AQUATIC INVASIVE SPECIES ANNEX

OVERVIEW

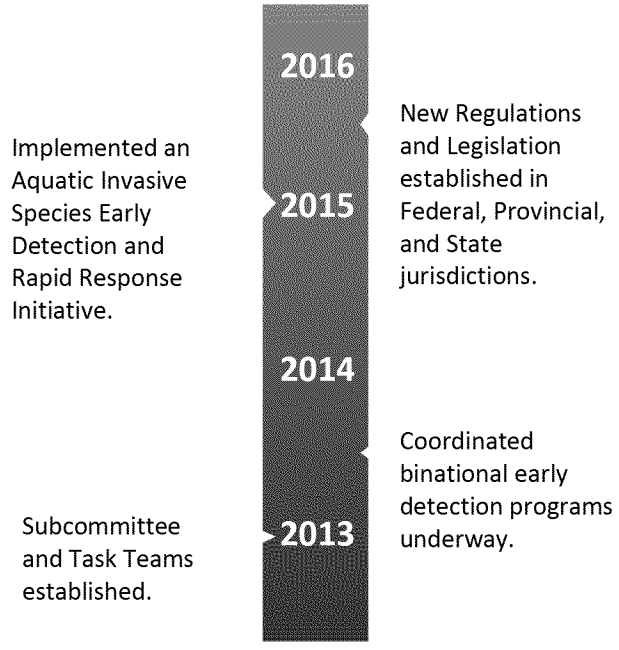
Aquatic invasive species (AIS) currently in the Great Lakes are undermining efforts to restore and protect ecosystem integrity and water quality. These organisms are altering the way nutrients and chemical contaminants move within the ecosystem, affecting the productivity of the lakes and integrity of the aquatic food web.

In addition, possible future invaders, such as Asian Carps, could further disrupt ecosystem integrity.

After invasive species become established in the Great Lakes, they are costly to control and nearly impossible to eradicate. Consequently, prevention is the most effective approach to dealing with this threat. The 2012 GLWQA commits the United States and Canada to: 1) preventing the introduction of AIS; 2) controlling or reducing the spread of existing AIS; and 3) eradicating, where feasible, existing AIS within the ecosystem.

The United States and Canada are working to minimize the risk of Asian carps and other species invading the Great Lakes by a combination of species and pathway risk assessment and by implementing risk management actions. A second line of defence has been also created by establishing an early detection and rapid response initiative with the goal of finding new invaders and preventing them from establishing self-sustaining populations. This basin wide effort resulted in several new detections of grass carp and associated agency rapid responses. As a result of actions undertaken during the previous three years, no new AIS are known to have become established in the Great Lakes. However, the recently detected evidence of Grass Carp reproduction in the Sandusky River, a tributary to Lake Erie in north-central Ohio in the United States, is of great concern. The United States and Canada are committed to further improving and strengthening the AIS actions and initiatives under the Aquatic Invasive Species Annex.

PROGRESS TOWARD MEETING GLWQA COMMITMENTS



This Annex is being implemented by the Aquatic Invasive Species (AIS) Annex Subcommittee, co-led by the United States Fish and Wildlife Service and Fisheries and Oceans Canada. The AIS Annex Subcommittee delivers its work in close cooperation with the Great Lakes Panel on Aquatic Nuisance Species, which is supported by the Great Lakes Commission and is partially funded by the United States Fish and Wildlife Service. Organizations on the subcommittee include: [Insert logos from: Fisheries and Oceans Canada, U.S. Fish and Wildlife Service, 1854 Treaty Authority, Canadian Aquatic Invasive Species Network, Chippewa-Ottawa Resource Authority, First Nation / Metis – Chiefs of Ontario, Great Lakes Indian Fish and Wildlife Commission, Great Lakes Commission, Great Lakes Fishery Commission, Great Lakes St. Lawrence Cities Initiative, Michigan Department of Environmental Quality, Minnesota Department of Natural Resources, New York Department of Environmental Conservation, Ohio Department of Natural Resources, Ontario Federation of Anglers and Hunters, Ontario Ministry of Natural Resources, Ontario Invasive Species Centre, The Nature Conservancy, U.S. Environmental Protection Agency, and U.S. National Oceanographic and Atmospheric Administration.]

BINATIONAL ACTIONS TAKEN

Conducting risk assessments on Aquatic Invasive Species for their entry into the Great Lakes.

- The United States and Canada undertook an assessment of existing species risks assessments, in coordination with Great Lakes jurisdictions and their partners. Based on this analysis, a binational assessment of the ecological risks and impacts related to Grass Carp establishment was completed, and is being peer reviewed.

- Members of the Aquatic Invasive Species Annex Subcommittee are also supporting work of the Conference of Great Lakes Governors and Premiers Aquatic Invasive Species Task Group to harmonize species risk assessments across the basin.

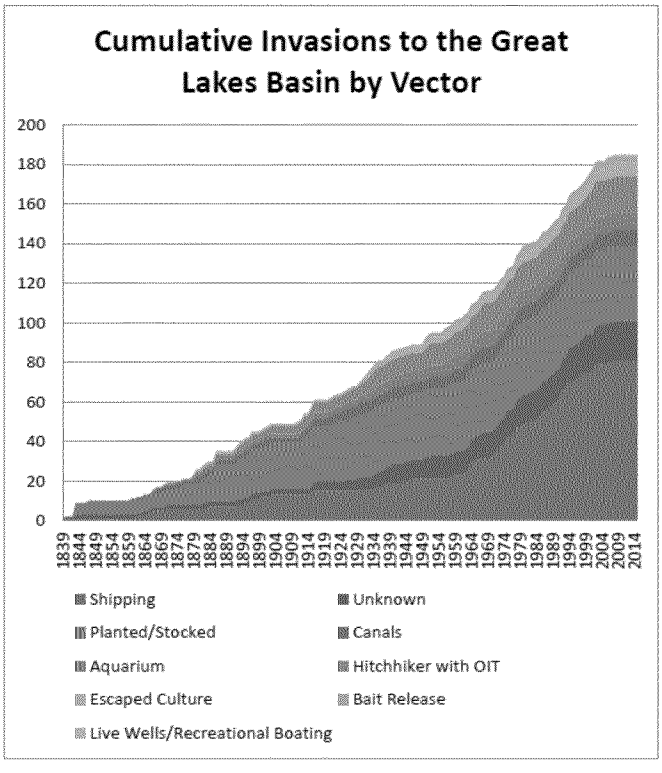
- A risk analysis of illegal trade and transport into Great Lakes jurisdictions was completed and a report of these findings was delivered to the Great Lakes Fishery Commission's binational Law Enforcement Committee. The report recommends risk management efforts to address the unacceptable risks documented for species regulated by state, provincial, and federal agencies in the internet, live bait, live food, aquaculture, private pond/lake stocking, water garden, aquarium/pet, and cultural release pathways. The AIS Subcommittee will continue to work with the Law Enforcement Committee to address risk management needs described in the risk analysis report.

- A new web-based tool called, *Great Lakes Detector of Invasive Aquatics in Trade*, has been developed by the Great Lakes Commission to better quantify the threat posed by the internet commerce pathway. The tool is available to managers in the United States and Canada to inform and help target risk assessment, monitoring and surveillance, and enforcement.

- In the United States, a government-industry partnership is working toward development of new U.S recreational boat design standards for building new "AIS-Safe Boats," and development of U.S. standards for AIS removal from existing recreational boats.
- In Canada, a National Recreational Boating Risk Assessment, with focus on the potential movement of AIS within Canadian and United States waters of the Great Lakes, was carried out during 2015, and the products of this assessment will assist in identifying areas to focus on minimizing risk of recreational boaters spreading AIS.

Success preventing invaders

Historically, an average of one non-native species was found to be established in the Great Lakes about every 8 months. Most of those introductions resulted from ballast water discharge. No ballast-mediated introductions, and no additional introductions from other pathways, have resulted in establishment of a nonnative species since 2008. The success of joint United States and Canada ballast water exchange management has been a major contributor, with no new introductions attributable to ships since 2006.



Source R. Sturtevant, GLANSIS-NOAA

Undertaking outreach and engagement in support of meeting various annex commitments.

- While most outreach and engagement efforts are implemented domestically, experts from government agencies and non-government groups are working across jurisdictional lines to share resources and approaches that modify human behavior so as to minimize risk of people spreading AIS.

- To support this work, the binational Great Lakes Panel on Aquatic Nuisance Species' Information and Education Committee developed a synthesis of communication and education campaigns, programs, and products, which support prevention efforts for a variety of pathways, including recreational boating.

By 2015, develop and implement an Aquatic Invasive Species early detection and rapid response initiative.

- The United States and Canada developed an AIS early detection and rapid response initiative as a part of a number of strategies being applied to prevent the introduction and spread of AIS. Early detection and rapid response provide a strong second line of defense to prevention efforts by finding AIS populations, including Asian Carps, while they are still within a small area and preventing them from becoming established. This effort marks the first basinwide early detection effort in the history of the Great Lakes, an effort that will be strengthened and enhanced in the future. A full account of the achievements to date under the initiative is available at www.binational.net (http://binational.net/2015/02/23/ais-early-detection/).
- Key components of the AIS early detection and rapid response initiative include:
    - An "AIS species watch list" of those species of the highest priority of risk of invading the Great Lakes.
    - A list of priority locations to undertake surveillance for the potential introduction of species on the "AIS species watch list";
    - Protocols for monitoring and surveillance methodologies (such as environmental DNA sampling and sampling using gears that collect fishes and bottom-dwelling invertebrates) so that a potential invader is promptly observed and reported;
    - The sharing of relevant information amongst the responsible departments and agencies to ensure prompt detection of invaders and prompt actions to respond to them; and
    - The coordination of plans and preparations for any response actions necessary to prevent the establishment of newly detected AIS.

- Asian carps are a key focus for binational early detection and rapid response with priority assessment locations established guided by risk assessments, with shared protocols for sampling, coordinated communication of detection results, and response planning efforts.
- Detections of Asian Carps in Canadian waters triggered several coordinated response efforts under the incident command system. Those responses successfully tested the Canadian domestic response framework.

- The Conference of Great Lakes Governors and Premiers has also provided critical leadership with the

establishment of their Mutual Aid Agreement as the basis for the states and provinces to share resources to deal with AIS.

Implementing early detection and rapid response.

- [Placeholder for additional text to come/decision on adapting and moving text below "A performance evaluation of…": Lake Superior lake-wide early detection efforts. States, tribes, United States Fish and Wildlife Service and Ontario are carrying out a coordinated early detection effort on Lake Superior.]

Conducting research to develop and test Aquatic Invasive Species detection, containment, and control technologies.

- The sea lamprey mating pheromone, 3kPZS, was official registered in the United States and Canada as the first ever vertebrate pheromone biopesticide. Like an alluring perfume, the mating pheromone is a scent released by male sea lampreys to lure females onto nesting sites. The pheromone could be used to lure male sea lamprey into traps. Research and development of the mating pheromone was funded by the Great Lakes Fishery Commission, with additional support from the Great Lakes Restoration Initiative, in collaboration with federal governments, university, and private industry partners.

DOMESTIC ACTIONS TAKEN

Conducting risk assessments on Aquatic Invasive Species for their entry into the Great Lakes.

- Approximately 160 risk assessments were conducted by the United States on non-native species and published on www.fws.gov (http://www.fws.gov/fisheries/ANS/species_erss_reports.html) These risk assessments have identified high risk fish, crustaceans, and mollusks that thrive in climates similar to the Great Lakes Basin and could become established if they are introduced in large enough numbers.

- The risk of barge shipping-related transport of fishes, within the Chicago Area Waterway System, was evaluated, and the resulting report delivered to the Asian Carp Regional Coordinating Committee. Results indicate that free-swimming surrogate fish, both wild fish and fish placed in and around barges by researchers, can remain between barges for substantial distances. In one trial, live fish were transported more than nine miles on the Illinois River through Brandon Road Pool, Lockport Lock, and the United States Army Corps of Engineers' electric dispersal barriers. Further

studies on the susceptibility of actual juvenile Asian carp to becoming entrained, methods to clear these junctions of all fish, and improvements in barge operation best management practices are being pursued to reduce this risk.

Preventing introduction and spread of Aquatic Invasive Species through regulations.

- Based on risk assessments and supporting science, the state of Michigan amended its prohibited species list to include several new invasive species. Additional information can be found at: http://www.michigan.gov/invasives/0,5664,7-324-68071---,00.html.

- The United States Fish and Wildlife Service has proposed adding 11 non-native freshwater species to the list of injurious species under the Lacey act. Ten fishes (Crucian Carp, Eurasian Minnow, Prussian Carp, Roach, Stone Moroko, Nile Perch, Amur Sleeper, European Perch, Zander, Wels Catfish) and one crayfish (common yabby) are included in the proposed rule making. A final rule is planned for release in 2016.

Implementing early detection and rapid response.

- Great Lakes states are have been actively monitoring and responding to detections of invasive species, including recent responses for invasive Water lettuce, New Zealand Mudsnail, Parrot Feather, Red Swamp Crayfish, Water Hyacinth, Water Chestnut, European Frogbit, Starry Stonewort, Northern Snakehead, and small killifish (Mummichog).

- The invasive species Hydrilla was discovered in the Cayuga Lake Inlet and Erie Canal, New York. An aggressive eradication projects started at both of these locations in response to concerns about the spread of this invasive plant species throughout the Great Lakes basin. Despite signs of a successful control, eradication may take several more years due to ability of root systems to lay dormant in the sediment. More information about Hydrilla can be found at http://stophydrillawny.org/.

- A performance evaluation of early detection monitoring surveillance programs on Lake Superior revealed new opportunities to substantially increase the speed and sensitivity of detecting newly-introduced species. By focusing efforts on areas within ports known to carry rare and invasive species, and by increasing the use of sampling equipment that captures a wide diversity of organisms, the effectiveness at detecting invasive species has nearly doubled. To continue improvement in the future, the United States Environmental Protection Agency and United States Fish and Wildlife Service have implemented an adaptive cycle of surveillance assessment, refinement, and implementation.

Conducting research to develop and test Aquatic Invasive Species detection, containment, and control technologies.

- The Great Lakes Restoration Initiative provides support to the multi-agency and binational Asian Carp Regional Coordinating Committee, which has implemented the Asian Carp Control Strategy Framework — including surveillance, response actions and testing of new control technologies.

More information about the Asian Carp Regional Coordinating Committee is available at http://www.asiancarp.us.

- U.S. federal partners supported the development and testing of a near-real-time environmental DNA surveillance tool that is being used to support law enforcement efforts for interdicting illegal transport of Asian carp species into Great Lakes jurisdictions.
- The United States tested the use of carbon dioxide as an environmentally sound approach to help contain Asian carps in the Mississippi River system. The results demonstrate that this containment technology may help at limiting the spread of Asian carps.
- Work was initiated in the United States on the development and testing of a system to deliver a piscicide (Antymicin) that can kill Bighead and Silver Carps while not harming other fishes. This technology could be used to reduce populations in the Chicago Area Waterway System and Illinois River, which would further reduce the risk of Asian carp establishment in the Great Lakes.

- New molecular genetic techniques are being developed for detecting rare invasive species. Current research efforts funded by the Great Lakes Restoration Initiative (GLRI) have focused on: 1) expanding the use of environmental DNA (i.e. "free" DNA found in water); 2) genetic analyses of larval fish samples to detect the reproduction of invasive fishes; and 3) genetic analyses of lake sediments or benthos for detection of invasive species such as the Zebra Mussel, Quagga Mussel, and New Zealand Mudsnail. The current trend of advancing molecular genetic methods coupled with decreasing costs is highly promising.

- Based on extensive testing, the commercial product "Zequanox" was approved for open-water use to control invasive Zebra and Quagga mussels in lakes and rivers. U.S. agency and academic partners are exploring its strategic use in the Great lakes and inland lakes. Zequanox is composed of dead cells derived from a naturally occurring soil microbe, and it controls invasive mussels in all life stages. Its active ingredient has low toxicity and presents little risk to non-target organisms.

- The United States is funding and supporting new methods to control the spread of invasive *Phragmities* including:
  - Research at Cornell University to identify insects that kill *Phragmites*. The researchers are evaluating the host-specificity of each insect species in preparation for wide-spread releases of insects that may help control *Phragmites* populations.
  - Work by the United States Geological Survey and its partners to identify the fungal microbes that help provide nutrients to nonnative Phragmites, and work to find ways to slow Phragmites growth by disrupting this symbiotic relationship.
  - Work by Wayne State University and United States Geological Survey scientists to silence important genes in Phragmites (e.g., those for flowering, seed set, and photosynthesis) in an effort to reduce its competitive advantage. Cooperating scientists are testing gene silencing of photosynthesis in *Phragmites*. The next step will be to test the technology in the field and develop an application method that will be feasible over a large scale.
  - More information about Phragmities can be found at http://greatlakesphragmites.net/research/control-options/.

Assessing the potential impacts of climate change on Aquatic Invasive Species.

- A climate change projection tool was developed that can project the AIS climate niche, within the Great Lakes basin, under several climate change scenarios published by the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/) for the years 2050 and 2070.

CANADA

Conducting risk assessments on Aquatic Invasive Species for their entry into the Great Lakes.

- During 2013, a national risk assessment of ballast water introductions of AIS species was completed with focus on the Great Lakes and St. Lawrence River. That risk assessment identified the need to reduce risk by incorporating ballast water treatment into systems of ships that discharge ballast into the Great Lakes.

- During 2013, a peer review of available tools was carried out, and science advice was published, about screening-level risk assessment protocols for nonindigenous freshwater organisms in trade in Canada that provides guidance to evaluating risks to support prevention actions.

Preventing introduction and spread of Aquatic Invasive Species through regulations.

- With extensive public and government consultation, Canada established new aquatic invasive species regulations under the Fisheries Act in June 2015 creating new prohibitions for species based on risk and enabling new measures for prevention and control of AIS in Canada and at its borders.

- The Province of Ontario, based on broad stakeholder input, gave royal assent in November 2015 to Bill 37 – the new Invasive Species Act – which will come into force within one year, providing tools and authorities needed to prevent and respond to all invasive species including prohibitions for high risk species.

Implementing early detection and rapid response.

- Canada, working closely with Ontario and United States jurisdictions, has delivered its Asian Carp Program based on four pillars: prevention, early warning, response, and management. The program includes extensive early detection surveillance activities in close conjunction with environmental DNA monitoring carried out by Ontario. More information can be found at http://asiancarp.ca/.

- Canada, in coordination with the Ontario Federation of Anglers and Hunters, the Invasive Species Centre, and Royal Ontario Museum carried out a large-scale outreach campaign specific to raise awareness and public understanding of best practices to prevent transporting Asian carps.

- Findings of Grass Carp in lakes Erie and Ontario between 2013 and 2015 have triggered successful coordinated response efforts under the incident command system testing the domestic response framework established for Asian carps.

- [Placeholder for additional text to come: Invading plant species have initiated response efforts. Water Soldier in the Trent River. Water Chestnut in Lake Ontario.]

Conducting research to develop and test Aquatic Invasive Species detection, containment, and control technologies.

- Research has been completed about the capacity for invasive fish species, including Asian Carp, to move through the Welland Canal and the St. Mary's River canals to help better understand the risk of spread and opportunities for control.

- Research on repulsion devices to potentially contain and control fish species, including Asian carps, has been carried out in a large-scale mesocosm.

- Canada continues to actively research monitoring and treatment technologies to advance efforts to prevent AIS movement in the ballast water of ships.

- [Placeholder for additional text to come: Molecular techniques – CDN research by OMNRF.]