

THE LENTIC RESOURCES
OF
LASSEN VOLCANIC NATIONAL PARK,
CALIFORNIA

by

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ABSTRACT

A fisheries study in Lassen Volcanic National Park took place in the summer of 1976. Fish populations, lake conditions, use and watershed conditions were studied. Findings indicate only 17 of 130 contain fish, and in six of those the fish are remnants of previous stockings. At most, ten percent of the lakes investigated in the park are capable of supporting reproductive salmonid populations, but about 80% of the lakes could support a maintenance stocked fishery.

Under present conditions, the park's lakes are not extremely valuable as a natural trout fishery. Fish stocking is not allowed under current Department of Interior Policy.

INTRODUCTION

Preliminary lake inventories were performed on named and unnamed lakes in Lassen Volcanic National Park between July 19 and September 30, 1976. This study stems from a need for a more detailed knowledge of fishery resources within the park.

The purpose of the study was multiple. First, it identifies and enumerates the water bodies in the park. The inventories identified those lakes in which trout species native to the area could survive and reproduce, and thus be self-sustaining. Problem areas and potential problem areas were identified. Research needs and study areas were noted when found. Evaluations of fish populations were made and recommendations on future management possibilities given. Lastly, unique chemical, physical and biological conditions were noted and management or research recommendations made.

Where deemed necessary, additional special reports were submitted (Appendix A) for some groups of lakes.

The purpose of this paper is to describe, in detail, the materials and methods used to carry out this study. Shortcomings of methods or materials are noted and discussed. The general results of the study are discussed, more specific results on individual lakes may be obtained from lake survey reports on file at Park Headquarters, Lassen Volcanic National Park. A sample lake inventory form is included in Appendix B.

This report should be read before attempting to analyze data from lake survey reports.

HISTORY

Lassen Volcanic National Park, in northern California, forms the southern terminus of the Cascade mountain range just north of the Sierra Nevadas. For this reason, the park and surrounding area, is rich in native flora and fauna.

However, most of the lakes within the park are isolated from major river drainages and most of these waters were naturally barren of fish life.

Introduction of coldwater gamefish became popular in California in the mid and late 19th Century (Ellis and Bryant, 1920). Throughout the latter part of that century, residents, travelers, stockmen and sports groups transplanted trout in many high altitude lakes of California. Transplanting of fish by the general public was in vogue until about 1909, when the Fish and Game Commission took over the job. At present, the California Department of Fish and Game continues to stock trout in many backcountry lakes in the state.

Wilderness in Lassen Volcanic National Park was officially designated in October of 1972 by the legislature through the Lassen Volcanic Wilderness Act (Public Law #92-510). U.S. Department of Interior policy on fishery management in wilderness areas states that it "must be compatible with the purpose or purposes for which the refuge or park was established and administered" (Hester, 1976). Within park natural areas "policies are aimed at perpetuating or restoring, if necessary, the natural scene which might have occurred without the modification of modern man" (Hester, 1976). Thus, stocking of fish within the park has been gradually reduced since 1972. At the present time, four lakes in the park are being stocked, they are: Manzanita, Summit, Butte and Crystal Lakes. According to current policy, stocking will eventually be phased out in all California parks. This policy has generated a good deal of controversy among fishermen and resource managers in California. An estimated 50% of California's high mountain lakes will be affected (Fullerton, 1976).

Trout were not the only strain of fish introduced in California mountain lakes. Species of chubs, suckers and dace were accidentally, and in some cases intentionally, introduced as "trout food" or live bait used by fishermen. In many parts of the state, including some lakes in Lassen Volcanic, these undesirable "trash fish" have caused serious fishery and environmental damage.

MATERIALS AND METHODS

Two men, Mr. Jesse M. Purvis and I, were employed by the National Park Service to complete preliminary lake investigations in Lassen Volcanic National Park. Mr. Purvis was employed for a period of 44 days from August 2 to September 30, 1976. I was employed for an additional ten days from July 19 to September 30, 1976. The volume of work to be completed in this time period made implementation of a 50-hour work week necessary.

The park was divided into 14 Resource Management Units (Figure 1) by the Resource Management Specialist, Alan Denniston. These management units serve as the basis for "Management Unit Reports" (Appendix A, in part) and organization of the work schedule during the study period. The management units are arranged primarily to delineate the major drainage basins within the park.

Figure 1. Lassen Volcanic National Park, Resource Management Units.

The map displays the Lassen Volcanic National Park area, divided into 13 numbered Resource Management Units (RMUs). The units are labeled as follows:

- 1. Bailey Creek
- 2. Bonita Creek
- 3. Ash Butte
- 4. Kings Creek
- 5. Red Mt. Creek
- 6. Bonita Creek
- 7. Kings Creek
- 8. Lost Creek
- 9. Manzanita Creek
- 10. Kings Creek
- 11. Kings Creek
- 12. Kings Creek
- 13. Kings Creek

The map also shows various geographical features, including mountains (e.g., Badger Mtn., Pilot Mtn., Red Mt.), lakes (e.g., Twin Lakes, Snag Lake, Kings Lake), and creeks (e.g., Kings Creek, Bonita Creek, Lost Creek, Manzanita Creek). A grid system is overlaid on the map, with coordinates ranging from 11 to 22 on the horizontal axis and 1 to 13 on the vertical axis.

RESOURCE MANAGEMENT UNITS

Locating and "naming" unnamed lakes was accomplished by use of a modified coordinate system. Lassen Volcanic National Park contains portions of six townships, which are: Township 30 North, Range 4, 5 and 6 East; Township 31 North, Range 4, 5 and 6 East; Mount Diablo meridian. These townships were renamed: SW, SC and SE; NW, NC and NE, respectively, for easier use in reporting on lakes within them (Figure 2).

Pinpointing the location of an unnamed lake within a township was done using the modified coordinate system. Each section was divided into ten segments from west to east (left to right) and another ten segments from south to north. The segments were counted from west to east and then from south to north. An example of the system used is given in Figure 3.

The standard "Lake Survey" form (Appendix B) used by the California Department of Fish and Game was slightly modified for use as a field form during this study. Fish population data sheets and lake inventory forms (Appendix B) were completed and filed in appropriate lake folders upon return from field work.

Each lake survey included measurement or observation of water temperature, color, clarity, depth, bottom and shoreline type, watershed condition and generalizations on type and intensity of use. Additionally, surface area of the lake, inlets, outlets, fishing intensity, accessibility, fish predators and relative abundance of aquatic invertebrates and vegetation were noted. Fish species present, if any, were sampled with rod and reel or experimental gill net.

Water temperature of the lake surface water, inlet(s) and outlet(s) was measured with hand held laboratory thermometers calibrated in degrees Celsius.

Apparent water color was observed from the lakeshore and recorded. Water clarity was estimated in smaller lakes when the boat was not in use. On larger lakes where a boat was used, a rock was attached to a sounding line and lowered over the shaded side of the boat until it disappeared, depth at that point was noted.

Maximum and mean depths were estimated when the boat was not used. When the boat was used, depths were sounded. The mean depth is, in actuality, more likely a median, or most frequently observed depth.

Bottom and shoreline types were classified by the approximate percentage of aggregate size classes used by the U.S. Forest Service (1973). Additionally, density of vegetative cover and type was noted in the classifications. U.S. Forest Service substrate material categories are arranged as follows: Bed rock - exposed rock mass in place; Boulders - large rocks over 5-6 feet in diameter; Rocks - 1-5 feet in diameter; Rubble - 2-12 inches in diameter; Gravel - 1/4 - 2 inches in diameter; Sand - about beach sand size; Mud - finer than sand and inorganic; Organic Debris - finer than sand but organic.

Figure 2. Nomenclature used to identify six townships in Lassen Volcanic National Park.

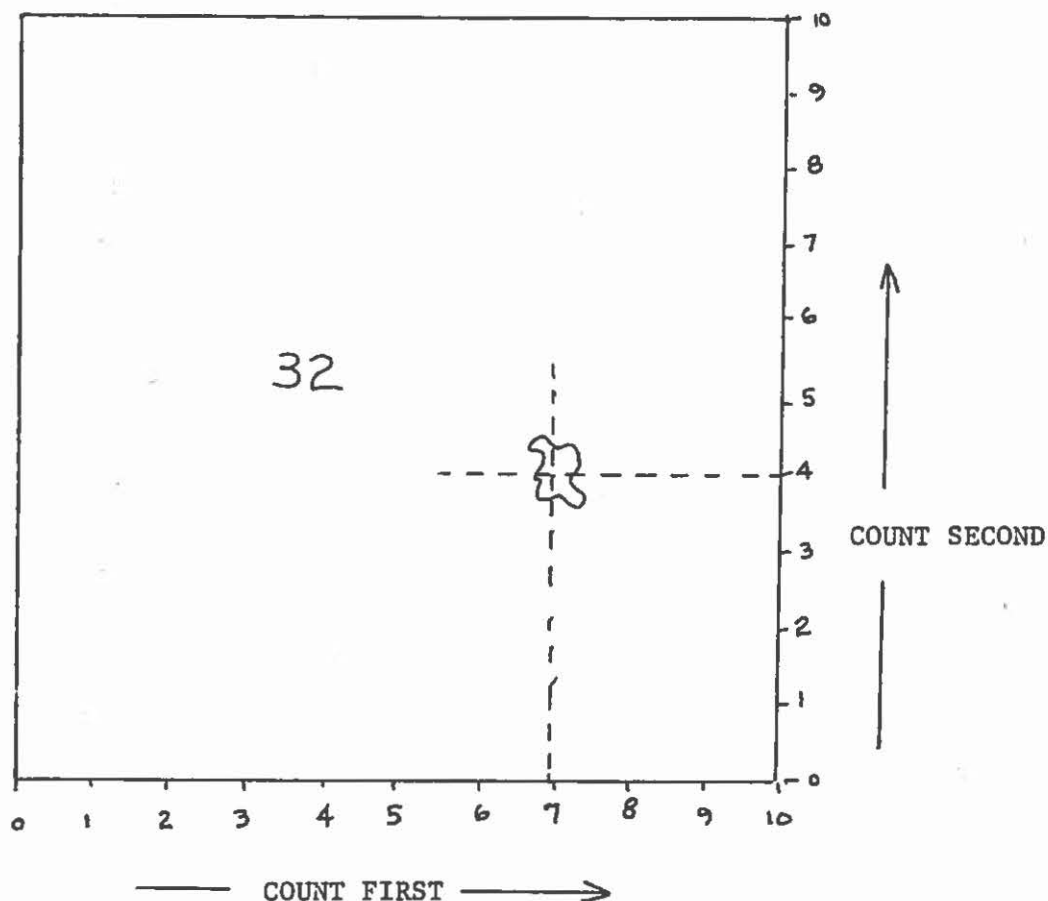


Figure 3. Example of the "modified coordinate system" used in locating and identifying unnamed lakes during the study. The lake shown in this example is 32- 7,4. 32 is the section number, seven and four are coordinates. Normally, these numbers would be preceded by the township designation (ie: NC 32- 7,4 if this section was in the NC township).

Watershed condition was noted, including dominant timber and ground cover species, depth or shallowness of soils, origin of soils (ie: shallow, rocky soil; deep humic soil; etc.), and any prominent features or problems observed in the area.

Use type and intensity were judged by the condition of the shoreline and immediate area. Trash, or lack of it, animal tracks, mammals and birds present, campfire rings and old campsites aided in the assessment of what kind of use an area received.

Surface area of smaller lakes and most unnamed lakes was estimated and acreage of larger named lakes was taken from previous reports, unless water level was far below normal. In such cases, surface area was estimated.

All inlets and outlets were located, and if dry, that was noted. If the streams were flowing, water and air temperatures were measured, width, depth, flow, bottom type and presence or absence of salmonid spawning areas were recorded. Flow was estimated in feet per second by the surface float method over a known distance.

Intensity of fishing was noted by counting the number of shore and boat fishermen seen during the study period. Additionally, any fishing tackle or other fishing debris seen aided in estimating the intensity of fishing.

Accessibility of a lake to visitors was noted as either road, trail or overland. If the lake was overland or reached by trail, the approximate mileage from a known landmark and difficulty of the hike were noted.

Any fish predators or evidence of them were identified where possible. Other interesting or unusual vertebrates species were noted when seen.

Aquatic invertebrates and plants were identified to the generic level or the lowest taxon possible by the lake surveyor. Abundance of these animals and plants was categorized as follows: abundant - covered or seen in more than approximately 70% of the lake or shore; common - covered or seen in approximately 20-70% of the lake or shore; few - covered or seen in approximately 5-20% of the lake or shore; rare - covered or seen in approximately less than 5% of the lake or shore. Most invertebrate and vegetation observations were limited to macroscopic species.

A panoramic photograph series was taken of each lake inventoried with a Kodak Pocket Instamatic Model 40 camera. Photographs were attached to individual lake reports upon completion of the report.

Lakes in which gill nets were set (Table 1) were chosen for gill netting because of their large size, high visitor use or past fishery reports.

Lakes that were not netted were sampled with rod and reel for a period of one hour each, or were not sampled if the bottom could be seen and no fish were visible. Spinning and/or fly fishing equipment was used when sampling with rod and reel.

Table 1. Lakes gill netted in Lassen Volcanic National Park in 1976.
Number of net nights (14 hours each) per lake, total catch
per unit effort, and salmonid catch per unit effort.

<u>Lake</u>	<u>#net nights (14 hr. ea)</u>	<u>Total CPUE</u>	<u>Trout CPUE</u>
Big Bear Lake	1	0	0
Butte Lake	2	49.5	2.5
Cluster Lake #2	2	0	0
Emerald Lake	1	0	0
Feather Lake South	1	0	0
Horseshoe Lake	1	45.0	17.0
Jakey Lake	1	0	0
Juniper Lake	2	32.0	0
Lower Twin Lake	2	0	0
Manzanita Lake	2	21.0	20.5
Rainbow Lake	2	0.5	0.5
Reflection Lake	1	15.0	1.0
Ridge Lake	1	16.0	16.0
Shadow Lake	1	1.0	1.0
Silver Lake	1	0	0
Snag Lake	2	55.0	10.5
Summit Lake	1	26.0	26.0
Upper Twin Lake	2	0	0

Lundgrens sinker-type experimental multifilament gill nets were used. The top of float line of each net was 150 feet in length and the bottom or lead line was 180 feet long on each of the nets. Each net was five feet deep and composed of six mesh panels of the following mesh sizes (mesh size measured knot to knot, stretched size) 18, 24, 29, 33, 38 and 46 mm.

The net was set from a two-man inflatable rubber raft and anchored at each end with a large rock tied to an anchor line from the lead line. Five one-gallon plastic jugs were attached to the float line at evenly spaced intervals for each set.

Any fish captured were identified to the specific level, measured (fork or total length) on a meter stick to the nearest millimeter, and weighed to the nearest tenth of a gram on an OHAUS "Dial-O-Gram" beam balance.

Stomach samples were taken from all salmonid species captured and preserved in 10% formalin. An analysis of these samples will be performed at Humboldt State University at a later date.

Prevailing weather conditions during the study period were recorded for future reference. These conditions are important to color, clarity and depth observations.

RESULTS

On hundred sixty-one of the 274 full or dry, named or unnamed lentic water bodies within the boundaries of the park were visited during the study period (Table 2). Of these, 31 were dry during the period, so inventories were not completed on them (Table 1).

Seventeen of the lakes contained fish during the period (Table 3). None of the unnamed lakes or ponds contained fish. The eight species of fish removed from these lakes were: rainbow trout (Salmo gairdneri), Eastern brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), coarseraker tui chub (Siphateles bicolor obesus), modoc sucker (Catostomus microps), tahoe sucker (C. tahoensis), golden shiner (Notemigonus crysoleucas) and lahontan redbreast (Richardsonius egregius).

The salmonids captured ranged in length from 11.2 cm (4.4 in.) to 52.7 cm (20.7 in.). The heaviest fish captured was a brown trout taken from Manzanita Lake, weighing 1914.5 gm (67.5 oz.). The lightest trout captured came from Ridge Lake and weighed 19.5 gm (0.7 oz.).

Most salmonids captured were in fair to good condition, but several fish from Summit Lake were in extremely poor condition (i.e.: K71.0). Oddly enough, the fish in best condition, an Eastern brook trout (K=1.71) also came from Summit Lake.

Manzanita Lake had the highest salmonid catch per unit of gill net effort and in many other lakes the catch per unit of effort was zero (Table 1).

Table 2. Lakes visited and inventoried in Lassen Volcanic National Park, July 19 - September 30, 1976

NAMED LAKES

<u>Lake</u>	<u>Survey Date</u>
Bathtub Lake (N)	8-11-76
Bathtub Lake (S)	8-11-76
Big Bear Lake	8-20-76
Blue Lake	8-10-76
Bluff Lake	9-09-76
Boiling Springs Lake	7-28-76
Butte Lake	8-12-76
Cliff Lake	8-30-76
Cluster Lake #1 (N)	8-20-76
Cluster Lake #2 (S)	8-19-76
Cold Boiling Lake	7-26-76
Conard Lake	7-26-76
Crater Pool	8-18-76
Crumbaugh Lake	7-26-76
Crystal Lake	9-08-76
Deer Lake	9-19-76
Drake Lake	7-28-76
Dream Lake	7-28-76
East Lake	9-16-76
Echo Lake	8-22-76
Emerald Lake	9-20-76
Emigrant Lake	8-18-76
Feather Lake (North)	8-18-76
Feather Lake (South)	8-21-76
Forest Lake	8-13-76
Glen Lake	9-08-76
Hat Lake	8-04-76
Hemlock Lake	7-22-76
Hidden Lake	9-09-76
Horseshoe Lake	9-10-76
Indian Lake	9-13-76
Ink Lake	7-27-76
Island Lake	9-16-76
Jakey Lake	9-14-76
Juniper Lake	9-13-76
Lake Helen	9-30-76
Lily Pond	9-22-76
Little Bear Lake	8-20-76
Little Willow Lake	9-17-76
Lower Twin Lake	8-24-76
Manzanita Lake	9-23-76
Rainbow Lake	8-23-76
Reflection Lake	9-22-76
Ridge Lake	7-27-76

NAMED LAKES

<u>Lake</u>	<u>Survey Date</u>
Shadow Lake	8-30-76
Sifford Lakes (10)	7-29/30-76
Silver Lake	8-21-76
Snag Lake	9-01-76
Soap Lake	8-18-76
Soda Lake	8-09-76
Summit Lake	9-20-76
Swan Lake	8-18-76
Teal Lake	9-02-76
Terrace Lake	8-30-76
Upper Twin Lake	8-23-76
Widow Lake	8-12-76

Total number lakes = 65

56 Names, but 10 in the
Sifford Group = 65

Two Dry Lakes were visited
but not inventoried (Bench
& crags) = 67

Table 2. Lakes visited and inventoried in Lassen Volcanic National Park, July 19 - September 30, 1976.

UNNAMED SURVEYED
UNMAPPED LAKES INVENTORIED

<u>Lake Coordinates</u>	<u>Survey Date</u>
BAILEY CREEK DRAINAGE (RM UNIT No. 1)	
SW 8- 9,6	8-10-76
SW 16- 7,8	8-09-76
BENNER CREEK DRAINAGE (RM UNIT 2)	
SE 13- 9,2	9-16-76
SE 23- 5,8	9-08-76
SE 23- 7,8	9-08-76
SE 23- 6,10	9-08-76
HAT CREEK DRAINAGE (RM UNIT 4)	
SC 8- 3,8	8-30-76
NC 33- 0,6	8-04-76
NC 33- 1,5	8-04-76
NC 31- 2,6	8-04-76
NC 17- 1,4	8-03-76
NC 29- 5,1	8-04-76
NC 29- 9,5	8-04-76
SC 8- 3,7	8-30-76
HOT SPRINGS CREEK DRAINAGE (RM UNIT 5)	
SC 19- 8,9	7-22-76
JUNIPER LAKE BASIN (RM UNIT 6)	
SE 16- 0,4	9-13-76
SE 22- 4,6	9-14-76
SE 16- 6,4	9-14-76
SE 21- 2,8	9-13-76
SE 22- 10,9	9-08-76
SE 23- 2,9	9-08-76
SE 23- 2,8	9-08-76
KINGS CREEK DRAINAGE (RM UNIT 7)	
NC 34- 3,0	8-20-76
SC 4- 8,9	9-20-76
SE 21- 2,5	9-13-76
SE 18- 7,3	9-09-76
RAIL CREEK DRAINAGE (RM UNIT 10)	
NC 13- 3,5	8-18-76
NC 22- 5,1	8-19-76
NC 23- 1,2	8-19-76
NC 16- 8,8	8-03-76
NC 27- 4,2	8-20-76
NC 27- 3,3	8-20-76
NC 27- 4,3	8-20-76
NC 22- 6,4	8-19-76
NC 27- 2,8	8-19-76
NC 13- 3,3	8-18-76

UNMAPPED LAKES INVENTORIED

Lake Coordinates

Survey Date

NC 13- 2,4	8-18-76
NC 34- 9,8	8-20-76
NC 27- 9,7	8-19-76
NC 27- 9,7a Unmapped	8-19-76
SNAG LAKE BASIN (RM UNIT 12)	
SE 11- 4,3	9-14-76
SE 11- 7,3	9-14-76
SE 11- 6,3	9-14-76
SE 11- 5,4	9-14-76
SE 12- 2,4	9-15-76
SE 12- 1,4	9-15-76
SE 10- 6,6	9-14-76
SE 10- 6,5	9-14-76
NE 32- 3,5	9-02-76
SULPHUR CREEK DRAINAGE (RM UNIT 13)	
SW 28- 6,8	8-13-76
SW 28- 4,9	8-10-76
SW 28- 3,8	8-10-76
SW 28- 3,0	8-13-76
SW 21- 5,0	8-13-76
SW 28- 4,5	8-02-76
TWIN LAKES BASIN (RM UNIT 14)	
NE 31- 6,5	8-19-76
NC 25- 6,1	8-19-76
SC 1- 6,8	8-22-76
SC 1- 6,9	8-22-76
SC 1- 7,6	8-22-76
SC 1- 7,7	8-22-76
NC 25- 4,7	8-18-76
NC 25- 2,9	8-18-76
NC 36- 0,3	8-22-76
NC 36- 6,0	8-18-76
SC 2- 9,9	8-22-76

Total No. Unnamed Lakes = 66
131

Total Lakes Inventoried = ~~130~~ 131

Table 2. Lakes visited and inventoried in Lassen Volcanic National Park, July 19 - September 30, 1976.

VISITED SURVEYED
DRY LAKES SEEN BUT NOT INVENTORIED-

Lake Coordinates

BAILEY CREEK DR.	RAIL CREEK DR.
SW 10- 2,5	NC 13- 4,5
BENNER CREEK DR.	NC 13- 5,5
SE 23- 4,8	NC 13- 3,4
SE 23- 9,7	NC 22- 4,7
SE 23- 7,8	NC 9- 8,2
SE 23- 7,6	NC 15- 0,7
SE 13- 8,1	SNAG LAKE BASIN
HAT CREEK DR.	SE 11- 5,5
NC 28- 3,7	SE 11- 6,4
SC 7- 8,7	SE 11- 7,2
SC 7- 8,6	TWIN LAKES BASIN
SC 7- 9,8	NE 17- 8,0
JUNIPER L. BASIN	NC 24- 2,1
SE 23- 2,5	NC 25- 4,1
SE 23- 0,6	SC 2- 6,6
SE 23- 0,7	KINGS CREEK DR.
SE 15- 2,7	SC 17- 3,7
SE 20- 9,8	

Total no. dry lakes = 29

Total number lakes investigated
 (dry and inventoried) = ~~161~~ 160

160
 Add 2 dry named lakes 2
162

Table 3. Species of fish in lakes of Lassen Volcanic National Park containing fish in 1976. Spawning possibilities listed as possible, marginal or unlikely.

<u>Lake Name</u>	<u>Fish Species</u>	<u>Salmonid Reproduction: Present Status</u>
Bathtub Lake(s)	Eastern brook trout	unlikely
Butte Lake	Rainbow trout, coarseraker tui chub & modoc sucker	- marginal
Crystal Lake	Rainbow trout	- marginal
Dream Lake	Eastern brook trout	possible -
Hat Lake	Eastern brook trout	possible -
Horseshoe Lake	Rainbow trout, Eastern brook trout & coarseraker tui chub	possible -
Juniper Lake	Lahontan redbside	unlikely - 0
Manzanita Lake	Rainbow trout, brown trout & golden shiner	possible -
Rainbow Lake	Rainbow trout	unlikely -
Reflection Lake	Rainbow trout, golden shiner	unlikely -
Ridge Lake	Eastern brook trout	possible -
Shadow Lake	Eastern brook trout	unlikely -
Snag Lake	Rainbow trout, modoc sucker, tahoe sucker & coarseraker tui chub	possible -
Summit Lake	Rainbow trout, Eastern brook trout	- marginal
Terrace Lake	Eastern brook trout	possible -
Upper Twin Lake	Rainbow trout	unlikely -
Widow Lake	Unknown	- marginal 0

Aquatic vegetation seen during the study included members of submerged, floating and emergent types (Table 4). The most common flowering plant seen during the period was sedge (Carex sp.), a rooted shoreline plant. Numerous members of the grass family (Gramineae) were also very common at most lakes. Some lakes contained dense populations of filamentous green algae (Chlorophyta). Mosses of the genera Sphagnum, Drepanocladus and Chiloscyphus were found in only several lakes.

Many aquatic invertebrates could only be identified to the order level, but some were further identified. Backswimmers (Notonecta sp.) water striders (Gerris sp.), midges (Chironomidae) and other true flies (Diptera), dragonflies (Anisoptera) and mayflies (Ephemeroptera) were the most common invertebrates seen during the study. Whirlygig beetles (Dineutes sp.), predaceous diving beetles (Dytiscus sp.) water scavenger beetles (Hydrophilus sp.), damselflies (Zygoptera), copepods (Copepoda) and freshwater snails (Gastropoda) were also occasionally seen during the study period. The most interesting invertebrate seen was a deep blue fairy shrimp (Anostraca) found in NC 34-3,0.

Fish predators were seen during the study period, but were not seen at all lakes. Belted kingfishers (Megaceryle alcyon) were the most common avian fish predators seen. Other fish eating birds were: ospreys (Pandion haliaetus), Bald Eagles (Haliaeetus leucocephalus), great blue herons (Ardea herodias), common merganser (Mergus merganser) and California gulls (Larus californicus).

The only mammalian fish predator seen, besides man, was a river otter (Lutra canadensis), seen by Alan Denniston at Snag Lake. Garter snakes (Thamnophis sp.) were common at many lakes investigated.

DISCUSSION

Some of the methods employed in this study are subjective, and therefore discussion of them should help in clarification.

Water clarity is dependent upon weather conditions, organic debris in the water, chemical composition of the water and depth. Water may appear less clear in bright overcast weather, than when the sky is clear. Obviously, concentrations of suspended materials in the water column will lessen the water clarity. Depth of the lake should be kept in mind when discussing water clarity. For example, if a lake is only ten feet deep and clear to the bottom, it is unknown how far visibility would extend if the same water was in a deeper lake. When comparing water clarity of several different lakes the prevailing conditions of the sky, and depth of the lake should be considered before attempting to make any assessments of suspended solids. Ideally, a submarine photometer is used to measure the depth of light penetration and a Secchi disc to measure clarity. In many instances during this study clarity was estimated and should be treated as an estimate, not an absolute value.

Table 4. Scientific and common names of aquatic plants seen during Lake Investigations of Lassen Volcanic National Park.

<u>Scientific Name</u>	<u>Common Name</u>
<u>Alnus</u> sp *	alder
<u>Carex</u> sp *	sedge
<u>Ceratophyllum</u> sp	hornwort
<u>Chiloscyphus</u> sp	--- (moss)
<u>Drepanocladus</u> sp	--- (moss)
<u>Eleocharis</u> sp *	spike rush
<u>Elodea</u> sp	water weed
<u>Isoetes</u> sp *	quill wort
<u>Juncus</u> sp *	rush
<u>Lemna</u> sp *	duckweed
<u>Menyanthes</u> sp *	buckbean
<u>Mimulus</u> sp *	monkey flower
<u>Myriophyllum</u> sp *	water milfoil
<u>Nuphar</u> sp *	yellow pond-lily
<u>Potamogeton</u> sp *	pond weed
<u>Ranunculus</u> sp *	water buttercup
<u>Salix</u> sp *	willow
<u>Scirpus</u> sp *	bulrush
<u>Sparganium</u> sp *	bur-reed
<u>Sphagnum</u> sp	peat moss

* species listed in A Flora of Lassen Volcanic N.P., Gillett, et al.

In combination, water color and clarity can yield a good deal of instant information about the chemical and biological characteristics of a lake. Deep blue water color is characteristic of "ultra-oligotrophic" lakes (those lakes poor in nutrients, flora and usually fauna) such as Lake Tahoe and Crater Lake. But, if shallow, the same lake may appear to be a different color because of colors reflected from bottom materials. Green lakes, similar to many found in this study, are typically moderately rich, or approaching eutrophication, and support an abundance of native flora and fauna.

Estimation of depth and area is also quite subjective, and accuracy increases through experience. At best, estimates of depth and area made during this study probably vary at least 10-15% from actual values.

Estimates of bottom material categories are similar to depth and area estimates. Some lakes with bottoms composed of mud and organic debris actually may have been composed of sand or gravel, coated by a thin layer of mud and organic debris.

Watershed condition, shoreline condition and intensity of use are all very relative, depending on the training and experience of the observer. A lake may appear to be in excellent condition to some visitors, but actually be suffering from a number of serious maladies.

Many of the lakes that were not sampled for fish, because the bottom could be seen and fish were apparently absent, possibly could have fish in them. Even lakes that were sampled with gill net or rod and reel and in which no fish were captured could have fish. In both instances, fish populations in such lakes are probably unsubstantial and of little value in that state as sport fisheries. The possibility does exist that fish exist in more lakes than found during the study, the methods used were not foolproof. For a study of this nature during the time allowed, methods and materials were chosen that would yield the most reliable results, in the shortest time period, without being prohibitively costly.

Although in some respects the study was superficial, it yielded valuable information on the status of the lentic aquatic resources of the park.

Several criteria were used in choosing which lakes would be investigated during the study. All named lakes were visited because many (37) of them have been stocked with fish in the past, many are sizeable and readily accessible to the visitor. Deciding which of the unnamed lakes to visit was a difficult task. As many unnamed lakes as possible were inventoried when visiting an area, especially if a large lake was being investigated. If lakes were concentrated in a small area, the area was visited and lakes were chosen to act as "type" lakes to represent conditions of the area. Most unnamed lakes that were by themselves or separated from other lakes were inventoried. Naturally, some lakes that may be unusual could have been omitted, but as many distinct water bodies as possible were investigated.

Aquatic vegetation found during the study was, in most cases, not too unusual. Most lakeshores were lined with sedge, a plant common to muddy and marshy areas. The richest lakes usually had several to many yellow pond-lilies floating on the water surface. Several exceptions to this generalization occurred, namely Manzanita and Summit Lakes. These lakes are very rich (see Manzanita and Summit Lake Report, West 1976), but no pond-lilies were found in them. Conditions were suitable for water weed, another fair indicator of Eutrophy.

Very few lakes visited had peat moss around their shores. This moss and the vascular plant buckbean usually indicate acidic conditions, some of which may hinder establishment of fish populations.

The majority of lakes investigated during the study were relatively rich in vegetation for high altitude lakes.

Aquatic invertebrates were abundant in most of the lakes. Large hatches of midges and mayflies were observed on several occasions in the larger lakes. Smaller lakes were characterized by invertebrates such as dragonflies, backswimmers, water striders and water scavenger beetles. These insects are common in many shallow, densely vegetated, rich ponds and lakes in this state. Fish food was plentiful in all but the most oligotrophic lakes, and food wise, fish populations could probably easily survive in roughly 80% of the lakes investigated.

Fish were present in only 17 of the lakes investigated, because of one major reason. Spawning areas suitable for salmonid reproduction were entirely lacking or below minimum standards in all but a handful of the lakes investigated. Planted fish populations are gradually dying off, or gone, from most of the lakes that are not being planted. Those lakes where fish populations were present were either recently stocked, sparsely populated or successfully maintaining populations. Only seven of the 17 lakes with fish in them at present can maintain or are maintaining self-replenishing populations of trout (Table 3). Four of the 11 lakes remaining in that category have "marginal" salmonid spawning conditions, and might be able to support reproductive populations. The last six lakes can probably not sustain reproductive trout populations. The fish populations of the lakes in the last category are either not salmonids, or they are salmonids suspected of being representatives of the last recorded stocking.

An estimated 10%, at most, of the lakes investigated in the park could possibly support reproductive populations of salmonids.

Many of the lakes with "trash fish" in them face possible overpopulation problems from these undesirable fish, and most of these lakes have been reported on previously in special reports (Appendix A).

It is doubtful that any more lakes in the park will produce notable sport fisheries, if present conditions prevail.

Present Park Service fishery management policies are agreed with by this author, in fact, they are long overdue. Stocking of fish in naturally barren waters seems hypocritical for an organization dedicated to the preservation or restoration of natural systems.

ACKNOWLEDGMENTS

The author wishes to acknowledge the park staff for their cooperation and assistance, which greatly contributed to the success of this project; especially Linda Forno, park receptionist, who typed final copies of all reports generated through this study.

Special thanks are due to Alan Denniston, Resource Management Specialist, Lassen Volcanic National Park; Louis Hallock, retired Superintendent, Lassen Volcanic National Park; Dr. Terry Roelofs, Associate Professor of Fisheries, Humboldt State University; Dr. Roger Barnhart, co-leader Fisheries Cooperative Unit, U.S. Fish and Wildlife Service, Humboldt State University; and Robert Elwell, California Department of Fish and Game.

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APPENDIX A

Contents; Special Reports on:

Twin Lakes Region; Cluster Lakes Region; Terrace, Shadow and Cliff Lakes; Manzanita Lake; Butte, Snag and Horseshoe Lakes; Summit Lake; Snag Lake; Juniper Lake; Resource Management Unit 14; Resource Management Unit 10.

TWIN LAKES REGIONAL REPORT

by

JOHN R. WEST
AUGUST 30, 1976

INTRODUCTION

The purpose of this paper is to summarize and discuss the general findings of a preliminary lake survey performed between August 17 and 26, 1976. The report encompasses the lakes of the Twin Lakes area, including: Echo Lake, Upper Twin Lake, Lower Twin Lake, Swan Lake and Rainbow Lake.

MATERIALS AND METHODS

Experimental gill nets 150 feet in length and five feet deep, composed of five panels of varied mesh size were used to sample the larger lakes. Swan Lake and Echo Lake were fished with rod and reel for a designated time period.

Two gill nets were set in Rainbow, Upper Twin and Lower Twin Lakes for a period of approximately 14 hours on the nights of August 22, 23, and 24 respectively.

Water color, clarity, depth and temperature were determined by observation and measurement during the study period. Relative abundance of aquatic invertebrates and vegetation was estimated by the lake "surveyor". Generalizations on use, accessibility, watershed condition, shoreline and bottom type were also made.

RESULTS

Specific results of the individual studies are given in each lake report.

A single female rainbow trout (Salmo Gairdneri), 17 inches in length and 39 ounces in weight, captured from Rainbow Lake was the only fish taken from any of the lakes. The only other lake in which fish were seen was Upper Twin Lake, where several large (+ 3 lb.) rainbow trout were observed feeding on the evening of August 23.

No more than one dozen visitors to this area were seen fishing, none reported any success.

Conditions of the water and surrounding area at most lakes was poor. Use was constant and quite heavy during the study period. One hundred to 125 people were in the area between August 22 and 25.

Human impact is readily visible to the trained observer and I feel that impact on this area has been great. Numerous campsites are located between ten and 70 feet from the lakeshore at both Upper and Lower Twin, Rainbow and Swan Lakes. Trash is found not only lining the shores of many lakes, but in the lakes themselves. Several campers were seen bathing and washing clothes in Lower Twin Lake and not less than two dozen campers were seen washing dishes in the lake, all were using soap.

DISCUSSION

The apparent lack of fishlife in all the Rainbow and Upper Twin Lakes is explainable from past stocking records. Rainbow and Upper Twin Lakes were last stocked in the summer of 1972 with fingerling rainbow trout. The other three lakes were stocked in either 1965 or 1967. Suitable spawning areas were entirely lacking or, at best, extremely limited. None of the spawning areas seen had running water during this study, but in higher water years spawning may be possible. This is highly unlikely, since several heavy snowfall seasons have occurred in this decade and no fish were seen or captured in Swan, Lower Twin, or Echo Lakes.

This should indicate to the resource manager that these lakes will support stocked populations of fish, but probably would not support "natural" populations. I do not feel that any future attempts to establish rainbow trout populations in these lakes would be more successful than past attempts.

Conditions necessary to sustain life in each lake are present. Food was abundant and shelter appeared to be adequate. Water temperatures during the study period were in the optimum range for either rainbow trout or brook trout (Salvelinus fontinalis).

A self-sustaining brook trout population might easily be established in any of these lakes, but National Park Service policies and my personal philosophy lead me to believe that such an exotic introduction would be a poor solution to this fishless "problem".

I would recommend that the administrators and managers of this park let those old fish remaining in Rainbow and Upper Twin Lakes follow their natural course. Do not try to establish any fishery in these lakes, for their values are great enough in other respects.

In my view, the greatest and most pressing problem is overuse and misuse of this area. Extensive foaming was noted in both Upper and Lower Twin Lakes. The problem is most noticeable at the downwind shore of Lower Twin Lake following a windy day. Foam piles up to six inches in height and 20 feet in length were seen during the study period. Foaming is a property natural to some waters with certain chemical constituents. It is also common in heavily used water bodies if "too much" soap or detergent has been introduced. "Too much" can be a

comparatively small amount if introduced into a lake with relatively low concentrations of natural chemicals.

Without considering the damage this foreign ingredient can do to native biological organisms, it could easily reach levels that would cause illness in humans and terrestrial wildlife. Although water purification procedures should be followed before drinking any lake water, I doubt, from my short experience and contact with visitors here, that 10% of those who use this water purify it or think of doing so.

Although the Twin Lakes show the greatest signs of misuse, these statements in part, apply to all lakes in the area.

I fear that soap may not be the only foreign material being introduced into these waters. The location of most campsites, close to the lake (s), leads me to believe that leftover food stuff and human waste may be getting into the water.

One of these conditions could cause some problem, but in combination, they could lead to irreparable damage in this system.

I recommend several steps to halt this damage. First, an in depth study of physical and chemical conditions should be carried out in at least the Twin Lakes. Through this study we would find, hopefully, what was causing the extensive foaming. The study could be done economically and professionally by a graduate student on a contract basis. It should be performed within the next year and include three to four months of constant monitoring followed by a detailed report on the condition of the lakes and the surrounding watershed basins.

A seasonal backcountry ranger should be employed to live and patrol this area during peak use months. Two rangers were seen during our ten-day stay, but numerous offenses occurred daily. These were offenses that could easily be corrected if proper controls were enforced.

Finally, all campsites less than 100 feet from any lakeshore should be destroyed. An active clean-up campaign should be undertaken to remove debris from the shore and lake. Both of these last two suggestions could easily be accomplished by volunteer forces under the supervision of the backcountry ranger.

Similar problems have been encountered and solved in other California high mountain areas (ie. Rae Lakes basin, Southern High Sierra). The problems here should be attended to as soon as possible to prevent further damage and restore those aquatic systems already damaged.

CLUSTER LAKES REGIONAL REPORT

by

John R. West
September 3, 1976

INTRODUCTION

The purpose of this report is to summarize and discuss the findings of preliminary lake inventories performed on lakes in the Cluster Lakes area. Cluster Lake #1, #2, Big Bear, Little Bear, Silver and Feather Lakes were studied between August 19 and 21, 1976

MATERIALS AND METHODS

Experimental gill nets were set in Cluster Lake #2, Big Bear Lake, Silver Lake and South Feather Lake on the nights of August 19, 20 and 21, respectively. Gill nets were set in the evening between 1700 and 1900 and removed between 0700 and 0900 the next morning. The nets remained in the lakes for approximately 14 hours each set.

Smaller lakes in T31N, R5E, Sections 13, 22, 23, 24, 25 and 27, including Soap and Emigrant Lakes, were inventoried during the same study period.

All inventories included a photograph of the lake and descriptions of various physical, morphological, chemical and biological factors important not only to fish and wildlife, but to man's recreation and enjoyment as well.

RESULTS

Results of each lake inventory are given in separate lake reports.

None of the lakes in the area appeared to be capable of supporting naturally reproductive populations of rainbow trout (Salmo gairdneri). Water level in most lakes was lower than normal and in some cases (ie: Cluster Lake #1 and Little Bear Lake) surface acreage was reduced to less than 50% of acreage at "full pool". Spawning areas in streams were noticeably absent and none of the lakes had flowing inlets or outlets.

Signs of human use are abundant and many visitors were seen in the area during the latter part of the study period. At most lakes environmental damage had not been too extensive, but Cluster Lake #1 and Little Bear Lake appear to have suffered moderate damage. No campers were seen at either of these lakes, probably because of extremely low water levels during the study period.

Wildlife was abundant in the area. Black tailed deer (Odocoileus hemionus columbianus), mule deer (Odocoileus hemionus hemionus), pine martens (Martes americana), golden mantled ground squirrels (Citellus lateralis), chipmunks (Eutamias sp.) and Douglas squirrels (Tamiasciurus douglassi) were most evident and appear to dominate the mammalian fauna of the area.

DISCUSSION

Lack of cold-water sportfish populations in this area does not surprise me. The factor most likely responsible for this lack of fishlife is probably the absence of spawning areas. Most lakes in this region were at one time stocked with rainbow trout and apparently those stocked populations have since died off or been removed by anglers.

Although no fish were captured in the nets, this does not preclude their presence. A catch of zero fish indicates that a population is either absent or present in such low abundance that it is of little value as a sport fishery.

Many, if not most, of the lakes investigated would probably support a stocked trout fishery. Physical, morphological and biological conditions in the lakes meet minimum standards for supporting maintenance stocked populations, but fall short of criteria necessary to maintain self-sustaining populations. Some of the lakes may be able to support reproductive populations of eastern brook trout (Salvelinus fontinalis), but as an exotic it is undesirable in National Park wilderness area waters.

I would recommend that these lakes be left in their present fishless condition. I do not feel that maintenance stocking of a "native" or stocking of an exotic would enhance the recreational value or quality of the backcountry experience for most visitors. None of the visitors I spoke with had fishing as their primary interest, in fact, most considered "solitude" and "naturalness of the area" the most important factors.

Although I am not concerned over the fishless state of the area, I am concerned about possible future damage to it. All of the systems investigated are somewhat fragile. The area receives moderate to heavy use and could easily be overused.

I recommend a closer look at the "human carrying capacity" of the area. Following this, I advise regular and frequent patrolling to ensure its protection and rehabilitation. In addition, I would recommend that closure to camping at Cluster Lake #1, Little Bear Lake and Feather Lake (North) be given serious consideration.

REPORT ON TERRACE, SHADOW AND CLIFF LAKES

by

John R. West
September 7, 1976

INTRODUCTION

Terrace, Shadow and Cliff Lakes, located at the NE foot of Reading Peak in Lassen Volcanic National Park, were investigated August 30 and 31, 1976. This paper discusses and summarizes the general results of preliminary lake inventories performed on these water bodies.

MATERIALS AND METHODS

An experimental gill net was set in Shadow Lake on the night of August 30 and was removed 14 hours later on the morning of August 31. Terrace and Cliff Lakes were sampled with rod and reel for one hour each. Five small lakes in T30N, R5E, Sections 7 and 8 were inventoried during the study period.

All inventories included the measurement and observation of the following characteristics: water color, clarity, depth, temperature, abundance of aquatic invertebrates and vegetation, watershed condition, shoreline type, bottom type, use and accessibility.

RESULTS

Specific results of each lake inventory are given in separate lake reports.

The gill net set in Shadow Lake yielded one large (+2.5 lb.) eastern brook trout (*Salvelinus fontinalis*).

One hour of rod and reel effort on the morning of August 31 at Terrace Lake yielded eleven small brook trout. They ranged in size from 14.0 cm (5.5 in.) to 17.5 cm (6.9 in.).

Cliff Lake was clear enough so that the bottom could be seen. No fish was seen or captured in one hour of effort. Numerous dead and dying tadpoles were seen lining the shores of the lake and in the inlet stream.

Three small lakes between Shadow and Cliff Lakes in Section 7 were dry.

Two small lakes near Cliff Lake in Section 8 contained water and one of them had a small glacier covering approximately 80% of its surface area. This "glacier lake" is very small and located adjacent to a scree slide at the bottom of the north slope of Reading Peak. We did not measure the size of the glacier but estimate that it is 125 feet in length, 75 feet in width and from three to ten feet thick.

DISCUSSION

The brook trout taken from Shadow Lake probably represents part of a very small population of similar fish. I feel that there may only be several other fish in this lake, if any at all. Shadow Lake was last planted in 1966 with rainbow trout (Salmo gairdneri). Terrace Lake, which evidently contains a reproductive population of brook trout, flows via its outlet into Shadow Lake. The outlet plunges down a nearly vertical "creek bed" into Shadow Lake and about 100 feet below. I believe that the brook trout captured in Shadow Lake was carried over the outlet of Terrace Lake, several years ago when it was a fingerling.

To survive such a fall fish must be quite small, such as those stocked from airplanes. This "carryover" may occur annually or every several years, but I seriously doubt that it would ever create a fishery worthy of note in Shadow Lake.

The "carryover" should indicate to resource managers the danger of stocking exotics in the uppermost lake of a multi-lake chain. In this instance, the park is lucky that no highly desirable species were located lower in the drainage. (Similar incidents have occurred in Sequoia and Kings Canyon National Parks, involving a mixture of golden trout (Salmo agau-bonita) and rainbow trout populations. Unfortunately, the most desirable species is usually the one that dies off or is degraded).

The relatively high catch rate (greatest found in the park so far) of brook trout in Terrace Lake indicates a fairly dense population. This is encouraging, until conditions of the fish are examined. I would say all fish captured were in poor to fair condition. Many small (ie: 5 inch) fish were mature and growth proceeds rather slowly following maturity.

Cliff Lake is one of the few lakes studied in the park that has spawning conditions suitable for rainbow trout reproduction. It was stocked with rainbow trout in past years, but something kept them from reproducing successfully. I believe that natural chemical conditions may inhibit successful spawning. A whitish-pink deposit (probably a compound of calcium) was noticed on most of the dry rocks and snags along the shore. Additionally, numerous dead and dying tadpoles were found in the inlet and around the shore. Some chemical phenomenon is apparently responsible for the death of these animals. No other dead vertebrate species were seen in the area.

The final point worthy of discussion is the "glacier lake" and its physical characteristics. I believe that this glacier is not just a heavy snowpack. The lowermost layers of it were composed of clear blue ice and the uppermost layers were "corn" snow. I feel that it may fluctuate in size from year to year, but it is apparently perennial in nature and probably fairly permanent.

Although I could come up with numerous research possibilities and management suggestions for this area, I will mention only those that I believe are most urgent and/or interesting.

Cliff Lake should be closed to camping or have stringent restrictions put on campers. It does not, at this time, show signs of overuse, but some campsites were found close to the water. Trash was present, but not abundant. I believe it is a delicate, beautiful, unique system and could easily be degraded by camper misuse.

Fishing should be encouraged in Terrace Lake for the remainder of this year. If sufficient numbers of fish are removed from the lake before next summer, the average size and condition of the fish population may be increased.

Annual monitoring of the size of the glacier at "glacier lake" might be of interest to the Interpretive Division.

None of the lakes in this area should be stocked, with the exception of Cliff Lake. It may be worthwhile to stock Cliff Lake with rainbow trout under the following conditions. A detailed limnological study should be performed to determine whether the lake is chemically suited to rainbow trout reproduction. If suitable and National Park Service policy will permit stocking, it should be stocked. No more than one group of fish should be stocked in this lake. If they are not successful at reproduction, the lake should be left alone.

Backcountry patrol should become a daily routine in this area. Day use is moderate to heavy and I suspect that some camping is done in closed areas. It would be an easy 1-2 hour downhill patrol from Road Marker 27 to the Summit Lake Ranger Station.

Terrace and Shadow Lakes, which are presently closed to camping, should be posted as closed to camping.

MANZANITA LAKE

by

John R. West
September 27, 1976

INTRODUCTION

Manzanita Lake was investigated on September 22, 1976. The purpose of this paper is to summarize and discuss the general findings of that investigation. Reflection Lake and Lily Pond were investigated during the same study period.

MATERIALS AND METHODS

Two experimental gill nets were set in Manzanita Lake on the night of September 22, 1976. Fourteen hours later on the morning of September 23, the nets were removed.

One experimental gill net was set in Reflection Lake on the night of September 21, and removed the next morning.

Lake inventories were completed on these lakes and Lily Pond during the study period. The inventories included measurement and observation of water temperature, color, clarity, depth, shoreline and bottom type, and watershed condition. Relative abundance of aquatic invertebrates and vegetation were estimated and generalizations on use type and intensity were made.

RESULTS

Specific results of these investigations are given in individual lake inventory reports.

The gill net set in Reflection Lake yielded one female rainbow trout (Salmo gairdneri) 49.7 cm (19.5") in length, weighing 169.16 gms (3 lbs. 10.3 oz.). The fourteen other fish captured in the net were golden shiners (Notemigonus crysoleucas) ^{averaging} weighing 12.1 cm (4.8") long and 24.6 gm (0.9 oz.) in weight.

Forty-two fish were captured in the two nets set in Manzanita Lake. The catch was composed of 12 brown trout (Salmo trutta), 29 rainbow trout and one golden shiner. The lone golden shiner weighed 21.4 gms (0.8 oz.) and was 11.2 cm (4.4") long. Average length of the brown trout was 42.3 cm (16.7"), far exceeding that of the rainbows which was 29.8 cm (11.7").

Average weight of the browns (1128.9 gm or 39.8 oz.) also exceeded the average weight of the rainbows (495.9 gm or 17.5 oz.).

No fish were seen or captured from Lily Pond during the study period.

The only lake investigated during the period with suitable salmonid spawning conditions was Manzanita Lake.

Aquatic vegetation was abundant in Manzanita and Reflection Lakes.

DISCUSSION

The large rainbow trout removed from Reflection Lake indicates that conditions there are suitable for sustaining trout, but it is doubtful that salmonid reproduction can occur to any extent. The lake was last stocked with rainbows in the mid summer of 1974, but more than 2/3 of these fish died during the plant. This large fish either remained from those stocked or moved into the lake from Manzanita Lake. A very small ephemeral stream connects Reflection and Manzanita Lakes, but flows at irregular intervals only during periods of high water.

The rainbow trout population in this lake is probably composed of, at most, a few large individuals.

The golden shiners captured in Reflection Lake were probably introduced as "bait" or "trout food" by anglers. Since such a great number of them were captured, their population in the lake is probably very extensive. Conditions for this fish species in Reflection Lake are excellent. Shiners spawn by attaching their adhesive eggs to submerged vegetation according to McKechnie (1966).

Since conditions for growth and reproduction of shiners in Reflection Lake are so favorable, they will probably overrun this lake in several years, unless controls are enacted. Several things could control the density of the shiner population here. Chemical treatment is a possibility, as is netting or encouraging angling for these exotic fish. Another interesting but highly unlikely control would be a natural one. If several brown trout happened to move into Reflection from Manzanita Lake, via the ephemeral stream mentioned before, they would rapidly and most efficiently bring the density of the shiner population down.

The fish fauna of Manzanita Lake is quite interesting. Brown trout were introduced in this lake before 1929 (Wallis, 1955) and are still thriving. It is not known whether rainbow trout were native to the lake, but they were stocked in 1848 by P. B. Reading (Wallis, 1955). Both trout species reproduce in Manzanita Creek and are plentiful in the lake.

The single golden shiner captured in Manzanita Lake probably represents a small population of similar fish. It is doubtful that these fish will establish a notable population in the near future. The brown trout, noted for its voracious feeding habits, will keep the population of shiners and any other small fish low.

Manzanita Lake is, at present, one of the four lakes still being stocked by California Department of Fish and Game. This stocking probably does little for angler success or the trout population density in the lake. Most of the stocked fish are probably consumed by the large brown and rainbow trout in the lake. The fish in the lake do not need to be fed supplementally, because food is very abundant. I can see no reason for continuing the stocking program here.

In conclusion, conditions for salmonid growth and reproduction in Manzanita Lake and Manzanita Creek are excellent. Management policies presently in effect appear adequate, but the stocking program should be discontinued.

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REPORT ON BUTTE, SNAG AND HORSESHOE LAKES

by

John R. West
September 27, 1976

INTRODUCTION

Butte, Snag and Horseshoe Lakes were investigated during August and September of 1976. During the same period several smaller lakes, including Bathtub Lake North, Bathtub Lake South, Widow Lake, Teal Lake, Hidden Lake and Bluff Lake, were investigated.

Butte, Snag and Horseshoe Lakes are all in the same drainage basin and therefore any actions taken in one of these lakes could possibly affect the conditions in one or both of the other two. At one time, it is believed, Butte and Snag Lakes might have been one large lake. Following the lava flow from Cinder Cone, this large lake was bisected, forming two smaller lakes. At present, water is believed to flow through the Fantastic Lava Beds from Snag Lake into Butte Lake.

MATERIALS AND METHODS

Two experimental gill nets were set in Butte Lake and Snag Lake on the nights of August 12 and September 2, 1976, respectively, for a period of 14 hours each. One experimental gill net was set in Horseshoe Lake on the night of September 9, 1976 for 14 hours.

Standard Lake inventories were completed during the study period on these three lakes, the lakes mentioned in the introduction, and several smaller lakes in the vicinity. These latter lakes were sampled with rod and reel for a period of approximately one hour each.

Water color, clarity, depth and temperature were determined by observation and measurement. Relative abundance of aquatic invertebrates and vegetation was estimated by the lake "surveyor". Generalizations on use, accessibility, shoreline and bottom type and watershed condition were made.

RESULTS

Specific detailed results on individual lakes are given in separate lake reports.

Rainbow trout (Salmo gairdneri), modoc suckers (Catostomus microps), and coarseraker tui chubs (Siphateles bicolor obesus) were found in Butte Lake (Table 1).

Rainbow trout, modoc suckers, coarseraker tui chubs and tahoe suckers (Catostomus tahoensis) were the species present in Snag Lake.

The fish fauna of Horseshoe Lake was composed of rainbow trout, coarseraker tui chubs and eastern brook trout (Salvelinus fontinalis).

In all three lakes, "trashfish" accounted for more than half of the entire catch, by number and biomass (Figure 1).

Spawning areas were present in the inlets of both Snag and Horseshoe Lakes. No spawning areas were seen at Butte Lake.

A small minnow-like fish was seen in Widow Lake by Jesse Purvis, who performed that survey, but none were captured and the true identity of these fish remains unknown. Time and equipment on hand did not allow for proper sampling of that lake.

An eastern brook trout taken from Bathtub Lake South by an angler was seen, but none were captured by Mr. Purvis during the inventory of that lake. No fish were seen or captured in any of the other lakes studied during the period.

Salmonid fry were abundant in Grassy Creek above Snag Lake and below Horseshoe Lake. Fry were also seen in a small inlet to Horseshoe Lake near its southwestern end.

Horseshoe and Butte Lakes were slightly lower than their "full pool" levels, but Snag Lake was approximately ten feet lower than normal. The surface area of the lake was reduced an estimated 50% by this extremely low water level.

Most of the watersheds investigated were in fairly good condition, with the exception of that around Butte Lake. Trash was abundant in the area of the shore near the campground and all along the north shore of the lake. Boating is popular at this end of the lake and human use of the water was heavy. The trail leading to Bathtub Lakes could easily be classified as a road, because it receives very heavy use and has expanded in width to twenty feet, in some places.

Snag Lake receives heavy use for a backcountry lake, and campsites are abundant around the lakeshores.

An established campground is present on the east shore of Horseshoe Lake. The trail leading to this area from Juniper Lake was once a road, and is in extremely poor condition. Gullies up to one and one half feet deep have formed along the trail from the erosive action of spring runoff and precipitation. Little corrective action is being or has been taken to remedy this eyesore.

Table 1. Number of biomass of fish caught per net night (14 hours) by species and total from Butte, Snag and Horseshoe Lakes. Percent (by number and weight) of trout in total catch. Mean weight (grams) and mean condition (K) of trout caught.

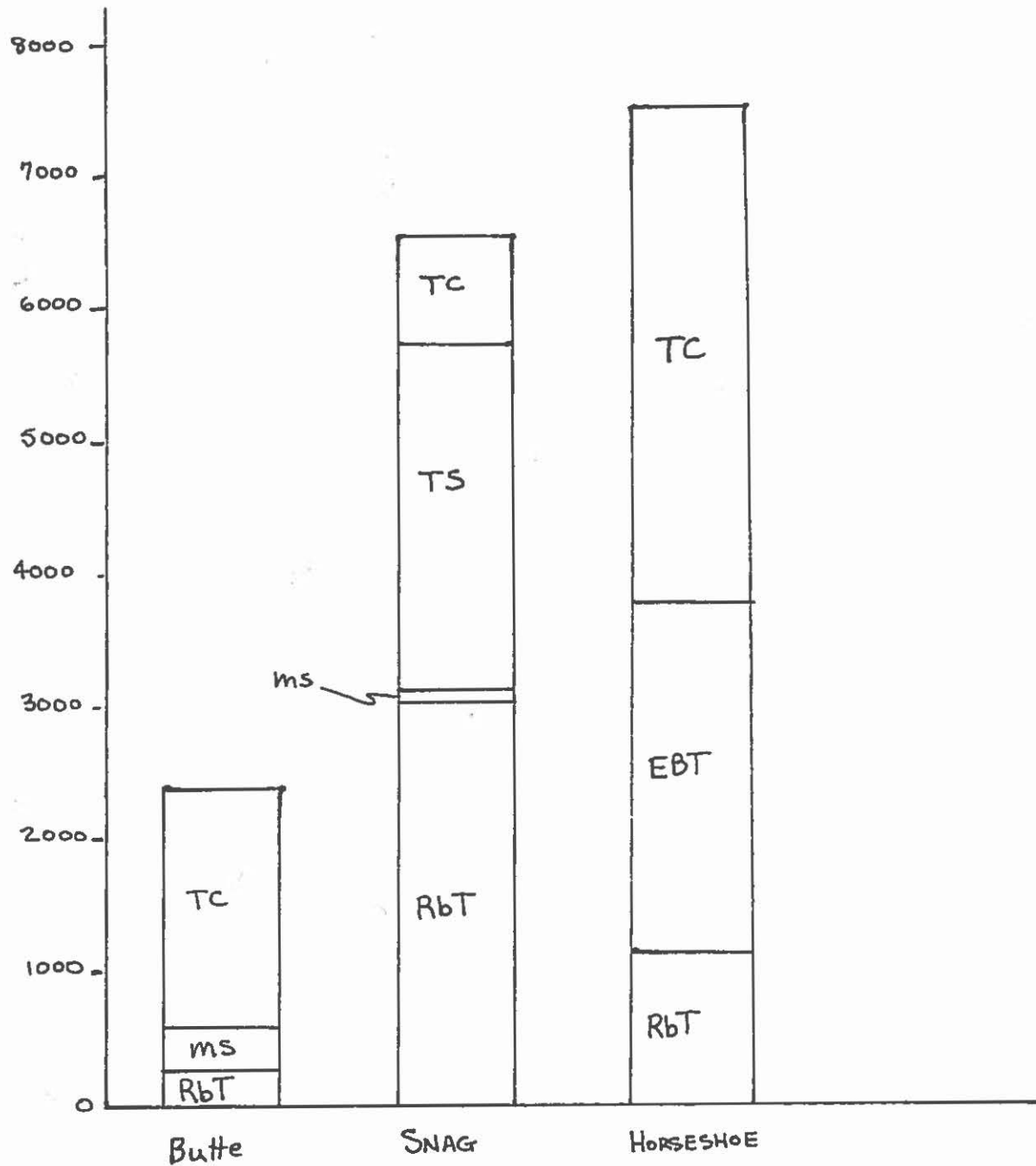
	<u>BUTTE</u>	<u>SNAG</u>	<u>HORSESHOE</u>
# RbT./net night	2.5	10.5	2.0
biomass RbT/ net night	256.4	3001.9	1104.9
mean wt. RbT	102.6	285.9	552.5
mean K RbT	1.08	1.03	1.17
 # EbT/net night	 ----	 ----	 15.0
biomass EbT/ net night	----	----	2630.8
mean wt. EbT	----	----	175.4
mean K EbT	----	----	1.12
 # TC / net night	 41.5	 8.0	 36.0
biomass TC/ net night	1781.3	596.5	3748.6
 # MS / net night	 5.5	 4.0	 ----
biomass MS/ net night	300.5	28.7	----
 # TS/ net night	 ----	 32.5	 ----
biomass TS/ net night	----	2671.8	----
 # fish / net night	 49.5	 55.0	 53.0
Biomass fish/ net night	2338.2	6499.8	7484.3
 % (by #) trout/ net night	 5.1	 19.1	 32.1
% (by wt.) trout/ net night	11.0	46.2	49.9

Figure 1. Biomass Relationships
of fish population samples from
Butte, Snag, and Horseshoe Lakes.

Biomass (grams) of fish
captured per net night.

KEY

- RbT- Rainbow Trout
- EBT- Eastern Brook Trout
- MS- Modoc Sucker
- TS- Tahoe Sucker
- TC- Tui chub



Bald eagles (Haliaeetus leucocephalus) and great blue herons (Ardea herodias) were seen at Snag Lake. It is not known whether these birds nest in the area. No nests were seen during the study period.

The only mammalian fish predator seen in the area was a river otter (Lutra canadensis) seen at Snag Lake by Alan Denniston following the study period.

DISCUSSION

Fish population composition of Butte, Snag and Horseshoe Lakes is interesting not only because of its diversity, but because of the nature of the differences between the three lakes. The farther up the drainage basin, the greater the percentage of game fish species in the population (s). I do not know the reason for this difference in population composition, but can only speculate. The lowest lake in the drainage, Butte Lake, may act as a "holding pool" for trashfish species. Because of the great abundance of trashfish, heavy competition for food probably occurs and trout evidently lose out to the heartier tui chubs.

I believe that low water level in Snag Lake may account for the greater abundance of sucker type fish in this lake. Normally these fish are found in slow moving or stagnant waters loaded with organic debris and bottom vegetation. Snag Lake fits this description well, aquatic vegetation choked the entire south half of the lake. Food was abundant for these fish at one end of the lake, and the other end provided fair habitat and food for game fish species. Water temperatures in this lake were fairly high, and this is also conducive to sucker populations. These conditions, except high water temperatures, are also good for trout populations.

A problem occurred in identification of the two sucker species found. Hubbell (1960) identified suckers from Butte Lake as tahoe suckers. Mr. Purvis and I both identified them as modoc suckers and tahoe suckers. We do not know whether we have made an error in identification, whether Hubbell has made one, or whether species composition has changed within the past 15 years. These two species are very closely related and only one physical feature is used to distinguish between them. An error could have easily been made by anyone.

I am hesitant to recommend any possible management changes to solve the "trashfish problem" in these lakes. Chemical treatment, popular in the recent past, could bring on public outcry and dissent from the ever increasing number of environmentally conscious wilderness visitors. Removal of these fish by anglers would probably act so slowly that it would tend to increase the health of the population.

Draining or active netting of these lakes is not feasible. Introduction of selective predators or predatory agents, if any exist, would be difficult and require serious study beforehand. All three lakes in the drainage would have to be treated simultaneously, including the streams feeding them. If treatment was the only alternative, which it is not, the effects would be widespread and effect entire ecosystems, not just specific areas. Obviously avian and mammalian fauna dependent on fish would be effected.

Personally I do not feel that this "problem" warrants any treatment. I recommend that the fisheries of these lakes be left in their present condition. Angling will remain fair to poor, but the broad and far reaching effects of any treatment will be avoided.

The population of small fish seen in Widow Lake should be identified. A sample of these fish could easily be taken in minnow traps, but other methods do exist. Active netting with seines, or even scoop nets and electroshocking are some of the other alternative methods.

The brook trout population in Bathtub Lake South is probably not too dense, but if a sample is desired, a gill net could be placed by one man and yield a good estimate of relative abundance.

Spawning conditions in Grassy Creek were excellent, as was the overall condition of this spring-fed stream. I feel that a detailed inventory of larger streams in the park is necessary to complete the picture of fishery and aquatic resources of the park. I will discuss this in detail in the report summarizing this summers' study.

I feel that the quality of the environment in this area is degraded enough to warrant separate discussion of possible remedies to problems and potential problems.

The litter problem at Butte Lake, although serious, is to be expected because of the type and intensity of use in this area. However, I do not believe that because a problem is anticipated it should be condoned. Some effort is made by protection and maintenance personnel to remove trash, but the seriousness of scope of the effort obviously does not have much effect on the problem. I recommend that the personnel there intensify their efforts in cleanup of the area. Although the potential for similar problems exists at other areas (ie: Horseshoe, Juniper and Manzanita Lakes), the problem is not as serious as these.

Heavy human use of the Butte Lake area could lead to deterioration of water quality. I recommend that fecal coliform bacteria levels be monitored in the heavy use area during the season.

Campsites at all lakes in the area less than 100 feet from the high water level should be removed. This problem is most serious at Snag Lake where designated sites should be established soon.

The final, most blatant, and potentially serious problem in the area is the condition of the trails. The Horseshoe Lake trail is in extremely poor condition and will rapidly deteriorate unless corrective action is taken immediately. An attempt was made by the Horseshoe Lake ranger to slow the erosion process on the trail, but it is obvious, to me, that this task is too difficult and extensive for one man to accomplish feasibly.

This is not the only trail that is in poor condition in this area. The trail to Rainbow Lake from Snag Lake is also in poor condition and apparently routine trail maintenance has been overlooked here. All of these problems could be easily solved by an efficient crew of trail workers. I believe that these problems stem from intolerable neglect on the part of the trail crew. I consider such neglect intolerable because these trails are in heavily used areas and could lead to potential visitor injury.

LITERATURE CITED

- Hubbell, P. M. 1960. A Study of General Ecological Conditions in a Group of Lakes in Lassen Volcanic National Park, 1960. Unpublished Masters Thesis, Humboldt State College. 46 pps.

A REVIEW OF CONDITIONS AT SUMMIT LAKE

BY

John R. West
September 29, 1976

INTRODUCTION

Summit Lake was investigated on September 20, 1976. The purpose of this paper is to discuss the findings of the study and recommend possible future management changes.

MATERIALS AND METHODS

A single experimental gill net was set in Summit Lake on the evening of September 20, 1976 for a period of 14 hours. The net was removed on the morning of September 21.

A standard lake inventory form was completed on the lake and surrounding area on the afternoon of September 20. The inventory included measurement and observation of water color, clarity, depth, bottom and shoreline type, watershed condition, temperature and generalizations on use type and intensity. Relative abundance of aquatic invertebrates and vegetation were noted at the time of the study.

RESULTS

Specific results of the study are given on the lake inventory form. Twenty-six fish were captured in the gill net set overnight in the lake. Of these, the largest was an eastern brook trout (Salvelinus fontinalis) 33.4 cm (13") in length and 654.1 grams (1.4 lbs.) in weight. The other twenty-five captured were all rainbow trout (Salmo gairdneri) ranging from 11.3 cm (4.5") to 22.6 cm (9.0") in length and weighing from 14.3 gm (0.5 oz.) to 126.0 gm (4.4 oz.).

The lake bottom and surrounding shoreline was covered by litter and other debris from human use. Most of the debris originates from misuse of the area by campers, day visitors and fishermen.

The outlet of the lake, Summit Creek, was dry at its mouth, but flowing approximately 100 feet from the lake. Salmonid fry were seen in the creek, but were not abundant. Approximately 100 yards from the lake, a septic drain field flows into Summit Creek from the south campground. This inflow has caused an algae bloom in the creek, choking it for 50 to 100 yards below the inflow.

DISCUSSION

This heavily used lake is regularly stocked with rainbow trout of catchable size by the California Department of Fish and Game. From records available to me, I could find no evidence of stocking with brook trout. I feel the brook trout captured in the gill net probably originated in the Kings Creek drainage, made its way up Summit Creek during high water, and from there moved into Summit Lake. This is just speculation and should be treated with caution in any future investigations or discussions of the lake. It could have been transplanted by anglers or accidentally from the hatchery truck.

The size range of rainbow trout captured indicates that the angler harvest of fish from this lake is probably fairly constant and moderately heavy. Most larger rainbows are probably harvested in the beginning of the season, if they are able to live through their first year in the lake.

The trash problem is extremely intense here and should be corrected immediately. Picnic and campground areas are much too close to the lake, this should also be corrected. Trash removal from the lake and its shores could easily be accomplished by several rangers with diving gear during practice dives. If not, local diving clubs would probably be eager to volunteer their time and equipment if air was supplied to do the job.

The septic drain field flowing into Summit Creek is a problem that should be corrected immediately. I saw raw, untreated sewage flowing into the creek during the investigation period. This type of problem could lead to serious visitor health hazard and complaints. I believe it will be just a matter of time before a visitor drinks the water below the sewage outfall and becomes ill. A fecal coliform bacteria count taken immediately below the outfall this year showed a high coliform concentration of 9400 MPN/100 ml.

A fecal coliform bacteria count was made in 1973 at Summit Lake and the lake water "showed a high coliform concentration of 2,300 MPN (most probable number) /100 ml." (Dept. of Interior, 1975) Environmental Protection Agency standards on coliform bacteria in recreational waters are:

- Swimming: No more than 200 MPN/100 ml.
- Fishing: No more than 1000 MPN/100 ml.
- Any use (ie: boating): No more than 2000 MPN/100 ml.
- Drinking water: No more than 2.2 MPN/100 ml.

If coliform bacteria counts reach such high levels at any time in the future, I believe the campgrounds should be closed to human use.

LITERATURE CITED

Dept. of the Interior, 1975. Preliminary Draft Master Plan, Lassen Volcanic National Park, California. Unpublished. Page 173, lines 2530-2545.

SNAG LAKE MANAGEMENT REPORT

by

Jesse M. Purvis
September 20, 1976

INTRODUCTION

On September 1 and 2, 1976 a survey of Snag Lake was completed to determine its value as a fishery and its place in the park ecosystem.

Snag Lake is located in Sections 27, 28 and 33 of T31N, R6E of Lassen Volcanic National Park. Access is by trail, five miles from Butte Lake Ranger Station or four miles from Juniper Lake Ranger Station.

In normal water years the surface pool is 445 acres in area.

MATERIALS AND METHODS

General materials and methods are described in the Management Unit 14 Report, (Twin Lakes), (Purvis, 9/76) or in the Lassen Park Report, (West, 9/76).

The gill nets (2) were set at approximately Station #8 and between Stations #15 and #17 as used by Everest (1964). It should be noted that the surface area was about 1/2 of the normal when the survey was done, so the actual locations of the net sets were probably a little farther offshore than the stations used by Everest.

RESULTS AND DISCUSSION

As noted before, the surface area of Snag Lake was about 1/2 of normal, exposing many areas along the banks. It is estimated that the water level was down about 8-12 feet.

According to Everest (1964) the water level of Snag Lake during his study (July 31 to August 27, 1963) dropped ten feet. It would be interesting to know if this drop occurs annually, or if it is a function of a low water year. No precipitation data was available for Snag Lake during the 1963 season.

Except for this variation in size of the lake, most of the other parameters of the lake are fairly well correlated with Everest (1964).

The apparent color of the water was green. Visibility was about 20 feet. Everest (1964) claimed 22 feet visibility.

The bottom near shore, and where it could be seen from the raft, appeared to be about 60% sand and 40% mud and organic debris.

Water temperature during 1976 was 1.5°C higher than in 1963. In 1963 it was 20°C on the surface and in 1976 it was 21.5°C.

Four streams were noted flowing into Snag Lake during the 1976 study. The first enters between Stations #19 and #22. The next two enter at Station #24. It appears that these are one stream which has formed a delta on the receding mudflat. The fourth inlet is Grassy Creek, and enters at Station #1 (during the 1976 study, its actual entrance into the lake occurred at about Station #3).

Spawning areas for salmonids are present in all of the flowing feeders. The areas are extensive in Grassy Creek, and slight in the remaining two or three. Juvenile fish of unknown species were observed in all of these inlets.

Wildlife noted were Canadian geese, cinammon teal, great blue herons, bald eagles, spotted sandpipers and deer. Alan Denniston, Resource Management Specialist, noted river otter on Snag Lake, September 21, 1976.

About 1/2 of the bottom substrate are sprouting aquatic vegetation. Most of this vegetation is a Potamogeton sp. Everest (1964) identified this as P. nodusus. Myriophyllum sp. is also present with the P. nodusus and has been identified as M. hippuroides.

Several other Potamogeton species were noted in the lake as well as Carex sp. and Juncus sp. A species of Elodea was noted at approximately 1/3 distance between Station #17 and #18.

Low water conditions made the stands of vegetation appear more dense than they might have been. Still the stands are dense, nonetheless.

Fish food organisms noted were Chironomidae and other Diptera, being abundant in all sections of the lake. The midges were conducting a hatch during the period of the 1976 study. Other food organisms seen in much smaller quantities were Odonata, Ephemeroptera, Trichoptera and Gastropoda. One of the rainbow trout had an eight inch garter snake in its mouth when it was retrieved from the net.

Four species of fish were caught in Snag Lake during the study of 1976; rainbow trout (Salmo gairdneri Richardson), coarseraker tui chub (Siphateles bicolor obesus Girard), modoc sucker (Catostomus microps Rutter) and tahoe sucker (C. tahoensis Gill and Jordan).

An average of 3.93 fish per hour were taken with the nets. By number, rainbow trout composed 19.1% of the catch, coarseraker tui chub 14.5%, modoc sucker 7.3% and tahoe sucker 59.1%. Apparently since 1963 the numbers of rainbow trout and tahoe sucker have increased, while the coarseraker tui chub population has declined.

No speckled dace (Rhinichthys osculus Girard) or Eastern brook trout (Salvelinus fontinalis Mitchell) were captured during the 1976 study. These fish composed only 0.7% and 2.0% of the catch in 1963, respectively. It is likely that the dace population is either very small or has disappeared entirely. The Eastern brook trout are thought also to be a small population and move up into the cooler waters of Grassy Creek during the summer.

The appearance of the Modoc sucker indicated either introduction of another undesirable "trash" fish, either intentionally or accidentally by an angler or a mistake was made in keying fish during the previous study. This is easy to do as the difference is often difficult to discern.

By weight the rainbow trout composed 46.2% of the catch, tui-chubs 9.2%, Modoc sucker 3.5% and Tahoe sucker 59.1%.

A total of 110 fish were netted, weighing 12.9996 kilograms. The average rainbow weighed 285.9 grams, tui-chub 57.4 grams, Modoc sucker 74.6 and Tahoe sucker 82.2 grams. The average condition factor (K) of the rainbow trout was 1.03. This indicates that the fish are just above the borderline for being considered as being in good shape.

There is apparently an adequate supply of food, cover and spawning grounds to maintain a salmonid population in this lake without stocking and this appears to be occurring. Unfortunately the salmonids must compete to some extent with the other fish for these parameters, and this limits the population to some extent. Exactly how much limiting is occurring is not known and would require extensive research to learn.

Stocking of Snag Lake is an undesirable management tool. The introduced fish would compete with the natives and put further stress on the system. It is highly unlikely that trout would overwhelm the other species by "sheer bulk of numbers" as has been tried in the past at other locations with little or no success (an example of this is Reflection Lake in the northwest corner of the park). The cost factor in planting is not justified by the return that would be garnered by the sportsman, and the knowledge that this lake had been recently stocked, or the sight of an airplane dumping fish might detract from the sportsman's wilderness experience.

Treatment of the lake with a chemical poison, such as rotenone, to remove all of the fish, coarse and game alike, and then to restock with a game fish is also an undesirable management tool. Treatment of Snag Lake would necessitate treatment of Grassy Creek, where the suckers and trout spawn, as well as the other inlets. The more bodies of water which must be treated, the more difficult it is to remove all of the fish. Horseshoe Lake might have to be done as some fish might escape via this route, and some fish may find refuge in pockets in the lava flow.

Also eggs may be present, which may escape the action of the treatment.

The best management policy for this lake appears to be to leave it alone. The lake appears to have held its conditions of 1963, or possibly improved, as far as sports fishing possibilities exist and no alteration is deemed necessary.

COMMENTS

The following are comments made on the management recommendations ("further investigation are needed to determine") section of Chapter VIII in Review of Trout Fishery Situation, Lassen Volcanic National Park, an unpublished manuscript by Orthello L. Wallis, 1955.

- A. Ratio of rainbow trout to Eastern brook trout; there are few brook trout in the lake, if any, and those that reside there probably tend to summer in Grassy Creek, which is cooler.
- B. Extent of chub population; 14.5% by number and 9.2% by weight.
- C. Size range of trout taken; to 1.14 kg.
- D. Amount of fishing pressure and relative success of the anglers; fishing pressure is medium to heavy for lakes in the park. Success is moderate. More fishing should be encouraged to aid the health of the trout population. Suckers and chubs should be removed high on the banks and/or buried when caught. They should not be returned to the lake.
- E. More about the biological and physical features of the lake; a study on the aquatic vegetation communities of the lake would be very interesting, especially the south end of the lake. This could be coupled with a limnological study. Special attention should be given to the invertebrates living in, on, or around the plants, as they may play an important role in the food web of this lake.

MANAGEMENT RECOMMENDATIONS

- 1. No fish shall be stocked in Snag Lake.
- 2. Trail crew should remove the garbage in and around the lake and on the lakeshore. This problem has been long unattended.

3. A further limnological study should be undertaken to note any changes since Everest's study of 1963.
4. A study of the aquatic vegetation communities should be undertaken when funds can be obtained.
5. No poisoning to remove trash fish shall be undertaken.

JUNIPER LAKE REGIONAL REPORT

BY

Jesse M. Purvis
September 29, 1976

INTRODUCTION

During the period of September 8 to 10 and 13 to 16, 1976, a study was conducted in the Juniper Lake area of Lassen Volcanic National Park, California, to determine the condition and status of the lakes and ponds and their environs, the extent of aquatic life, presence or absence of fish populations and their condition in relation to other populations. Management recommendations were made from the observations recorded.

For the purpose of this paper, the Juniper Lake region may be said to contain the following lakes: Juniper, Indian, Crystal, Glen, Island, East and Jakey, and a myriad of smaller, unnamed lakes which are in the immediate vicinity of the lakes just mentioned. Only the named lakes are considered in this report as the unnamed lakes are shown to be similar to others in the park (see Purvis, 1976).

MATERIALS AND METHODS

A detailed discussion of the methods and materials used during the study may be found in either Purvis (op cit) or in the overall report on the fishery study of the park during 1976 by West (1976). Specifics are noted below.

Two gill nets were set in Juniper Lake and one net was set in Jakey Lake. Crystal Lake, Glen Lake, Indian Lake, Island Lake and East Lake were fished for a recorded amount of time.

RESULTS AND DISCUSSION

Water temperature at the surface in the lakes in this region ranged from 13°C to 21°C. The 13°C temperatures (Island Lake, East Lake; 9/16/76) occurred after a recent snow flurry (9/14-9/15/76) had dropped two to four inches of precipitation on the ground. On the day of the storm, before it hit, the surface temperature at Jakey Lake was 19°C. It is, therefore, quite possible that the water temperatures at Island and East Lakes may normally be higher in the summer months than was experienced during the study. It is usually the case that the temperature at the very surface of lakes will change more rapidly than the temperature at depth due to more intimate contact with the much colder air. These cold temperatures might also give us a view as to the conditions that may exist in late fall and early winter in this area of the park.

Correlation between air and water temperatures was quite good except at Glen Lake at 1130 on the 8th of August when the air temperature was 14°C and the water temperature was 21°C. This difference may be the result of the air not having warmed up yet on that morning. It was clear and calm that morning.

Juniper Lake has a maximum recorded depth of 235 feet (Everest, 1964). Everest (op cit) states that the visibility as measured with the Secchi disc ranged from 76 to 81 feet. It was found during the 1976 study that a rock attached to a line disappeared from view at 58 feet on a calm day. It should be noted that the rock is not so nearly as easy to see as is the black and white pattern of the Secchi disc, so actual visibility is probably greater than 58 feet and may be in the vicinity of 80 feet as found before.

The depth of the other named lakes in this area ranged from 10 to 31 feet, with visibility usually being to the bottom as deep as 28 feet.

The bottom type of these lakes is 75% to 80% mud and organic debris except for Indian Lake which is 100% mud and organic debris. Indian Lake is only twelve feet deep, and the shallower lakes in the park have tended to show this bottom composition. East Lake, however, is only 10 feet deep, yet only 75% of the bottom substrate is mud and organic debris. This is probably due to the exposed, rocky terrain in some areas around the lake.

The other portions of the bottom substrate of these lakes is usually rubble and sand.

Red fir and lodgepole pine are the predominant forest trees in this section of the park.

Interesting animals located in this region of the park include Columbian blacktailed deer (Odocoileus hemionus var. columbianus), pine martens (Martes americana), and gray jays (Perisoreus obscurus griseus). A belted kingfisher (Megaceryle alcyon) was also seen at Jakey Lake.

Glen, East and Island Lakes are not reached by improved trails, but must be attained by cross-country hiking.

No species of game fish were caught in any lake in this region. In fact, the only fish caught were in Juniper Lake where Lahontan reddsides (Richardsonius egregius) were captured. They are fairly abundant, apparently, as we captured 2.29 fish per hour in the gill net sets.

Salmonids were at one time planted in Juniper, Jakey, Glen, Indian and Crystal Lakes. No reproductive sites are available so as soon as all of the fish perish, the fishery resource of the lake becomes depleted. Crystal Lake was planted with juvenile rainbow trout earlier this year, and several were seen cruising. None were caught by angling, though one did tug at the bait, but was not hooked.

Summary of
Aquatic Resources Inventory for
Management Unit 14 (Twin Lakes)
Lassen Volcanic National Park

by

JESSE M. PURVIS
September 7, 1976

A study of the aquatic resources was conducted in Management Unit 14 (Twin Lakes) during the period of August 17 to 25, 1976. The Twin Lakes Management Unit consists of the following lakes: Upper Twin Lake, Lower Twin Lake, Rainbow Lake, Feather Lake, Echo Lake, Swan Lake and approximately 19 unnamed lakes located in parts of Sections 1 and 2 of T30N, R5E, Sections 24, 25, 35 and 36 of T31N, R5E, and parts of Sections 17, 20 and 31 of T31N, R6E.

The study was conducted to determine the condition and status of the lakes and ponds and their environs, the extent of aquatic life, presence or absence of fish populations and their condition in relation to other populations. Management recommendations were made from the observations noted.

METHODS AND MATERIALS

Thermometers calibrated in Centigrade degrees were used to measure the water temperature and the ambient air temperature. A small, inexpensive camera was used to take color photographs of the bodies of water. The prevailing weather conditions at the time of observation were noted as they can have influence on what was observed. Fly and spin fishing tackle was used to sample the fish populations, as well as two gill nets. The nets were 150 feet long by five feet high and consisted of five panels of various mesh sizes ranging from about 1/2 inch to two inches. The nets were set from a two-man, inflatable rubber raft with the aid of a partner. A rock anchor was attached to each end of the net and deposited on the bottom. Five one-gallon plastic jugs were used as floats for each net and attached at evenly spaced intervals.

Fishing tackle was operated for a recorded amount of time in Echo, Swan, North Feather and Upper Twin Lakes. Gill nets were set in Upper Twin Lake (2), Lower Twin Lake (2), Rainbow Lake (2), and Feather Lake (1). The nets were set overnight from approximately 5:00 p.m. to 7:30 a.m. All fish captured were weighted on a beam balance to the nearest tenth of a gram and measured (fork length) to the nearest tenth of a centimeter. Condition factors for all salmonids were calculated from this data, using the formula

$$K = \frac{10000W}{L^3}$$

Where the K is the condition factor of a given fish, W is the weight in grams of that fish and L is the fishes length in millimeters. Stomach samples and scale samples were taken from all fish for later analysis of feeding, age and growth. The abundance and species composition of each lake was calculated both by numbers of fish and by biomasses. Extent of natural propagation was noted.

Apparent color of the lakes was noted and the approximate clarity. In lakes where the boat was used (Upper and Lower Twin, Rainbow and Feather) the clarity was noted by taking a rock attached to a line and dropping it over the side and noting the depth at which the rock disappeared. The area of the lake was either estimated or taken from the notes of previous studies. Shoreline features as well as features of the watershed in general was noted. The bottom of each lake was categorized and ratios of bottom materials were recorded. A maximum depth was recorded for each lake, either by sounding or by inspection and an average depth was estimated.

Aquatic plant species present and their relative abundance were noted and food organisms were handled in the same manner. Fish predators were noted if observed or evidence of their occurrence was seen. Any suitable spawning sites were carefully noted so that it would be known if any fish population was capable of replenishing itself. Use type and degree was noted for each lake, as was fishing intensity.

Suggestions were made for improvements to the area and recommendations were forwarded, based on the observations with regards to present management policy and for consideration in the formulation of any future management policy.

All data recorded in the field were recorded on a standard "Lake Survey Form" obtained from the California Department of Fish and Game. This data was later transcribed onto a form made up for the study. These forms are the basis for this report.

RESULTS

The temperatures of the lakes themselves ranged from 5°C to 20°C, the ambient air temperature ranged from 5°C to 22°C. The greatest difference between air and water temperatures occurred at Swan Lake on August 18 when at 2:30 p.m. the air was 5°C and the water was 12°C. Since most of the observations were made late in the morning or in the afternoon the majority of air and water temperatures are quite close to each other.

The larger lakes tended to be blue, blue-green, or green in color while the smaller, unnamed lakes tended to be either green or brown.

According to Rangers Patton and Schneegas, there are some large brown trout (Salmo trutta) left over from the last plant in 1970. No sign of these fish were seen.

Other specific results may be found in the individual lake inventory forms on file at Park Headquarters.

MANAGEMENT RECOMMENDATIONS

1. None of the lakes in this area should be stocked. They have shown a lack of suitability for successful populations in the past, and this condition is not likely to change.
2. Another study should be made at Crystal Lake, when feasible, to determine the extent of the brown trout population, if any. A gill net should be used. This would also enable the researcher to determine the success of this year's plant of rainbow trout.
3. The name "East Lake" painted on a rock at that location should be scrubbed off with a wire brush. This is very detracting in a wilderness and is wholly out of place.

LITERATURE CITED

- Everest, F.H. 1964. A survey of Juniper Lake, Lassen Volcanic National Park. June - August 1964. Unpublished manuscript in park files. 33 pages.
- Purvis, J.M. 1976. Summary of Aquatic Resources Inventory for Management Unit 14 (Twin Lakes) Lassen Volcanic National Park. Unpublished manuscript in park files. 8 pages.
- West, J.R. 1976. The Lentic Resources of Lassen Volcanic National Park, California. Unpublished manuscript in park files. 20 pages and Appendix A and Appendix B.

Most of the small lakes were so shallow that the bottom could be seen in them while standing on the shore. In the larger lakes the maximum clarity occurred in Upper Twin Lake on August 23 when the rock disappeared from view at 23 feet below the surface.

The maximum depth recorded was also at Upper Twin Lake when bottom was hit at 55 feet below the surface. The average depth at Upper Twin Lake was approximately 20 feet. The average depth of the other named lakes ranged from three feet (Rainbow Lake) to 20 feet (Lower Twin Lake). The average depth of the unnamed lakes ranged from less than one foot to slightly more than one foot. None of these unnamed lakes were observed to be deeper than about four feet.

Lower Twin Lake is the largest lake in the management unit, having a surface area of 55 acres. Echo Lake is the smallest of the named lakes, being only nine surface acres. The unnamed lakes range from one-sixth of an acre to 14 acres. The 14 acre lake is the large body of water north of Feather Lake and is often called North Feather Lake.

Mud and organic debris is the predominant bottom type in all of the named lakes except Lower Twin Lake, where sand composes 60% of the bottom. In some of the lakes (Rainbow, Feather, Echo) mud and organic debris compose either 95% or 100% of the bottom. This mud often is rather shallow in depth and overlies a layer of sand and/or gravel. In the unnamed lakes mud and organic debris is again predominant, usually being 100% of the bottom.

Red fir is the predominant forest species in this management unit, being 40% to 90% of the standing trees. Other important tree species are white fir and lodgepole pine. Most of this area is in a gentle part of the park, relatively flat or only slightly rolling with scattered volcanic mountains (Fairfield Peak, Cinder Cone) and some uplifted ridges. The soil type is a shallow, loose soil often containing amounts of sand or cinders. Streams in the area tend to run intermittent and were not running during the study period. In season, Rainbow Lake flows into Lower Twin Lake, as does Upper Twin Lake. The water from Lower Twin Lake then flows northerly about two miles then easterly for about a mile where it encounters the Fantastic Lava Beds. Here the water enters the lava beds and is thought to drain through these into Butte Lake. The rest of the lakes in the unit are in enclosed basins and lose water by seepage, and evaporation and gain water by seepage and runoff.

Both mule deer and Columbian blacktailed deer are abundant here. Pine martens were sighted on several occasions. A wide variety of fowl inhabit the area, including ducks and geese and raptors. Several varieties of woodpeckers were also encountered here.

All of the named lakes in the unit are easily accessible by trail, being immediately adjacent to one of the several routes through the area. The main trail originates at the Summit Lake campgrounds and goes to Snag Lake.

At Lower Twin Lake a branch trail takes off to Swan Lake and another goes towards Badger Flat, passing Feather Lake on its way. None of the unnamed lakes are more than a mile off of any established trail, most being much closer. Location is not difficult with a map and suitable compass.

The predominant aquatic plant in the unit are members of the Carex genus. Other aquatic plants which were found include Isoetes sp., Scirpus sp., Potamogeton sp., Sparganium sp. (found only at Rainbow Lake), and various members of the family Graminae.

The genus Notonecta, or backswimmers, were the predominant food organism seen during the study, being present in nearly all of the lakes and always in large quantities. Other food organisms seen were Gerris sp. (water striders), Dineutes sp. (whirligig beetles), Hydrophilus sp. (water scavenger beetles), Dytiscus sp. (predacious diving beetles), Dipterans (flies), Chironomidae (midges, a family of Dipterans), Ephemeroptera (mayflies), and bees. Hatches of both chironomids and ephemeropterans were observed to occur during the study.

The only fish caught during the study in this management unit was a rainbow trout (Salmo gairdneri) caught in a gill net in Rainbow Lake. The fish weighed 1121.5 grams and was 43.0 centimeters long. The K for this fish was 1.4. One or two other fish were observed rising to the mayfly hatch that was occurring during observations (August 22 and 23). Reports reached me that one or more anglers had caught some large fish in Rainbow Lake since that time, but that report is unconfirmed and no creel census cards were filled out.

Fish were observed in Upper Twin Lake, but none were caught in 29 hours of gill net effort and two hours of angling from the raft. No other fish were observed in any of the other lakes in this management unit.

The bottom of the lakes, their shorelines, inlets and outlet streams appear to possess little or no suitable spawning sites for salmonids.

The uses of this area can be broken down into two categories. Natural uses and those uses of the resource, which are made by the plants and animals which have become established there. These include mammal and avian watering, nesting, breeding, feeding, etc. These uses are heavy to very heavy, especially by the deer.

Human uses are those uses which are made of the area by human visitors. These include hiking, backpacking, camping, sightseeing, fishing, bird-watching, photography and others. These uses are also heavy due to the easy accessibility to the area from trailheads, the gentle trails and the scenic beauty of the area. Recently fishing has declined as a use because the availability of fishable waters has diminished due to lack of stocking of fish in lakes. Campers and others still exert a heavy pressure on the area and often do not observe proper wilderness etiquette in the use of water supplies.

DISCUSSION

Being late in the summer, most of the lakes could be expected to be found fairly warm and this was the case. Even extremely cold nights could do little to lower the temperature of even the surface of the waters. Most of the larger lakes were warm enough that swimming was pleasant. In some of the smaller, unnamed lakes the temperature at the surface would fall during the night, and it would take until noon or after for the water to warm up to the ambient air temperature. This is the expected occurrence in very small lakes and ponds.

A report was made by my partner, John R. West, on the Twin Lakes region and this covers a lot of the material concerning Upper and Lower Twin Lakes, Echo Lake, Swan Lake and Rainbow Lake. Mr. West has also completed a report on the Cluster Lakes region and this includes Feather Lake. The reader is referred to these reports for further information.

Blue and green are typically encountered colors of good sized lakes and usually is evidence that there are no drastic pollution problems. This reflects the reflection of light from the body of water, and also the color of the bottom materials in some instances.

A brown color is usually an indication that there is an excessive amount of organic material in the water, which is decomposing. This is the case in the small, shallow lakes where the ratio of volume to surface area is small. Hence, any organic debris which falls into the pond, such as leaf litter, falls into a smaller volume of water. Hence, the water becomes more concentrated with the products of organic decomposition. In very shallow lakes the brown color is also a reflection of the color of the debris on the bottom.

In the shallow lakes it was impossible to tell how far one could actually see if water of that type were in a deeper basin. In order to more exactly measure the clarity of these waters, a sample would have to be taken and appropriate clarity, or light penetration, or turbidity measurements be made.

The clarity of the larger, deeper lakes is usually quite good ranging from 10 feet to over 20 feet, as mentioned above. The depth to which can be seen is a variable, depending on the amount and angle of sunlight, presence or absence of clouds, and how much the surface of the lake is being disturbed by wind action. So if a deep clarity is observed on a calm day, one might find that on a cloudy, blasty day that the depth to which can be seen is much less than previously reported. Conversely, in a calmer situation one may be able to see further into the water column. Again, more detailed measurements of the water would be interesting.

The maximum depths recorded for the larger lakes reflects only a cursory sampling effort by sounding with the rock. They should be approached cautiously for two reasons.

First, very little of each lake that was sounded was actually sounded. Second, most of the lakes were down in volume from normal and high water years, so this must be taken into account. The average depth estimated for the lakes should also be approached cautiously because this is an estimation. It should also be noted that this average depth may be closer to a median than a mean in some, if not most or all, cases.

In many of the unnamed lakes, which are very shallow, the average depth may be very close to the maximum depth, the lake being a low spot in the ground where water has seeped in and remained.

The surface acreage for the larger lakes was taken from work previously done by other park employees. Since this has been a low water year these values may be slightly large, although it is believed that the difference is slight.

The bottom composition of a lake is a reflection of its geological characteristics and the amount of organic debris that is brought into the basin. In smaller lakes without outlets this organic debris which enters can not leave except through decomposition so the layer consistently builds up and is thickened. Eventually these lakes will be encroached upon by the forest and fill in, and the lake will no longer exist. In larger lakes this process is also occurring, but at a much slower and less noticeable rate. If the lake has an outlet some of the organic debris can be carried out, which aids in slowing up the filling of the lake.

The sand and gravel under the layer of organic debris is a part of the geological basin that the lake is in and reflects the geological history of the area.

The organic debris found usually consists of decomposing vegetable matter and fallen trees or logs.

The easy access of all the lakes and ponds within this unit makes them extremely popular with visitors, hence use is heavy and sometimes abusive.

The aquatic plants found within the lakes and upon their shores are typical plants one would expect to find at this latitude and altitude.

The amount of food organisms found seems to indicate that there is sufficient food available to feed a population.

Unfortunately the lack of spawning sites dictates that fish can not live successfully here. In order to have a fishery in the unit fish would have to be stocked and this is in opposition to the management policy of backcountry and wilderness areas in the National Park System in the Western Region.

The fish which was caught in Rainbow Lake, the others which were seen, and the ones which may have been caught out of the lake are probably remnants of the last stocking effort in 1972. One of the fish which was observed was only about 15 to 20 cm. in length. It may be that some spawning does take place occasionally in the outlet stream of this lake. The conditions there are marginal at best, but the possibility remains. If this is so, then spawning might occur every few years when conditions are proper and if a pair of fish, male and female, have survived from the last batch of adults. It is also slightly possible that this may occur in Upper Twin Lake. None of the other lakes in the system are capable of supporting a fish population.

The sparsity of captured fish in Rainbow Lake and the lack of captured fish in Upper Twin Lake would seem to indicate that the populations in these two lakes are very meager.

The repercussions of extensive visitor use upon the unit are ominous. The foaming seen on Lower Twin Lake (see Twin Lakes Regional Report by John West), the washing of dishes, clothes and persons in the lakes while using soap, the proximity of campsites to lakes which may bring in human waste products and garbage, and other factors seem to be leading to a rapid deterioration of the aesthetic value of this unit.

MANAGEMENT RECOMMENDATIONS

the Twin Lakes

None of the lakes in Management Unit ~~14~~ should be stocked with fish. Fish have apparently not been able to reproduce themselves here in the past and it is doubtful that they can accomplish this now. Introducing fish to this unit would only serve to increase the pressure placed on it by visitors and lead to further deterioration of the environment. There is evidence that backcountry users are not primarily interested in fishing (walking from the Twin Lakes cabin to Summit Lake I encountered 43 hikers going into the area, only 5 were interested in fishing in the area), and the cost factor versus the value realized by the tourist is not worthwhile. Finally, introducing fish to the unit would serve to increase the amount of organic debris in the lakes.

A seasonal backcountry ranger should be hired by the park when funds are available. He should be stationed at the Twin Lakes cabin and be responsible for the Twin Lakes area and the Cluster Lakes area. Campsites which are too close to the water should be destroyed or moved further back from the shore. People who are observed using soap in the waters, or discarding used wash water in the water should be cited.

A chemical analysis of the water of Lower Twin Lake should be made to try and determine the cause of the foaming. It might also be wise to take a coliform bacteria count of the lake to see if excessive pollution has made the water unsafe for human use. If the coliform count is too high then the lake should be closed to all human use until the problem is alleviated. It may be wise to close the lake to camping for one year anyway.

A study of Upper Twin Lake and of Rainbow Lake should be made to examine the extent of spawning in these two lakes. The lakes should be closed to fishing during the study.

The trail crews should clean up the lakes and lakeshores as much as possible. There is an enormous amount of garbage left behind and it appears that no effort has been made to clean it up.

Use of this backcountry area by hikers, campers, etc. should be closely monitored. Rangers should walk through the area more often to note uses, abuses and general condition.

A study should be made on the extent of deer browsing to determine if overbrowsing is occurring.

A study should be made to determine the extent of the pine marten population.

A bird inventory would be very helpful in evaluating and formulating future management policies and decisions.

No changes should be made in the current management policy without an in-depth study of the factors involved.

SUMMARY OF
AQUATIC RESOURCES INVENTORY FOR
MANAGEMENT UNIT 10 (RAIL CREEK)
LASSEN VOLCANIC NATIONAL PARK

BY

Jesse M. Purvis
September 27, 1976

INTRODUCTION

A study of the aquatic resources was conducted in Management Unit 10 (Rail Creek) during August 3 and August 18 to 21, 1976. The Rail Creek Management Unit consists of the following lakes: Emigrant Lake, Soap Lake, Cluster Lake #1, Cluster Lake #2, Big Bear Lake, Little Bear Lake, Silver Lake and 13 unnamed lakes, located in Sections 14 and 15 and parts of Sections 9, 13, 16, 22, 23, 27 and 34 of T31N R5E. In addition, there are 11 dry lakes in this unit, (a dry lake in this context is one which is without water, or with little water, part of the year, usually late summer).

The study was conducted to determine the condition and status of the lakes and ponds and their environs, the extent of aquatic life, presence or absence of fish populations, and their condition in relation to other populations. Management recommendations were made from the observations noted.

METHODS AND MATERIALS

A description of general methods and materials may be found in the summary of Management Unit 14 (Purvis, 1976), or the overall park report (West, 1976).

Fishing tackle was operated in Soap Lake, Cluster Lake #1 and Little Bear Lake for a recorded amount of time. Gill nets were set in Cluster Lake #2 (2), Big Bear Lake (1), and Silver Lake (1).

RESULTS

The temperature range of both the surface waters and the ambient air was quite broad during the study. Water temperature varied from a low of 8°C (Emigrant Lake at 0930 on an extremely overcast morning with a light rain) to a high of 24°C (unnamed lake in Section 27 on a clear, calm day). The temperature of the air varied from 5°C (Soap Lake at 0915 on the same morning that Emigrant Lake

was done) to 21°C (Silver Lake at 1505 on a mostly clear day with some clouds, Cluster Lake #1 at 1030 on a clear, calm day).

The range of differences between water and air temperatures experienced a wide variation during the study. In some instances, (Big Bear Lake at 1620 on a partly cloudy day), both air and water temperatures were the same (here 20°C). In another instance, the air was 8°C warmer than the water (unnamed lake in section 27). In still another case the water was 7°C warmer than the air (unnamed lake in section 22).

The larger lakes tended to be blue, blue-green, or green. The smaller lakes tended to be either green or brown in color.

The visibility in the smaller unnamed lakes ranged widely, from about 16 inches (section 13) to eight feet (section 27).

In the named lakes, the shallowest visibility occurred in Emigrant Lake where the visibility was only 2 to 3 feet. The deepest visibility occurred in Silver Lake where the rock used for the purpose disappeared from view at a depth of 35 feet.

Silver Lake was also the deepest lake in the Rail Creek Management Unit, with a maximum depth recorded of 45 feet. Soap and Emigrant Lakes showed maximum depths of three to five feet and are therefore the shallowest of the named lakes. Depths in the unnamed lakes in this management unit ranged from two feet to fifteen feet, with most of the depths being less than six feet. This is deeper than the unnamed lakes in most of the other management units.

Mud and organic debris compose 80%-100% of the bottom materials in all of the named lakes except Cluster Lake #1. In this lake, the bottom is 20% rubble, 50% sand, and 30% mud. In the unnamed lakes, mud and organic debris composed 100% of the bottom materials in all of the lakes excepting two. In one of these lakes, rubble composed 10% of the bottom, and in the other, sand and gravel composed 10%-15% of the bottom substrate.

Named lakes ranged from 5 acres (Emigrant Lake) to 32 acres (Silver Lake) in area, with a good array of intermediate sizes. Among the unnamed lakes, a 10 acre lake is found (section 27). Several lakes of approximately 1/3 acre are also found. Most of the unnamed lakes are less than 2 acres in area.

Red fir, white fir, lodgepole pine, and Jeffrey pine are the main constituents of the forest in this area. Red fir is probably the predominant tree, but the other species mentioned are also well represented. Near Soap Lake, the forest is 100% lodgepole pine.

This was noted both by observation and by confirmation on the forest cover-type maps of the park. The terrain is gentle and rolling in most of this area with only a few steep hills. Consequently, the trails in this area are easy for hikers to walk and a good deal of human use occurs.

In wet seasons, Cluster Lake #2 flows the short distance to Cluster Lake #1. The outlet of Cluster Lake #1 is the ephemeral stream, Rail Creek. None of the other lakes in the management unit have flowing outlets.

Both mule deer (Odocoileus hemionus hemionus) and Columbian black-tailed deer (O. h. columbianus) are abundant here. Pine martens (Martes americana) were sighted on three occasions in this management unit. In addition, a wide variety of fowl are to be found here, including, but not limited to Buteo sp. (hawks), Anatidae (ducks and geese), Pici (woodpeckers), Parus gambeli (mountain chickadee), and Junco hyemelis oregonus (Oregon junco).

All of the named lakes in the area are easily accessible by improved trails. The unnamed lakes which are not immediately adjacent to a trail are so close as to not be difficult to reach with the aid of a map and suitable compass.

The predominant aquatic plants in the area are members of the genera Carex, Nuphar, Juncus, Isoetes, Potamogeton, and the family Graminae. Also found in very small quantities are members of the genera Scirpus and Salix.

The primary food organism in this management unit is the genus Notonecta. They are present in abundance in nearly all of the bodies of water. Also present in some of the lakes and ponds, or in smaller quantities were Chironomidae and other Dipterans, Ephemeroptera, Trichoptera, Odonata, Dineutes, Dytiscus, Gerris, Hydrophilus, Hymenoptera, Rana pipiens pipiens, and Gastropoda.

No fish were observed or caught in any of these lakes or ponds during the study. Nor were spawning sites observed.

Angler use is light in the area, with the majority of the human use being concentrated among hikers and campers. These are heavy uses.

Wildlife use of the water resources of Management Unit 10 also appears to be heavy, from sightings, tracks, and scat. A canine skull was located near one of the ponds in section 13, but it is not known for sure what species it is of.

DISCUSSION

A general discussion of results is found in the report for Management Unit 14 (Twin Lakes), (Purvis 1976). The generalizations made there and the general observations and comments are valid in Management Unit 10 as well as the two units are adjacent to each other.

The broad range of temperature values reflects the varying weather conditions present during the study. On the 18th and 19th of August a cold front moved in over the park, bringing with it cold, near-freezing temperatures and light to heavy precipitation. On the 20th the front left, leaving behind warm weather.

Due to the low water year, Little Bear Lake and Cluster Lake #1 were down 1/2 or more in area and volume, exposing much of their shallows' bottom area to the atmosphere.

One of the unnamed lakes in this area, located in NE & NE1/4, NW1/4 of Section 27 in T31N R5E is larger than most, if not all, of the other unnamed lakes in the park. Due to its large size (10 acres) and deep depth (15 feet) it exhibits many characteristics more typical of the larger, named lakes such as color, visibility and heavier visitor use, though it is not too heavy here as the lake is off the trail a bit.

Easy access to all of the lakes in this management unit makes them very popular with park visitors, however it is not nearly so littered with trash as is the Twin Lakes area. There still exists a problem here, though, which needs rectification.

The quantity of food organisms found in these lakes would seem to indicate that a stock of fish could be maintained here. Due to lack of spawning sites, however, the only fish population possibility would be through maintenance stocking.

Maintenance stocking now runs counter to Park Service policy for wilderness areas. Most of the backcountry in Lassen Volcanic National Park, including the Rail Creek Management Unit, is a legislated wilderness.

Fish have been planted at one time or another in the following lakes in the Rail Creek Unit: Big Bear (last stocked in 1972 with 4,000 rainbow trout (Salmo gairdneri), Little Bear (1967, 2,500 rainbows), Cluster #2 (1970, 3,600 rainbows), Emigrant (1967, 1,000 rainbows) and Silver (1967, 10,000 rainbows). All of these lakes are now devoid of fish.

It is possible that some of these lakes could support a maintenance-stocked population of some fish such as the Eastern brook trout (Salvelinus fontinalis), but as mentioned above, this runs against Park Service policy.

MANAGEMENT RECOMMENDATIONS

1. No stocking of any fish species shall occur in the Rail Creek Management Unit.
2. A seasonal backcountry ranger type should be hired by the park to patrol the area between Summit Lake, Horseshoe Lake and Butte Lake, as this region is heavily used and sometimes abused by visitors.. The duties of this person would be to aid and assist visitors with information and park regulations, to pick up litter and make sure that campsites are correctly located and to enforce park regulations, where necessary.
3. The trail crew should also be responsible for the removal of garbage.
4. No changes in the current management policy should be made without first making an in-depth study of the factors involved, and careful consideration.

APPENDIX B

Contents:

- Sample - California Department of Fish and Game Lake Survey (field form)
- Sample - Lake Inventory Form (office form)
- Sample - Fish Population Data Sheet

SAMPLE

CALIFORNIA DEPARTMENT OF FISH AND GAME
LAKE SURVEY

(Field Form)

NAME OF LAKE _____ CO. _____

DATE _____ ^{Photo #}
EXTENT OBSER. _____

TRIB. TO _____

RELATION TO OTHER WATERS ^{Color:} _____

Clarity: _____

WATERSHED AND IMMED. DRAINAGE BASIN (Type: Terrain; Soil; Vegetation) _____

ALTITUDE _____

AREA _____ How determined _____ ~~VOLUME~~ _____

SHORE AND IMMED. TERRAIN (Type: Soil and Vegetation) _____

BOTTOM (Bedrock, Boulder, Rubble, Gravel, Sand, Mud, Silt, Organic Debris) _____

DEPTH: Max. _____ ^{Σ =}
% under 10 ft. _____ How determined _____

^{sp. fab.}
AQUATIC PLANTS _____

^{sp. fab.}
FOOD _____

TEMPERATURES: Water Air Time and Date Weather

Surface at Shore _____

Head of Outlet _____

Weather: _____

SAMPLE

LAKE INVENTORY FORM

Lake Name-
Survey Date-
1966 Bio. Class.-
Area-

Location-
Survey by-
1966 Mgt. Class.-

Altitude-

Watershed and Immediate Drainage Basin (Terrain, Forest Type, Geology, etc.):

Bottom Type-
Max. Depth-
Mean Depth-

Apparent color-
Clarity-

Accessibility (Road or Trail & miles of trail)-

Use and Type-

TEMPERATURE

	<u>Water</u>	<u>Air</u>	<u>Time</u>
surface at shore	_____	_____	_____
head of outlet	_____	_____	_____

WEATHER (wind, clouds, precip.):

<u>INLET STREAMS</u>	<u>No. 1</u>	<u>No. 2</u>	<u>No. 3</u>	<u>No. 4</u>
width	_____	_____	_____	_____
depth	_____	_____	_____	_____
bottom type	_____	_____	_____	_____
spawn area (size)	_____	_____	_____	_____
flow	_____	_____	_____	_____
water temp. (°C)	_____	_____	_____	_____
air temp. (°C)	_____	_____	_____	_____
time	_____	_____	_____	_____

Remarks:

OUTLET STREAM:

width-
depth-
bottom type-
flow-
spawn area (size)-
water temp. (°C)-
air temp. (°C)-
time-

Remarks:

Aquatic Vegetation:

Species

Abundance (abundant, common, few rare)

Food Organisms:

Species

Abundance (abundant, common, few rare)

Fish Predators:

Fishing Intensity:

Boats-

Shore-

Fish:

Species composition-

Mean condition factor-

Catch/unit effort:

Range of fork length-

Relative abundance-

% of catch (number) by species-

% of catch (weight) by species-

Natural propagation (yes, no, or possibly)-

Management recommendations:

Survey done by-

