

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

EAGLE LAKE
FISHERY MANAGEMENT PLAN

2005 through 2010

by

Michael Dean
and
Paul Chappell



Northern California—North Coast Region

2005



TABLE OF CONTENTS

	Page No.
EXECUTIVE SUMMARY	4
FORWARD	5
 RESOURCE STATUS	
Description of the Area	
General Setting	6
Eagle Lake Area Map	6
History of the Fishery	
Historic Trout Population Size and Use of Pine Creek	7
Unique Seasonal Attributes	7
Unique Eagle Lake Rainbow Trout Characteristics	8
Past Angler Use and Success	8
Angler Surveys: Past and Present	8
Angler Opinion Survey	9
History, Need and Operation of Egg Taking Station	10
Rearing and Marking of Artificially Propagated Trout	12
Stocking of Reared Trout	12
Trucking Trout from Pine Creek Fish Trap	13
The Current Fishery	
Aquatic Species Present	13
Trout Growth and Size	13
Hooking Mortality	14
Angling Regulations: Past and Present	14
 ENVIRONMENTAL PROBLEMS AND ISSUES	
Restoring the Natural Run: Opportunities and Roadblocks	14
Fish Barriers (Eagle Lake tributaries)	15
Brook Trout in Natural Spawning and Rearing Areas	15
 MANAGEMENT PROGRAM	
Management Goals	17
Management Objectives	17
Fishery Management Elements	
Monitoring the Fishery	17
Angling Regulations	17
Continued Egg-take, Hatchery Rearing and Stocking Operation	17
Pine Creek and the 'Natural Run'	18
Management Alternatives Considered	19
Wild and Heritage Trout Designation	20

REFERENCES	21
------------------	----

ATTACHMENTS

1. California Fish and Game Commission Wild and Heritage Trout Policy	22
2. List of individuals, agencies and organizations providing comments	24

EXECUTIVE SUMMARY

Largely as a result of highly alkaline water, Eagle Lake may be the only lake in California with its native fish assemblage still intact (Moyle, 2002). The native Eagle Lake rainbow trout (*Oncorhynchus mykiss aquilarum*) has adapted to this harsh but productive environment and can live up to eleven years. It is thriving today as a result of an artificial propagation program. This document is intended largely as an operations guide for planning purposes and to communicate management direction.

Beginning in the 1940s the California Department of Fish and Game (CDFG) became concerned that the number of Eagle Lake rainbow trout was dangerously low and action was needed to prevent extinction. Natural reproduction in the only suitable spawning tributary, Pine Creek, is tenuous at best as a result of low and inconsistent stream flow. Relatively few juvenile trout could be produced in a good year and year-class failure would occur in some years. In 1958 a barrier was constructed and in 1959 a trapping and artificial spawning-rearing program was established to provide progeny for stocking back into the lake. The current artificial propagation program has been very successful and the lake now supports a popular and productive trophy trout fishery. These fish will also thrive in other freshwaters, and progeny are produced for stocking elsewhere in California.

In the spring of each year, adult Eagle Lake rainbow trout are trapped as they enter Pine Creek. About two million eggs are collected, fertilized, water hardened and shipped to various State trout hatcheries for rearing. Annually, about 200,000 of the resulting best-quality progeny are stocked back into the lake. Annual stocking occurs in the spring near the south end of the lake and again in the fall near the north end of the lake. This program is intended to provide as 'wild' a fish as possible, so no hatchery brood stock is maintained.

Restoration of a naturally spawning component to the population is very desirable and being pursued. However, even under ideal conditions Pine Creek is not capable of producing enough juvenile Eagle Lake rainbow trout to support a significant fishery in the lake. Therefore the artificial propagation program will be continued.

Management Goals

- Maintain a high quality trophy trout fishery in Eagle Lake
- Restore a naturally spawning component to the Eagle Lake rainbow trout population
- Maintain good public access

Management Objectives

- Maintain average size of creel fish at least 18 inches (total length)
- Maintain catch-rate of at least 0.4 trout per hour (based on angler survey)
- Remove remaining fish migration barriers in Pine Creek
- Eradicate or control brook trout in Pine Creek
- Provide a means to allow adult trout access to Pine Creek upstream of the trap

Monitoring the Fishery

- Angler opinion surveys should be conducted every five years.
- Statistically valid angler creel surveys will be conducted annually.
- Limnological surveys (pH, alkalinity) will be conducted weekly from June through October.

FOREWARD

California Fish and Game Commission policy (Attachment 1) requires management plans be prepared for all waters designated within the "Wild and Heritage Trout Programs" (WTP). Pursuant to this policy, program staff has prepared plans for many designated waters. More often than not, these plans have become comprehensive in scope covering numerous resource issues and include large amounts of background information, geographic and botanical data, and an assortment of miscellaneous data and material of general interest. Unfortunately, the volume of this information results in a plan so large it is often difficult to prepare and update, and plans are often less than 'user friendly'. Further, as the WTP has grown, plans have become outdated and staff can no longer keep up with this mandate.

Fishery management plans need only address fishery management. Other issues often included are directly related to timber and land management, water quality and quantity, water diversion and use, and nonfishery recreational issues. While these issues and associated information are interesting and often pertinent, they are almost always under the jurisdiction and purview of other programs within the CDFG and other agencies. Including these discussions and concerns does not significantly add to the effectiveness or intent of the fishery management plan.

Therefore we have established a shorter, more concise management plan format dealing specifically with fishery management. Information relating to other aspects of aquatic system management will be minimized and left to more appropriate management plans (e.g., a watershed management plan). References directing the reader to other information sources will be made where available and appropriate.

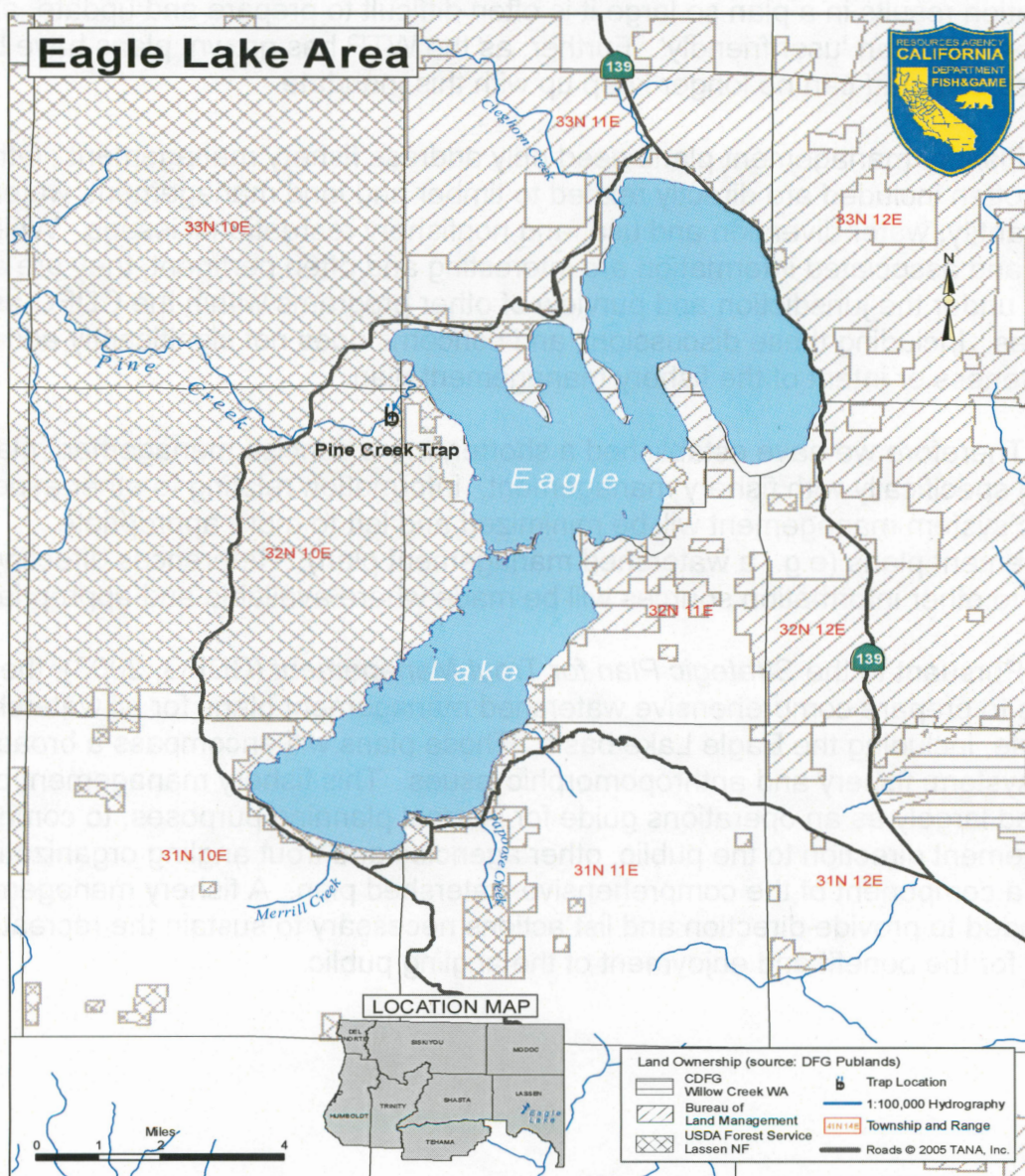
Pursuant to the *Strategic Plan for Trout Management* (CDFG, 2003), the CDFG intends to prepare comprehensive watershed management plans for all watersheds in the State, including the Eagle Lake basin. These plans will encompass a broad range of ecosystem, fishery and anthropomorphic issues. This fishery management plan is intended largely as an operations guide for internal planning purposes, to communicate management direction to the public, other agencies and trout angling organizations, and will be a component of the comprehensive watershed plan. A fishery management plan is intended to provide direction and list actions necessary to sustain the recreational fishery for the benefit and enjoyment of the angling public.

RESOURCE STATUS

Description of the Area

General Setting

Eagle Lake is located about 15 miles north of Susanville in northeast California at about 5,100 feet above sea level. This part of California is generally considered high desert. The northern end of the lake is surrounded by sage-scrub while the southern end is situated in mixed coniferous forest. The area is largely surrounded by Federal lands but some private holdings occur along portions of the lake. The lake is roughly 25,000 surface acres in size with a maximum depth of about 100 feet. The water of Eagle Lake is highly alkaline, making it unsuitable for most freshwater fish species. Fish occurring in the lake are uniquely adapted to this alkaline environment.



History of the Fishery

Historic Trout Population Size and Use of Pine Creek

Historically (pre-1949) the trout population inhabiting Eagle Lake was small, probably less than a few thousand adult fish, although some historic anecdotal information suggests the population may have been larger prior to 1900. The population was (and remains) adfluvial in nature, meaning adults spent most of their lives in the lake and only moved into the tributaries to spawn, primarily using Pine Creek. The resulting offspring reared in the creek for one or two years before migrating to the lake. Pine Creek was the principal spawning and rearing tributary, and other streams may have been used during wet years. However, only Pine Creek provided adequate flow and suitable water quality for successful spawning and rearing, and even it was (and continues to be) very inconsistent. There were certainly periods of several years where no successful spawning occurred.

Further, although trout were present in the lake, their numbers were so low, no viable sport fishery existed. John Snyder reported "...it is difficult to catch this trout in the lake" (Snyder, 1940). This was probably because there were so few. It was not until about 1960 when the effects of artificial spawning and rearing operations augmented the population to the point that a meaningful recreational fishery developed.

The CDFG initially began the artificial propagation program to halt the severe population decline that was apparent, potentially preventing extinction. This effort was so successful that a recreational fishery developed. Over time, spawning and stocking efforts were refined and directed toward bolstering this developing fishery. As a result of these efforts, the fishery has become very productive, widely known and very popular.

Unique Seasonal Attributes

The surface of Eagle Lake usually begins to freeze by late November and can be completely frozen by early January. During the transition period, surface ice and cold temperatures make fishing difficult, and once frozen, some ice fishing is possible (see current angling regulations section). After the spring thaw, fish are distributed throughout the lake until lengthening days and high sun angle warm the water, making trout habitat less suitable in the northern basin. This effect continues, driving trout to the deeper, cooler waters at the southern end of the lake. These dog-days of summer can provide some good angling but fish are generally deep. By late September and into October surface water cools to the point that fish begin to move into shallower water and feed aggressively on insects and native tui chub where anglers are more successful.

Unique Eagle Lake Rainbow Trout Characteristics

It appears that until about 10,000 years ago Lahontan cutthroat trout were the only salmonid fish present in Eagle Lake. As the climate became warmer and drier, Pine Creek was no longer a suitable spawning tributary and they became extinct (Behnke, 2002). Eagle Lake rainbow trout appear to have been derived from an ancestral coastal rainbow-redband form that moved into the Eagle Lake basin through a headwaters transfer from the Pit River within the last 10,000 years (Behnke, 1992). As the climate became drier, the lake became more alkaline. The ancestral rainbow-redband trout adapted to this harsh environment and evolved into an apparent separate subspecies. It should be noted here that, although these fish are currently described as a separate subspecies, some believe (Weins, 1981; Behnke, 1992) they may not satisfy the definition of a subspecies based on degree of distinction from other species and subspecies. In this case, Eagle Lake rainbow trout would simply be considered *Oncorhynchus mykiss*, or coastal rainbow trout.

Eagle Lake rainbow trout are unique in several respects. Based on scale analysis and capture of tagged and marked fish, we have determined they are fairly long-lived. While most rainbow trout live three to five years (on average), these fish can live up to 11 years. Their ability to live twice as long as most rainbow trout may be an evolutionary adaptation and essential to the species survival, considering that successful reproduction in Pine Creek may only have been possible once every several years.

Further, these fish are capable of not only surviving but actually thriving in waters with a pH well in excess of 8.4 and can survive in a pH up to 9.8. Other trout species (with the exception of Lahontan cutthroat) generally cannot tolerate pH more than about 8.4 as a result of the severe inhibition of branchial ammonia excretion (Wright, 1992). This ability to survive harsh alkaline conditions gives these fish the ability to grow exceptionally well in less alkaline conditions found in most other freshwaters in California. This makes Eagle Lake rainbow trout ideal for use in put-and-grow and catchable trout programs throughout the north State.

Past Angler Use and Success

As noted above, the fishery in Eagle Lake was very limited before the artificial spawning and rearing program was developed. The lake experienced little angler use and few fish were available for harvest. Angler success was extremely low.

Angler Surveys: Past and Present

Angler creel surveys were conducted sporadically from 1964 through 2000. These surveys were not statistically designed and some results are of limited value. Subsequently, a stratified random sampling design was developed to provide more statistically rigorous results. This sampling protocol is still in use today. A summary of

important and meaningful results from more recent angler surveys is provided in Table 1. It should be noted that the number of anglers, total hours and total catch are observed values and have not been expanded. This data represents a minimum number in each case. Catch-per-unit-effort (CPUE or trout caught per hour) is a calculated value and is indicative of angling success in each year.

Table 1. Summary of past angler creel survey data and Pine Creek trap data.

Year	# Anglers	# Hours	Catch	CPUE	Average Trout Length (in.)	Average Length @ Pine Creek trap (in.)
1983	656	2,490	541	0.2	16.0	--
1984	789	2,972	487	0.2	17.0	--
1985	714	3,154	714	0.2	16.6	--
1986	1,326	5,284	659	0.1	18.7	--
1987	1,939	7,928	1,240	0.2	16.9	--
1988	1,473	5,763	1,443	0.3	16.8	--
1989	1,349	5,523	946	0.2	17.0	--
1991	976	4,027	966	0.2	17.9	--
1992	1,519	6,262	1,262	0.2	16.5	--
1993	1,080	4,441	1,152	0.3	17.0	--
1994	1,305	1,973	1,223	0.6	16.9	--
1995	654	2,519	597	0.2	17.1	--
1999	1,086	3,568	1,297	0.4	17.5	17.4
2000	985	3,329	1,446	0.4	18.0	18.3
2001	--	--	--	--	--	19.5
2002	2,519	8,686	3,119	0.4	17.4	--
2003	2,239	8,047	2,523	0.3	17.3	17.8
2004	2,189	7,424	2,274	0.3	17.2	17.1
Average	1,341	4,905	1,254	0.3	17.2	18.0

- Notes: 1) Surveys were not conducted in 1990, 1996, 1997, 1998, or 2001.
 2) CPUE is the number of trout caught per hour.
 3) Number of anglers, number of hours and catch represent data from anglers interviewed, not the total (expansion) for a given year.
 4) Dashed lines (--) indicate data not available.

Angler Opinion Survey

An angler opinion survey was conducted in 2000 to determine angler satisfaction and several angling related parameters. This study was designed to provide an unbiased, statistically valid method to evaluate the current fishery and angler opinion.

Experts in the fields of economics, statistics and demographics were consulted to assure the survey would provide the required impartiality needed to achieve objectives. The protocols developed by this team of experts provided data collection techniques valid for this and any comparable future surveys at Eagle Lake.

Some of the more pertinent and interesting findings of the 2000 Angler Opinion Survey are:

- 89% of anglers interviewed were very or somewhat satisfied with their overall angling experience.
- 77% of anglers interviewed were satisfied with the current legal take limit (2 trout per day, 4 in possession).
- 86% of anglers interviewed were satisfied with the size of trout caught.
- 81% of anglers interviewed were satisfied the number of trout caught on an average day.

Complete results, methods, and discussion can be found in the Eagle Lake Angler Opinion Survey 2000, available from the CDFG at 601 Locust Street, Redding, CA 96001, or by calling (530) 225-2300.

History, Need and Operation of Egg Taking Station

As far back as 1913, John Snyder observed that many trout were stranded and died in Pine Creek (Snyder, 1940). He stated these native trout ...“lead a precarious existence” since “The only spawning and nursery stream is Pine Creek, a small tributary with a fitful flow. Often many spawning fish are cut off by low water before they return to the lake, and many young trout are destroyed in a like manner”. Snyder later reported the Eagle Lake rainbow trout population observed in Pine Creek was in jeopardy of extinction as a result of habitat degradation (unpublished report). Principal causes were low stream flows (drought effects), logging, excessive livestock grazing, poorly engineered and poorly installed railroad and road grades, and water diversions. Historical records are unclear but few apparent corrective actions were taken.

By the mid-1940s, the population of Eagle Lake rainbow trout had decreased to the point that the CDFG became concerned they might become extinct without some intervention. It was decided that an experimental egg taking program should be initiated to provide augmentation to the remaining population. In 1949 and 1950, Harry Chandler (fishery biologist, CDFG) collected 35 and 75, respectively, adult Eagle Lake rainbow trout at the Pine Creek estuary. These fish were artificially spawned and eggs were incubated and reared at Clear Creek State Fish Hatchery, Lake Almanor. The resulting progeny of the 1949 spawning (258 yearlings) were stocked back into the upper reaches of Pine Creek. Unfortunately, it appears brook trout were being stocked into the same areas. It is therefore doubtful that many of the artificially spawned Eagle Lake rainbow trout survived. Those fish collected in 1950 were held at Crystal Lake State Fish Hatchery until their release into the Pine Creek estuary in 1956. Between 1951 and 1958 some eggs were taken near Bogard but records are unclear and incomplete.

In 1959 the CDFG, with funding from the Wildlife Conservation Board, constructed the Pine Creek egg taking facility which is still in use. There have been some minor modifications to the facility to improve effectiveness and operation, but it is operated in much the same way today as it was in 1959.

Once the egg quota was met at the new egg taking facility, trout continued to ascend Pine Creek attempting to spawn. Because the streamflow in Pine Creek is so inconsistent and short-lived, nearly all these fish were stranded and died. Local residents made numerous attempts to rescue these fish, with little success. This situation continued until 1990 when CDFG staff began to operate the trap even after the cessation of egg collection to obtain biological data and help minimize fish loss in the creek. In some years as many as 12,000 fish were processed and rescued from the trap.

This process was stressful on fish and required excessive personnel time and expense. Consequently, beginning in 2002 an Alaskan style fish weir was installed near the mouth of Pine Creek to prevent trout migration into the creek. This weir is now installed as soon as fish migration begins. Center sections are removed just prior to the egg taking operation (allowing fish to enter the creek and trap) and reinstalled once egg taking is complete. This effort dramatically lowered the number of fish rescued and significantly reduced resulting trout mortality. Funding for the weir was provided by the California Inland Fisheries Foundation, Project Eagle Lake Rainbow Trout. These donations and help from the angling public are critical to the success of this project.

Trout begin to move out of the lake when water temperatures in Pine Creek reach about 40°F, which can occur anytime from March through April. At this point, sections of the weir are removed and the trap is opened allowing fish to enter. Trapped fish are sorted by size and sex, and their sexual maturity determined. Once an adequate number of ripe females are obtained, CDFG hatchery staff collect eggs which are immediately fertilized, water hardened and shipped to Crystal Lake State Fish Hatchery for incubation and subsequent rearing. Those eggs destined for the Eagle Lake trophy trout program are reared at both Crystal Lake and Darrah Springs State fish hatcheries. The remaining eggs are transported to other State fish hatcheries for other fishery programs.

Once the egg quota is obtained, the weir is closed to prevent further upstream immigration from the lake. The trap remains open to capture those fish remaining in the creek, and those fish not entering the trap are rescued by hand and returned directly to the lake. Biological information (length, weight, sex, presence of marks, etc.) is collected from most fish entering the trap. They are then transported to, and released at the south end of the lake. When water temperatures rise above about 55°F, fish migration stops, the trap is closed and the weir is removed.

All trout processed through the trap are marked with an adipose fin clip for future identification at the trap and in angler creel surveys. This marking procedure will also allow us to estimate the effectiveness of the current postspawn trap and rescue operation by estimating survival of these fish and their contribution to the fishery.

Since the 1959 installation of the egg taking facility, fish migration beyond the Pine Creek trap has been blocked to prevent the historic fish loss. Recently, some adult spawners have been radio-tagged and moved above the barrier to determine their ability to successfully migrate to spawning and juvenile rearing areas upstream of Bogard. Results have been mixed and very dependent on water year, especially the size of the snow pack in headwater areas. Future studies are planned but should only be conducted when the snow pack is large enough to ensure adequate stream flow for the duration of the study. Results must be considered in the effort to restore a naturally spawning component to the population.

Rearing and Marking of Artificially Propagated Eagle Lake Rainbow Trout

Equal numbers of trout destined for Eagle Lake are reared at both Crystal Lake and Darrah Springs State fish hatcheries. This practice ensures the availability of a large stocking allotment should a catastrophic event occur at one of the hatcheries. Trout to be planted in the spring are reared at Darrah Springs and about 20,000 are marked each year with a freeze brand on the left side. Trout to be planted in the fall are reared at Crystal Lake and about 20,000 are marked each year with a freeze brand on the right side. The freeze branding program will allow us to:

- Estimate the current trout population in the lake (Peterson mark-recapture method)
- Evaluate year class performance by release group
- Evaluate harvest rate by year class

All fish reared and stocked into the lake are derived from eggs taken directly from returning 'wild spawners' (F1 generation). No hatchery brood stock is maintained for the Eagle Lake trophy trout program. This practice is intended to minimize possible domestication effects.

Stocking of Reared Trout

Currently, CDFG annually stocks about 200,000 Eagle Lake rainbow trout into the lake and about 1,000 into upper Pine Creek. Trout are reared to two-to-the-pound prior to release. About 100,000 fish reared at Crystal Lake Hatchery are stocked each fall near the Pine Creek estuary or at Stone's Landing, depending on water quality. About 100,000 reared at Darrah Springs Hatchery are stocked each spring at the South Shore Marina. Fall versus spring stocking strategies each have potential benefits and risks (i.e., abundant food vs. longer 'growing season'). Pending results of current studies, we may change the number of fish stocked at each location. One thousand fish are stocked into Pine Creek in an attempt to control brook trout (see Brook Trout in Natural Spawning on page 15).

Loading, transporting and stocking are always stressful on fish. Due to the unique water quality conditions in Eagle Lake, especially high pH, it is important that fish are transported at densities lower than 'normal' to minimize stocking stress and associated mortality. This stress-reducing practice should be continued.

Trucking Trout from Pine Creek Trap

All trout spawned at the Pine Creek trap and those entering the trap after the egg taking operation is complete are returned to the lake. Historically fish were simply returned to the lake at a convenient location near the north end. The majority of these fish re-entered the trap within twenty-four hours. This caused undue stress on fish and complicated trap operations. Therefore, we began transporting these fish by truck to the south end of the lake to minimize return rates. Using this technique, less than 1% of these fish return to the trap. This practice reduces fish stress and mortality and keeps more fish available in the fishery.

The Current Fishery

Aquatic Species Present

Aside from the disappearance of Lahontan cutthroat trout and the appearance of Eagle Lake rainbow trout, the fish assemblage in the lake is apparently the same as it was more than 10,000 years ago and is typical for waters in the Lahontan basin. Eagle Lake is apparently the only large lake in California where the historic fish assemblage is still present (Moyle, 2002).

The following fish species can be found in Eagle Lake:

- | | |
|----------------------------|--|
| • Eagle Lake rainbow trout | <i>Oncorhynchus mykiss aquilarum</i> |
| • Lahontan redbreast | <i>Richardsonius egregius</i> (Girard) |
| • Tahoe sucker | <i>Catostomus tahoensis</i> (Gill, Jordan) |
| • Tui chub | <i>Gila bicolor</i> (Girard) |
| • Speckled dace | <i>Rhinichthys osculus</i> |

Numerous aquatic invertebrate species can also be found in the lake including mayflies (Ephemeroptera), caddis flies (Trichoptera), stoneflies (Plecoptera), black flies (Simuliidae), shoreflies and gnats (Diptera and others), leeches, a few gastropods, various zooplankton (*Daphnia*, *Leptodora*, *Hyaella*) and scuds (Amphipoda) (Moyle, 2002).

Trout Growth and Size

Eagle Lake rainbow trout are typically stocked at two-to-the-pound averaging about 11.5 inches in total length. However, fish stocked in the spring are usually smaller, averaging about 10 inches, while fall stocked fish are larger, averaging about

13 inches. After stocking, fish typically grow about three inches per year. By the end of the third year, length growth slows and average weight increases. The average size of creeled fish varies from about 16 to 18.5 inches, depending on annual water quality. The largest fish ever recorded from Eagle Lake was 30 inches in length.

Hooking Mortality and Catch-and-Release Angling

In most freshwaters, incidental hooking mortality is typically about 5% when using artificial lures and about 50% using bait (Taylor, 1992). The CDFG often encourages catch-and-release fishing to reduce impacts to the fish population and maintain higher catch rates. Eagle Lake is unique in that water quality is often so stressful to fish that catch-and-release fishing results in hooking mortality rates much higher than that for cooler, nonalkaline waters. Therefore, in general, catch-and-release angling is discouraged during the warm summer months. When the pH rises above 9.4 and surface water temperature exceeds 60°F, the CDFG posts signs around the lake requesting that anglers keep fish up to the legal limit, and not practice catch-and-release fishing.

Angling Regulations: Past and Present

Current angling regulations do not require the use of artificial lures or special terminal fishing tackle, nor is there any size restriction. Prior to 1992, the bag limit was three trout per-day with three in possession. In 1992, the CDFG recommended that the California Fish and Game Commission reduce the daily bag limit to two trout but increase the possession limit to four trout. The Commission enacted this recommendation. The fishing season is from the Saturday preceding Memorial Day through December 31.

The area inside the breakwater at the Gallatin Marina, the Pine Creek Slough and Pine Creek between Eagle Lake and State Highway 44 are closed to all angling. Pine Creek upstream of State Highway 44 is open to angling under "Special Trout Regulations" (Saturday preceding Memorial Day, no special gear requirements, 5 trout per-day, 10 in possession). This upper area of Pine Creek supports a large population of nonnative brook trout that may be hindering re-establishment of a wild spawning component to the Eagle Lake rainbow trout population (Moyle, 2002). Anglers are encouraged to harvest brook trout from this area.

ENVIRONMENTAL PROBLEMS AND ISSUES

Restoring the Natural Run: Opportunities and Roadblocks

Some believe that by restoring Pine Creek as a spawning and rearing tributary, the Eagle Lake rainbow trout population could eventually return to a naturally spawning condition. We must review the historic condition of the creek and the run, and realize that, at most, Pine Creek could produce only a few thousand one and two-year-old fish

to out-migrate to the lake. While a wild, naturally spawning component to the population is very desirable, it is unrealistic to believe it could support a significant fishery in the lake.

The current opportunities to restoring Pine Creek as a spawning and juvenile rearing tributary include eliminating a few possible remaining migration barriers and the extirpation of nonnative, very competitive brook trout. The restoration of the Pine Creek run component is important in maintaining the larger population's genetic diversity through natural selection and should continue to be pursued. Restoring the Pine Creek run is also important in maintaining the legacy of this unique heritage trout.

However, the Eagle Lake area is largely a desert with average precipitation less than 15 inches annually and porous volcanic soils. We must recognize that the major roadblocks are inadequate and inconsistent stream flows, and the consequent inability of the creek to produce a significant and consistent number of trout progeny. This is true even in wet years when spawning conditions are good. Further, these 'good conditions' occur only about one in 10 years. Therefore, we should continue to maintain the artificial propagation program to provide sufficient numbers of trout available for this quality trophy trout fishery.

Fish Barriers (Eagle Lake tributaries)

In addition to Pine Creek, there are several small tributary streams entering Eagle Lake. These streams are all very seasonal and rarely carry water for more than a few months, making them unsuitable for spawning or juvenile rearing. In wet years, trout leave the lake attempting to ascend these streams to spawn. This almost always results in considerable fish loss when adult trout are stranded as flows rapidly recede. In no case is successful juvenile recruitment possible. Consequently, to prevent such ill-fated trout spawning migrations, CDFG staff has constructed permanent barriers in the lower reaches of some streams and temporary barriers on others.

Brook Trout in Natural Spawning and Rearing Areas

Brook trout were stocked in the upper reaches of Pine Creek from the late 1930s through 1949 to provide diversity in angling opportunity. It was not until 1949 that it was realized brook trout were out-competing the native Eagle Lake rainbow trout. Subsequently, the stocking of brook trout was discontinued and until 1976 fingerling Eagle Lake rainbow trout were substituted. Unfortunately, this action likely only contributed to the success of brook trout, since fingerling trout provide good forage. Consequently, brook trout remain well established in the headwaters of Pine Creek.

Currently, we are attempting to control the brook trout population by stocking one-year-old Eagle Lake rainbow trout in the upper main stem of the creek (about 1,000 annually). The goal is to reduce the brook trout population through predation. We recognize this technique will not eliminate all brook trout from the upper main stem reach and may be ineffective in the braided headwater and spring areas. However, if

brook trout numbers can be lowered below a critical threshold with this technique, significant Eagle Lake rainbow trout natural recruitment may be possible. Periodic estimates of brook trout density in index reaches will be used to estimate effectiveness. If this effort proves unsuccessful, we will consider other options, such as chemical treatment.

While chemical treatment (rotenone) may be the most effective tool available for the eradication of brook trout, the present political climate does not support its use as a first option. Further, chemical treatment is not a panacea with guaranteed results. Brook trout are a tenacious species, capable of finding refuge deep in rocky spring and headwater areas. After an extensive chemical treatment, a few surviving brook trout could repopulate the creek within a few years. Therefore, for a chemical treatment to be successful, it must be carefully planned and diligently carried out. A part of this plan should include a public education component to prevent an illegal reintroduction.

CDFG along with the U.S. Forest Service (USFS) and other interested individuals and organizations (esp., Pine Creek Coordinated Resource Management Planning group or CRMP) remain committed to working toward restoring a naturally spawning component to the Eagle Lake rainbow trout population. Pine Creek provides the only opportunity to realize this goal. The removal of brook trout is paramount to the success of this effort.

MANAGEMENT PROGRAM

Management Goals

- Maintain a high quality trophy trout fishery in Eagle Lake
- Restore a naturally spawning component to the Eagle Lake rainbow trout population
- Maintain good public access

Management Objectives

- Maintain average size of creel fish at least 18 inches (total length)
- Maintain catch-rate of at least 0.4 trout per hour (based on angler survey)
- Remove remaining fish migration barriers in Pine Creek
- Eradicate or control brook trout in Pine Creek
- Provide a means to allow adult trout access to Pine Creek upstream of the trap

Fishery Management Elements

Monitoring the Fishery

- Angler opinion surveys should be conducted every five years.
- Statistically valid angler creel surveys will be conducted annually.
- Limnological surveys (pH, alkalinity) will be conducted weekly from June through October.

These surveys are critical to proper management of the fishery and are expensive to conduct. Funding has been, and continues to be provided by the California Inland Fisheries Foundation, Project Eagle Lake Rainbow Trout. The CDFG and the angling public are indebted to this foundation for their continued financial support.

Angling Regulations

Current angling regulations appear to provide adequate protection for the trout population while allowing a popular and productive fishery. We intend to continue recommending the California Fish and Game Commission maintain current angling regulations unless new information indicates a change is necessary.

Continued Egg-take, Hatchery Rearing and Stocking Operation

If a viable and productive fishery is to be maintained in Eagle Lake, the artificial propagation and stocking program must be continued. In addition to working toward some natural production in Pine Creek, we will continue to take about 2 million eggs per year and stock 200,000 progeny back into the lake. Fish will be reared at both Crystal Lake and Darrah Springs State fish hatcheries to an average weight of two fish to the pound prior to stocking. About one-half of the

fish will be released in the spring at the South Shore Marina and the remainder in the fall at the Pine Creek estuary. Pending results of current studies, we may change the number of fish stocked at each location. About 1,000 yearlings will be stocked annually in Pine Creek in an effort to reduce the brook trout population.

It is important to recognize that the CDFG has adopted an "Eagle Lake Rainbow Trout Select Broodstock Plan." This plan has been approved by the CDFG Hatchery Operations Committee. It specifies, among other things, that, in general, many of the largest of returning spawners will be used as the egg source for the Eagle Lake trophy trout program and no fish from the same year class are paired (crossed) to reduce the chances of a sibling cross. Further, after rearing, only the largest of the graded fish are selected for planting into Eagle Lake. This ensures the best, most robust fish are available to the fishery. This plan also specifies that no broodstock will be maintained for the program to minimize possible domestication effects. This plan also specifies that egg taking operations should be temporally spaced to ensure eggs are taken across the spawning run, to avoid unnaturally altering run-timing.

All Eagle Lake rainbow trout destined for Eagle Lake will be transported at lower than 'normal densities' to minimize stocking stress and associated mortality.

In addition, the CDFG has found that Eagle Lake rainbow trout grow exceptionally well in other waters throughout the State and are ideal for other stocking programs, primarily put-and-grow and put-and-take. They are also a critical component in the hatchery broodstock program. Therefore, of the 2 million eggs taken, about 1.5 million will be reared for these uses. This egg source is a valuable resource to California anglers.

Pine Creek and the 'Natural Run'

The CDFG will continue work with the USFS, the Pine Creek CRMP and others to restore a naturally spawning component to the Eagle Lake rainbow trout population. However, action on this issue must proceed with caution, considering that in most years, streamflow is generally too low to support adult trout. Consequently, to avoid unacceptable mortality (and little or no successful juvenile trout recruitment) adult trout must only be passed above the barrier following wet winters with substantial spring snow pack. This will provide the greatest opportunity for successful spawning and rearing, and minimize adult trout losses. We should also explore various ways of passing trout above the barrier, such as trucking trout above the canyon reach downstream of Bogard, moving fish just above the trap, or installation of some type of fishway. The method yielding the greatest spawning and rearing success should become the preferred method.

In any case, decisions regarding specific techniques to be used (e.g., radio tags versus PIT tags, or fish ladder versus trucking) will be made by the CDFG unit fishery biologist and CDFG Fishery Program Manager after consultation with our partners at the USFS and Pine Creek CRMP. Specific techniques will not be discussed in this document since technologies are evolving rapidly and new data continues to become available. We intend to move toward establishing a naturally spawning component but must remain adaptable in this effort.

Management Alternatives Considered

Management alternatives evaluated and rejected:

- No action; discontinue artificial propagation program, remove the Pine Creek fish trap and rely on a "100% natural run".
 - This alternative would soon result in a drastic reduction in the trout population and virtually eliminate the existing fishery. Further, the population would likely decline to the point it may warrant listing under the Endangered Species Act (as threatened or endangered), and could eventually become extinct. This action would also have a significant negative effect on current CDFG hatchery operations.
- Reduce the egg take and artificial propagation program to minimal levels and attempt to restore a naturally spawning run in Pine Creek.
 - As discussed above, this option would result in a dramatically reduced fishery in Eagle Lake. The business and angling communities are not likely to find this option acceptable. This action could have a significant negative effect on current CDFG hatchery operations.
- Continue with the artificial propagation program and make no attempt to restore a naturally spawning run in Pine Creek.
 - While this alternative would preserve the existing Eagle Lake rainbow trout population and current fishery, it would not advance our desire to promote a naturally spawning component to the existing trout population.

Management alternative adopted:

- Continue with the artificial propagation program and continue efforts to restore a naturally spawning component in Pine Creek.
 - This option offers the greatest advantage. The greater fishery resources of the State will continue to benefit from the out-planting of Eagle Lake rainbow trout progeny, the current trout population and fishery in Eagle Lake will be maintained and a naturally spawning component to the population could eventually be realized.

Wild and Heritage Trout Designation

In 1999 along with 5 other California native trout waters, Eagle Lake was designated by the California Fish and Game Commission as a "Heritage Trout Water." The Heritage Trout Program (HTP) was created by the Commission in 1998 following a joint recommendation by the CDFG and California Trout. Goals of the HTP are:

- Increase public awareness of the beauty, diversity, historical significance and special values of native trout and their habitat.
- Diversify opportunities to fish for and observe native trout in their historic habitats.
- Build public support and increase public involvement in native trout restoration efforts.
- Increase collaborative efforts with organizations and individuals involved with native trout restoration and management.

By policy, waters designated in the HTP are also designated as wild trout waters. Both these designations make Eagle Lake and its' trout a higher priority for the CDFG, and ensure the highest level of management activity. For example, "Wild Trout Program" staff were instrumental in the preparation of this management plan and Sport Fish Restoration Act funds are used to support various marking operations (e.g., freeze branding). For more information about the HTP or the Wild Trout Program, contact the CDFG's regional office at 601 Locust St, Redding CA 96001, (530) 225-2300 or see our website http://www.dfg.ca.gov/fishing/html/WildAndHeritageTrout/WHTrout_0.htm

REFERENCES

- Behnke, Robert J. 1992. Native Trout of Western North America. American Fisheries Society Monograph No. 6. American Fisheries Society, Bethesda, MD. 275 p.
- Behnke, Robert J. 2002. Trout and Salmon of North America. Free Press, a division of Simon and Schuster, Inc., Chanticleer Press, Inc., New York, NY. 359 p.
- California Department of Fish and Game. 2003. Strategic plan for trout management; a plan for 2004 and beyond. Available from CDFG, Fisheries Program Branch, 1516 9th St Sacramento CA, 95814.
- Kimsey, B. Undated. The Fishes of Eagle Lake, Lassen County CA. Available from CDFG, Susanville, CA.
- Moyle, P.B. 2002. Inland fishes of California. University of Calif. Press, Berkeley, CA. 502 p.
- Snyder, J.O. 1940. The trouts of California. Fish & Game Quarterly Vol. 26 #2 p. 129.
- Taylor, M.J. and K.R. White. 1992. A meta-analysis of hooking mortality of non-anadromous trout. North Am. Jour. of Fish Mgt., 12:760-67.
- Weins, J.A. 1981. Forum: avian subspecies in the 1980's. Auk 99:593-615
- Wright, P.A., G. Iwama, C. Wood. 1992. Ammonia and urea excretion in Lahontan cutthroat trout adapted to the highly alkaline Pyramid Lake. J. Exp. Biol. 175:153-172 (1993).

Attachment 1. Fish and Game Commission Wild Trout Policy

COMMISSION DESIGNATED WILD TROUT WATERS

It is the policy of the Fish and Game Commission to:

- I. Designate certain State waters to be managed exclusively for wild trout. Commission designated wild trout waters should provide a quality experience by providing the angler with an opportunity to fish in aesthetically pleasing and environmentally productive waters with trout populations whose numbers or sizes are largely unaffected by the angling process. Waters designated by the Commission for wild trout management shall meet the following criteria:
 - A. Angler Access:
 1. Open for public angling with unrestricted access when of sufficient dimensions to accommodate anglers without overcrowding.
 - Or,
 2. Open for public angling with controlled access under a plan approved by the Commission setting forth the number of anglers and the method of distribution.
 - B. Able to support, with appropriate angling regulations, wild trout populations of sufficient magnitude to provide satisfactory trout catches in terms of number or size of fish.
- II. Wild trout waters shall be managed in accordance with the following stipulations:
 - A. Domestic strains of catchable-sized trout shall not be planted in designated wild trout waters.
 - B. Hatchery-produced trout of suitable wild and semiwild strains may be planted in designated waters, but only if necessary to supplement natural trout reproduction.
 - C. Habitat protection is of utmost importance for maintenance of wild trout populations. All necessary actions, consistent with State law, shall be taken to prevent adverse impact by land or water development projects affecting designated wild trout waters.
- III. The CDFG shall prepare and periodically update a management plan for each water designated as a wild trout water.
- IV. Certain designated wild trout waters may further be designated by the Commission as "Heritage Trout Waters", to recognize the beauty, diversity, historical significance and special values of California's native trout. Heritage Trout Waters shall meet the following additional criteria:
 - A. Only waters supporting populations that best exemplify indigenous strains of native trout within their historic drainages may qualify for designation.
 - B. Heritage Trout Waters shall be able to provide anglers with the opportunity to catch native trout consistent with the conservation of the native trout present.

- V. Recognizing the importance of native trout to California's heritage, the CDFG shall emphasize education and outreach efforts to inform the public about our native trout, their habitats and the activities for restoration of native trout when implementing the Heritage Trout Program. {A list of designated waters follows in the original text}

Attachment 2. The following is a list of individuals, agencies and organizations providing comments on the DRAFT Eagle Lake Fishery Management Plan.

- USDA Forest Service, Lassen National Forest, Susanville
- Bureau of Land Management, Eagle Lake Field Office
- Dr. Mark Rockwell, Federation of Fly Fishers
- Mr. Stacy Dixon, Susanville Indian Rancheria
- Mr. Martin Balding
- Mr. Jay Fair
- Mr. Wayne Jambois
- Ms. Karen Martin
- Ms. Vicky Scott

We wish to express sincere thanks to all those who spent time reviewing this document. In general, all the reviewers were happy to see a formal plan being prepared and concurred with management direction. Many very thoughtful and insightful comments were provided that helped refine and provide a more concise fishery management plan. Where appropriate, changes and clarifications were made, and in some cases one-on-one discussions provided answers and clarifications to comments and questions. One of our goals in the preparation of this plan was brevity. This allows the document to be easily understood, and easily updated and adapted as new information comes to light. Keeping this document current and working with all our partners and concerned individuals will provide significant benefits to the fishery, the angling public and the local community.