2003 Update
Fish Community Objectives for Lake Ontario

Introduction

Management of Great Lakes fisheries includes the development of fish community objectives ("FCO's") every five years by the agencies that share fisheries management responsibilities for each of the lakes. Following consultation to gather public input on the future of Lake Ontario fisheries during the winter of 1996/97, The New York State Department of Environmental Conservation (NYSDEC) and the Ontario Ministry of Natural Resources (OMNR) prepared "Fish Community Objectives For Lake Ontario" (Great Lakes Fishery Commission Special Publication 99-1). The FCO document summarizes scientific understanding of the major factors influencing Lake Ontario's fish communities, and specifies strategic objectives that have guided the management of Lake Ontario fisheries by NYSDEC and OMNR during the past five years.

We are currently seeking public input to help us review and, if appropriate, revise the existing FCO's. Please take time to review the current FCO document at **www.glfc.org/lakecom/loc/lochome.asp#pub** or contact the NYSDEC Cape Vincent Fisheries Station (P.O. Box 292, Cape Vincent, New York 13618 (315) 654-2147) to request a copy.

The discussion entitled "The Dilemma of Developing Fish Community Objectives" on pages 32 to 34 of the FCO document describes NYSDEC and OMNR's commitment to develop fish community objectives that are based on the most current and complete scientific understanding of the ecosystem, and are responsive to the social, economic, and cultural needs of Lake Ontario stakeholders. In 1996, stakeholders indicated a desire to "restore" the trophy trout and salmon fishery of the late 1980's through increased stocking of trout and salmon. Stakeholders also expressed support for restoration of native species and for an increase in naturally spawned or "wild" fish. In Lake Ontario, alewives in sufficient abundance are necessary to support a healthy trout and salmon fishery, however, alewives can also limit natural reproduction of native species. In addition, reductions in nutrients and changes to Lake Ontario food webs resulting from invasive (non-native) species have reduced the lake's capacity to produce alewives and support historic levels of trout and salmon fishing. Current stocking levels of trout and salmon are an attempt to balance between maintaining a quality trout and salmon fishery and minimizing the risk of creating a predator-prey imbalance that would jeopardize the alewife population. The conflicting roles of alewives and stakeholder desires present a fishery management dilemma

This "2003 Update" is a supplement to the current FCO document, and topics addressed here highlight the current status of the Lake Ontario fish community and factors affecting the fish community. In some cases, we have referenced page numbers in the existing FCO document to avoid repetition and to encourage the reader to pursue these topics further.

Guiding Principles (pages 8-9) This important set of "values" commonly held by NYSDEC and OMNR provides the foundation on which our respective fisheries management programs are based.

Habitat Zones and Food Webs This section presents a base of information that is critical to understanding changes that are currently taking place in Lake Ontario, particularly those changes caused by invasive species introduced from ballast water releases. Energy flows upward through the food web from sunlight and nutrients, ultimately to trout and salmon. Diversion of the "natural" flow of energy to invasive species is disrupting Lake Ontario's food webs, resulting in greater instability and uncertainty. Due to its importance, this section is provided below for your convenience:

"To simplify our presentation, Lake Ontario was partitioned into two major overlapping and interacting habitat zones – a nearshore zone and an offshore zone. Feeding relationships among fish and other organisms within each zone are called food webs. The fish community inhabiting the nearshore zone is considered to be part of one food web, whereas the offshore zone is divided into a benthic (living near the bottom) food web and a pelagic (living in the open water) food web. Benthic and pelagic organisms are also part of the nearshore food web. Most aquatic food webs depend mainly on the production of microscopic plants called algae, which require light and nutrients to thrive. Algae are eaten by tiny animals living in the water column called zooplankton and by certain bottom-dwelling organisms called benthos. Benthos depend mainly on dead material (detritus) that settles to the bottom. Zooplankton and benthos provided the link from algae to fish and cycle material through the food web."

I. The Nearshore Zone and Food Web (water depths less than 50 feet)(page 13)
Nearshore habitats are critical to nearly all Lake Ontario fish, as eggs, fry, and juvenile life stages of most fish depend on these habitats during these most vulnerable life stages. The nearshore zone is home to a great number of "warm water" fishes, including walleye, small and largemouth bass, yellow perch, sunfish, northern pike, and brown bullhead.

An abundance of zebra and quagga mussels, invasive species first recorded in Lake Ontario in the late 1989 and 1991, respectively, in the nearshore zone has altered or eliminated habitat for small, native organisms that live on the lake bottom in shallow water. Initially, zebra mussels were expected to greatly change the Lake Ontario food web, however, quagga mussels have now greatly surpassed zebra mussels in both abundance and the range of depths where they exist. Although the full extent of the effects of these exotic mussels on nearshore fisheries is not yet fully understood, reproductive success, diets and growth rates of some fish species have changed following colonization of the lake by these mussels.

Three additional invasive species have been recorded in Lake Ontario's nearshore zone since 1997. The New Zealand mud snail was found in the waters off Wilson, New York in 1991. This snail may compete with other, native snails and mussels in the lake. The small crustacean *Echinogammarus* is a "scud" that was recently introduced from Eurasia, and is rapidly replacing the native scud *Gammarus* in some areas of Lake Ontario. Scuds are small, benthic animals that are an important source of food for many fish. The impacts of *Echinogammarus* on the Lake Ontario fish community are not yet fully understood.

Round gobies, also from Eurasia, were first recorded in Ontario waters of Lake Ontario in 1998, the Bay of Quinte in 1999, and in New York waters of Lake Ontario in 2001. This fish is rapidly becoming abundant in the nearshore waters of Lake Ontario. Round gobies are aggressive, bottom-dwelling fish that feed on zebra and quagga mussels, aquatic insects, fish eggs, and small (juvenile) fish. Where gobies have become abundant, numbers of some native species have declined. Other bottom-dwelling fish in the nearshore zone, such as darters, sculpins and logperch, will probably decline as round gobies increase. Even if numbers of round gobies greatly increase in Lake Ontario, they will not significantly reduce the abundance of zebra and quagga mussels.

Recent outbreaks of botulism in Lake Erie are linked to zebra/quagga mussels and round gobies, which transmit botulinum toxin to birds and fish that eat mussels and gobies. This has resulted in large-scale die-offs of fish, amphibians, and birds on Lake Erie over the past three years. Although several herring gulls and ducks have tested positive for botulism poisoning on Lake Ontario in 2002, there have been no large die-offs.

Nearshore Zone Food Web and Fisheries Highlights:

- Although zebra mussels once dominated the nearshore zone, they are now found primarily in water less than 10 feet deep. Quagga mussels now dominate the lake bottom from the water's edge to depths beyond 400 feet.
- At the base of the food web, the abundance of green algae (phytoplankton) is lower than what would be expected for the current level of phosphorus (plant nutrient) in the water due to the effects of zebra and quagga mussels.
- Spring abundance of diatoms, a microscopic algae that is an important food source for zooplankton and opossum shrimp (*Mysis*), has declined in the Eastern Basin of Lake Ontario since the establishment of zebra and quagga mussels.
- In the Bay of Quinte, walleye stocks have declined but appear to have stabilized at lower levels. Increased water transparency and lower food web changes, both due to zebra/quagga mussel infestation, have modified fish habitat so that it is less suitable for walleye. Increased water transparency has led to greater abundance of submerged plants, resulting in increased numbers of largemouth bass, pumpkinseeds, bluegills, and black crappies. Whereas smallmouth bass populations in the Bay of Quinte showed signs of expansion in the mid-1990's, more recently numbers have declined.
- Catches of warmwater fish species in the Eastern Basin of Lake Ontario have declined to record low levels. Smallmouth bass have reached record low levels, and both walleye and rock bass are declining. Yellow perch abundance remains low but stable compared to historic levels.
- In contrast to the Eastern Basin, abundance of smallmouth bass and yellow perch in the Pultneyville, New York area has greatly increased in recent years. A high abundance of double-crested cormorants (fish-eating birds) in the New York waters of the Eastern Basin has contributed to the decline of localized fish

populations, including smallmouth bass and yellow perch. Cormorant numbers in the Pultneyville area are low in comparison to the Eastern Basin.

- Since 1990, the number of double-crested cormorant nests on Lake Ontario (NY and Ontario waters) has increased from 6,714 to over 28,000.
- Catches of lake sturgeon in the Eastern Basin increased slightly in recent years.
- Since 1997, the number of anglers in New York targeting smallmouth bass has increased.
- American eel abundance is currently at historically low levels, and continues to decline.
- A recent study compared the number of fish species found historically in bays of the Eastern Basin to those collected in 2000 and 2001. The study revealed the reduction or loss of six species, including blue pike (extinct), Atlantic salmon, muskellunge, lake herring, and lake whitefish. The study also documented range expansions (or possibly omissions from early surveys) of bridle shiners, central stonerollers, northern redbelly dace, yellow bullheads, and brook sticklebacks.
- A decrease in the number of active commercial fishers, declining white perch abundance, and parasites in brown bullheads have led to a decline in the number of pounds of fish sold from New York's Eastern Basin commercial fishery. Reported fishing effort decreased dramatically in 2002 due to low prices for yellow perch.

<u>II. The Offhore Zone (water depths greater than 50 feet) (page 14)</u> The fish community living in the nearshore zone is considered to be part of one food web, while the fish community in the offshore zone is dependent upon two food webs: the **offshore benthic** (living near the bottom of the lake) and the **offshore pelagic** (living in the open water). Movements of animals up and down in the water column (particularly opossum shrimp (*Mysis)*, alewife, and smelt) connect the offshore benthic and pelagic food webs.

<u>The Offshore Benthic Zone and Food Web</u> The offshore benthic food web is made up of several species of deepwater zooplankon, *Mysis*, and deepwater scuds (*Diporeia*). Quagga mussels now dominate the lake bottom out to depths greater than 400 feet, and the deepwater scud, *Diporeia*, has declined sharply. *Diporeia* are eaten by prey fish (alewife, rainbow smelt, and slimy sculpin), young lake trout, and lake whitefish. Quaaga mussels are eaten by lake whitefish, but are a poor source of energy. In addition, surveys in 2002 detected some abnormal geographic distributions and suggest that, lakewide, *Mysis* numbers have declined. Members of the benthic fish community include juvenile and adult lake trout, slimy sculpins, lake whitefish, burbot (freshwater cod), lake herring (close relative of lake whitefish), and round whitefish. In comparison to alewife, rainbow smelt inhabit deeper, colder water throughout the year, and are more likely to interact with lake trout and lake whitefish than with Pacific salmon. For these reasons, we have included rainbow smelt in the offshore benthic category.

<u>Offshore Benthic Zone Food Web and Fisheries Highlights:</u>

- Quagga mussel density has increased to over 18,800 mussels per square yard in water 246 feet deep. Over 2,000 quagga mussels per square yard can be found in water 425 feet deep. As quagga mussel density increases over a broader range of depths, we can expect more changes in Lake Ontario's food webs.

- In 1992, abundance of *Diporeia* in water 245 feet deep was about 5,800 per square yard. Today, *Diporeia* are absent from depths less than 300 feet. At a deeper site (425 feet) used to study changes over time, numbers of *Diporeia* per square yard have declined from 2,300 to 710 over the past ten years. Similar trends are being observed for small, native clams and worms that serve as alternate food sources for benthic fishes.
- In 2002, abundance of slimy sculpins at depths greater than 245 feet increased for the third consecutive year, but remained below the record high level observed in 1991.
- Abundance of age-one and older rainbow smelt in 2002 was just above the record low level observed in 2000.
- Lake whitefish in northeastern Lake Ontario showed signs of recovery in the early 1990's, but more recently have declined in number and condition (relative health or "plumpness" of fish). A similar pattern has been observed for lake herring.
- Lake trout stocking was reduced 37% (from 790,000 to 500,000 fish per year) in 1993 to help reduce predation on alewives. Reduced stocking and poorer survival of newly stocked fish have contributed to a recent decline in numbers of adult lake trout (age three and older). Survival of naturally spawned lake trout to the fingerling stage has been documented in each of the last ten years, and survival of fingerlings to older ages has been documented. These milestones are important early indicators of progress toward lake trout rehabilitation goals for Lake Ontario.
- Similar to lake whitefish, burbot abundance in the Eastern Basin increased in the mid-1990's, but has since declined.
- Round whitefish can still be found in very low numbers in the northwestern portion of Lake Ontario, but they have not been documented in other portions of the Lake in the past twenty years.
- Sea lampreys are an invasive species that historically contributed to the collapse of a number of native fish stocks, including lake trout and lake whitefish. The amount of damage sea lampreys cause to fish is measured by the percentage of adult lake trout with fresh wounds each fall. A recent increase in the proportion of lake trout with sea lamprey wounds may not, however, indicate an increase in sea lamprey numbers. Because there are now fewer adult lake trout available to sea lamprey, the same number of lamprey could account for the increased wounding rates observed.

The Offshore Pelagic Zone and Food Web Trout and salmon in the offshore pelagic food web depend on small bait fish (prey fish) for food. Prey fish (predominantly alewife and rainbow smelt) feed on zooplankton, *Mysis*, and the swimming, larval form of zebra and quagga mussels. In 1998, the invasive fish hook water flea was first found in Lake Ontario. This large zooplankter preys upon smaller, native zooplankton, and can reduce the amount of food available to prey fish. Although alewives can and do eat fish hook fleas, they are not an energy-rich food source compared to native zooplankton and *Mysis*.

In addition to zooplankton and other small invertebrates, alewives also feed on the fry of many native fish species, such as lake trout and yellow perch. A shift in the depth distribution of alewives shortly after zebra and quagga mussels colonized Lake Ontario apparently decreased alewife predation on fry, resulting in increased natural reproduction of native fish species.

In 1993, NYSDEC and OMNR reduced the numbers of trout and salmon stocked into Lake Ontario to reduce "predation pressure" on alewives, hopefully allowing alewife numbers to stabilize. Alewife condition improved shortly after the stocking reductions, and adult alewife abundance reached record low levels in 1998 and 1999. Despite low adult abundance, alewife reproductive success in 1998 and 1999 was exceptional, likely due to warm spring water temperatures and short winters during those years. The large numbers of young alewives produced during 1998 and 1999 increased adult abundance in 2000 and 2001, but this increase did not persist and abundance declined in 2002. Also, condition of adult alewives in the fall of 2002 was near the record low level recorded in 1992. Reduced nutrients in Lake Ontario, the diversion of energy flow in food webs to invasive species (primarily zebra and quagga mussels, which are not eaten by prey fish), and predation by trout and salmon, are causing stress in prey fish populations. In turn, predator species may show signs of stress (reduced growth and condition) as prey fish populations decline in abundance and condition.

<u>Offshore Pelagic Zone Food Web and Fisheries Highlights:</u>

- Zooplankton surveys show a lake-wide decline in small zooplankton when the invasive fish hook flea reaches peak density in August.
- Abnormal geographic distributions of *Mysis* detected in 2002 suggest that, lakewide, numbers have declined. *Mysis* provide an energy-rich food source for alewives from fall through spring.
- Improved water flow regulation in the Salmon River (New York) has resulted in greater natural reproduction of chinook salmon. Cornell University scientists estimated that 335,000 wild chinook salmon were produced in the Salmon River in 2001. Increased natural reproduction of chinook salmon has also been observed in the Credit River (Ontario). The contribution of natural reproduction to the chinook salmon fishery is not currently known.
- Growth rates and condition of chinook and coho salmon have recently declined, possibly due to a decrease in the abundance and condition of adult alewives.
- There is a weak and variable relationship between the numbers of chinook salmon stocked into Lake Ontario and the numbers caught by anglers in later years. This is because a trout or salmon stocked at a small size faces many hazards on its way to becoming an adult, including predation by other fish or birds, insufficient food, or unsuitable water temperatures, all of which may vary from year to year.
- Catch rates in the open-lake, recreational fishery (the number of hours it takes, on average, to catch a trout or salmon) provide a measure of quality for trout and salmon fisheries. Except-during 2002, catch rates since 1997 for brown trout, rainbow trout, and coho salmon have been similar to those from the late 1980's/early 1990's. Catch rates for Chinook salmon in recent years have been about 14% lower than those during the same time period. In June and July 2002, abnormal water temperatures

and possibly shifts in the distribution of prey fish resulted in poor catch rates for all species. Catch rates did, however, return to normal levels during August and September.

- Although angler catches of Atlantic salmon in the open-lake fishery are relatively uncommon, anecdotal reports indicate improved catches in the Salmon River and its tributaries in recent years.