Great Lakes Panel on Aquatic Nuisance Species
Research Committee

ANS Research Priorities for the Great Lakes
July 2003

Background:
Aquatic nuisance species (ANS) significantly affect the ecological and economic integrity of the Great Lakes-St. Lawrence region. Over 170 aquatic invasive species have now been documented in the region, including well known species such as zebra mussel, sea lamprey, purple loosestrife, Eurasian watermilfoil, round goby, ruffe, spiny water flea, 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 ANS introductions, to manage and control existing populations and to respond to new introductions upon their discovery. The Research 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 ANS prevention and control in the Great Lakes.

The categories are based in part on those used in the National Invasive Species Council's Management Plan. 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. The list reflects research priorities for the Great Lakes rather than inland lakes and is intended to be dynamic, changing as our knowledge expands and our focus varies. Priorities from these lists that concerned policy or information and education were referred to the appropriate Great Lakes ANS Panel committee for their consideration.

The priorities were gathered from the eleven documents listed below.

- *Aquatic Nuisance Species Research Relevant to the Great Lakes Basin: Research Guidance and Descriptive Inventory*, 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

Prevention – Ballast Water and NOBOB Vessels:
Transoceanic shipping remains the primary vector for ANS 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 have been attributed to ballast tank transport and discharge of untreated ballast water. Intra-coastal and Great Lakes vessels can facilitate the spread of ANS already present within the Great Lakes-St. Lawrence system. Research is underway to identify the potential for NOBOB vessels to introduce new invasive species and to identify and develop means of treating ballast water 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.

- Dedicate purchased or leased vessels to the testing of ballast water treatment technologies. Alternatively, make ballast water treatment test platforms available in the form of shore-based facilities or MARAD vessels. Conduct full-scale demonstrations of ballast water treatment technologies on shore or ship under actual operating conditions.
- Develop technologies that can be used to reduce the number or concentration of ANS discharged with ballast water.
- Develop technologies to reduce entrained and accumulated sediment in ship ballast water and tanks.
- Determine the physical, chemical, and biological characteristics, including pathogens that may affect the treatment of ballast water.
- Identify measures to assess the effectiveness and environmental soundness of alternative ballast water treatment technologies
- Determine the safety of ballast water practices and technologies for shipboard or shore-side applications.
- Develop a technology feasibility study center able to assess ballast treatment technologies prior to demonstration on actual ships.
- Determine the ecological vulnerability and biological, physical, and chemical characteristics of receiving waters that may be impacted by ballast water discharges and which affect the likelihood of successful invasion
- 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 compatible waters where they can become established.
- 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. Evaluate how this information can be utilized to aid prevention efforts.
- Support research on human health issues from pathogen transport.

Prevention – Other Vectors:
Prevention of new ANS 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.

- Expand the “hot list” of 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 to aid prevention, monitoring and response efforts.
- Investigate the relative risk from sources and pathways of introducing new ANS, including bait fish, recreational boating, cargo, ornamental plants, and aquaculture.
- Describe characteristics of baitfish commerce in Great Lakes states, including harvest gear, sites and quantities and commercial traffic patterns, and identify risk of ANS transport.
- Develop genetic tools to identify relationships among source communities and newly established communities to identify high-risk trade routes.
- Develop a program to address potential high-threat invader organisms present in European fresh and brackish water systems.
- Conduct research on invasive characteristics of genetically modified aquatic plants and animals.
- Determine and map potential ranges for ANS in the Great Lakes

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.

- Encourage collaboration on projects and data sharing.
- Support use of the Great Lakes-St. Lawrence Research Inventory to link ANS research databases nationally and internationally on the internet to foster better communication among researchers.
- Evaluate and strengthen lines of communication used by aquatic nuisance species researchers to facilitate information transfer regarding aquatic nuisance species research needs and findings.
- Inventory and assess current research efforts in areas of biology and life history, control and mitigation, ecosystem effects, prevention of introductions, socio-economic considerations and analysis, and spread of established ANS populations.
- Perform timely literature reviews and translation of information on all newly introduced species to eliminate duplication of research.
- Enhance communication on ANS issues between scientists and Sea Grant agents, as well as the general public and efficiently and effectively communicate research results to policy makers and other stakeholders.
- Develop means of information sharing to ensure that advances in knowledge of patterns of aquatic invasions, research, and technologies to treat ballast water are made available.
- Coordinate data and encourage use, sharing and accessibility of geographic information system data to facilitate documentation of existing and potential ranges of introduced species.

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 ANS become established and to provide a chance of potential success of an eradication response.

- Compile data on native species to provide a better understanding of the community structure in the Great Lakes region to provide data for rapid response
- Establish coordinated monitoring programs 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
- Identify incentives for participation in regional monitoring programs and rapid response programs
- Coordinate and enhance the monitoring of high-risk areas for the early detection of invasive species.
- Develop rapid response plans from both regional and species-specific perspectives.

Control and Management:
Advances in ANS 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.

- Research effective and environmentally sound chemical, physical and biological eradication/control options and technologies for aquatic nuisance species.
- Examine and implement chemical, physical, and biological control methods to address already established species, including the use of dispersal barriers at choke points.
- Evaluate ways to maximize benefits of control options, including minimized costs to the affected industry.
- Research the social/political/economic acceptability of control options

- Develop and register effective chemical control measures including attractants and repellents.
- Develop and evaluate containment options for aquatic nuisance species.
- Conduct targeted biological research on control points for reducing potential aquatic nuisance species invasions.
- Conduct research on resting stages and probabilities for establishment by species
- Enhance bioengineering of species-specific pathogens

Economics:
The costs from zebra mussel control with a power plant or municipal water intake are easily measured and accounted for, however the ecosystem and natural resource damages that occur as a result 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 native ecosystems.

- Evaluate current and historical damage (physical, biological, industrial, recreational, ecosystem) to the Great Lakes caused by the invasion of nonindigenous aquatic nuisance species.
- Develop more reliable ecosystem models to assist management in making decisions on mitigation of impacts or on the control of established nonindigenous aquatic nuisance species.
- Compare the costs of ANS prevention with the costs of ANS control and management.

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 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 require greater study and understanding.

- Expand the theory of fish community resilience and recommend and test means of increasing resilience through fishery and habitat management.
- Determine the ecosystem response to the control/containment of nonindigenous aquatic nuisance species.
- Determine impacts of nonindigenous on economically important native species.
- Conduct food web disruption studies, including mechanisms and trophic levels.
- Determine the causes of the Lake Erie dead zone and the links to botulism.
- Prepare risk assessments to determine potential impacts on native species.
- Conduct research on effects of aquatic nuisance species on water quality.
- Conduct research on fish disease transport.
- Identify and assess the economic and ecological impacts associated with each invasive species.
- Determine the effects of ANS colonization on aquatic biodiversity.
- Continue and expand research to determine the spread and impacts (biological and economic) of invasive species in the Great Lakes ecosystem.
- Determine lower trophic level and food web dynamics, with emphasis on the effects of invasive species.
- Assess the specific positive and negative effects of species introductions.
- Conduct research on potential effects of aquatic nuisance species identified as possible invaders
- Assess the relationship between observed wounding indices and the actual mortality caused by sea lamprey.
- Assess the lethality of attack from sea lamprey by species and size group.
- Determine the most effective means of minimizing sea lamprey damage to fish.