# INVASIVE SPECIES

## Ecosystems and Non-native Species

*How did aliens become a part of the Great Lakes ecosystem?*

GREAT LAKES FACT SHEET

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# Background

Invasive species make their way into the Great Lakes by land, air and water. Ballast water from international ships is one of the pathways by which invasive species are introduced into the aquatic environment. Ballast water is taken on by a ship to control its buoyancy and stability. As cargo is unloaded, ballast water is taken on to maintain weight. When the vessel is reloaded with new cargo, the ballast water is released into the lakes, along with the sediment and organisms contained in it.

Occasionally, non-native species kept in captivity (e.g., farmed or domesticated species) are released into the environment accidentally or intentionally. This can happen in a number of ways: as a result of natural phenomena such as flooding; during the transport of live species; when pets are released or escape into the wild; or when non-native species are used as bait fish. Now considered a particularly threatening invasive species, Asian carp were introduced into the United States as a management tool for aquaculture farms and sewage treatment facilities. After escaping from fish farms during flooding along the Mississippi River, the carp made their way north and have been found within a few kilometres of Lake Michigan. If Asian carp manage to get into the Great Lakes, they will pose a devastating threat to the region's biodiversity and prosperity.

There are more than 4 million registered boats used recreationally in the Great Lakes. Recreational boaters travelling between lakes can contribute to the spread of invasive species. Zebra and quagga mussels can attach to boat hulls while spiny water fleas can attach to anchor lines. Invasive plant species such as Eurasian watermilfoil can also be spread from lake to lake when stem fragments become attached to parts of boats.

## WHAT ARE INVASIVE SPECIES?

There are 186 non-native (or alien) species that have become established in the Great Lakes Basin. Some of these species, known as invasive species, are capable of causing significant harm to the lakes by disrupting local ecosystems. They can affect local habitats, introduce parasites and disease, and put native species at risk by outcompeting them for food. Zebra and quagga mussels, round goby, sea lampreys and Asian carp are among the better known of these invaders.

Globalized trade and increasing levels of human activity, such as industrial development, recreation and travel, have accelerated the rate of introduction and distribution of invasive species in the Great Lakes. Most invasive species can survive in a variety of climates, making it easy for them to thrive in a wide range of ecosystems. Once introduced, they can spread quickly as they often have no natural predators and few competitors for food sources in their new environments. This can make it extremely difficult to eradicate them. For these reasons, the most effective means of addressing invasive species is to prevent their introduction.

## HOW DO INVASIVE SPECIES AFFECT THE GREAT LAKES?

Invasive species ...

- **alter the aquatic food chain:** Invasive species outcompete native species for food, which has detrimental effects for the entire food web. For example, zebra mussels – clam-like freshwater shellfish named for their striped shells – compete with native Diporeia, a shrimp-like bottom-dwelling invertebrate, for plankton. Plankton are small plant and animal organisms that float or drift in great numbers in fresh or salt water and make up an important food source for aquatic species. Smaller fish rely heavily on Diporeia as a food source while, in turn, themselves becoming prey for larger fish, such as trout and whitefish. Decreasing availability of Diporeia compromises this food chain by stunting the growth of individual fish and reducing fish populations.

- **destroy fish habitat and introduce disease:** Invasive species can threaten the habitat of native species and can also introduce new diseases. For example, the round goby is a voracious bottom-feeder known to destroy traditional spawning areas of native Great Lakes fish species and feed on their eggs, reducing reproduction rates. Invasive pathogens such as viral hemorrhagic septicaemia (VHS) can also affect Great Lakes fish species. VHS causes fish to hemorrhage, which can result in internal organ failure and death. VHS may also affect fish behaviours (e.g., causing them to swim more slowly or closer to the surface), making them increasingly susceptible to predators.

- **affect commercial fisheries and recreational fishing:** Great Lakes fisheries are estimated to contribute approximately $7 billion annually to the region's economy. Invasive species cost the Great Lakes commercial and sport fishing industries a significant amount in lost revenues each year. The sea lamprey, a primitive and parasitic fish, is of particular concern to the fisheries. Immensely destructive to fish stocks, sea lampreys have a suction cup mouth with sharp teeth surrounding a file-like tongue. They attach to fish and feed on their blood, usually killing the fish.

- **may alter the phosphorus cycle:** The zebra mussel, along with its relative, the quagga mussel, may be a contributing factor in the resurgence of algal blooms in Lake Erie. It is thought that the mussels, in filtering plankton and other particles out of the water, redeposit the phosphorus contained in these particles in a more soluble form closer to the shoreline. Algal growth in nearshore areas is stimulated by this increase in available phosphorus. The mussels' ability to filter particles from the water also increases the clarity of nearshore waters, creating an ideal habitat for Cladophora, a long, hair-like algae that prefers shallow, light-filled water.

- **impact water intake systems:** Water intake pipes are particularly vulnerable to clogging by zebra and quagga mussels. These mussels are capable of attaching to most submerged hard surfaces by means of elastic fibres that contain a natural adhesive. Once attached, the mussels reproduce rapidly and can colonize extensive portions of intake pipes, eventually clogging them and requiring costly removal by industries, municipalities and utilities.

## CHALLENGES AHEAD

Controlling invasive species, such as sea lampreys and Asian carp, is one of the most difficult challenges facing the Great Lakes. It is made all the more difficult because climate change is fundamentally altering the region's ecosystems.

**Climate change:** Climate change may provide further opportunities for the proliferation of invasive species. The frequency and intensity of extreme climatic events disturb ecosystems, making them vulnerable to invasions. Warmer water temperatures have been reported in the Great Lakes in recent years. As these temperatures continue to rise, the environment may become more hospitable to invasive species such as sea lampreys and zebra mussels, who thrive in warmer water, while becoming less hospitable to native, cold-water species.

**Sea lampreys:** In 1955, the Governments of Canada and the U.S. came together to form the Great Lakes Fishery Commission, in part to address the spread of the sea lamprey. The sea lamprey program has been successful in reducing populations by approximately 90 per cent of peak numbers reached in the 1960s. Measures used to control this invasive species include the use of lampricides (chemicals designed to target the larvae of the sea lamprey in river systems), electric fencing in canals and the release of sterilized males to reduce reproductive success. Although these controls help to keep sea lamprey populations in check, they are unlikely to fully eradicate this invasive species, in part due to its ability to produce large numbers of eggs.

**Asian carp:** Among the greatest potential threats to the Great Lakes, Asian carp have been known to weigh as much as 50 kilograms and to grow to more than a metre in length. One of the species of invasive carp, silver carp, are sometimes referred to as "flying carp" because they are known to leap 2 to 3 metres out of the water when startled, posing a hazard for people fishing, boating, swimming and water skiing. Their sheer size protects them from potential predators, they have a voracious appetite for plankton, and they have made their way dangerously close to the Great Lakes. An electric barrier in the Chicago Sanitary and Ship Canal, erected to restrict the spread of round gobies, also works to repel Asian carp, which are extremely sensitive to electrical currents. Rotenone (a plant-based toxin) has also been used to poison the waters of the canal in an effort to kill any Asian carp that may have migrated north. Within the past year, however, traces of DNA from Asian carp have been found on the "wrong" side of the barrier. DNA analysis cannot determine if the traces came from a living fish, as opposed to, for example, outputs from local restaurants that serve carp. However, any suggestion that carp have found their way into the Great Lakes is bound to cause concern. In 2010, Michigan, along with four other Great Lakes states, launched a lawsuit asking the U.S. federal government to close the locks on the Chicago Area Waterway System to create an ecological separation of the Great Lakes from the Mississippi River Basin at Chicago. In 2012, the U.S. Supreme Court denied the states' petition, but it is unlikely that this will be the end of the debate, both in the courts and beyond, given the severity of the threat that Asian carp pose to the lakes.

## WHAT IS BEING DONE?

In addition to the work of the Great Lakes Fishery Commission, there are a number of initiatives in place to address invasive species in the Great Lakes. The following are just a few examples of these strategies:

### International Collaboration

- **Great Lakes Water Quality Agreement (GLWQA):** In 1972, Canada and the United States signed the GLWQA "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes." Amended most recently in 2012, the agreement addresses ongoing threats to the lakes, including invasive species.

- **Asian Carp Control:** Canadian and U.S. federal, provincial and state fisheries agencies are currently conducting a binational risk assessment on the threat of Asian carp to the ecosystem and fisheries of the Great Lakes. The results of this scientific undertaking will help focus future monitoring, control and regulatory efforts on keeping these fish from entering the Great Lakes. In 2009, Americans and Canadians from various government agencies worked together to eradicate Asian carp living in a 10 kilometre stretch of the Chicago Sanitary and Ship Canal so that maintenance could be done on the electric barrier keeping them out of Lake Michigan.

- **Ballast Water Management:** In 2006, both Canada and the U.S. implemented mandatory ballast water control and management regulations to help reduce the transfer of non-native species.

### Federal Initiatives

- **Canadian Action Plan to Address the Threat of Aquatic Invasive Species:** This plan was developed in 2004 by the federal government in partnership with provincial and regional governments. The plan defines a comprehensive approach to managing invasive species: prevention, early detection, rapid response and management.

### Federal-Provincial Collaboration

- **Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA):** The COA commits the federal and Ontario governments to reduce the threat of aquatic invasive species to Great Lakes ecosystems. One of the agreement's goals is to ensure that Canada is in full compliance with the federal government's Ballast Water Control and Management Regulations. An updated COA is currently under development to reflect recent amendments to the GLWQA.

### Provincial Initiatives

- **Invasive Species Awareness Program (ISAP):** The Ontario Ministry of Natural Resources, in partnership with the Ontario Federation of Anglers and Hunters (OFAH), coordinates ISAP, a program that develops educational materials, operates monitoring programs and hosts an invasive species hotline.

- **Ontario's Biodiversity Strategy:** Issued in 2005 and updated in 2011, this Ontario Ministry of Natural Resources strategy is intended to protect the province's biodiversity and identifies invasive species as one of the principal threats to it. The strategy was developed and is carried out by government and non-governmental groups.

## WHAT CAN YOU DO?

- **Take responsibility for your pets:** Releasing exotic aquarium species into the wild can harm local ecosystems. Check with your local municipality for more information.
- **Garden with native plants:** Plant native species in your garden in order to reduce the risk of invasive species accidentally being released into the local ecosystem. This is especially important in areas that are prone to flooding.
- **Clean your boat:** Keeping your boat clean will help to reduce the transfer of invasive species from one lake to another.
- **Know your bait:** If you are fishing, use only fish from within the local ecosystem as bait. Ask your bait dealer where the bait comes from and if it is a native species. And do not empty your bait bucket in or near water – it's against the law.
- **Get involved:** Look for opportunities to get involved in public consultations on important issues such as invasive species and on agreements and legislation related to the Great Lakes. Urge government, businesses and other organizations to take action on Great Lakes issues.

## SELECTED RESOURCES

For more information about invasive species in the Great Lakes, consult the following resources:

Environment Canada. Invasive Alien Species in Canada. **http://www.ec.gc.ca/eee-ias/**

Environment Canada. Invasive Species: Non-Native Species in the Great Lakes-St. Lawrence Basin. **http://www.ec.gc.ca/stl/default.asp?lang=En&n=0ADE85C3-1**

Fisheries and Oceans Canada. Aquatic Invasive Species. **http://www.dfo-mpo.gc.ca/science/enviro/ais-eae/index-eng.htm**

Government of Canada. Invasive Species in Canada. **http://www.invasivespecies.gc.ca/english/view.asp?x=1**

Great Lakes Information Network. Invasive Species in the Great Lakes Region. **http://www.great-lakes.net/envt/flora-fauna/invasive/invasive.html**

Ontario Ministry of Natural Resources. Invasive Species: A Threat to Ontario's Biodiversity. **http://www.mnr.gov.on.ca/en/Business/Biodiversity/2ColumnSubPage/STDPROD_069027.html**

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PHOTOS

**Cover:** Sea lamprey. T. Lawrence, Great Lakes Fishery Commission.

**Background:** Zebra mussels, Port Credit Marina, Lake Ontario. © Gene Wilburn.

**Sea lampreys:** Sea lamprey attached to a salmon. M. Gaden, Great Lakes Fishery Commission.

**Asian carp:** Asian carp jumping in boat wake. T. Lawrence, Great Lakes Fishery Commission.

**What Can You Do?** Recreational boating on the Great Lakes. © Michigan Sea Grant. www.miseagrant.umich.edu