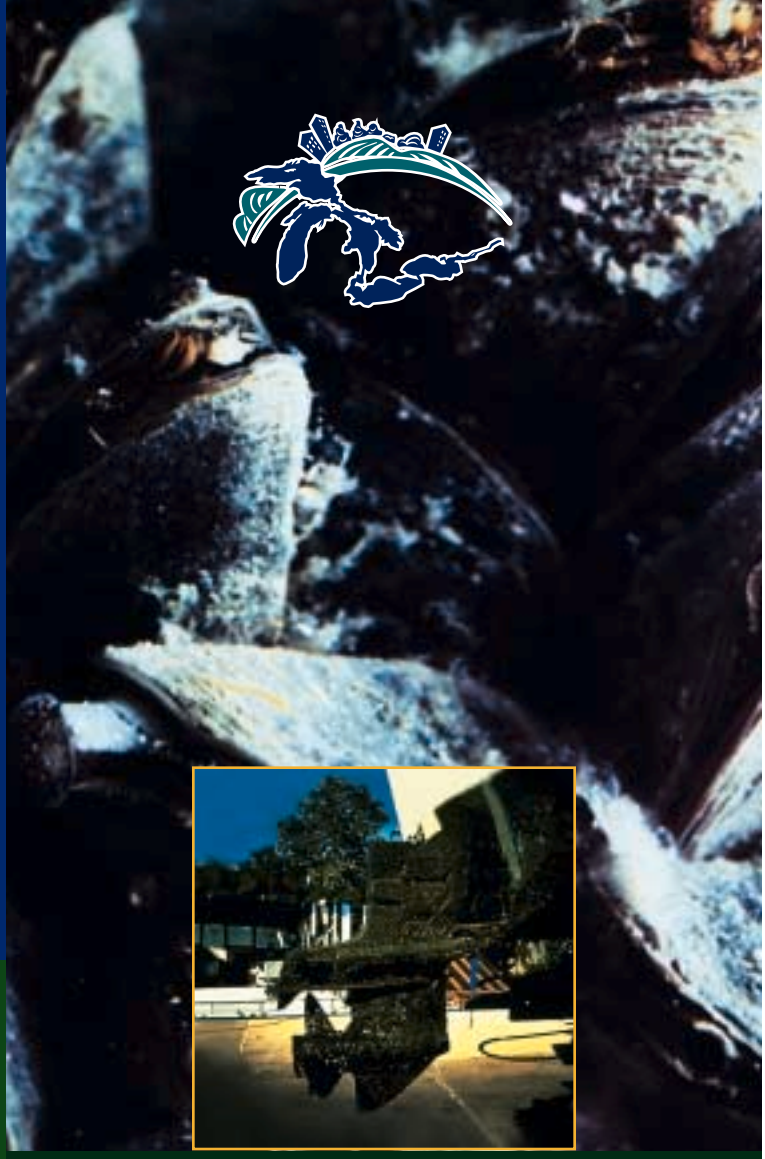

AQUATIC NON-NATIVE INVASIVE SPECIES:

Invaders Pose Major Threat to the Great Lakes

CANADA-ONTARIO AGREEMENT RESPECTING THE GREAT LAKES BASIN ECOSYSTEM

Canada Ontario

Since the 1800s, scientists have identified more than 160 invaders – fish, crustaceans, aquatic plants and species of plankton – that have successfully infiltrated and found a permanent home in the Great Lakes. On average, that is one new species successfully integrating into a delicately-balanced ecosystem every 11 months. Some are so common, the carp, the alewife, the lamprey, that many people think they must have always been here. While some invaders co-exist peacefully with the native inhabitants, about one-in-ten explodes on the scene.

The scientists call them aquatic non-native invasive species (NIS). With no natural predators, parasites or pathogens, aquatic NIS can spread quickly throughout a water body. Once firmly established, a prolific aquatic NIS like the zebra mussel can permanently disrupt an ecosystem's biological integrity. Aquatic NIS can wrest habitat, food resources and spawning sites from native species, driving their competitors into retreat or even extinction.

Although the governments of Canada and the United States, along with the Government of Ontario and state governments have had some success in managing the sea lamprey, other aquatic NIS are out of control, and new invaders continue to reach the Great Lakes Basin every year.

Cover: zebra mussels
Cover inset: boat engine encrusted with zebra mussels

1. At least one-third of aquatic NIS have entered the Great Lakes via ballast water discharged by ocean going ships.
2. the spiny water flea; a recent invader
3. sea lamprey wound

On average, another aquatic non-native invasive species grabs a niche in the Great Lakes ecosystem every 11 months.

Portrait of a typical aquatic NIS

"The successful aquatic NIS is usually a colonizing species in its own home environment as well as ours," says Dr. Doug Dodge, a retired Ministry of Natural Resources biologist specializing in Great Lakes issues. During his career, Dr. Dodge worked with the International Joint Commission and the Great Lakes Fishery Commission on the control of aquatic NIS.

Aquatic NIS are very accommodating, very hardy, and very adaptable plants and animals, says Dr. Dodge. The animals tend to be voracious eaters and are extremely prolific, quickly grabbing a huge chunk of a lake's productivity for themselves and starving out their competitors. The plants are typically aggressive colonizers that spread quickly, crowding out the meeker indigenous vegetation.

"It's one of the great ironies, that invading species weren't a major problem when the lakes were heavily polluted," says Dr. Dodge. Once we collectively began to improve sewage treatment, clean up industrial wastewaters and reduce nutrient loadings, the native species took too long to reoccupy their former range. "Non-native invasives quickly took advantage of the opening and moved right in," he says.

4. trapped sea lamprey

Like the proverbial unwanted house guest, aquatic NIS can be nearly impossible to get rid of once they've got a fin firmly lodged under the dinner table. The best way to control an aquatic NIS is to bar the door tightly. "There is usually some futile attempt to find a biological predator to control the invasive," says Dr. Dodge, "but then, who will tame the tamer?"

Musseling in to the Great Lakes

Look up "non-native invasive" in the encyclopedia and you'll likely find a picture of the tiny zebra mussel. Much like the ruffe, the goby and the spiny water flea, the zebra mussel arrived as a stowaway in a ship's ballast tanks from its original home in the Caspian Sea. Since the first zebra mussels were discovered in Lake St. Clair in 1988, they have spread throughout the Great Lakes and across Ontario, Quebec, as far west as Kansas and down to the Gulf of Mexico.

Thick clusters of zebra mussels have caused extensive and costly damage, clogging water intakes at treatment plants and hydro stations, and blocking fire protection piping and cooling systems. In a single season, colonies of 32,000 mussels per square metre can cover any suitable hard surface, such as a ship's hull. Small marker buoys can even sink under the weight of the encrusting mussels. Maintenance becomes a gruelling and never-ending chore.

Extremely efficient filter feeders, zebra mussels can remove much of the plankton, detritus and other essential food sources at the bottom of the food web. While they have undoubtedly helped clear murky water, they have also devastated native populations of mussels, clams, small fish and everything else that feeds on them. There is even evidence that zebra mussels increase the availability of PCBs and other pollutants, leading to higher contaminant levels up the food chain.

Boats and ballast

How do aquatic NIS get here? In less environmentally-enlightened times some species were released intentionally to improve the local fishing or to remind a homesick settler of

the old country. The coho and chinook salmon, the rainbow trout and the brown trout were introduced to improve sports fishing and counter an earlier invasion of alewives. Fish have escaped from fish farms and hatcheries. Some aquatic NIS are dumped into the nearest lake along with the other contents of an aquarium or a bait bucket.

At least one-third of the aquatic NIS that have entered the Great Lakes did so in the ballast water discharged by ocean-going ships. Once they have unloaded, large cargo ships refill their ballast tanks with the local harbour water which includes a complement of the local aquatic life. This helps maintain stability, especially on rough seas. When this ballast is discharged at the final destination, the organisms are released into the receiving waters.

The Great Lakes-St. Lawrence Waterway is a major international shipping route that stretches 3,700 kilometres into the heartland of North America. Some 145 ports and terminals in the basin handle more than 250 million tonnes of cargo each year. A growing global economy may mean even more foreign ships docking at Great Lakes ports … and even more aquatic NIS knocking at our door.

"This is the trickiest issue the commercial shipping industry has to deal with," says Captain Rejean Lanteigne, vice president of operations for the Canadian Shipowners Association. "It affects not just us, but cruise ships, tour boats, the navy, anybody who sails in international waters." The association represents bulk carriers, tankers and cargo vessels which ply the waters of the Great Lakes and St. Lawrence Seaway, as well as the Arctic, Maritimes and Eastern American Seaboard.

A single bulk cargo vessel in the Great Lakes can carry up to 20,000 tonnes of ballast water and contain several hundred different aquatic species. "The invasion of non-native species is one of the United Nation's top five environmental concerns," says Captain Lanteigne. "All ship owners recognize this as a serious issue. Once these (species) are introduced, you can't prevent their spread, so you have to prevent their release."

Flushing and refilling a ship's ballast tanks with mid-ocean saltwater while still at sea is currently the most accepted method of control, but even it is not 100 percent effective. A ship can carry tonnes of unpumpable slop and sediments in the bottom of its tanks.

Battling the sea lamprey

The sea lamprey is a primitive jawless fish that was originally native to both sides of the Atlantic Ocean. Eel-like in appearance and growing to almost a metre in length, the lamprey attaches itself to its prey with a sucking disk and cuts through the scales and skin to suck out the bodily fluids within. It is estimated that only one fish in seven survives the attack of the parasitic lamprey. By the 1940s, the sea lamprey had invaded Lake Erie and the upper Great Lakes, and quickly precipitated the collapse of the lake trout and whitefish populations.

In 1954, Canada and the United States signed the Convention on Great Lakes Fisheries creating the Great Lakes Fishery Commission to protect the fast-disappearing fish resource base. The Department of Fisheries and Oceans is the Commission's primary Canadian agent and has undertaken extensive (and expensive) lamprey control projects on the gravelly streams and rivers where the lamprey spawn each spring.

Selective lampricides are used to kill lamprey larvae where they have burrowed into the stream bed, sterile males are released to reduce spawning success, and barriers are built to block the upstream migration of spawning adults. These efforts have helped reduce sea lamprey populations in the Great Lakes to just 10 percent of their peak levels in the 1950s. However, it has proven impossible to rid the basin of the sea lamprey. Once an invading species like the lamprey has taken hold, the best that can be done is manage its numbers and, hopefully, lessen its effect on the ecosystem.

Even a vessel that declares it has "no ballast on board" (NOBOB) can hold a thriving load of aquatic NIS. If such a ship takes on ballast water in the Great Lakes, it becomes mixed with the unpumpable sludge and can be released in another part of basin without any treatment or control. The majority of the ships entering the Great Lakes are NOBOB – they come in loaded – discharge cargo, then load Great Lakes ballast on top of the sludge and unpumpable slops. *(cont'd)*

5. round goby; a recent invader **6.** zebra mussels clogging intake pipe


5


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"You have to worry about the muddy sediments," says Capt. Lanteigne, "and, at this point, there is no known (treatment) technology that is effective and practical. So the testing goes on." Private and public sector researchers are investigating a number of promising methods, including filtration, hydrocyclonic separation, and chemical and physical biocides to eliminate aquatic NIS.

Shipowners are involved in a number of cooperative technology development programs with the Department of Fisheries and Oceans, Transport Canada, the U.S. Coast Guard and the International Maritime Organization. The primary goal is to identify ballast treatment options that might be rapidly developed for interim application in the Great Lakes, and others more suited to long-term use internationally.

Tighter controls on the way

In 1989, the Canadian Coast Guard implemented voluntary guidelines that require any ocean-going vessel planning to enter the Great Lakes to first exchange its freshwater ballast with saltwater taken from beyond the continental shelf. Water in the open ocean contains comparatively fewer organisms and they are not likely to survive in a freshwater environment.

Similar, though mandatory, requirements based on Canadian guidelines have been enacted in the United States under its Non-indigenous Aquatic Nuisance Species Prevention and Control Act in the Great Lakes in 1993. Every ship entering the Great Lakes system is tested to ensure that its ballast water has a salinity content of at least 30 parts per thousand. Canada is currently working to harmonize its regulations with those of the United States.

Aquatic non-native invasive species are likely to be a growing problem in the Great Lakes as trade and globalization increase the worldwide spread of species. Under the new Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA), the Government of Canada will work with the shipping industry to reduce the entry and spread of aquatic NIS through regulations targeting the vessels entering the Great Lakes, and new technology to rid these ships of their unwanted aquatic stowaways.

The individual boat owner and angler has an important role to play in preventing the further spread of invasive species. Once in the Great Lakes, aquatic NIS quickly move on to more remote ecosystems and inland lakes by hitchhiking on smaller boats and travelling along canals and connected waterways. Under COA, the Government of Ontario will support outreach and education programs that will be designed to reduce the movement and spread of aquatic NIS throughout the basin.

Prevention remains the key. We have to learn our lesson from the zebra mussel and take strong preventative action now, warns Dr. Dodge, "or there could be something much worse carried into the Great Lakes tomorrow."

What you can do!

Whenever you move your boat from one waterbody to another, aquatic NIS may tag along for the ride. Learn how to identify zebra mussels and other non-native invasives, and then take the steps to eliminate unwanted stowaways.

To get the latest information and report sightings, call the Ontario Ministry of Natural Resources' Invading Species Hotline 1-800-563-7711, or check out their website at: **www.mnr.gov.on.ca/fishing/threat.html.**

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Canada-Ontario Agreement
Respecting the Great Lakes Basin Ecosystem

To learn more about COA and aquatic non-native invasive species in the Great Lakes Basin, contact:

Transport Canada
(519) 383-1826

Fisheries and Oceans
www.dfo-mpo.gc.ca/regions/CENTRAL/index.htm

Environment Canada
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