Great Lakes Panel on Aquatic Nuisance Species
Research Committee

Aquatic Invasive Species Research Priorities for the Great Lakes – 2005

Background:
Aquatic invasive species (AIS) significantly affect the ecological and economic integrity of the Great Lakes-St. Lawrence region. Over 170 aquatic invasive species have been documented in the region[1], including well known species such as zebra mussel, sea lamprey, purple loosestrife, Eurasian watermilfoil, round goby, ruffe, spiny water fleas, quagga mussel and rusty crayfish. Pathways for introduction include shipping (ballast water discharge and hull fouling), live/fresh fish industry, aquarium trade, biological control, recreational boating, recreational fisheries enhancement, bait business and horticultural practices. Some of the introductions associated with these commercial activities were accidental, others were intentional.

More information and research is needed to prevent future unintentional AIS introductions, to manage and control existing populations and to respond to new introductions upon their discovery. The Research Coordination Committee of the Great Lakes Panel on Aquatic Nuisance Species has compiled the following document to serve as a resource for, and provide guidance to private foundations and local, state/provincial and federal agencies that provide funding for research on AIS prevention and control in the Great Lakes as well as those involved with AIS research, management and control.

Research on some of the priorities is already underway, yet these items remain priorities because more needs to be known or accomplished in that area before we strike it from the list. These research priorities were identified for the Great Lakes rather than inland lakes, but they could be applied to coastal regions as well. The list is intended to be dynamic, changing as our knowledge expands and our focus varies. Lists of policy or information and education priorities will be developed by the appropriate committee of the Great Lakes Panel.

Priorities from twelve documents were considered in development of this list.

- *Aquatic Nuisance Species Research Relevant to the Great Lakes Basin: Research Guidance and Descriptive Inventory*, Great Lakes Panel on Aquatic Nuisance Species
- *Ballast Water Management Policy*, Great Lakes Panel on Aquatic Nuisance Species
- *Michigan State Management Plan Update*, 2002
- *A Great Lakes Action Plan for the Prevention and Control of Nonindigenous Aquatic Nuisance Species*, 2000
- *Recommended Ballast Water Research Priorities, Ballast Water and Shipping Committee*, National Aquatic Nuisance Species Task Force
- *An Evaluation of the National Invasive Species Act to Support Its Reauthorization*, Great Lakes Commission, 2002
- *Ruffe Control Program – Research Needs*, U.S. Fish and Wildlife Service
- *Research and Management Priorities for Aquatic Invasive Species in the Great Lakes*, International Association for Great Lakes Research, 2002
- *Great Lakes Strategy 2002*, U.S. Environmental Protection Agency, 2002
- *11th Biennial Report on Great Lakes Water Quality*, International Joint Commission, 2002
- *Fish Research Priorities for the Great Lakes*, Great Lakes Fishery Commission
- *Great Lakes Fish Health Committee – Research Priorities*, Great Lakes Fishery Commission

[1] Ricciardi, A., unpublished data

Prevention – Ballast Water and NOBOB Vessels:
Transoceanic shipping remains the primary vector for AIS introductions. According to the 2002 IAGLR *Research and Management Priorities for Aquatic Invasive Species in the Great Lakes*, 36 of 50 (72%) nonindigenous aquatic species established in the Great Lakes between 1959 and 2000 have been attributed to ballast tank transport and discharge of untreated ballast water. Intra-coastal and Great Lakes vessels can facilitate the spread of AIS already present within the Great Lakes-St. Lawrence system. Research is underway to identify to identify and develop means of treating ballast water and sediment to eliminate this mode of species introduction. Until a 100 percent effective means of preventing ballast-mediated introductions is put into practice, significant research effort should continue to be devoted to ballast water and NOBOB vessels.

- Purchase or lease vessels for full-scale ballast water treatment technology testing platforms. Make full-scale ballast water treatment test platforms available in the form of shore-based facilities or MARAD vessels and conduct full-scale demonstrations of ballast water treatment technologies on shore or ship under actual operating conditions.
- Evaluate ship practices, such as those identified in the Code of Best Practices developed by the Shipping Federation of Canada that may reduce the likelihood of taking on invasive species in ballast water or discharging them into waters where they can become established.
- Continue to develop technologies to reduce the number or concentration of AIS discharged with ballast water in accordance with applicable standards as they are developed.
- Continue to develop technologies to reduce entrained and accumulated sediment in ship ballast water and tanks in accordance with applicable standards as they are developed.
- Conduct research on factors affecting the resuspension of organisms in sediment in ballast tanks.
- Identify measures to assess the effectiveness and environmental soundness of alternative ballast water treatment technologies.
- Conduct research on ballast patterns specifically salt water or external vessels especially NOBOBs.
- Develop a program to capture detailed data of NOBOB traffic patterns, volumes of ballast loaded and ballast practices.
- Identify maritime transportation routes such as has been done with the Ponto-Caspian region that have demonstrated or have the potential capability to advance the spread of aquatic nuisance species.

Prevention – Other Vectors:
Prevention of new AIS introductions must remain a top priority. Efforts should focus on pathways, origins, technologies and methods to eliminate organisms in transport and prevent their uptake as possible.

- Conduct research as needed to verify and expand the “hot list” of high risk potential invasive species with source locations, characteristics and probable impacts and identify them as regional priorities for prevention and control. Evaluate how this information can be utilized and connected with marine transportation routes to aid prevention, monitoring and response efforts.
- Determine the relative risk from pathways and vectors other than ballast water for introducing new AIS, including bait fish; recreational boating; cargo, packing material, and dunnage; aquaculture, and ornamental plants and watergardens.
- Conduct research as needed on the risks of hull fouling, especially with regards to transoceanic passage into the Great Lakes.
- Determine and map potential ranges and habitat for AIS in the Great Lakes
- Implement genetic tools to identify relationships among source communities and newly established communities to identify high-risk trade routes. Create a web-based gene bank to quickly identify new invaders.
- Support research to advance the understanding of aquatic invasion biology, particularly characteristics of successful/unsuccessful invasions and invaders.
- Quantify life history characteristics that lead to successful invasions; for example, propagule pressure and trophic disruption.
- Develop a program to identify, assess, and address potential high-threat invader organisms present in foreign fresh and brackish water systems.

Coordination and Information Management:
Coordination among research efforts should be strongly encouraged to help avoid duplication of efforts and concomitant dilution of research funds. Researchers and funding agencies are encouraged to utilize existing internet-based resources to allow collaboration and data sharing among projects.

- Establish a web-based gene bank database for rapid identification of new invasive species.
- Develop and widely share the AIS hot list with regional rapid response agencies and monitoring efforts
- Develop and promote use of Internet-based research coordination and information system such as the Great Lakes-St. Lawrence Research Inventory, SGNIS, the Invasive Species Clearing House and the Great Lakes Aquatic Nuisance Species Information System (GLANSIS) to foster timely communication and information sharing among researchers, policy makers, extension agents, stakeholders and the general public.
- Provide funding for translation of foreign research articles on newly introduced species for use in rapid response efforts and other needs.

Detection, Monitoring and Rapid Response:
Given the widespread impact of invasive species once established, there needs to be a regional, coordinated monitoring program to allow for rapid detection of newly introduced species, provide base-line community data to provide measurement of ecological change as AIS become established and to provide a chance of potential success of an eradication response.

- Establish and provide funding for coordinated monitoring programs focusing on high-risk areas to provide early detection of new introductions and effectively determine the distribution and abundance of species already present and to gauge prevention and control success
- Compile and analyze existing data on native and established non-native species to provide a better understanding of the community and ecosystem structure in the Great Lakes region to provide reference data for rapid response efforts
- Develop rapid response plans from both regional and species-specific perspectives.

Control and Management:
Advances in AIS control and management have and are being made, but the progress often moves slower than the species themselves. Management and if possible, containment of existing populations, will help provide researchers time to develop new methods to eradicate and better control invasive species. Sea lamprey control remains a high priority. Recent developments in pheromone research are expected to augment lamprey control efforts but rising abundance of lamprey in Lake Michigan underscores the need for additional control efforts. Efficiency and environmental soundness must be considered as various control options are identified and developed.

- Develop and apply environmentally sound chemical, physical, and biological control methods including attractant and repellents to address already established species, including the use of dispersal barriers at choke points.
- Develop ecological forecasting methods for AIS-driven or influenced events, for example propagule production or harmful algal blooms, to assist in vector management or protection of public health

Economics:
Ecosystem and natural resource damages that occur as a result of invasive species are not easily measured unless an economically important resource has been affected. Yet decision and policy makers rely on such data to justify expenditure of public monies for the prevention and control of invasive species. More economic information is needed on the effects of invasive species on our ecosystems.

- Develop and validate approaches for assessing economic impacts of AIS and cost-benefit analyses of various response scenarios to manage individual species by control or eradication.
- Evaluate current and historical damage (physical, biological, industrial, recreational, ecosystem, beneficial uses) to the Great Lakes caused by the invasion of nonindigenous aquatic nuisance species to provide decision makers with information to balance the cost of AIS prevention with the costs of AIS control and management.
- Conduct cost-benefit studies on all potential vectors for AIS spread and introduction.

Ecosystem Response and Impacts:
More needs to be known of the potential ecosystem impacts of invasive species as well as the impacts that have caused changes in Great Lakes ecology. Ecosystem response to invasive species and the potential for resisting or facilitating invasion by introduced species also require research. Improving or maintaining the resistance of Great Lakes ecosystems to invasion and better assessment of biological impacts are among those areas that require greater study and understanding.

- Determine impacts of AIS on economically important species and aquatic biodiversity.
- Conduct food web disruption studies, including mechanisms and trophic levels.
- Support research on potential human health and ecosystem issues from potential pathogen or parasite transport.