

Management of Fish in Ontario

Background Report Supporting Ontario's
Provincial Fish Strategy

Draft – January 2014

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1/10/2014

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Summary

This document was written to support the development of *Ontario's Provincial Fish Strategy: Fish for the Future*, and provides a contemporary overview of the management of fisheries, fish communities and their supporting ecosystems in the province of Ontario.

This document begins with a description of the diverse fish communities found within Ontario, and then provides an overview of these communities' ecological, socio-cultural and economic values. The remainder of the document focuses on the present-day role and activities of the Ontario Ministry of Natural Resources (MNR) in managing the province's fisheries, fish communities and their supporting ecosystems.

Resumé

Ce document a été rédigé pour soutenir le développement de *Ontario's Provincial Fish Strategy: Fish for the Future* (Politique stratégique provinciale relative à la pêche pour l'Ontario : Assurer la pérennité des ressources halieutiques), et donne un aperçu contemporain de la gestion de la pêche, les communautés de poissons et leurs écosystèmes associés dans la province de l'Ontario.

Ce document commence par une description des communautés de poissons divers trouvés en Ontario, puis donne un aperçu des valeurs écologiques, socio-culturels et économiques de ces communautés. Le reste du document se concentre sur le rôle et les activités du ministère des richesses naturelles (MRN) dans la gestion de la pêche, les communautés de poissons de la province et leurs écosystèmes associés.

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1.0 Introduction

This document was written to support the development of *Ontario's Provincial Fish Strategy: Fish for the Future*, and provides a contemporary overview of the management of fisheries, fish communities and their supporting ecosystems in the province of Ontario.

This document begins with a description of the diverse fish communities found within Ontario, and then provides an overview of these communities' ecological, socio-cultural and economic values. The remainder of the document focuses on the present-day role and activities of the Ontario Ministry of Natural Resources (MNR) in managing the province's fisheries, fish communities and their supporting ecosystems.

2.0 Diversity of Ontario's Fish Communities

Ontario has a wide array of aquatic ecosystems that make up 24% of Canada's freshwater, and include more than 250,000 lakes and countless kilometres of rivers and streams. Seventy-one per cent of these waters flow to Hudson Bay via the Hudson Bay-James Bay Basins and the Nelson River Basin, whereas the remaining twenty-nine per cent drain to the Great Lakes-St. Lawrence system.

The distribution of fish across Ontario's aquatic ecosystems is a result of re-colonization after the last glaciation and current climate, as well as human influence. In terms of the number of fish species, the wide range of aquatic ecosystems and habitats across the province supports a high diversity of freshwater fishes; in fact, Ontario has the highest diversity in Canada, with approximately 128 species native to the province and at least 17 naturalized species. A number of invasive species of fish are also found in Ontario.

Ontario Fish Species – A Globally Significant Resource

Ontario has a responsibility to manage fish species that extends well beyond the borders of our province.

Did you know?

- Ontario is home to approximately 128 native and at least 17 naturalized species of fish.
- About 25% of the world's native self-sustaining populations of Lake Trout are in Ontario. Because the Lake Trout is a sensitive species that is adapted to a narrow range of environmental conditions, it is an excellent indicator of the health of fragile aquatic ecosystems. Approximately 5% of the province's Lake Trout populations have already been lost, due largely to human activities; 43% of the lost populations were in southeastern Ontario.
- Ontario has 22% of all Muskellunge populations in North America. Muskellunge are valued ecologically as a top predator in Ontario, and are often managed to provide 'trophy' fishing opportunities. Historically, Muskellunge were threatened by excessive commercial and recreational harvest; however, Ontario has seen considerable change in public perception of the species, to the point where release rates commonly exceed 95%.

(Source: MNR data)

Within the province, species diversity of freshwater fishes is highest in the south and declines northward. Correspondingly, fish communities in southern Ontario are typically comprised of a greater number of species than their northern counterparts. These broad differences among fish communities can be characterized by drawing comparisons across ecozones.

Ontario's fish communities are uniquely adapted to the aquatic ecosystems found in each of the province's four ecozones, namely Hudson Bay Lowlands, Ontario Shield, Mixed Wood Plains and Great Lakes. The diversity of fish communities reflects the broad range of habitats and climates across Ontario. Within the province, the highest diversity of freshwater fishes occurs in the watersheds of the Mixed Wood Plains ecozone, whereas it is lowest in the Hudson Bay Lowlands. The following synopsis of Ontario's four ecozones is based on information obtained from the Ecosystem Status and Trends Report project.

Fish Communities

Fish communities can be classified in a number of different ways. In Ontario, fish communities are typically thought of in terms of their lake-dwelling versus riverine populations and water temperature (i.e., coldwater, coolwater and warmwater). Although not every waterbody supports species that conveniently fit into a single temperature-based category (e.g., some lakes contain both coldwater species, such as Lake Trout, and coolwater species, such as Northern Pike), this classification method has proven useful for characterizing Ontario's lakes and streams.

Coldwater Fish Community: Assemblages of fish that prefer average summer surface water temperature cooler than 19 °C and low productivity environments. Lake Trout, Brook Trout and Lake Whitefish are species typically found in coldwater lakes. Slimy Sculpin, Brook Trout and American Brook Lamprey are typical of coldwater rivers and streams.

Coolwater Fish Community: Assemblages of fish that prefer average summer surface water temperature between 19 °C - 25 °C and medium productivity environments. Walleye and Northern Pike are species typically found in coolwater lakes. Walleye, Iowa Darter and Northern Pike are often found in coolwater rivers and streams.

Warmwater Fish Community: Assemblages of fish that prefer average summer surface water temperature warmer than 25 °C and high productivity environments. Largemouth Bass, Bluegill, Carp, Brown Bullhead and Bowfin are typical of warmwater fish communities.

(Source: Adapted from Ryder and Edwards 1985; Coker et al. 2001)

Hudson Bay Lowlands

The Hudson Bay Lowlands is the northernmost ecozone in Ontario and covers approximately 23 per cent of the province. The Hudson Bay Lowlands predominantly encompasses Fisheries Management Zones (FMZ) 1 and 3 (Figure 1). The aquatic habitats in the area include large rivers that cross the extensive wetlands that dominate the landscape on their way to Hudson Bay, including the Moose, Albany, Attawapiskat, Winisk and Severn Rivers. The area also contains a multitude of shallow bog lakes and ponds, with 95 per cent of the lakes being smaller than 100 hectares. A few large, shallow coolwater lakes are present, such as Missisa and Kesagami Lakes. A local anomaly, the Sutton Ridges, is an upland area that survived the recession of the last glacier and is characterized by its deeper lakes and swifter streams.

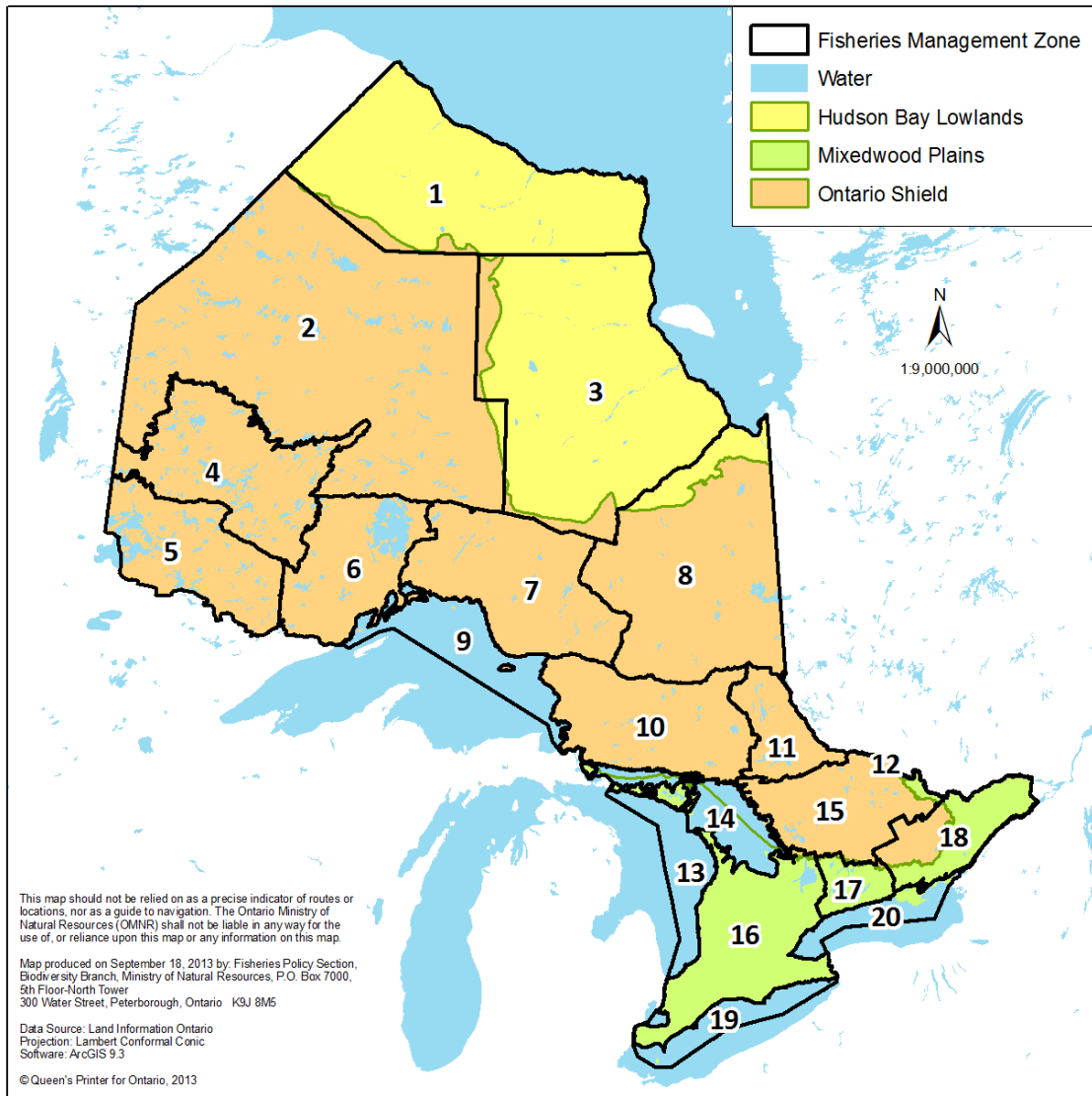


Figure 1: Ontario's 20 Fisheries Management Zones overlaid atop the province's four ecozones (Hudson Bay Lowlands, Ontario Shield, Mixed Wood Plains and Great Lakes).

Although fish monitoring and assessment in FMZs 1 and 3 has thus far been limited, at least 45 fish species are known to occur in the area. Minnows (*Cyprinidae*), sticklebacks (*Gasterosteidae*), sculpins (*Cottus* spp.) and darters (*Etheostoma* spp.) comprise the fish communities found in shallow bog ponds. Larger species such as Northern Pike (*Esox lucius*), Walleye (*Sander vitreus*), Lake Whitefish (*Coregonus clupeaformis*), Cisco (*Coregonus artedii*) and suckers (*Catostomus* spp.) are widespread in the larger lakes and rivers. The lakes and streams on the Sutton Ridges support a wider array of fish species, including the only four known Lake Trout (*Salvelinus namaycush*) populations in the area. Many coastal streams and rivers contain resident and sea run

Brook Trout (*Salvelinus fontinalis*), Lake Whitefish and Cisco. The lone invasive species of fish is the Smallmouth Bass (*Micropterus dolomieu*), which has only recently been documented in the Moose and Albany Rivers.

The monitoring and assessment conducted to date indicate that the rivers, streams and lakes of the area are relatively undisturbed compared to more developed areas of Ontario. The level of disturbance in this area is expected to increase, however, as both present mining operations and hydroelectric development expand. Increased resource extraction and development is expected to disrupt local habitats and provide human access to presently unexploited fish populations. In addition to direct development and resource extraction pressures, climate change is expected to have varied and widespread impacts on the aquatic ecosystems of the Hudson Bay Lowlands.

Ontario Shield

The Ontario Shield is the largest ecozone in the province, covering about 61 per cent of Ontario. The ecozone contains the majority of ten FMZs, including: 2, 4, 5, 6, 7, 8, 10, 11, 12 and 15 (Figure 1). The aquatic habitats in the area include tens of thousands of lakes, ranging in size from small ponds to 62,000 hectares. Some of the largest and most recognized lakes in the area include Lac Seul, Lake of the Woods, Lake Nipigon and Lake Nipissing. Thousands of kilometres of rivers and streams are also present, such as the Winnipeg, Nipigon and French Rivers. This overall richness of aquatic habitat supports diverse cold, cool and warmwater fish communities.

Approximately 50 fish species are known to occur in the area. Northern Pike, White Sucker (*Catostomus commersonii*), Yellow Perch (*Perca flavescens*) and Walleye are the most dominant large-bodied fish species found in the lakes. Other large-bodied species that frequently occur are Lake Whitefish, Burbot (*Lota lota*) and Cisco. The deep, cold, well-oxygenated lakes in the area provide the primary habitat for Lake Trout populations in the province. The most prevalent member of the small-bodied fish community is Spottail Shiner (*Notropis hudsonius*), followed by Johnny Darter (*Etheostoma nigrum*), Ninespine Stickleback (*Pungitius pungitius*) and Trout Perch (*Percopsis omiscomaycus*). Brook Trout occurs extensively, commonly residing in streams. Smallmouth and Largemouth Bass (*Micropterus salmoides*), Black Crappie (*Pomoxis nigromaculatus*) and Rainbow Smelt (*Osmerus mordax*) have expanded their range significantly in this area.

The aquatic ecosystems of the Ontario Shield are relatively undisturbed, though they are directly affected by a number of habitat stresses. Human impacts due to pollution (e.g., acid rain, excessive nutrients), hydroelectric development and habitat alteration (e.g., cottage shoreline development, forestry road building) are present and likely to increase with planned future development and resource extraction. The effects of

climate change are also expected to intensify, predominately affecting the coldwater fish communities in the area.

Mixed Wood Plains

The Mixed Wood Plains is Ontario's smallest ecozone, covering approximately 8 per cent of the province. Three management zones, FMZs 16, 17 and 18, are predominantly encompassed by the ecozone (Figure 1). The area has highly variable topography, surficial and bedrock geology and productivity; it thus supports a large variety of aquatic habitats, including rivers, streams, wetlands and lake systems. There are more than 100,000 kilometres of flowing waters in the area, ranging in size from small creeks and streams to large rivers, including the Ontario portion of the St. Lawrence River and a 580 km stretch of the Ottawa River. Large and productive warmwater rivers, such as the Thames and Grand Rivers, are found in the Lake Erie lowlands. Coldwater tributaries of Lake Ontario and Lake Huron (including Georgian Bay) are also prominent features.

In addition to warmwater rivers and streams, there are a number of warm, shallow, productive lakes and reservoirs distributed throughout the area, including the Kawartha and Rideau Lake systems. Lake Simcoe, a deep coldwater lake, is the most dominant lacustrine feature, though the majority of coldwater lakes are found on the Frontenac Axis.

The Mixed Wood Plains ecozone supports approximately 161 species of fish, including both native and alien species. The warmwater lakes and rivers support populations of Largemouth Bass, Smallmouth Bass, Muskellunge (*Esox masquinongy*), Black Crappie, Pumpkinseed (*Lepomis gibbosus*) and Bluegill (*Lepomis macrochirus*). The large rivers also have coolwater fish communities, a high diversity of small fish species and a proportionally large number of species at risk. The coldwater lakes in the Mixed Wood Plains have simple communities of primarily Lake Trout and Lake Whitefish populations. Lake Simcoe, however, has cold, cool and warmwater fish communities, and more than 52 fish species are resident in this lake.

Rivers and streams flowing into the Great Lakes often support resident native Brook Trout and naturalized Brown Trout (*Salmo trutta*) in the headwaters, and provide spawning and nursery habitat for naturalized migratory salmonids, such as Rainbow Trout (*Onchorynchus mykiss*), Chinook Salmon (*Onchorhynchus tshawytscha*), Coho Salmon (*Onchorhynchus kisutch*) and re-introduced Atlantic Salmon (*Salmo salar*).

Between 1973 and 1995, 24 fish species new to the area were documented, most due to intentional or accidental introduction. Invasive species, such as Round Goby (*Neogobius melanostomus*), are found in the area.

The aquatic ecosystems in the area are more disturbed than those of the Hudson Bay Lowlands and Ontario Shield, as they are impacted by the agricultural and urban areas that dominate these heavily altered landscapes. Fish communities are changing in response to alterations in aquatic habitats across the area. Major stresses include changes in the productivity of lake habitats; altered flow regimes in river systems; fragmentation and impoundment of rivers and streams; loss of riparian areas; and the spread of invasive species from the Great Lakes. The primary causes of these stresses are increased urban and agricultural development in watersheds.

Great Lakes

The Great Lakes ecozone is comprised of five large lakes and their connecting waterways, which contain nearly 20% of the world's supply of surface freshwater. Portions of four of these lakes lie in Canada (i.e., Lakes Superior, Huron, Erie and Ontario), and are shared with the United States. The ecozone encompasses FMZs 9, 13, 14, 19 and 20; each of the four Great Lakes is an FMZ, with the exception of Lake Huron, which is represented by two FMZs (Figure 1). The combined surface area of the Canadian (i.e., Ontario) portion of these four lakes is about 88,000 km².

The Great Lakes were shaped by glaciation more than 10,000 years ago. Their vast waters contain a variety of habitats, such as deep offshore coldwater areas, open water pelagic areas, coastal wetlands and nearshore warmwater embayments. This incredible variety of habitats has resulted in diverse and unique fish communities.

There are approximately 145 species of fish – including both native and alien – that inhabit the Great Lakes. The number of species in each of the lower Great Lakes (i.e., Lakes Erie and Ontario) is similar, but higher than that found in Lakes Huron and Superior; the lower latitude, geology, physical and chemical characteristics of Lakes Ontario and Erie contribute to their greater productivity. Lake Ontario is unique in that it was colonized by a number of marine forms, including Atlantic Salmon, Threespine Stickleback (*Gasterosteus aculeatus*) and the American Eel (*Anguilla rostrata*). Lake Erie is the shallowest and warmest of the Great Lakes, and is also the most productive.

The deep open waters of the Great Lakes were once dominated by two main predators, Lake Trout and Burbot, as well as by Lake Whitefish and ciscoes. The pelagic fish communities have experienced drastic changes since European settlement, and many native salmonine and coregonine stocks have been lost. Today, Rainbow Trout and Coho and Chinook Salmon, all native to the Pacific Ocean, are the most plentiful top predators in the open water areas of Lake Ontario. Lake Superior is still dominated by Lake Trout, Burbot and ciscoes, and rehabilitation efforts have allowed Lake Trout to recently reclaim a position of dominance in Lake Huron. The dominant predator in Lake Erie is Walleye.

The nearshore waters of the Great Lakes contain a more diverse community than the deep waters, and differences between the lakes' fish communities are most evident here. Most of Lake Erie and the Bay of Quinte in Lake Ontario have extensive areas of shallow water habitats that support abundant warmer water communities composed of bass, Walleye, Yellow Perch, Muskellunge and Northern Pike. Generally, the steep basins of Lakes Huron and Superior have narrow littoral zones and less abundant warmwater fish communities.

Today, Great Lakes ecosystems are much improved from the 1970s, although habitat degradation and overfishing have had varying degrees of impact on their ecology and fish communities. Also, pollution, especially in the form of excessive nutrient loading and toxic contaminants, has placed additional stresses on fish populations. Contributing to these threats to native diversity has been a succession of invasions and deliberate releases of alien aquatic species that have established substantial populations since the 1880s. Many alien species have, or have the potential to, significantly alter aquatic ecosystems, especially as climate warming may enhance the suitability of Great Lakes habitats for these species.

Ontario's Ecozones

Hudson Bay Lowlands: Our northernmost ecozone covers 23 per cent of the province. It is mostly wetlands, but also supports boreal and subarctic forests, tundra, tidal marshes and numerous rivers and lakes.

Ontario Shield: Our largest ecozone covers 61 per cent of the province. Lakes, ponds and wetlands make up almost 23 per cent of the area and about 68 per cent of the area is forested. A large diversity of ecosystems are found throughout its varied topography.

Mixed Wood Plains: Our smallest ecozone covers only 8 per cent of the province, but is home to about 92 per cent of Ontario's population. The original forests, wetlands, prairies and alvars that once covered this ecozone have largely been replaced by agricultural and settled landscapes.

Great Lakes: We share four of the five Great Lakes with the United States. Ontario's Great Lakes area is about 8 per cent of the province - similar in size to the Mixed Wood Plains. About 85 per cent of our drinking water comes from here. There is a diversity of habitats in the Great lakes: cold deepwater, shallow nearshore, islands and coastal wetlands.

(Source: Adapted from Ontario's Biodiversity Strategy 2011)

3.0 Importance of Ontario's Fish and Fisheries

Fish benefit the ecology and ecosystems of Ontario, as well as its cultures and economy. Throughout Ontario, fish support a variety of fisheries, including: recreational fisheries, commercial food fisheries, commercial bait fisheries and Aboriginal fisheries. Fish contribute substantially to Ontario's economy, with recreational and commercial fishing and their supporting industries valued in the billions of dollars annually. Fish populations are also valued as a source of wild eggs, which are used for establishing broodstock in aquaculture operations. It is also recognized that there is intrinsic value to fish and that fish populations provide socio-cultural benefits and ecosystem services.

Ecological Value of Fish Communities

Fish generate many fundamental ecosystem services that are essential for ecosystem function. Some of these services have a regulating function, such as the regulation of carbon fluxes, nutrient cycling, food web dynamics and sediment processes, whereas other services have a linking function, such as the transport of nutrients within and between ecosystems.

Fish provide linkages between ecosystems as a result of their migration patterns, which transport nutrients between water bodies. For example, suckers in many Ontario lakes migrate into tributary streams to spawn, transferring carbon and other nutrients in the eggs they deposit and through the decomposition of any adult fish that die. This transfer of carbon and other nutrients can contribute to the production of algae, which can in turn drive production at higher trophic levels, such as those occupied by aquatic invertebrates and fish. Fish are also conduits of energy and nutrients between terrestrial and aquatic ecosystems. For instance, fish eat many terrestrial invertebrates, and are in turn prey for several species of terrestrial mammals and birds, such as Black Bear, River Otter and Bald Eagle.

Importantly, fish also generate demand-derived ecosystem services. Unlike fundamental ecosystem services, these services are based on human values and demand, but can also provide ecological value. For instance, fish are sensitive to many stresses and their response to a stress can often be identified early, making them suitable early warning signals of anthropogenic, biological and environmental stress on aquatic ecosystems. Conversely, fish are also indicators of ecosystem recovery. The physical and physiological conditions of individual fish can be used to assess ecosystem stress, as can fish species abundance, richness and composition. Due to their dependency on clean, coldwater habitats that are well-oxygenated, Brook Trout and Lake Trout are often used in Ontario as indicators of habitat and water quality conditions.

Social and Cultural Value of Fisheries

Recreational Fisheries

In Ontario, the *Heritage Hunting and Fishing Act, 2002* states that a person has a right to hunt and fish in accordance with the law. Ontario offers a diverse array of recreational fishing opportunities: fishing for sunfish off a dock in central Ontario; fly fishing on a Great Lakes tributary; fly-in fishing on a remote northern lake; and everything in between. In 2010, approximately 1,238,000 resident and non-resident anglers fished in Ontario for a total of nearly 17 million days. The majority of this fishing occurred in southern Ontario, accounting for more than 11 million days fished. Anglers spent 2.7 and 2.9 million days fishing in northwestern and northeastern Ontario in 2010, respectively. Ontario has more resident anglers (more than 900,000) than any other province or territory in Canada, although on a proportional basis, Ontario falls slightly below the national average for residents participating in angling activities (7% vs. 8%, respectively). Ontario also has more active non-resident anglers (approximately 338,000) than the combined number of non-resident anglers in all other provinces and territories. However, the number of non-resident anglers has dropped nearly 50%, from more than 600,000 in 2000.

More days are spent fishing on Lake Huron (including Georgian Bay) than any other waterbody in Ontario, followed by Lake Ontario, Lake Erie, Lake Simcoe and Lake of the Woods. The Kawartha Lakes in Fisheries Management Zone 17 are the most intensively fished group of waterbodies in the province. Large rivers like the Ottawa River, St. Lawrence River and Grand River are also popular recreational fishing spots. Lake Simcoe and Lake Nipissing are the most popular ice fishing destinations in the province. Walleye is the most preferred species in the province, followed by bass and Northern Pike in open water fisheries. Walleye, Yellow Perch, Northern Pike and Lake Trout are the most preferred species in winter ice fisheries.

There are various aspects to the social and cultural value derived from fisheries, including the intrinsic value of fish. Fishing can connect anglers with family and friends, and also with nature and the out-of-doors. In addition, both anglers and non-anglers alike can appreciate watching fish on a calm lake or while snorkeling, or simply enjoying a meal of freshly-caught Ontario fish.

Commercial Fisheries

Ontario's commercial food fishery is one of the largest freshwater fisheries in the world, and is part of Ontario's heritage and culture. Many towns, such as Port Dover and Port Stanley on the Canadian shores of Lake Erie, were founded because of commercial fishing activities. Today, the towns of Kingsville and Wheatley are home to some of the largest commercial freshwater fish processing centres in Canada.

While most commercial food fishing takes place on the Great Lakes, substantial fisheries exist on large inland lakes, such as Lake of the Woods, Lake Nipigon and Lake Nipissing. There are also fisheries on some smaller inland lakes in northwestern and eastern Ontario.

Aboriginal Fisheries

Since time immemorial, fish have been of central importance to Aboriginal peoples in Ontario. Throughout the province, Aboriginal peoples have constitutionally protected Aboriginal and treaty rights to fish for food, social and ceremonial purposes. There are also several Aboriginal commercial fisheries across Ontario, which often stem from historic practice.

Many species of fish were, and continue to be, important to Aboriginal peoples as an integral part of their spiritual and cultural identities. Lake Sturgeon (*Acipenser fulvescens*), for example, is considered to be sacred by some Aboriginal peoples. It is a clan within the Ojibwe clan system and there are various stories, ceremonies and traditional teachings that acknowledge its significance. Sturgeon has been an important traditional food source for Aboriginal communities and continues to be highly valued today.

There are many historic fishing sites across Ontario where Aboriginal peoples gathered at specific times throughout the year. Whether at Bawating (Sault Ste. Marie), Toronto, Manitou Rapids on Rainy River, or the mouth of the Winisk River, these sites brought Aboriginal families and communities together to fish and often became traditional meeting places to share goods and information, to enter into agreements, and to participate in spiritual and cultural ceremonies.

One such site is the Mnjikaning Fish Weirs, located at the Narrows between Lakes Simcoe and Couchiching. This National Historic Site contains the largest and best preserved wooden fish weirs in eastern North America. According to carbon dating, First Nations began using the site more than 5000 years ago, beginning around 3300 B.C. The site remained in use by First Nations until the years preceding World War II.

It is recognized that the history of Aboriginal fisheries long pre-dates the existence of the province, and that these fisheries continue to contribute significantly to the dietary, social, cultural and economic needs of many Aboriginal communities in Ontario today.

Ontario's Fisheries

Ontario has a variety of important recreational, commercial and subsistence fisheries.

Did you know?

- Ontario has over 900,000 resident recreational anglers, more than any other province or territory in Canada
- Anglers fished nearly 17 million days in 2010
- Ontario's commercial food fishery caught nearly 12 million kg of fish in 2011, making it one of the largest freshwater fisheries in the world
- 1200 bait licences were issued and approximately 144 million fish were harvested for bait in 2010

(Source: MNR data)

Economic Value of Fisheries

Recreational Fisheries

In 2010, anglers reported spending over \$850 million on consumable goods and services in Ontario (Table 1), such as packages purchased from lodges or outfitters that include accommodation, food, transportation and use of fishing equipment. Other consumables include travel costs within Ontario, boat launch fees and moorage. Anglers also spent over \$1.4 billion in 2010 on fishing-related investment goods (Table 1), such as boating equipment, buildings and vehicles. Collectively, expenditures related to recreational fishing in Ontario were estimated to exceed \$2.2 billion (OMNR, 2013).

Recreational fishing is a key tourism driver in Ontario. For instance, in 2000, there were an estimated 1,190 resource-based tourism sites in Ontario that were accessible by floatplane, train or boat; over three-quarters of these were fly-in outpost camps, the majority of which were located in northern Ontario. In 2004-05, 25% of U.S. travelers to Ontario participated in fishing. In northern Ontario, this contribution is even more apparent, with more than 40% of U.S. travelers participating in recreational fishing, and fishing cited most often as the reason for taking an overnight trip in northern Ontario. In 2010, it was estimated that fishing-related vacation packages generated more than

\$130 million in Ontario, more than \$100 million of which was generated from non-residents.

Table 1: Reported expenditures and investments by recreational anglers in Ontario, 1995-2010 (OMNR, 2013).

Angler Expenditures (\$Billions)	1995	2000	2005	2010
Consumables	1.030	0.991	0.979	0.853
Investments Wholly Attributable to Fishing	0.671	0.700	0.761	0.766
Investments Partially Attributable to Fishing	0.669	0.642	0.597	0.643
Total (nominal dollars)	2.370	2.333	2.337	2.262

Recreational fishing also makes important contributions to the MNR's Fish and Wildlife Special Purpose Account (SPA). Funds held in the SPA are used exclusively for management of fish and wildlife in Ontario. From 2009-2010, recreational fishing licence sales contributed \$35.5 million to the SPA, which was approximately 62% of the accounts' value that year.

Commercial Food Fisheries

There are approximately 500 active commercial fish licences in Ontario, of which more than 100 are held by Aboriginal individuals or communities. In 2011, commercial licence holders caught nearly 12,000 metric tonnes (about 12 million kg) of fish. The dockside value of their harvest varies from year to year, however in 2011 that figure was more than \$33 million. Including processing and sales to food stores and restaurants in Ontario, the U.S. and around the world, the industry's contribution to Ontario's economy was about \$234 million in 2011. From 2009-2010, commercial fish licence sales and fishing royalties contributed \$923 thousand to the SPA, which was approximately 2% of the accounts' value that year. Commercial fishing and its associated processing and shipping activities employ a significant amount of people in a number of smaller communities around the Great Lakes. Commercial fishing is also an important economic development initiative for a number of Aboriginal communities across the province.

In the Great Lakes, Lake Erie accounts for approximately 80% of the landed value (i.e., the price awarded to fishers for their catch) and 75% of the commercial harvest. Lake Huron makes up most of the remainder, accounting for approximately 17% of the value and 15% of the harvest from the Great Lakes. Rainbow Smelt, Yellow Perch, Walleye

and Lake Whitefish make up approximately 80% of Great Lakes harvest by weight; White Bass (*Morone chrysops*), White Perch (*Morone americana*), Cisco, Lake Trout and several other species make up the balance of the harvest. Lakes Superior and Ontario support small commercial fisheries. The principal commercial fish on Lake Superior is Lake Whitefish, followed by Cisco. A variety of species are fished on Lake Ontario, including Yellow Perch and Sunfish, which support a locally important commercial fish industry.

Commercial fishing on inland lakes targets a diversity of species. On Lake Nipigon in northwestern Ontario, Lake Whitefish accounts for about 80% of the harvest. The remainder of the harvest is divided among Rainbow Smelt, Lake Trout, Northern Pike, ciscoes and suckers. The fisheries on other lakes with commercial activity in the northwest also predominately harvest Lake Whitefish, with smaller harvests of Northern Pike, Lake Trout, Yellow Perch, Walleye and Black Crappie also occurring. On Lake Nipissing in the northeast, Walleye is the primary target species. In southeastern Ontario inland waters, Brown Bullhead (*Ameiurus nebulosus*), sunfishes (*Lepomis* spp.), Yellow Perch, Black Crappie, Common Carp (*Cyprinus carpio*), Bowfin (*Amia calva*), suckers, Rock Bass (*Ambloplites rupestris*), White Perch, Channel Catfish (*Ictalurus punctatus*) and Northern Pike are harvested for commercial purposes.

Commercial Bait Fisheries

Approximately 60% of anglers in Ontario use live baitfish, supporting the largest live baitfish industry in Canada. It is estimated that direct sales of baitfish in Ontario are worth approximately \$17 million annually. A licence is required to harvest, buy or sell baitfish or leeches for commercial purposes. In 2010, 1208 commercial bait licences were issued, of which 651 were dealer licences and 557 were harvester licenses; because an individual may hold more than one licence, slightly fewer individuals were involved in the bait industry than there were licences issued. The issuance of baitfish licences in 2009-2010 raised approximately \$314 thousand in licence fees, which represented about 0.5% of the SPA's value that year.

The bait industry harvested approximately 144 million fish in 2010, of which almost 60% or approximately 86 million were recorded as "baitfish" (mixed bait species). Among the remaining 40% of baitfish which were identified, Emerald Shiner (*Notropis atherinoides*) made up the majority, with over 58 million fish harvested; approximately 90 thousand Lake Herring were also harvested. In addition, over 26 million leeches were harvested commercially.

Harvesting occurs throughout the province, with the bulk of the "baitfish" and Emerald Shiner harvest coming from southern Ontario, particularly from Lakes Simcoe and Erie;

most of the leeches come from northwestern Ontario and most Cisco come from northeastern Ontario.

4.0 Managing Ontario's Fisheries, Fish Communities and Supporting Ecosystems

The MNR has legislative responsibility for sustainably managing Ontario's natural resources, including fish. To meet its responsibility, the MNR uses a variety of policy, planning and management tools.

Legislation

The *Constitution Act, 1867* vests the legislative authority over sea coast and inland fisheries to the Parliament of Canada, and authority over natural resources, management and sale of public lands, and property and civil rights to the provinces. This division of responsibility has established the framework for the management of fisheries, fish communities and their supporting ecosystems in Ontario.

Fisheries management falls within the direct mandates of Fisheries and Oceans Canada (DFO) and the MNR; the mandates of some other authorities (e.g., Transport Canada, Ontario Ministry of the Environment, Conservation Authorities) also include aspects that relate to fisheries management. The primary Acts and regulations that apply to the management of fisheries and their habitats in Ontario are the *Fisheries Act*; the Ontario Fishery Regulations, 2007; the *Aboriginal Communal Fishing Licences Regulations*, 2009; and the *Fish and Wildlife Conservation Act, 1997*. There is additional federal and provincial legislation (Appendix 2), and national and international agreements, which help MNR and other authorities achieve their mandates to manage fish, fisheries and their supporting ecosystems in Ontario.

Strategic Direction

Currently, the management principles in *Our Sustainable Future: A Renewed Call to Action* (2011); *Ontario's Biodiversity Strategy: Protecting What Sustains Us* (2011); *Biodiversity: It's in our Nature* (2012); *MNR's Statement of Environmental Values*; the *Strategic Plan for Ontario's Fisheries II* (1992); the *Joint Strategic Plan for Management of Great Lakes Fisheries*; and the guiding principles that derive from these documents provide the strategic direction for managing fisheries, fish communities and their supporting ecosystems in Ontario. The draft *Provincial Fish Strategy* incorporates the strategic direction provided in the aforementioned documents.

Ontario's Strategic Direction for Managing Fisheries Resources

Our Sustainable Future: A Renewed Call to Action (OSF, 2011)

Our Sustainable Future sets out the long-term strategic directions and current priorities of the Ministry of Natural Resources. The Ministry first published its strategic directions in 1990 and has updated them every five or six years in order to ensure they address changes, issues and opportunities affecting Ontario's natural resources and respond to the needs of Ontario citizens.

Ontario's Biodiversity Strategy: Protecting What Sustains Us (OBS, 2011) and Biodiversity: It's in Our Nature (BIION, 2012)

Ontario's Biodiversity Strategy is the guiding framework for coordinating the conservation of our province's rich variety of life and ecosystems. The strategy helps Ontario do its part in relation to the *Canadian Biodiversity Strategy* and the *UN Convention on Biological Diversity* and was released by the Ontario Biodiversity Council. Biodiversity: It's in Our Nature is the implementation plan that sets out the action the government will undertake to contribute to the vision and goals outlined in the OBS.

MNR's Statement of Environmental Values (SEV)

The MNR's Statement of Environmental Values is required under the Environmental Bill of Rights. The SEV identifies the Ministry's commitment to the environment and documents its accountability for ensuring consideration of the environment in its decisions. The SEV explains how the purposes of the EBR will be applied when decisions that might significantly affect the environment are made by the MNR, and how consideration of the EBR will be integrated with other considerations – including social, economic and scientific – that are part of decision-making in the Ministry.

Strategic Plan for Ontario Fisheries II (SPOF II, 1992)

The original Strategic Plan for Ontario Fisheries (SPOF I) was developed in 1976 and provided a long-term plan for managing Ontario's fisheries resources. In 1989, the Ministry of Natural Resources, in consultation with the public, updated the Strategic Plan for Ontario Fisheries (SPOF II) for the 1990s and beyond. SPOF II identified the ecological, economic, and social values we place on our fisheries, and mapped out a course of action to sustain aquatic ecosystems for the future.

Joint Strategic Plan for Management of Great Lakes Fisheries (JSPMGLF, 1997)

The Joint Strategic Plan for Management of Great Lakes Fisheries is a voluntary, multi-jurisdictional agreement signed by Canadian, U.S. and U.S. Tribal resource management agencies. The Joint Strategic Plan fosters cooperation among the jurisdictions, development of shared fish community objectives, data sharing, and adherence to ecosystem management. Implementation of the Plan is facilitated by the Great Lakes Fishery Commission.

Managing Fisheries

As the lead planning agency for fisheries management in Ontario, the MNR is responsible for: policy, planning and program development; allocation of fish to Aboriginal, recreational, commercial and baitfish fisheries; managing fisheries using regulations and licensing; enforcing fishing regulations and relevant legislation; fish culture and stocking; species at risk and invasive species management; and fish habitat rehabilitation.

Scale of Management

Fisheries management in Ontario operates at a number of spatial and temporal scales depending on the type of fishery (e.g., recreational or commercial) and the nature of any stresses impacting the fishery. Historically, recreational fisheries management occurred across 37 Fishing Divisions, but, over time, a sharp rise in individual lake fishing exceptions to Division-wide regulations occurred. Thus, fishing regulations were frequently focused on individual lakes. This approach was both costly and ineffective, in part because it failed to recognize the mobility of anglers; when more restrictive regulations are put in place, for example, fishing pressure tends to shift to other waterbodies (Lester et al. 2003).

In January 2008, 20 Fisheries Management Zones (FMZs) replaced the former 37 Fishing Divisions (Figure 2) as the spatial unit for management; this change to landscape-scale management was a key component of the *Ecological Framework for Fisheries Management* (OMNR, 2005). The new FMZ boundaries are based on ecological factors and angler use patterns, such as the provincial climate zones, watersheds, fishing pressure and road networks. These landscape-scale zones are now the unit of planning and management for most recreational fisheries in Ontario. Ontario's recreational fisheries for both native and naturalized sport fishes are managed through fishing regulations, such as catch limits, closed seasons and gear restrictions, which are applied at the zone level, although exceptions to the regulations do exist for some lakes. Typically, fish are also monitored and assessed at the zone level. However, higher risk fisheries or those with significant social, economic and ecological value may continue to be managed on an individual lake basis within the context of zone management. Examples of these intensively managed fisheries include those found on Lake Nipissing and Lake Simcoe.

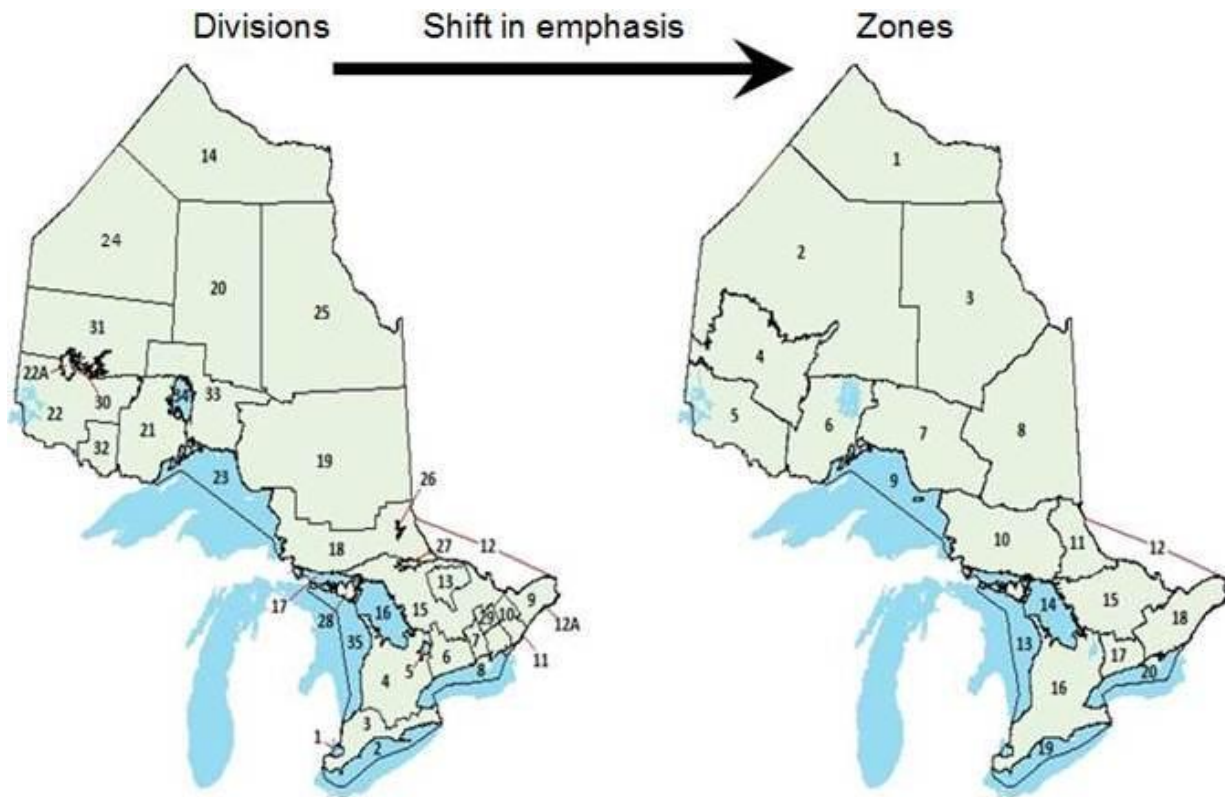


Figure 2: In 2008, Ontario's thirty-seven Fishing Divisions were replaced by twenty Fisheries Management Zones, providing the framework to manage fisheries on a landscape-scale.

The majority of Ontario's commercial food fisheries are on the Great Lakes. The Great Lakes Fishery Commission promotes and facilitates bi-national management of both commercial and recreational fisheries on these lakes. In terms of the commercial fishery, each Great Lake is partitioned into quota management zones (Figure 3); within the Canadian waters of each lake, the MNR issues licences, sets annual individual species catch quotas and monitors harvests by commercial fishermen within those quota management zones. Management of inland commercial food fisheries is mostly at the spatial scale of the lake. On each lake, the MNR issues licenses and sets annual individual species catch quotas; monitoring of the harvest also occurs, but is currently less intensive than that conducted on the Great Lakes.

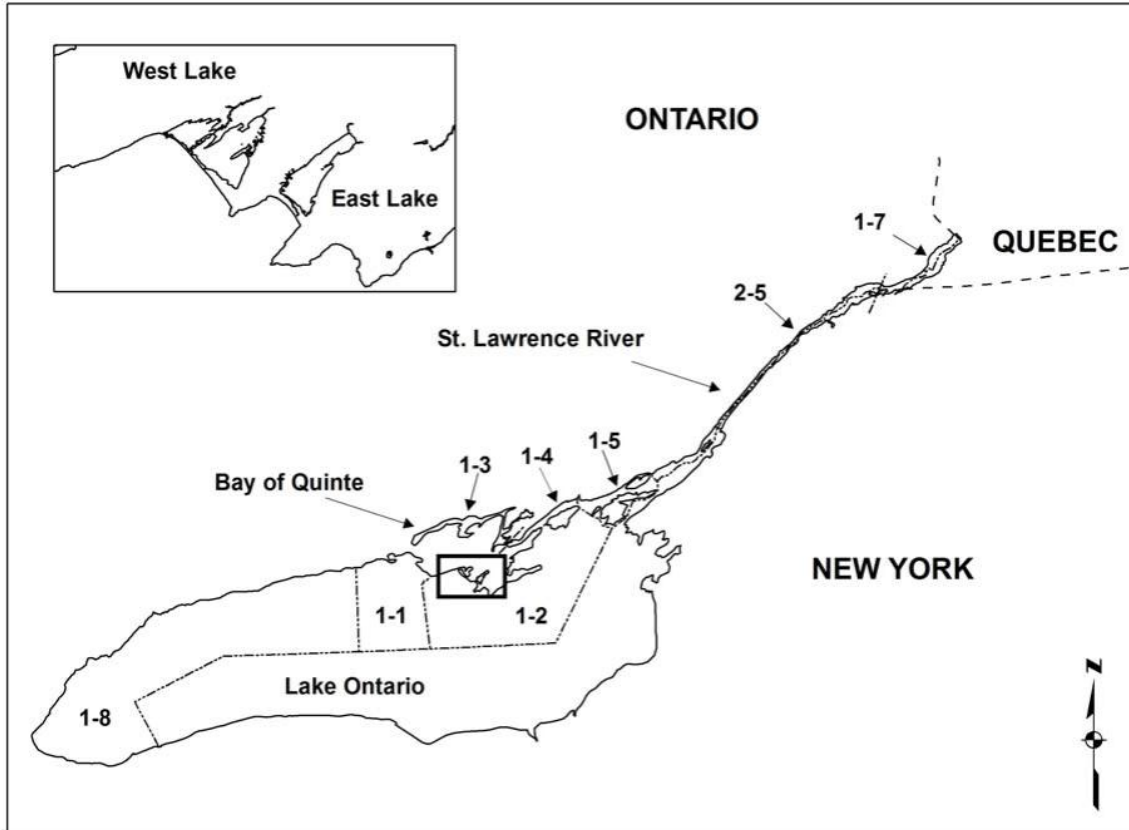


Figure 3: Commercial Fish Quota Zones in Lake Ontario and the St. Lawrence River, illustrating how the Great Lakes are partitioned into quota management zones for commercial fisheries management.

The commercial baitfish industry in Ontario is currently managed on the basis of over 3000 Bait Harvest Areas (BHA) (Figure 4). The standard size of a BHA in most MNR Districts throughout the province is the Township, Mercator Block or Base-map Block, although some Districts use watershed boundaries or have divided townships into smaller blocks and licence them separately. In some areas, such as private property, the BHA may be as small as a single pond. Individual bait harvesters are licenced for one or multiple BHAs.

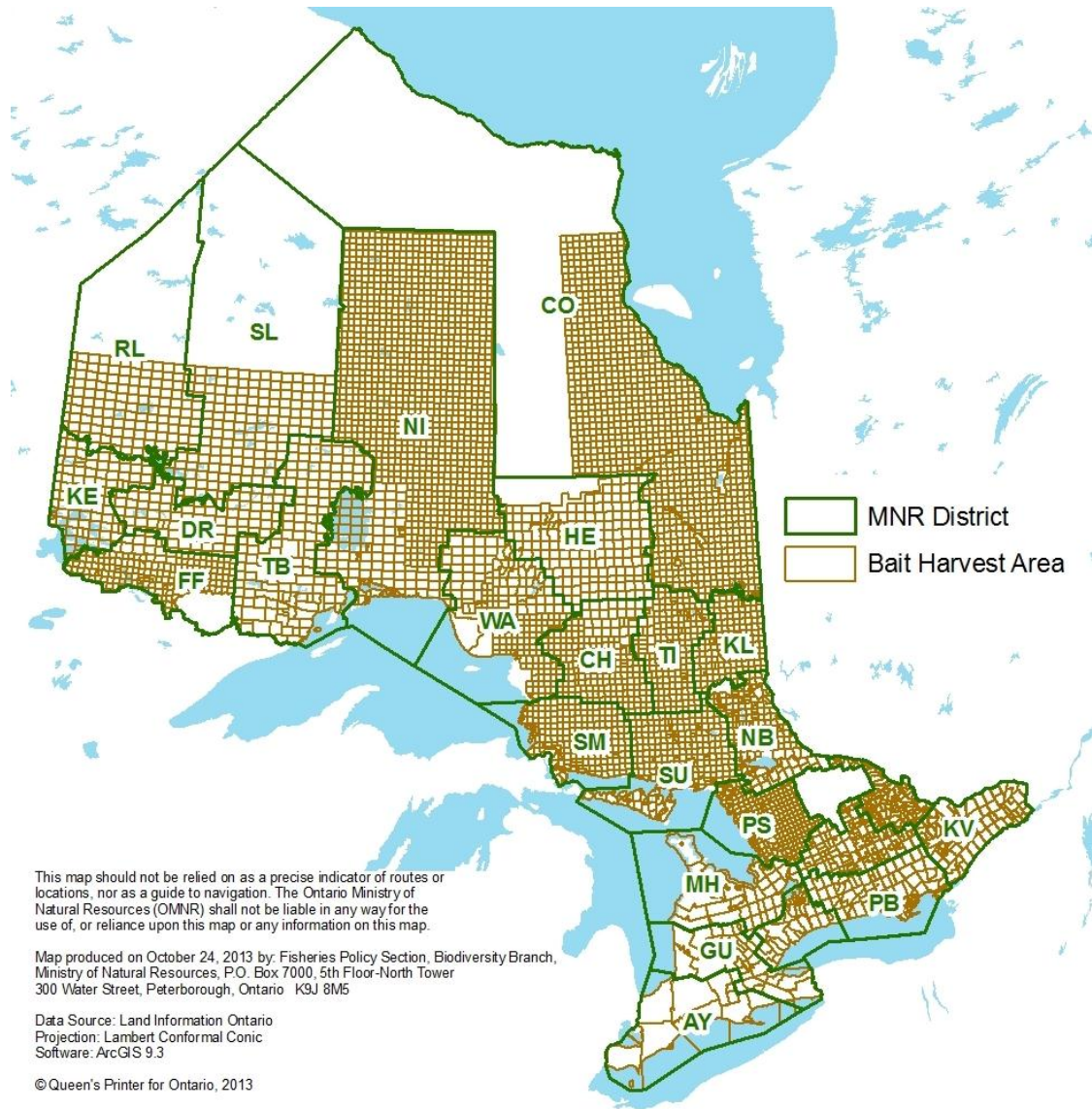


Figure 4: Bait Harvest Areas overlaid atop MNR Districts.

Fisheries Management Planning

Historically, fisheries management planning used administrative boundaries (i.e., MNR Districts) as its spatial unit. District Fisheries Management Plans were developed by MNR to guide fisheries management in all Ontario waters, within the framework of the SPOF I. District fisheries management planning began in the mid-1980s and the plans served to identify issues, strategies and actions, such as stocking, seasons and limits, for management of fisheries resources. Implementation of the plans resulted in an unprecedented increase in the number and complexity of angling regulations as a result of a management approach that focused on individual lakes and rivers. All District Fisheries Management Plans are in the process of being replaced by FMZ Plans (or

plans at other spatial planning scales), which identify objectives and strategies for managing fisheries in each FMZ; consistent with direction from the *Ecological Framework for Fisheries Management*, MNR produces FMZ Plans in consultation with FMZ Advisory Councils. Within some FMZs, fisheries that are considered higher risk or are of significant social, economic and ecological value may continue to be managed on an individual basis (e.g., Lake Nipissing, Lake Simcoe).

The fisheries management planning undertaken for each of the Great Lakes FMZs recognizes the bi-national nature, size and ecological complexity of these lakes. This planning has been guided by the Great Lakes Fishery Commission's (GLFC) *Joint Strategic Plan for Management of Great Lakes Fisheries* that was first adopted by Canadian and U.S. jurisdictions in 1981. As part of a commitment under the GLFC, specific fish community objectives for each Great Lake have been developed and agreed upon, and are reviewed periodically by the joint management agencies, which include MNR.

Management of Ontario's recreational and commercial fisheries occurs through an adaptive management framework. Adaptive management is a systematic process of continuously improving management approaches and policies over time. It involves monitoring the results of management actions, periodically adjusting those actions as understanding of the managed system improves or the level of risk to the resource changes. Adaptive management acknowledges that there is uncertainty about how natural systems work and how they may respond to management interventions, and provides a mechanism for continuous improvement of management decisions over time.

Monitoring and Reporting

Monitoring is critical to managing fisheries under an adaptive framework. Monitoring supports fisheries management and evaluates the success of fisheries management by: estimating current status, trends, and changes in Ontario's fish resources, including the effect of management actions on those parameters; describing the geographic coverage, extent and characteristics of aquatic resources in Ontario; seeking associations between natural and anthropogenic stresses and the condition of aquatic resources; providing information for periodic reports on the state of aquatic resources in Ontario; and helping MNR anticipate the future needs of the organization. Monitoring is essential for determining if current management actions require adjustment and for informing policy development and implementation decisions.

Several different types of monitoring activities are required to support management of fisheries and aquatic resources depending on the objectives and scale, and these different monitoring activities are dependent on each other. In addition to supporting fisheries and aquatic resources management, the data and information collected by

monitoring fish resources and aquatic ecosystems supports other related MNR priorities, such as the maintenance of biological diversity.

MNR conducts long-term intensive fisheries monitoring for the Great Lakes and selected inland lakes, and landscape level broad-scale monitoring for inland lakes. A small number of targeted monitoring programs are nested within this framework. Targeted monitoring may be required when there is a need to track the response of a particular feature or species, such as a species at risk. Targeted monitoring should only be undertaken within an adaptive management context, and only when dictated by risk. It must have a clear rationale, focused and measurable objectives, and must be carried out using science-based protocols. At present time, no standard program exists for monitoring flowing waters in Ontario, although there is a program for monitoring and assessing fish communities in non-wadeable rivers, and another for evaluating benthic macroinvertebrates, fish communities, physical habitat and water temperatures in wadeable streams (i.e., *Ontario Stream Assessment Protocol*).

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Science and Monitoring to Support Fisheries Management: Some Examples

Broad-scale Monitoring (BsM): A monitoring program applied to inland lakes across the province to collect basic information on fish populations and aquatic habitat, and a key component of the *Ecological Framework for Fisheries Management*. It provides MNR fisheries managers and Fisheries Management Zone Advisory Councils with the necessary information for setting management objectives, developing management strategies and measuring the performance of management actions. The information collected by the program is also used in reports to the public on the status of fisheries in Ontario.

Intensive Monitoring: MNR continues to intensively monitor selected lakes (including the Great Lakes) to collect detailed data on a smaller number of water bodies in Ontario. The Fisheries Assessment Unit Network, which was established after SPOF I, became an important component of this intensive monitoring system; the Network was designed to routinely monitor the response of fish communities to various stresses and levels of stress. A variety of netting standards, such as Fall Walleye Index Netting and End of Spring Trap Netting, were developed to collect monitoring data. The information derived from intensive monitoring is important for managing very large and economically important fisheries, and for supporting and interpreting the data from broad-scale monitoring.

Riverine Index Netting (RIN): A monitoring protocol used for assessing fish populations and communities in medium to large non-wadable rivers. It is one of only a few methods that exist for monitoring non-wadable rivers in the world. The information obtained from monitoring is important for reporting on the status of fish populations and communities, as well as for the future development of additional riverine sampling and monitoring methodologies.

(Source: MNR monitoring protocols)

Allocation and Licensing

Ontario's first priority in allocation is the conservation of the fisheries resource. After conservation, existing Aboriginal and treaty rights to fish for food, social and ceremonial purposes take priority over other uses. Where there are existing Aboriginal commercial fishing rights, the MNR endeavours to allocate in accordance with its understanding of case law. Remaining available fish are managed for the benefit of recreational, commercial food and bait fisheries.

Direct allocation of fisheries resources through the use of licensing regulations is largely confined to the management of Ontario's commercial food fisheries. For Ontario's

recreational fisheries, the allocation of fisheries resources implicitly occurs through both fishing licences issued to individual fishers and fishing regulations. However, the regulations do not specify where a fisher may catch and harvest those fish, resulting in essentially open access fisheries for recreationally harvested fish species in Ontario.

Commercial fishing licences, which are issued under the *Fish and Wildlife Conservation Act, 1997*, have specific quotas that limit the amount (kg) and species of fish that can be harvested. The sum of all quotas constitutes a formal allocation of fish to this user group. Commercial quotas can be applied to a complete waterbody, or they may be applied to an area within a waterbody, such as is done on the Great Lakes and other large waterbodies. The number of commercial fisheries on a waterbody is also controlled. The number of licences that are issued on a particular waterbody is based on the level of harvest that fish populations can sustain over the long-term and the current level of harvest by other user groups.

In terms of commercial bait fisheries, there is no limit on the number or amount of legal baitfishes that may be harvested. Instead, allocation is through an exclusive use block system based on the BHA.

Regulations

For many fish species, the province establishes catch and possession limits, size limits, fishing seasons and the fishing gear that can be used by recreational and commercial fishers. The type of measures applied depends on the zone fishery objectives and the state of the fishery, and are intended to help ensure sustainable use of the fisheries resource. In recent years, the MNR has undertaken a review to reduce the number of recreational fishing regulations by streamlining them across FMZs and to ensure they are effective and are achieving fisheries objectives. Regulatory guidelines, known as toolkits, have been developed for most major sport fish species to provide a series of broad-scale regulatory options to ensure seasons and catch limits are standardized.

Recreational fisheries are primarily regulated by the Ontario Fishery Regulations, 2007 (OFR) under the federal *Fisheries Act*. The OFR lay out basic controls for fishing in Ontario, such as bait and gear restrictions, acceptable non-angling methods, size limits and transport of fish. In addition, broad overarching close times and catch and possession limits for fish species are set out in schedules to the OFR.

Commercial food fisheries in Ontario are primarily regulated through conditions attached to the commercial fishing licence and by the OFR under the federal *Fisheries Act*. Conditions can be used to restrict the commercial fishing activity of licence holders to a specified area within a waterbody; licence conditions can also indicate the time of year when species can be harvested, the quantity of fish that may be harvested, the requirement to keep a daily catch report and the type of capture equipment that can be

used. Licence conditions can also include the size of fish that may be harvested, as some sizes may carry high levels of contaminants. Regulations can relate to the type of gear markings required on certain waterbodies, fishing close times and the permittance of observers to monitor activities and review records aboard a licensed commercial fishing vessel.

Commercial bait fisheries are regulated by the conditions attached to the commercial bait licence and by the OFR under the federal *Fisheries Act*. Annual reporting of bait harvest and sales information is mandatory, and there are restrictions on which fish species may legally be used as bait. Recently, requirements for training and development of Hazard Analysis and Critical Control Point plans have come into effect, as have restrictions on the movement of live baitfish in some areas.

Compliance

Conservation Officers support fisheries management primarily by promoting compliance with the *Fish and Wildlife Conservation Act, 1997*, the Ontario Fishery Regulations, 2007 and the federal *Fisheries Act*. Regulatory compliance is achieved through activities ranging from outreach and education to field inspections and prosecutions.

Enforcement priorities are set as part of an annual planning process. Fisheries managers and enforcement specialists determine which activities that pose risks can be managed by compliance and enforcement actions. Priorities are then set on the basis of risk posed to human health and safety, natural resources, the economy and social/cultural values.

Responsible Fishing Practices

Fishing activities can have potentially negative impacts on the target fish population and/or on species associated with or dependent on the targeted population (such as predators or prey). Fishing can also impact the habitats in which it occurs. The introduction and transfer of alien and invasive species through the release of live bait and by moving boats between lakes is another potentially negative impact of fishing that can have ecological, social and economic consequences.

To minimize the direct and indirect impacts of fishing, the MNR promotes responsible fishing practices in addition to licensing requirements and regulations. The MNR works with its partners, stakeholders and academia to review and update these policies and practices as necessary.

Research and Development

As a science-based Ministry, the MNR is dependent on scientific and technical information to carry out its mandate. Research and development conducted or supported by the MNR is designed to meet the scientific needs of natural resources

policy development and management activities. Applied research in the fields of fisheries and aquatic ecology, for instance, has informed development of regulations and policies directly related to recreational fishing and shoreline development. Research in terrestrial fields, such as forestry, has led to improved management guidelines that minimize or avoid adverse impacts to aquatic ecosystems. MNR researchers and their partners are also providing scientific support to a growing diversity of aquatic research questions, including species at risk, renewable energy, climate change, and biodiversity conservation.

Fish Stocking

Since before Confederation, the stocking of artificially propagated fish and the transfer of wild fish have played an important role in fisheries management in Ontario. Fish stocking and transfers can meet a variety of objectives, including rehabilitation of a depressed population and provision of new, more diversified angling opportunities that reduce the pressure on native populations. In the future, there may be an opportunity to also employ stocking as a tool in the recovery of species at risk. The MNR has developed the *Guidelines for Stocking Fish in Inland Waters of Ontario* to ensure that all stocking activities are conducted in an ecologically responsible manner.

The MNR currently operates nine provincial fish culture stations to support these various objectives. These fish culture stations annually produce about 8 million fish consisting of 11 different species. Two thousand water bodies are stocked on a four year cycle, and stocking is generally split 50:50 between the Great Lakes and inland lakes. Sixty percent of the stock is used for rehabilitation of native populations and genetic stocks to re-establish self-sustaining populations, and the remaining 40% to create, maintain or enhance recreational fisheries (e.g., put-grow-take).

MNR fish culture stations and partner hatcheries provide varied combinations of Lake Trout, Brown Trout, Rainbow Trout, Chinook Salmon, Coho Salmon, Atlantic Salmon and Walleye for the Great Lakes. Lake Whitefish, Lake Trout, Brook Trout, Aurora Trout (*Salvelinus fontinalis timagamiensis*), Rainbow Trout, Brown Trout, Walleye, Muskellunge and F1 Splake (*Salvelinus fontinalis* x *Salvelinus namaycush*) – the sterile, hybrid offspring that results when a male Brook Trout is crossed with a female Lake Trout – are provided for numerous inland lakes.

Genetic conservation and stock restorations are also very important components of the MNR's fish culture program. For example, the fish culture system helped to save the Aurora Trout from extinction due to acid-stressed environmental conditions. Lake Simcoe Lake Trout and Lake Whitefish populations are also being preserved through annual wild spawn collections and stocking activities, and Great Lakes Lake Trout stocks are also being restored.

Fish Health

In the wild, fish are susceptible to a number of stresses, such as disease pathogens, natural physiological stress and extremes in environmental conditions, including warm water temperatures and low concentrations of dissolved oxygen. All of these factors can result in fish die-offs. While some fish die-offs are expected, such as those caused by stress due to spawning, reports from the public are important to help the MNR identify die-offs associated with fish diseases. For this reason, the MNR encourages the reporting of all die-offs and maintains a toll-free reporting line through which members of the public can report and provide information on die-offs. The MNR also conducts surveillance for fish disease, namely viral hemorrhagic septicemia (VHS), in partnership with the Canadian Food Inspection Agency. Surveillance activities include sampling high risk lakes, sampling any die-offs, and conducting random sampling across the province.

Fish die-offs found to be caused by disease are treated very seriously. The MNR has taken specific steps to slow the spread of certain fish diseases, such as VHS, and to advise anglers on how to protect Ontario's fisheries and fish communities. For instance, to slow the spread of VHS from waters in which it has been detected, the MNR established two special management zones, the VHS Management Zone and the Lake Simcoe Management Zone, and applied management actions to each. To date, these actions have included prohibiting commercial bait operators from moving live baitfish out of the VHS Management Zone, and from moving baitfish (live or dead) into or out of the Lake Simcoe Management Zone.

Food Fish Safety

The MNR administers the *Fish Inspection Act (Ontario), 1990*, which, together with Quality Control Regulation 456, establishes standards for the handling and processing of fish. The *Fish Inspection Act* and its regulations prohibit the sale of tainted, decomposed or unwholesome fish for human consumption, and set out standards for the safe handling and processing of fish at licensed facilities, as well as for facility design and operation.

MNR currently administers an interim food fish safety program that includes audits of non-federally registered fish processors. The MNR program was designed to protect human health until new legislation that includes fish is developed under Ontario's *Food Safety and Quality Act, 2001*, and a new Ontario fish inspection program is implemented.

The *Guide to Eating Ontario Sport Fish* gives guidelines for eating sport fish in waterbodies throughout Ontario. The MNR and Ontario Ministry of the Environment collect fish that are then analyzed for a variety of substances, including mercury, PCBs,

mirex, DDT and dioxins. The results are used to develop advisory tables that give size-specific consumption advice for fish species tested from each waterbody.

Guide to Eating Ontario Sport Fish

Ontario's program for monitoring contaminants in sport fish was initiated in 1976, and is led by the Ontario Ministry of the Environment (MOE). The Guide to Eating Ontario Sport Fish is published every two years to provide detailed information on the quantities of Ontario sport fish that can be consumed based on Health Canada guidelines.

(Source: MOE)

Managing for Fish Communities

Invasive Species Prevention and Management

Invasive species are a serious threat to aquatic biodiversity in Ontario and are a major cause of declines in abundance of some native species. In Canada, the top pathways for introduction of aquatic invasive species include shipping; recreational and commercial boating; use of live bait for fishing; the aquarium and water garden trade; live food fish; unauthorized introductions; and canal and water diversions.

The introduction of invasive species, including the Zebra Mussel (*Dreissena polymorpha*), Sea Lamprey (*Petromyzon marinus*) and Round Goby, has resulted in significant negative ecological, economic and social consequences. Many invasive species have negatively affected native fish communities and the important recreational and commercial fisheries that depend on them. Sea Lamprey, for instance, strongly contributed to the significant declines in both Lake Trout populations and their associated fisheries on the Great Lakes. Further, an invasive species is almost always a permanent liability to society, and can require costly control in perpetuity. For example, the invasion of the Zebra Mussel has resulted in hundreds of millions of dollars in control and maintenance costs for industrial water users.

In addition, some native species have established populations in aquatic ecosystems in which they were not historically present. The most likely pathways for these introductions have included unauthorized or ill-advised stocking and use of live bait for fishing. The introduction of species such as Smallmouth Bass, Rock Bass and Yellow Perch has, in many cases, disrupted the native fish community and negatively impacted highly valued sport fish species such as Brook Trout and Lake Trout. In the case of Smallmouth Bass and Rock Bass, they have reduced the diversity and abundance of native prey fishes in the shallow waters of pristine Ontario lakes through predation. In these same lakes, Smallmouth Bass and Rock Bass compete with Lake Trout for

access to the remaining shallow water prey fish, forcing Lake Trout to eat less nutritious prey (Vander Zanden et al. 1999); this type of food web change can have severe impacts on Lake Trout populations, including reduced growth and reproductive success. In the case of Yellow Perch, competition with Brook Trout for bottom-dwelling prey in small, undisturbed lakes has resulted in Brook Trout shifting its diet to less nutritious prey. This diet shift has had population level impacts, with Brook Trout being fewer in number and slower in growth than before competition with Yellow Perch (Fraser 1978; Browne 2009).

Ontario's program to help prevent the introduction and spread of invasive species includes research, monitoring, education and outreach, prevention initiatives, control and containment, and collaboration with other jurisdictions, agencies and organizations. MNR works with numerous government and non-government partners to focus efforts on addressing the pathways of introduction and managing the spread through strategic management involving: legislation, regulation and compliance monitoring; risk management, including risk assessment, early detection and rapid response; engagement of Ontarians to promote stewardship, education and awareness; and science-based monitoring and research.

The Ontario Invasive Species Strategic Plan

The Ontario Invasive Species Strategic Plan outlines Ontario's approach to the prevention, early detection and rapid response to new invasive species, and the effective management of existing invasive species.

Under the Plan, invasive species are defined as harmful alien species whose introduction or spread threatens the environment, the economy, or society, including human health. A species can be considered invasive even if it is native to Ontario, provided it has been introduced beyond its natural range due to human activity. A species may also be considered invasive if its introduction or spread can be linked to our changing climate.

Where a native species is considered invasive, local management plans (e.g., FMZ Plans) can be used to identify specific management objectives and strategies to minimize the impact and spread of the species.

Species at Risk Recovery Planning

The Species at Risk in Ontario (SARO) list is an important tool for recovery planning that falls under the provincial *Endangered Species Act, 2007*. Planning for the recovery of species at risk involves the development and implementation of recovery strategies. Such strategies are dynamic, science-based documents that provide recommendations on how best to recover threatened, endangered and extirpated species. Developing and

implementing recovery strategies involves the efforts of many, often including government agencies, the academic community, taxonomic experts, Aboriginal peoples, stakeholder groups and members of the public. Species listed as being of special concern are managed through the actions outlined in management plans.

How are Species listed "at risk"?

In Ontario, species that may be at risk are reviewed by a team of experts known as the Committee on the Status of Species at Risk in Ontario (COSSARO). COSSARO can be made up of people with expertise in certain scientific disciplines or Aboriginal Traditional Knowledge.

The committee's responsibilities include:

- Classifying species;
- Maintaining criteria for assessing and classifying species at risk;
- Maintaining a list of species to be assessed in the future; and
- Reporting classifications to the Minister of Natural Resources.

COSSARO was established in 1995, but was only recognized legally as a committee with the introduction of the *Endangered Species Act* in 2007. COSSARO is an independent body composed of members from both the public and private sectors. The Minister of Natural Resources may make recommendations on committee members, but the final decision on who can be a member is made by the Lieutenant Governor in Council.

COSSARO must classify each "at risk" species into one of five categories:

- Extinct: no longer lives anywhere in the world;
- Extirpated: lives somewhere in the world, and at one time lived in the wild in Ontario, but no longer lives in the wild in Ontario;
- Endangered: lives in the wild in Ontario, but is facing imminent extinction or extirpation;
- Threatened: lives in the wild in Ontario, is not endangered, but is likely to become endangered if steps are not taken to address factors threatening it; or
- Special Concern: lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered due to a combination of biological characteristics and identified threats.

(Source: MNR Website)

There is a long history of cooperation on species at risk management among federal and provincial government agencies. Fisheries and Oceans Canada is the lead agency for fishes at risk that are listed under Schedule 1 of the federal *Species at Risk Act* (SARA), 2002, and leads the development and implementation of recovery strategies for these species in cooperation with the MNR and other partners. Recovery of fishes at

risk that are listed under the ESA, but not SARA, is led by MNR. For fishes listed under both *Acts*, there is cooperation on the development and implementation of recovery strategies.

Although recovery planning has traditionally focused on individual species (e.g., Recovery Strategy for Redside Dace), there has been a shift toward using a broader multi-species or ecosystem-level recovery approach that may prove more effective and economical. For example, watershed recovery plans have been developed by multi-agency recovery teams to address threats and outline approaches to protect aquatic species and their habitats (e.g., Sydenham River and Ausable River Recovery Strategies). Also, multi-species plans may be developed for species with similar traits, habitat requirements, distributions and/or vulnerability to key threats (e.g., Multi-Turtle Recovery Strategy, mussel recovery strategies).

The finalization of a recovery strategy triggers the requirement for the Government of Ontario to develop a government response statement. A response statement provides the government's goal for the recovery of the species and a summary of the prioritized action that it intends to take in response to the associated recovery strategy.

Recovery of Native Populations

Efforts to recover fish species and fish communities are not limited to those that are listed under endangered species legislation. Lake Trout is one species that, while still wide-spread across its Ontario range, has suffered local declines due to a number of different factors, specifically: acid precipitation in the Sudbury basin; eutrophication in Lake Simcoe; and the combined effects of over-exploitation and sea lamprey in the Great Lakes. Recovery efforts are underway in all of these areas to restore self-sustaining populations of this top predator.

The MNR cannot affect the recovery of a species without contributions from partners. These contributions cover a broad range of recovery needs, depending on the project specifics. Habitat restoration projects often occur at the grassroots level, with individual property owners demonstrating a stewardship ethic. These relatively small projects can help recover local fish populations. In the case of the Lake Simcoe Muskellunge restoration program, the culture of fish in non-government hatchery facilities is a key component to the success of the project. On a broader scale, it was only through the contribution of partners that appropriate funding was acquired and coordinated to enable the Lake Ontario Atlantic Salmon Restoration Program. Partners can also play a key role in the advocacy for species, fish communities and their supporting ecosystems as priorities for Ontarians.

Managing for Supporting Ecosystems

Habitat Protection and Rehabilitation

Fish habitat includes spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes. The federal *Fisheries Act* is the principle statute used to protect fish habitat in Canada, and is administered by Fisheries and Oceans Canada.

The *Provincial Policy Statement (PPS)*, which is issued under the *Planning Act, 1990*, integrates all provincial ministries' land use interests related to municipal planning and development. While the Ministry of Municipal Affairs and Housing has overall responsibility for the PPS, MNR has the lead for the policies and the provision of technical advice regarding the protection of fish habitat. MNR's *Natural Heritage Reference Manual* is a key tool for the delivery of such technical advice.

In addition to habitat protection, MNR supports habitat restoration, rehabilitation and enhancement projects that benefit fish and other aquatic organisms. For example, the Land Stewardship and Habitat Restoration Program offers eligible organizations funding to undertake projects that support biodiversity conservation, such as riparian plantings and fish habitat enhancement. This work helps to ensure the sustainability of healthy habitats over the long-term.

(Note: The Government of Canada recently made changes to the federal *Fisheries Act*. This will result in changes to how fish habitat is managed in Ontario.)

Resource Management Planning

The MNR leads many resource management planning initiatives. Resource management planning is an exercise that outlines how a particular resource will be used, developed or conserved. Because resource management activities can impact aquatic ecosystems, the MNR has developed standards, guidelines and best management practices for these activities.

One example of a resource management planning initiative led by the MNR is forest management planning. The *Crown Forest Sustainability Act, 1994*, is administered by the MNR and provides protection for environmental, social and economic values. Under the *Act*, forestry operations must follow Forest Management Plans and adhere to site-specific environmental protection requirements in and around water to protect fish habitat. As well, operational policies, such as the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* and the *Environmental Guidelines for Access Roads and Water Crossings*, provide direction on various aspects of conserving biodiversity, including aquatic habitats.

The MNR also leads land use planning, under the authority of the *Public Lands Act, 1990*, to determine appropriate land uses on Crown lands. Among other things, land use planning establishes broad direction for resource activities and road access, which may both impact fisheries and aquatic ecosystems. Land use planning also identifies areas with potential for some types of development. This direction is reflected in the *Crown Land Use Policy Atlas*.

Protected Areas

Ontario's system of protected areas (i.e., Provincial Parks and Conservation Reserves) are designed to protect representative ecosystems, biodiversity and provincially significant elements of Ontario's natural and cultural heritage, and are managed to ensure that ecological integrity is maintained or enhanced. In addition, protected areas provide opportunities for compatible, ecologically sustainable recreation.

A variety of aquatic ecosystems are protected in provincial parks and conservation reserves. Protected areas contain about 6% of Ontario's aquatic habitats, including inland lakes, rivers and coastal wetlands. These areas support a variety of fishing opportunities and experiences, as well as associated economic benefits. In addition, protected areas can act as benchmarks for aquatic and fisheries research and monitoring.

The *Far North Act, 2010* sets out an objective to protect at least half of the Far North of Ontario in an interconnected network of protected areas identified through a joint land-use planning process between First Nations and the Government of Ontario. To accomplish this, the *Act* provides a legislative foundation to develop Community Based Land Use Plans that will identify areas to be protected and areas for potential sustainable development opportunities.

In addition, the Government of Canada maintains a system of National Parks and a system of Marine Protected Areas across Canada. In Ontario, several of these protected areas contribute to conserving Ontario's biodiversity and representative ecosystems, including Lake Superior National Marine Conservation Area and Fathom Five National Marine Park, which protect both ecological and cultural values on the Great Lakes.

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Appendix 1: Glossary

Glossary A to E

Adaptive Management: A systematic approach to improving management and accommodating change by learning from the outcome of management interventions.

Allocation: Assignment of aquatic resources for fish production and other water uses. This includes providing for sufficient numbers of fish to escape harvest in order to perpetuate the fishery as well as assigning a portion of the annual allowable yield to a group or individual.

Alien Species: Species of plants, animals and micro-organisms introduced by human action outside their natural past or present distribution.

Aquatic Species: A wildlife species that is a fish, as defined in Section 2 of the *Fisheries Act*, or a marine plant, as defined by Section 47 of that Act.

Biodiversity: The natural variety and variability among all living organisms from all sources, including among other things, terrestrial, marine and other aquatic ecosystems, the ecological complexes in which they naturally occur, and the ways in which they interact with the physical environment. Biodiversity includes the diversity of genes, populations and species, and communities and ecosystems.

Climate Change: Any change in climate over time due to natural variability or as a result of human activity.

Community: An assemblage or group of species that interact together in a common area.

Conservation: The management of the human use of natural resources so they may yield the greatest sustainable benefit to current generations, while maintaining the potential to meet the needs of future generations. This may include consumptive and non-consumptive use without complete destruction or conversion. Thus, conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment.

Consumable Goods and Services: Expenditures on goods and services (e.g., food, camping, accommodation, transportation, supplies, etc.) incurred during fishing trips or excursions.

Diversity: The variety of species or communities found in a given region or habitat.

Ecological Framework for Fisheries Management: A fisheries management framework introduced in 2008 that had four basic pillars: (i) streamlined fisheries

regulations; (ii) creation of new Fisheries Management Zones; (iii) increased public involvement through creation of FMZ Councils; and (iv) development and implementation of a new state of the resource monitoring program. The EFFM represented a change in management approach from managing fisheries on an individual waterbody basis to a landscape-scale.

Ecosystem: A dynamic complex of plant, animal and micro-organism communities and their physical environment functioning as an ecological unit.

Ecozone: An area of the Earth's surface that represents a large ecological zone with characteristic natural features and climate. Ecozones are distinguished from one another by their unique mosaics of plants, wildlife, climate, landforms and human activities.

Glossary E to L

Environmental Bill of Rights: Ontario's Environmental Bill of Rights was proclaimed in 1994. The purposes of this Act are: to protect, conserve and where reasonable, restore the integrity of the environment; to provide sustainability of the environment by the means provided in the Act; and to protect the right to a healthful environment by the means provided in the Act.

Eutrophication: Abundant accumulation of nutrients in a waterbody that cause excessive plant growth.

Fish: Includes parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals (as defined in the Fisheries Act).

Fisheries Assessment Unit Network: A network of lakes selected on the basis of their species composition in which the response of fish communities to various stresses and levels of stress is monitored routinely.

Fishery: A term that is usually used to describe the human use of a group of fish, and can include the catching, preparing and selling fish.

Fishery Resources: A fish stock recognized by humans to be of current or potential value and that humans can use for benefit or gain.

Great Lakes: The five Laurentian Great Lakes (Lakes Superior, Huron, Michigan, Erie, Ontario).

Introduction: The entry of an organism to a geographic region, brought about by human action, resulting in the establishment of a population.

Invasive Species: Alien species whose introduction or spread threatens the environment, the economy, and/or society, including human health.

Investment Goods: Expenditures on durable goods (e.g., boats, motors, special vehicles, camping gear, land, buildings, etc.) in support of recreational fishing activities.

Lake: A standing body of water, including a pond.

Landscapes: Complexes of ecosystems in geographically defined areas.

Loading: The amount (concentration multiplied by flow rate) of a substance being emitted or discharged.

Glossary N to R

Native Species: Species that are naturally occurring in a region or have migrated into the region and established without having been transported by human actions into the region, and without establishment being principally the result of human alterations of the region's environment.

Naturalized Species: Alien species that have established stable self-sustaining populations.

Protected Area: A clearly defined geographic space, recognized, dedicated and managed through legal or effective means to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

Protection: A commitment to protect individuals, a population or subpopulation or an ecosystem (or portions of one) from adverse impacts that may result in their loss.

Protection (of habitats): Prescribing guidelines and conditions, and enforcing laws for the purpose of preventing the harmful alteration, destruction or disruption of fish habitat.

Quota: A negotiated licence condition assigned to a commercial fishing licence that states the quantity of fish of different species that may be legally landed.

Recovery: An action that is taken to reduce or eliminate a condition or circumstance that causes a species to be listed as threatened, endangered or extirpated.

Recovery (of ecosystems): An action that is taken to reduce or eliminate a condition or circumstance that causes an ecosystem to be degraded, for the purpose of increasing its capacity to sustain a productive fisheries resource.

Rehabilitation: The return of a species, a population or an ecosystem to a healthy, functioning state.

Restoration: The return of a species, a population or an ecosystem to its state prior to a disturbance.

Restoration (of habitats): The treatment or clean-up of fish habitat that has been altered, disrupted or degraded for the purpose of increasing its capability to sustain a productive fisheries resource.

Riparian: The areas of vegetation on the banks/sides of streams, rivers and other bodies of water. These areas help remove sediments from water, reduce erosion and flooding and support wildlife populations, including providing fisheries habitat.

Glossary R to W

Risk Assessment: The process of characterizing the likelihood of an unacceptable outcome and the magnitude of the consequences of that outcome. Likelihood may be determined qualitatively or quantitatively based on the type and amount of information available. The magnitude of the consequences can be measured in biological and socioeconomic terms.

River: A flowing body of water; including creeks, streams or brooks.

Science: Refers to research (i.e., the development and synthesis of fact based knowledge derived through rigorous scientific methods) and related activities such as monitoring and assessing resources, transferring science, and providing scientific advice. Both natural and social science are included in this definition.

Species: A group of genetically similar individuals which actually or potentially interbreed.

Species at Risk: Any wild plant or animal threatened by or vulnerable to extirpation or extinction in Ontario. Species at Risk are assigned a designation to represent the degree of imperilment (Special Concern, Threatened, Endangered or Extirpated).

Spread: Is the expansion of the geographical distribution of an organism within a geographical region.

Stewardship: An ethic that embodies cooperative planning and management of environmental resources in which individuals, organizations, communities and other groups actively engage in the prevention of habitat loss, as well as the facilitation of resource recovery and/or replenishment, usually with a focus on long-term sustainability.

Stress: A stimulus or succession of stimuli which, if of sufficient magnitude, will tend to disrupt the stability of a system.

Supporting Ecosystem: A dynamic complex of plant, animal and micro-organism communities and their physical environment functioning as an ecological unit. Ecosystems that support fish communities can have aquatic, wetland, riparian or terrestrial components.

Sustainable Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable Use: The use of natural resources in a way and at a rate that conserves an ecological balance without depleting or permanently damaging them, thereby maintaining the potential for future generations to meet their needs and aspirations. Sustainable use in this document refers to consumptive uses of biological resources.

Trophic Level: Classification of organisms in a community based on feeding relationships.

Watershed: The area of land that drains into a river, lake or other water body.

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Appendix 2: Legislation, regulation and agency responsibilities for management of fisheries, fish communities and their supporting ecosystems in Ontario

Legislation	Agency	Provisions related to fish
Federal Legislation and Regulations		
Canada National Parks Act, 2000	Parks Canada	Allows for park wardens to enforce Fisheries Act provisions on Park lands
Canadian Environmental Assessment Act, 2012	Environment Canada	Regulates the process to predict the environmental effects of proposed initiatives before they are carried out
Fisheries Act (Fisheries Protection Provisions)	Fisheries and Oceans Canada (& delegated authorities)	Regulates activities affecting fish and fish habitat, deposit of sediment and other deleterious substances
Ontario Fishery Regulations, 2007	Fisheries and Oceans Canada (& delegated authorities)	Regulates aspects of fisheries management in Ontario (including seasons, limits and methods)
Navigation Protection Act	Transport Canada	Regulates works built on, over, through or across any navigable water
Species at Risk Act, 2002	Environment Canada	Protects Species At Risk and the habitats critical for their survival
Provincial Legislation		
Beds of Navigable Waters Act, R.S.O. 1990	Ministry of Natural Resources	Regulates the beds of navigable waters on Crown Land
Conservation Authorities Act, R.S.O. 1990	Conservation Authorities	Furtheres the conservation and management of natural resources in watersheds; regulates floodplain management

<u>Drainage Act, R.S.O. 1990</u>	Ministry of Agriculture and Food	Permits individuals and municipalities to initiate and maintain drainage works
<u>Endangered Species Act, 2007</u>	Ministry of Natural Resources	Protects Species At Risk and their habitat
<u>Environmental Assessment Act, R.S.O. 1990</u>	Ministry of the Environment	Sets out requirements for the assessment of the effects on the environment of public and private projects
<u>Environmental Protection Act, R.S.O. 1990</u> (Beaches Protection Act)	Ministry of the Environment	Regulates the removal of sand and gravel from beaches
<u>Fish and Wildlife Conservation Act, 1997</u>	Ministry of Natural Resources	Complements the OFR, 2007 with provisions that relate to licensing, selling and possession of fish
<u>Fish Inspection Act, R.S.O. 1990</u>	Ministry of Natural Resources	Regulates the standards of fish processing and sale
<u>Food Safety and Quality Act, 2001</u>	Ministry of Agriculture and Food	Regulates the standards and quality of fish used for food
<u>Lakes and Rivers Improvement Act, R.S.O. 1990</u>	Ministry of Natural Resources	Regulates activities affecting lakes and rivers, including construction of water control structures
<u>Municipal Act, 2001</u>	Ministry of Municipal Affairs and Housing (Municipalities through enactment of by-laws)	Requires and regulates approvals for construction over municipal lands, including shore and other road allowances, whether dry land or flooded

<u>Nutrient Management Act, 2002</u>	Ministry of the Environment Ministry of Agriculture and Food	Enforcement of pollution prevention provisions Management of nutrients applied to agricultural lands
<u>Planning Act, R.S.O. 1990</u>	Ministry of Municipal Affairs and Housing (& delegated authorities)	Requires planning decisions to have regard to matters of provincial interest, such as the conservation & management of natural resources
<u>Ontario Water Resources Act, R.S.O. 1990</u>	Ministry of the Environment	Regulates discharge into waterbodies and withdrawal of water
<u>Public Lands Act, R.S.O. 1990</u>	Ministry of Natural Resources	Regulates land-use and development plans and alteration on shorelands

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