Executive Summary

Chartered under U.S. federal law, the Great Lakes Panel on Aquatic Nuisance Species is responsible for advancing aquatic nuisance species (ANS) prevention and control efforts in the Great Lakes-St. Lawrence system. The Panel, a binational body comprised of representatives from government (state, provincial, federal, tribal), business and industry, universities, citizen environmental groups and the larger user community, primarily operates through coordination, while providing guidance on research initiatives, policy development and information/education programs on a regional basis.

The introduction and spread of ANS is an urgent issue posing a significant risk to the environmental and economic health of the Great Lakes-St. Lawrence system. The Great Lakes Panel recognizes that ballast water (water and entrained solids) from ocean-going commercial vessels is a primary vector for the introduction of ANS to the Great Lakes-St. Lawrence system. Organisms discharged with ballast water, and those left in the residual water and sediment after ballast discharge, are a threat to the integrity of the ecosystem and many water-dependent sectors of the economy. While introduction of new species via ballast water is of considerable concern in the Great Lakes-St. Lawrence region, the spread of established ANS populations within the system via ballast water also demands attention. The Panel is further concerned over other commercial and recreational activities (e.g., aquaculture, recreational boating) and their role in providing pathways for ANS introduction and spread in the Great Lakes-St. Lawrence system.

More information is needed to determine the extent to which current regulations and guidelines concerning ballast water exchange have mitigated the introduction and spread of ANS in the Great Lakes-St. Lawrence system. Additional discoveries of ANS continue to occur, as does the spread of established populations from lake to lake; therefore the Great Lakes Panel recommends new policy initiatives to address the issue of ballast water management and its effectiveness.

Science-based criteria must be established to develop standards upon which regulations/guidelines are based. These criteria will provide the benchmark by which ballast water exchange, management practices and treatment technologies can be evaluated with the ultimate goal of eliminating ANS discharges. Once criteria are established, a systemwide ballast water management program can be developed, consisting of policies, regulations, guidelines and options for management practices and treatment technologies. This regional program can be implemented through a coordinated, binational approach that is adopted in partnership by governmental entities, the maritime industry, research community, nongovernmental groups and other appropriate stakeholders. The program must ensure the safety of vessels and crew, and be effective, efficient, scientifically based, environmentally sound and economically viable. Further, it must be accompanied by the application of compatible regulations or guidelines at national and international levels.

Research efforts on ANS prevention and control issues are in need of substantially increased funding. Research priorities include potential ballast water management practices and treatment technologies, determination of the efficacy of ballast exchange under different operating conditions and tank designs, ship design and engineering, assessment of vessels with "no ballast on board" (NOBOBs) as vectors for ANS introductions, the economic and environmental impact of ANS introductions, and the economic costs of prevention/control efforts. It is critical that results of such research are efficiently communicated to managers and policymakers to ensure the timely development and application of effective ballast water management measures.

This policy position, as adopted by the Panel membership, is based on the following objective: *To eliminate ballast-associated ANS introductions into waters of the Great Lakes-St. Lawrence system, and reduce ANS dispersal between the lakes through the regional development and application of a timely, effective, scientifically based, environmentally sound and economically viable binational ballast water management program*. This policy position should be revisited periodically to review and evaluate recommended actions as technologies and the status of ANS distributions change over time.

Background

Ballast water is a major pathway for the introduction and spread of ANS to the Great Lakes-St. Lawrence system and other coastal and fresh waters of North America. As ships load and unload cargo in ports throughout the world, they take on and discharge ballast water to maintain crew safety and stability and reduce hull stress. Ballast water, as well as residual water and sediment in NOBOBs, can include organisms such as pathogens, phytoplankton, zooplankton, macrophytes, mollusks, invertebrate resting stages and fish. Ballast water pumped onboard in U.S. and Canadian ports also is recognized as a vector for interlake and intralake spread of ANS within the Great Lakes-St. Lawrence system. As ships transit the system, these organisms can be released with discharged ballast water, and consequently, can either establish new populations or expand the range of existing ones.

Such species can cause significant ecological and economic impacts and may pose human health risks. Scientifically based literature indicates that the zebra mussel (*Dreissena polymorpha*), quagga mussel (*Dreissena bugensis*), Eurasian ruffe *(Gymnocephalus cernuus)*, round goby (*Neogobius melanostomus*) and spiny waterflea *(Bythotrephes cederstroemi)* were introduced into the Great Lakes-St. Lawrence system via foreign ballast water. Interlake and intralake ballast water discharge by commercial shipping, together with other vectors, has spread these and other species across the Great Lakes-St. Lawrence system.

In 1988, the International Joint Commission and the Great Lakes Fishery Commission called upon the governments of the United States and Canada to deal with the issue of ANS invasions in the Great Lakes-St. Lawrence system. In response to this and other concerns, the Canadian Coast Guard established voluntary ballast exchange guidelines in 1989. In 1991, the International Maritime Organization (IMO) formally adopted guidelines based on the action plan of the Canadian Coast Guard. Meanwhile, the U.S. Congress enacted the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) in 1990. Subsequently, in 1993, the U.S. Coast Guard began implementation of ballast water management regulations that required vessels bound for the Great Lakes to: 1) exchange their ballast water on the high seas, 2) retain ballast onboard or 3) use an environmentally sound alternative. Despite good compliance with the existing regulations and guidelines in the Great Lakes-St. Lawrence system, concern has mounted over the effectiveness of these provisions as additional discoveries of ANS continue to occur, as does the spread of established populations from lake to lake.

NANPCA, reauthorized as the National Invasive Species Act (NISA) of 1996, established ballast exchange guidelines for all U.S. coastal regions; these guidelines are mandatory in the Great Lakes-St. Lawrence system and are voluntary in other coastal waters. In 1998, changes to the Canada Shipping Act allowed for the creation of ballast water management regulations. The program is currently voluntary, with a pending regulatory program that would, if implemented, be consistent with those of the United States and the international community.

Under the current regulatory regime, a minimum salinity of at least 30 parts per thousand (ppt) must be achieved following a high-seas ballast exchange. As a result of their current design, ballast tanks cannot be pumped dry. Therefore a portion of the original ballast water and the organisms it contains remain in the tanks and are mixed with exchange water. Also, open-ocean ballast exchange is not fully effective due to the survival of some resistant forms of ANS (e.g., euryhaline organisms, resting life stages, viruses and other pathogens) and can compromise crew and ship safety. Another significant ballast water management problem is that on average, since 1995, nearly 80 percent of commercial vessels enter the Great Lakes-St. Lawrence system in a NOBOB condition, and are exempt under current ballast water regulations. Residual ballast water and sediment in these ships' ballast tanks may contain organisms and their resting life stages that can be discharged when new water is added to the ballast tank and later released into the Great Lakes-St. Lawrence system or other waters. The Great Lakes-St. Lawrence region now recognizes the potential for introduction of ANS via NOBOBs, and legislation has been introduced in some U.S.

states and Ontario to regulate the ballast management practices of all vessels. A ballast water management program – based on efficient, effective, scientifically based, environmentally sound and economically viable regulations, guidelines and policies – must be developed and implemented on a regional level to prevent the introduction and spread of ANS via commercial shipping.

Presented below is a series of Panel findings and recommendations designed to advance ANS prevention and control by way of a ballast water management program. Elements of this policy statement include establishment of criteria for ballast water management/treatment; scope, consistency and coordination of laws and programs; and technology options and research needs. Findings and recommendations are directed at all relevant governmental, public and private interests with a role and responsibility for the ecological and economic health of the Great Lakes-St. Lawrence system and beyond.

I. Establishment of Criteria for Ballast Water Management Practices/Treatment Technologies

Issue Description:
Great Lakes-St. Lawrence jurisdictions (both individually and collectively) lack criteria that can be used to assess the quality of ballast water discharge. The absence of such criteria hinders the development of scientifically based regulations/guidelines and, therefore, the application of a ballast water management program.

Various water quality management options that have been developed and applied elsewhere may be of use in a regional ballast water management program for the Great Lakes-St. Lawrence system. Risk assessment-based approaches target only those vessels deemed an excessive risk to the ecosystem based on the port of origin. Methods using best available technologies (BATs) are based on achievable physical, chemical, biological or technological/engineering criteria, allowing carriers to select a preferred technology. Methods based on best management practices (BMPs) rely on operational procedures (such as taking on ballast in areas of low ANS concentrations or regularly cleaning the ballast tanks) that a ship's captain can implement to minimize the likelihood of ANS contamination of the vessel's ballast water. A permitting approach under the U.S. Clean Water Act's National Pollution Discharge Elimination System (NPDES) could treat ANS as biological pollutants, setting acceptable discharge limits and using incentives and/or fines to encourage compliance.

Findings:
Ballast water criteria must be established that eliminate future introductions and intrasystem transfer of ANS. Regulations or guidelines based on these criteria must provide an attainable target that does not pose unreasonable constraints on the movement of goods via the Great Lakes-St. Lawrence transportation system. The criteria must be technologically achievable, enforceable, practical (i.e., accomplished with a reasonable effort), environmentally acceptable, economically viable and applied within a reasonable timeframe. As technological advances are made, more stringent criteria should be applied. Efforts should be made to develop biologically based criteria designed to bring ANS introductions to zero within a specified period of time. Any ballast water criteria must consider: 1) the potential introduction of ANS from both salt and freshwater foreign ports into the Great Lakes-St. Lawrence system and connecting channels and 2) intrasystem transfer of ANS already present within the Great Lakes-St. Lawrence system.

Recommendations:
1. Urge the U.S. and Canadian governments (at the state/provincial, federal and binational levels), in consultation with relevant maritime interests, to establish an efficient and effective binational program for development of ballast water criteria with consistent application of regulations/guidelines throughout the Great Lakes-St. Lawrence system. The development of these criteria should be conducted in close cooperation with the Ballast Water and Shipping Committee of the ANS Task Force, as well as binational organizations, such as the International Joint Commission.
2. Ensure that in developing the program, governments:
   a) Use research to assess and quantify the existing narrative criteria, "at least as effective as ballast water exchange," before providing it as guidance as alternative methods of ballast water management are reviewed.

b) Develop standard assays or protocols for screening the biological effectiveness of treatment technologies;
c) Develop scientifically defensible, enforceable and real-time field techniques to confirm that ballast treatment(s) has taken place, and establish protocols to follow if the treatment(s) did not occur; and
d) Incorporate tests for all life stages, including resting stages and cysts, of potential ANS where possible, considering the day-to-day shipping operations and capabilities.

3. Ensure that established criteria are integrated with the development of ballast water management practices and treatment technologies.

II. Scope, Consistency and Coordination of Laws and Programs

Issue Description:
The nature of ANS introduction and spread via ballast water demands a multijurisdictional, systemwide, coordinated approach, particularly due to the ecological and economic consequences of ANS infestations. This approach does not currently exist. The United States has mandatory regulations in the Great Lakes-St. Lawrence system while Canada has the authority to establish regulations but operates under voluntary guidelines. Additionally, there are vessels, including NOBOBs, which are exempt from ballast exchange requirements that have the potential to introduce and disperse ANS throughout the Great Lakes-St. Lawrence system. Consequently, the United States and Canada must adopt a comprehensive and consistent ballast water management program, driven by a system of incentives, target dates and enforcement to eliminate significant programmatic gaps and enhance the region's ability to prevent ANS introduction and dispersal in the Great Lakes-St. Lawrence system.

A. Regional Approach to Ballast Water Management

Findings:
Existing gaps and inconsistencies in ballast water management can be addressed only by adopting a binational, systemwide approach whereby criteria and associated regulations/guidelines are coordinated among all relevant jurisdictions. Although efforts made by individual states and provinces have been instrumental in raising the issue of ballast water management, regional initiatives that harmonize federal, state and provincial approaches hold potential to be more effective and efficient than efforts made by individual jurisdictions.

Recommendations:

1. Ensure that the development and implementation of a ballast water management program takes place at least at the Great Lakes-St. Lawrence systemwide level. As part of this process, urge states and provinces, in cooperation with federal, regional and binational entities, to take an active role in the regional development of consistent and coordinated U.S. and Canadian regulations/guidelines.
2. Develop and implement a regional ballast water management program that is efficient, effective, scientifically based and environmentally sound, yet seeks to avoid placing the Great Lakes-St. Lawrence maritime transportation system at a competitive disadvantage.
3. Urge Canadian Foreign Affairs and the U.S. State Department to negotiate an agreement to ensure binational dedication and accountability in achieving the objectives of a regional ballast water management program.
4. Ensure that state, provincial and local policymakers are aware of the importance of regional cooperation during the development and implementation of a ballast water management program.
5. Offer the ballast water management program for the Great Lakes-St. Lawrence system as a model to all coastal regions and applicable waterways of the United States and Canada to maximize effectiveness of ANS prevention and control efforts on a national scale. As part of this model program, consideration should be given to existing federal (e.g., Clean Water Act) and state/provincial legislation for use in strengthening ballast water management efforts.
6. Urge Canadian and U.S. IMO delegates to expedite development and application of international regulations/guidelines that are consistent with those established for the Great Lakes-St. Lawrence system.

B. Application of Regulations/Guidelines to All Vessels, Including NOBOBs

Findings:
Current U. S. Coast Guard regulations and Canadian guidelines apply only to ocean-going vessels entering the Great Lakes-St. Lawrence system "in ballast." There are vessels that are not currently included under ballast regulations: NOBOBs, vessels conducting coastwise voyages and those operating only on the Great Lakes (lakers). Approximately 80 percent of ocean-going commercial vessels entering the system fully loaded with cargo report no ballast on board and thus are exempt from the ballast exchange requirements. Yet, these vessels can transport ANS into the Great Lakes-St. Lawrence system in the residual water and sediment of "empty" ballast tanks. Vessels that conduct coastwise voyages, but do not operate outside the Exclusive Economic Zone (EEZ), are exempt and could introduce ANS to the Great Lakes-St. Lawrence system. Lakers, also exempt from current regulations, can spread species via ballast water taken on in infested waters and released in other waters within the Great Lakes-St. Lawrence system.

Recommendations:

1. Apply new legal regimes based on incrementally achievable criteria with the goal of zero ANS discharge.

2. Expedite development of ANS discharge policies, regulations/guidelines, best management practices and treatment technologies that apply to all commercial vessels operating in the Great Lakes-St. Lawrence system that use ballast water regardless of the port of origin or jurisdiction.
3. Develop and implement, in the short term, regulations/guidelines applicable to NOBOBs, such as best management practices and best available technologies.
4. Develop regulations/guidelines that require new ship construction to incorporate best available technology for ballast water management at the time of contract signing. Encourage the Canadian and U.S. IMO delegates to participate in the development of these provisions.
5. Develop regulations/guidelines and/or incentive-based policies that will facilitate the implementation of ship design that improves efficiency of ballast water management in all new vessel construction.

C. Cooperation and Coordination

Findings:
The success of ANS prevention and control efforts is fundamentally dependent upon the full cooperation and coordination of relevant U.S. and Canadian government agencies, the maritime industry and other appropriate stakeholders in the development and application of systemwide ballast water management criteria and associated regulations/guidelines. It is essential to ensure that: 1) interested parties are not working at cross-purposes; 2) consistent measures are developed and applied, and 3) duplication of effort is avoided and limited resources are efficiently used. Cooperation and coordination beyond the Great Lakes-St. Lawrence system is also important, given that this region's programs must be harmonized with those at state, provincial, federal, binational and international levels.

Recommendations:

1. Ensure that government jurisdictions, the maritime industry, research scientists and other interest groups work in a cooperative and coordinated manner, with the guidance of the Great Lakes Panel and other appropriate regional/binational entities, to achieve the objectives of a regional ballast water management program for the Great Lakes-St. Lawrence system.
2. Coordinate ballast water management program initiatives among the Great Lakes Panel representatives, the International Joint Commission, the Ballast Water and Shipping Committee of the ANS Task Force, the Canadian Marine Advisory Council and the Council of Great Lake Governors.
3. Develop a coordinated and targeted information/education program to convey ballast water management initiatives and needs to policymakers, elected officials, stakeholders and other interested parties both within and beyond the Great Lakes-St. Lawrence system.
4. Urge all parties involved in the development and application of a ballast water management program for the Great Lakes-St. Lawrence system to participate in the development of comprehensive national and international ballast water management programs.

5. Ensure that the Great Lakes Panel, in cooperation with other regional interests, works with the U.S. Congress on reauthorization of the National Invasive Species Act. Broad-based, binational participation and expertise provides the Panel with a unique, regional perspective on ballast water management issues that should play an instrumental role in the reauthorization process.

III. Technology Options and Research Needs

Issue Description:
Recognition of the limitations of ballast water exchange has prompted investigation of alternate ballast water management technologies such as on-board filtration, biocide application, heat, ultraviolet light, and shore-side treatment. Once developed, preferred ship-board technologies must be incorporated into new vessel design, and affordable technologies should be added to existing vessels. Safety, technical, environmental and economic impact considerations must be weighed against the permanent harm ANS introductions can bring to the ecosystem, economy and society in general. Delays in developing and applying effective ballast water technologies protract the high level of risk that new ANS will be introduced to the Great Lakes-St. Lawrence system. Therefore, carriers should be accorded incentives to promote voluntary cooperation in the development and application of new technologies.

Technical aspects of ANS ballast water controls are complex because ship design varies with type and volume of cargo, trade patterns, and different ballasting systems. Ballast pumping rates range from 800 gallons per minute (gpm) on passenger ships; to 8,800 gpm on ocean going vessels; to as high as 79,200 gpm on the largest Great Lakes vessels. In 1996 the National Academy of Science's Marine Board identified physical separation (filtration) and chemical and thermal treatments as the most promising ballast water management technologies. These and other technologies are now being tested. For example, a hydrocyclone and ultraviolet light unit has been installed on the 880 gpm ballast system of the passenger vessel *REGAL PRINCESS*. Also, the Great Lakes Ballast Technology Demonstration Project, co-directed by the Lake Carriers' Association and the Northeast Midwest Institute, has successfully demonstrated 50-micron filtration at 1500 gpm. However, none of the technologies under development have been applied in scaled-up operations to meet the needs of cargo ships or tankers. The Great Lakes Ballast Technology Demonstration project has commissioned full-scale design studies that will answer remaining questions about installation requirements. These and other ongoing efforts must be coordinated to maximize funding and information sharing.

A. Evaluation of Ballast Water Management Practices/Treatment Technologies

Findings:
Though an imperfect solution, ballast water exchange will continue to be used for the foreseeable future and may ultimately be combined with other technologies and approaches. The effectiveness of ballast exchange must be better understood to support existing maritime operations, protect the Great Lakes-St. Lawrence ecosystem and to determine its potential to augment other management practices/treatment technologies. Alternatives must be identified and evaluated in a coordinated, efficient and timely manner. This is critically important (and challenging) due to the many management options being considered; multiplicity of parties involved; lack of clear performance standards; and uncertainties about effectiveness, cost and operational feasibility of proposed management practices/treatment systems.

Recommendations:
1. Evaluate ballast water management practices and treatment technologies, including ballast water exchange, in terms of crew safety, effectiveness, real-world technical viability, environmental acceptability, economic feasibility, practicality and enforceability.
2. Evaluate how vessel structure, age, operating conditions, crew capabilities and other factors affect ballast water technologies and management approaches.
3. Consider the use and effectiveness of combinations of ballast water treatments.
4. Assess the effectiveness of best management practices and non-chemical treatment methods (e.g., ultraviolet treatment) for ballast water management.

5. Develop protocols for the use of biocides as a treatment option for ballast management, particularly in regard to NOBOBs, and evaluate their use in terms of environmental implications; effectiveness; physical effects on vessels; health and safety risks; and consistency with the stated policies of federal, state, provincial and regional Great Lakes-St. Lawrence entities.
6. Evaluate the potential of shore-based ballast water treatment facilities at critical chokepoints in the Great Lakes-St. Lawrence system as one component of a ballast water management program.
7. Implement full-scale application on commercial vessels of promising ballast water management/treatment technologies that have shown potential in demonstration projects to minimize ANS discharges.
8. Develop and implement a ballast water sampling program using water quality and/or biological criteria as benchmarks to measure improvements that occur with various treatment methods.

B. Research Funding and Coordination

Findings:
Significant funding increases will be critical for the development of promising technologies. Research results must be shared in a timely manner to ensure prompt development of commercial-scale products from prototype investigations. Coordination and communication among the many public agencies and private sector interests working on alternate technologies are essential to the timely regional development and application of effective ballast water management measures.

Recommendations:
1. Establish secure, dedicated, long-term, federal funding that will provide sufficient support for research, ballast water sampling and monitoring, and demonstration projects for ballast water management practices and technologies.
2. Develop and utilize mechanisms to expedite sharing and widespread dissemination of results, such as a single Internet site, that cross-links research topics with projects, researchers and funding organizations.

C. Management of NOBOBs

Findings:
Little is known about the potential for NOBOBs to introduce and spread ANS found in the unpumpable water and sediment of "empty" ballast tanks. Characterization of the actual risks for ANS introductions and dispersal from this transport vector is needed, along with the development of management practices and treatment technologies.

Recommendations:
1. Evaluate the potential for NOBOBs to introduce and spread ANS and assess the economic and environmental risks such introductions pose. Include in this evaluation identification of all life stages of organisms, including resting stages and cysts, that are present in NOBOBs.
2. Determine the utility, environmental implications and desired duration of short-term management approaches to NOBOBs, including partial exchange, best management practices, and physical and chemical treatment.
3. Evaluate, in conjunction with the marine industry and federal authorities, long-term approaches including technological alternatives, new ship design and other management options that address the ANS problems associated with NOBOBs.

D. Estimation of Costs and Economic Impacts

Findings:
Few analyses have been conducted on the economic impact of ballast water management/treatment on user groups in the Great Lakes-St. Lawrence system. All costs to the maritime industry, governments and the larger user community must be assessed, as should the environmental, economic and societal costs of ANS introduction and spread.

Recommendations:

1. Evaluate the costs of retrofitting existing vessels and incorporating ballast water treatment technologies into new vessels.
2. Compare the potential environmental impacts and economic costs of ANS invasions against the cost of development and implementation of ballast water treatment measures.
3. As promising management options/technologies are identified by research, assess the potential implementation costs to guide development at the full-scale level.
4. Examine the potential to modify trade patterns of lakers and ocean going vessels in the Great Lakes-St. Lawrence system to minimize the discharge of foreign ballast. Evaluate the potential economic impacts of ballast water measures in terms of varying vessel types, types of commodities and volume, differing ballasting systems and alternative transportation modes.
5. Examine the economic impacts of requiring all ships to stop at a certain point for ballast water treatment (e.g., shoreside treatment).
6. Identify and evaluate options to mitigate the financial burden of ballast water management requirements for the shipping industry (e.g., tax credits, federal funding).

E. Assessment of Human, Fish and Wildlife Health Risks from Pathogens

Findings:

Ballast water is a vehicle for pathogens and diseases. The relatively low water temperatures in the Great Lakes-St. Lawrence reduce, but do not eliminate, the risk of environmental and public health impacts from ballast water-mediated pathogens and diseases including, but not limited to, cholera and cryptosporidium.

Recommendations:

1. Assess the nature and scope of the public health risks posed by potential ballast water pathogens.
2. Conduct a fish and wildlife pathogen risk assessment to expand knowledge of this issue.
3. Assess the nature and scope of public health risks already present in the waters of the Great Lakes-St. Lawrence system as a framework by which to compare/assess shipborne risks.

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The Great Lakes Panel on Aquatic Nuisance Species was officially convened in late 1991 by the Great Lakes Commission in response to section 1203 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646). The Panel is directed to identify Great Lakes priorities; assist/make recommendations to a national Task Force on Aquatic Nuisance Species (also established via P.L. 101-646); coordinate exotic species program activities in the region; advise public and private interests on control efforts; and submit an annual report to the task force describing prevention, research and control activities in the Great Lakes Basin.

The Panel membership is drawn from U.S. and Canadian federal agencies, the eight Great Lakes states and the province of Ontario, regional agencies, user groups, local communities, tribal authorities, commercial interests, and the university/research community.

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