RESULTS OF FISH PLANTING AND A STOCKING PLAN FOR GLACIER NATIONAL PARK

By

Ancil D. Holloway

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
CHICAGO 54, ILL.

March 10, 1945

MEMORANDUM for the Regional Director, Region Two.

Attached are two approved copies of "Results of Fish Planting and a Stocking Plan for Glacier National Park". In accordance with the suggestion submitted in your memorandum of March 6, Mr. Garrison's exceptions, comments, and recommendations are being made a part of each report.

Biologist

In duplicate
Enclosure 2535898

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
GLACIER NATIONAL PARK
BELTON, MONTANA

Office of the Superintendent March 1, 1945

MEMORANDUM for the Regional Director, Region Two.

Reference is made to your memorandum of February 22 with attached copy of the Director's memorandum of January 26, and to Biologist Holloway's report on the "Result of Fish Planting and a Stocking Plan for Glacier National Park"; also to a copy of your memorandum of February 24 with Biologist Cahalane's memorandum of February 20 relating to the proposed stocking plan for waters in Glacier National Park.

We are forwarding the four copies with our signature of approval and make the following exceptions, comments, and recommendations.

1. We are in agreement with the Director's long range, three point fisheries program describing the plans of this Service for measurement and use of aquatic resources in the national parks as described in his memorandum of January 26, 1945.

2. We are in accord with Mr. Holloway's recommendation that additional aquatic research of the waters of Glacier National Park should be provided to formulate a sound fish cultural program for Glacier.

3. We recommend that no fish be planted in Cut Bank Creek below the chalets. Due to the character of this creek and to the behavior of flood waters, fish have not been planted between the chalets and the park boundary for several years. We are not in favor of planting legal sized fish in this stream as recommended by Mr. Holloway.

4. We are not in accord with the planting of exotics and recommend that no exotics be planted unless special circumstances warrant.

5. We do not favor the planting of legal sized fish. It is felt that if certain bodies of water will not support growth for fish under legal size, we should not plant fish in these waters. The planting of large size fish in "bathtubs" is not recommended. In other words, waters stocked should support fish growth.

6. We are in agreement with the marking of fish and recommend that when the fish have reached legal size, some creel census should be taken along streams and lakes where marked fish have been planted.

7. We concur and follow Mr. Holloway's plan for planting, distributing and transporting fish. A fish distribution boat as described in Fishery Leaflet 56 would be faster than the method of distribution from cans. However, it would not seem practical here in that our lakes are so widely separated that the transportation of the boat would be a problem in itself unless we had one for each lake. We thought that perhaps after the war an amphibious craft would be available upon which we could mount our distribution tank. The amphibian could be driven from the hatchery into the lakes and fish distributed quicker than from a boat.

8. We are in accord with the closing of certain spawning streams to fishing and after further study will recommend special regulations.

9. The question of a change in the opening date for the regular fishing season has been raised. The opening date for the park is May 30 while the opening date for the State is the third Sunday in May. We believe it would be advisable and advantageous to the park to have the two opening dates conform. It would mean opening the park fishing season about 10 days earlier. A separate recommendation will be submitted on this.

10. Ashley Lake vs. Yellowstone strain of blackspotted trout. We feel that this is purely a technical matter best decided by biologists and fish experts; however, we wish to quote the following from the 1944 Annual Report of the Glacier National Park Fish Hatchery, Creston, Montana, as prepared by Blendon H. Cook, Superintendent:

> "During June, a shipment of 100,000 eyed blackspotted trout eggs of Ashley Lake strain were furnished us by the State Hatchery at Somers, Montana. Nearly half of this lot were lost during the egg, fry, and early feeding stages and our experience of heavy early losses on this lot coincides with the experience of the State hatcheries handling this strain during pervious years. However, this lot since reaching the two inch size has done very well and the year's end finds the station with 49,050 2-1/2 inch fish on hand."

We have been informed by local fishermen that the Ashley Lake blackspotted trout are a mixed strain and that fertilization is about 60% while that of the Yellowstone is over 90%. We are not familiar with the migratory habits of either strain. The above statements may have some merit and we are submitting them for what they are worth.

As soon as Mr. Holloway's report has been approved by the Director, we would like to have a copy as we will be thinking about fish planting soon and will need the report for reference.

Lemuel A. Garrison,
Acting Superintendent.

In duplicate

RESULTS OF FISH PLANTING AND A STOCKING PLAN FOR GLACIER NATIONAL PARK

By Ancil D. Holloway

Division of Game-fish and Hatcheries

Fish and Wildlife Service

Approved Jan. 17 1945

/s/ Albert M. Day
Acting Director, Fish and Wildlife Service

Approved Feb 24 1945 1945

/s/ J. W. Emmett
Superintendent, Glacier National Park

Approved March 10 - 1945 Submitted January 15 1945

/s/ Conrad F. Wroth
Acting Director, National Park Service

/s/ Ancil D. Holloway
Biologist

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INTRODUCTION

The field data for this report were collected from June 27 to July 30, 1944. The short time available for the investigation permitted examinations of only the most accessible and certain problem waters. As a very accurate record of past stocking had been kept, and a great deal of previous investigations had been made in the Park, studies of a preliminary, exploratory type were not required. In 1932, a survey party under the direction of Dr. A. S. Hazzard, covered the waters from Summit Creek northward to Sherburne Lake and also Lake McDonald. In 1934, J. W. Nancey and party conducted a survey from the Kennedy Creek Drainage to Waterton Lake and from Kintla Lake to the Quartz Creek drainage; and Dr. Leonard P. Schultz and party examined the waters from the Bear Creek drainage nort to logging Lake, thus completing the original survey. In 1939 Dr. Hazzard compiled all of the data and made a stocking plan for the Park. This plan was based on the best information available at the time. It called for annual plantings of 1,911,920 fingerlings, 65,000 eggs and 20,000 fry. Although this elaborate program resulted in the overstocking of some of the higher lakes, it was apparently successful in building up a satisfactory fish population in nearly all of the higher lakes and in most of those of the east side, the streams and St. Mary Lake being exceptions. On the west side of the Park, July and August fishing is poor in Lake McDonald. Mud Lake, and streams tributary to the North and Middle Forks of the Flathead River, and only fair in Kintla and Bowman Lakes, and in the North and Middle Forks of the Flathead River. Other west side waters afford satisfacory angling throughout the season. The fishing on the west side of the Park is furnished by blackspotted and Dolly Varden trouts, and on the east side by brook and rainbow in the more accessible waters, and blackspotted in the higher inaccessible waters. Other species that contribute to fishing on the east side are the Mackinaw trout in Waterton, Crossley, Glenns, and St. Mary Lakes; the grayling in Elizabeth Lake; and the little redfish in Swiftcurrent and Josephine Lakes; the Dolly Varden in the waters tributary to the Saskatchewan drainage; and the pickerel in Lake Sherburne.

ACKNOWLEDGEMENTS

The large amount of field data collected in the short time available could not have been gathered without the fine cooperation given by Superintendent D. S. Libbey and other Park Service personnel. Particular acknowledgement should be made to M. C. Batty, who assisted in the field work during most of the survey and A. D. Cannavina, who furnished planting records and answers to innumerable questions which helped to form a background necessary to interpret present conditions. Donald L. Libbey, son of the Superintendent, assisted the author during the entire field investigation. His stimulating personality when the going was toughest, his ability to start the most stubborn of outboard motors, and his intimate knowledge of the waters, contributed greatly to the success of the field work.

PHYSIOGRAPHY AND RUNOFF

Glacier Park embraces the mountains east of the Upper Flathead Valley, over a strip 32 to 40 miles wide, which includes the Livingston (Clark) and Lewis ranges. These mountains have peaks reaching altitudes of 8,000 to 10,000 feet. They are separated at the north by the Waterton Valley (4,186 feet). The Flathead Valley on the west is 3,500 feet in altitude at the Canadian boundary and 3,100 feet at Belton, Mont. The streams leaving the Park on the Great Plains are at an altitude of about 5,000 feet.

The sedimentary and alluvial deposits are conducive to the storage of large amounts of rainfall. However, only about 15-20 inches of precipitation occurs annually, and most of this comes in the form of snow, a part of which remains as snow and ice in the protected areas at high altitudes throughout most of the summer. Floods caused by rain are rare, if indeed they ever occur. The first spring thaw occurs in March or April, melting the snow at lower altitudes and on sunny slopes. The resulting high water takes on the nature of a flood except that the increased height of three to five feet in the streams may be prolonged for several days. Usually in May or early June a second freshet occurs, resulting from thawing at higher altitudes. The erosive action of these high waters prevents bottom fish foods of the streams from becoming abundant. During the short growing season the streams are fed by melting glaciers and snow, and by seepage from the alluvial soil and sedimentary rock. The water maintains such a low temperature that insect life cannot become abundant as it does in warmer waters.

Three major river systems arise in the Park. The entire west side of the area is drained by the Flathead River, a tributary of the Columbia, which flows into the Pacific Ocean. Two Medicine and Milk Rivers and Cutbank Creek drainages in the southeast corner of the Park drain into the Missouri River and thence to the Gulf of Mexico. The remainder of the Park waters flow into Saskatchawan River and ultimately into Hudson Bay. Schultz (1941) states that of the 23 species of fish listed only three endemic species occur in all three stream systems, but that there are many similarities between the fishes of the three drainages.

THE BLACKSPOTTED TROUT PROBLEM IN THE FLATHEAD RIVER DRAINAGE, INCLUDING LAKES BOWMAN, KINTLA, AND MCDONALD

These waters provide excellent fishing for about a month at the beginning of the season and for the same length of time in the fall. The fishing season extends from May 30 to October 15. The mediocre fishing during July and August in these waters, is apparently connected with the migrations of the Dolly Varden and blackspotted trouts. The Dolly Vardens begin to reach the North and South Forks of the Flathead

River in late August and increase in numbers in the accessible streams and lakes of the west side until the fishing season closes. The blackspotted migration apparently follows that of the Dolly Varden. The migration downstream is apparently completed sometime in June, varying with the stream conditions that are influenced primarily by temperatures. This migration affects fishing during July and August in that large fish are scarce and the available supply probably consists for the most part of sexually immature fish. This is true of the blackspotted trout to a greater extent than of the Dolly Varden. The fact that July and August fishing is satisfactory in the higher and inaccessible lakes is believed to be due to the existence of two different strains of blackspotted trout in the Park. The native blackspotted trout which is present at least for the most part in the inaccessible and higher lakes, is less migratory than the Yellowstone strain, which has been planted in recent years, particularly in Kintla, Bowman, and McDonald Lakes, and the Flathead River drainage. The catches of blackspotted trout in the North and Middle Forks of the Flathead and their tributary streams during July and August, are confined to fingerlings sizes, and the so-called "blue-backs". Specimens collected in tributary streams ranged in size from 90 to 176 mm (4 to 7-1/2 inches), and in the North Fork from 157 to 255 mm (6-1/4 to 10-1/4 inches), and were all one year of age, or in their second summer (Table 1). These sizes, although not collected in large numbers, are apparently representative of those available as some two dozen fishermen told us that they had not been able to catch any larger trout except occasionally in the North and Middle Forks of the Flathead. In Kintla, Bowman, and McDonald Lakes, approximately 35 percent of the blackspotted trout taken were in the so-called "blueback" stage. This color is apparently lost when the fish approach sexual maturity. Examinations of the females indicated that the majority of blackspotted trout mature when they are three years of age although some apparently spawn a year earlier. Migrations from the lakes are apparently closely connected with sexual development. The tributary streams of the North and Middle Forks are well populated with fingerling blackspotted trout from natural reproduction. Except in the North and Middle Forks of the Flathead River, these are not contributing to the Park catches during July and August. There is evidence that the stocking of the Yellowstone strain has contributed to improved fishing in Flathead River and Lake in the summer months and in the Park during spring and fall.

Because of the tendency of the Yellowstone blackspotted trout to migrate to the larger waters of the Flathead River drainage during the summer, it is recommended that it is use be discontinued and that eggs be taken from the local strain. The State of Montana has egg-collecting stations on nearby ashley Lake, where it is believed eggs

can be obtained. The blackspotted trout in Ashley Lake is a pure strain of the local race. It has been planted with success in streams and lakes of adjacent National Forests which encourages the belief that it will remain in Park waters during the summer.

THE DOLLY VARDEN TROUT

This trout is classed by most fishermen as undesirable because of the predacious feeding habits and its poor eating qualities. Its contribution to the fishing on the west side of the Park, however, is important because of its large size and occurrence in moderate numbers. Its population is being maintained without the help of hatchery stock. This trout occurs in most of the waters in the Park not blocked by barriers except those of the Missouri River system.

STOCKING RECOMMENDATIONS

The stocking rates recommended follow those proposed in "Instructions for conducting stream and lake surveys" (Fisheries Circular No. 28, by H. S. Davis), except that stream stocking rates are reduced 50 percent. This practice has been shown through experience to be more satisfactory. Instead of using the total surface area of a lake to calculate the planting needs, we have used the area of the "bench" and slope down to about 25 feet in depth. The numbers suggested are based on the food grade of the area, spawning conditions in available streams and on the "bench", the fishing intensity, and the fish population already present.

Kintla Lake: This lake has about 14 miles of shoreline. The "bench" averages about 60 feet in width, giving a stocking area of 102 acres. The "bench" is rated as number 1 in food grade. Spawning conditions however are relatively poor. The fishing intensity is medium. The stocking rate is 180 three-inch fingerlings per acre, or 16,360 annually. Three-inch fingerlings are recommended for Kintla to test their value as compared with that of the five-inch size recommended for Bowman Lake. They should be marked.

Bowman Lake: This lake has about 15-1/2 miles of shore line with a "bench" averaging 80 feet in width, which gives a stocking area of 124 acres. The food grade is rated as 1, spawning as relatively poor, and fishing of medium intensity. The stocking rate is 111.6 five-inch fingerlings per acre, or 13,838 annually. They should be marked.

Lake McDonald: This lake has about 22 miles for shoreline with a "bench" approximately 100 feet wide, giving about 267 acres of stocking area. Food conditions are rated as grade 2 and spawning conditions as relatively poor although much better than in Kintla and

Bowman. The fishing intensity is heavy. This lake will care for a very large percentage of the Park fishing if satisfactory fishing is developed and maintained thus reducing the cost of stocking in other waters.

An effort to provide fishing in this lake with advanced fry of the blackspotted trout has been unsuccessful. Between 1919, when the first Glacier Park fish hatchery began producing, and 1940, its last year of operation, there were 1,821,244 advanced fry planted. From 1940 to 1943, inclusive, 519,840 fingerlings 1 to 2 inches in length, and 220,819 fingerlings and adults from 3 to 8 inches in length were planted. The records do not show the origin of these fish. It is known that eggs were taken locally from Hove Lake before 1941. This lake is populated with a local strain of blackspotted trout. After the new hatchery began operations at Creston, a few eggs from the Ashley Lake or local strain were used. It is believed that sufficient advanced fry of the local strain have been planted to prove that they are not practical for use in this lake. The larger fingerlings and yearlings planted are known to be of Yellowstone origin and, for the most part, probably, have been lost to midsummer fishing by migration.

Attempts to provide angling with other species also have been made. In 1922 and 1923, 332,000 advanced d fry of landlocked salmon were planted; in the years 1922, 1931, and 1936, 576,660 advanced fry of steelhead; in 1919, 1920, 1921, and 1923, 340,500 advanced fry of brook trout; between 1919 and 1929, 743,150 advanced fry of rainbow. Very few recoveries from any of these plants are known. It is believed that this can be blamed primarily on the small size of the fish when planted. Due to the success of brook trout in waters of the Flathead drainage outside of the Park and in the lakes on the east side of the Park, it is believed they would be most economical to use in providing summer fishing. As there are apparently no exotic species present, and as the planting of larger sizes of the local strain of blackspotted trout has not been given adequate trial, these are recommended for planting during the next four or five years. If they are not successful it would then seem advisable from the technical standpoint to consider the planting of legal length blackspotted trout or the introduction of brook trout. Stocking is recommended at the rate of 240 per acre, or 39,729 five-inch, fingerling blackspotted trout annually. They should be marked.

Mud Lake: This lake contains about 30 acres with a flat bottom at 12 to 15 m feet, and is said to have a maximum depth of 26 feet. Vegetation is abundant. I was informed that the fish were apparently smothered out several winters ago by prolonged heavy snows. However, since no spawning areas are available, the almost total lack of game fish may be due to lack of annual stocking. As the lake is very accessible and rich in fish foods, it is believed well worth planting. The food grade is 1, spawing facilities none, and fishing

expected to be heavy. Planting should be at the rate of 240 acre, or 7,200 three-inch, native blackspotted fingerlings annually. They should be marked.

Camas Creek: Since this stream is accessible by truck at various points in its lower nine miles, it was selected as a test stream to determine the value of planting native blackspotted trout in west side streams. In view of the large number of beaver dams, the presence of considerable vegetation, less gradient and relatively warmer water, the food grade was raised one step over that in Hazzard's survey report. The average width of the stream is 25 feet, pool and food grade B 2, and the recommended stocking at the rate of 810 per mile, or 7,290 three-inch, native blackspotted trout annually for three years for the 9 miles between the mouth and Rogers Lake. These should be marked.

Dutch Creek: This is a tributary of Camus Creek. The two-mile section below the road bridge should be planted. The pool and food grade is B 3, and the stream averages 15 feet in width. The recommended stocking is 375 per mile, or 750 three-inch, blackspotted trout annully for three years. They should be marked by clipping the adipose fin.

WATERS ON THE EAST SIDE OF THE PARK

Cutbank Creek: A chalet is located on this stream about one mile above the Park boundary and it is doubtful if the cost of planting would be warranted except when the chalet is in operation. About four miles of the stream would normally be fished intensively. The stream averages 20 feet in width and has a pool and food grade of B 2. Brook trout are present but are not reporducing well. The most economical way to support the fishing load in normal times would be to plant legal-length fish in the spring. Since most of the fishing is done after July 1, planting should be about one month in advance, or by the first of June in order that the fish will have time to become wild. The recommended stocking is 300 per mile, or 1,200 7-to-8-inch brook trout annually. If more than 500 anglers fish the stream annually, additional fish should be planted at the rate of 500 additional fish for every 100 fisherman days. By planting legal-length fish in the spring we can save the winter loss as well as provide good fishing for the chalet f visitors.

Middle Two Medicine Lake: The lake provides fair rainbow and brook trout fishing and is one of the more popular angling areas of the Park. Some stocking is needed to increase the population so that it will more fully utilize the food supply. There are 6.5 miles of shore line with a "bench" averaging 70 feet in width, making 55 acres available for stocking. The recommended planting is 148.8 per acre, or 8, 184 five-inch brook trout annually for two years. After the war plant at the same rate annually.

Upper Two Medicine Lake: This lake was fished with a fly rod and rainbow and brook trout were caught. Hazzard says that this lake has available spawning grounds in the outlet stream. The stream was examined but is only a few feet in length between the lake and a waterfall. There is no tributary that fish can use for spawning. Some spawning might occur on the "bench" but this would probably be negligible. For these reasons we recommend light stocking as necessary to maintain a sizeable fish population. The lake has 2.5 miles of shore line with a "bench" 50 feet in width, giving 10.5 acres for stocking. The food grade is 1. Fishing intensity is light although it can be expected to be heavier than in most of the relatively inaccessible lakes. The recommended planting is 74.4 per acre or 781 five-inch brook trout every other year, or half that amount every year. Only one planting is necessary until after the war.

Swiftcurrent Lake: This lake is one of the heaviest fished lakes examined and the only one that appeared to be stocked to capacity except Otokomi Lake, which is accessible only by a five-mile trail. A great amount of natural reproduction occurs as is shown by the presence of large numbers of trout under six inches in length. The crop of one-to-two-inch fingerlings was particularly abundant. Two excellent spawning streams enter the lake. There are approximately 2.5 miles of shore line with a "bench" averaging 100 feet in width. Vegetation is abundant and food conditions are excellent. Amphipods were found in the stomachs of several fish examined. The brook trout were in better condition than the rainbow. No stocking is recommended. It is believed that the natural reproduction is ample to keep the lake well stocked. This lake undoubtedly gets fish from downstream wash during the high waters at the time of the spring thaw.

Josephine Lake: This lake lies above Swiftcurrent on the Cataract Creek drainage, and in normal times gets a great deal of fishing. The lake is not stocked to capacity. Some reproduction was observed. Spawning conditions do not appear to be a s good as they are for Swiftcurrent Creek. Although the lake has a comparatively wide "bench", very little vegetation occurs except in a narrow fringe on the upper west side. The lake has about 3.5 miles of shore line with the "bench" averaging 120 feet in width, making 51 acres of area for stocking. The food grade is 1 but the spawning areas are considered below average. The stocking recommendation is 148.8 per acre, or 7,500 five-inch brook trout fingerlings annually for two years. If normal fishing intensity is restored it can be planted annually.

Fishercap Lake: This lake lies just above Swiftcurrent Lake on the Swiftcurrent Creek drainage. It is not considered by the fishermen as affording good fishing. However, the all lake appears to be the richest in fish foods of any of the waters examined. It has approximately 20 acres of area with a maximum depth of eight feet. The entire bottom is covered with vegetation. It had the largest net catch and highest average condition factors of any

water in the Park. The poor fishing is probably due to the lack of competition for food. Fishing, therefore, should be improved by increasing the number of fish. The food grade is 1, spawning conditions are only fair, and the fishing intensity is heavy. Sizes of three or five inches may be planted. Due to the amount of vegetation small fish should survive well. Recommendations are for 240 per acre, or 4,800 three-inch (148 per acre or 2,976 five-inch) brook trout. The lake should be planted for two successive years and if heavy fishing prevails it may be planted annually.

Red Rock Lake: No specimens were taken from this lake. The lake is fished rather intensively during normal times. Brook and rainbow trouts are present. It has about one mile of shore line with a "bench" averaging 60 feet in width giving a stocking area of 7 acres. The food grade is 1 but spawning facilities are poor. Stocking recommendations are at the rate of 240 per acre or 1,680 three-inch brook trout every other year (if five-inch brook trout are used, 1,042.)

Bullhead Lake: No specimens were taken from this lake but brook and rainbow are present. It has approximately 2.5 miles of shore line with a "bench" averaging 60 feet in width, making a stoc king area of 18 acres. The food grade is 1, spawning poor, and fishing heavy. Stocking with brook trout every other year is recommended. Use 240 per acre or 4,320 three-inch (2,678 five-inch) brook trout.

St. Mary Lake: Except for the Mackinaw or lake trout which provides fair fishing by trolling in July and August, this lake is considered next to Lake McDonald as providing poor fishing during the summer months. The lake has about 21 miles of shore line with a "bench" averaging only about 40 feet in width. The lake frequently gets rough from wind action which discourages fishing from small boats. In five nights (35 hours) of gill netting with 600 feet of nets, only three cutthroats and no rainbows were taken. Yet between 1916 and 1943 inclusive, 2,339,709 cutthroat and 958,750 rainbow were planted. These were advance fry except 5,600 three to six-inch cutthroats planted in 1941 and 1943. It is believed that cutthroats have been given adequate trial. Angling undoubtedly would be rather heavy on St. Mary Lake during the tourist season if good fishing and safe boats were available. If a species could be introduced that would provide a large part of the catch from natural reproduction, the maintenance of the fishing would not be too expensive. It is believed that the brook trout is best u suited for this purpose. After three years of continuous planting we should be able to get some indication of what brook trout will do. There are approximately 101 acres of planting area. Stocking recommendations are based on a number 1 food grade, poor spawning conditions (there are five small spawning creeks but this is a small amount for the area involved), and heavy fishing. Plant 148 per acre of 15,028 five-inch brook trout annually for three years; 1/3 in the upper basin and 2/3 below the "narrows".

It is believed that the Mackinaw fishing can be improved and as it occurs at the height of the tourist season improvement is deemed desirable. The Rocky mountain and lake whitefishes, long-nosed and white suckers, a lake chub, and perhaps other species, provide forage for the Mackinaw trout. The suckers are numberous. We are, therefore, recommending the stocking of 15,000 yearlings (3 to 5 inches) annually for three years.

Elizabeth Lake: This lake was fished from the bank with a fly rod. Excellent rainbow and grayling fishing was evident. No stocking is recommended because of the light fishing intensity. It is believed that adequate spawining facilities are available to maintain good fishing in this inaccessible lake.

Crossley Lake: We secured very little information on this lake as we were unable to take specimens by hand fishing and time did not permit the use of nets. A very small amount of brook trout reproduction was observed. The lake has a reputation of affording only poor fishing. Rainbow and brook trout provide most of the catch. If it is anticipated that the lake will have considerable use after the war it should be stocked. Brook trout are probably best adapted to the conditions here. The lake has about 3 miles of shore line with a "bench" averaging 50 feet in width, making 17 acres of stocking area. The food grade is 1, spawning facilities poor, and fishing intensity light. Recommendations are for 120 per acre or 2,040 three-inch brook trout fingerlings (or 1,265 five-inch). One planting should be adequate until further investigations are made. Whether it is desirable to plant this lake will depend, probably, on the presence or absence of a summer camp.

Glenns Lake: See discussion under Crossley Lake. The lake has about 6 miles of shore line with a "bench" averaging 70 feet in width, making a stocking area of 51 acres. The food grade is number 1, spawning conditions poor and fishing intensity light. Brook trout are recommended at the rate of 120 per acre or 7,080 three inches in length (or 4,389 five inch in length). Not more than one planting should be done until further investigation has been made.

Otokomo (Roes) Lake: This lake was visited primarily to secure a picture of the conditions in the higher inaccessible lakes. It is reached over five miles of foot trail from the St. Mary campground. The altitude is 6,500 feet. It was fished with rod and fly. Of the 27 fish taken, at least 18 showed a combination of rainbow and blackspotted characteristics. Only two typical rainbow trout were caught. If the hybrids are non-fertile and the fish caught representative of the population, the lake should eventually become exclusively populated with blackspotted trout. Although all the fish were in a satisfactory condition, the variation of the condition factors indicated that the population had reached the approximate carrying capacity of the lake. The fish in this lake have access to a small outlet stream but probably most of the spawning occurs o n the

"bench". Spawning was observed on July 21, and examination of specimens indicated that most of the spawning had already occurred. If the fishing in Otokomo Lake is typical of that in other inaccessible lakes, Glacier National Park has some very fine fishing.

Sherburne Lake: Gill nets were fished only one night in this lake, taking five pickerel ranging in length from 24-1/2 to 30-3/4 inches, and three lake whitefish between 12 and 14 inches. No stocking is recommended. Results from trout could not be expected in the presence of the pickerel. Excellent fishing for pickerel occurs here. Forage fish in the form of whitefish and suckers are available.

CONDITION FACTORS

The use of condition factors is a direct and quick method of determining if a water is overpopulated or if some other factor is adversely affecting the fish. The condition factor is the relation of weight to length and may be expressed in the metric or English system, and by standard, total, or to fork of tail measurements. All weights are expressed in grams, and lengths in millimeters and total lengths.

With the system used the minimum condition factor that would permit a satisfactory appearance of cutthroat, rainbow, and brook trouts, and for the silver salmon (little redfish) is approximately 55. For Dolly Vardens the minimum is about 70.

Uniformly high condition factors with good growth ratios indicate that the fish population is insufficient to utilize fully the food supply. This is true of most of the Glacier Park lakes examined.

A great amount of variation from minimum to high condition factors from a given water may mean that the fish population has reached a size where it is fully utilizing the food supply and cannot be much increased as in Otokomo Lake.

Except for Dolly Varden trout condition factors were high in all Park waters. The number of this species taken was small. As shown in Table 5 those from Bowman Lake were in rather poor condition with an average condition factor of 66. This was the only water in which poor-conditioned Dolly Vardens were taken. Nearly all these fish examined were parasitized with round worms as would be expected, but there appeared to be no correlation between the number of parasites and the condition of the fish. In contrast to the poor condition of the Dolly Vardens in Bowman Lake the cutthroats had a uniformly high condition factor.

DISTRIBUTION WHEN PLANTING

Well conducted planting is an important phase of the fishery program. If the planting is not properly done little may be realized from the investment. Proper planting requires placing of fish in healthy condition at points where they will be most likely to avoid predators, to obtain food, and to reach "keeper" size. Hatchery trout, when planted a dozen or more in a place, may not disperse for several hours or days. When thus grouped together they are easy prey for predatory fish, birds, etc. Wide distribution of from two to four fish at a place in areas where large fish are less likely to be present is important. In lakes such distribution can be attained by planting from a boat run as near the shore or weed line as possible and the fish dropped or poured from the containers on the side next to the shore or weed line. Deep holes, dark water, logs, etc., where large fish may harbor, should be passed over without planting. Wide, shallow benches with boulders and shallow weed areas are excellent places for making plants.

In streams, wide distribution is usually more difficult and more expensive to accomplish than in lakes, back-packing usually being necessary. Where barriers do not interfere with the fish entering certain reaches of the stream, the fish may be distributed from points accessible by truck. Intervening areas may be too inaccessible for planting. However, the fish may distribute themselves through these areas in a few weeks or months. In distribution avoid planting in deep holes, but favor shallow water along shore and beaver ponds where abundant food and cover exist.

TRANSPORTATION METHODS

The important thing in fish handling is to keep the fish in prime condition until they are released. I am convinced that much of the poor survival experienced from trout plantings is due to inexperience in handling the fish. It is not enough that they should merely reach the waters alive. They should be as active when they reach their destination as when they are loaded at the hatchery. Fortunately, keeping them so is not difficult at Glacier because of the low water temperature at the hatchery and the well-equipped tanks available for hauling. When these taks are not loaded heavier than their stated carrying capacity the fish arrive at their destination in excellent condition. It is a failing of inexperienced men to overload the containers, but men with years of experience in hauling fish and little or no experience in checking results sometimes make the same mistake. By trying to haul a few extra fish they may defeat their purpose. Although the truck may arrive at its destination with few if any dead fish, the fish may be in such a condition that few survive after being planted. It takes some experience to detect the characteristic behavior in over-crowded tanks.

HOLDING FISH AT THE LAKE OR STREAM FOR DISTRIBUTION

As noted, it is important to obtain wide distribution and to get the fish planted at the right places. This takes time and necessitates the holding of fish from one to several hours while the distribution work is being done. If the fish are to be held for less than an hour they can ordinarily be left in the tank provided they are in good condition and there is proper aeration. If they must be held for longer periods, they should be placed in a live box until needed. Live boxes are ordinarily 18 to 30 inches in width and four to six feet in length. Three such boxes should ordinarily take care of all holding needs in the Park. They should be made of light sturdy materials for the frame and a number 4 hardware cloth for a covering. If made so that the smaller will fit inside the next larger, this will facilitate handling. Tops will be needed if the live boxes are to be left without an attendant. When the fish of a single truck load are to be planted in more than one body of water they may be placed in live boxes at the various points and planted later. This method makes it possible to keep the fish in good condition until planted. Fish have been held overnight in such containers without apparent harm. This is not advisable if it can be avoided. It is doubtful if it could be done in the Park unless an attendant was left with the fish.

FISH DISTRIBUTION BOAT

In order to distribute fish adequately around the lake shores a fish distribution boat is needed. The method of distributing from cans is slow because of the limited number that can be hauled at one trip and often results in the fish being planted in poor condition. A boat large enough to carry 12 or more cubic feet of water, two men, and operated by an outboard motor would save a great deal of time and make it possible to plant the fish in healthy condition.

Fishery Leaflet 56, attached, describes a fish distribution boat for warm water fish. Larger boats using the same principles are in use. In such boats the fish compartment extends from the front of the boat back about 3/4 of its length. A space between the fish container and the sides of the boat permits the passage of a man while removing the fish with a net. Seats for the motor operator and one passenger are in the rear of the boat. The funnel shapped inlet, at least two exhaust vents, and two or more compartments with waterflow vents, as described in the leaflet, should be included as a necessary part of the boat. The compartments are needed to keep the fish from crowding around the saud water inlets. The outlet gates will not be needed as they will not function with trout.

GENERAL POLICIES

As previously stated, time permited an inspection of only a limited number of waters. An effort was made to investigate the

waters that had poor angling and those that normally carry a heavy fishing load and to obtain a general idea of fishing conditions.

Whenever rainbow and cutthroat trouts were found together hybrids were collected. This is a phenomenon prevalent throughout the range of these species. It was also found that where brook and rainbow trouts inhabit the same lake that the former appeared better suited to the conditions. This was apparent in the difference in condition factors and in the amount of natural reproduction found. It may prove advisable to discontinue the stocking of rainbows. Another fact influencing this suggestion is that if rainbows are not raised at the hatchery we will eliminate the possibility of getting them mixed with the cutthroats and accidentally introduced into the cutthroat waters of the Flathead drainage.

The question of a change in the fishing season has been raised. The season now opens on May 30 and is closed October 15. May 30 as an opening date apparently protects the cutthroat during spawning season in all the lower and accessible waters. As spawning occurs in the higher waters in July and August, it follows that there can be no satisfactory closing date for all Park waters. As there is little fishing in the higher lakes the cutthroat actually needs no protection there during the spawning season. I doubt if the present opening date can be improved upon. The closing date of Octaober 15 probably is at the height of the brook trout spawning season in the lower accessible lakes on the east side of the Park. However, I am told that there is little fishing after the middle of September. It would appear that the present open dates are not limiting fish production in the Park. The late date of October 15 may materially facilitate pickerel fishing in Lake Sherburne. The limit of 10 fish per person per day is adequate and in conformance with creel limits elsewhere.

In some of the higher lakes where the available spawning areas in feeder streams are limited and the fish spawn during the height of the tourist season, the cutthroat may concentrate in large numbers in small streams areas. Where this is known to happen as in Hidden Lake, it probably would be good management to close the spawning areas in the streams to fishing. This would mean closing the stream from its mouth to a point just above the first barrier.

EXPERIMENTAL AND INVESTIGATIVE WORK

The proposed marking of all trout planted in the Flathead Drainage will permit an evaluation of three-inch, as compared to five-inch, fingerlings cutthroats for planting in the lakes and should provide information on migration and reproduction. Likewise, it will give additional evidence on the success of the native cutthroat in streams.

Additional investigative work is needed. All the lakes should be studied to evaluate the relation of carrying capacity to fish populations, to determine spawning facilities, and to estimate the need for planting to maintain fishing. The most important problem at present is to provide good summer fishing in Lake McDonald and St. Mary Lake, improve the fishing in Kintla and Bowman Lakes and determine whether the streams can be made to provide more summer fishing. The streams are rather poor in bottom foods, but a large portion of the food of the adult cutthroat is terrestrial insects. For this reason and the fact that comparable streams on nearby National Forests provide fair to good summer cutthroat fishing, it is believed that an increased amount of summer angling can be developed in Glacier Park streams. It is thought unwise to inaugurate an extensive (and expensive) stream stocking program until we are assured of its being successful. Hence experimental stocking of native cutthroats was recommended in Camus and Dutch Creeks.

Table 1. Fish Stocking Recommendations for Glacier National Park. **

	3-inch Cutthroat	5-inch Cutthroat	3-inch Brook	5-inch Brook	7-8 inch Brook	3-5 inch Mackinaw	Remarks
Kintla Lake	18,000(1)						Annually
Bowman Lake		14,000(2)					Annually
Lake McDonald		40,000(3)					Annually
Camas Creek	7,300(4)						Annually for three years
Dutch Creek	750(4)						" " " "
Mud Lake	7,200(1)						Annually
Cutbank Creek					1,200		Annually. See text.
Josephine Lake				7,500			Annually. See foot note *
Fishercap Lake			4,800				" " " " "
Redrock Lake			1,600				Every other year.
Bullhead Lake			4,000				" " "
St. Mary Lake				15,000		15,000	Annually for three years
Upper Two Medicine Lake				800			Every other year. See text.
Middle Two Medicine Lake				8,000			Annually. See foot note *
Crossley Lake			2,000				One year. See text.
Glenns Lake			7,000				" " "

(1) Mark by clipping left pelvic fin.
(2) Mark by clipping right pelvic fin.
(3) Mark by clipping adipose fin.
(4) Mark by clipping both pelvic fins.

* Plant for two years. If normal fishing intensity is restored they can be planted annually.
** If the total number of mature cutthroat are not available the first year priority should be given to Camus and Dutch Creeks first, and Lake McDonald second.

TABLE 2. Black Spotted Trout Data

Water	Number Specimens	Age Years	Average length M.M.	Average Weight	Average Condition Factor	Range of Condition Factors
	21	2	293	247	99	80 to 133
KINTLA LAKE	2	2 or 3	335	390	93	84 to 101
(Yellowstone strain)	1	3	336	368	97	---
	1	3 or 4	418	617	84	---
	28	2	331	314	96	88 to 115
BOWMAN LAKE	1	2 or 3	324	326	95	---
(Yellowstone strain)	1	3	402	--	--	---
	16	2	281	216	93	81 to 102
LAKE MC DONALD	7	2 or 3	305	264	91	83 to 95
(Yellowstone strain)	3	3	536	583	88	78 to 95
MUD LAKE						
(Yellowstone strain)	1	2	382	681	122	---
HIDDEN LAKE	2	3	509	---	---	---
(Native)	1	4	520	---	---	---
ROGER LAKE	4	2	278	243	102	94 to 112
(Native)	3	3	360	524	104	101 to 108
ST. MARY LAKE	2	2	247	109	101	
(Yellowstone strain)	1	3	223	223	97	
LOGGING LAKE	5	2	384	---	---	---
(Native)	2	3	441	---	---	---
OTOKOMI LAKE						
(Roes)	1	1	203	79	95	---
Cutthroat and Rainbow hybrid	1	2	275	128	62	---
Collected by line series	22	3	321	342	102	One 55 - 81 to 118
(native)	3	4	404	550	72	63 to 100
MIDDLE TWO MEDICINE CREEK						
(Rainbow Hybrids)	2	3 or 4	409	600	89	85 to 93
QUARTZ CREEK						
(Yellowstone strain)	28	1	124	28	101	78 to 122 Very uniform
CAMUS CREEK						
(Yellowstone strain)	9	1	137	20	84	64 to 97
FERN CREEK						
(Yellowstone strain)	15	1	136	23	90	82 to 102
NORTH FORK FLATHEAD RIVER						
(Yellowstone strain)	14	1	180	68	87	60 to 103

Table 3. Blackspotted trout Data
Collected in December

WATER	DATE	LENGTH (inches)	WEIGHT (grams)	AGE	SEX
Lake McDonald	12/15/44	14.4	—	4	male
" "	12/2/44	15.4	—	4	male
" "	12/15/44	14.4	—	4	male
" "	"	16.2	—	4	male
" "	"	17.1	—	5	male
" "	"	17.0	—	5	male
" "	"	18.3	—	6	male
" "	"	15.6	600	4	female
" "	"	13.5	—	4	female
" "	"	15.3	—	5	female
" "	"	18.4	—	5	female
" "	"	13.6	419.8	4	female
" "	"	15.3	—	4	female
" "	"	16.8	—	4	female
" "	"	14.1	453.1	4	female
Robideau Creek	8/27/44	10.0	—	3	female

TABLE 4. Rainbow Data

Water	Number Specimens	Age Years	Average Length	Average Weight	Average Condition Factor	Range of Condition Factors
ELIZABETH LAKE	2	3	325	312	92	87 to 90
MOKOWANIS RIVER	4	2	199	74	84	86 to 95
JOSEPHINE LAKE	5	2	271	184	92	85 to 101
	12	3	303	261	86	81 to 103
	1	4	308	292	100	---
SWIFT CURRENT LAKE	23	2	264	179	96	84 to 108
	5	2 or 3	287	224	94	78 to 103
	13	3	317	241	95	85 to 100
MIDDLE TWO MEDICINE LAKE	5	1	239	156	114	110 to 132
	19	2	297	274	102	50 to 123
	2	2 or 3	307	325	106	104 to 108
	2	3	320	294	92	75 and 106

TABLE 4. Grayling and Silver Salmon Data

ELIZABETH LAKE	1	2	231	102	82.43	---
	7	3	358	348	75.6	70 to 83
Silver Salmon (Redfish)						
JOSEPHINE LAKE	7	2	196	58	77	70 to 88
SWIFT CURRENT LAKE	16	3	257	168	99	95 to 102

TABLE 5. Dolly Varden Data

Water	Number Specimens	Length M.M. (Range) (Mean)	Weight (Grams) (Range) (Mean)	Range of Condition Factors
KINTLA LAKE	1	274	147	72
	2	365 - 376	366 - 419	75 - 78
		372	398	77
	5	428 - 478	573 - 192	73 - 84
		457	760	79
	1	502	1145	91
Total (Mean)	9	423	554	79
NORTH FORK FLATHEAD RIVER	3	308 - 310	280 - 292	96 - 98
		309	284	97
	1	584	1701	85
	2	648 - 698	2154 -2721	79 - 80
		673	2438	80
Total (Mean)	6	425	1191	89
LAKE MC DONALD	3	278 - 316	198 - 227	92 - 93
		285	215	93
	6	300 - 362	218 - 364	76 - 89
		323	270	81
Total (Mean)	9	311	252	85
BOWMAN LAKE	2	276 - 295	189 - 395	74 - 184
		286	292	129
	6	332 - 392	260 - 468	68 - 77
		368	364	72
	5	403 - 462	498 - 582	72 - 76
		426	548	75
	2	517 - 559		
		538	727	42
Total (Mean)	15	339	428	66

TABLE 6. Brook Trout Data

Water	Number Specimens	Length M.M. (Range) (Mean)	Weight (Grams) (Range) (Mean)	Range of Condition Factors
JOSEPHINE LAKE	1	190	73	106
	56	206 - 295	94 - 269	80 - 117
		256	183	104
	3	302 - 313	273 - 326	92 - 106
		309	292	99
Total (Mean)	60	258	186	102
SWIFT CURRENT LAKE	1	145	66	215
	52	221 - 293	108 - 289	85 - 130
		261	192	108
	4	301 - 319	269 - 329	99 - 107
		311	310	103
Total (Mean)	57	262	198	110
MIDDLE TWO MEDICINE LAKE	1	163	38	88
	18	228 - 299	125 - 260	84 - 117
		251	190	105
	9	303 - 313	272 - 342	96 - 113
		308	303	104
	1	433	309	356
Total (Mean)	29	278	130	112
FISHERCAP LAKE	4	103 - 195	10 - 74	86 - 118
		148	57	98
	137	231 - 298	73 - 307	78 - 155
		247	182	119
	5	301 - 332	228 - 402	84 - 129
		312	344	113
Total (Mean)	146	246	184	118

Table 7. Relative population densities expressed by catch of legal fish per night of 100 feet of gill nets.*

Water	Cutthroat	Brook	Rainbow	Dolly Varden	Silver Salmon	Mackinaw	Total
Fishercap L.		38.5					38.5
Swift Current L.		13.2	10.2		4		27.4
Josephine L.		12.0	4.5				16.5
M. Two Medicine L.		7.2	4.0				11.2
Bowman L.	3.1			1.3			4.4
Kintla L.	3.1			1.1			4.2
L. McDonald	1.6			0.5			2.1
St. Mary L.	0.7			0.5		0.7	1.9

*Gill nets with mesh of stretch measures of 2 3/5; 3 1/2; and 4 1/2 inches were used. By weight, the order of rating would be approximately the same.