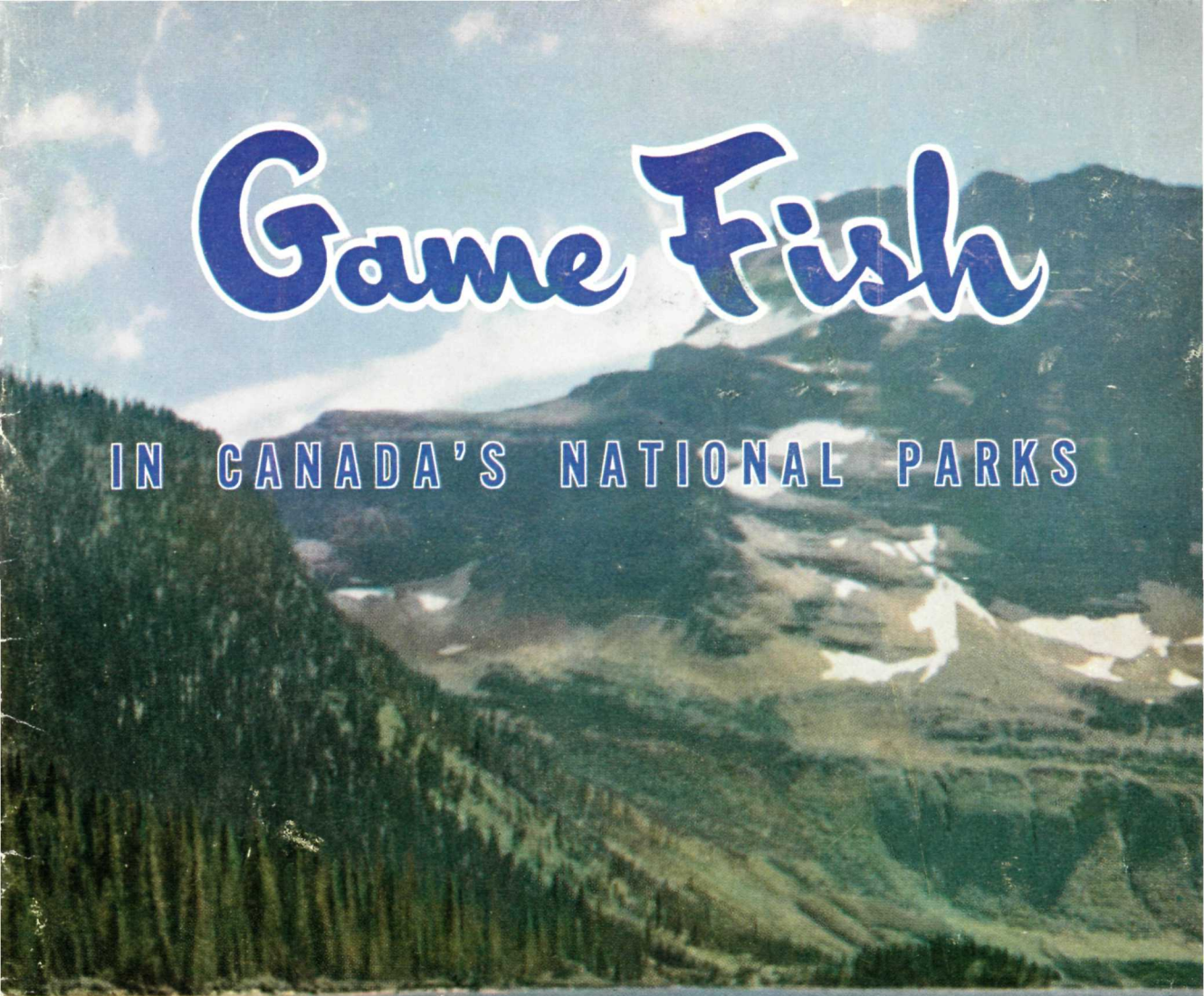
Game Fish

IN CANADA'S NATIONAL PARKS



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IN

CANADA'S NATIONAL PARKS

by

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DEPARTMENT OF RESOURCES AND DEVELOPMENT
DEVELOPMENT SERVICES BRANCH
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Game Fish IN CANADA'S NATIONAL PARKS

Enjoy thy stream, O harmless fish;
And when an angler for his dish,
Through gluttony's vile sin,
Attempts, a wretch, to pull thee OUT,
God give thee strength, O gentle trout,
To pull the raskall IN!

—J. WOLCOT.

ANGLERS come in many shapes, sizes and temperaments, which is surely a tribute to the universal appeal of angling. From the dry fly "purist" with his imported hand-made rod, tapered line and delicate flies to the boy with the sapling, string and bent pin, there is a kinship among anglers which goes far deeper than a mere love of fish or even of catching them. Angling is much more than a mere battle of wits and equipment against the cunning of a fish. It offers release from the cares of the workaday world and a chance to see and enjoy the unspoiled beauty of nature, together with the possible added thrill of capturing a colourful aquatic creature satisfying to the eye and often to the inner man as well.

Many anglers are experts in the mysteries of taking game fish from their native haunts. Experts also are those whose job it is to put the game fish there in the first place and then maintain their numbers in the face of an increasing army of anglers. Some of the problems encountered in this work and the means by which they are overcome are discussed here so that the angler may know something of the activity which precedes his angling holiday in one of Canada's National Parks.

Angling in the national parks is a major attraction for visitors. The present condition, however, has not been achieved without much labour. The maintenance and improvement of angling in waters within national parks, whether in the mountains, on the prairies, or in the Eastern Provinces, involves the solution of many problems. Some of these are basic to successful fish management in any area, and others are peculiar to individual locations. The sport and relaxation of angling have been made available in the national parks through a wise policy of research and management.

Problems dealing with the basic requirements of the fish involve such items as food, shelter, areas suitable for reproduction, suitable water temperatures and related factors. Special local problems may be dependent on such factors as rate of flow of water, silt, dissolved gases in the water, presence of large numbers of animals or birds which feed on fish, unfavourable water temperatures, high angling pressure, and competition of fish of several species for a common food supply.

The solution of such problems affecting national park waters calls for close teamwork by two Federal government agencies. The Canadian Wildlife Service acts in an advisory capacity regarding all fish and wildlife matters in the parks, and its officers conduct scientific investigations as and where required. Officers of the National Parks Service, guided by the results of these investigations, operate the hatcheries and egg-collecting stations, distribute the fish, collect data from anglers and perform other related duties.

Before fish are introduced into a lake or when a change in the fish population of a lake seems desirable, a biological survey of the area involved is conducted. These field surveys provide basic information from which it is possible, in most cases, to determine which species of fish can be most easily introduced into a given lake, which species of fish should be encouraged in lakes where several species are present, which species of fish are most suitable in lakes which are heavily or lightly fished and many other important facts.

Before a survey can be conducted it is necessary to transport men and equipment to the area concerned. This is usually done by truck, jeep, or packhorse. Sometimes the terrain is too rugged even for pack-animals. Then equipment and supplies have to be brought in on the backs of the workers. Portable pneumatic boats are used under certain conditions for lake investigations.

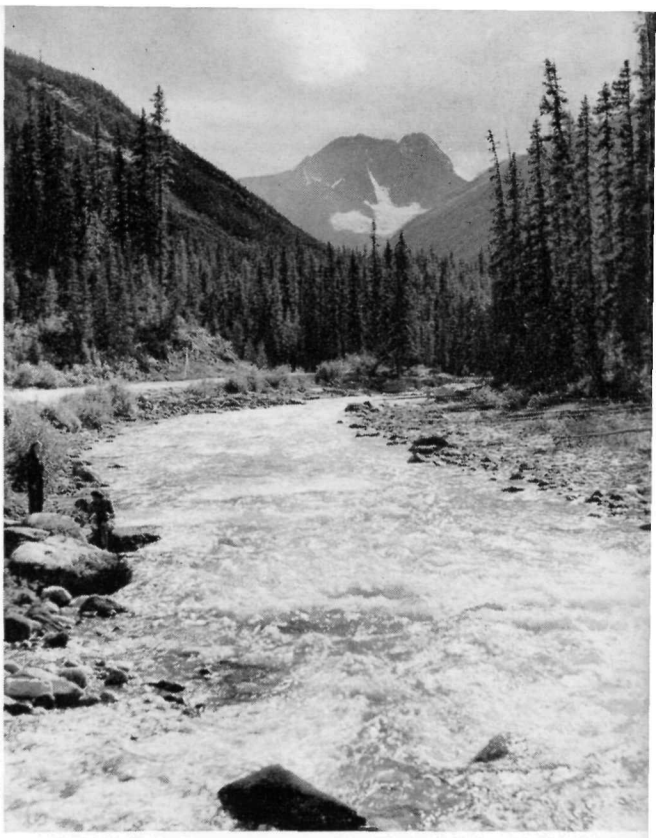
Lake O'Hara, Yoho National Park.

Mountain Parks

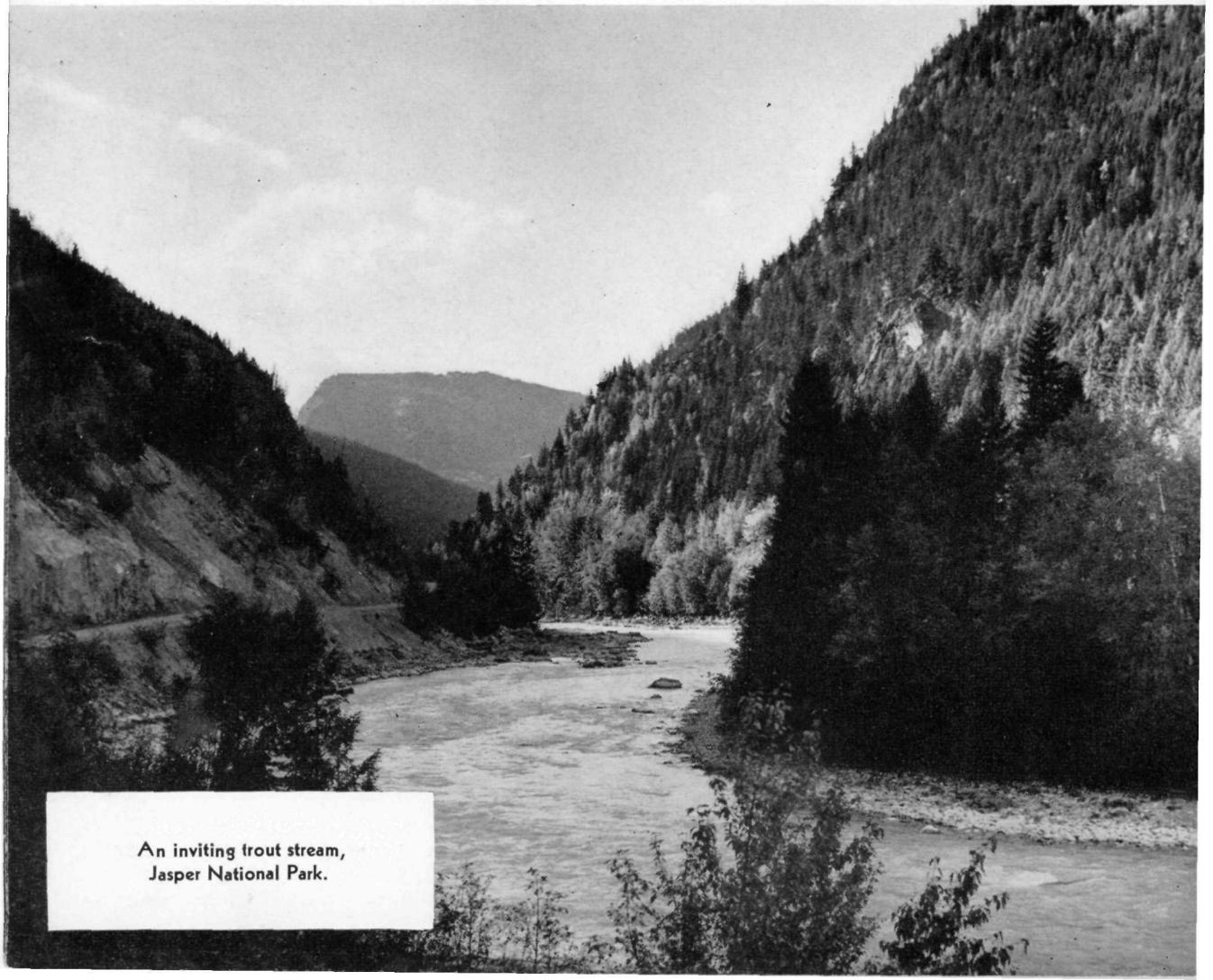
FROM the Selkirk Mountains in British Columbia to the Maritimes in Eastern Canada the national parks present a wide variety of game fish to appeal to both the discriminating and the casual angler. In the western mountains, Jasper and Banff National Parks in Alberta possess no fewer than six species of trout. The fighting rainbow, the cutthroat, and the eastern brook or speckled trout are highly prized by most anglers, while the lake trout, the Dolly Varden and the brown trout add variety and interest to the group. Waterton Lakes National Park, in the extreme southwest corner of Alberta, offers all of these species except brown trout. Pike are taken in Jasper and Waterton Lakes Parks.

The cutthroat trout is common to the four national parks in British Columbia—Yoho, Kootenay, Glacier and Mount Revelstoke. In addition the Dolly Varden is native to the waters of the first three. All except Glacier have rainbow trout, while lake trout await the lure in Yoho.

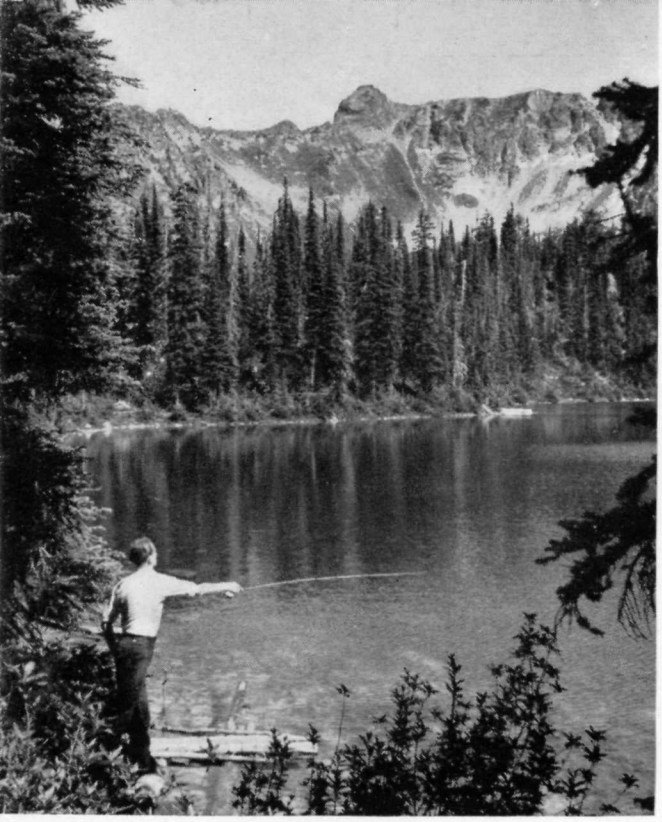
All seven western mountain parks mentioned contain waters inhabited by the Rocky Mountain whitefish. This species, although not a true game fish, provides good sport for anglers on fly or bait at certain seasons and is a welcome addition to the pan.



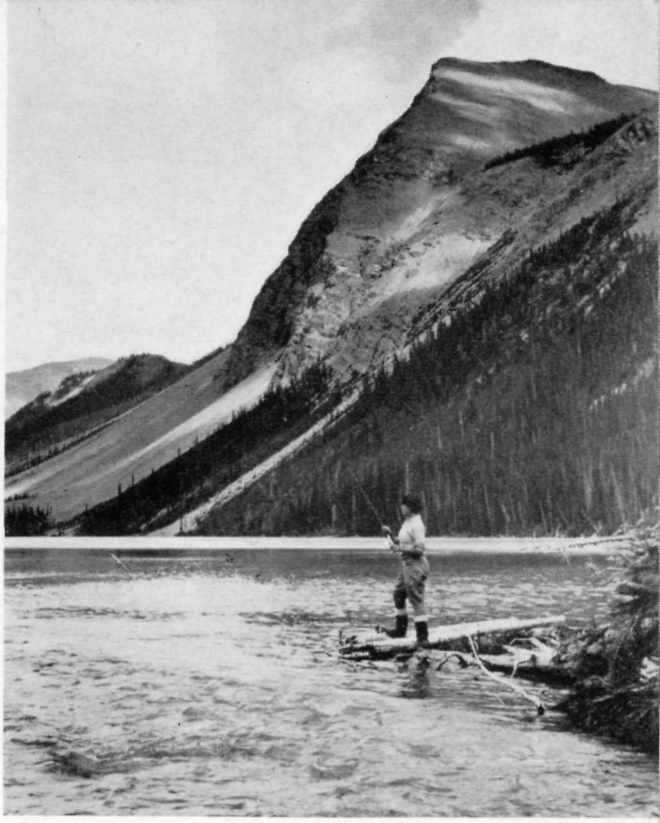
Vermilion River, Kootenay National Park.



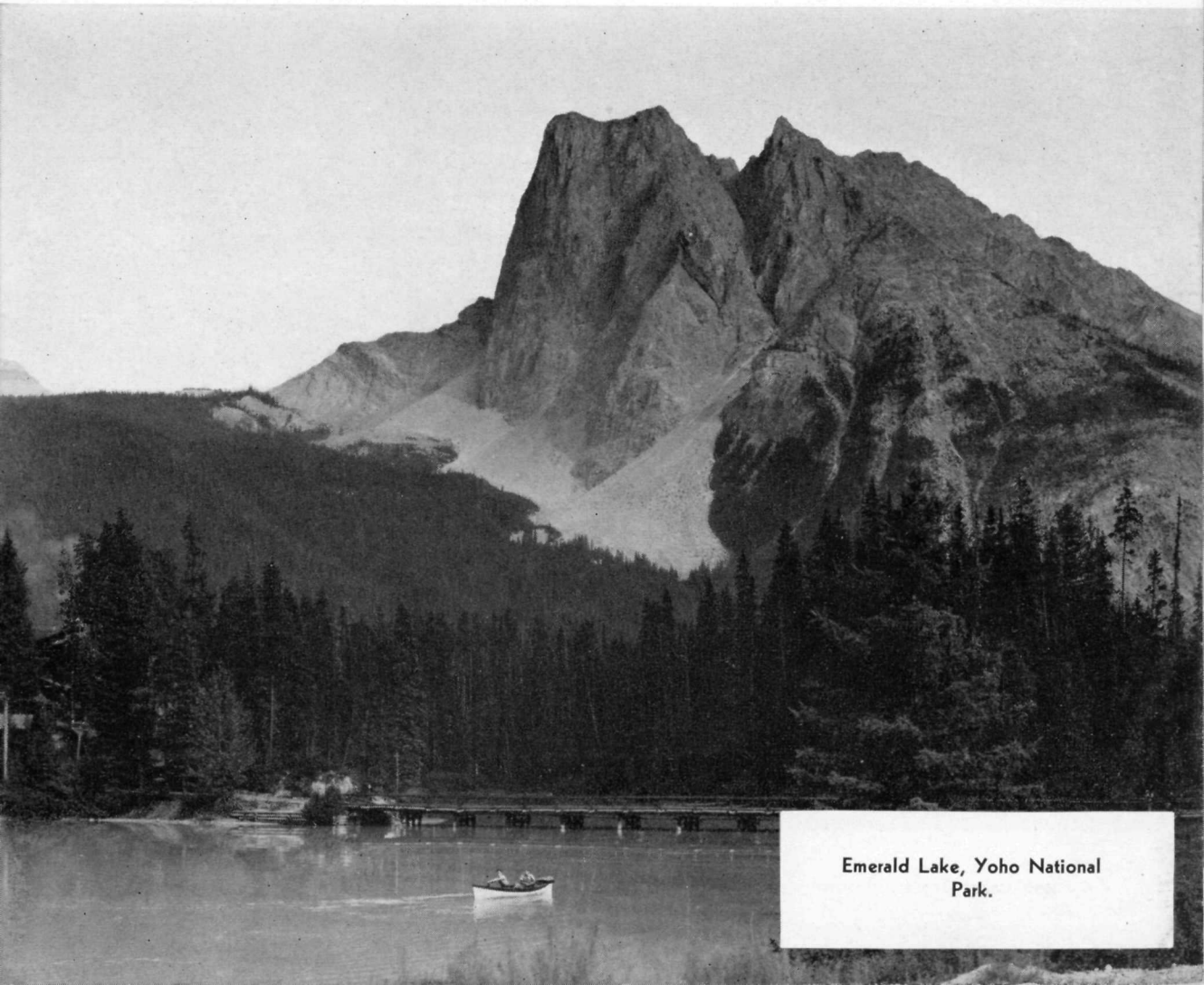
An inviting trout stream, Jasper National Park.



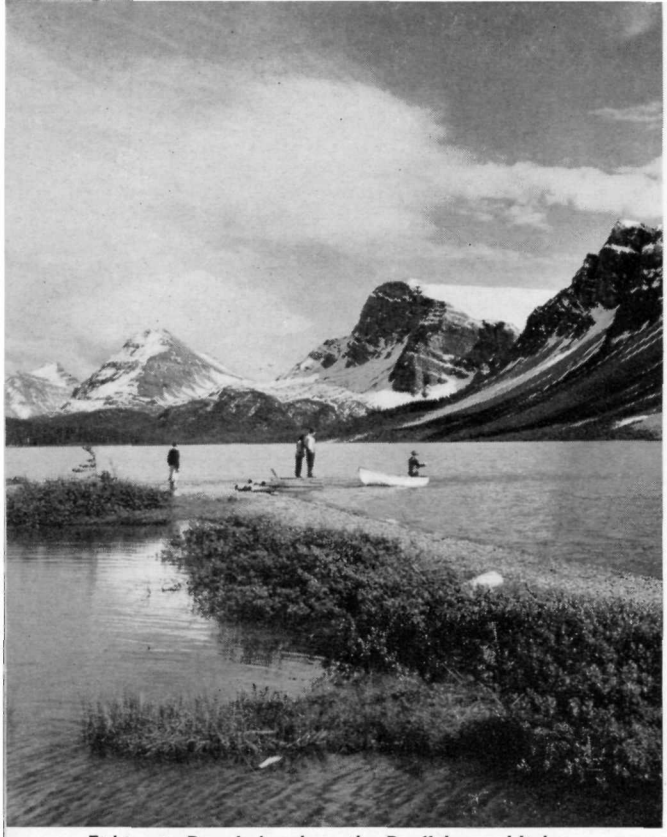
Lake Eva, Mount Revelstoke National Park.



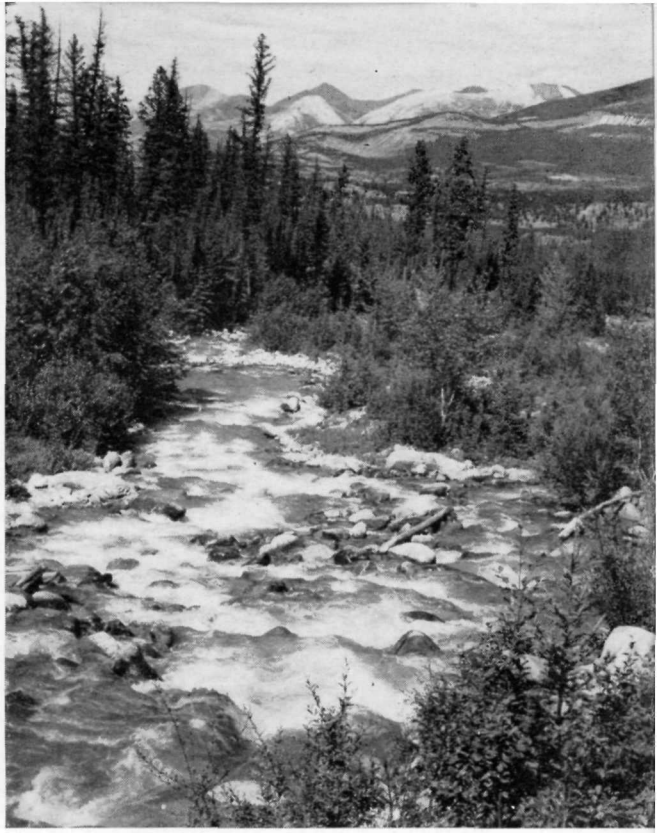
Fishing at Marvel Lake, Banff National Park.



Emerald Lake, Yoho National Park.



Fishing in Bow Lake along the Banff-Jasper Highway.



Portal Creek from the Banff-Jasper Highway.

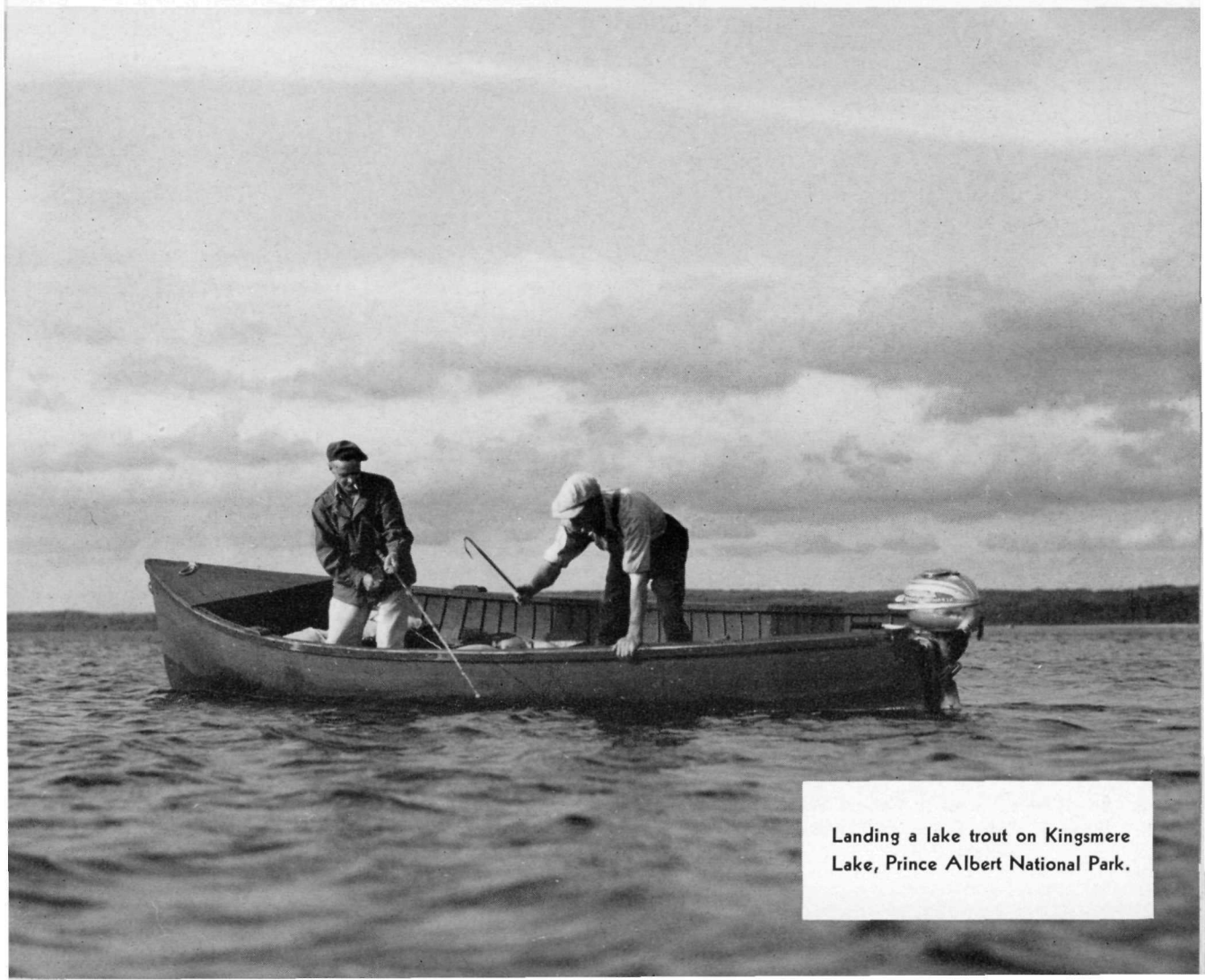
Amethyst Lake, Jasper National Park.

Prairie Parks

DESCENDING from the mountains to the prairie, one finds that the lakes of Prince Albert National Park in Saskatchewan and Riding Mountain National Park in Manitoba are the home of large pike, specimens over 15 pounds in weight being taken there on occasion. Prince Albert Park also attracts the fisherman with large lake trout and pickerel. The lake trout attain a weight of 35 pounds in the larger lakes.

Adult lake trout have been introduced into Clear Lake, in Riding Mountain Park. According to current reports, the introduced specimens have shown satisfactory growth. Suitable food organisms and spawning areas are present in the lake, and it is hoped that the lake trout there will increase naturally and be the source of continuing enjoyment to the angler.

Moon Lake, Riding Mountain National Park.



Landing a lake trout on Kingsmere Lake, Prince Albert National Park.

Eastern Parks

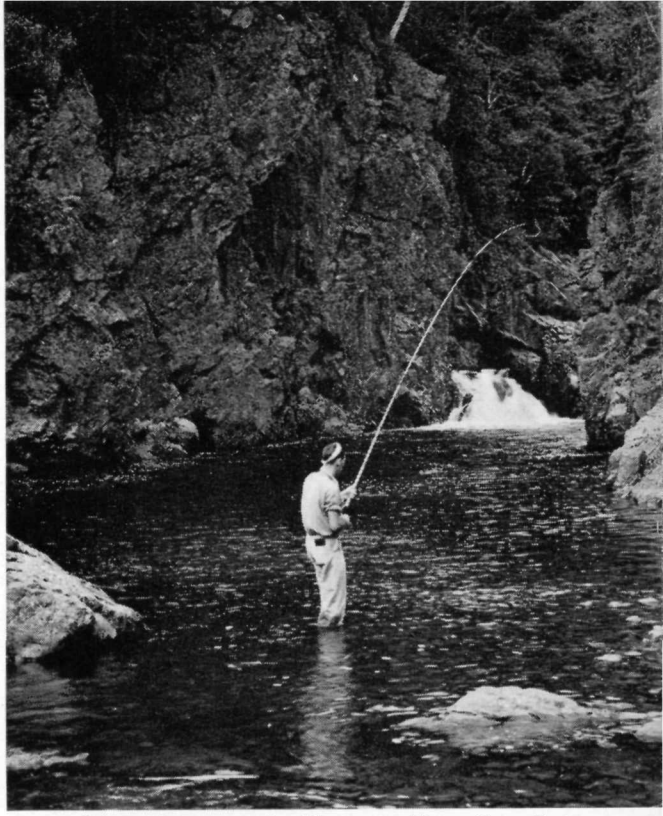
FAMOUS among the game fishes of Eastern Canada are the smallmouth black bass and the giant maskinonge, both rivalling the mountain trout in popularity among sportsmen. Georgian Bay Islands and St. Lawrence Islands National Parks, in Ontario, provide fishing for these species in their native waters.

The visitor to Point Pelee National Park, also in Ontario, may supply his creel with pike from the inland ponds or with pickerel and smallmouth black bass from the adjacent waters of Lake Erie.

Fundy National Park, in New Brunswick, with its several lakes and streams supports good populations of eastern brook trout. Atlantic salmon angling facilities are being developed.

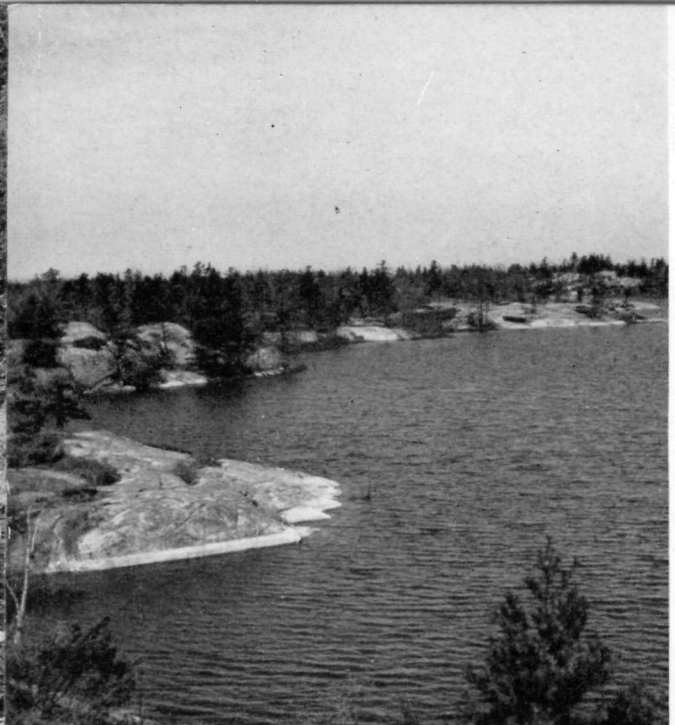
Several of the small lakes and ponds in Prince Edward Island National Park contain brook trout and white-perch and afford opportunities for angling. Deep-sea fishing is also available in coastal waters adjacent to this park.

The Cape Breton Highlands National Park in Nova Scotia makes a unique contribution to sport fishing in the national parks with its Atlantic salmon and swordfish. It also provides good angling for eastern brook trout.

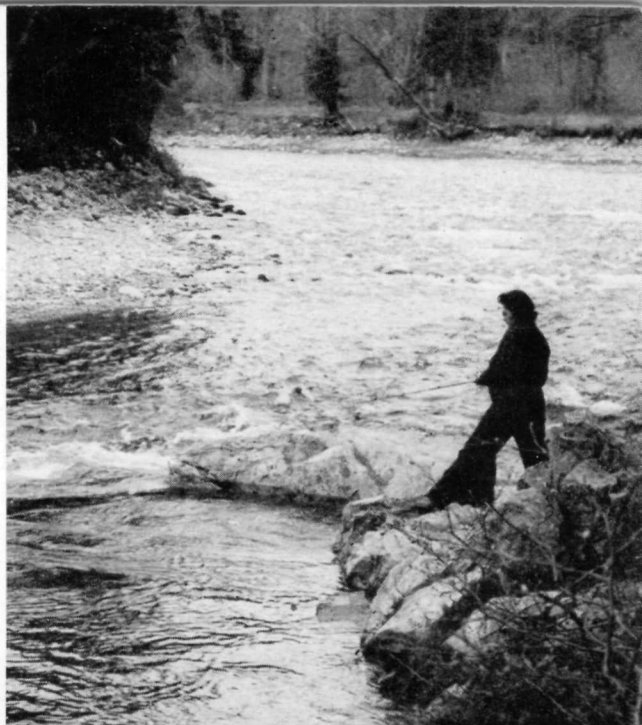


Salmon fishing on the Cheticamp River, Cape Breton Highlands National Park.

Sword-fishing boats in harbour at Ingonish, Cape Breton Highlands National Park.



Fairy Lake on Beausoleil Island, Georgian Bay Islands National Park.

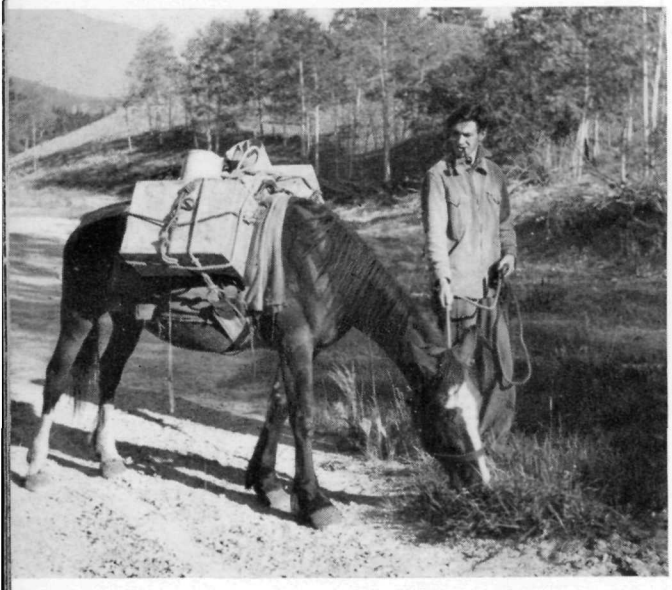


Trout pool on Point Wolf River, Fundy National Park.

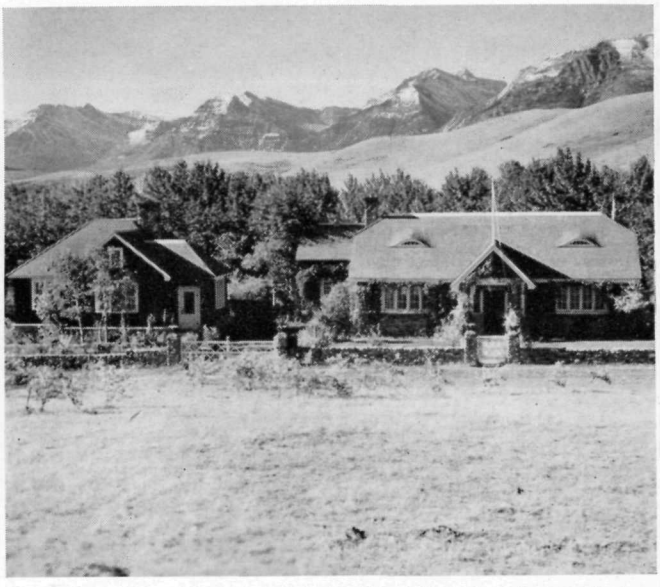
Bass fishing near Cedar Island, St. Lawrence Islands National Park.

Biological INVESTIGATIONS HELP TO INSURE GOOD FISHING

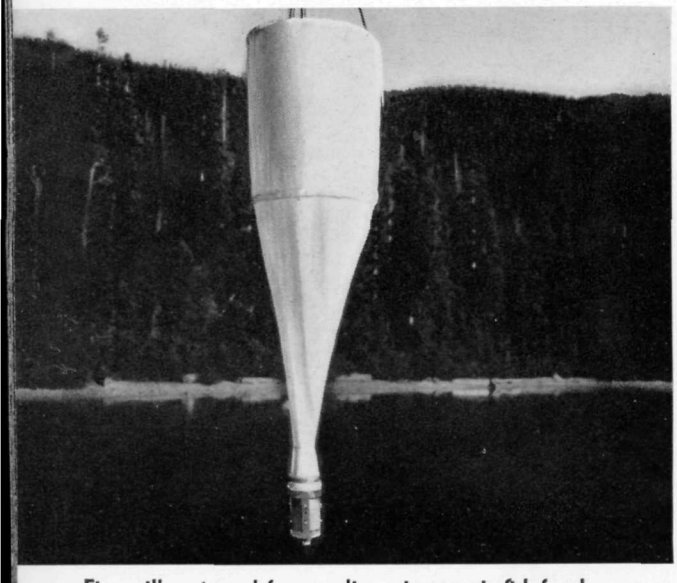
Stripping eggs from adult Rainbow Trout.



Transferring fish to remote areas by packhorse.



Fish hatchery and Supt's. residence, Waterton Lakes National Park.



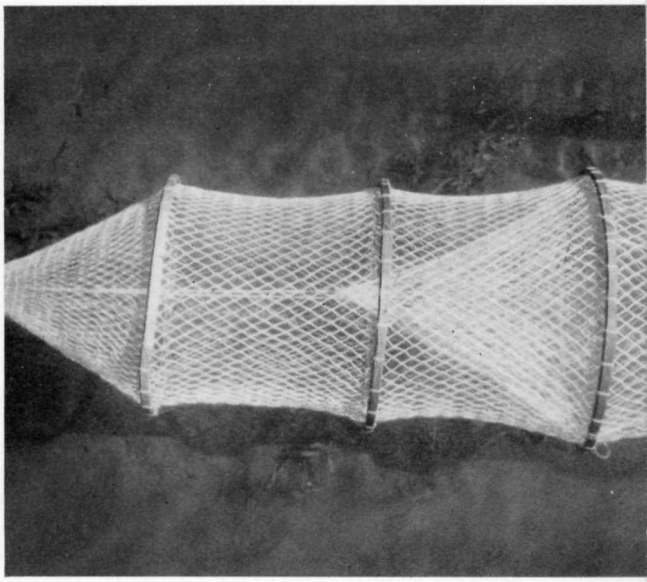
Fine silk net used for sampling microscopic fish food.

Typical bottom fauna consumed by fish.

Limnologist sampling stream bottom fauna.

Transportation used for field investigations in the National Parks.

Pneumatic boats are used in remote areas.



Hoop-nets are used for testing fish populations.

Field kit used for chemical analysis of water.

Collecting small insect larvae from rock taken from stream bottom.

Scientific Research and Management...

BIOLOGICAL SURVEYS—LAKES

In general, a basic biological survey consists of obtaining as much information as possible regarding the fish present in the lake, the chemical composition of the water, including the presence and concentration of dissolved gases, the amount and type of microscopic food available in the water, and the numbers and kinds of food animals present on the shores and in the bottom mud.

The first step in the actual survey is to prepare a map of the area. On such a map, after many soundings have been made, it is possible to draw a series of contour lines which indicates the shape of the basin and from which may be calculated the areas and volumes of the water strata of different depths. This preliminary sounding is done with a calibrated line attached to a weight and operated from a boat, which is usually propelled across the surface in straight lines between fixed points on the shores. These precautions are necessary so that the soundings may be accurately located on the map.

Temperature Is Important.—Water temperature is important to all species of game fish. A temperature series is therefore taken from the surface of the lake to the bottom at the deepest point. Several means are available for taking underwater temperatures. The most common method is the use of a reversing thermometer. This instrument is lowered to the desired depth, held there for a minute or two until it has assumed the temperature of the water, and then caused to turn upside down by means of a release which is slipped down the line supporting the thermometer. The thermometer is so designed that when it turns over the mercury column is broken. Consequently, when the thermometer is drawn to the surface, the temperature indicated is that of the water at the required depth and not that of the intervening layers of water. The mercury column is easily united for the next reading.

Another method of obtaining water temperature is to use a water sampling bottle, which is lowered with both ends open so that water may freely pass through. At the appropriate depth a weight sliding down the line releases spring-operated valves, which close the bottle and secure a sample of the water at that point. This is then hauled rapidly to the surface, where the temperature of the contained water is secured by inserting a small thermometer through an opening in the bottle. This method is not so accurate as the use of a reversing thermometer, but it permits the use of an ordinary thermometer, which is much less expensive.

Light.—Light is usually a necessity for fish life because aquatic plants, on which some fish feed, depend on light for their growth. In a clear lake, light may penetrate to great depths, while in a heavily silted glacial lake it may penetrate only a few inches. Food plants grow as poorly in a heavily silted lake as do vegetables under heavy shade. Where the plants are scarce, small water animals can find little or no food, and the fish feed chiefly on insects which drop into the water near the shore.

The colour of the water, as well as its transparency to light of different colours, may be measured with portable equipment. A rough determination of transparency of the water may be made by suspending a white pie-plate or other similar sized object from the end of a calibrated line, lowering it into the water and observing the depth at which the plate is just visible to an observer in a boat. In general, unless silt or other non-organic matter is present, a low transparency indicates high productivity since the heavy growth of microscopic plants in a productive lake reduces the transparency of the water.

Having observed the temperature and other physical properties of the water at various levels in the lake, the investigator's next step is to study the water itself and the dissolved gases which it contains.

Water Chemistry.—The water sample brought up for temperature determination may also be used for chemical analysis. A small portable chemical kit is carried in the field, and may be used in the boat on the lake. It is necessary to carry out chemical analysis as soon as possible after the water sample has been obtained, in order that a true picture of conditions may be secured. Chemical factors, dissolved gases particularly, may change quite rapidly after the sample has been collected. The amount of oxygen dissolved in the water is of the same importance to fish as the amount of oxygen in the air is to human beings. Determinations of dissolved oxygen and of other chemical factors of the water are made at various depths so that the portions of the lake suitable for occupancy by game fish of the various species may be found. The examination of the water may be extended to include an analysis of total dissolved materials, dissolved carbon dioxide, total hardness and several other factors.

Plankton.—The microscopic plants and animals found in the open waters of lakes at all depths are known collectively as plankton. Plankton is used as food by practically all young fish and minnows, and even by some large fish which can collect it efficiently. Samples of the plankton are secured by allowing the water to pass through nets of fine silk. These nets, and the net portions of ingenious mechanical traps, usually have meshes so fine that they contain approximately 30,000 apertures per square inch. The tiny creatures retained in the nets are preserved in a solution of formalin for later examination in the laboratory.

Bottom Animals.—Shrimps, snails, small clams, immature insects and similar organisms which inhabit the bottom deposits of a lake are used as food by many fish. These organisms are collected by means of a small box-like dredge, usually 6 or 9 inches square, which secures a sample of mud from an area of bottom covering 36 or 81 square inches. The thickness of the sample depends on the hardness of the bottom deposits. A weighted dredge may be used to secure samples from a bottom that is too hard for penetration by an unweighted dredge. The mud, with its contained animals, plants, and other bottom litter, is hauled to the surface and washed through one or more screens. The finest screen generally used has 1,600 apertures per square inch, since experience has shown that organisms which pass through such a screen form only a small part of the weight of animals present in any sample.

When the fine particles have been washed through the screen the remaining stones, sticks, and debris are examined carefully, and all live animals present are carefully picked up with fine forceps and preserved in a small vial of alcohol. The number of animals thus secured from 36 square inches of bottom mud may vary from a few to more than 1,000. The preserved specimens are saved for later laboratory analysis.

Fish.—The fish in the lake could be sampled — and sometimes are — through the use of ordinary angling tackle of a kind suited to the species present and to local conditions. However, many species of fish which may be present in a lake along with game fish are almost impossible to capture by angling.

In order to obtain large numbers of fish for examination, to secure fish of all species present, and to avoid, as far as possible, any selective action which certain angling tackle may possess, fish for analysis are usually secured through the use of nets or traps or other types of equipment commonly used in the commercial fishing industry. For most purposes gill nets, of selected sizes and set in a standard manner, are used. These nets may not give a completely true picture of the relative sizes and abundance of fish of different species present in a lake, but by operating standard

sets of nets under standard conditions it is possible to compare populations of fish in different bodies of water and thus secure information by relating unknown fish populations to those with which we are familiar as a result of previous experience. Seines, trammel nets, pound nets, traps and other means are also used to secure fish for examination. The fish are measured and weighed, their sex, condition, and stomach contents examined, parasites observed, and finally a number of scales are removed for use in determining the age and past history of the specimen.

BIOLOGICAL SURVEYS—STREAMS

Most of the information secured regarding lakes can be duplicated in the case of streams although modifications in equipment and methods are necessary. Streams are, however, somewhat more difficult to deal with than lakes as their flow varies; the fish may migrate and the amount of food and shelter for fish is seriously reduced at times. Mountain streams because of their cold water, severe freshets and steep, changing rocky beds offer additional difficulties.

Laboratory Studies

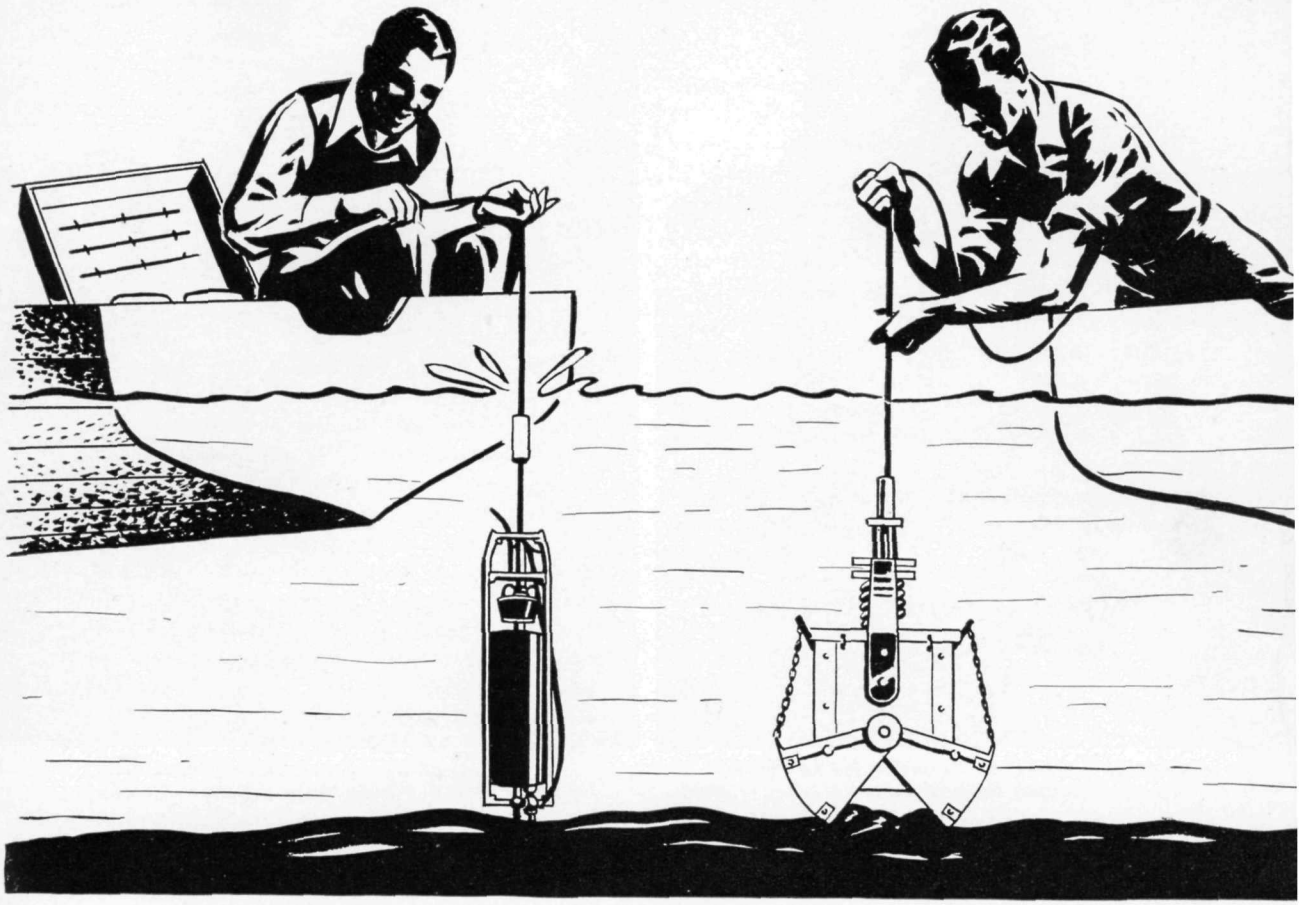
After the summer field investigations have been completed, the material collected is taken to the laboratory for examination during the winter period, when field investigations are difficult and in some areas impossible.

Analysis of Plankton Samples.—The plankton samples are examined under the microscope or by means of a projector capable of great magnification, and the kinds and numbers of organisms are enumerated. The weight of these organisms, though slight, is determined by means of a delicate balance. Through a knowledge of the amount of water filtered to obtain the sample, the total numbers and weights of the organisms in the whole or any part of the lake may be calculated. Such a calculation provides a measure of the available food for young fish suspended in the water at the time the sample was taken. When a series of samples is taken throughout the year, it is possible to calculate the total yearly production of microscopic fish food in the lake and also the rate at which it is produced. Since the young of all fish feed on plankton, its importance to fish production in lakes is great.

Analysis of Bottom Samples.—The samples of bottom animals are treated in a manner similar to those of plankton, and finally the amount of animal fish food per acre of bottom may be determined. As an example of the amounts of food supplies involved, it may be noted that lakes in the Mountain National Parks may have, during the summer, populations of bottom animals whose dry weight ranges between one and 30 pounds per acre. This standing crop is renewed several times during the season, so that the yearly crop of bottom animals may have a dry weight of more than a hundred pounds per acre.

Fish.—The fish material for laboratory examination may consist of whole specimens, samples of stomach contents, reproductive organs, parasites and scales. A detailed examination of preserved whole specimens provides information regarding life history and racial characteristics of the fish as well as providing a means of comparing the relative condition of fish from various water areas. An analysis of stomach contents provides an index of the food of the fish, and, taken in conjunction with samples of plankton and bottom fauna from the same area, may indicate preference for certain food items or actual selection of one particular type of food from among the many that may be present. Food selection by some species of fish is well marked, and since some species feed at night it appears that senses other than sight are involved in some types of selection. An examination of the reproductive organs of the fish indicates whether it is mature or immature and, if mature, may indicate whether or not reproductive potential is normal. The presence of internal parasites in fish is a general condition, but the kinds and numbers of parasites present may have some bearing on the health and reproductive capacity of the fish.

The Age of a Fish.—The scales of the fish offer one of the most important items



Taking water sample for chemical analysis, and using a dredge for sampling bottom fauna.

for laboratory studies. The number of scales on a fish is fixed at an early age, and as the fish grows each scale increases in size so that the fish remains at all times fully covered. The growth of the scales, like the growth of the fish, is not uniform. Growth is more rapid in summer when temperatures are high and food is abundant than in winter when temperatures are low and food scarce. The scale grows by the deposition of material along its outer edges, in the form of concentric rings. The changing character of these rings, and the spacing between them, which varies from winter to summer, permit an exact determination of the age of the fish to be made from microscopic examination of the scales. Another method of study involves the examination of enlarged projected images of the scales from which accurate measurements may be made. Not only can the age of the fish, and thus its growth rate, be determined from an examination of the scales, but by careful measurement of the various year zones on the scales it is possible to calculate the size of the fish at previous ages and thus to determine growth rates for various periods in its past history. Spawning activity usually results in a change in rate of scale deposition, with the result that something of the spawning history of a mature fish is also recorded on its scales. Scales for examination are usually collected from one side of the fish, about midway of its length, and are stored dry in small envelopes until required. Complete data regarding the fish are recorded on the outside of the envelope.

Through careful examination of many fish and their food organisms and an evaluation of their physical and chemical environment it is possible to detect the ills of the fish population and to make plans to improve its future welfare.

These field and laboratory studies, then, are methods for obtaining the pertinent information about a lake from the view-point of fish production.

Rustic sign and creel census box on the Bow River, Banff National Park.

Creel census box near Kicking Horse River, Yoho National Park.

Recording the Angler's Catch . .

Although much information may be secured regarding fish, their food, their reproduction and other phases of their life histories through field and laboratory examination of them and of the water area in which they are found, it cannot always be predicted what size or species of fish an angler will take from a lake or even that he will catch anything. Since the game fish populations in national parks waters are largely used for the enjoyment and relaxation of the public, and since a knowledge of the fish removed from them is of vital importance in the maintenance of the fish populations, recourse is made to a creel census to secure data regarding the fish taken by anglers.

The creel census is based on voluntary completion by anglers of special cards designed to secure data regarding the numbers, species and lengths of fish caught, the type of lure used, the time of day, and—most important—the time in hours and minutes required for the capture. Each angler is requested to complete a separate card for each day's fishing. Returns are regarded as confidential, in order to overcome the traditional reluctance of a fisher-

man to report the taking of few or no fish. Actually a report of little or no catch is particularly valuable in the angler's own interest, as it may indicate an area where management action is urgently required. During 1948 no fewer than 6,070 creel census cards were returned, reporting the capture of 29,542 fish from 117 lakes and 68 streams in 11 national parks.

One of the first serious attempts to collect extensive angling statistics was the collection of data regarding the length, weight, and number of fish taken from the waters of the Maligne system in Jasper National Park, beginning in 1933, when angling in the area was first permitted. The information regarding the catch of each angler was recorded by a person whose duty it was to collect such information.

A considerable volume of data was collected in this manner, and its analysis has indicated that one unit of the system, Beaver Lake, is probably the most productive body of water known in any national park in Canada. This lake, with an area of only 90 acres and a depth of only about 6 feet, produced, during the period 1933-1947, a total of 18,500 pounds of eastern brook trout, or an average of 13.7 pounds of trout per acre per year for a period of 15 years.

Creel census operations, of a type now widely used in Canada and the United States, were begun in Prince Albert National Park in 1940, and extended to five other parks in 1941. Since then other extensions have been made and at present creel census data are collected in 11 national parks. This census work is a basic tool in the management of the game fish populations of the areas. Changes in open and close seasons, angling regulations of several types, stocking schedules and other management operations are based, in large measure, on the information collected through the creel census each year, supplemented by special studies in areas where insufficient or inconclusive information is secured through the creel census.

Analysis of this information, and its correlation with corresponding data for earlier years, is of inestimable value to fish management policy and practice. If the creel census data indicates that too large a proportion of the angling catch consists of immature fish, then steps may be taken, by changing the regulations, to protect the desired portion of the fish population. If the fishing effort, or number of hours required to capture a fish, becomes progressively greater for a given species of fish during succeeding years, this may be an indication of the imminent depletion of this species, and steps may be taken to check such depletion by whatever means may be most suitable, before it has reached serious proportions.

The National Parks Service feels that it now has the means at hand, through the creel census, of directing its fisheries management operations toward the production of angling that will satisfy increasing numbers of anglers.

When the information secured through field and laboratory studies has been analysed, it is possible to provide the administrator with a sound plan for fisheries management. The biological survey is merely the groundwork on which the plan is based, while additional surveys and analyses of creel census data are required to check on the progress of the work and to alter the management procedures as needed for best results.

Fish Hatcheries . . .

Some of the water areas which are now included within the National Parks of Canada were well supplied with fish when the first white explorers visited the country. Waters such as Lake Minnewanka in Banff National Park were famous for their fish in Indian times. They were mentioned in the journals of the early explorers who passed through the area, and who probably made use of the fish to supplement their diet of buffalo and other game. Many of the lakes in the Mountain National Parks contained no fish until game fish were introduced.

Shortly after the establishment of Banff National Park, it was decided that fish could be introduced to many of the water areas which did not, at that time, contain them. In order to carry out this work most effectively a hatchery was built, so that trout could be hatched and reared within the park from eggs shipped in from outside points. During the early years of its operation the hatchery supplied fish to areas in the foothills of Alberta as well as to many of the lakes within the park. A hatchery established later in Waterton Lakes National Park operated in a similar manner. More than half the lakes in each of these parks, which now provide excellent angling, were devoid of fish when the parks were established: they were brought to their present desirable condition through the introduction of fish hatched and raised in the fish hatcheries.

The hatcheries in Banff and Waterton Lakes National Parks were established in 1914 and 1928 respectively by the Dominion Department of Fisheries. They were operated by this department until they were taken over by the National Parks Service in the early thirties.

A small hatchery was established by the National Parks Service in Jasper National Park in the late twenties, and a modern full-sized hatchery was constructed in that park in 1941.

Young and adult fish, for distribution in areas not served by the three National Parks Service hatcheries, are obtained by live trapping in the parks or through the co-operation of provincial government departments and the Dominion Department of Fisheries.

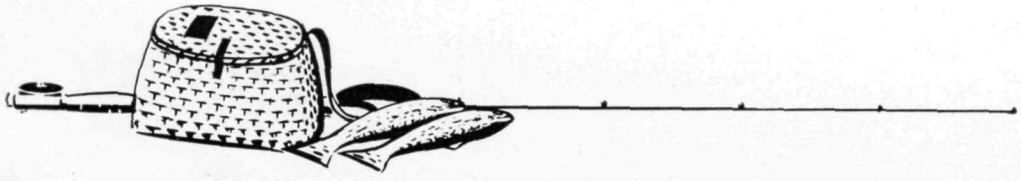
At present, satisfactory trout populations exist in most of the larger water areas which are suitable as trout habitat. In many of the parks, however, there are numerous smaller bodies of water about which little is known in regard to fish culture possibilities.

Full credit is due the hatcherymen for stocking new lakes to add to the enjoyment of the angler. The successful introduction of eastern brook trout into the Maligne Lake system in Jasper National Park is one of the highlights in the history of Canadian fish culture. However, many views regarding hatchery practice are being revised at present.

Planting of fish is not always the remedy for overfishing, and it offers no solution for waters in which the game fish are crowded and stunted or in which the coarse and predatory fish have obtained the upper hand, crowding out the game fish. The success of fish planting must depend also upon the choice of suitable waters for the particular species involved, the frequency and time of planting and the time of opening the waters to fishing.

Although information regarding the successful introduction of fish to many lakes through the distribution of hatchery products is available, there is reason to believe that some distributions of hatchery-produced fish in the past have been made to areas where they were at least unnecessary and in some cases definitely harmful. Through lack of adequate information some of these stocking efforts have been comparable to driving cattle into a pasture with no knowledge of how many cattle were already there, how much forage was available or how many were likely to be taken out.

Based on modern ideas of hatchery use the present game fish policy of the National Parks Service, under the guidance



Interior of Jasper Fish Hatchery.

Banff Fish Hatchery and display pool.

of the Canadian Wildlife Service, is to carry out stocking operations only where:

(a) natural reproduction is limited or absent;

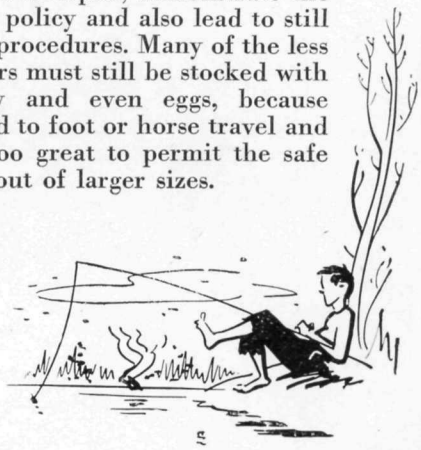
(b) a population of fish is wiped out due to winter-kill or other catastrophe;

(c) a species more adapted to local conditions is being introduced.

The introduction and maintenance of populations of exotic species are carried on only under special conditions.

It is known from studies conducted outside national parks that returns to anglers of hatchery-released fish have varied from a little more than one per cent to approximately 50 per cent. In order to secure accurate information regarding survival of hatchery-produced fish released in national park waters, a program of marking fish, by tagging and fin clipping, was begun in 1947. This makes it possible to study the history of the fish from release to capture by anglers. This program, operating in conjunction with and largely dependent on the creel census organization, has already produced interesting information regarding rates of growth and movements of trout in lakes. Reliance is placed on the returns of tagged and marked fish supplied through the creel census by anglers to answer many questions regarding satisfactory use of hatchery products. It is quite probable that a different result will be obtained from each water area investigated. Until the answers are available it will be difficult to determine whether or not the hatchery facilities are being used to greatest advantage.

An increasing proportion of fish distributed from national parks hatcheries consists of yearlings, since experience elsewhere has shown increased rates of survival for fish of this size as compared to smaller sizes. The present tagging and marking program will, it is hoped, demonstrate the wisdom of this policy and also lead to still more effective procedures. Many of the less accessible waters must still be stocked with fingerlings, fry and even eggs, because access is limited to foot or horse travel and distances are too great to permit the safe transport of trout of larger sizes.



Other Management Methods

For the many fisheries problems that cannot be solved by introduction of additional stock from hatcheries, other solutions must be sought.

Artificial Spawning Areas.—In areas where no spawning grounds exist, they may be created artificially. This can be done by dumping truck loads of gravel in appropriate places on the ice of a lake during the winter. When the ice melts, the gravel falls to the bottom, and provides spawning areas for the use of certain species of trout. This method has been used in several lakes in Jasper National Park with good results.

Increased Food Supply.—In some water areas food is scarce and fish are crowded and stunted. In such cases, if some of the fish are killed with poison or removed with nets or traps the remaining fish, each with an increased food supply may grow more rapidly and reach a size more attractive to anglers. In such a lake more fishing, rather than less, is the cure for small, stunted fish.

Another way of improving conditions for a stunted fish population is either to increase the amount or change the form of the food available in the lake.

In some cases this may be done through the introduction of forage fish which feed on microscopic animals and are themselves eaten by game fish. Only small lake trout can utilize plankton efficiently. The introduction of forage fish permits the indirect use of plankton by large lake trout and this permits their satisfactory growth in areas where they would otherwise remain stunted.

In other cases the food supply of a lake may be increased by fertilizing the water, permitting the increased growth of microscopic plants and of the microscopic animals that feed on them. Small fish may grow rapidly under such conditions, but the growth of larger game fish is less directly influenced and may not justify the cost of the fertilizer. In many lakes, the supply of oxygen for use by the trout during the winter is severely limited by the long period of ice cover. If the lake is fertilized and plant growth increased, the death and decay of the increased quantities of plants may utilize so much oxygen that during the winter, under the ice, there may not be enough oxygen for the fish which, therefore, die. Many of the lakes in the Mountain National Parks are so near the critical point in winter oxygen supply that the trout die if the winter is much longer than the average. To fertilize such lakes would wipe out their fish populations regularly each winter and thus remove them from the category of continuous fish producers.

Control of Competition for Food.—Competition for food in a lake may occur between trout and coarse fish such as suckers. Sometimes the coarse fish may be removed by means of nets or traps thus leaving more food available for the trout. Sucker reduction in a lake in Jasper Park resulted in increased growth of the trout. It also resulted in improved conditions for the remaining suckers. Complete removal of a fish population from a small lake is possible through the use of suitable poisons. After a complete kill, the desired species of fish is re-introduced with the hope that the undesirable species will not re-appear.

Competition with rough fish and predation by other species may be reduced through the introduction of trout sufficiently large to maintain themselves in the presence of the other species. In one case such action has involved the introduction of four-pound lake trout, and in another of two-year-old rainbow trout. These introductions have been successful under conditions where the introduction of trout of smaller sizes had failed.

Anglers in national parks who use live fish for bait (contrary to the fishing regulations) have been guilty of introducing coarse fish to many lakes through release of bait. This seemingly unimportant breach of the regulations has ruined the trout fishing in a number of lakes formerly popular with anglers. Restoration of good angling in such lakes, if possible at all, is an expensive and time-consuming process, often necessitating the removal of the entire fish population and its subsequent replacement by the desired species.

Predators.—Control of birds and mammals, which feed on game fish, has been suggested as a means of improving populations of these fish. In national parks birds and mammals have the same rights as fish, and no control of their activities is attempted except at hatcheries. There, through the use of suitable screens and other protective devices, the birds and mammals are prevented from reaching the growing fish, but after the fish leave the hatchery they must depend on natural shelter and their own cunning to elude their animal enemies as they do the angler.

Fire Protection Is Important.—Protection of national park forest areas from fire is an important part of fish management, since alteration of a watershed by fire results in a more rapid run-off and more serious flooding conditions in streams. The removal of forest-cover also permits the water temperature to be raised by exposure to the sun, and this may render some areas unsuitable for game fish.

Controlling the Catch.—Angling regulations offer an excellent means of managing fish populations, since a wise choice of close season, minimum legal length and daily limit will result in the best use of the available supply of game fish and its equitable distribution among the angling public. The best available scientific knowledge is used as a guide for regulation of fishing in the National Parks of Canada. Because this knowledge is continually increasing and conditions in water areas are continually changing, the regulations are

amended as and when necessary, in order that their existence may at all times be justified.

The present trend in many areas is to reduce the number and complexity of angling regulations. In some highly productive waters in southern United States it has been found that even with relaxed size limits and year-round open seasons, not all the surplus fish are harvested by anglers. Evidence at hand indicates that, under the conditions of limited productivity existing in many national parks waters, the present angling regulations must be maintained to prevent over-utilization and attendant damage to the fish populations.

In areas where production is severely limited, angler satisfaction may still be maintained through suitable regulations. Most anglers would feel more satisfied to make a limit catch of five fish than to take *only five fish* in an area with a ten-fish limit.

Habitat Improvement.—Improvement of habitat by providing more shelter and living space for fish has been used with success in increasing fish populations in some areas. In the national parks the amount and type of such work is limited to what can be done without altering the natural landscape in any way which would interfere with its aesthetic qualities.

Hybrid Fish.—Production of varieties of fish with new and useful characteristics is possible through cross-breeding. Work of this type is already in progress in national parks fish hatcheries, and it may be possible to produce varieties of hybrid fish more adaptable to certain conditions than any species now known. This work may lead to the establishment of angling in areas where conditions are now too severe for the successful production of game fish.

ANGLING FOR RELAXATION

Our ancestors, no doubt, were often forced to fish in order to eat but in most cases today the angler's catch is not an essential part of his food supply. However, there is a need to relax from the strain and stress of modern living and fishing is the favourite form of relaxation of millions of people.

As the number of anglers increase and the productivity of angling waters reaches an upper limit angling for food must give way to angling for sport. The alternative is a drastic reduction in catch per angler or artificial maintenance of inferior angling through heavy, expensive stocking.

The maintenance of good angling in the National Parks of Canada largely depends on the cooperation of the anglers. Experience has shown that this co-operation is always freely available from those anglers who understand the purposes for which this great natural heritage is maintained.

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