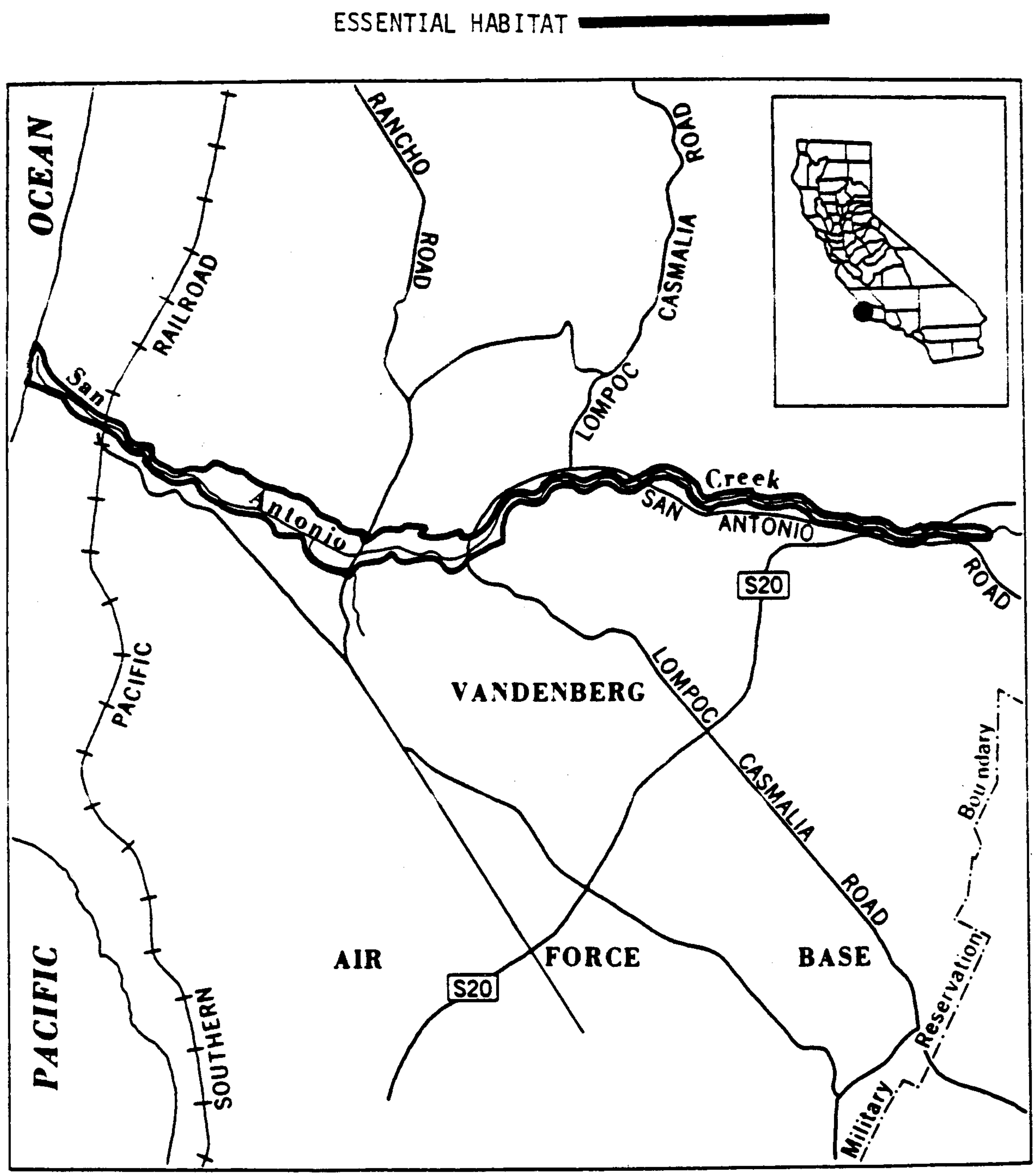
1. <u>Del Valle zone</u>. An area of land and water with the following components (San Bernardino meridian): Santa Clara River within T4N, R16W and R17W, beginning at its confluence with San Martinez Grande Canyon, at a point 0.9 of a mile (1.5 kilometers) southwest of Del Valle settlement, and extending upstream approximately 5.6 miles (8.8 kilometers) to the overcrossing of Interstate Highway 5.

2. <u>San Francisquito Canyon zone</u>. An area of land and water with the following components (San Bernardino meridian): San Francisquito Canyon watercourse, within T5N, R16W and T6N, R15W, beginning at a point where the Angeles National Forest boundary intersects the San Francisquito Canyon watercourse approximately 2½ miles southwest of San Francisquito Powerhouse No. 2, and extending upstream in San Francisquito Canyon approximately 8.4 miles (13.5 kilometers) to San Francisquito Powerhouse No. 1, near its junction with Clearwater Canyon.

3. <u>Soledad Canyon zone</u>. An area of land and water in Los Angeles County, with the following components (San Bernardino meridian): Santa Clara River within T4N, R13W and R14W, beginning at a point 1.4 miles (2.3 kilometers) upstream in Soledad Canyon from the community of Lang, at the downstream end of the area called River's End Park, at 34° 26' 7" N, 118° 21' 51" W, thence extending upstream approximately 8.5 miles (13.7 kilometers) to its confluence with Arrastre Canyon, at a point located about 0.6 of a mile (1 kilometer) southwest of Los Angeles County Rehabilitation Camp, thence upstream in Arrastre Canyon approximately 0.8 of a mile (1.4 kilometers) to 34° 26' 7" N, 118° 11' 51" W.

APPENDIX B

Essential habitat for the unarmored threespine stickleback in Santa Barbara County, California



San Antonio Creek Zone

Santa Barbara County, CALIFORNIA

Description of the zone of essential habitat for the unarmored threespine stickleback in Santa Barbara County.

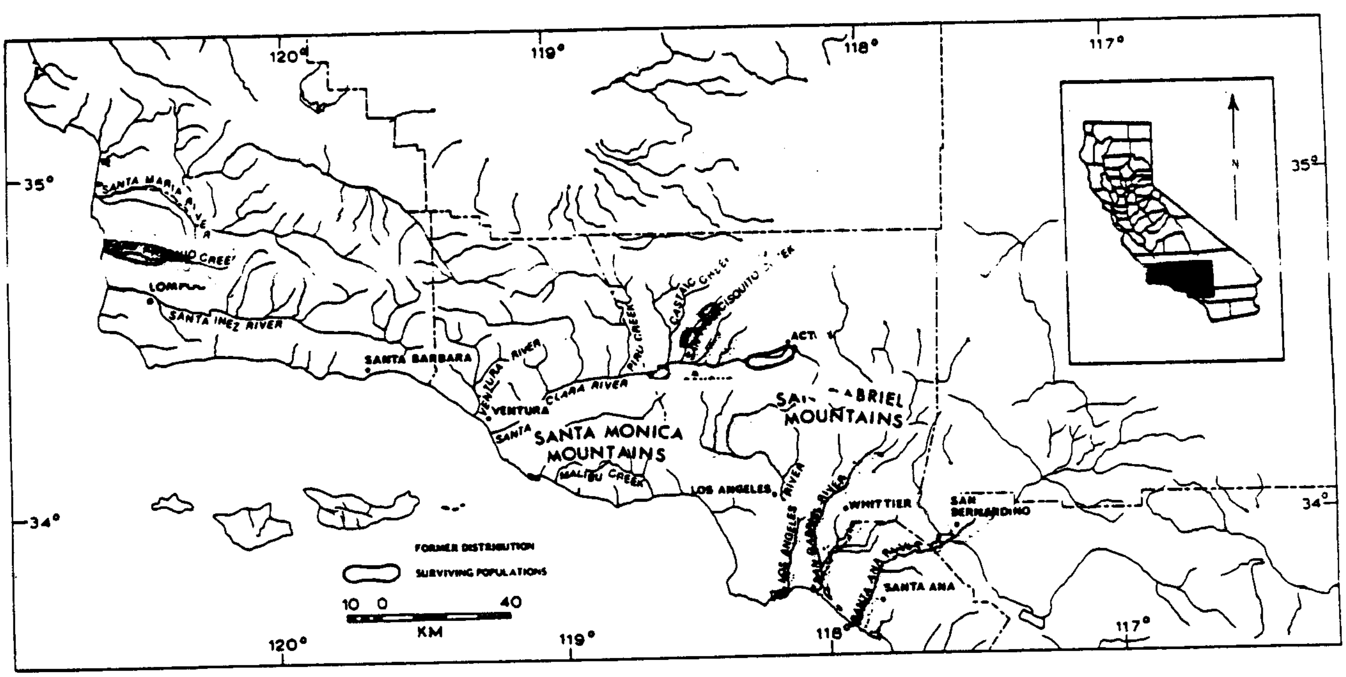
<u>San Antonio Creek zone</u>. An area of land and water with the following components (using California Grid Zone 5 coordinates): San Antonio Creek watercourse, beginning at the Pacific Ocean beach boundary at 482,000 N; 1,213,000 E and including natural dunes or sandbars in the stream mouth, thence upstream approximately 8.4 miles (13.5 kilometers) to the eastern boundary at 473,357 N; 1,256,250 E in Barka Slough. Lateral flood plain areas elevated less than ten feet above the main streambed constitute seasonal marsh utilized for feeding and reproduction by this species and are considered a necessary component of the essential habitat. Total designated area of stream and associated seasonal marsh is approximately 611 acres.

APPENDIX C

ESSENTIAL MANAGEMENT AREA

The designation of another habitat management category called the essential management area may also be beneficial. The essential management area includes all areas in the Santa Clara River watershed upstream from the juncture with and including San Martinez Grande Canyon that are not within the proposed critical habitat and all of the San Antonio Creek watershed that is not included within the proposed critical habitat.

The essential management area does not require the intensive management that is required within the proposed critical habitat to maintain satisfactory habitat conditions for the unarmored threespine stickle. However, it must be managed to the extent that adequate flows of good quality water are maintained in the proposed critical habitat so that the quantity and quality of that habitat is not significantly reduced.



Essential Management Area

APPENDIX D

STICKLEBACK EMERGENCY CONTINGENCY PLAN
(For Essential Habitat Zones in Los Angeles County)

EMERGENCY FIELD PROCEDURES
FOR PROTECTION OF THE
UNARMORED THREESPINE STICKLEBACK

A. PURPOSE AND NEED

The unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) is listed as an endangered species by the U.S. Fish and Wildlife Service (FWS). At present, the major *G. a. williamsoni* populations are confined to portions of the Santa Clara River drainage in Los Angeles County.

These populations are susceptible to extinction as a result of a single catastrophic event such as a toxic chemical spill.

B. GOAL

Insure the continued existence of the unarmored threespine stickleback.

C. OBJECTIVES

1. Define responsibilities and tasks of the various State and Federal agencies involved in the recovery and protection of the unarmored threespine stickleback.
2. Establish lines of authority and coordination when the plan is in effect.

D. SCOPE

The Stickleback Emergency Contingency Plan will act as an attachment to the Angeles National Forest Oil and Hazardous Substances Pollution Contingency Plan (HSP Plan).

Emergency field procedures will be activated when a hazardous spill or other threat occurs within the upper Santa Clara drainage.

The key to the success of this plan will be timely notification. It will then be the responsibility of the Stickleback Response Team Leader to take immediate on-site action.

THE SAFETY OF PERSONNEL AND THE PUBLIC IS THE MOST IMPORTANT CONSIDERATION IN ALL ACTIONS INVOLVING TOXIC SPILLS.

E. RESPONSIBILITY

All agencies will establish primary contacts and initial response team leaders for the protection and salvage of the unarmored threespine stickleback.

Participating agencies and their roles:

CALIFORNIA DEPARTMENT OF FISH AND GAME - Serves as the lead agency responsible for the protection of the unarmored threespine stickleback.

U.S.D.A. FOREST SERVICE - Will provide assistance and act as team leaders on hazardous toxic spills which occur on federal lands. The main emphasis on Forest Service lands will be to stop the spread of toxic materials.

U.S.D.I. FISH AND WILDLIFE SERVICE - Serves as the lead agency responsible for the recovery of the unarmored threespine stickleback. Is responsible for monitoring affects of toxic contamination on the U.T.S.

Preliminary Response Team Leaders who will implement the plan until arrival of the CDFG representative are listed below:

AGENCY	HOME PHONE	OFFICE PHONE
California Department of Fish and Game		
24 Hour Emergency		(800) 852-7550
Warren Crooker	(805) 255-1489	(213) 590-5132
Long Beach Office		(213) 590-5132
U.S.D.A. Forest Service, Angeles National Forest		
Steve Bear, Tujunga RD	(818) 368-6916	(818) 899-1900
Debbie Raphael, Saugus RD	(805) 724-1075	(805) 252-9710
Glenn Johnson, Saugus RD	(805) 251-3158	(805) 252-9710
Bill Brown, Supervisor's Office	(818) 794-3010	(818) 577-0050
Joe Gonzales, Supervisor's Office	(818) 447-2388	(818) 577-0050

F. ON-SITE ACTIONS

The type of on-site action taken will depend on the severity of the toxic contamination. The following factors must be considered: 1) location of spill, 2) type of contaminant, 3) amount of contaminant, and 4) stream flow condition.

To aid Response Team Leaders in deciding appropriate on-site action, the Soledad Canyon reach of the Santa Clara River and San Francisquito Creek, a tributary to the to the Santa Clara River, have been divided into zones of influence (see Figures 1 and 2).

A description of each zone of influence and a discussion of potential effects, by area, are given below. An assumption has been made that stickleback are evenly distributed throughout the zones of influence.

SOLEDAD CANYON

ZONE A

This zone encompasses the uppermost reach of the Santa Clara River. It is approximately 3.3 miles in length and lies between Acton Camp and County Highway Bridge #904 near Wild Country Park (aka "Roar").

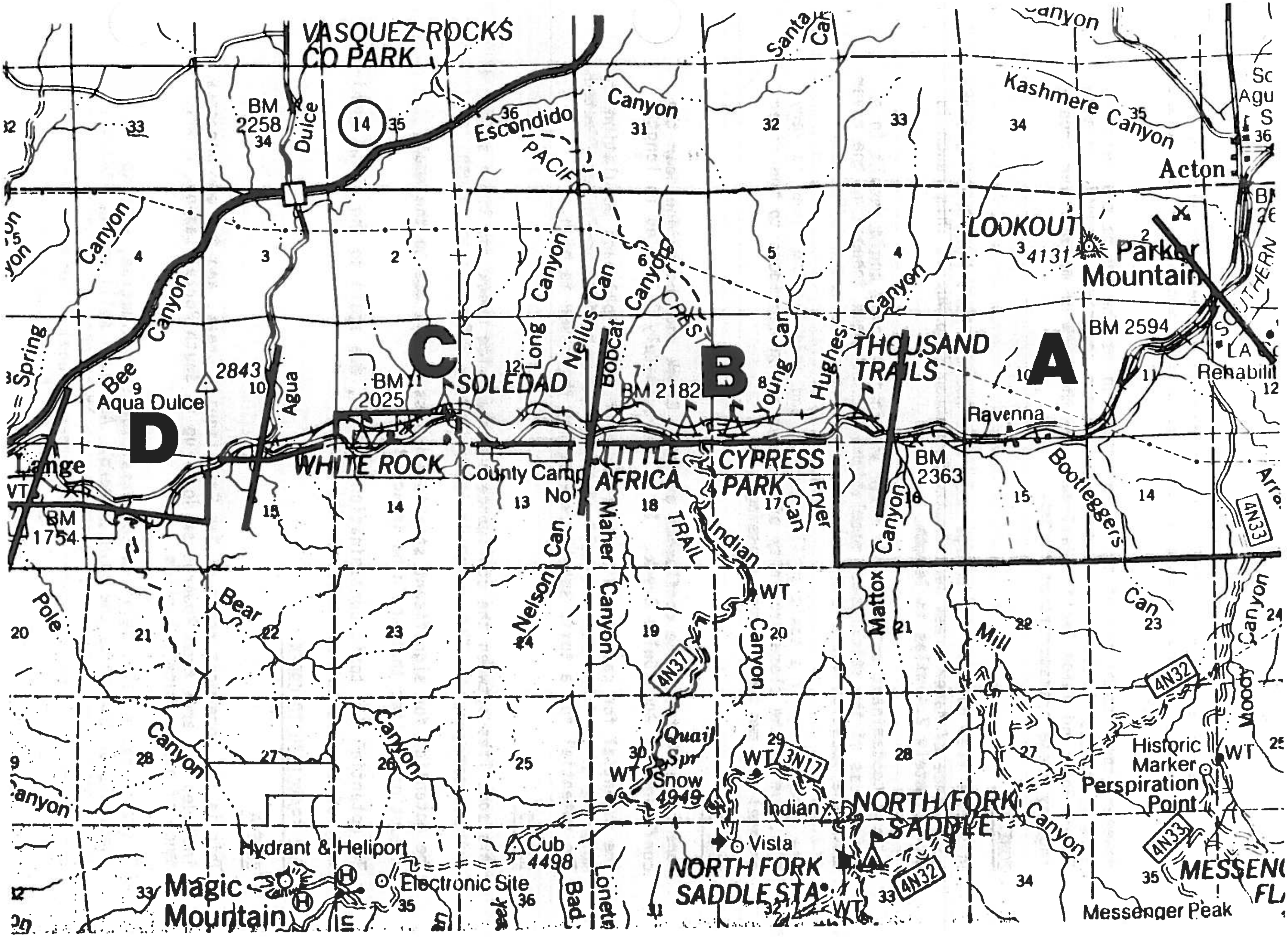


Figure 1. Zones of influence along the Soledad Canyon reach of the Santa Clara River.

Zone A has a very high potential for extirpation of the stickleback population in Soledad Canyon should a toxic contaminant enter the river, since all fish and their habitat could be directly impacted.

However, the probability of toxic contamination is low due to the relatively safe distances (>500') and flat slopes between the river channel, Soledad Canyon Road and Union Pacific Railroad, and the lack of major river crossings by these transportation routes.

ZONE B

This zone lies between the bridge near Wild Country Park (aka Roar) and the confluence of Maher Creek near County Detention Camp No. 1. This reach is approximately 2.4 miles in length.

A toxic contaminant entering the river within this zone could result in a major loss of the stickleback population. Stickleback inhabiting the river above the location where the contaminant enters would not be affected.

The probability of a toxic spill occurring and entering the river is very high, due to the close proximity of transportation corridors to the river channel and two major river crossings.

ZONE C

Zone C lies between the confluence of Maher Creek and the bridge near the confluence of Agua Dulce Creek. It is approximately 3.1 miles in length.

The potential for catastrophic destruction of the stickleback population is moderate since less than one-half of the existing habitat would be affected. The potential for a toxic substance entering the river is high.

ZONE D

This zone lies between the confluence of Agua Dulce Creek and River's End, a private campground. This reach is approximately 2.2 miles in length.

The potential for significant stickleback loss is low due to the small amount of habitat that would be impacted.

The potential for toxic contamination is high, due again to the close proximity of transportation routes to the river.

SAN FRANCISQUITO CREEK

ZONE A

This is the uppermost reach of San Francisquito Creek, and for our purposes includes the area from Powerhouse No. 1 up to South Portal Canyon, a distance of approximately 2 miles.

This zone has a relatively low potential for contamination, with spills of chemicals or toxicants the main concern. Any such spill would, however, have a good chance of impacting the entire stickleback population during continuous flow periods (generally November - June). The major source for contamination would be from spills off of San Francisquito Canyon Road.

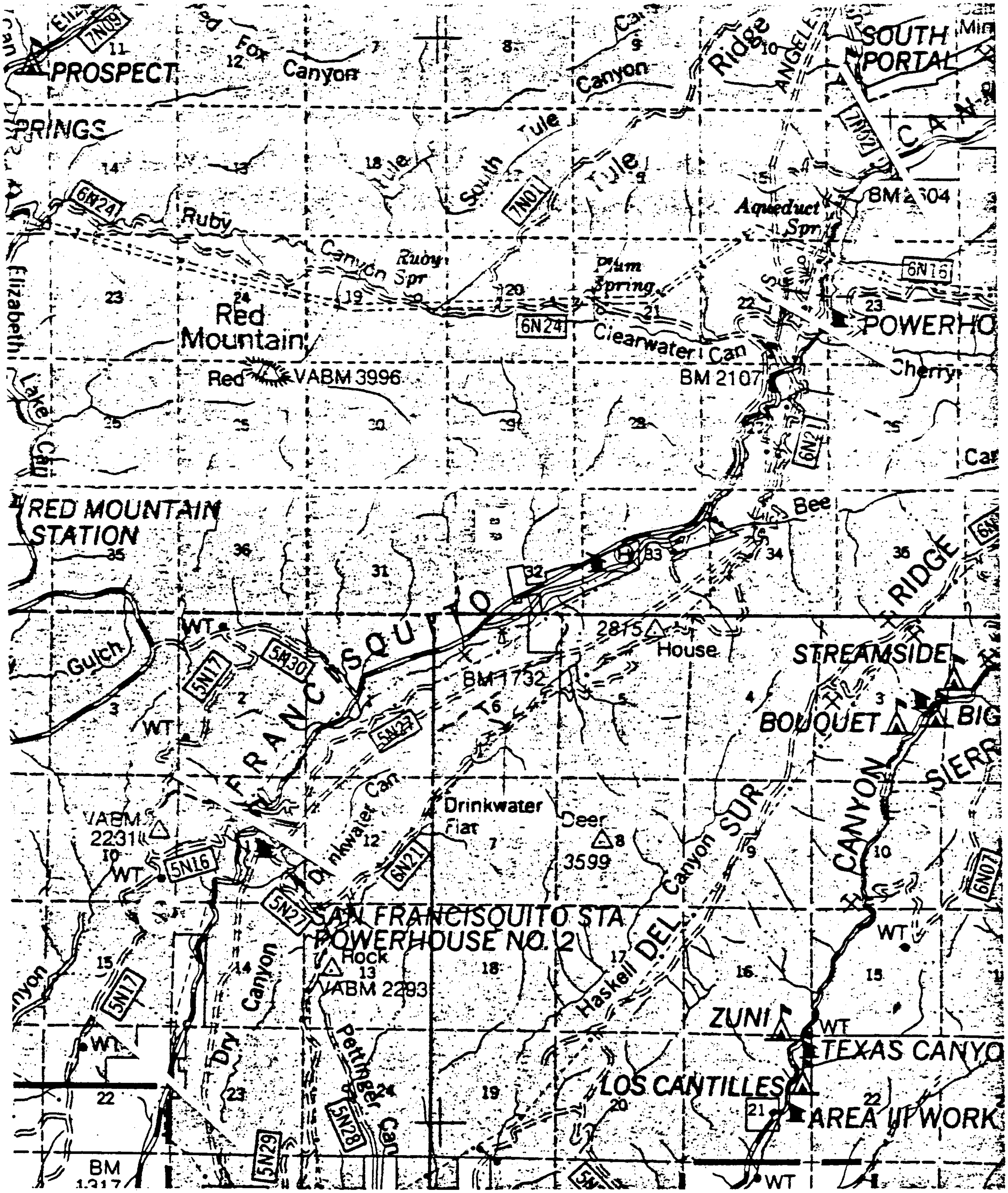


Figure 2. Zones of influence along San Francisquito Creek.

ZONE B

This section lies between Powerhouse No. 1 and Powerhouse No. 2, a distance of approximately 5-1/2 miles.

This zone contains the bulk of the stickleback population within San Francisquito Creek. Risk of loss is high due to the potential for loss of hydraulic oil from Powerhouse No. 1, as well as oil or toxic waste spills or dumping off of San Francisquito Canyon Road, which is located immediately adjacent to the stream bed through most of this section.

ZONE C

This zone includes the area from Powerhouse No. 2 down to the Forest boundary, a distance of approximately 2 miles.

The potential for loss of stickleback in this section is fairly low due to the small amount of suitable year-long habitat available. The area could be impacted by both road-related spills and dumping from San Francisquito Canyon Road, and hydraulic oil spills from Powerhouse No. 2, as well as from contaminant entering from Zone B.

ACTION PLAN

The Response Team Leader will take the following action(s):

1. Evaluate potential for fish loss.

2. If contaminant or other threat is determined to be a threat to stickleback survival, start salvage procedures.

   If in doubt, proceed with salvage efforts. Stickleback can always be returned to the stream once the threat has been alleviated.

3. Salvage procedures will include capturing as many stickleback as possible, maintaining immediate life-support systems, and placing these fish upstream from the source of contamination or in a temporary holding facility until it is safe to return them to their natural habitat.

   Stickleback will be captured using equipment stored at the Tujunga Ranger District Office, Saugus Ranger District Office, and County Camp 11, or by any other means as deemed appropriate.

   Salvage equipment stored at each of these locations will include the following:

   1) One small-mesh minnow seine (10-12 feet in length)
   2) Two (2) long-handled dip nets
   3) Twelve (12) five-gallon plastic buckets
   4) Six (6) battery-powered fish tank aerators and 4 oxygen bottles
   5) Twenty-five feet of aquarium tubing
   6) Six (6) gang valves
   7) Air stones
   8) Two (2) pair elbow-length plastic or neoprene gloves
   9) Two (2) pair hip boots
   10) Two (2) pair chest waders

4. Recovery team members will be briefed as soon as possible about the situation. Phone (213) 590-5151 or 5152

5. Recovery team will meet, if necessary, within 48 hours to review salvage efforts and evaluate potential consequences of toxic contamination.

6. If salvaged stickleback are placed into a temporary hold facility, they will be reintroduced into the affected area once it has been judged safe to do so.

7. Monitoring will be conducted at various times throughout the year to determine success of operation.

Prepared by	Forest Wildlife Biologist	9/19/85 Date
Recommended by	Land Management Planning/ Resource Staff Officer	9/20/85 Date
Approved by	Forest Supervisor Angeles National Forest	9/24/85 Date

APPENDIX E.

List of Agencies Asked to Submit Comments on the Agency Review Draft.

California Department of Fish and Game, Sacramento, California

California Department of Fish and Game, Region 5, Long Beach, California

Los Angeles County Planning Department, Los Angeles, California

U.S. Air Force, Environmental Planning Section, Vandenberg AFB, California

U.S. Fish and Wildlife Service, Office of Endangered Species, Washington, D.C.

U.S. Fish and Wildlife Service, Region One, Portland, Oregon

U.S. Fish and Wildlife Service, Division of Law Enforcement, Sacramento, California

U.S. Forest Service, Angeles National Forest, Pasadena, California

U.S. Forest Service, Tujunga Ranger District, San Fernando, California

Team Leader, Unarmored Threespine Stickleback Recovery Team, Goleta, California