

**PRELIMINARY DRAFT
SUBJECT TO REVISION**

Dept of Fish and Game

JAN 31 1995

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

IFD-National Library

**MANZANITA LAKE (LASSEN VOLCANIC NATIONAL PARK)
FISHERIES MANAGEMENT PLAN**



by

John M. Deinstadt
Inland Fisheries Division

Glenn F. Sibbald
Inland Fisheries Division

and

Al Denniston
Lassen Volcanic National Park

January 1995

**LASSEN VOLCANIC NATIONAL PARK
Research Library**

Deinstadt
(Manzanita Lake)

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

MANZANITA LAKE (LASSEN VOLCANIC NATIONAL PARK)
FISHERIES MANAGEMENT PLAN



by

John M. Deinstadt
Inland Fisheries Division

Glenn F. Sibbald
Inland Fisheries Division

and

Al Denniston
Lassen Volcanic National Park

January 1995

TABLE OF CONTENTS

Page

INTRODUCTION - - - - -	
RESOURCE STATUS - - - - -	
Description of Manzanita Lake - - - - -	
Location and Access - - - - -	
Physical Characteristics - - - - -	
Limnological Characteristics - - - - -	
Description of the Fishery - - - - -	
Early History - - - - -	
Past Management Studies and Programs - - - - -	
Early Stocking Programs - - - - -	
Wallis' 1954 Assessment - - - - -	
Hubbell's 1961 Study - - - - -	
1984-1991 Rainbow Trout Fingerling Evaluation - -	
Wild Trout Baseline Angling Study - - - - -	
Angler Box Survey Monitoring Program - - - - -	
Trout Age and Growth Studies - - - - -	
NATIONAL PARK SERVICE FISHERIES POLICIES - - - - -	
RESOURCE MANAGEMENT PROBLEMS - - - - -	
Habitat Problems - - - - -	
Replacement of the Levee and Outlet Structure - - -	
Shoreline Habitat - - - - -	
Relocating the Visitor Center - - - - -	
Fisheries Problems - - - - -	
Maintenance of a Wild Rainbow Trout Fishery - - - -	
Illegal Angling - - - - -	
Public Acceptance of Catch-and-Release Angling - - -	
Golden Shiners - - - - -	
FISHERIES MANAGEMENT PROGRAM - - - - -	
Management Goals - - - - -	
Monitoring Trout Recruitment - - - - -	
Angler Box Surveys - - - - -	
Trout Population Surveys - - - - -	
Spawning Run Surveys - - - - -	
Monitoring Angling Success - - - - -	
Angler Box Surveys - - - - -	
Angler Census - - - - -	
Limnological Surveys - - - - -	
ACKNOWLEDGMENTS - - - - -	
REFERENCES - - - - -	
PROGRAM IMPLEMENTATION SCHEDULE - - - - -	

INTRODUCTION

In 1986, with the concurrence of Lassen Volcanic National Park (Park), the California Fish and Game Commission (Commission) designated Manzanita Lake a Catch-and-Release water. This designation was part of a then relatively new program known as the Trout and Steelhead Conservation and Management Planning Act established by the California Legislature in 1979. Under this Act, the California Department of Fish and Game (Department) has been mandated to annually recommend to the Commission 25 miles of stream and one lake suitable for catch-and-release trout management. Designation formalizes the Department's use of catch-and-release regulations to manage a stream or lake as a quality "wild trout" fishery.

Under a policy adopted by the Department in 1991, management plans are to be written for all Commission designated catch-and-release waters. When a designated water is located within National Park boundaries, the Department recognizes that the National Park Service (NPS) has full jurisdiction over managing the fishery in that water. In the case of Manzanita Lake, the Department and the Park have long cooperated in managing the fishery. When the Department approached the Park about developing a management plan that would outline mutual concerns regarding the fishery and how the Department hoped to assist the Park address these concerns, the idea was accepted and supported by the Park.

This plan describes the status of the Manzanita Lake fishery, reviews the lake's past and current management programs, identifies problems, and outlines activities designed to effectively manage the fishery from 1995 through 1999. It should be emphasized that this plan is meant to guide a joint program,

but not limit the flexibility that both the Department and the Park need to meet unanticipated problems (ie. the recent six-year drought or the State's fiscal problems).

RESOURCE STATUS

Description of Manzanita Lake

Location and Access

Manzanita Lake is located in northern California's Lassen Volcanic National Park approximately 200 miles north of San Francisco. The lake lies near the Park's northwest corner about 1/2 mile southeast of the intersection of State Highways 44 and 89 (Figure 1). One may reach the Park by taking California's main north-south highway, Interstate 5, to Redding and then driving east approximately 40 miles on Highway 44 to the Park's northwest entrance. Most anglers drive about 1/2 mile beyond the entrance station and turn right on to a secondary road which takes them to the southeast end of the lake (Figure 2). Several parking sites near the lake are accessible from this road together with an unimproved boat launching site. The Manzanita Lake campground and store are located on the same road just a short distance beyond the lake.

Physical Characteristics 1/

Manzanita Lake originally formed in a shallow basin at the foot of the volcanic Chaos Jumbles. Pacific Gas and Electric Company, which owned the water rights to the lake in the

1/ Description of physical characteristics of Manzanita Lake is summarized from Hubbell's 1961 report.

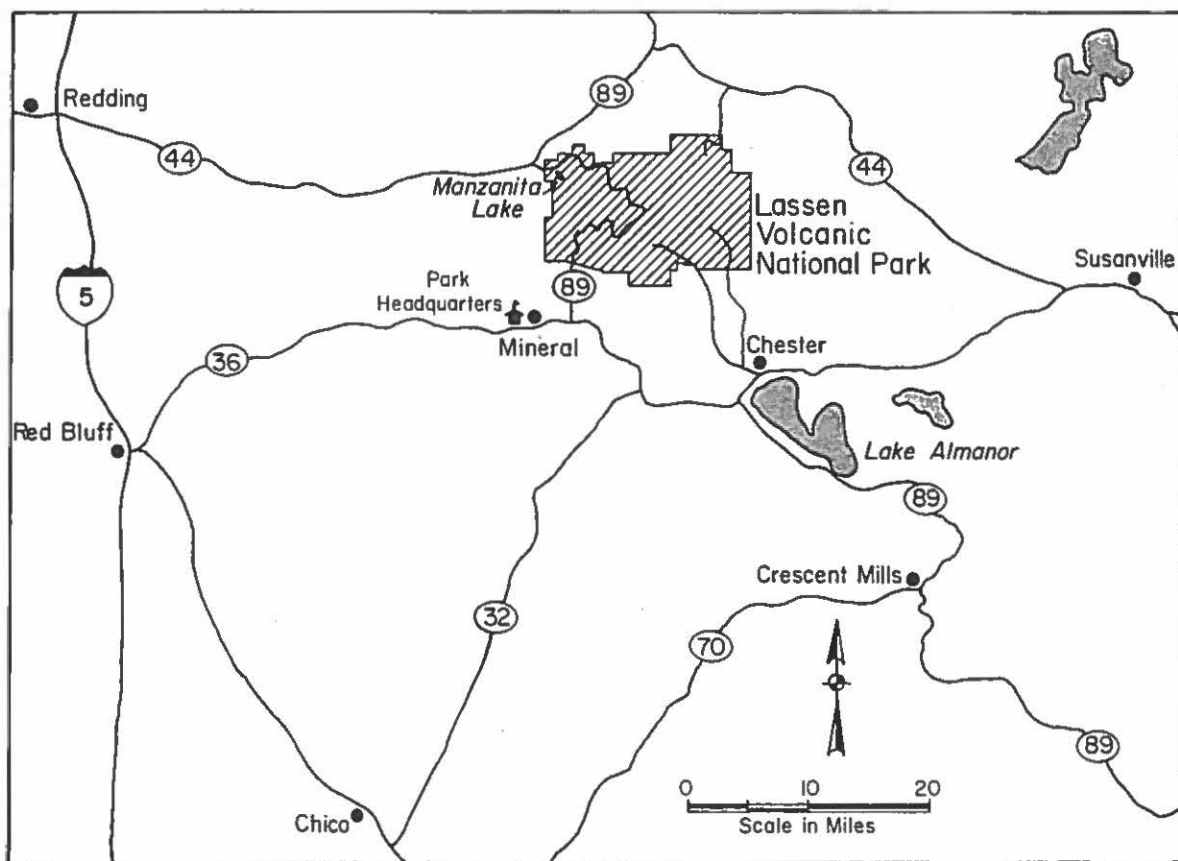


FIGURE 1. Location of Lassen Volcanic National Park and access from nearby towns.

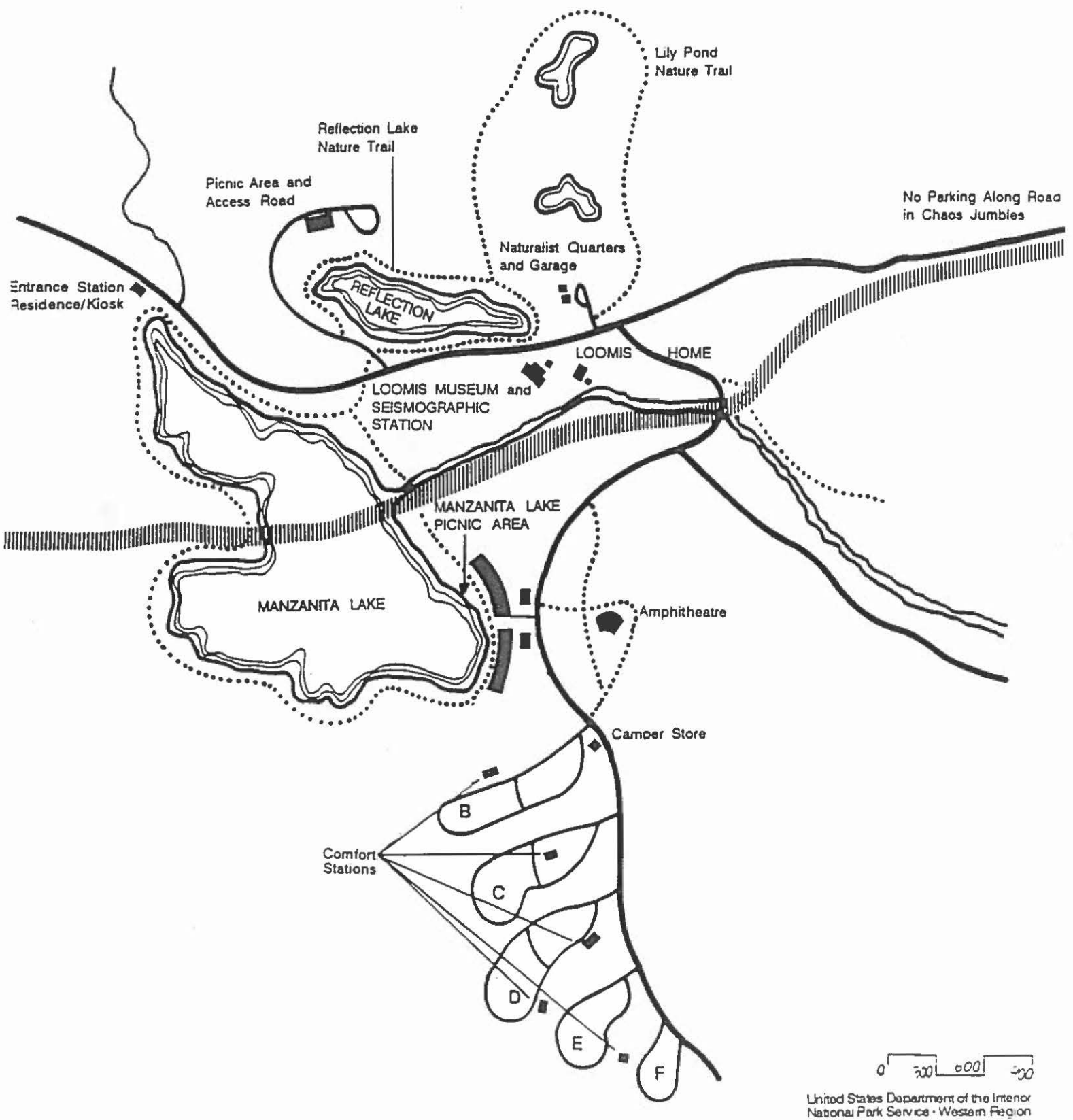


FIGURE 2. Access to Manzanita Lake and adjacent facilities.

early 1900's, dammed the outlet stream and increased the surface area to approximately 53 acres. The lake outline is irregular, with two arms forming the western half of the lake, and a single extension to the east (Figure 3). The long axis of the lake measures 1/2 mile, and the greatest width is about 1/3 mile. The maximum depth is 32 feet, with 2/3 of the lake being 15-feet deep or less. The banks of the southern portion of the lake are gently sloped. The banks are steeper in the outlet stream arm, where, at one point, the depth reaches 25 feet within 100 feet of the shore. The lake bottom consists of volcanic sand and cinders, mostly covered with a layer of silt and organic debris.

Three streams feed into the lake; Manzanita Creek and an overflow channel from Reflection Lake flow year-round and enter along the northeast shoreline, an un-named stream that only flows during spring run-off enters on the south shore.

Manzanita Creek is the largest of the three inflowing streams, approximately 4.5-miles long from its origins at the base of Crescent Cliff to the lake. The stream is spring-fed and relatively cold, with temperatures averaging 42°-48° F. A 4-foot-high dam, filled in behind with sediment, blocks upstream fish migration approximately 0.7 miles upstream of the lake. Most of the trout spawning occurs much further downstream. Manzanita Creek is the only stream entering the lake that provides spawning habitat.

A small stream flows from the dam in the northwest arm of the lake. As the water leaves the lake, it flows through a collapsed wooden grizzly-type grate. The stream below consists of approximately 300 yards of short, deep, boulder and log plunge pools, small cascades, and occasional short gravel riffles, ending in a small, shallow pond on a porous sand flat. Little water flows out of the pond, with shallow surface flow extending

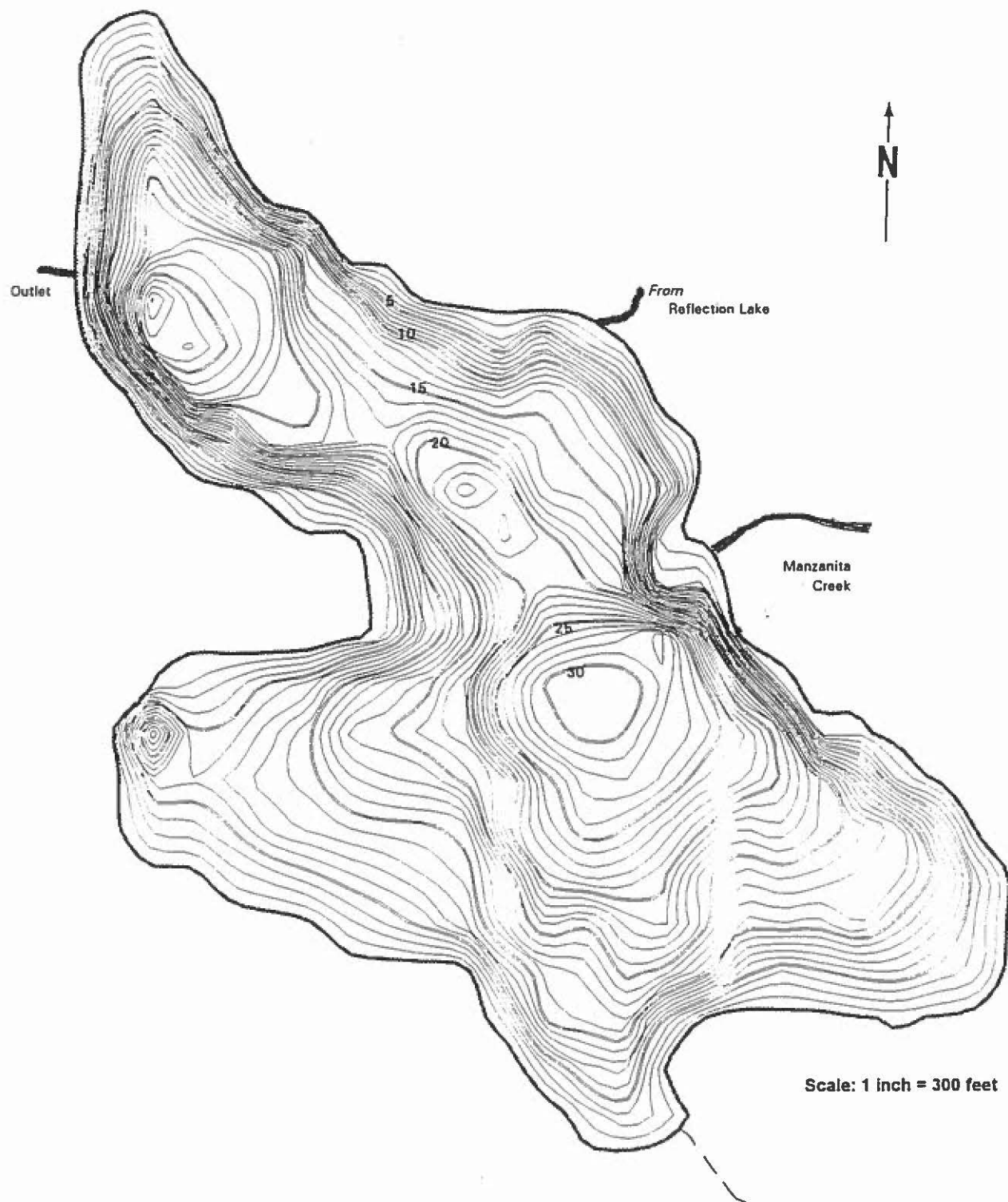


FIGURE 3. Contour map of Manzanita Lake.

for only another 200+ yards before sinking entirely into the sand. Habitat between the lake and the pond is very well suited for rearing and holding trout, but good spawning gravel is limited to the few riffles. Trout leaving the lake to spawn downstream would be unable to return to the lake due to several downstream woody debris barriers and the collapsed grate at the dam.

Limnological Characteristics

In 1961, Hubbell found that water temperatures varied very little throughout Manzanita Lake. Summer surface temperatures ranged from 62°-68° F, while temperatures at depth ranged from 56°-60° F. No thermocline developed during that season. What temperature variation there was at depth was attributed to the varying inflows of cold, dense water from Manzanita Creek. Berry (1990) measured summer surface temperatures ranging from 57°-68° F, and deep water temperatures of 48°-55° F. A slight thermocline appeared to develop between depths of 3-6 feet in July.

Dissolved oxygen is well mixed within the water column, averaging at 9-10 parts per million (ppm) from the surface to mid- to bottom depths. Berry (1990) recorded a low oxygen reading of 6 ppm at a depth of 25+ feet. Total alkalinity in the lake has been measured averaging from 25-30 ppm. Hubbell (1961) found the lake surface pH to increase from 6.8 in June to 8.6 in September. Berry (1990) noted that the surface pH ranged from 8.9-9.4. The lake water clarity is moderate, with Secchi disc readings of 21-27.5 feet (Hubbell 1961).

Dense beds of submerged aquatic plants carpet 75-80% of the lake bottom (Hubbell 1961). Pink flowering Polygonum float across

large areas of the surface in the shallow southern lake areas. Myriophyllum and Potamogeton grow throughout the deeper parts of the lake.

Manzanita Lake supports rich populations of invertebrates, many of which provide forage for the fast growing trout. Caddisfly, dragonfly, damselfly, mayfly, chironomid and other dipteran larva and adults are found in large numbers at the lake. Leeches, aquatic snails, fingernail clams, amphipods, annelid worms, and a variety of aquatic beetles and bugs are also plentiful, adding considerable diversity and biomass to the forage base (Hubbell 1961).

Description of the Fishery

Early History

The earliest report of trout in Manzanita Lake credits Major P.B. Reading with stocking "the first fish that ever swam in the lake" in 1848. The Major supposedly brought trout in buckets of water to the lake from Lost or Hat Creek. But with no reliable information available on Manzanita Lake prior to the reported stocking, Wallis (1955) concluded that the question of whether or not rainbow trout were actually native in Manzanita Lake will never be properly answered.

Native or not, the rainbow trout in Manzanita Lake apparently thrived after the planting. A newspaper account of a trip to Manzanita Lake in 1878 indicated that the lake was filled with trout. Native Americans were taking trout with bow and arrow and by spearing them by torchlight. The fish were very wary of anglers, but local citizens were able to catch their share.

In 1880, Rudolph Klotz, a local sawmill owner, introduced "black cat fish" into Manzanita Lake and several other waters in the area. The fish were probably brown bullheads, which persisted in the lake well into the 1900's. The bullheads were apparently the only fish that survived the catastrophic mud flows of 1915, which killed off all trout in the lake.

Past Management Studies and Programs

Early Stocking Programs

After the Mt. Lassen eruption, William Rice, an Anderson merchant and ardent fisherman, applied to the Mt. Shasta State Fish Hatchery (then known as the Sissons Hatchery) for 125,000 young rainbow trout for stocking in Manzanita Lake. The trout were shipped to Anderson via the railroad and, with 500 pounds of ice, trucked into the lake. Mr. Rice reported catching 2-1/2 pound trout in the lake in 1922 (Robinson 1943).

In 1925, the Park made its first request to the Department for trout for Manzanita Lake. Although available records do not show what happened between 1925 and 1931, it appears brown trout were introduced and produced a spawning run large enough to allow egg-taking operations in Manzanita Creek. Between 1931 and 1934, a combination of rainbow trout, brown trout, and a small number of brook trout were stocked in the lake. Over the next 19 years, the management program at the lake included annual plants of about 25,000 to 75,000 brown trout (Wallis 1955).

In 1953, the Department told the Park that it may stop raising brown trout. At the time, the Department recommended chemically treating Manzanita and adjoining Reflection lakes to eradicate exotic brown trout. It recommended replacing this species with rainbow trout. The Department further offered to provide the

technical personnel and the materials needed for the treatment. The NPS shortly agreed to the proposal. In the meantime, the Department and some sportsmen began to wonder if eliminating brown trout from selected trophy-trout waters around the State was a good policy. The State proposed to study this question and asked that the agreement to chemical treatment be postponed. The NPS responded that any change in the Manzanita Lake stocking policy be centered around maintaining rainbow trout rather than exotic brown trout, but agreed to the postponement (Wallis 1955).

Wallis' 1954 Assessment

Orthello Wallis, a well-known NPS biologist, was given the assignment of assessing the existing fishery and recommending a future management program for Manzanita Lake. He spent portions of May and June 1954 in the Park. In a follow-up report, he identified seven possible solutions to the management problems at the lake including chemical treatment and restocking with rainbow trout, rainbow or brown trout fingerling stocking, and sustaining the fishery with catchable-size rainbow plants. Wallis concluded that a chemical treatment would not, because of their presence in the stream, eradicate brown trout. He also recognized that brown bullheads were very difficult to kill with a treatment. Rainbow trout, he thought, could not sustain satisfactory "natural fishing" as brown trout had done and could not be expected to attain a large size. Because of the artificiality of the program and problems which could arise from increasing angling (damage to shoreline vegetation, increased litter, etc.), he opposed a catchable trout program. He recognized that skilled anglers often did well at Manzanita Lake and, in contrast to most heavily fished roadside waters, could catch trophy-size trout (Wallis 1955).

Wallis' management recommendations included retaining the brown trout fishery and, if possible, allowing natural reproduction to sustain the fishery. He concluded that two additional studies were urgently needed--catch and spawning surveys. The latter study should be conducted in the spring and fall and may involve traps or weirs. In his estimation, a small rainbow trout population would continue to be present in Manzanita Lake sustained by natural reproduction in Manzanita Creek and downstream migration from Reflection Lake (Wallis 1955).

It is difficult to assess what impact Wallis' recommendations had on the management of Manzanita Lake over the next two decades. The NPS did not let Manzanita Lake go the way of most heavily fished roadside waters at the time and become a put-and-take catchable trout fishery. However, with the exception of five years in which no trout were planted, and two years in which only rainbow trout were planted, the lake continued to be stocked with brown trout fingerlings for a period of 22 years.

Hubbell's 1961 Study

Paul Hubbell, then a student at Humboldt State University at Arcata, California, studied the Manzanita and Reflection lakes fisheries from June through September 1961. His work included describing biological conditions, collecting basic limnological parameters, sampling and aging the brown and rainbow trout populations, and conducting a creel census (Hubbell 1961).

Hubbell found Manzanita was a rich lake with limnological conditions suitable for trout, but one with only a small population, many of which were relatively large fish. Brown trout were the dominant species with lesser numbers of rainbow trout, brook trout, and brown bullheads present in the lake. He felt that because of their low density, bullheads were not

serious competitors with trout for available food. His creel census showed the catch rate for trout was low (0.20 fish/hour). Seventy percent of the 250 anglers checked caught nothing. Ninety percent of the trout caught were browns and the balance were rainbows. Trout ≥ 14 inches constituted 23% of the brown and 31% of the rainbow trout catch. No mention was made of anglers releasing any of their catch (Hubbell 1961).

Hubbell's management suggestions were similar to those of Wallis. He recommended that the lake be managed as a brown trout fishery. However, he felt that it should be stocked with marked brown trout which would permit an assessment of the role of stocked and wild fish. He, too, recommended a creel survey which would give accurate estimates of trout harvest and angling pressure (Hubbell 1961).

Efforts were made to collect creel census data after Hubbell's study, but these programs did not involve an evaluation of marked trout or the type of survey from which accurate season-long estimates of angling effort and catch could be calculated. Stocking, primarily brown trout fingerlings, continued, but not on the consistent annual basis of earlier years. From 1977 through 1982, Manzanita Lake was not stocked.

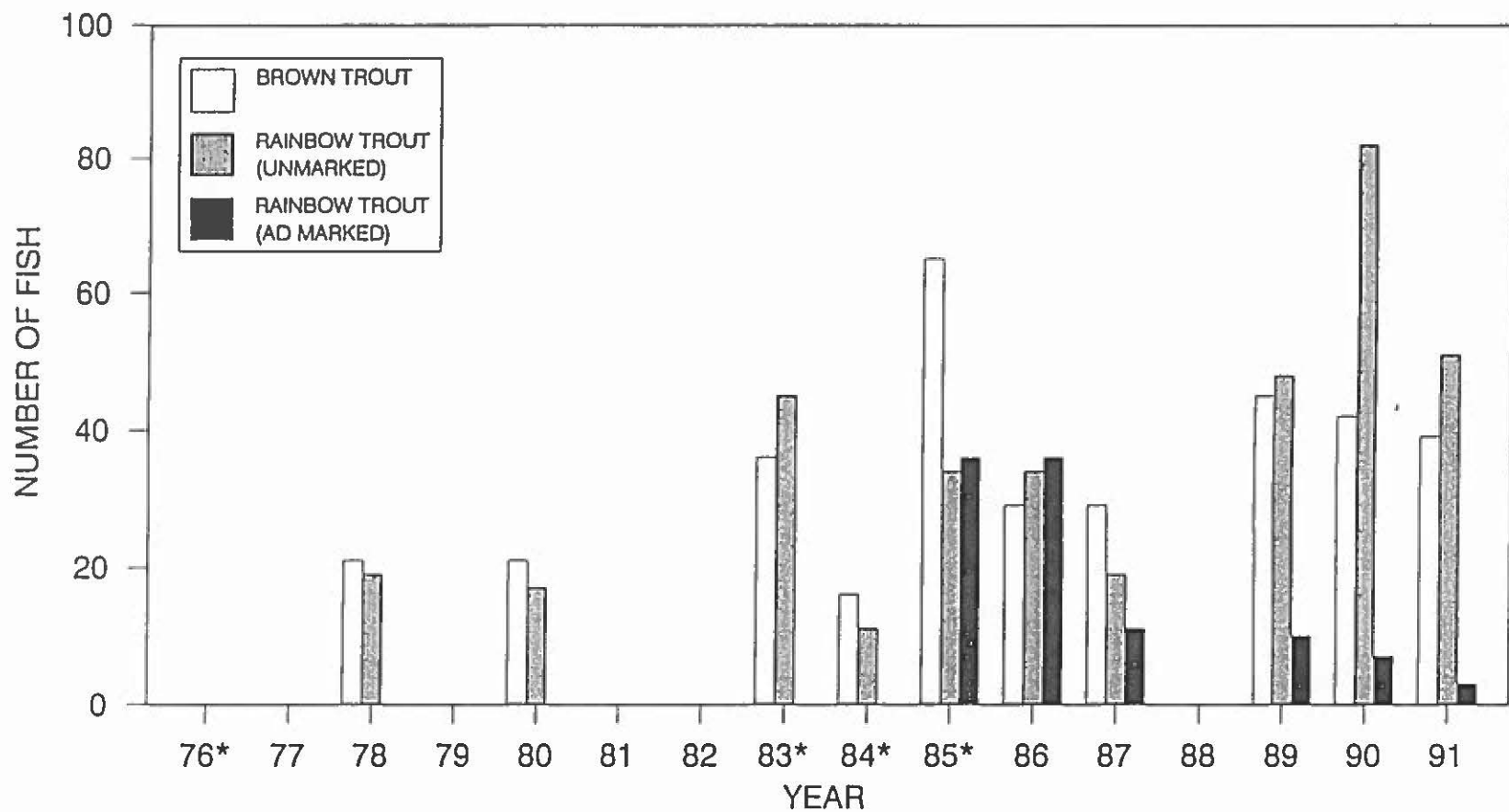
1984-1991 Rainbow Trout Fingerling Evaluation

In 1983, the Department, in cooperation with the Park, undertook an evaluation of the contributions of wild and stocked trout to the Manzanita Lake fishery. Contrary to the expectations of earlier researchers, this evaluation did not involve marked brown trout, but marked Eagle Lake rainbow trout. Five thousand fingerlings bearing an adipose clip were stocked in 1983 and 1984. An additional 5,000 unmarked Eagle Lake trout fingerlings were stocked in 1985. During the study, special angling

regulations were imposed on the lake--the limit was reduced to two-trout, fish kept could not exceed 10 inches in length, and fishing was restricted to the use of artificial lures and flies. The purpose of these regulations was to prevent the harvest of rainbow trout at levels which would preclude their potentially sustaining a trophy trout fishery, yet allow an evaluation of the comparative abundance of smaller stocked and wild trout. Fish populations present in the lake were sampled with a boat electrofishing unit each fall from 1983 through 1991 (W. Donald Weidlein and Terry Healey, Department biologists, Region 1, personal communication).

The results of the electrofishing survey were both interesting and surprising. Contrary to previous findings or conclusions, the number of rainbow trout captured was about equal to or, in some surveys, greater than the number of brown trout. In the early phases of the study, marked Eagle Lake trout comprised about half of the rainbow trout catch. Toward the end of the study, the wild rainbow trout population was approximately equal to or greater than the brown trout population. Part of the Eagle Lake trout stocked as fingerlings survived in Manzanita Lake for six years or longer (Figure 4).

During the rainbow trout fingerling planting study, the NPS adopted a no-stocking policy in essentially all of its waters. The fingerling study had shown, however, that with a sharply reduced harvest rate, a significant rainbow trout population could be maintained in the lake. Further, it appeared that this population may survive in numbers similar to the wary, long-lived, and piscivorous brown trout population. One of the major questions at this time in the lake's management history was: How much had fingerling stocking contributed to the rainbow trout population present in the lake from 1989 through 1991?



* Denotes years when 5000 rainbow t. fling. were planted. In 1983 and 1984 these were AD marked.

FIGURE 4. Number of brown trout and marked and unmarked rainbow trout captured at Manzanita Lake during fall electrofishing surveys conducted from 1976-91.

Wild Trout Baseline Angling Study

At the start of the 1990 general fishing season, the Department, in cooperation with the Park, initiated a study designed to provide "season-long" angling effort and catch estimates. Though recommended both in the 1950's by Wallis and the 1960's by Hubbell, this survey was not done as a result of these recommendations, but as a "standard" part of the Department's Wild Trout Program. Acknowledgedly, the Department was a few decades late in recognizing the need for this study. Combined with the creel census, the Department initiated a voluntary catch data collection program using angler-survey boxes (Deinstadt, Lentz, and Sibbald 1993). Also included in the 1990 study was a monthly limnological survey intended to provide an updated assessment of temperature, dissolved oxygen, and pH conditions in the lake during the census period.

Angling effort from April 28 through October 31, 1990 totaled and estimated 16,059 hours. Anglers caught and released 6,068 trout (5,626 rainbow and 440 brown trout) at an average rate of 0.38 fish/hour. Angling effort increased from 1,513 hours in May to a peak of 5,389 hours in July then decreased reaching a low of 593 hours in October (Table 1). Catch rates ranged from 0.31 trout/hour in September to 0.58 trout/hour in May. Lure anglers caught an estimated 203 trout in 859 hours of fishing (0.24 fish/hour). Fly anglers fished 15,176 hours and caught 5,860 trout (0.39 trout/hour). Shore, boat, and float-tube anglers fished an estimated 3,800, 6,305, and 5,930 hours, respectively. Float-tube anglers had the highest catch rate (0.41 trout/hour) followed by boat anglers (0.40 trout/hour) and shore angler (0.29 trout/hour).

Four percent of the rainbow trout released by anglers were reported to be less than 12 inches in length, 28.5% were 12.0 to

TABLE 1. Estimated Angling Effort and Success at Manzanita Lake, April 28 through October 31, 1990.

	May	Jun	Jul	Aug	Sep	Oct	Total
Hours fished	1,513	4,378	5,389	1,991	2,196	593	16,059
Trout released							
Rainbow	792	1,607	1,786	592	646	203	5,626
Brown	87	151	100	48	42	12	440
Total	879	1,758	1,886	640	688	215	6,068
Trout catch/hour							
Rainbow	52	0.37	0.33	0.30	0.29	0.34	0.35
Brown	0.06	0.03	0.02	0.02	0.02	0.02	0.03
Total	0.58	0.40	0.35	0.32	0.31	0.36	0.38

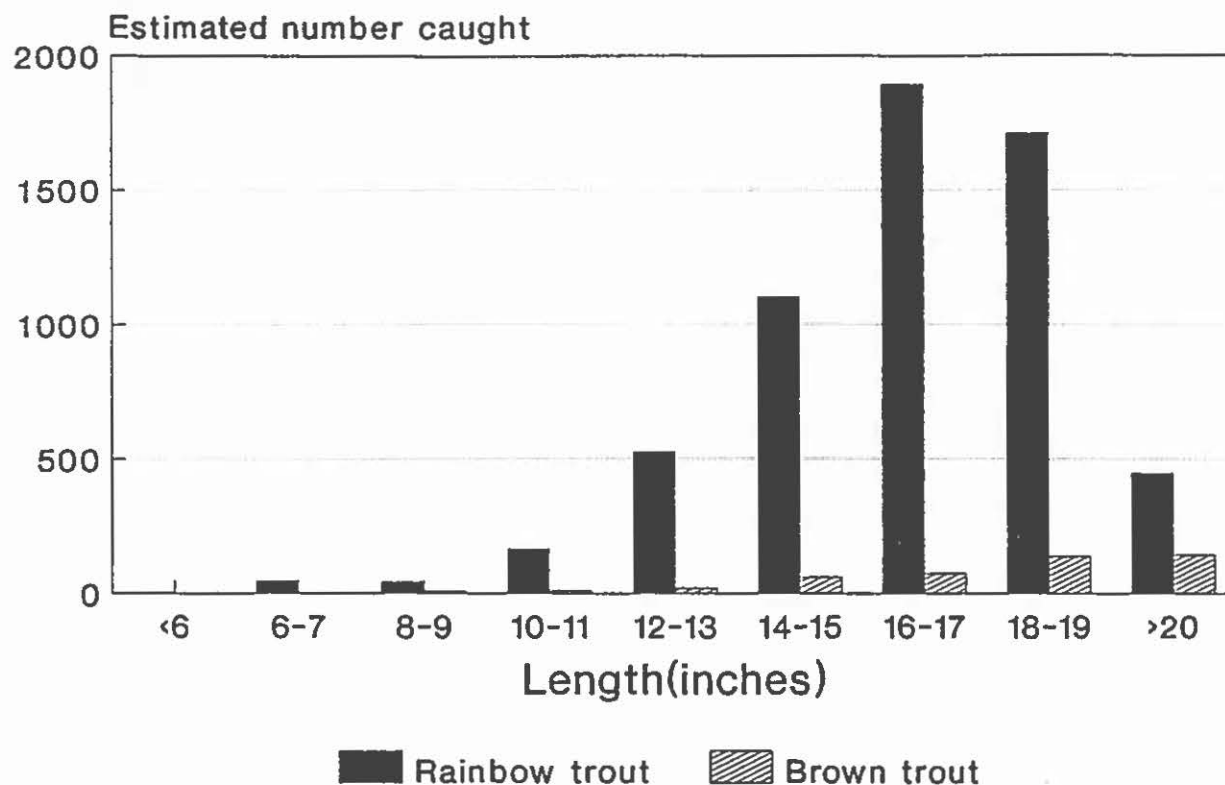


FIGURE 5. Lengths of rainbow and brown trout anglers reported releasing during the 1990 "season-long" creel census at Manzanita Lake.

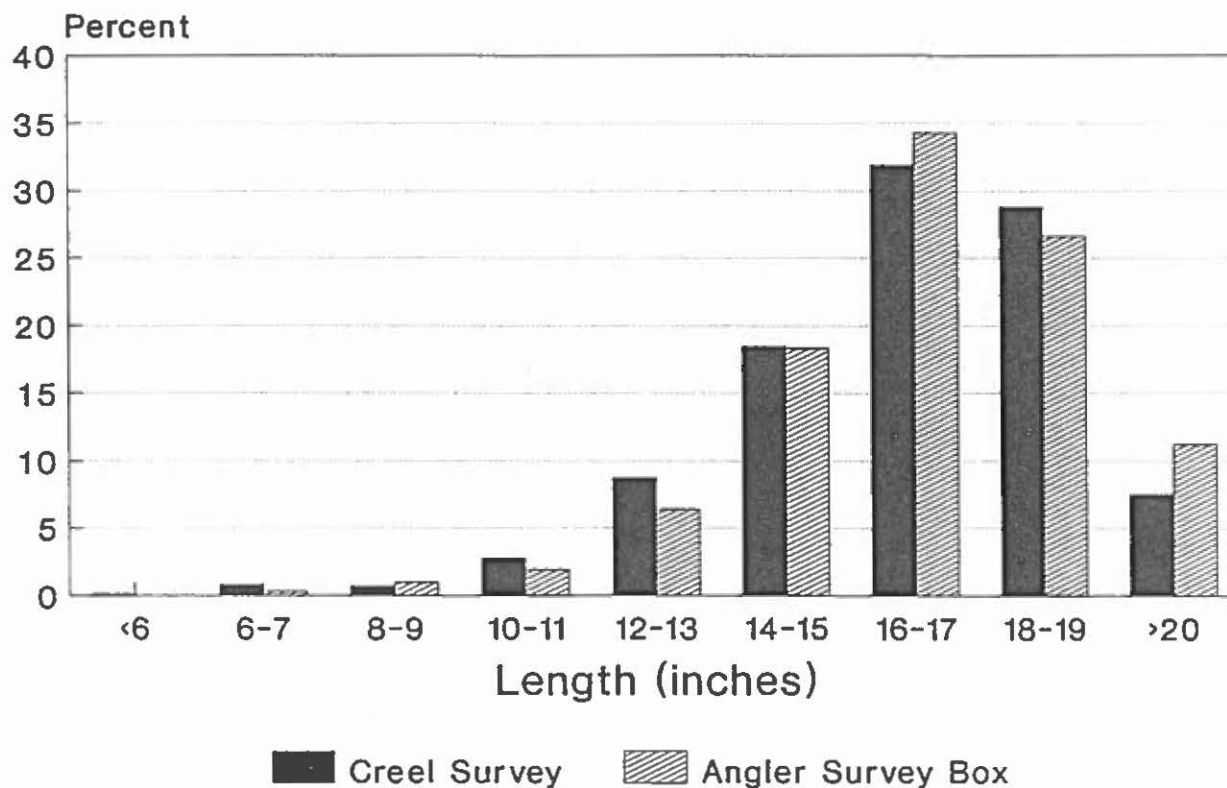


FIGURE 6. Comparison of the lengths of trout released at Manzanita Lake in 1990 based on creel census and angler survey box data.

15.9 inches, 61% were 16.0 to 19.9 inches, and 7% were equal to or greater than 20 inches in length (Figure 5). Brown trout less than 12 inches in length accounted for 4% of the fish released of that species. Fish 12.0 to 15.9, 16.0 to 19.9, and equal to or greater than 20 inches comprised 17%, 45.5%, and 33.5% of the brown trout released.

A comparison of the results from the creel-survey and angler-survey-box forms showed close correlations in the lengths of trout anglers reported releasing (Figure 6). The species composition of the catch, using these two data bases, was also similar. The mean catch rate compiled from angler-survey boxes was, however, appreciably higher (0.74 vs 0.38 trout/hour) than compiled from the angler survey.

At the start of the 1990 season, the NPS replaced the 10-inch maximum size restriction with a zero-trout (catch-and-release only) regulation. The Commission, in acknowledgment of the excellent reports it had received about fishing at the lake, and with the consent of the Park, had earlier designated Manzanita Lake a Catch-and-Release water.

The 1990 survey documented that rainbow trout were sustaining one of the best trophy-size trout fisheries in the State. It was recognized that Manzanita Lake was one of the more challenging fisheries in the State's Wild Trout Program. And, that the catch rates there were lower than at most designated waters. However, the opportunity to catch large trout compensated for the angler's desire for a higher catch rate.

Contrary to earlier assessments, rainbow trout sustained a satisfactory "natural" fishery in 1990. Though the wild brown trout catch supplemented the trophy-trout fishery, it alone was far too low to sustain an attractive fishery in 1990. The

difference between the rainbow and brown trout catch appears to be more related to angling vulnerability than population abundance. Obviously, the present era of catch-and-release angling has brought with it opportunities to test the performance of trout which were not available in a day when almost all anglers were harvest oriented.

Limnological data collected during the 1990 survey were summarized above in the description of the lake. Results from an electrofishing survey conducted in 1990 are presented below in a description of fish populations.

Angler-Survey Box Monitoring Program

After the 1990 "season-long" angler survey, the Department and the Park cooperatively continued to monitor the Manzanita Lake fishery through the use of angler-survey boxes. The primary purpose of continuing this survey was to assess trends in the relative abundance and size of rainbow trout. Secondarily, the results were a means of monitoring trends in angling quality. The lingering management question is whether rainbow trout recruitment from Manzanita Creek can continue to sustain the trophy-trout fishery.

From 1990 through 1993, based on reports from angler-survey boxes, the percentage of rainbow trout in the catch remained relatively unchanged (Figure 7). Rainbow trout catch rates were lower in 1992 and 1993 (Figure 8). The size structure of the rainbow trout catch from 1990 through 1993 also remained fairly constant (Figure 9). Therefore, to date, it appears that rainbow recruitment from Manzanita Creek is sustaining the desired trophy-trout fishery.

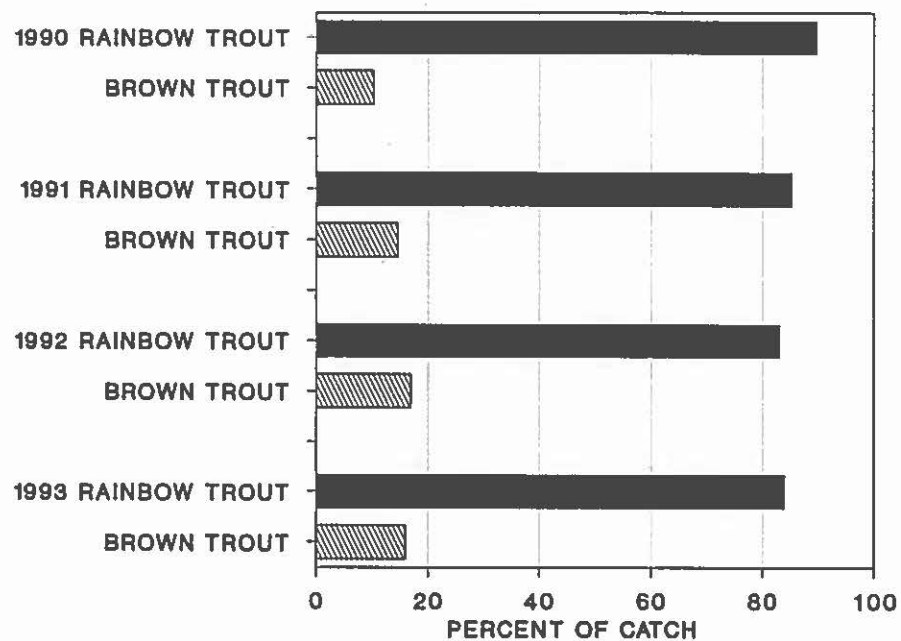


FIGURE 7. Percent of catch by species at Manzanita Lake, from 1990-93, based on angler box survey data.

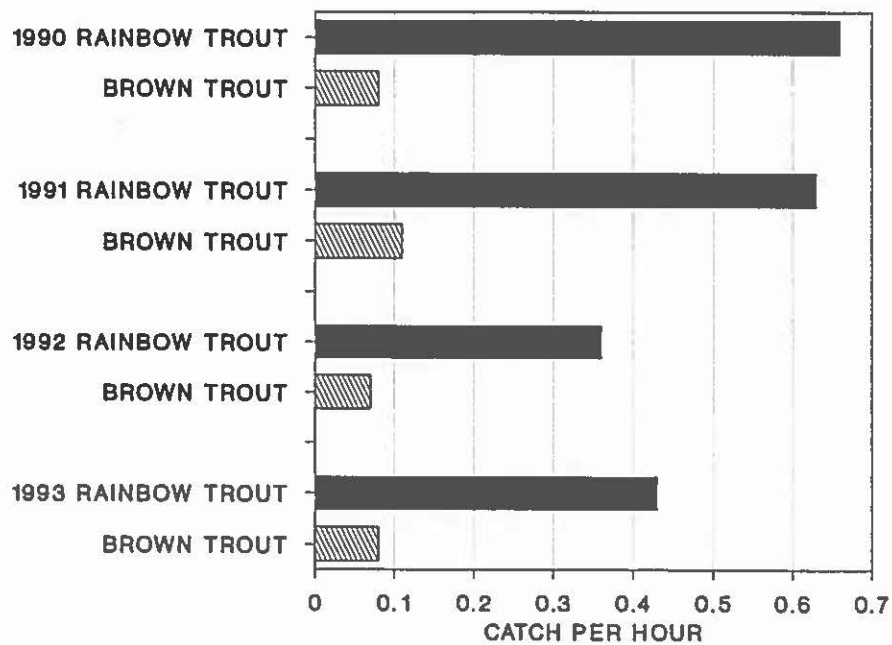


FIGURE 8. Catch per hour at Manzanita Lake, from 1990-93, based on angler box survey data.

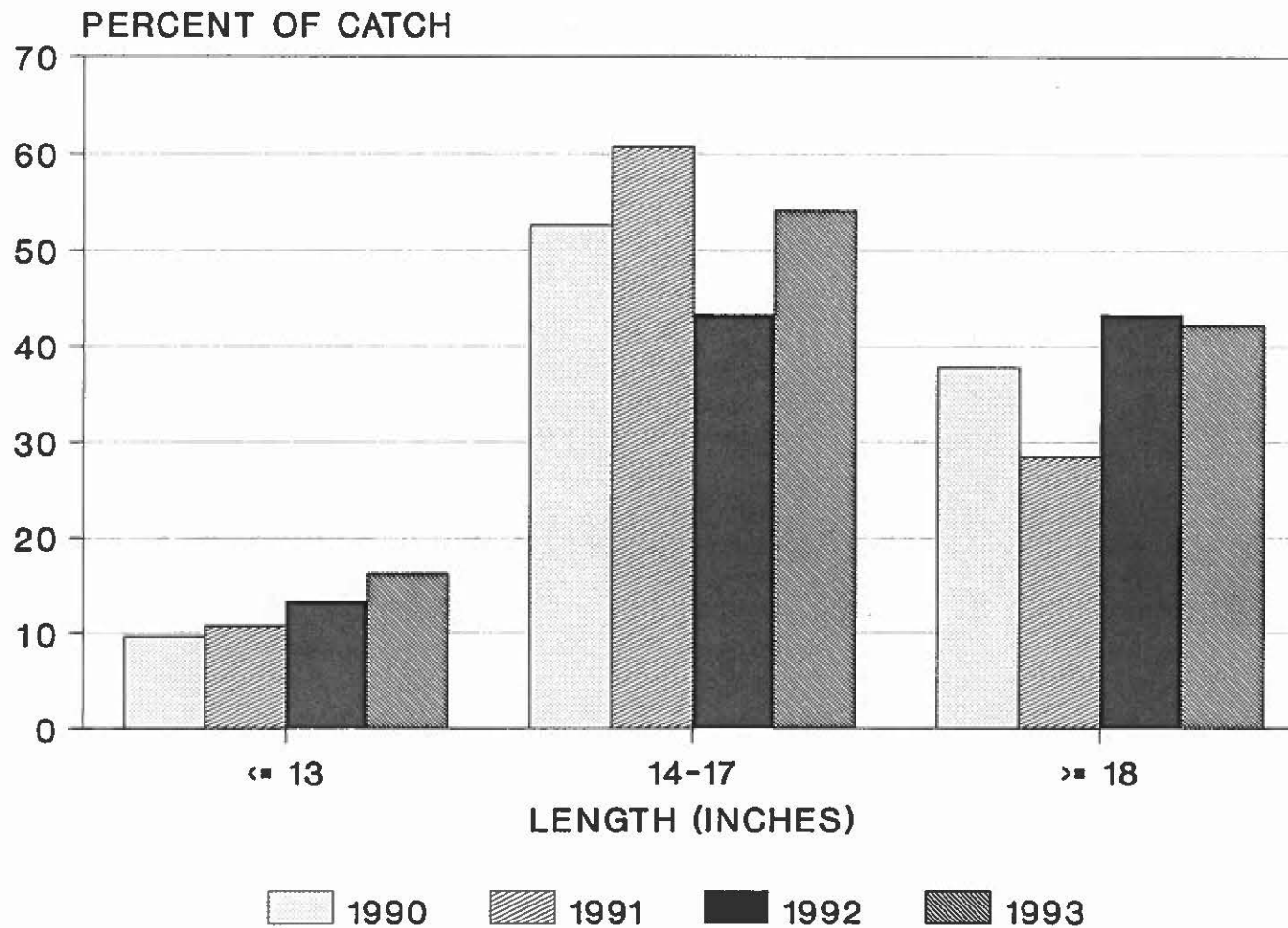


FIGURE 9. Lengths of rainbow trout released at Manzanita Lake, from 1990-93, based on angler box survey data.

Trout Age and Growth Studies

Age I through VI brown trout sampled in Manzanita Lake in the early 1960s averaged 5.8-, 9.5-, 13.5-, 16.9-, 19.8-, and 22.9- inches fork length at the time of captured. Age I through V rainbow trout sampled at the same time averaged 5.9-, 10.9-, 12.0-, 16.2-, and 22.4-inches fork length at the time of capture (Hubbell 1961). These data indicate that the current trophy-trout fishery is sustained by age IV, V, and VI fish.

NATIONAL PARK SERVICE FISHERIES MANAGEMENT POLICY

In 1968 a decision was made by the Director of the NPS to discontinue the artificial stocking of non-native fish in natural aquatic park ecosystems. The policy also prohibited the stocking of either native or non-native fish in naturally barren waters. That decision was partly based on a report to Secretary of Interior Stewart Udall by a group of scientists headed by A. Starker Leopold from the University of California on Wildlife Management in the National Parks. The report recommended an ecosystems approach to the management of wild populations.

Implementation of the policy at the Park began in 1968, when a fish stocking phaseout was begun. By 1975, stocking of all lakes and streams in the park was reduced to only four lakes (Butte, Crystal, Manzanita and Summit) and two streams (Kings and Hot Springs creeks).

The no-stocking policy was generally supported by the public but some individuals and groups desired stocking to continue. As a result, the NPS Director authorized Sierran parks to continue planting fish on a limited basis during a field investigation and reevaluation of NPS Policy. In 1976, the NPS, in cooperation

with the Department, began a study to determine the biological, economical, and recreational aspects on a no-stocking policy. Field investigations were completed and policy was reevaluated prior to the last revision of NPS Management Policies in December 1988. Under the revised policies, fish stocking, which was allowed during the interim study and review period, was discontinued in all park waters in 1990.

For management purposes all national parks are divided into four zones: Natural, Historic, Development, and Special Use. The fisheries policy that relates to zoning in Lassen Park is:

In natural, cultural, and park development zones, fisheries management will seek to preserve or restore natural aquatic habitats and the natural abundance and distribution of native aquatic species, including fish, together with the associated terrestrial habitats and species. In these zones, waters that are naturally barren of fish will not be stocked with any species. Artificial stocking of native fish will be employed in natural zones only to reestablish native species in their historic ranges; stocking of exotic fish species will not be permitted in cultural zones only where there is a special need associated with the historic events or individual commemorated and where an exotic species, if used, could not spread to natural zones or waters outside the park. Stocking with native species, but not with exotic species, will be permitted in park development zones. Stocking programs for other purposes in these zones will be discontinued or phased out except where there is congressional intent expressed in law or a House or Senate report accompanying legislation.

The area adjacent to the north and east shores of Manzanita Lake is zoned for development, but the lake proper is included in the

Chaos Crags-Chaos Jumbles Outstanding Natural Feature Subzone; therefore, fish stocking is not an option under current NPS Policy.

RESOURCE MANAGEMENT PROBLEMS

Habitat Problems and Recommendations

Replacement of the Levee and Outlet Structure

Decades ago, the level of Manzanita Lake was raised through the construction of a levee and outlet structure along the lake's northwest shoreline. The NPS has determined that the levee and outlet structure need to be replaced with ones that could withstand a "hundred year flood event". In determining how to correct this problem, one of the possible alternatives was to remove the levee and return the lake to its historic natural level. This option, if selected, would significantly reduce the size of the lake. It is expected that this option and the preferred alternative, a reconstruction project that would retain the present lake level and will be reviewed during the winter and spring of 1994.

Manzanita Lake is one of the best trophy trout waters in California. The factors that set this lake apart from so many others in the State are not clearly understood. It is apparent, however, that tampering with the lake level could change the characteristics that allow it to sustain an exceptionally productive sport fishery. Macroinvertebrate production, nursery areas for young trout, a shore free of mats of rooted aquatic plants, etc. could all change.

Recommendation:

The Department should continue to support alternatives which will adequately correct the potential problem, but produce the least physical disturbance and result in maintaining Manzanita Lake at its current level.

Shoreline Habitat

Until recently, anglers were free to walk completely around the shoreline of Manzanita Lake. In 19__, the NPS acted to protect the small meadow-like, often marshy area at the Manzanita Creek inlet to the lake. A few hundred feet, primarily on the south side of the stream is now closed to the public. At this time no other fragile plant communities along the shoreline are known to require such protection.

Recommendation:

The Department should strive to be aware of the impact of fishing on shoreline vegetation and, if requested, assist the Park in developing angler-use strategies which may both permit fishing and preserve fragile plant communities.

Relocating the Visitor Center

Historically, a museum (visitor center) at the north end of the Park was located on a hill immediately adjacent to Manzanita Creek a short distance above the inlet to the Manzanita Lake. This site was abandoned when it was thought that an earthquake could trigger rock slides in the area. A temporary visitor center was located just inside the Park boundary at the northwest entrance to the Park. It has been proposed and now appears that the old museum will be reopened as a year-round visitor contact

station. As part of this proposal, an historic structure known as the Loomis House will also be reopened and maintained as a ranger station.

The proximity of the museum building and its adjoining parking lot to Manzanita Creek will naturally cause many visitors to want to walk down to the stream. During most of the year such activity would not be a concern, but now, disrupting spawning activity in the spring and fall could decrease the recruitment needed to sustain the Manzanita Lake fishery. The NPS has also documented that this stretch of stream is a feeding area for bald eagles--another cause for concern over increased visitor presence.

If the planned visitor center relocation project is carried out, the NPS has proposed that its impact be evaluated and appropriate mitigation projects be initiated.

Recommendation:

The Department should offer to be involved in the planning and field evaluation of the potential impact of allowing visitors to hike along lower Manzanita Creek during the spring rainbow trout and fall brown trout spawning periods.

Fisheries Problems

Maintenance of a Wild Rainbow Trout Fishery

The greatest problem facing long-term maintenance of the trophy trout fishery in Manzanita Lake is thought by some Department biologists to be the NPS policy against stocking fingerlings. Their experience at Manzanita Lake and elsewhere causes them to believe that natural recruitment of wild rainbow trout into the

lake from Manzanita Creek will be too low to sustain the present fishery. All concerned are interested in the results of current efforts to monitor trends in the fishery.

Recommendation:

The angler-survey box monitoring program currently used to follow trends in fishing and, more importantly, trout recruitment should be continued through at least 1997. If the monitoring program indicates rainbow trout recruitment is decreasing, a study of spawning and spawning success should be undertaken.

Illegal Angling

Illegal anglers at Manzanita Lake fall largely into three categories: (1) Those who would not normally violate the law, but are unaware of the special angling regulations; (2) Those who know the regulations, but, for a variety of reasons openly choose to ignore them; and, (3) Those, whom are generally termed poachers, that stealthfully seek to harvest trophy-size trout from the lake. While Park rangers regularly patrol the lake and annually cite violators, the presence of anglers who understand and support the catch-and-release program is recognized as the best means of controlling most illegal fishing. These anglers are usually willing to tell those fishing with bait or keeping trout that they are breaking the law. If they encounter persistent violators, most are willing to report them to Park personnel. Poachers who use baited trout lines or other means to take fish from the lake require a special effort to apprehend.

In today's world there are some risks in confronting people who are violating the law. Department and Park personnel generally recognize these risks and, while not wanting to discourage

anglers from asking others if they know the regulations, should warn anglers to be tactful and cautious in the way this is done.

Recommendation:

The Department should, through news articles, talks, and other means, endeavor to educate anglers about the proper procedures to take when violations are observed.

Public Acceptance of Catch-and-Release Angling

While public exposure to catch-and-release angling has increased in recent years, there are still numerous anglers who feel use of these regulations unfairly exclude them from enjoying their traditional fishing opportunities. To such anglers, catch-and-release programs cater to fly fishermen and deprive the average angler of his right to keep and eat trout. These programs further irritate many of anglers because they prohibit use of their preferred fishing method, bait angling.

To date, no special effort has been made to explain the rationale for the fisheries management program at Manzanita Lake to the public. Though a possible display in the relocated visitor center and an informational sign on the lake may not change the attitude of those strongly opposed to catch-and-release management, such displays may help thousands of visitors understand why the program is being used. And, perhaps equally important, that it has been very successful.

Recommendation:

The Department should now, if requested, act upon its previous discussions with the Park regarding the creation of a lake-side

informational sign, campfire slide show, or other programs the Park may wish to use in explaining the Manzanita Lake management program to Park visitors.

Golden Shiners

An abundant population of golden shiners is present in Reflection Lake just across State Highway 89 from Manzanita Lake (Figure 2). A small stream carries the outflow from Reflection Lake into Manzanita Lake. Though a few spawners migrate upstream into Reflection Lake, the lake's resident trout population has essentially disappeared.

Several good trout lakes in California have been severely degraded by the introduction of golden shiners. Chemical treatments have usually been required to restore these fisheries. Two points of review exist within the Department regarding a potential threat to the Manzanita Lake fishery from the golden shiner population in Reflection Lake. One is that the shiners have been present in Reflection Lake for many years and have not impacted the adjoining trophy trout fishery. This being the case, why be concerned. The second point of view is that despite the recognition that the Manzanita Lake fishery has apparently been unaffected, why take the chance that this will indefinitely remain the case. To date, the issue has not been seriously addressed.

Recommendation:

The Department should evaluate its experience statewide with regard to the loss of productive trout lakes due to the introduction of golden shiners. Based on this review, the Park should be advised of the long-term risks to the Manzanita Lake fishery from the golden shiner population in Reflection Lake. If

a treatment appears to be an appropriate course, and the Park desires such action, the Department should help the Park prepare the necessary environmental documents and provide the expertise needed to carry out a successful treatment.

FISHERIES MANAGEMENT PROGRAM

Management Goals

The goal for managing the Manzanita Lake fishery are:

1. To maintain an abundant, self-sustaining wild rainbow and brown trout populations in Manzanita Lake.
2. To maintain satisfactory fishing for wild, trophy-size rainbow and brown trout. Satisfactory is defined as catching large trout (the majority 16 inches and greater in length) at an average rate of not less than 0.30 fish/hour.
3. To provide anglers and other Park visitors with information that explains the rationale for the current fisheries management program at the lake and along the lower reaches of Manzanita Creek.

Monitoring Trout Recruitment

Angler-Survey Boxes

Under the present program, two angler-survey boxes, one at the unimproved boat-launching site and one near the main parking lot, are maintained by the Park. The number of surveys completed by anglers increased substantially in 1993 (from a 1990-1992 average of 114 to 229 in 1993). Efforts are being made through talks, news articles, the California angling regulations booklet, and

other means to encourage fisherman to fill out angler-box-survey forms available on numerous wild trout waters through the State. The Park will continue to periodically forward completed forms to the Department. Department personnel will compile the data and annually review indicated trends in trout recruitment and angling quality with the Park.

Trout Population Surveys

If the angler box survey or creel survey data indicate rainbow trout recruitment is decreasing, the Department, with the approval and help of the Park, should resume conducting a fall fish population survey utilizing the Region 1 electrofishing boat. Prior to resuming this survey, however, an effort should be made to observe the species composition and size structure of the lake's fish populations by means of a snorkeling survey. After both surveys are completed, comparisons between the two should be made and the electrofishing results should be compared with those of earlier surveys. Hopefully, these two surveys will provide insights into whether the rainbow trout population has declined.

Spawning-Run Surveys

If rainbow trout recruitment appears to be declining, it is recommended that the Park and the Department jointly sponsor a graduate student study of trout spawning and spawning conditions in Manzanita Creek. This proposed study may involve trapping the spring and fall runs, mapping spawning sites, and evaluating egg-to-fry survival. Care should be taken to avoid spawning related mortalities that could potentially be increased through the operation of traps, etc. The information provided by this

proposed study should produce baseline spawning-run counts and reveal any major problems with available spawning habitat and egg-to-fry survival.

In the meantime, it is recommended that the Department and the Park jointly undertake an assessment of current spawning activity. This assessment should involve determining, roughly, the distribution of the rainbow and brown trout spawning run in Manzanita Creek. No less than three times during the runs, an effort should be made to count the spawners present between the mouth of Manzanita Creek and the upstream paved road crossing and culvert. The approximate lengths of trout in spawning population should also be estimated. These surveys, if conducted systematically, should provide some useful, though acknowledgedly loose, baseline data on the characteristics of the current runs.

Monitoring Angling Success

Angler-Box Surveys

Data on the lengths of trout released by anglers, based on comparisons at Manzanita Lake and other waters, are essentially the same whether collected by a census taker or reported on angler-survey box forms. As a means of measuring whether the size goal set for satisfactory angling is being achieved, box data are considered a very inexpensive and acceptable method.

However, catch rates derived from the angler-box surveys are assumed, as they were in 1990, to be inflated. Therefore, as a means of determining whether the goal for satisfactory fishing (a minimum average catch rate of 0.30 trout/hour), is being attained, box data are not a direct answer. It is also assumed, however, that the bias in angler-survey-box data is consistent.

If, therefore, the 1990 and 1991 catch rates (Figure 8) indicate the goal is being attained, the box data are considered an appropriate means of measuring program success.

Regardless of possible biases, the trends in fishing success shown by angler-survey-box data are considered quite useful. Data collection, compilation, and evaluation take place during the use of the boxes to monitor trout recruitment.

Creel Censuses

The 1990 creel census or angler survey provided a long needed and accurate assessment of the Manzanita Lake fishery. Generally, the Department's Wild Trout Project tries to conduct a census on heavily used and productive designated wild trout fisheries at least once every five years. Manzanita Lake, acclaimed as one of the best trophy-trout lakes in California, should warrant a census at five year intervals. Therefore, a census has been scheduled (Program Implementation Schedule), but given the Department's current fiscal problems, it appears unlikely the survey will be conducted.

The primary factor in deciding when California's "blue ribbon" wild trout waters will be censused in the future will be the need for information. If a fishery is, based on existing monitoring programs, doing well, scheduled programs are likely to be cancelled. If, however, there are environmental problems, a special angling regulation appears need, or an existing one is not working effectively, scheduled censuses will be given a priority. Regardless, California's most valuable wild trout waters warrant censusing at no less than 10-year intervals.

Limnological Surveys

Except for the continuing fish population surveys conducted at Manzanita Lake, very little is known about physical, chemical and biotic composition and the relationships among biological and environmental components in the Manzanita Creek system. NPS objectives for managing lakes and streams in the park require a holistic approach. If such an ecosystems approach to management is to succeed, the chemical and biotic components and the range of seasonal and annual variation in these components must be measured. Initial surveys proposed will sample at a number of dispersed sites, at various depths, and during each of the four seasons. Parameters surveyed will include temperature, pH, dissolved oxygen, specific conductance, and total dissolved solids. Sampling will be conducted for periods of 24 hours at half-hour intervals.

The primary analysis will emphasize determining basic productivity based on variation in dissolved oxygen over the 24-hour sampling periods. In addition, chronological variation and trends will be determined for all five variables. Following this inventory of natural variation, the program will be scaled back to monitor at intervals necessary to detect change related to management and use.

REFERENCES

(Will be added in a later draft)

TABLE . Program Implementation Schedule for the Manzanita Lake Wild Trout Management Plan from 1993 through 1997.

Task	Responsible agency	Implementation date
A. Fishery Management		
1. Monitoring rainbow trout recruitment		
a. Angler box surveys		
1) Maintaining boxes	IFD-NPS	Annually
2) Compiling data	IFD	Annually
3) File report	IFD-Region 1-NPS	Annually
b. Trout population surveys		
1) Snorkeling survey	Region 1-IFD	If needed
2) Boat electrofishing survey	Region 1-NPS	If needed
c. Spawning run surveys		
1) Spawner assessments	Region 1-NPS	1994-1995-1996
2) Spawning habitat assessments	Region 1-NPS	1994-1995-1996
3) Trapping spawning run	HSU-Region 1-NPS	If needed
4) Spawning site mapping	HSU-Region 1-NPS	If needed
5) Egg-fry survival study	HSU-Region 1-NPS	If needed
2. Monitoring angler success		
a. Angler box surveys (as above)		
b. Angler census		
1) Coordination	Region 1-NPS	1995
2) Man and supervise	Region 1	1995
3) Compiling data	IFD	1996
4) File report	IFD-Region 1-NPS	1996
3. Limnological studies	NPS	1995-1997
4. Age and growth study	IFD	1995
5. Eradicating golden shiners from Reflection Lake	NPS-Region 1	If approved
B. Coordinating Habitat and Recreational Use Management		
1. Coordinating proposed physical changes in lake or tributary habitat	NPS-Region 1-IFD	As needed
2. Coordinating proposed changes in recreational use policies affecting the lake fishery	NPS-Region 1-IFD	As needed
C. Park Visitor and Angler Education		
1. Informational sign describing management of the lake fishery		
a. Developing text-layout	IFD-NPS-Region 1	1995
b. Matching above to NPS standards	NPS	1995
c. Construction and installation	IFD-NPS-Region 1	1995
d. Maintenance	NPS	As needed
2. Developing a campfire slide presentation on management of the lake fishery.	IFD-NPS-Region 1	1995

Limnological Surveys

Except for the continuing fish population surveys conducted at Manzanita Lake, very little is known about physical, chemical and biotic composition and the relationships among biological and environmental components in the Manzanita Creek system. NPS objectives for managing lakes and streams in the park require a holistic approach. If such an ecosystems approach to management is to succeed, the chemical and biotic components and the range of seasonal and annual variation in these components must be measured. Initial surveys proposed will sample at a number of dispersed sites, at various depths, and during each of the four seasons. Parameters surveyed will include temperature, pH, dissolved oxygen, specific conductance, and total dissolved solids. Sampling will be conducted for periods of 24 hours at half-hour intervals.

The primary analysis will emphasize determining basic productivity based on variation in dissolved oxygen over the 24-hour sampling periods. In addition, chronological variation and trends will be determined for all five variables. Following this inventory of natural variation, the program will be scaled back to monitor at intervals necessary to detect change related to management and use.

REFERENCES

(Will be added in a later draft)