Ministry of Natural Resources

Ontario

Hon. Alan W. Pope
Minister

W. T. Foster
Deputy Minister

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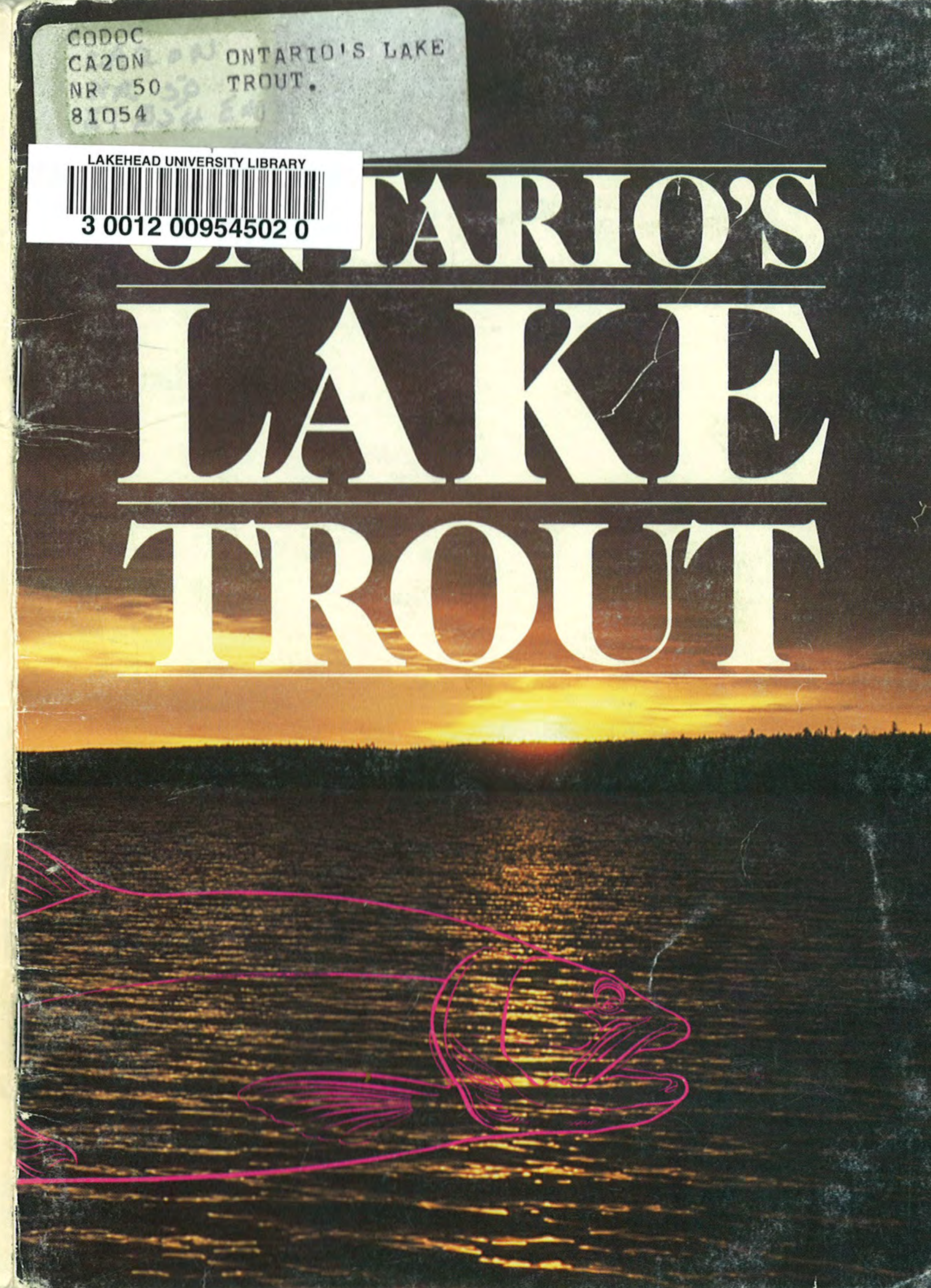
ONTARIO'S LAKE TROUT



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Cover photo: Erika Thimm

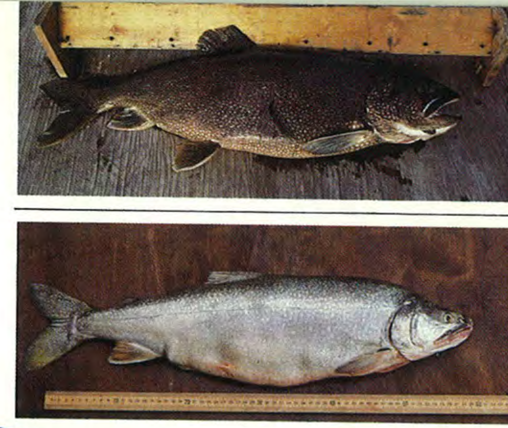
Fisheries Branch 1981

INTRODUCTION

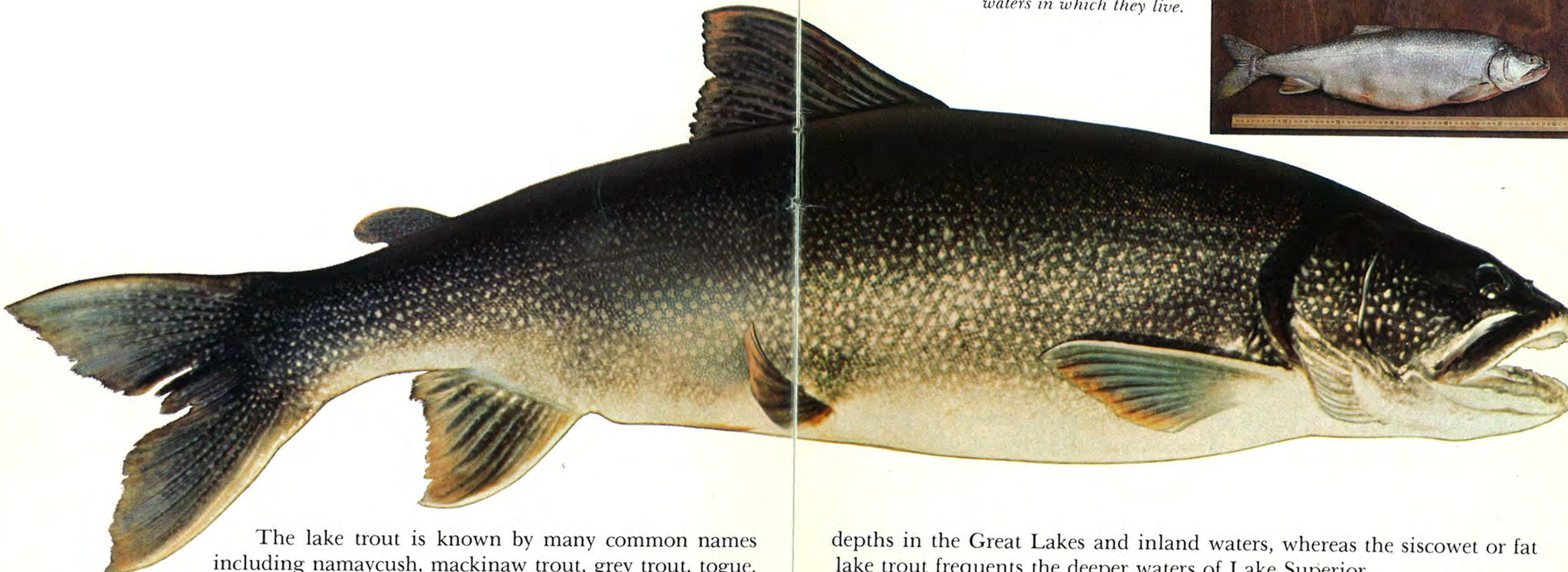
The lake trout, scientifically referred to as *Salvelinus namaycush,* has a long history in Ontario. It was an important part of the diet of many native people and was quickly adopted as a major food source by early explorers. Its excellent table qualities led to the early development of many subsistence, commercial and sport fisheries which have waxed and waned over the ensuing years.

In recent years, however, the lake trout has become a species in trouble. Its existence is threatened by man's encroachment on its environment.

DESCRIPTION



The colouration of lake trout varies depending on the waters in which they live.



The lake trout is known by many common names including namaycush, mackinaw trout, grey trout, togue, landlocked salmon, Great Lakes trout and touladi. It is a member of the salmon family (Salmonidae) which includes all salmon, trout, whitefish and char. This family is characterized by soft-rayed fins (they do not possess spines) and a well-developed adipose fin (a small fatty fin located near the tail).

The lake trout is a char, as are the brook trout, Dolly Varden trout, aurora trout and Arctic char. Chars are distinguished from other trout (rainbow, brown and cutthroat) by the bone, or vomer, in the centre of the roof of the mouth. The vomer of a char has teeth only on the frontal portion, the head, whereas the vomer of other trout has teeth on the shaft and the head.

There are a number of sub-populations or races of lake trout. Two have been given sub-specific status: the common lake trout, *Salvelinus namaycush namaycush* (Walbaum) and the siscowet, *Salvelinus namaycush siscowet* (Agassiz). The common lake trout is found at moderate depths in the Great Lakes and inland waters, whereas the siscowet or fat lake trout frequents the deeper waters of Lake Superior.

Lake trout may be silver-grey, green, brown, dark olive, or black, depending on the waters in which they live. The colouration is darkest on the back, becoming white to grey on the underside. The numerous pale or light coloured spots on the back, sides, cheeks, gill covers and dorsal and tail fins give the fish a mottled appearance. The leading edges of the pectoral fins are whitish. Lake trout may be distinguished from other trout and chars by the absence of coloured spots on their sides and by their prominently forked tails.

Male and female lake trout are not readily distinguishable externally, except during the fall spawning season when the male sometimes develops a prominent black stripe along its side and yellow or orange colouring on its paired fins. Sexually mature male lake trout do not normally develop the hooked jaw that is common in other trout species.

The flesh of the lake trout is firm in texture, rich in flavour and high in energy value. It varies in colour from white to pink to deep red or orange.

DISTRIBUTION

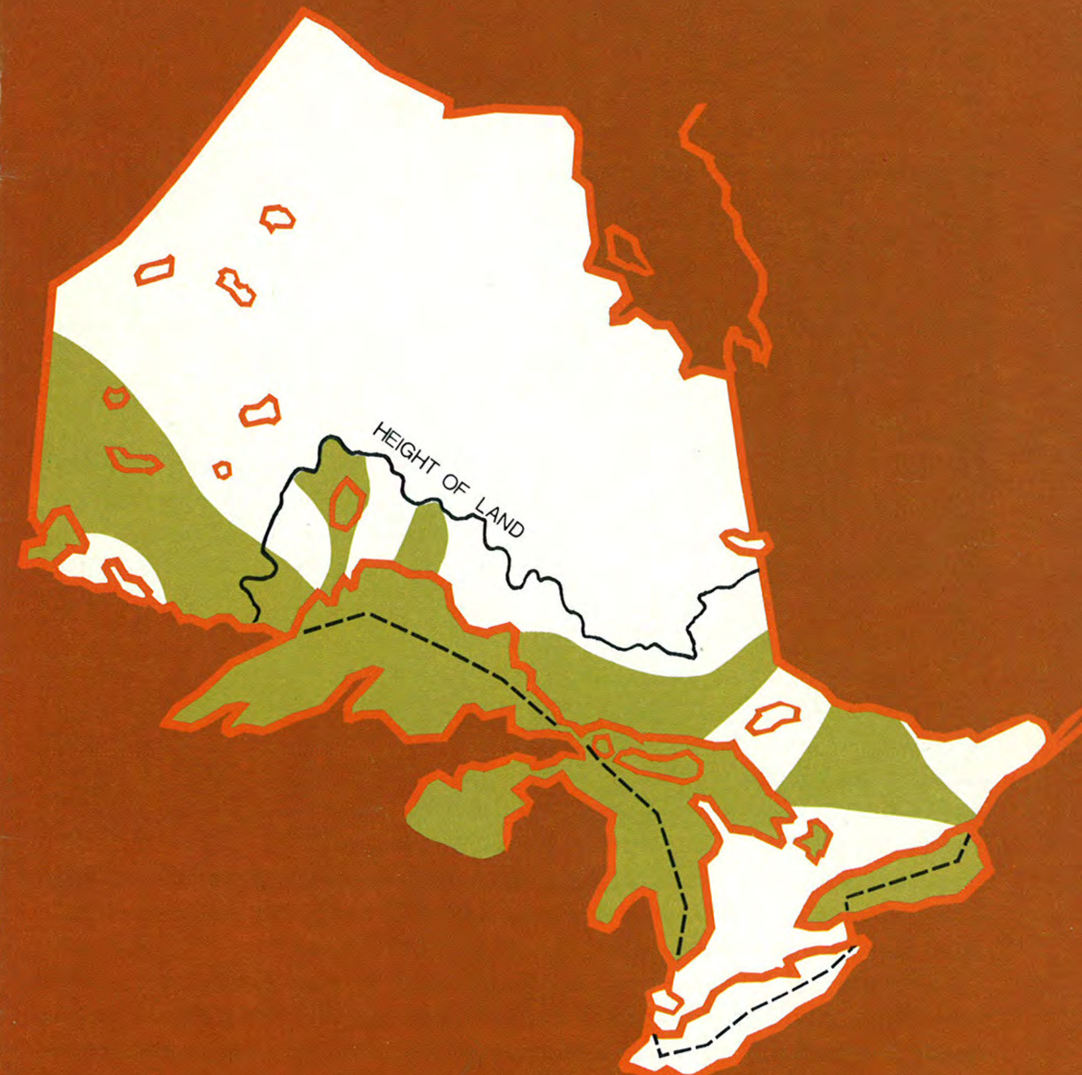
Native lake trout inhabit waters from Alaska to Labrador in the north, and from Maine to central Wisconsin in the south. In Ontario, they are known to reside in approximately 2100 inland lakes, as well as in the Great Lakes. Of the inland waters, lake trout are native to approximately 1800 lakes, introduced in 200 and of unknown origin in 100. They are found almost entirely in the hard rock country of the Canadian Shield.

The distribution pattern of Ontario's inland lake trout waters is discontinuous. Lake trout lakes are abundant in northwestern Ontario, in an area extending from the southern half of the Manitoba border to Lake Superior.

Major concentrations are also found in a wide band extending from southeastern Lake Superior to the Quebec border, in the region of Lake Timiskaming; and on the highlands between Georgian Bay and the middle reaches of the Ottawa River, in a band extending as far south as southern Georgian Bay and the eastern end of Lake Ontario.

Scattered pockets of lake trout lakes are found north and northeast of the concentration near the Manitoba border; northwest of Lake Nipigon; and north of Lake Superior, south of the height of land. The lake trout is not present in inland waters in extreme southwestern and southeastern Ontario.

General Distribution of Lake Trout Lakes in the Province of Ontario



HABITAT

Lakes may be described in terms of their basic productivity as oligotrophic, mesotrophic or eutrophic. Lakes low in nutrients are said to be oligotrophic, while lakes rich in nutrients are eutrophic. Mesotrophic lakes are intermediate.

It is important to recognize that these differences are not absolute, but one of degree. The productivity of a lake changes naturally as the lake ages, but the rate of change from oligotrophy to eutrophy is generally a very slow and gradual process taking hundreds to thousands of years. Recently, however, man and his activities have greatly accelerated the process of eutrophication.

Although lake trout lakes exhibit a wide range of physical and chemical conditions, they tend to be more oligotrophic than non-lake trout lakes. In fact, the lake trout is perhaps the most typical, or index, species of an oligotrophic lake.

In addition to being relatively infertile, lake trout lakes are generally deep and clear, with low annual temperatures and high dissolved oxygen concentrations. In Ontario, lake trout seldom occur in lakes less than 15 metres (50 ft.) deep and more than one-half of the province's lake trout lakes have maximum depths greater than 30 metres (100 ft.).

Although the lake trout is considered to be a resident of large lakes, two-thirds of Ontario's lake trout lakes are less than 405 hectares (1000 acres), nearly one-half are less than 202 hectares (500 acres) and 14 percent are less than 40 hectares (100 acres) in surface area.

Although the lake trout is primarily an inhabitant of deep, freshwater lakes, it may also be found in rivers and cold, shallow lakes at high latitudes and altitudes.

AGE & GROWTH

Few lake trout over 18 kilograms are caught now. Most are less than 5 kilograms.

Courtesy In-Fisherman Magazine

Lake trout are long-lived and continue to grow throughout their life span. Maximum ages of 62 and 53 years have been recorded for lake trout in the Northwest Territories. Most lake trout caught by anglers in Ontario, however, are between 4 and 10 years old.

The largest lake trout on record is a fish weighing 46.3 kg (102 lbs.). It was 126 centimetres (49.5 in.) long and between 20 and 25 years old. It was caught in a gill net in Lake Athabaska, Saskatchewan, in 1961. Ontario's record lake trout was angled in Lake Superior in 1952. It weighed 28.6 kg (63 lbs., 2 oz.) and was 131 cm (51.5 in.) long. Few lake trout over 18 kg (40 lbs.) are caught now and most are less than 5 kg.

REPRODUCTION

Lake trout are late maturing relative to most other freshwater fish. The size and age at sexual maturity varies widely, but generally lake trout are 6 to 8 years old before they spawn for the first time. In some northern Canadian lakes, however, first maturity may not be reached until age 13. As a general rule, males mature one year earlier than females. In northern lakes, individuals may spawn only every second or third year.

The number of eggs produced varies as a function of size and age. Lake trout are not very prolific and the number of eggs produced ranges from about 900 to 2000 per kilogram of body weight, with an average of about 1500. Thus, a female weighing 5 kg theoretically may only spawn 4500 to 10,000 eggs. This number is small compared to many other species, therefore the lake trout is said to have a low reproductive potential.

Spawning occurs once a year, usually in October. The onset and duration of spawning varies considerably from lake to lake and from year to year and is governed by such factors as physiological differences among stocks, physical characteristics of lakes, latitudes and climatic conditions such as wind, light and water temperature.

Spawning generally occurs in lakes, although there are a few recorded instances of lake trout spawning in rivers or streams. It typically takes place in water from a few centimetres to 3 to 5 metres deep, although in particularly large or deep lakes, such as Lake Superior, lake trout have been known to spawn at depths greater than 33 metres.

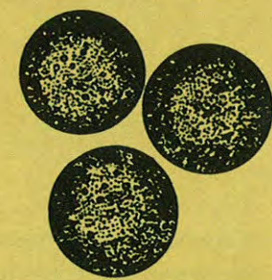
Spawning grounds are usually located off shorelines exposed to prevailing winds and over rocky reefs and shoals which are kept clear of silt and other debris by wave action and currents. Preferred spawning substrates are gravel, rubble and angular boulders about 5 to 20 centimetres in diameter.

Males arrive on the spawning grounds first and are generally more numerous than females throughout the spawning season. The fish may clear the spawning site by fanning and rubbing with the anal or tail fin but in most situations this is probably not necessary due to the effective cleansing action of the waves and currents.

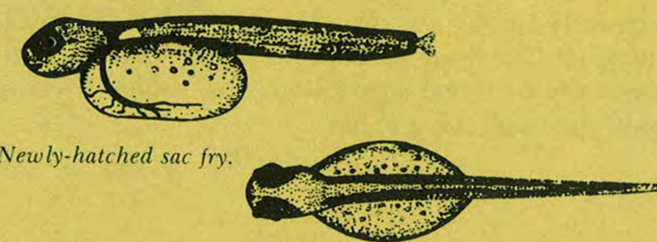
Spawning activity takes place at night, mainly between dusk and midnight. Lake trout are polygamous and spawning may occur between one or two males and one female, or several males and females may compose a spawning group. The spawning act itself lasts only a few seconds and is repeated, often over several nights, until all the eggs have been deposited.

Lake trout do not defend their spawning territory against other fish. No attempt is made to bury or care for the eggs and those eggs which do not

Eggs at fertilization.



Developing egg.



Newly-hatched sac fry.

Fingerling at approximately 10 months.

become deposited in the spaces between the sharp, angular rocks may be eaten by a variety of predators. In most circumstances, this is not considered to have a serious effect on reproductive success.

The spawning period lasts for approximately one to two weeks. After spawning, the adults disperse widely, but usually return to the same spawning grounds each year.

The eggs develop slowly, taking about 4 to 5 months to complete development. Hatching usually occurs from mid-February to late March. The newly-hatched fry have a large yolk sac and they spend about a month among the rocks at the spawning site while the yolk sac is being absorbed.

MOVEMENTS

During the fall, winter and spring, lake trout are dispersed throughout a lake, including the shallow, inshore areas. As surface water temperatures warm in the spring the trout move to the deeper, colder parts of a lake, tending to concentrate where dissolved oxygen is greater than about 5 parts per million and the water temperature is between 6 and 13°C (44 and 57°F).

The lake trout may make short feeding forays into warmer water, but these movements are mainly at night and not for extended periods of time.

Although lake trout are considered to be solitary in habit the species may occasionally be found in small groups, generally composed of young lake trout of the same size and age.

FOOD

Lake trout are opportunistic feeders, preying on a wide variety of food organisms including fish, zooplankton, crustaceans, insects, molluscs and even small mammals and birds. Shortly after hatching, before the yolk has been completely absorbed, the fry feed on microscopic animals (zooplankton) and tiny insects. At about four months they begin eating tiny larval fish. The major food of lake trout less than 35 cm (14 in.) long is invertebrates, but fish are consumed in increasingly large quantities as the trout grow.

In large lakes, adult lake trout eat fish almost exclusively. Generally, preferred foods are species common to the cold depths inhabited by the lake trout: ciscoes, whitefish, sculpins, smelt, alewives, yellow perch, suckers and minnows. Cannibalism occurs only occasionally, probably due to the greater abundance of other forage fish.

In some inland lakes, adult lake trout are said to be planktivorous because they continue to feed mainly on zooplankton, crustaceans and immature stages of insects, especially in summer when the trout may be separated from forage fish by a water temperature barrier. As summer is the main growing period, these populations tend to have a slower growth rate and attain a smaller maximum size than populations with forage fish available throughout the year.

THE STATUS OF ONTARIO'S LAKE TROUT

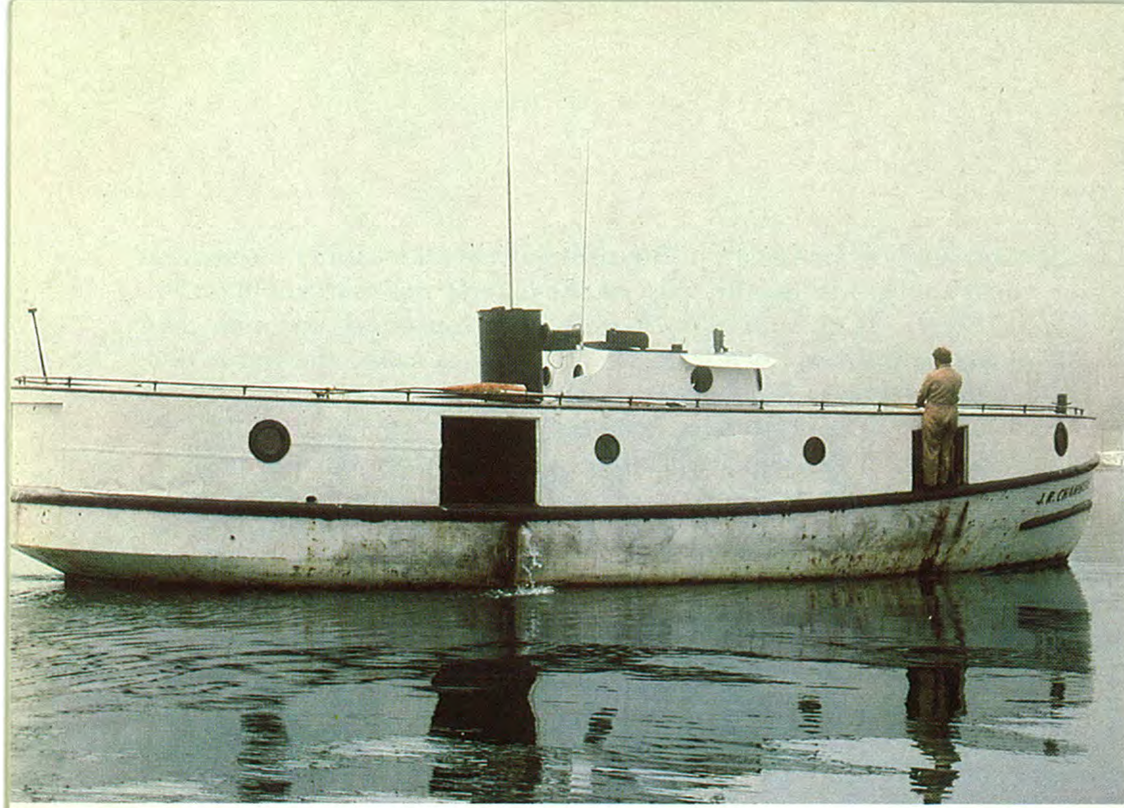
Although angling for lake trout flourished at several localities throughout the Great Lakes, historically most of the harvest was taken by the commercial fishery. At the turn of the century, lake trout comprised more than 50% of the commercial catch from the upper Great Lakes and nearly one-third of the total provincial harvest. Today, lake trout make up less than 1% of the annual commercial catch in Ontario.

Excessive fishing and sea lamprey predation have been identified as the two major factors in the collapse of lake trout stocks in the Great Lakes. A process known as "fishing-up" occurred. Harvesting methods had become more efficient. Consequently, stocks were being systematically exploited. At the same time, however, mode of travel improved and more areas of the lake became accessible to commercial fishing. As a result, lake-wide production levels remained relatively constant and masked the over-fishing of many local discrete stocks.

The sea lamprey likely existed in Lake Ontario since its formation. Large lake trout may have acted as the main host to this predator enabling smaller, but mature, lake trout and sea lamprey to co-exist. The loss of these large trout to the fishery, and the subsequent heavy exploitation and increased lamprey predation on the smaller trout, which could not withstand the lamprey attacks, led to the collapse of the Lake Ontario lake trout stocks in the 1940's and to their extinction by 1950.

The opening of the Welland Canal in 1829 provided the sea lamprey with access to the other Great Lakes. It was first reported in Lake Erie in 1921, in Lake Huron in 1937, and in Lake Superior in 1946. The sea lamprey soon became a major predator, in addition to man, of the lake trout.

The sea lamprey arrived in the upper Great Lakes at a time when lake trout populations were already under stress from the commercial fishery. The subsequent collapse was sequential and abrupt. In the Canadian waters of Lake Huron, production of lake trout fell from more than 1800 metric tonnes (4 million pounds) in 1936 to less than 180 metric tonnes (400,000 pounds) in 1948. By 1955, lake trout were virtually extinct except for two small stocks which have survived to this time. In the Canadian waters of Lake Superior, the catch declined to 22 metric tonnes (48,000 lbs.) by 1961 compared to the average annual catch of 590 metric tonnes (1.3 million pounds) in the decade prior to 1955. The decline stopped just short of a complete collapse of the fishery as a result of a sea lamprey control program that started in Lake Superior in 1953.



A Great Lakes commercial gillnet fishing boat.

First attempts at lamprey control were the installation of mechanical and electrical barriers to block the upstream migration of spawning adults. A chemical, toxic to sea lamprey ammocoetes (the larval form), was first used in Lake Superior in 1958. Its use was later extended to the other Great Lakes. Although lamprey populations are now only about 10% of their former peak abundance, control is contingent upon chemical treatments made at selected sites each year.

Recovery of depleted lake trout stocks is slow under natural conditions, due to their late age of maturity, low reproductive potential and slow growth rate. With the near annihilation of native stocks, rehabilitation in Lake Superior through the re-establishment of naturally reproducing stocks has been an even slower process than originally anticipated. Even though native lake trout were never exterminated in Lake Superior and lamprey control and stocking began in the 1950's, it will probably be another 10 to 20 years before natural reproduction can maintain large populations of lake trout in this lake.

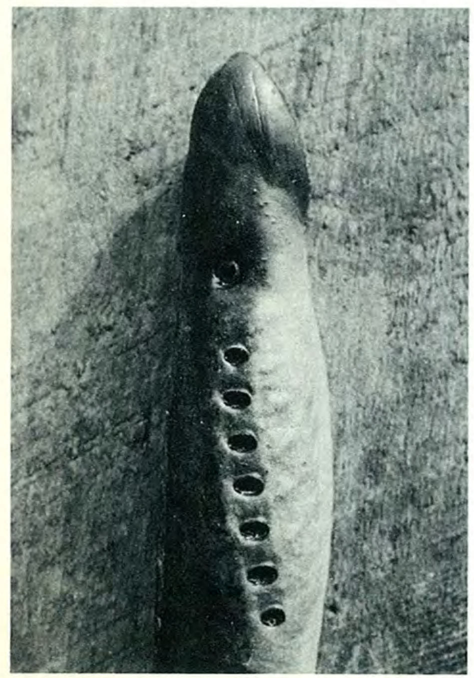
Early attempts to reintroduce lake trout into Lake Ontario were unsuccessful. Nevertheless, the species was stocked again in 1976. Initial survival and growth of these planted fish looks promising, but it is too early to determine if natural reproduction will be successful.

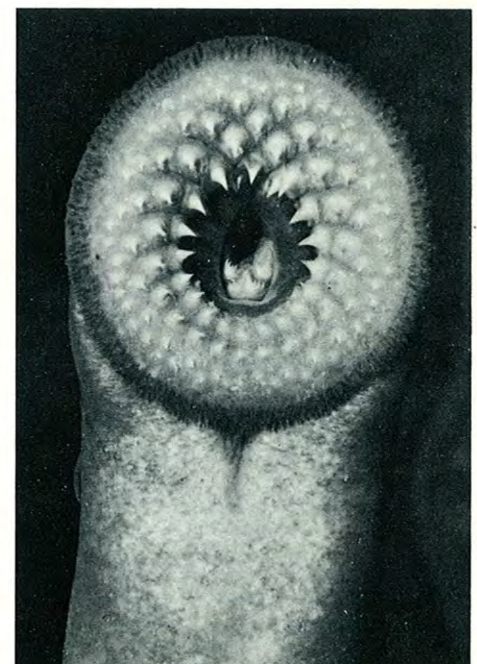
If rehabilitation efforts are successful over the next few decades, there should be a dramatic increase in angling and the re-establishment of some tightly controlled commercial fisheries for lake trout in the Great Lakes.

Lake trout populations are also declining in Ontario's inland waters. Lake trout lakes are infertile and only support a limited biomass of fish. Most inland lakes can only withstand an annual lake trout harvest of 0.25 kg to 0.75 kg per hectare. In many lakes the harvest far exceeds this amount.

Modern advances in technology have led to more and more boats being equipped with downriggers, depth sounders and oxygen probes — all of which contribute to increased angler success. Many of our once remote northern lakes have also become readily accessible to fishermen, due to the expanding network of logging roads and the increased popularity of snowmobiles, all-terrain vehicles and fly-in services.

The most distinctive characteristics of the sea lamprey are the circular mouth, studded with sharp, conical teeth and the seven gill openings on each side of the head.





Sea lamprey

The lake trout, with its low reproductive potential and high vulnerability to angling, has not been able to withstand this increased fishing pressure. Consequently, many of Ontario's lake trout lakes are exhibiting signs of overexploitation: more time is required for fishermen to catch fish, the average size of fish caught is decreasing, and an increasing number of immature fish are being taken.

Inland lake trout stocks are maintained, with few exceptions, through natural reproduction. A few lakes, such as Manitou and Simcoe, are becoming increasingly dependent on hatchery-stocked fish and lake trout are planted in many other lakes to meet the demands of the sport fishery. Lake trout lakes will only support a limited number of lake trout, regardless of the number that are stocked. In many cases, angler expectations are unrealistic in that these lakes are expected to support lake trout populations well beyond their natural productive capabilities. Stocking lake trout on a put-and-take basis has been described as a "band-aid treatment" and is often a reaction to a symptom rather than the treatment of the cause.

We must control, or fine-tune, exploitation to the extent that harvest levels will be within the natural limits of lakes to produce fish on a sustained yield basis. Exploitation as a major stress is best controlled by regulating the users. These are often hard lessons to learn, but necessary ones. More, not less, regulatory control can be expected in the future as we attempt to confine harvest within natural limits.

Another stress that has been imposed on Ontario's lake trout populations is the introduction of other species. Smelt, carp, bass, walleye, suckers and other fish species have been introduced, sometimes accidentally, into many of our lakes. In some instances, the introductions were beneficial to lake trout, providing a new food source or acting as a buffer to angling pressure; but, more often, they were detrimental to lake trout. The introduction of other species of fish into these lakes serves to increase stress on the self-sustaining populations as competition for space and food is increased. Other stresses are also applied through predation on eggs and fry and the introduction of new parasites and diseases.

One of the most significant impacts of humans on water quality is nutrient enrichment. Its effect on Lake Simcoe has received a great deal of publicity recently, but the problem is not confined to this lake alone. It is becoming increasingly widespread, threatening the survival of many of our inland lake trout fisheries.

The deep, infertile, oligotrophic lakes that are inhabited by lake trout are often the most aesthetically pleasing to cottagers. As a result, the shorelines of many high quality lake trout lakes have been developed recently with cottages. These residences are equipped with running water, flush toilets, showers and other convenience appliances. Many are winterized, as well, and used year round. The soil surrounding these oligotrophic lakes is usually characteristically thin — unable to absorb and hold the nutrient outflow of these systems. As a result, there has been an increased flow of nutrients into the lakes.

Nutrient enrichment is not only caused by cottagers. It is a product of marinas, mills, industries and a multitude of other sources. Even treated municipal sewage adds to the problem. In agricultural areas, farm fertilizers and silts reach the lakes by direct runoff or through tributary streams. The fertilizers add nutrients to the waters and the silts destroy the natural spawning grounds. Natural processes change a deep, clear, infertile lake into a shallow, weedy, fertile lake over thousands of years, but man augments and greatly accelerates the rate of change, to the extent that the process may be completed in less than a human lifespan.

In oligotrophic lakes, high nutrient loading usually leads to the profuse growth of algae and phytoplankton. At first, the changes are usually noted only in the bays, estuaries and inshore waters, where the nutrients first arrive or are concentrated. Before long, though, they may become evident in the main body of water. The effect is both visual and chemical. Algal

A good days catch!

and phytoplankton blooms may occur and their decomposition in the bottom waters requires large amounts of oxygen. Consequently, the oxygen concentration levels in the deep basins are lowered. This has an adverse effect on lake trout populations, for they inhabit these deep basins during the summer because of their need for cold, well-oxygenated water.

An increase in algae growth on the spawning shoals also can impair reproductive success. This could have devastating effects on a species such as lake trout, with its low reproductive potential.

Another serious impact on fish and fish habitat is acid precipitation. Most lake trout lakes have a pH between 6.0 and 7.4 and lake trout seldom

Dorion Fish Culture Station rears lake trout for stocking in Lake Superior.

occur in lakes with a pH less than 5.5. The oligotrophic lakes inhabited by lake trout are capable of neutralizing the acids in natural rain or snow, which has a pH of about 5.6. When oxides of sulphur and nitrogen enter the atmosphere, from the smelting of primary ores and the burning of fossil fuels (such as coal), however, they form much stronger acids in the rain or snow. In some areas, acid precipitation with a pH as low as 2.9 have been recorded. Shield lakes are poorly buffered and are not able to neutralize the additional inputs of these airborne acids. Rapid acidification may result with the attendant loss of fish populations.

More and more boats are being equipped with downriggers, depth sounders and oxygen probes.

SUMMARY

Ice fishing for lake trout is a popular winter sport.

The lake trout is particularly ill-equipped to withstand the stresses imposed by man and his technology. It lives in our most unproductive, cold and poorly buffered waters. The species itself is slow-growing, late-maturing, has a low reproductive potential and is easily captured. Because the lake trout and its habitat are susceptible to man's activities, it serves as an environmental barometer (an early warning system) to alert us to changes in the health of aquatic systems. As a general rule, healthy environments for fish indicate healthy environments for humans.

Lake trout can be stocked in lakes; seasons and creel limits can be manipulated; but, no amount of management will be successful in maintaining and improving this resource unless the stresses affecting the species are reduced or removed.

The restoration of our lakes and fisheries is possible, but it will not be easy. The problem is complex with no simple solutions. Time, self-sacrifice and the cooperation of fishermen, cottagers, farmers, urban dwellers, developers and industrialists, as well as all levels of government in Ontario, Canada and the United States will be required to maintain and restore our lake trout populations.

It is an enormous undertaking; but one that must succeed if the lake trout is to remain a viable species in Ontario.