Ballast Water Management and Aquatic Nuisance Species

Setting a Research Agenda for the Great Lakes

Findings and Recommendations from
a Symposium Sponsored by the
Great Lakes Panel on Aquatic Nuisance Species

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Executive Summary

In April 1999 the Great Lakes Panel on Aquatic Nuisance Species sponsored a symposium titled *Ballast Water Management and Aquatic Nuisance Species: Setting a Research Agenda for the Great Lakes.* Symposium participants reviewed current approaches to ballast water management, assessed prospective technologies and management approaches, and establish associated research priorities. The purpose of the symposium was to provide the U.S. Environmental Protection Agency, Great Lakes National Program Office (which funded the effort) and other agencies and organizations working on the ballast water issue with specific recommendations to help guide the collective effort, including priorities for allocating research funding. Using input received at the symposium, Panel support staff at the Great Lakes Commission developed detailed findings and recommendations. This material was reviewed and ranked by symposium participants and members of the Great Lakes Panel. The following is a brief summary of the major findings and associated recommendations. The complete findings and recommendations are available on the Panel's webpage on the Great Lakes Information Network (www.glc.org/ans/anspanel.html), along with the symposium program, narrative summary, and attendees list.

Assessing the Safety, Effectiveness and Costs of Ballast Exchange: Ballast exchange is inadequate for preventing ANS invasions via ballast water. It will likely remain in use for some time, however, and may ultimately be combined with other management approaches and technologies. The impacts, effectiveness and safety of ballast exchanged need to be better understood.

Recommendations:
1) Develop vessel design standards to ensure safe ballast water exchange.
2) Improve methods for confirming ballast water exchange.
3) Evaluate alternative approaches to ballast water exchange.
4) Determine the effects of ballast exchange on different classes of ships.

Addressing Vessels with No Ballast on Board: A majority of vessels entering the Great Lakes-St. Lawrence River system report no ballast on board (NOBOB) and are not required to conduct open-ocean ballast exchange. They still carry residual slop and sediment in their ballast tanks that may be a source of ANS introductions, however, making this a priority for the Great Lakes region.

Recommendations:
1) Evaluate the costs and technical feasibility of shoreside facilities to treat ballast water, including NOBOB vessels.
2) Carefully consider the environmental and safety impacts of chemical treatment options.
3) Examine short-term approaches to NOBOBs such as "swish and spit" and partial exchange.
4) Evaluate the risks posed by residual slop and sediment in NOBOBs.
5) Evaluate the suite of organisms that are present in NOBOBs, including resting stages and cysts.
6) Assess the effectiveness of environmentally friendly treatment alternatives (e.g., heat).

Evaluating Research Proposals: Ballast water research and development activities are being conducted by numerous public and private entities. A general consensus is needed concerning standards to guide and evaluate ballast water research efforts.

Recommendations:
1) Facilitate "real-world" applications of proposed technologies and management approaches.
2) Identify issues related to the operational feasibility of proposed technologies.
3) Develop criteria for evaluating research proposals.

Assessing Human Health Risks from Pathogens in Ballast Water: The presence of pathogens in ballast water and the potential threat to public health merits greater attention.

Recommendations:
1) Assess the nature and scope of the risk to public health posed by pathogens in ballast water.
2) Assess the risk from fish pathogens to Great Lakes fishery resources.

Establishing Ballast Water Standards: Standards, criteria and regulatory guidance for ballast water management options are needed to guide policy makers, industry and the research community.

Recommendations:
1) Consider safety, biological effectiveness, operational feasibility, costs and related issues.
2) Ensure accountability and compliance with regulatory requirements.
3) Develop protocols for assessing the biological effectiveness of treatment technologies and management approaches.
4) Evaluate the needs of different classes of vessels.
5) Consider the use and effectiveness of secondary treatments.

Estimating Cost and Economic Impacts: Substantial uncertainty exists concerning costs and economic impacts of alternative ballast water technologies and management practices. However, costs must be balanced against the impacts of exotic species.

Recommendations:
1) Evaluate the technical and economic feasibility of retrofitting existing vessels and the costs of incorporating ballast management technologies into new vessels.
2) Document costs and environmental impacts from nonindigenous aquatic nuisance species.
3) Develop criteria for analyzing the costs and economic impacts of ballast water measures.
4) Evaluate impacts from ballast water requirements on Great Lakes maritime commerce.
5) Identify options to mitigate ballast water costs to the shipping industry.
6) Examine the social and environmental costs associated with the Jones Act and cabotage laws.

Improving Communication, Coordination and Collaboration: The ballast water "community" is large and diverse and the issues are fluid and complex. Ongoing communication and coordination among all parties is critical.

Recommendations:
1) Communicate the importance of the ballast water issue to elected officials and user groups.
2) Participate actively in the International Maritime Organization's (IMO) policy work on ballast water management.
3) Build relationships with the shipping industry and pursue collaborative opportunities.
4) Utilize facilities and expertise of universities, government labs, etc. for evaluating ballast water technologies.
5) Communicate, collaborate, coordinate and convene the ballast water "community" on an ongoing basis.

Miscellaneous Recommendations:
1) Identify short-term design requirements for vessels and long-term targets.
2) Evaluate the risk posed by hull fouling as a vector of ANS introductions and evaluate potential treatment options.
3) Evaluate the risk of ANS introductions from barges entering the Great Lakes from the Illinois and Hudson rivers.
4) Identify "lessons learned" from pollution control efforts in other areas (e.g., point source controls).

Summary Proceedings of a Special Symposium:

Ballast Water Management and Aquatic Nuisance Species: A Research Agenda for the Great Lakes

BACKGROUND

In 1990, Congress passed the Nonindigenous Aquatic Nuisance Prevention and Control Act (P.L. 101-646) for the purpose of preventing unintentional introductions of nonindigenous aquatic species; coordinating research, control and information dissemination; developing and carrying out environmentally sound control methods; minimizing economic and ecological impacts; and establishing a research and technology program to benefit state governments. The Act specifically recognized the Great Lakes as a valuable resource and, in Section 1203, called upon the Great Lakes Commission, an interstate compact agency, to convene a Great Lakes Panel on Aquatic Nuisance Species to assist a national Aquatic Nuisance Species (ANS) Task Force in Great Lakes-related prevention and control efforts.

The Great Lakes Panel is comprised of 35 individuals drawn from U.S. and Canadian federal agencies; the eight Great Lakes states and the provinces of Ontario and Quebec; regional agencies; concerned citizen groups; municipal representatives; tribal authorities; commercial interests; and the university/research community. The Panel is responsible for identifying Great Lakes priorities; making recommendations to the ANS Task Force; assisting the Task Force in coordinating federal programs; coordinating non-federal programs in the region; advising on control efforts; and reporting on prevention, research and control activities in the Great Lakes region.

In April 1999 the Great Lakes Panel sponsored a symposium titled *Ballast Water Management and Aquatic Nuisance Species: Setting a Research Agenda for the Great Lakes* with funding provided by the U.S. Environmental Protection Agency (U.S. EPA), Great Lakes National Program Office. The symposium was held in conjunction with the Ninth International Zebra Mussel and Aquatic Nuisance Species Conference in Duluth, MN, which included a day-long session of presentations on ballast water research initiatives. The purpose of the symposium was to convene policymakers, researchers and industry representatives to collectively assess current approaches to ballast water management, identify prospective technologies and establish associated research priorities. Of special interest were research approaches with particular promise for providing effective and practicable solutions for preventing new introductions of nonindigenous aquatic nuisance species via ballast water.

The symposium grew out of a general consensus on the need to prevent new ANS introductions and a recognition that ballast water represents the most significant pathway through which new nonindigenous aquatic species enter the Great Lakes Basin. Having identified aquatic nuisance species as a priority issue, U.S. EPA sought guidance on how to best facilitate progress on the ballast water issue, including priority applications for grant funding allocated to the ANS area. The volume and diversity of work being conducted in the area of ballast water management and the associated uncertainty concerning prospective solutions highlighted the need for a "research agenda" to guide U.S. EPA and other entities that fund, manage or conduct research on ballast water.

SYMPOSIUM FINDINGS AND RECOMMENDATIONS

The ballast water research symposium was attended by approximately 50 individuals representing a cross section of the policymaking, maritime and research communities. The agenda included a review of current ballast water research initiatives and panel presentations from the research and "user" communities. The bulk of the session entailed facilitated discussion on the following two key questions:

1) *What specific priorities for Great Lakes-related ballast water research should be pursued in the context of the Binational United States-Canadian Ballast Water Research Strategy? (This may include new areas of investigation or increased emphasis on current research.)*

2) *How can research, policymaking and funding be better coordinated to strengthen the collective management effort and hasten development and application of cost-effective and environmentally sound ballast water practices?*

An important framework for the symposium discussions was provided by the Binational Ballast Water Research Strategy, an element of the 1996-97 Binational Report on Great Lakes Water Quality submitted in accordance with the Great Lakes Water Quality Agreement. The research strategy incorporated guidance from research initiatives embodied in the Canadian Great Lakes 2000 Agenda and recommendations from the Marine Board of the U.S. National Academy of Sciences. The Great Lakes Panel endorsed the strategy in a March 1998 policy statement. The ballast water research symposium sought to build upon the binational strategy by providing U.S. EPA and other agencies and organizations working on the ballast water issue with specific recommendations to help guide the collective effort, including priorities for allocating research funding.

The findings and recommendations provided below reflect the April 1999 symposium discussions and subsequent review and comment from symposium attendees and the members of the Great Lakes Panel. Within each category, recommendations are listed in priority order, as determined by these individuals. The recommendations will be disseminated as guidance to the broad range of entities that fund, manage, conduct or utilize ballast water research within and outside of the Great Lakes Basin.

Symposium Findings–General

The following are general findings from the ballast water research symposium.

- The Great Lakes are part of a larger ecosystem, including both North America and the global environment in general. As a result, the Great Lakes are both a recipient and a source of ANS invasions to and from other regions. The Great Lakes management community must be concerned not only about what is entering Great Lakes ecosystem but what is being introduced to other ecosystems with which the region is connected. Effective ballast management strategies must be implemented on all U.S. and Canadian coasts and, ultimately, throughout the world.
- The urge to implement solutions to the ballast water problem must be balanced against the need to address the many technical and economic uncertainties surrounding the technologies currently under consideration. However, the greater the delay in identifying and applying effective prevention strategies, the greater the risk that new nonindigenous species will be introduced to the Great Lakes.
- Potential environmental impacts from chemical control options and other ballast water management strategies must be balanced against a realization that ANS introductions represent a permanent change to the ecosystem that cannot be reversed. While chemicals degrade, exotic species become a permanent part of the ecosystem.
- The potential costs and economic impacts of ballast water treatment requirements must be balanced against the costs to society in general resulting from nonindigenous species. Ultimately, costs and benefits must be compared along with options for avoiding undue burden–financial or otherwise–on any one sector of society.
- Increased effort is needed in the area of applied engineering and large-scale testing. Such efforts will be particularly useful in determining real costs and evaluating operational issues. However, adequate funding is still needed for basic research on issues such as ecosystem dynamics and the biology and life cycle of specific organisms.
- Some technologies and management approaches may not be 100 percent effective but may still be useful in particular circumstances or in combination with ballast exchange or other treatment options.
- The world market must be taken into account when considering on-board equipment for ballast water filtering and treatment. The Great Lakes represent a small portion of the global trade and one of the few markets that would currently impose such equipment.
- It will be important to establish long-term targets that organize and direct activities (e.g., in 30 years all vessels will be designed and engineered to accommodate safe and effective ballast exchange or other mechanisms for managing ballast water).

A) Assessing the Safety, Effectiveness and Costs of Ballast Exchange

Findings: Ballast exchange currently is the primary mechanism for preventing the spread of nonindigenous aquatic species via ballast water. While ballast exchange by itself is considered inadequate as a long-term solution, it nonetheless will continue to be used for some time and may ultimately be combined with other technologies and management approaches. Thus, an outstanding need exists to better understand the efficacy and effects–particularly from a safety perspective–of ballast exchange, both to support and protect existing maritime operations and to determine its potential to augment other management strategies.

Recommendations:

1) Develop standards for the design and construction of new ships to ensure they can safely and effectively accommodate ballast exchange.
2) Develop a scientifically defensible, enforceable and real-time field technique to enable vessel operators and regulators to confirm that exchange has taken place. Such a technique must be more defensible than the current standard requiring salinity levels of 30 parts per thousand.
3) Evaluate the effectiveness and costs of alternative approaches to exchanging ballast water, such as flow-through exchange.
4) Determine the effects of ballast exchange on different classes of ships of various age and condition to assess the safety of the practice. Some issues to consider, among others, include dynamic stress, metal fatigue, brittle fracture and steel type.

B) Addressing Vessels with No Ballast on Board

Findings: Vessels entering the Great Lakes-St. Lawrence River system in a fully loaded condition with no ballast on board (referred to as NOBOBs) are a major priority–and a particularly difficult challenge–for the Great Lakes community. While such vessels contain no pumpable ballast water (and thus are not required to conduct an open-ocean exchange), they still carry residual slop and sediment in their ballast tanks (typically one to two hundred metric tonnes). This slop and the organic material it contains is resuspended after vessels offload cargo, take on ballast water and move on to their next port of call where the ballast water is dumped as new cargo is loaded. The majority–75 to 95 percent–of vessels entering the Great Lakes-St. Lawrence River system are NOBOBs, making this a high priority.

Recommendations:

1) Evaluate the potential for establishing shoreside facilities at critical "chokepoints" in the Great Lakes-St. Lawrence River system that could be used to treat ballast water, including NOBOBs, with biocides or other approaches. Conduct an inventory to determine if appropriate facilities already exist. Among the factors to be analyzed are facility requirements (e.g., treatment capacity) and the potential level of usage from vessels.
2) Carefully consider the environmental impacts of biocides, such as glutaraldehyde, periacetic acid and other chemicals, along with the threat they may pose to the health and safety of ship personnel. Vessel operating conditions and the capability of crews to safely administer these chemicals must be taken into account.
3) Examine short-term approaches to NOBOBs such as "swish and spit" and partial exchange.
4) Evaluate and assess the risks posed by residual slop and sediment in NOBOBs and their potential to introduce and spread nonindigenous aquatic species.
5) Evaluate the suite of organisms that are present in NOBOBs, including resting stages and cysts.
6) Assess the effectiveness of environmentally friendly treatment alternatives (e.g., heat).

C) Evaluating Research Proposals

Findings: Research and development activities related to ballast water management are funded, managed, or conducted by a variety of U.S. and Canadian agencies, foundations, industry groups, academic institutions and regional entities. All parties have an interest in ensuring that limited research funding is applied in an efficient and credible manner in support of technologies that are feasible from technical, biological, economic and safety perspectives. However, the variety of available technologies combined with operational and financial constraints pose a significant challenge to funders and regulators who must allocate resources in search of practicable, long-term solutions. The collective effort will benefit from a general consensus concerning the standards that research efforts should meet and their relevancy and applicability to the challenge of preventing ANS introductions via ballast water.

Recommendations:

1) Facilitate opportunities for ship-borne demonstrations of technologies and management approaches to provide real-world applications.
2) The maritime community should develop a series of issues to be considered when evaluating the operational feasibility of a proposed technology or management strategy. Some potential issues may include crew safety, maintenance needs, bypass problems, accountability, flow rates, etc.
3) Develop criteria for use in evaluating proposed Great Lakes-related ballast water research initiatives. This should include both general criteria that all research should meet, as well as criteria specific to the ballast water issue. General criteria may address the following:
   - Has a literature survey been conducted to confirm that the project responds to an unmet need?
   - Does the project build on and synthesize existing work?
   - Does the project involve a partnership or collaborative effort (e.g., such as between biologists and engineers)?
   - Does the project involve sufficient scientific rigor, including a peer review process?
   - Will project results be adequately disseminated and publicized through established scientific journals and other mechanisms?

   Criteria specifically related to ballast water management may include the following:
   - Will the project document biological effectiveness in killing organisms in ballast water (i.e., developing or meeting standards for ballast exchange)?
   - Will the project identify and assess potential environmental impacts?
   - Does the project include realistic cost estimates?
   - Does the project consider operational issues, including the safety of the ship and crew?
   - Can the technology be monitored in the field to ensure accountability?

D) Assessing Human Health Risks from Pathogens in Ballast Water

Findings: Ballast water has long been recognized as a means for transporting pathogens and studies have shown that vessels entering the Great Lakes do carry bacteria in their ballast water. The relatively low temperatures in the Great Lakes reduce, but do not eliminate, the risk of adverse public health impacts from pathogens in ballast water. In addition, faulty marine sanitation devices, particularly among third-party (non U.S. or Canadian) vessels, can potentially contribute untreated or inadequately treated sewage to the Great Lakes. Because of the potential threat to public health, the presence and impacts of pathogens in ballast water merits greater attention.

Recommendations:

1) Assess the nature and scope of the risk to public health posed by pathogens in ballast water. More and better information on the issue is needed. Ports, in particular, are accountable to their surrounding communities to ensure ballast water discharges and related maritime operations do not threaten public health and safety.
2) Fish pathogens in ballast water may also threaten Great Lakes fishery resources, including pathogens carried by species that may already be established in the Great Lakes. A risk assessment is needed on this issue and improved knowledge generally.

E) Establishing Standards and Criteria for Evaluating Ballast Management Technologies and Their Implementation

Findings: Perhaps the greatest challenge facing the community of stakeholders involved in the ballast water issue is identifying prospective technologies, treatment systems and management strategies and exploring these options in a coordinated, efficient and timely manner. This challenge is compounded by the many options under consideration; the uncertainty surrounding their potential effectiveness, costs and operational feasibility; the multitude of parties involved; and the lack of clear regulatory guidance or agreed-upon performance standards. While it represents a daunting task, establishing standards and criteria for evaluating ballast water management options will provide critical guidance and a common goal or frame of reference for policy makers, industry and the research community.

Recommendations:

1) The safety of the ship and crew is a primary concern and must be explicitly addressed when considering proposed treatment technologies or management approaches. Safety must not be an excuse for inaction, however. Ultimately, vessels must be updated, as needed, to meet new standards.
2) Develop a system of accountability to ensure that all vessels comply with applicable ballast management requirements and that "bad actors" are not able to get away with–and will be held liable for–inadequate treatment of ballast water. As part of this system, field tools and techniques, and sufficient monitoring and enforcement, are needed to enable vessel operators and regulators to confirm that treatment has been conducted in a complete, timely and effective manner.
3) Treatment systems that involve the use of synthetic chemicals merit extended analysis in order to fully understand potential risks to crew members and the environment. Downstream impacts from chemical applications and their potential to bioaccumulate in the ecosystem are extremely serious issues that must be fully explored before they are accepted for use in the Great Lakes.
4) Given that existing legal authorities are limited in their ability to influence ship design and have greater potential to compel treatment of ballast water discharges, on-shore treatment warrants consideration as one component of a legal/regulatory regime.
5) Establish standards for proposed ballast water technologies and management strategies to guide researchers, vessel operators and the broader maritime community. Such standards must consider a wide array of factors, including biological effectiveness, technical/operational feasibility, safety, and costs, among others. The views of all stakeholders involved in the ballast water issue must be considered in establishing such standards.
6) Evaluate the feasibility that proposed technologies and treatment systems can be operated and maintained under "real-world" conditions that account for crew safety and capabilities, operating conditions and other factors.
7) Develop standard, agreed-upon assays or protocols for screening the biological effectiveness of treatment technologies and management approaches. Such protocols may vary from one region to another and should consider the unique environmental conditions in the Great Lakes.
8) Evaluate whether different classes of vessels may require or benefit from different technologies and management approaches based on their structure, operating conditions, crew capabilities and other factors. For example, shoreside treatment may be a feasible treatment option for certain types of ships with certain operating patterns.
9) Consider the use and effectiveness of secondary treatments.

F) Estimating Costs and Economic Impacts

Findings: Substantial uncertainty exists concerning the potential costs and associated economic impacts of alternative technologies, management practices and regulatory regimes for preventing ANS introductions via ballast water. Relatively little serious analysis has been conducted on the "real-world" costs of alternative technologies and their implications for the economics of the Great Lakes maritime industry. Potential costs to the shipping community, however, must be balanced against the costs of ANS invasions to the ecosystem, and the health and socioeconomic well being of other groups and society in general. Ultimately, the costs of alternative ballast water measures should be considered separately from who will pay for them. Costs may differ significantly depending on varying scenarios and creative mechanisms may exist to avoid an undue financial burden on the shipping industry. Together with biological effectiveness and technical feasibility, these issues must be considered in identifying practicable, long-term solutions to the ballast water challenge.

1) Evaluate the technical and economic feasibility of retrofitting existing vessels, particularly bulk vessels operating in the Great Lakes, as well as the costs of incorporating ballast management technologies into new vessels.
2) Document the costs and environmental impacts associated with nonindigenous aquatic nuisance species so they can be balanced against the potential costs of ballast water measures.
3) Develop agreed-upon standards and criteria for analyzing the costs and economic impacts of ballast water technologies and management approaches to guide researchers, policy makers, regulators and vessel operators in assessing competing options.
4) Examine trade patterns in the Great Lakes and evaluate the potential economic and financial impacts of ballast water measures in light of varying vessel types, commodities and alternate transportation modes. Specifically, consider modal elasticity in the regional transportation system and the potential effects of ballast water requirements on Great Lakes maritime commerce, regional economies and the environment.
5) Examine the costs to the shipping industry if all ships had to stop at a certain point for ballast water treatment.
6) Identify and evaluate options for mitigating the financial burden of ballast water requirements to the shipping industry through tax credits, federal funding, or other mechanisms.
7) Examine the social and environmental costs associated with the Jones Act and cabotage laws.

G) Improving Communication, Coordination and Collaboration

Findings: Preventing ANS introductions via ballast water involves a multitude of technical, biological and economic variables that ultimately impact or require the involvement of numerous agencies, institutions and private sector entities. The binational (U.S.-Canadian) and multilateral (International Maritime Organization) dimensions further complicate matters, as well as the uncertainty that surrounds many critical factors (e.g., costs, performance standards, etc.). In such a fluid and complex environment, ongoing communication, coordination and collaboration among the affected stakeholders is critical to ensuring an effective, efficient–and ultimately successful–response to the management challenge. In most cases, such efforts can be pursued within the context of mechanisms and structures that already exist within and outside of the Great Lakes Basin. The recommendations below should be viewed as ongoing processes to be integrated, in one form or another, into the work programs of all entities involved in the ballast water issue.

Recommendations:

1) Communicate with elected officials on the importance of the ballast water issue in general and specific research priorities. Continue advocacy efforts and cultivate political "champions" to advocate on behalf of research funding and related needs within the legislative and appropriations process.
2) The Great Lakes region, and the U.S. and Canada generally, should participate actively in the International Maritime Organization's (IMO) policy work on ballast water management. The IMO can be a repository for ballast water research being conducted around the world and a mechanism for communicating research findings with the maritime/shipping community. As part of this process, consensus should be reached as soon as possible on standards and criteria for evaluating proposed ballast water treatment options.
3) Build relationships with the shipping industry and pursue opportunities for agencies, researchers and industry entities to work collaboratively on the ballast water issue. Encourage participation from all sectors of the shipping industry to avoid disproportionate costs to the Great Lakes shipping industry that are not shared by other regions of the country.
4) Develop networks and mechanisms, particularly through the Internet, that ensure timely and effective dissemination of information and research results on the ballast water issue. However, ensure that information and research results are credible and meet accepted standards of quality.
5) Inform constituent groups of how they are affected by the ANS issue and ensure they understand the role played by ballast water. Communicate research results and show accountability for the resources being spent on the effort.

Encourage resource users to advocate for adequate funding and policy guidance from state and federal governments. Grassroots support will be critical to ensuring continued attention on the issue.

6) Convene regular meetings and conferences to bring together the regulatory, maritime and research communities to discuss and coordinate developments in the area of ballast water research.
7) Broadly publicize the ballast water research strategy to the full array of entities involved or interested in the issue and seek formal recognition of it from the U.S. and Canadian governments to ensure the proper connection between funding and policymaking.
8) Utilize the resources and expertise of universities and governments labs in evaluating ballast water treatment technologies. These institutions usually do not have a stake in a particular technology and can serve as a neutral broker in comparing competing options.
9) Evaluate existing ballast water policies and programs and clarify the roles and responsibilities of government agencies and private sector partners to ensure proper management and coordination of the collective effort.
10) Identify facilities that can be used for large-scale testing of proposed technologies. Fish hatcheries, for example, may provide the type of infrastructure needed for realistic testing of treatment options.
11) Establish an email list server on ballast water to facilitate interaction and communication among people working on or interested in the issue.
12) Pursue and exploit partnerships with high-tech industries that may produce solutions to the ballast water problem.
13) Establish ANS panels for the East Coast, the Gulf of Mexico and other appropriate regions to coordinate regional responses to the ANS issue similar to the valuable work being conducted by the Great Lakes and Western Regional Panels. Together with the national ANS Task Force, these panels should coordinate regional ballast water efforts to ensure effective exchange of information, avoid duplication of effort, and pursue partnerships and collaborative initiatives.

H) Miscellaneous Recommendations

9) Determine whether baseline design requirements can be identified in the short term and incorporated into new ships and consider setting a target date after which all new ships must incorporate designs and technologies that can be used to prevent ANS introductions via ballast water.
10) Determine the risk posed by hull fouling as a vector of ANS introductions and evaluate potential treatment options.
11) Evaluate the risk posed by barges operating on the Mississippi River and entering the Great Lakes via the Illinois River and Hudson River canal.
12) Review the history of pollution control efforts in other areas (e.g., point source controls) and identify the “lessons learned” from their technology development programs, including the role played by government subsidies.