

THE REVISED FISHERY MANAGEMENT PLAN
FOR THE LITTLE KERN GOLDEN TROUT

Prepared by

Daniel P. Christenson

California Department of Fish and Game

April, 1984

THE REVISED FISHERY MANAGEMENT PLAN
FOR THE LITTLE KERN GOLDEN TROUT

Approved by:

George Nokes
George Nokes, Regional Manager
Region 4
Department of Fish and Game

8/28/84
Date

James Crates
James Crates, Supervisor
Sequoia National Forest

8/30/84
Date

Boyd Evison
Boyd Evison, Superintendent
Sequoia-Kings Canyon National Park

9/4/84
Date

William S. Shake
William Shake
Assistant Regional Director
Federal Assistance
U.S. Fish and Wildlife Service

9/10/84
Date

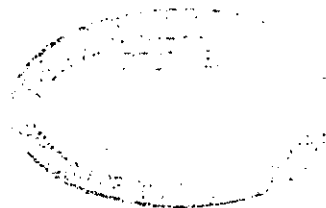


TABLE OF CONTENTS

Introduction.....	4
History.....	7
Recent Activities.....	10
Pre-Project Status.....	10
Problems.....	13
Management Plan.....	15
Appendix.....	25

INTRODUCTION

A fishery management plan for the Little Kern golden trout (Salmo aguabonita whitei) was published by the California Department of Fish and Game (Christenson, 1978). This revision supercedes that document and updates the plan to incorporate current information. The purpose of this plan is to summarize the available information on the Little Kern golden trout, and to propose activities to be carried out by the cooperating agencies to ensure the protection of this subspecies and its habitat.

The golden trout, of which the Little Kern golden trout is a subspecies, has been designated as the official State Fish by the California State Legislature. It is recognized by the California Department of Fish and Game as a threatened species (Fisk, 1971) and is a subject of consideration by its Threatened Trout Committee. The Little Kern golden trout was proposed for federal listing as Threatened under the Endangered Species Act of 1973 on September 1, 1977 by the United States Fish and Wildlife Service (Federal Register, vol. 42, No. 170). On April 13, 1978 the Director of the U.S. Fish and Wildlife Service officially listed the Little Kern golden trout as Threatened (Federal Register, vol. 43, No. 72) and designated its Critical Habitat (Figure 1). As a result of these actions, U.S. Fish and Wildlife Service has official responsibilities regarding activities affecting this species.

The Sequoia National Forest submitted the draft Environmental Analysis Report on the Management Plan to the U.S. Fish and Wildlife Service on March 1, 1979. The final report was approved on July 24, 1983. A summary of the requirements and constraints suggested in the final Analysis Report are listed below.

1. Finish genetic sampling and periodically sample known pure populations to assure that they have not become contaminated.
2. Cooperating agencies prepare an annual work plan.
3. Approval of pesticide application plans by appropriate governmental agencies.
4. Prepare and implement a public information program.
5. Schedule chemical treatments to minimize impact on the public to the extent feasible. The quantity of treatments should not exceed the point that over half the drainage cannot support fishing.
6. Chemical treatments are not to exceed the ability to restock from donor populations.

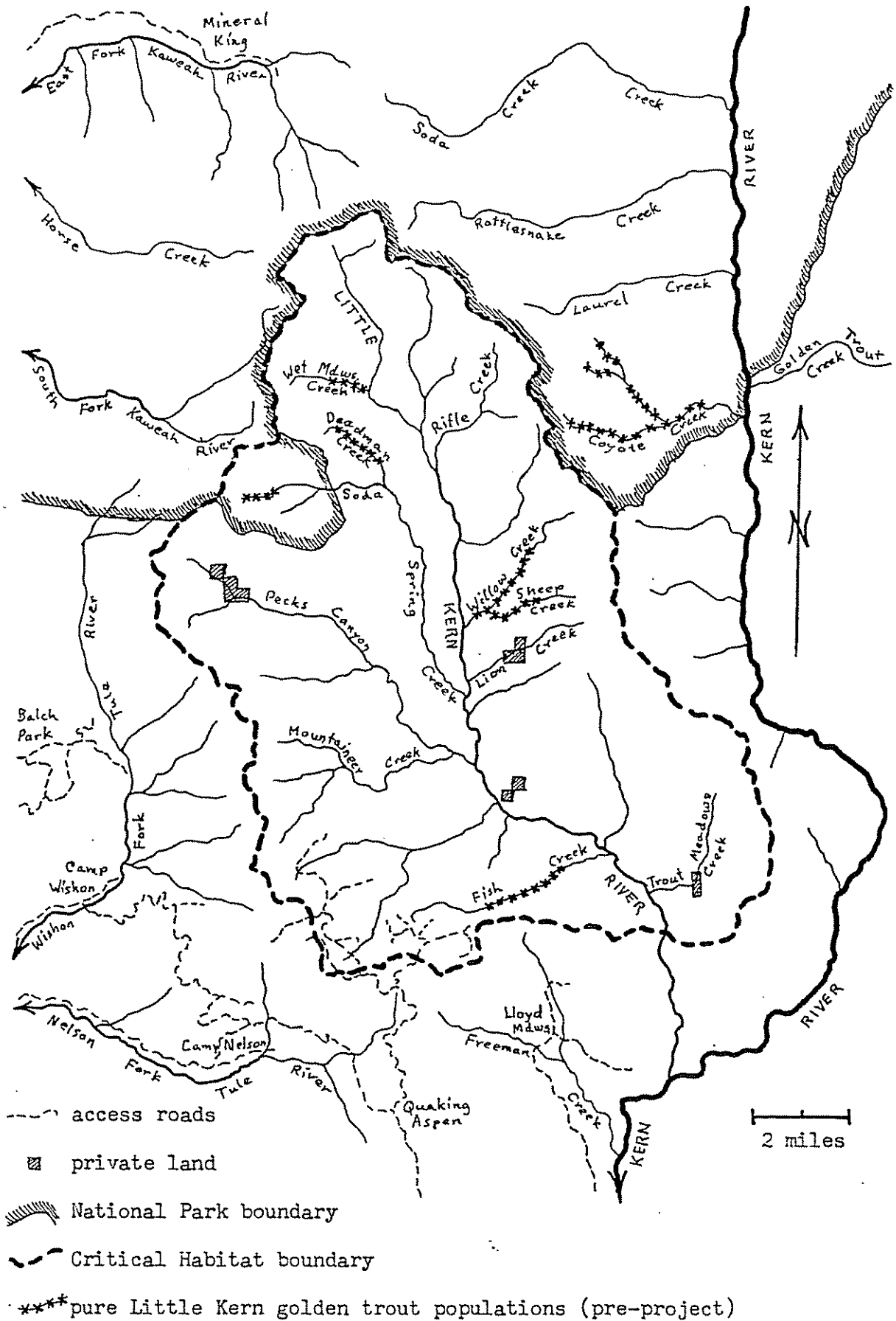


FIGURE I - LITTLE KERN GOLDEN TROUT CRITICAL HABITAT

7. Salvage non-Little Kern golden trout as much as possible.
8. Retain populations of western sucker (Catostomus occidentalis) where they occur naturally.
9. Monitor effectiveness of chemical treatments.
10. Treated waters to be restocked by transplanting to speed recovery.
11. Monitor recovery of restored populations.
12. Monitor habitat, water quality and fish population.
13. Revise Management Plan to meet Environmental Analysis and Biological Opinion requirements.
14. Initiate formal consultation if recovery problems arise.
15. Conduct sensitive plant and archeological surveys prior to fish barrier construction.

The U.S. Fish and Wildlife Service reviewed the Management Plan and Environmental Analysis and issued its Biological Opinion on April 13, 1979. The following modifications to the Plan were recommended.

1. Reestablishment of stable, self-sustaining populations of Little Kern golden trout within the entire Critical Habitat area by removal of all other trout. This includes the so-called "unique trout" of the Mountaineer Creek drainage and North Fork Clicks Creek. [Note: Recent genetic analysis shows that they are not Little Kern golden trout, but rainbow trout (Salmo gairdnerii), very closely related to those in the Lower McCloud River of the Sacramento River system - Smith and Gall, 1981].
2. Minimize the likelihood of unauthorized fish introductions especially rainbow trout by any or all of the following.
 - a. Inform the public of all management activities to achieve understanding and cooperation.
 - b. Closure of streams to fishing.
 - c. Closure of roads and/or limitation of vehicular access to only emergency and authorized uses within the designated Critical Habitat.

This revised Management Plan reflects these modifications and additional information which has resulted from recent genetic analysis and field surveys. The primary management objective in the Little Kern River, its tributaries and watershed, is to protect, enhance and perpetuate the Little Kern golden trout. Implementation of the plan by the cooperating agencies is necessary to ensure the restoration and protection of the Little Kern golden trout and its habitat. Those responsible for implementing the plan are the California Department of Fish and Game with jurisdiction over fish and wildlife resources outside the National Parks, Sequoia National Forest which manages federally-owned lands within their jurisdiction and Sequoia National Park which manages the federally-owned lands and fish and wildlife resources within their boundaries.

HISTORY

The Little Kern golden trout, which is closely related to the Kern River rainbow trout (Salmo gairdnerii gilberti) and the golden trout of the South Fork Kern River and Golden Trout Creek (Salmo aguabonita aguabonita) (Gold and Gall, 1975; Smith and Gall, 1981; Gall, Bannon, Smith and Bentley, 1982) was originally widespread throughout the Little Kern River drainage in eastern Tulare County. Early activities of settlers in the area and possibly Indians even earlier included transplanting of Little Kern golden trout into many nearby waters (Schreck, 1969). Planting records indicate that beginning in the late 1800's, Little Kern golden trout were transplanted into waters of the South Fork Kaweah River, East Fork Kaweah River, several nearby tributaries of the Kern including Coyote Creek and a few isolated waters to the north as far as the Kings River watershed (Table 1).

Biologist Barton W. Evermann described this subspecies from specimens taken from the South Fork Kaweah River at South Fork Meadows in 1904. Waters in that area had previously been planted with Little Kern golden trout taken from Soda Spring Creek near Quinns Horse Camp. Nearly identical appearing trout were found in Soda Spring Creek, Wet Meadows Creek and the Little Kern River near Broder Cabin (Evermann, 1906).

Introduction of non-native trouts to the Little Kern River drainage may have begun in the late 19th century (Table 2). Early records are often vague as to the exact location of the introductions. In the 1930's and 1940's there was widespread introduction in many locations in the drainage (Schreck, 1969). Fishery biologists became concerned about the effects of planting non-native trout during this period (Dill, 1941, 1945). Biologist William A. Dill noted what appeared to be hybridization between Little Kern golden trout and introduced rainbow trout and recommended against further planting of non-native fish in the Little Kern River basin.

Table 1. Early Distribution of Little Kern Golden Trout to Nearby Drainages

<u>Date</u>	<u>Water Planted</u>	<u>Source</u>
1375-1880	E.F. Kaweah River	Little Kern River
1870+	Franklin Lakes	Little Kern River
1880	Monarch Lakes	Little Kern River
	Crystal Lake	
1880	Eagle Lake	Little Kern River
1882	Coyote Creek	Little Kern River
1885	S.F. Kaweah River	Soda Spring Creek
1885	Evelyn Lake	Soda Spring Creek
1885	Whitman Creek	Soda Spring Creek
1887	Coyote Creek	Rifle Creek
?	Rattlesnake Creek	Little Kern River
1894	Big Arroyo Creek	Little Kern River
1894	Hockett Meadow	Soda Spring Creek
1903-1904	S.F. Kaweah River	Hockett Meadow
1904	Horse Creek	Hockett Meadow
1904	Evelyn Lake	Hockett Meadow
1910	Peppermint Creek	Fish Creek
1910	Boggy Meadows	Little Kern River
1910	Clover Creek	Little Kern River
1947	Osa Creek	Little Kern River

Table 2. Introduction of Exotic Fish Species into the Little Kern River Drainage

<u>Year</u>	<u>Species</u>	<u>Water</u>
1870	Rainbow trout	Bullfrog Lakes (same lakes as in Little Kern Basin?)
1870+	?	Soda Creek (Soda Spring Ck?)
1870+	?	Peaks Canyon (Peck's Canyon?)
1906	Brown trout	Twin Lakes (same lakes as in Little Kern Basin?)
1913	Golden trout	Twin Lakes (same lakes as in Little Kern Basin?)
1930-1941	Rainbow trout	Many waters of the Little Kern River drainage including: Little Kern River Alpine Creek Clicks Creek Mountaineer Creek Peck's Canyon Shotgun Creek
1930-1941+	Easternbrook trout	Many waters of the Little Kern River drainage including: Silver Lake Bullfrog Lakes Hidden Lake Maggie Lake Frog Lake Twin Lake Clicks Creek
1934	Golden trout	Twin Lakes (same lakes as in Little Kern Basin?)
1935	Brown trout	Clicks Creek
1944	Rainbow trout	Silver Lake

RECENT ACTIVITIES

California Department of Fish and Game began surveying fish populations in the Little Kern River drainage in 1965 to determine if any pure Little Kern golden trout remained and their extent and exact locations so that restoration efforts could be planned. On the basis of evaluation of the external characteristics and uniformity of appearance, the fish in upper Soda Spring Creek were believed to be the significant remaining population of Little Kern golden trout (Christenson, 1965, 1968) and efforts were begun to expand this population.

An artificial barrier was constructed by Sequoia National Forest and California Department of Fish and Game personnel near the mouth of Soda Spring Creek in 1970 and preparations were made to chemically treat Hidden Lake and the Soda Spring Creek drainage below the pure population. Efforts were suspended due to concerns regarding the purity of Little Kern golden trout populations and the unknown possible effects of the chemicals on other aquatic organisms. A thorough survey of the Little Kern River drainage was conducted in 1973 jointly by Sequoia National Forest and the California Department of Fish and Game personnel to evaluate the status of the Little Kern golden trout and its habitat. The resulting report (Evans, Smith and Bell, 1973) contains basic information on the history of fishery studies and management in the Little Kern River drainage and data on the physical and biological characteristics of the aquatic environments including isolating barriers and recreational use. This report has provided a basis for subsequent studies and management.

Genetic studies at the University of California at Davis conducted since 1973 have greatly clarified the taxonomic status of the Little Kern golden trout and facilitated management decisions. A summary of these studies and the results are included in Appendix II. In 1975 the population in upper Soda Spring Creek along with a second population in Deadman Creek were confirmed to be Little Kern golden trout by their genetic similarity to golden trout of the South Fork Kern River and Golden Trout Creek (Gold and Gall, 1975). Further genetic analyses have identified four other Little Kern golden trout populations, lower Wet Meadows Creek, Willow Creek (including Sheep Creek), Fish Creek and Coyote Creek (including the Crytes Lake tributary) which is a tributary to the Kern River (Smith and Gall, 1981). All other isolated populations tested are not Little Kern golden trout, being either introgressed rainbow-golden or rainbow trout (Figure 2).

PRE-PROJECT STATUS

Descriptions of the remaining populations are given below. This represents the status prior to any restoration efforts. There remained about 10.8 miles of stream habitat in the Little Kern River drainage which contained less than 5,000 Little Kern golden trout prior to any restoration. The Coyote Creek drainage where they had been introduced years ago, also

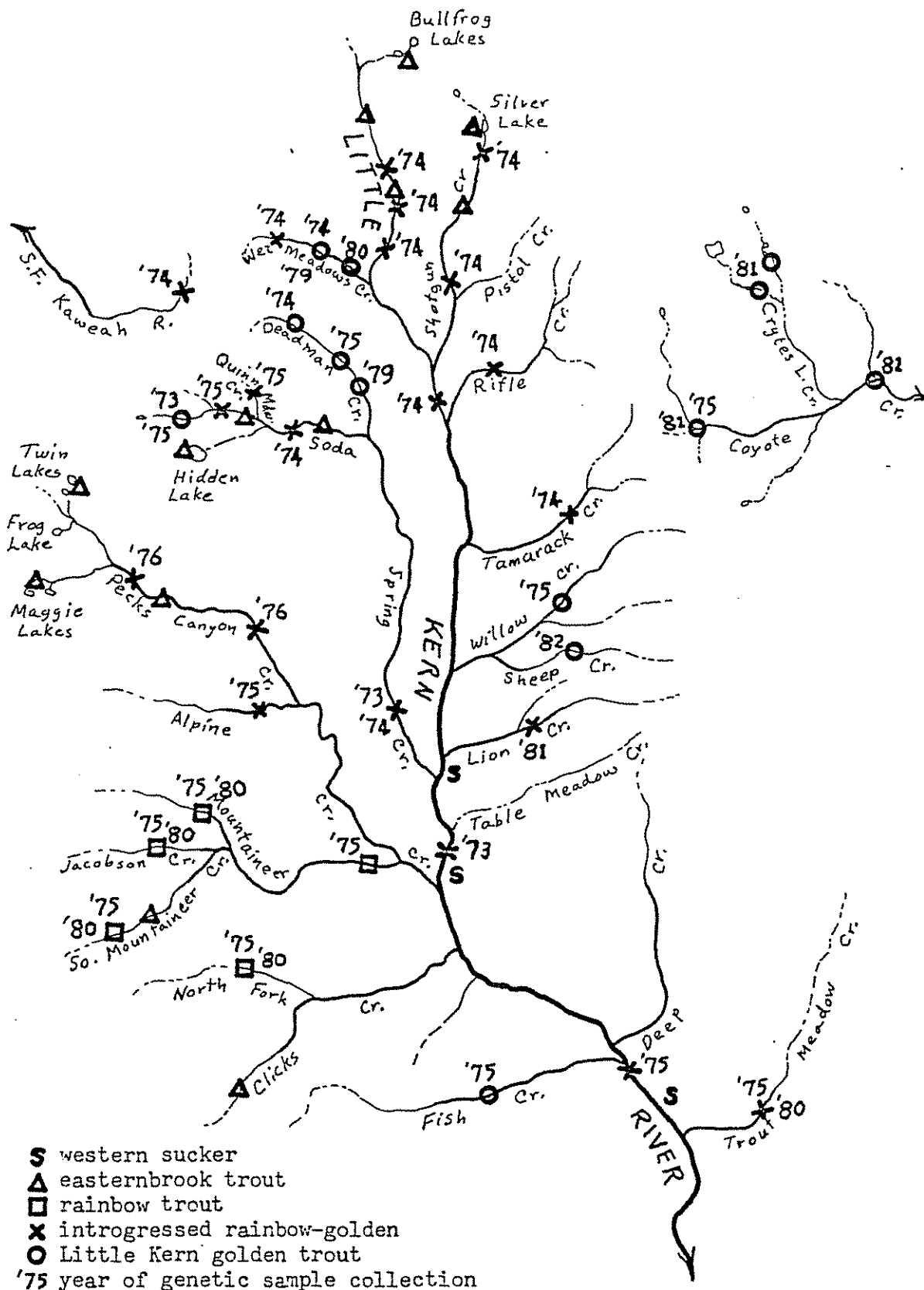


FIGURE 2 - KNOWN DISTRIBUTION OF FISH SPECIES - PRE-PROJECT

contained Little Kern golden trout. The amount of habitat restored by 1983 brings the total to 33.8 stream miles and three lakes in the Little Kern River drainage. Details of these projects are described in the Specific Action Plan section beginning on page 16.

Wet Meadows Creek Stock

Wet Meadows Creek contained Little Kern golden trout between a barrier near the mouth and the trail crossing below a rock-fall barrier about midway along the stream, a distance of 0.9 mile. This population was estimated at about 500 Little Kern golden trout. It is rather unusual because the population upstream had been determined to be introgressed rainbow-golden hybrids, yet they had not influenced the genetic characteristics of the population downstream. Possible explanation of this condition could be the apparent lack of downstream migratory tendency and the likelihood that any downstream moving rainbow-golden hybrids found fully occupied habitat with no opportunity to interbreed.

Rifle Creek Stock

Coyote Creek, a tributary to the Kern River in Sequoia National Park, was planted with Little Kern golden trout from Rifle Creek and the upper Little Kern River in the late 1800's (see Table 1). The Rifle Creek population had since been lost to introgression with rainbow trout. Most of the Coyote Creek drainage had become populated with these fish either through migration or transplanting. This population occupies approximately six miles of Coyote Creek and its tributaries and three lakes, and was estimated at about 3,000 Little Kern golden trout.

Willow Creek Stock

The entire drainage of Willow Creek upstream from the first major barrier above the mouth contained Little Kern golden trout. This population includes Sheep Creek and a small, unnamed tributary entering Willow Creek from the south above Sheep Creek. There are about 4.2 miles of habitat in these streams. A section of Willow Creek less than two miles long was estimated to have 1,294 (\pm 140) Little Kern golden trout (Smith, 1977). The entire population was probably about 2,500 since some of the stream miles not included in Smith's study are of lesser quality (i.e. steeper gradients, smaller stream size, etc.).

Soda Spring Creek Stock

The upper Soda Spring Creek population was found in about one mile of the headwaters which is isolated by a natural cascade barrier. It was estimated that there were 4,068 (\pm 2,100) Little Kern golden trout in this population (Rankel, 1976). This is most likely an overestimate since a later study indicated a population of 830 (\pm 329) (Smith, 1977). The latter appears more realistic in view of the habitat and population densities observed in recent years. This population is protected by an angling closure imposed by Sequoia National Park.

Deadman Creek Stock

The Deadman Creek population was found to occur in about 1.7 miles of stream between the trail crossing and the lowermost barrier above the mouth. This stream is a tributary to Soda Spring Creek and the Little Kern golden trout here are almost identical in genetic characteristics to those in upper Soda Spring Creek. There were about 400 Little Kern golden trout in this population (Smith, 1977, estimated 446 ± 104).

Fish Creek Stock

About three miles of Fish Creek were occupied by Little Kern golden trout. This includes the reach from the first barrier above its mouth to the gorge above the upper trail crossing. The meadow portion of this stream (about 1.5 miles) has been severely impacted by erosion. Sedimentation from this source has also detrimentally effected the section downstream. As a result, the fish population was severely reduced. In 1977, it was estimated that 1,920 Little Kern golden trout were present in Fish Creek (Smith, 1977). The stream, in its unaltered state, would have accommodated more than this number. Additionally, the time of the estimate was followed by a severe drought, continued erosion and further sedimentation reducing the population to about 50 adults by 1980. The habitat is slowly improving with the establishment of willows for streamside cover and bank stabilization. The population could be expected to reach about 300 under existing conditions. Reproduction often produces high numbers of fry but few survive to adulthood.

PROBLEMS

Hybrid Introgression

The principal cause of the decline of the Little Kern golden trout has been the introduction and establishment of rainbow trout in the Little Kern River drainage. Several decades ago, anglers believing that fish populations were declining, requested the supplementing of natural stocks with hatchery trout. As a result, the California Department of Fish and Game and individuals planted rainbow trout in many streams of the drainage. The introduced rainbows survived and interbred with the native Little Kern golden trout in almost all streams where they were planted. The result was the replacement of pure Little Kern golden trout by hybrid introgression yielding a mixed rainbow-golden which is neither rainbow trout nor Little Kern golden trout.

Brook Trout Introduction

Brook trout (Salvelinus fontinalis) have been planted in several waters within the Little Kern River drainage. Although their effect has not been

as severe nor as widespread as the rainbow trout, they are able to successfully compete with Little Kern golden trout to the detriment of the latter. This is especially true in upper Clicks Creek and in lakes where brook trout have been known to eliminate golden trout populations. In several streams where brook trout have become established, they have not completely displaced the Little Kern golden trout but apparently caused reductions in their numbers.

Illegal Introductions

Current law prohibits planting of any fish without California Department of Fish and Game permission. It is the policy of the responsible agencies to dedicate the Little Kern River drainage and Little Kern golden trout Critical Habitat to the preservation of this endemic subspecies. No other fish species beside Little Kern golden trout and native suckers will be permitted in the Little Kern River drainage. In spite of these measures, there remains the possibility of deliberate or ill-advised introductions of other species into the drainage. Attitudes of the general public, especially those who visit the area, present the greatest problem. Lack of understanding of the importance of preserving the Little Kern golden trout and its habitat and lack of cooperation with the restoration program will cause continued threat to this subspecies. Proximity of rainbow trout populations, other fish species and ease of access to Little Kern golden trout streams can also influence the likelihood of illegal fish introductions.

Habitat Deterioration

Stream habitat alteration, erosion, sedimentation and streamside vegetation damage can cause reductions in Little Kern golden trout populations by influencing cover, food production and spawning areas required by individual fish. Stream carried particles can result in gill tissue damage and direct mortality of trout. Activities which disturb soils and vegetation within the Little Kern River watershed can contribute to stream habitat deterioration. Fish Creek is an extreme example of habitat damage. Similar problems are evident or developing in other parts of the drainage such as Lion Meadow, Grey Meadow and Clicks Creek.

Overharvest of Little Kern Golden Trout

Native trout stocks allegedly depleted by angling was the justification for introducing rainbow trout and other species in the 1930's and 1940's. Localized heavy recreational use can still reduce Little Kern golden trout populations to the point where fishing success is low. Motorized vehicle access resulted in heavy concentrations of recreational use prior to wilderness designation in 1978. Even since that time, the attractive aspects of wilderness designation have resulted in localized heavy recreational use. Little Kern golden trout populations may have unusually limited reproductive rates (Smith, 1977) and individuals can be easily caught, making them vulnerable to overharvest. Restored populations rebuilding following transplanting of Little Kern golden trout are especially sensitive to angling pressure since the initial numbers planted is usually very limited.

MANAGEMENT PLAN

Objectives

The principal objective is to provide a program for restoring the Little Kern golden trout to a level where the subspecies can be delisted from Threatened status. This will ensure their continued existence for aesthetic, recreational, scientific and educational values. Toward this end, each remnant population is to be protected, maintained and enhanced and additional stream sections populated with representatives of each stock.

Further objectives are to remove all non-Little Kern golden trout fish species except native suckers, restore damaged Critical Habitat and to protect Little Kern golden trout populations from genetic contamination, competition from non-native fish species, habitat deterioration and excessive angler harvest. To achieve these objectives, the responsible agencies will cooperate in implementing a program for the conservation of this subspecies.

Plan Description

1. Public information - It is necessary to provide information on the purposes and activities of the plan in order to promote the understanding of the resource of the area and help to achieve cooperation with this program. It is the key factor in the discouragement of illegal introduction of species other than Little Kern golden trout into the Critical Habitat area.
2. Restoration and maintenance of Little Kern golden trout populations - Representative samples from each of the remaining Little Kern golden trout populations (including any identified in the future) will be established and maintained in a number of isolated stream sections and lakes within the Critical Habitat. The aggregate of the separate stocks and combinations will be restored to all other suitable waters within the Critical Habitat. Restoration may include pre-treatment surveys, barrier alteration or construction if needed, salvage of non-Little Kern golden trout populations if practical, chemical treatment, to remove all hybrid or exotic trout, retreatment if necessary and transplanting of Little Kern golden trout to rehabilitated habitats. Fish salvage preceding treatments will be conducted providing there are sufficient fish to justify a salvage, pack stock for moving the fish can reach the stream, and there is a suitable place to stock the salvaged trout. The decision as to whether or not to salvage trout will be made in each individual treatment plan. All established populations will be periodically inventoried to monitor recovery and detect reductions in population.
3. Habitat protection - Habitat restoration plans will be developed and implemented to correct known problems. Protection measures may include surveys to detect problems, periodic resource monitoring to evaluate changes in habitat conditions, evaluation of land use and developments for their impact on the habitat and private land acquisition if necessary to ensure habitat protection and management.

4. Protect Little Kern golden trout populations from introduction of rainbow trout or other non-Little Kern golden trout fish species - Public information and cooperation will be emphasized to prevent illegal fish planting. Existing laws and regulations will be enforced. Other measures may be taken if necessary to reduce the likelihood of illegal introductions.
5. Protect the Little Kern golden trout populations from overharvest - Public education concerning the effects of overharvest and promoting dispersed angler use is the preferred method. Other measures may also be taken if necessary.
6. Preservation of native western sucker populations.
7. Other activities to increase knowledge of Little Kern golden trout and their habitat and improve their recovery and management.

Specific Action Plan

Activities proposed to accomplish the objectives of this Management Plan are outlined below. Included under each activity is the progress toward completion as of 1983 which will provide a status report on the Management Plan. Annual reports will provide information on the future progress toward the management goals. Proposed activities are those foreseen at this time and are subject to change as more information and experience is gained. Location of activities are depicted on Figure 3. The use of helicopters may be necessary for wilderness access during periods when other forms of transport are impossible or when required for the safety and welfare of Little Kern golden trout populations or individuals. Each request for such use will be considered by the appropriate managing agency.

1. Public Information

- a. Prepare and implement a public notification plan to inform the public of the purpose, progress and status of the Management Plan and notify them of current activities. A plan was prepared in 1981 and is to be implemented each year of management activity. A copy of the plan is presented in Appendix III.
- b. The responsible agencies will coordinate their activities on a yearly basis.
- c. Every opportunity will be taken to discuss the Management Plan with groups or individuals through meetings, letters, phone calls and personal contact. Consideration will be given to the preparation of a film or other audio visual aids to promote understanding of the Plan.
- d. Annual activity reports will be prepared to document Management Plan progress.

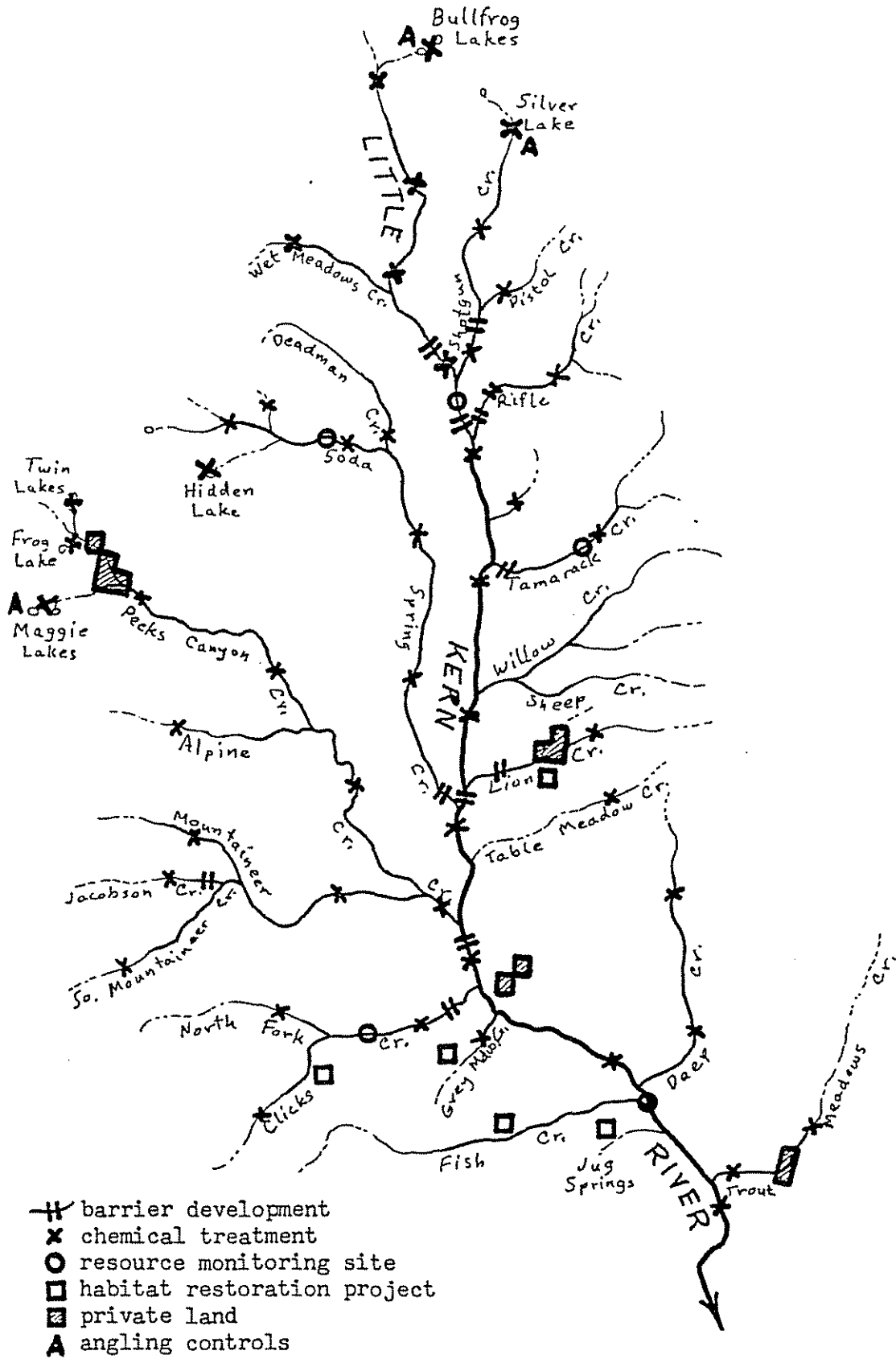


FIGURE 3 - LITTLE KERN GOLDEN TROUT MANAGEMENT PLAN ACTIVITIES

2. Restoration and Maintenance of Little Kern Golden Trout Populations

- a. Barrier construction - Alter streambed or construct barriers to prevent upstream fish migration to isolate Little Kern golden trout fish stocks and facilitate restoration. Barriers have been constructed as follows: 1970 - on Soda Spring Creek about $\frac{1}{4}$ mile above its mouth; 1980 - on Shotgun Creek about $\frac{1}{4}$ mile above its mouth; on Rifle Creek at its mouth and 150 yards upstream; on Tamarack Creek near its mouth and on Lion Creek about $\frac{1}{4}$ mile above its mouth; and 1982 - on the Little Kern River just above Rifle Creek. Additional barriers have been proposed for the Little Kern River above Shotgun Creek, above Soda Spring Creek and below Table Meadow Creek, Clicks Creek near its mouth, and Jacobson Creek near its mouth. Other barriers may be necessary depending on restoration and management needs. Barrier construction will be approved by the cooperating agencies after ground review and analysis of needs and benefits. Barrier construction will preferably be done in bedrock to avoid maintenance and visual obtrusions in keeping with wilderness aesthetics.
- b. Periodic inventories of Little Kern golden trout populations - To determine status, detect reduction in numbers and monitor recovery of restored population. A Little Kern Golden Trout Standard Population Inventory Method was developed in 1980. A summary of the inventory procedure is presented in Appendix IV. Each endemic stock will be inventoried each year during the implementation of this plan and restored populations will be inventoried annually until fully recovered and as frequently as necessary thereafter. Recovery will be considered complete when post-treatment indices approximate those of pre-treatment.
- c. Restoration of Wet Meadows Creek stock - This stock is designated for Wet Meadows Creek, the upper Little Kern River and Bullfrog Lakes. Upper and lower Bullfrog Lakes were treated with antimycin in 1975, evaluated in 1976 and 1980 verifying success. Lower Bullfrog Lake was stocked with Little Kern golden trout from Wet Meadows Creek in 1980 and 1981. Both lakes will continue to be planted on a maintenance basis. Attempts to improve spawning conditions may be made to achieve a self-sustaining Little Kern golden trout fishery.

Upper Wet Meadows Creek was treated with rotenone and antimycin in 1979. Rainbow-golden hybrids were salvaged prior to treatment and transplanted to the Little Kern River. The chemicals were detoxified above the pure population. The treatment was spot checked with rotenone in 1980 and determined to be successful. It was then planted with Little Kern golden trout from lower Wet Meadows Creek. It was again evaluated in 1981 and planted with additional Little Kern golden trout from downstream. Additional transplants may be needed to fully restore the stream section.

Little Kern River upstream from the barrier below Broder Cabin site was treated with rotenone and antimycin in 1975 and restocked with Little Kern golden trout from Soda Spring Creek and Deadman Creek. The survival of rainbow-golden hybrids and brook trout required retreatment in 1976. Some of the Little Kern golden trout were salvaged and restocked following the treatment along with additional Little Kern golden trout from Soda Spring Creek. The presence of brook trout in 1980 required another treatment. In 1980 and 1981 Little Kern golden trout were salvaged and planted in Silver Lake prior to treatment with rotenone in 1981. The toxicity of this treatment dissipated at the lower end of the section. To ensure complete success, the stream was treated again with rotenone and antimycin in 1982. The chemical was detoxified at the lower end of the section and the treatment was determined to be successful. Little Kern golden trout were then restocked from Wet Meadows Creek in 1982 and 1983. Restoration will continue downstream to a point above Shotgun Creek. Transplanting will continue until fully restored. Barrier construction may be needed to isolate these populations.

- d. Restoration of Rifle Creek stock - This stock is designated for Rifle Creek, Shotgun Creek, Pistol Creek and Silver Lake. Silver Lake and a $\frac{1}{4}$ mile section of Shotgun Creek below the lake were treated with antimycin in 1974. Evaluations in 1975 indicated success of the treatment. Little Kern golden trout were transplanted from Soda Spring Creek in 1976 and from the upper Little Kern River salvage in 1980 and 1981. After this population is diminished by angling, the balance will be gillnetted or treated if necessary prior to replanting with Little Kern golden trout from Coyote Creek or Rifle Creek. The lake may require maintenance stocking to provide an adequate fishery. Attempts to improve spawning conditions may help to achieve a self-sustaining fishery.

Pistol Creek was spot checked with rotenone in 1982 and found to be barren of fish life. It will be stocked with Little Kern golden trout from Coyote Creek or Rifle Creek to determine if a population can become established.

Rifle Creek was chemically treated in 1983 and restocked with Little Kern golden trout from Coyote Creek. Rainbow-golden hybrids were salvaged and transplanted to the Little Kern River prior to treatment. Transplanting will continue until fully restored.

Shotgun Creek will be chemically treated and restocked with Little Kern golden trout from Coyote Creek, Rifle Creek, Silver Lake or Pistol Creek. Rainbow-golden hybrids may be salvaged from portions of the stream for transplant prior to treatment. A small portion of upper Shotgun Creek was included in the 1974 treatment of Silver Lake.

- e. Restoration of Willow Creek stock - This stock includes the Sheep Creek population and is designated for the Willow Creek drainage, Tamarack Creek, Lion Creek and Table Meadow Creek. Tamarack Creek was treated with rotenone and antimycin in 1979. Rainbow-golden hybrids were salvaged prior to treatment and transplanted to the Little Kern River. Little Kern golden trout were transplanted from Willow Creek following treatment. Evaluation in 1980 yielded some unmarked trout in the lower section so a partial retreatment was done. Evaluation indicated success in 1980 so additional Little Kern golden trout were transplanted from Willow Creek in 1980, 1981, 1982 and 1983. Transplanting will continue until fully restored.

Lion Creek was treated with rotenone and antimycin in 1981. Rainbow-golden hybrids were salvaged and transplanted to the Little Kern River prior to treatment. Detoxification was attempted at the barrier $\frac{1}{2}$ mile above the mouth with little success. The stream was spot checked with rotenone and the treatment was determined to be successful. Little Kern golden trout were transplanted from Willow Creek and Sheep Creek in 1981, 1982 and 1983. Transplanting from Sheep Creek will continue until fully restored.

Table Meadow Creek was spot checked with rotenone in 1982 and found to be barren. It was stocked with Little Kern golden trout from Sheep Creek the same year. Additional stocking will be done from Sheep Creek to determine if a population can become established.

- f. Restoration of Soda Spring Creek stock - This stock includes the Deadman Creek population and is designated for the Soda Spring Creek drainage and Mountaineer Creek drainage. About 1 mile of middle Soda Spring Creek below the barrier isolating the pure population was treated with antimycin in 1979. Included in the treatment was Hidden Lake, Hidden Lake Creek and Quinn Meadow Creek. The treatment was evaluated by spot treatment in 1980 and a few unmarked trout were found so a portion of the stream was retreated with rotenone. An additional stream section was treated in 1981. Rainbow-golden hybrids were salvaged and transplanted each year. Little Kern golden trout were transplanted to middle Soda Spring Creek in 1980 from the rehabilitated section of Shotgun Creek immediately below Silver Lake and from upper Soda Spring Creek in 1980, 1981 and 1982. Quinn Meadow Creek was planted with Little Kern golden trout from upper Soda Spring Creek in 1983. Unmarked trout were found in a portion of Soda Spring Creek in 1982 and 1983 so additional retreatments may be required to ensure success. Transplants will continue until fully recovered.

Upper Alpine Creek and upper Mountaineer Creek will be chemically treated and planted with Little Kern golden trout from upper Soda Spring Creek.

Lower Deadman Creek was chemically treated with antimycin in 1974 and with rotenone in 1981. The stream is being repopulated by Little Kern golden trout moving downstream from upper Deadman Creek.

Jacobson Creek was chemically treated with rotenone in 1982. Later, some rainbow trout and fry were found so retreatment was necessary. Little Kern golden trout were transplanted from Deadman Creek in 1982. Unmarked trout were found in 1983, making retreatment necessary. Following successful treatment, transplanting will be done from Deadman Creek to fully restore the population.

Other chemical treatments will be done on South Mountaineer Creek, upper, middle and lower Maggie Lakes, Frog Lake, north and south Twin Lakes, Maggie Lake Creek and Pecks Canyon Creek. All will be planted with Little Kern golden trout from Deadman Creek.

Chemical treatments will be done on the lower portion of the Soda Spring Creek drainage (below Deadman Creek), lower Alpine Creek drainage and lower Mountaineer Creek drainage. All these streams will be planted with Little Kern golden trout from upper Soda Spring Creek and Deadman Creek combined.

- g. Restoration of Fish Creek stock - This stock is designated for Fish Creek, Clicks Creek drainage, Trout Meadow Creek and Deep Creek. Deep Creek was chemically treated with rotenone in 1980. Rainbow-golden hybrids were salvaged and transplanted to the Little Kern River prior to treatment. The stream was spot treated in 1980 and 1981 and the treatment was confirmed to be successful. Little Kern golden trout were transplanted from Fish Creek in 1980 and 1981. The population was extended upstream in 1982 by transplanting Little Kern golden trout from the restored population. Additional transplanting may be necessary to achieve full recovery.

Upper Fish Creek was surveyed in 1981 and found to be barren. Little Kern golden trout were transplanted from the populated section downstream in 1982. Additional transplants may be needed to determine if a self-sustaining population can be achieved.

The North Fork Clicks Creek was chemically treated with rotenone in 1982. Rainbow trout were salvaged and transplanted to upper Little Poso Creek (Kern County) prior to treatment. The stream was spot treated in 1982 and the treatment found to be successful. Unmarked trout were found in 1983 making retreatment necessary. Transplanting of Little Kern golden trout from Fish Creek will be done until the population is fully restored.

- h. Restoration of the balance of the Little Kern River drainage - This section includes the Little Kern River below the portion designated for Wet Meadows Creek Little Kern golden trout stock, the lowermost sections of all other Creeks restored to all other Little Kern golden trout stocks, Grey Meadow Creek and all other minor tributaries not included above. The restoration will extend to a barrier about one mile downstream from the mouth of Trout Meadows Creek. Salvage and transplanting of rainbow-golden hybrids may be done prior to treatments. The stream sections will be chemically treated, spot treated to determine success, retreated if necessary and restocked with Little Kern golden trout from tributary sources upstream until fully restored.
- 3. Protection and Restoration of Habitat
 - a. Conduct periodic surveys to detect changes in stream habitat, streamside vegetation, watershed conditions and land uses and developments within the Critical Habitat which may be harmful to the Little Kern golden trout populations.
 - b. Restore damaged habitat through streambank stabilization and raising the water tables in eroded portions of Fish Creek, Lion Creek, Grey Meadow Creek, Coffin Meadow, Round Meadow, Jug Spring, Clicks Creek and other locations as needed and feasible. This can be done through development and implementation of comprehensive restoration plans for each problem area. Restoration work at Fish Creek included placement of rock rip-rap on sections of bank being eroded away and planting of willow slips in 1975, placing log deflectors, log check dams, planting willow slips and planting jeffrey pine seedlings in 1977, headcut stabilization and debris removal in 1979 and willow slip planting in 1980 and 1982. Much of this work was not effective because of high water flow and further erosion, however, many willow slips have become established and are helping stabilize streambanks and provide cover for fish. Meadow erosion control in upper Fish and Clicks Creek was done in 1983. Further work will be done to restore these and other damaged habitats. Other techniques may be developed and implemented to solve habitat problems, such as fencing streambank areas.
 - c. Conduct resource monitoring programs to detect changes in stream ecosystems which could be harmful to Little Kern golden trout populations. Five representative sites were chosen in 1974 and initial surveys began. The five 100-meter sites are: Little Kern River above Rifle Creek, middle Tamarack Creek, middle Soda Spring Creek (below Sequoia National Park boundary), lower Clicks Creek and Little Kern River above the horse bridge. At each site, samples were taken of the following parameters: visual appearance (photographed), water temperature, stream width, stream gradient, streambed

substrate, streamflow, sediments, water chemistry - mineral constituents, nutrients, hydrogen ion concentration, dissolved oxygen, alkalinity, hardness and turbidity, bacteria, aquatic invertebrates and fish population. A description of this monitoring program is presented in Appendix V. The sampling was done a second time in 1978 and 1979. This will be repeated on a five-year frequency during the period of the Recovery Activities. Changes or additions to the site locations, numbers and frequency may be made if necessary.

- d. Private lands within the Critical Habitat should be acquired if they become available or if activities on those sites create threats to the Little Kern golden trout populations.
4. Further Protect Little Kern golden trout Populations from Illegal Introduction of non-Little Kern golden trout Fish Species

The following measures, listed in order of priority, may be implemented if determined to be necessary after discussion and agreement of the cooperating agencies.

- a. Public education will stress the effects on the native Little Kern golden trout, loss of genetic integrity, competition, waste of past restoration efforts and cost of correcting problems created by illegal transplants. This approach will be integrated with Specific Action Plan, item one (page 20).
 - b. Access reduction to make illegal introduction more difficult. This may include limiting vehicle access for authorized or emergency purposes or road closures.
 - c. Provide a protective buffer zone by conversion to Little Kern golden trout of immediately adjacent fish populations outside the Critical Habitat. This may be done if approved by the cooperating agencies and it is determined that there is a definite threat to the Little Kern golden trout populations within the Critical Habitat.
5. Further protect Little Kern golden trout populations from overharvest, if necessary, by implementing the following measures after discussion and agreement of the cooperating agencies, listed in order of priority.
 - a. Public education to achieve dispersal of angler use stressing the vulnerability of the Little Kern golden trout and their limited reproduction. This will be done in conjunction with Specific Action item one.
 - b. Voluntary reduced bag limits to protect lake populations.

- c. Reduction of bag limits or imposing size limits.
- d. Stream closure to angling.
- e. Change wilderness entry quotas.
- f. Reduce use in impacted areas by rerouting trails or prohibiting camping.
- g. Control vehicular access.

A sign was prepared in 1982 for posting at Bullfrog Lakes which requests anglers to return Little Kern golden trout taken from the lakes so that the limited fish population will not be reduced. A similar sign will be placed at Silver Lake after restocking with Rifle Creek stock of Little Kern golden trout. Similar measures may be needed at other locations if angling pressures exceed the ability of the Little Kern golden trout populations to support good fishing.

- 6. Maintenance of native sucker populations - This species will be salvaged from populations in the Little Kern River drainage where they now occur and will be restocked in those same habitats following chemical treatments.
- 7. Other activities to increase knowledge of the Little Kern golden trout and its habitats and to improve the protection and management of the subspecies. Little Kern golden trout population and habitat surveys (Evermann, 1904; Dill, 1940, 1945; Christenson, 1965-1968; Evans, Smith and Bell, 1973), genetic research at U.C. Davis (Gall, Gold, Smith, Bannon and Bentley, 1973-1982), reproductive biology and behavior studies (Smith, 1977), artificial propagation experiments (Stephens and Marshall, 1982), migration studies (Konno, 1982) and fecundity studies (Babcock, 1982) have all increased the understanding of the Little Kern golden trout resource. Further studies of the biology and ecology of the Little Kern golden trout will be done as needs are determined and funds are available. Efforts to artificially propagate Little Kern golden trout will be continued so that restoration rates can be increased. Monitoring of genetic purity of restored stocks will be done to ensure that the objectives of the plan are achieved.

APPENDIX

- I References
- II Summary of Genetic Studies at U.C. Davis
- III Public Notification Plan
- IV Standard Population Inventory Method
- V Resource Monitoring Program

APPENDIX I
REFERENCES

- Babcock, Jennifer L. 1982. Little Kern Golden Trout Fecundity, California State University - Fresno, Masters Degree project in progress.
- Christenson, Daniel P. 1965. Little Kern River, Tulare County, Stream and Lake Survey, California Department of Fish and Game, Report to Region 4 Files. 3 pp.
- Christenson, Daniel P. 1966. Little Kern River Drainage, Tulare County, Golden Trout Survey, California Department of Fish and Game, Region 4 Monthly Report, June, 1966. p. 1.
- Christenson, Daniel P. 1968. Rare and Endangered Species Program, California Department of Fish and Game, Region 4 Monthly Report, June, 1968. p. 3.
- Christenson, Daniel P. 1978. A Fishery Management Plan for the Little Kern Golden Trout, California Department of Fish and Game, Inland Fisheries Endangered Species Program Special Publication 78-1, 14 pp.
- Dill, William A. 1941. The Little Kern River Drainage, Tulare County, Progress Report No. 1., California Division of Fish and Game, 12 pp.
- Dill, William A. 1945. The Little Kern River Drainage, Tulare County, Progress Report No. 2, California Division of Fish and Game, 19 pp.
- Evans, Willis A., Randolph Smith and Margaret Bell. 1973. A Reconnaissance Survey of the Fish Resources of the Little Kern River Drainage, California, California Department of Fish and Game and USDA Forest Service, Region 5, 40 pp.
- Evermann, Barton W. 1906. The Golden Trout of the Southern High Sierras, Bulletin of the Bureau of Fisheries, Vol. XXV, 1905-1, p. 1-51.
- Fisk, Leonard O. 1971. Status of Certain Depleted Inland Fishes, California Department of Fish and Game, Inland Fisheries Administrative Report No. 72-1, 13 pp.
- Gall, Graham A.E. Michael Bannon, Randolph C. Smith and Boyd Bentley. 1982. Progress Report, California Native Trout of the Rainbow Series, University of California, Davis, Department of Animal Science, 9 pp.
- Gold, John R. and Graham A.E. Gall. 1975. Further Record of Little Kern Golden Trout, Salmo aguabonita whitei, in the Little Kern River Drainage, California, California Fish and Game Vol. 64, No. 4, p. 248-250.
- Konno, Eddy S. 1982. Little Kern Golden Trout Migration Patterns, California State University - Fresno, Masters Degree project in progress.

- Rankel, Gary L. 1976. Studies Conducted on the Golden Trout (Salmo aguabonita) Population in Upper Soda Spring Creek, Sequoia National Park on August 13 and 19, 1976. USDI Fish and Wildlife Service, Reno, Nevada. 4 pp.
- Schreck, Carl B. 1969. Trouts of the Upper Kern River Basin, California. Colorado Cooperative Fishery Unit, Colorado State University. 120 pp.
- Smith, James R. 1977. Aspects of the Reproductive Biology and Behavior of the Little Kern Golden Trout. California State University - Fresno. Department of Biology. 151 pp.
- Smith, Randolph C. and Graham A.E. Gall. 1981. Biochemical - Genetic and Meristic Analysis of Populations of Little Kern River Basin Golden Trout. University of California - Davis, Fisheries Research Biology Facility, 65 pp.
- Stephens, Stanley J. and Laird E. Marshall. 1982. Artificial Propagation of Little Kern Golden Trout in a Hatchery. California Department of Fish and Game - Report to Region 4 Files. 4 pp.

APPENDIX II
LITTLE KERN GOLDEN TROUT
Summary of Genetic Studies at UC Davis

Year	Sample Location	Approximate Mid-Sample Elevation	Sample Size	Genetic Determination
1973	Little Kern River above Mountaineer Creek	6,200	25	RTxGT
1973	Soda Spring Creek at lower trail crossing	6,400	25	RTxGT
1973	Soda Spring Creek above upper barrier	8,800	33	GT-LK
1974	Little Kern River above Broder Cabin site	9,000	37	RTxGT
1974	Little Kern River above upper trail crossing	8,600	39	RTxGT
1974	Soda Spring Creek below SNP boundary	7,800	39	RTxGT
1974	Little Kern River above Rifle Creek	7,200	41	RTxGT
1974	Tamarack Creek 1 mile above main trail crossing	7,800	40	RTxGT
1974*	Soda Spring Creek at lower trail crossing	6,400	31	RTxGT
1974	Kaweah River, SF at Green Meadow	9,400	36	RTxGT
1974	Wet Meadows Creek above trail crossing	9,000	38	RTxGT
1974	Wet Meadows Creek below trail crossing	8,800	35	GT-LK
1974	Deadman Creek below trail crossing	8,400	26	GT-LK
1974	Shotgun Creek below Silver Lake	9,800	34	RTxGT
1974	Little Kern River above Wet Meadows Creek	8,200	33	RTxGT
1974	Rifle Creek at main trail crossing	7,400	35	RTxGT
1974	Shotgun Creek above Pistol Creek	7,800	31	RTxGT
1975	Fish Creek below upper trail crossing	6,200	40	GT-LK
1975	South Mountaineer Creek above Jacobson Creek	7,200	40	"unique"
1975	Clicks Creek, NF 1 mile above mouth	7,400	40	"unique"
1975	Little Kern River above horse bridge	5,800	34	RTxGT
1975	Trout Meadows Creek below guard station	6,000	36	RTxGT
1975	Jacobson Creek ½ mile above mouth	7,200	33	"unique"
1975	Mountaineer Creek 1 mile above mouth	6,400	44	"unique"
1975	Mountaineer Creek above South Mountaineer Creek	7,200	38	"unique"
1975	Alpine Creek above Pecks Canyon Creek	7,200	39	RTxGT
1975	Willow Creek below trail crossing	7,000	38	GT-LK
1975	Deadman Creek 1 mile below trail crossing	8,000	34	GT-LK
1975	Quinn Meadow Creek below guard station	8,200	25	RTxGT
1975*	Soda Spring Creek above upper barrier	8,800	25	GT-LK
1975	Soda Spring Creek below upper barrier	8,400	24	RTxGT
1975	Coyote Creek at upper trail crossing	9,400	40	GT-LK
1976	Pecks Canyon Creek 2 miles above mouth	8,200	32	RTxGT
1976	Pecks Canyon Creek at Maggie Lake Creek	8,600	31	RTxGT
1979	Deadman Creek 1 mile above mouth	7,600	14	GT-LK
1979*	Wet Meadows Creek below trail crossing	8,800	21	GT-LK
1980*	Mountaineer Creek above South Mountaineer Creek	7,200	22	RT
1980*	Jacobson Creek above mouth	7,200	20	RT
1980*	South Mountaineer Creek above Jacobson Creek	7,200	11	RT
1980*	Clicks Creek, NF 1 mile above mouth	7,400	13	RT
1980	Wet Meadows Creek ¼ mile above mouth	8,200	24	GT-LK
1980	Little Kern River above Broder Cabin site	9,000	16	GT-LK
1980*	Trout Meadows Creek below guard station	6,000	13	RTxGT
1981	Lion Creek at Lion Meadow	7,000	27	RTxGT
1981	Coyote Creek below lower trail crossing	7,600	29	GT-LK
1981	Crytes Lake Creek, E&W branches above barrier	10,800	17	GT-LK
1981*	Coyote Creek at upper trail crossing	9,400	18	GT-LK
1982	Sheep Creek ¼ mile above trail crossing	7,200	23	GT-LK

*repeat sample

APPENDIX III
CALIFORNIA DEPARTMENT OF FISH AND GAME
SEQUOIA NATIONAL FOREST
SEQUOIA NATIONAL PARK

Little Kern Golden Trout Management
Public Notification Plan
(1981)

- I. Golden Trout Wilderness Area Users Leaflet - Describe GT-LK status, background, and problems. Outline management goals and proposed activities for the coming season. Suggest avoidance of fishing in rehabilitated waters and treated section (after proposed treatment date, alternate waters for fishing). Caution concerning use of treated waters.
 - a. Sequoia National Forest (SNF) submit draft to California Department of Fish and Game (CFG) and Sequoia National Park (SNP) by April 1.
 - b. CFG and SNP submit comments to SNF by April 15.
 - c. SNF publish and distribute to all concerned agencies by May 1.
CFG - 100 copies, SNP - 2,000 copies.

- II. Pre-season Press Release - Describe the status of GT-LK populations, management goals, progress toward goals and activities proposed for the coming season.
 - a. CFG submit draft to SNF and SNP by May 1.
 - b. SNF and SNP submit comments to CFG by May 15.
 - c. CFG issue release to news media and the contact list of organizations and individuals by June 1.

- III. Public Notification of Chemical Treatments - Provide advance information on proposed treatments giving the schedule of activities, background information, and precautions to area users.
 - a. CFG submit draft to SNF and SNP at least three weeks prior to any chemical treatment (including spot checks).
 - b. SNF and SNP will reply within five working days time to indicate nonconcurrence and suggest changes in wording.
 - c. CFG will incorporate any changes required to satisfy SNF and SNP concern and issue notice to local news media and contact list no later than two weeks prior to the chemical treatment.

- IV. Internal Agency Notification - Each agency, CFG, SNF, SNP, will be responsible for distribution of information within their own organization as they deem necessary.

APPENDIX IV
LITTLE KERN GOLDEN TROUT
STANDARD POPULATION INVENTORY METHOD
(Stephens and Christenson, 1980)

A standardized method for assessing trout populations in streams was needed to determine their general condition and detect changes in fish sizes and numbers. Electrofishing, though very precise, is not practical for sampling a large number of streams with a limited expenditure of time. A rapid method for evaluating populations was developed by Stan Stephens and Dan Christenson in 1980 and has been used to monitor GT-LK populations for their ability to serve as donors for rehabilitated habitats and to determine recovery rates of restored populations. This method involves subjective observation and a certain degree of flyfishing skill, therefore, comparable results require that experienced individuals conduct the surveys, preferably the same persons. A description of the method follows.

1. A designated stream section is walked by an individual moving upstream and each site (usually a pool) where one would expect to see trout is noted.
2. The approximate length (in centimeters) of each fish seen is recorded for a site. If none are seen, a zero is recorded.
3. The site is then fished with barbless fly and the approximate size of any fish that strikes at the fly is recorded. Those that are known or expected to be the same fish as one previously seen are circled on the data sheet to indicate a duplication. If none strike, a zero is recorded. (A hookless fly may be used to reduce stress to the fish and eliminate step #4).
4. The approximate size of any fish caught is also recorded. As in step #3, those that are known or expected to be the same fish as either seen or struck are circled on the data sheet to indicate duplication. Caught fish can be used for closer examination (e.g. species determination, presence of identifying marks, measurement, weighing, etc.) or collected for transplanting or other purposes.
5. The survey is continued until 50 sites have been observed or the end of the designated section is reached.
6. Less than ideal water conditions, lighting, visibility, etc., can influence the results and should be noted.

A relative index of abundance is then calculated by adding the number of fish seen, strikes and caught, subtracting the duplications and dividing by the total number of sites observed. For example, if there were 15 fish seen, 7 strikes with 3 duplicates, 6 caught with 4 duplicates in 13 sites, the index would then be:

$$\frac{15 + 7 - 3 + 6 - 4}{13} = \frac{21}{13} \text{ or } 1.62$$

The data may also be used to determine a rough mean size and length frequency distribution (lengths are estimates only).

APPENDIX V
LITTLE KERN RIVER DRAINAGE
RESOURCE MONITORING PROGRAM

This program has been established to help evaluate habitat conditions in the Little Kern River drainage and detect any changes that may be occurring which could be detrimental to the Little Kern golden trout. Initial sampling to establish base line data was done in 1974. It is proposed that sampling be repeated on a five-year frequency unless conditions indicate greater or shorter periods are needed. The five sites selected for monitoring are listed below. The number and location of these sites may be changed depending on the need for this information.

- Site 1 - Little Kern River - above Rifle Creek
- Site 2 - Tamarack Creek - middle section
- Site 3 - Soda Spring Creek - below Sequoia National Park boundary
- Site 4 - Clicks Creek - lower section
- Site 5 - Little Kern River - above the horse bridge

At each site, a 100-meter section of stream has been delineated and identified by description and photographs. A series of samples is collected during the normal low flow period which will document environmental conditions for the site. Comparison of data from one sampling period to another will indicate whether changes may have taken place. These changes can be evaluated to determine if a threat to the golden trout exists. If so, the source of the problem can be investigated and corrective measures recommended and taken. The following parameters can be included in the sampling program:

1. Physical conditions
 - a. location description
 - b. photographic description
 - c. stream width
 - d. stream gradient
 - e. streambed substrate type
 - f. streamflow
 - g. sediments
2. Water quality
 - a. mineral constituents
 - b. nutrients
 - c. hydrogen ion concentration
 - d. dissolved oxygen
 - e. alkalinity
 - f. hardness
 - g. turbidity
 - h. temperature
3. Biological characteristics
 - a. bacteria
 - b. aquatic invertebrates
 - c. fish population

A specific schedule of sample collection is necessary for obtaining valid, comparable undisturbed data for some of the factors. Of first importance is locating the exact same 100-meter section and ensuring that the transect line follows the same course along the stream. The first collections should be the aquatic invertebrates samples. There are 20 randomly selected sites, one in each 5-meter segment of the transect. These should be collected beginning with the downstream end and working upstream so each will not be subjected to disturbance from above. As this is being done, water quality samples can be taken just upstream from the upper limit of the transect to ensure that those samples are undisturbed. If available, a thermograph should also be

installed upstream from the transect early in the period to obtain as much temperature data as possible. The thermograph should be calibrated occasionally during the period with a thermometer. Occasional air temperatures should be taken as well. Bacterial samples can be collected with the water quality sampling. Photographs of significant features and general appearance can be taken at anytime.

Before the end of the first day but after completion of the aquatic invertebrate sampling, the section must be electrofished to collect a fish sample. Collection should always begin at the lower end of the transect and proceed upstream. Each fish should be marked, measured and released alive approximately where taken. The second electrofishing sample must be collected on the following day. Marked and unmarked fish collected are then measured and released back into the stream. All other samples must also be collected after the aquatic invertebrate sampling. Ten sediment sample sites have been randomly selected, one in each ten-meter segment of the transect, where one liter samples of stream bottom material are collected. Stones over one inch in diameter are removed and the balance washed through standard sieves to separate gravel, coarse sand, fine sand and silt. These components are measured volumetrically and percentage composition determined. Stream width, gradient and substrate data is recorded at each meter of the transect. One streamflow determination is necessary, and should be done at a suitable site using a standard flow meter method.