H R Newcomb

DEPARTMENT OF AGRICULTURE
U. S. FOREST SERVICE

Progress Report
of the

LAKE SURVEY OF THE MT. HOOD NATIONAL FOREST

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by

Charles J. Campbell
Junior Biologist

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INTRODUCTION

Purpose of the Survey

This is a progress report on the lake and stream Survey being conducted on the Mt. Hood National Forest. The survey is being carried on under the joint cooperative agreement between the U. S. Bureau of Fisheries, Department of Interior, and the U. S. Forest Service, Department of Agriculture signed March 18, 1935. It is part of the cooperative program of the U. S. Forest Service and the U. S. Bureau of Fisheries for stream and lake surveys, detailed fresh water investigations, and stream and lake improvement in the National Forests of Region 6 approved June 25, 1937.

The purpose of the survey is:

(1) to develop a practical scientific fish planting program for the forest,

(2) to determine the need for stream and lake improvement,

(3) to determine if present regulations and restrictions on fishing are satisfactory, and to recommend such changes as seem advisable,

(4) to open for study special problems of the National Forest waters,

(5) and to locate possible hatchery or rearing pond sites.

During the survey collections were made of scale samples, fish, vegetation, plankton, insects, crustaceans, and molluses. These collections were sent to various specialists for classification so that important data on distribution of different lake fauna and flora can be ascertained. The material on scales and fish specimens has not as yet been returned but what has been learned from the other material collected is included in this report. As the work continues it will all be included and made available to biologists doing similar work and to naturalists in other fields.

This report contains the results of the field work done to date. This is confined to lakes with the exception of one inspection trip over some stream improvement devices. The data are for the date upon which the lakes were surveyed only and so do not give seasonal variation. In the future more frequent checks of at least the more important lakes may be possible and give more accurate and valuable information. It is hoped that a winter trip into the area covered this summer may be made to learn something of snow and ice conditions and winter conditions in general on the lakes.

Personnel

The survey party consisted of Charles J. Campbell, Junior Biologist and from three to five CCC enrollees. The number varied some as fires now and then necessitated the loss of one or more crew members.

Time in the Field

The previous Junior Biologist who was to make this survey did not return in June as planned and the start of the new fiscal year delayed the hiring of another until July. Actual survey work started on July 24 and continued until October 20. Freezing weather at the high elevations where most of the lakes are found makes this type of work all but impossible by this time. The earlier part of July was devoted to getting a creel census under way on four strategically located lakes of the forest; starting a random catch record for both streams and lakes at other points, and in taking care of the necessary details connected with establishing a CCC spike camp.

Area Covered

Only the lakes in that part of the forest covered during the 1939 season are included in this report. With the exception of two or three lakes, the Lakes Ranger District was covered completely. All the lakes of the Bull Run Ranger District were covered except those well back in the Bull Run Reserve. On the Clackamas River District only one lake was surveyed. This leaves the Barlow, Hood River, Columbia Gorge, and practically all of the Clackamas River Ranger District yet to be covered. On none of these district, however, is there such a concentration of lakes as is found on the Lakes District. This report will be enlarged to include these area as the work progresses.

Equipment

Most of the equipment and scientific instruments used in the survey was loaned to the Forest Service by the Bureau of Fisheries. The various items of equipment used are: Ekman dredge, plankton nets, fish nets, water sample bottle, portable rubber air boat, thermometers, sieves, preservatives, notebooks, pH determination set, and other supplies commonly used in biological field work.

The Forest Service furnished automotive transportation, preservatives, vials, camping equipment, maps, collapsible shore sampler, rubber air boat, plant press, maximum-minimum thermometer, and a sounding outfit. The army furnished food supplies for the CCC crew. Fishing tackle, with which most of the fish specimens were taken, was furnished by the party.

Methods used in the Survey

In general the method of carrying out the work and recording the data was that described by Dr. H. S. Davis in "Instructions for Making Stream and Lake Surveys", Fisheries Circular No. 26, put out by the Bureau of Fisheries in 1938. Areas were determined by traversing rather than by plane tabling as traverse notes can be kept in a notebook and the map drawn later indoors in case of rainy weather. This method is just as fast on small lakes such as are found on this forest, as it is not necessary to set up two or more base line in case of irregularities, and it is quite accurate if reasonable care is used.

Acknowledgements

The writer wishes to express thanks to Mr. Glenn Mitchell of the Regional Office, Mr. Waha, Supervisor and Mr. Steele, Assistant Supervisor of the Mt. Hood Forest, the district rangers and their staffs, and Mr. John Mills, Project Superintendent of the CCC camp for assisting in various ways and furnishing information concerning the lakes. Thanks are due to Dr. Paul R. Needham, Bureau of Fisheries, and Dr. Francis P. Griffiths Oregon State Game Commission for valuable suggestions and willing cooperation.

The cooperation of Dr. Trevor Kincaid of the University of Washington in identifying plankton and mounting a set of slides for the Forest, and of Mr. Garland Powell of the Oregon State College Herbarium in plant identification is sincerely appreciated.

General Characteristics of Forest and Lakes

The Mt. Hood National Forest comprises 1,099,507 acres. It is bounded on the south by the Willamette National Forest, on the north by the Columbia River, on the east by the Warm Springs Indian Reservation and cessation of timber, and on the west by the Willamette valley. The Forest falls into Clackamas, Hood River, Wasco, Jefferson, and Marian Counties. Most of the lakes covered in 1939 were in Marian and Jefferson counties, and the rest in Clackamas.

The average annual rainfall is about 60 inches. Snow banks were found near some of the higher lakes as late as the middle of August. Mt. Hood is the highest peak in the forest, 11,253 feet, and has 8 glaciers furnishing a constant supply of water to the streams of the forest so that very few of them dry up.

The four largest rivers on the forest are the Clackamas, the Sandy, Hood, and the Bull Run. Some of the headwaters of the Breitenbush and Deschutes Rivers are also located in this forest. The entire water shed of the Bull Run is closed to public as it is from here that the city of Portland gets its water supply. Except for necessary fire pre-suppression work this large area is left as nature intended it. Fishing and hunting are of course entirely prohibited.

The Mt. Hood Forest can be crossed by surfaced highway by way of the Mt. Hood Loop and the Wapinitia cut-off, or, by remaining on the loop a traveler may continue around the mountain and come out on the Columbia River. The Forest Service maintains numerous secondary roads during the summer which make most of the lakes and streams easily available to the angler. The presence of these roads coupled with the close proximity of Portland, the largest center of population in the state, is in a large measure responsible for the fishing problem on the Forest. In most cases the anglers can, and thousands of them do, drive to, or within easy walking distance of the streams and lakes they wish to fish. Availability and large population make for heavy fishing, heavier than many of the small lakes and streams can support. The sportsman expects fish for the money he spends for his license and in a large measure looks to the National

Forests for them. Our problem is to keep the waters producing fish at their highest capacity to furnish as much fishing as possible for as many people as possible.

There are approximately 115 lakes on the forest that have been named. Most of these have been stocked at some time, and furnish fishing. The Lakes Ranger District has the greatest concentration of lakes including many small bodies of water that have never been named. 65 of the lakes were surveyed during the past summer, and these range in size from 240 acres down to 1 acre. The average size of these lakes is 12.1 acres, but the greater share of the total area is contained in three lakes of 55, 90, and 240 acres. On the whole the lakes are shallow, 73 feet being the deepest found to date, and only four being over 50 feet deep. The average maximum depth is 17.6 feet.

The lakes are practically all over 3000 feet in elevation, and many of them are the result of glaciation, some being formed by lateral or terminal moraines, and some occupying old cirques. Beaver have made others, and some are just basins that catch and hold the spring run-off.

Most of these small, shallow lakes have no running inlets and outlets except in the spring. That some of them support fish at all would indicate that they have running water during the winter. This is one of the things that should be checked this winter. Of the lakes surveyed only 23 or 35.3% had running water when surveyed. This includes those with either inlets or outlets or both; also a few were surveyed later in the fall and had running water in places that may have been dry in the summer. Part of those having running water have spawning possibilities, and young fish were found in these. The majority of these lakes have no spawning facilities and fishing can be maintained only by repeated stocking. Frequently gravel shoals in run-offed lakes that might be suitable for Eastern Brook spawning are exposed in a short time by lowering water levels when the run-off stops, making spawning impossible or unsuccessful.

Fluctuating water levels also make it difficult or impossible for aquatic or emergent plants to become established. Wave action removes all organic material from the shore gravel making it much less productive. Aquatic vegetation is important as it furnishes shelter and food for many organisms that are food for fish. It also furnishes shelter and protection for small fish. Vegetation is common in a few of the lakes, but in the majority is scarce or absent.

Temperatures varied greatly, but as they were taken only once per lake, that is on one day, the seasonal variation was not determined. The extreme high surface temperature recorded for the summer was 80° in Lower Goodfellow lake on July 26, 1939, and the extreme low surface temperature was 45° in Hidden Lake on October 16, 1939. Surface temperatures vary considerably with the weather conditions. Most of the lakes were between 60° and 70°. In very few lakes was there any sign of thermal stratification. In general there were only a few degrees difference between the bottom and the surface temperatures. In the case of the lake with the 80° surface the bottom (9 feet down) was 66° due to inflowing springs. This condition makes the lake habitable for trout.

Trout Foods

Trout foods naturally fall into four classifications. These are: (1) Plankton forms, (2) bottom and shoal organisms, (3) terrestrial food, and (4) vertebrate foods. These classifications will be taken up separately.

Plankton

Plankton is the term applied to those small forms of life found free swimming in the water but at the will of the currents. They are independent of the bottom, but are incapable of moving in a definite direction for an indefinite time. Some algae, numerous crustacea, and a few other forms make up the plankton population. They are usually found in the upper layers of the water, and are from microscopic size, up to the one insect larva plankton which may be nearly 1/2 inch long.

Most of the lakes surveyed are relatively rich in plankton. Water fleas and copepods were the most common types found. Most of these are large enough to be seen if placed over a white background. The copepods especially may be brilliantly colored, and if numerous be seen readily in the lakes. There is considerable seasonal variation in plankton populations and for this reason quantitative determinations were not made on the lakes as they were visited on only one day during the season. Collections were made for qualitative determinations to learn the various species present and their distribution.

Dr. Trevor Kincaid identified the material and presented the Forest with a reference collection mounted on microscope slides. The various species and the percentage of the lakes in which they were found is given in Table 1.

Table 1
Species and Distribution of Plankton

Name			% age of lakes in which found
Cladocera (water fleas)			
Diaphanosoma	brachyurum	Lieven	4.6
Daphnia	longispina	O. F. Muller	36.9
Daphnia	pulex	DeGeer	3
Holopedium	gibberum	Zaddach	47.7
Coriodaphnia	reticulata	Jurine	3
Bosmina	longispina	Leydig	41.5
Alona	affinis	Leydig	3
Alona	guttata	Sars	1.5
Pleuroxus	denticulatus	Birge	3
Chydorus	sphaericus	O. F. Muller	3
Alonella	excisa	Fischer	3
Polyphemus	pediculus	Linne	1.5

Table 1 continued on next page.

Table 1 (Cont'd.)
Species and Distribution of Plankton

Name			% age of lakes in which found
Copepoda			
Epischura	nevadensis	Poppe	70.7
Diaptomus	tyrrelli	Forbes	20
Diaptomus	lintoni	Forbes	6.1
Diaptomus	franciscanus	Lilljeborg	15.4
Diaptomus	shoshone	Forbes	3
Diaptomus	washingtonensis	Marsh	7.7
Diaptomus	wardi	Pearse	3
Diaptomus	signicauda	Lilljeborg	41.5
Cyclops	serrulatus	Fischer	1.5
Rotifera (wheel animalcules)			
Keratella	cochlearis		4.6
Ostracoda			
Sp.			1.5
Diptera (true flies)			
Corethra	sp. (larva)		3

Plankton was collected by means of a silk tow net. Sometimes it may be so abundant as to clog the net after towing a few feet, and at other times so scarce that it is difficult to obtain enough for a sample. Clackamas Lake for example had practically no plankton. It is a very cold, clear lake (46°) and has considerable water running through it.

Generally the alpine lakes are limited as to number of species although the number of individuals may be high.

Young fish in particular feed on plankton to a large extent, making this form of food important from a fish production standpoint. Also larger organisms that furnish food to fish, feed on plankton; in other words it forms a basic part of the food chain.

Bottom and Shoal Organisms

The bottoms of most lakes are covered from a few inches to a foot or more deep with muck or silt. In and on this layer of much many organisms make their home. These organisms form a large part of the fish food at all seasons of the year, and are the most important as they are available all the year around, including seasons when other types of food are not. The chief foods found in the bottom are midge larvae, alderfly larvae, scuds, mayfly nymphs, odonata nymphs, clams, segmented worms, round worms, and clams. These have all been found in stomachs of fish, although clams but seldom, together with other forms that have not been found in the bottom samples.

These samples are taken with an Ekman dredge that picks up 1/4 cubic foot of material. This material is then put through a 30 mesh sieve, and the organisms removed and counted. In some cases it was found that allowing the dredge to sink well below the surface of very soft bottoms gave distorted results as the upper layer contained most of the organisms. Several samples were taken in each lake and the charts give the average number of organisms per 1/4 cubic foot. Sometimes scuds, annelid worms, or midge larvae are very abundant, raising the average considerably. In one lake, Lower Goodfellow, 211 small midge larvae were found in one sample. In a lake of the Willamette Forest 626 midge larvae were found in 1/4 cubic foot.*

Clams are frequently very numerous also and give somewhat distorted results as they are not taken to any great extent by trout. 191 clams were found in 1/4 cubic foot from one lake. Qualitative samples were taken from all lakes, but space does not permit the inclusion of all this data. Lack of equipment made quantitative determinations impossible in the field. It is hoped that in the future such studies may be made.

Shoal foods are those organisms found in the shallow waters along shore. Trout feed in the shallows a great deal -- a fact familiar to any angler. These forms were collected by means of a sheet metal sampler one square foot in cross section. It is made in four flat pieces that can be clipped together. This is then forced into the bottom a few inches to avoid leakage of organisms. The bottom material is then sieved through a 30 mesh screen to remove the organisms. When ten screenfuls have been removed successively with no organisms in them it is considered that all the organisms in the square foot have been removed.

The shore foods are similar to the bottom foods, but Odonata nymphs, scuds, and beetles are more apt to be common. Water boatmen, backswimmers, and beetles may often be seen near shore in large numbers, but are seldom taken in the sampler as they are very agile and spend little time on the bottom. Scuds may be very numerous along shore as illustrated by one lake having 301 per square foot. Qualitative samples were taken from all the lakes, and the number per square foot for each lake is shown on the charts.

Terrestrial Foods

The third category of food is that furnished from the land or air. This consists of all sorts of insects, spiders, etc. that fall or are knocked into the water. During the seasons of the year they are available they furnish a large proportion of the food taken by trout. These fish, as is the case with most wild life, feed most extensively on what is most available. At times the surface of a lake may be nearly covered with winged ants that have become exhausted over the water or have been blown there. At such times the fish will feed extensively on them. A large variety of spiders may be found on alpine lakes, and they are often seen skating across the water drawn by a long web as a sail. These, while not taken extensively, furnish their bit. Where shores are overhung by brush or grass leaf hoppers, grasshoppers, terrestrial beetles and other land forms

* Lake Survey of the Willamette Forest, Department of Agriculture 1937 Fred C. Ziesenhenne

fall into the water furnishing food.

Much of this food falling on the surface is aquatic in origin. Mayflies, caddis flies, stoneflies, midges and similar forms furnish food during their immature aquatic existence, are taken in quantities as they rise to the surface to emerge, and continue to furnish food as adults. They must lay their eggs in or on the water and in their dipping flights over the surface for this purpose many are taken. After fulfilling this mission they fall exhausted on the water and may be snapped up by trout. The vast swarms or hatches of mayflies are familiar to all anglers and the large amount of food they furnish, at least periodically, can be seen. The large Odonata fall into this category also. A common sight is that of a dragon fly swooping over a lake, dropping every few yards to release eggs, only to have a trout leap for it at every descent. When they have lived their span and fall on the water they furnish easier prey. Trout only six or seven inches long will frequently be found with one or more large dragon flies jammed into their stomachs.

While difficult to estimate the amount of food from this source, it is definitely important and should not be overlooked.

Vertebrate

In this category fall small vertebrates as frogs, salamanders, small fish or forage fish. The alpine lakes seldom have forage fish so young trout fill part at least of this niche. Salamanders are present in a few lakes having trout and these furnish some food. Larger fish are the ones mainly benefitted by this source of food.

Plant Life

As previously stated the plant life in many of the lakes is limited by highly inorganic shorelines, wave action, and fluctuation of water levels. A collection of the plants found in and around the lakes was made, and these specimens were identified by Garland Powell and others of the Herbarium staff at Oregon State College. The following table shows the types of plant life found.

Table 2

Aquatic Plants

Scientific name	Common name	Remarks
Potentilla palustris	Marsh cowberry	Along shore, emerg.
Isoetes howellii	Howell's quillwort	Submerged, small
Equisetum	Snake or joint grass	Found in up to 6' of water.
Eleocharis palustris	Creeping spike rush	Along shore
Carex exicata	Western inflated sedge	" "
Carex aquaticis	Water sedge	" "

Table 2. Continued on next page

Table 2 (continued)

Scientific name	Common name	Remarks
Sparganium simplex	Narrow leaf burreed	Long narrow floating leaves.
Potamogeton epihydrous	Nuttall pondweed	Floating leaves.
Potamogeton natans	Common floating	Leaves reddish Floating.
Utricularis vulgaris	Bladderwort	Submerged
Menyanthes trifoliata	Bog bean, Buck bean	Along shore, emerg.
Dicholyma capillaceum	Moss	Found 56' deep
Fontinalis gigantea	Moss	Submerged
Ranunculus aquatilis (?)	White water buttercup	Submerged, dissected leaves.

Algae of some kind are present in all the lakes at least to some extent. Vancheria was present in some. In one lake, Clackamas, with very cold, clear water were a great many individuals of a colonial Nostoc. These were a giant form, some of the globes being as large as a man's head. Smaller forms, ear-like in shape were found attached to rocks near cold spring inlets. Everyone of these ear-like forms examined contained a midge larvae within it. It seems reasonable to expect that these larvae upon emergence would furnish some food.

Chemistry of The Lakes

There is little or no trouble from pollution in the alpine lakes. Because of lack of chemical testing equipment that could be successfully carried on pack boards little chemical work was attempted. Such tests as were made -- on Olallie Lake -- showed oxygen to be sufficient, 4 parts per million of carbon dioxide, and 8 parts per million of calcium carbonate to be present. For next season a small, easily handled testing kit is planned and more complete chemical data will be taken on all lakes.

pH determinations were made on all lakes surveyed. Nitrazine paper was tried during the 1938 season for this work and was found unsatisfactory, so this year a LaMotte colorimetric set was used. All lakes were quite close to neutral or pH 7, the lowest value found being 6.3, and the highest 7.5.

Fresh water shrimp or scuds are said to prefer waters on the alkalin side. In the light of past season's experience they seem to stand a slight acidity. Scuds were present in 55.4% of the lakes, and in two cases the pH was 6.5, in one case 6.6, and in six cases 6.7. In all other lakes containing scuds the pH was higher than 6.7. While too many other factors enter in to make this conclusive, it does throw some light on the ecology of this form of life.

Beaver Planting Sites

During the survey a lookout was kept for locations where beaver might be advantageously planted. Several lakes were picked where such projects might be profitable.

Hickman Lake is on the Bull Run Reserve and so is closed to fishing and is valuable as an experimental lake, but it formerly had a colony of beaver. The lake is so situated that a small dam would raise the lake 4 or 5 feet and do no damage. Beaver if planted might make such a dam.

Burnt Lake is also situated so that a small dam would raise the water considerably, and in so doing incorporate some small ponds with their fish food into the main lake. If introduced beaver would do this job it would be to the advantage of all concerned.

Salmon (Mack Hall) Lake is a shallow lake recommended for an experimental plant. It has plenty of alder for beaver food and a running outlet. If this lake could be deepened it would be much better from a fishing standpoint, and beaver would dam the outlet, thus raising the lake. No damage would be done.

Surprise Lake formerly had beaver, but at present the outlet goes dry in late summer and the lake becomes very shallow. If beaver were introduced and dammed the outlet this lake would be deepened and would be less likely to get so low during the summer.

Shellrock Lake also has an outlet that goes dry by late summer. This is a good sized lake, but has a maximum depth of 12 feet; most of the lake is considerably more shallow than this. Beaver might dam the outlet in the spring and so raise the lake level. There is a good supply of alder and willow on the lake.

Anvil Lake is a small beaver made lake furnishing cutthroat fishing. There were no recent beaver signs when the lake was surveyed. Introduction of beaver should enlarge and improve the lake.

Cripple Creek lake is a large but very shallow lake that would be improved by deepening. Beaver might dam the outlet and accomplish this task.

Winter Kill

The matter of winter kill has been the subject of many publications and the theories as to its cause have been widely discussed. Therefore, this phase of the matter will not be gone into here. Several lakes were found that because of their shallowness one would not expect to hold fish, but which did contain fish that had survived at least one winter. This raises the question, "What is the least depth of water in which fish may be planted"? Some shallow lakes, notably Salmon, were recommended for planting in order to get information that may answer this question.

Species of Fish Present

The lakes of the Mt. Hood Forest are suited only for salmonid fishes, and none have been found to date with other fish than trout in them. Three species of trout were found during the survey; Eastern Brook trout, Salvelinus fontinalis, Rainbow trout, Salmo gairdnerii, and Cutthroat trout, Salmo clarkii. The first of these is introduced and the other two are native. Their distribution can be seen in the tables.

Of the 65 lakes surveyed only 4 had native fish in them; the others all contained introduced Eastern Brook. The native species and the Eastern Brook are the only satisfactory fish for mountain lakes. Mackinaw trout (Cristivomer namaycush) and Loch Leven (Salmo levenensis) make slow growth in such places and tend to become cannibals almost exclusively defying all attempts to take them on a hook and line. As such they are more of a detriment than an aid to good fishing.

Parasites

Fish, like most forms of life, are afflicted commonly with parasites of one kind or another. In general a normal infestation of parasites does the host little if any harm. In some cases, however, quite the opposite is true. The only infestation of parasites, that may be serious, seen during 1939 was in Olallie Lake. Here a 15 inch trout was picked up dead and given to the author. Upon examination it proved to be heavily infested with the larval form of the tapeworm Dibothruim cordiceps. This parasite if it did not cause the death of the fish was at least a strong contributing factor. The majority of the fish examined from the lake proved to be infested to some degree by this worm.

D. cordiceps is a fairly common parasite in this country, and was first found in Elk Lake (Deschutes Forest) where it was determined to have been brought in by pelicans. Since then it has been found in a number of Cascade lakes, and other water birds such as sea gulls have been found to carry it.

Water Dogs

Almost without exception the lakes surveyed had large populations of Pacific newts, locally known as "water dogs". They are lizard-like in superficial appearance, and are an air breathing amphibian. They are dark to light brown on the dorsal surface and bright yellowish orange on the ventral. They were observed coming to the surface for air in as much as 35 feet of water. They break the surface when getting air and so are often mistaken for rising fish. As they are poisonous when eaten they furnish no fish food. On the contrary they will eat young fish when possible. When fish are planted the water dogs clean up any dead ones and also capture those that maybe a bit sick or dazed. In this way they are detrimental, and it is my opinion that they compete considerably with trout for food. They can be seen rooting around the bottom evidently after the same organisms trout are known to feed on. There is no method developed as yet to eradicate these creatures, and such a method would be of much

value, as in addition to the above mentioned harmful characteristics they certainly add nothing of an esthetic nature to the lakes.

Improvements

The lakes are in little need of physical improvement as most of them have a good amount of log or rock cover. Some could be bettered by installation of cover, but this should not be attempted unless sufficient cover devices are put in to avoid concentrating the fish in a few places. If only a few cover devices are put in they tend to draw the small fish to those points; these are followed by larger fish, and these in turn to anglers. This situation represents poor management practice.

Where possible the introduction of aquatic plants into lakes with none should be tried. Such plantings should be placed to avoid strong wave action or be protected from it. Bottom forms may often be planted in balls of mud or in containers such as strawberry boxes filled with soil and fertilizer. This give the plant a chance to get a start.

Pyramid lake has a small inlet that forks before entering the lake. If this were confined to one channel when the lake is planted it might furnish a limited amount of spawning.

Holding and Rearing Pond Sites

One of the objects of the survey was to locate possible holding and rearing pond sites. Zigzag, headquarters of the Bull Run District, is one good location. Fish have been held here in live pens in Bear Creek in the past. Two rearing and holding ponds are now under construction at this location.

High Rock Spring on the Lakes District has a fairly good flow of water and fish have been held here in the past in large wooden "bath tub". As this is the only available water for some distance, and is within striking distance of a number of lakes it is valuable for this purpose.

Clackamas Lake has a large flow of spring water, but it is so cold that it would be unsuitable for rearing ponds unless some method were devised by which the water could be warmed. For holding ponds or live pens it would be quite satisfactory.

The inlet of Breitenbush Lake is warmer than Clackamas as it was 48° on the date surveyed. There is considerable fairly level land at the head of the lake, and perhaps rearing ponds could be developed here. The elevation (5500') is such as to make a very short growing season however. This location is relatively close to a large number of lakes than can be reached by road and short distances by trail, so holding ponds here would be advantageous if a large number of fish were to be planted in the area.

More sites will undoubtedly come to light as the remaining lakes and the streams are surveyed.

Stocking Recommendations

One and one half days were spent with Dr. Paul Needham discussing stocking policies before these recommendations were made. They should not be considered final as they will undoubtedly require alteration in the light of facts that will be learned in the future.

In the light of the data collected this season most of the lakes do not have sufficient food to support such large numbers of fish as have been put into them in the past. For this reason the recommendations call for smaller numbers of fish than have been stocked in recent years. The very small lakes are capable of supporting only a limited number of fish just as a pasture will support only a limited amount of stock. Where possible in such lakes the best way to furnish fishing is to plant legal sized trout. In this way the fisherman's money is spent to raise poundage of trout in the hatchery, and this poundage is returned directly in catchable sized fish. Where small lakes are located on a road so that they can be planted from a truck this was recommended, with an alternative of small fish if legal size cannot be procured.

Two inch fish were generally recommended as this is the size most apt to be available. As the fish get smaller the survival percentage goes down rapidly, so in the larger lakes if smaller fish are obtained the numbers can be raised. As it is not worthwhile to pack in less than 1000 fish to a lake no numbers smaller than this were recommended. A group of small lakes may all be stocked from one pack string load, and this was taken into consideration in the stocking policy.

When planting barren lakes it is well to follow up each succeeding year for two years with a smaller plant to avoid excessive cannibalism which experience shows to be at its worst when some of the fish are twice as large as others.

In lakes recommended for cutthroat no other species should be planted, even if the lake has to be skipped. These lakes furnish some fishing from natural propagation and cutthroat fishing is too scarce to be spoiled by the introduction of other species. Best results are obtained from planting only one species in a lake.

Table 3. Food Chart of the Bull Run Ranger District

No.	Name of Lake	Date Surveyed	Elevation	Bottom Forms per $\frac{1}{4}$ cu.ft.	No. of Samples	Species of Trout pres.	Shore Forms per sq.ft.	pH	Shrimp pres. (X)
1	Big Goodfellow	July 24;1939	3150'	10	6		21	6.7	X
2	Middle Goodfellow	July 25;1939	2900'	5	6		27	6.9	X
3	Lower Goodfellow	July 26;1939	2880'	65	4	Eb (?)	29	6.5	X
4	Hickman	July 27;1939	3380'	18	5		27	6.9	X
49	Plaza	Sept.27;1939	3800'	27	5	Eb	78	6.7	X
55	Salmon (Mack Hall)	Oct. 3,1939	3900'	38	5		252	6.95	X
56	Veda	Oct. 9;1939	4200'	10	5	Eb	77	7.1	X
57	Kinzel	Oct. 10;1939	4250'	17	2	Eb	8	6.3	
58	Burnt	Oct. 11;1939	4075'	24	5		59	7.0	X
59	Dumbbell	Oct. 12;1939	4480'	25	5	Eb	65		X
60	Devil's	Oct. 13;1939	4090'	52	5	Eb	49	6.4	
61	Hidden	Oct. 16;1939	3800'	90	3	Eb	86	6.7	X
62	Mirror	Oct. 17;1939	4150'	41	5	Eb	77	7.1	X
63	Eena	Oct. 17;1939	3600'	9	3	Eb	18	6.5	
65	Wind	Oct. 20,1939	4300'	69	5		38	6.8	

Table 4. Food Chart of the Lakes of the Lakes Ranger District

No.	Name of Lake	Date Surveyed	Elevation	Bottom Forms per $\frac{1}{4}$ cu.ft.	No. of Samples	Species of Trout pres.	Shore Forms per Sq. ft.	pH	Shrimp Pres. (X)
5	Brietenbush	Aug. 1;1939	5500'	12	6	Eb	27	7.1	X
6	Pyramid	Aug. 2;1939	5390'	46	5		66	6.9	
7	Horseshoe	Aug. 6;1939	5400'	5	7	Eb	15	6.7	
8	Nup-te-pa	Aug. 7;1939	4950'	40	3		63	6.5	
9	Mangriff	Aug. 7;1939	4960'	2	3		5	6.7	
10	Monon	Aug. 4;1939	4970'	7	7	Eb	20	6.9	X (?)
11	Head	Aug. 9;1939	4950'	13	2	Eb	39	6.25	
12	Gibson	Aug. 11;1939	5600'	18	4		3	6.7	
13	First	Aug. 14;1939	4900'	5	3	Eb	12	6.7	
14	Red	Aug. 15;1939	4520'	28	5	Eb	11	6.7	
15	Averill	Aug. 16;1939	4600'	12	5	Eb	23	6.9	
16	Wall	Aug. 17;1939	4800'	10	5	Eb	19	6.7	
17	Sheep	Aug. 18;1939	4810'	4	5	Eb	15	6.8	
18	Lyden	Aug. 18;1939	4900'	16	3	Eb	21	6.3	
19	Boaster's	Aug. 21;1939	4900'	17	5	Eb	11		
20	Upper	Aug. 22;1939	5380'	2	5	Eb	2	6.7	
21	Eloise	Aug. 22;1939	5350'	34	5	Eb	20	6.7	
22	U	Aug. 23;1939	5300'	28	3		7	6.5	
23	Indian	Aug. 24;1939	5250'	11	5		11	6.6	
24	Ring	Aug. 24;1939	5225'	6	3		10	6.7	
25	Top	Aug. 25;1939	5250'	21	5	Eb	32	6.7	
26	Timber	Aug. 28;1939	5180'	10	5		7	6.7	
27	View	Aug. 29;1939	5260'	19	4	Eb	12	6.9	
28	Lower	Sept. 1;1939	4750'	1	5	Eb	24	6.9	X
29	Middle	Aug. 30;1939	4990'	6	4	Eb	34	6.9	X
30	Gifford	Aug. 30;1939	4990'	18	5	Eb	15	6.9	X
31	Jaybird	Sept.11;1939	4990'	79	3	Eb	31	6.4	
32	Pear	Sept.11;1939	4995'	15	3		62	6.5	
33	Si	Sept. 6;1939	4270'	30	5		223	6.5	X
34	Ollalie	Aug. 8;1939	4936'	23	6	Eb	20	6.7	X
35	Fish	Sept. 6,1939	4400'	6	6	Cut	41	7.4	X
36	Surprise	Sept.7-8,1939	4370'	113	3	Cut	280	6.7	X
37	Finley	Sept. 8,1939	5000'	83	3	Eb	11	6.7	

Table 4 continued

No.	Name of Lake	Date Surveyed	Elevation	Bottom Forms per $\frac{1}{4}$ cu.ft.	No. of Samples	Species of Trout pres.	Shore Forms per sq. ft.	pH	Shrimp pres. (X)
38	Russ	Sept.12;1939	4600'	4	5	Eb	66	7.3	X
39	Jude	Sept.13;1939	4590'	9	3	Eb	116	7.5	X
40	Brook	Sept.12;1939	4590'	108	4		305	7.1	X
41	Clackamas	Sept.14;1939	3340'	258	2	Eb Cut	20	7.1	X
42	Bear	Sept.18;1939	4000'	12	3	Eb	143	6.7	X
43	Rock; upper	Sept.20;1939	4290'	5	4	Eb	52	6.6	X
44	Rock; Middle	Sept.19;1939	4250'	16	5	Eb	97	6.9	X
45	Rock, Lower	Sept.22;1939	3900'	32	3	Eb Eb	38	7.3	X
46	Serene	Sept.21,1939	4200'	17	5	Eb	62	7.1	X
47	Shellrock	Sept.22&25;'39	3850'	28	5	Eb	23	7.0	X
48	Hideaway	Sept.25&26,'39	3950'	69	6	Eb	83	7.0	X
51	Buck	Sept. 29,1939	3940'	4	4		51	6.9	
52	Shining	Sept.30;1939	4170'	27	7	Eb	443	7.1	X
53	Dinger	Oct. 2;1939	4050'	28	5	?	81	7.2	X
54	Anvil	Oct. 2;1939	3950'	40	2	Cut	Common	7.1	X
64	Frog	Oct. 18,1939	4000'	48	5	Eb	263	7.1	X

Table 5. Food Chart of the Lakes of the Clackamas River Ranger District

50	Cripple Creek	Sept.28,1939	4340'	25	5	Eb	115	7.3	X

Table 6. Stocking Chart for the Lakes of the Bull Run Ranger District

No.	Name of Lake	Location T	R	S	Elevation	Size in acres	Species	Number	Size	Frequency	Remarks
1	Big Goodfellow	2S	7E	4	3150'	18.5	Leave for experimental purposes				
2	Middle Goodfellow	2S	7E	5	2900'	9	"	"	"	"	
3	Lower Goodfellow	2S	7E	5	2880'	19	"	"	"	"	
4	Hickman	2S	7E	2	3380'	11.8	"	"	"	"	
49	Plaza	4S	7E	17-18	3800'	6	Eb	3000	2"	Annually	
55	Salmon (Mack Hall)	4S	7E	16	3900'	2	Cut	1000	2"	Annually (for 3 yrs.)	Eper. plant.
56	Veda	4S	8E	1-2	4200'	2.9	Eb	1000	2"	Annually	4-5" fish better
57	Kinzel	4S	8E	5	4250'	1	Eb	1000	2"	Triennially	Start 1941
58	Burnt	2S	8E	34	4075'	6.4	Mbs	1500	1½"	Annually	Cont. pres. expr.plant
59	Dumbbell (Bull Run Reserve)	2S	8E	32-33	4480'	4.6	Eb	1000	2"	Annually	
60	Devil's	3S	8E	8	4090'	1	Eb	1000	1½"	Biennially	
61	Hidden	3S	8E	14	3800'	1.2	Eb	1000	2"	Biennially	
62	Mirror	3S	8E	23	4150'	6.9	Eb	2500	2"	Annually	
63	Eena	3S	8E	14	3600'	1.1	Eb	200	legal	Annually	1/8 mi. from rd.
								1000	2"	Biennially	start 1941
65	Wind	3S	8E	27	4300	2.3	Eb	1000	2"	Annually	Exper.continue if successful

Table 7. Stocking Chart for the Lakes of the Lakes Ranger District

No.	Name of Lake	T	R	S	Elevation	Size in Acres	Species	Number	Size	Frequency	Remarks
5	OK Breitenbush	9S	8E	25	5500'	55	Eb	1500	legal	Annually	On road, plant from car
								10,000	2"	Annually	
6	OK Pyramid	9S	8E	27	5390'	4.8	Cut	1000	3"	Annually	Exper. cont. if success
7	OK Horseshoe	9S	8E	34	5400'	14	Eb	500	legal	Annually	On road, plant from car
								1500	2"	Annually	
8	OK Nhp-te-pa	9S	8E	12	4950'	1.5	Eb	1000	2"	Annually	Cont. if successful
9	✓ Mangriff	9S	8E	13	4960'	1	Past experience indicates lake unsuitable for fish.				
10	OK Monon	9S	8E	13-14	4970'	91	Eb	2000	legal	Annually	On road, plant from car
								10,000	2"	Annually	
11	OK Head	9S	8E	2	4950'	4.1	Eb	400	legal	Annually	" " " " "
								1000	2"	Annually	
12	OK Gibson	9S	8E	23	5600'	5	Eb	1000	2"	Annually	If successful
13	OK First	9S	8E	2	4900'	2.8	Eb	400	legal	Annually	On road, plant from car
								1000	2"	Annually	
14	✓ Red	9S	8E	8	4520'	5.8	Eb	2000	2"	Biennially	
15	OK Averill	9S	8E	4-5	4600'	11.6	Eb	2500	2"	Biennially	
16	OK Wall	9S	8E	4	4800'	4.8	Eb	1000	2"	Annually	
17	OK Sheep	9S	8E	3	4810'	3.6	Eb	1000	2"	Annually	
18	OK Lyden	8S	8E	4	4900'	.9	Eb	1000	2"	Biennially	
19	OK Boaster's	8S	8E	4	4900'	1.1	Eb	1000	2"	Biennially	
20	OK Upper	9S	8E	15	5380'	7.3	Eb	1000	2"	Annually	Poor food supply
21	OK Eloise	9S	8E	10	5350'	4.3	Eb	1000	2"	Annually	
22	OK U	9S	8E	10	5300'	1.3	Eb	1000	2"	Experimental	Stock lightly next 2 yrs. if successful
23	OK Indian	9S	8E	16	5250'	1.5	Eb	1000	2"	Triennially	If successful
24	OK Ring	9S	8E	10	5225'	1.8	Eb	1000	2"	Biennially	If successful
25	OK Top	9S	8E	16	5250'	2.5	Eb	1000	2"	Annually	
26	OK Timber	9S	8E	14	5180'	9.75	Eb	2000	2"	Annually	
27	OK View	9S	8E	14	5260'	7.1	Eb	1500	2"	Annually	
28	OK Lower	9S	8E	2-3	4750'	11.9	Eb	1500	2"	Annually	Food supply poor
29	OK Middle	8S	8E	3	4990'	1.8	Eb	1000	2"	Biennially	

Table 7. Continued

No.	Name of Lake	T	R	S	Elevation	Size in Acres	Species	Number	Size	Frequency	Remarks
30	Gifford	8S	8E	3	4990'	7.8	Eb	1500	2"	Biennially	Start 1942 Now overst.
31	Jaybird	8S	9E	3	4990'	1.5	Eb	1000	2"	Biennially	Food abundant
32	Pear	8S	8E	3	4995'	.75	Eb	Try extras from nearby lakes. Continue if successful			
33	Si	8S	8E	21-22	4270'	3	Eb	1000	2"	Biennially	
34	Ollalie	9S	8E	11-12	4936'	238.7	Eb	25000	2"	Annually	
35	Fish	8S	8E	22	4400'	18	Cut	2000	2"	Biennially	Cut. only
36	Surprise	8S	8E	22	4370'	4	Cut	1000	2"	Biennially	Cut. only
37	Finley	8S	8E	3	5000'	1.5	Eb	1000	2"	Biennially	Remove the few large fish present.
38	Russ	8S	8½E	26	4600'	6	Eb	1000	2"	Biennially	
39	Jude	8S	8½E	26	4590'	1.7	Eb	1000	2"	Biennially	Start 1941
40	Brook	8S	8½E	26	4590'	4	Eb	2000	2"	Biennially	Scuds abundant
41	Clackamas	5S	8½E	36	3340'	7	Cut	500	legal	Annually	Slow growth in lake
								1500	2"	Biennially	
42	Bear	5S	7E	11	4000'	5.1	Eb	1000	2"	Biennially	Start 1941
43	Rock; Upper	5S	7E	17	4290'	4.1	Eb	1000	2"	Biennially	
44	Rock; Middle	5S	7E	8	4250'	12.5	Eb	2000	2"	Annually	
45	Rock, Lower	5S	7E	8	3900'	7.8	Rb	2000	2"	Biennially	
46	Serene	5S	7E	7	4200'	22	Eb	5000	2"	Biennially	
47	Shellrock	5S	7E	17	3850'	15	Eb	3000	2"	Annually	
48	Hideaway	5S	7E	21	3950'	14.9	Eb	3000	2"	Annually	
51	Buck	5S	8E	30	3940'	9.1	Eb	1000	2"	Triennially	Experimental. Follow up lightly 1st. 3 yrs.
52	Shining	4S	6E	36	4170'	13.7	Eb	3000	2"	Annually	
53	Dinger	5S	8E	9	4050'	15	Cut	3000	2"	Annually	
54	Anvil	5S	8E	17	3950'	1.7	Natural stocking sufficient				
64	Frog	4S	9E	17	4000'	11.4	Eb	3000	2"	Annually	
66	Triangle	8S	8E	13		3	Unsuitable for stocking				
67	Frying Pan	4S	8E	26		3	Unsuitable for stocking				

Table 8. Stocking Chart for the Lakes of the Clackamas River Ranger District

50	Cripple Creek	5S	7E	19	4340'	11.8	Eb	1500	3"	Biennially