News on Aquatic Invasions from the Great Lakes Commission **ANS UPDATE**

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Ballast Water and Saltwater Flushing: Closing a Gap in the Protection Framework for the Great Lakes

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Ballast water was identified as a vector for invasive species to the Great Lakes region in the late 1980s. In 1993 the U.S. established regulations for ships with (pumpable) ballast water to conduct open-ocean ballast water exchange (BWE) in order to conduct ballast operations in the Great Lakes (and upper Hudson River). Ships not carrying pumpable ballast water were not regulated.

The recommendation for BWE was based on the idea that ballast water of coastal origin and containing coastal organisms would be replaced by mid-ocean seawater and organisms, the latter being far lower in population density and less likely to survive if discharged into the freshwater Great Lakes. However, the efficacy of BWE has been seriously questioned in recent years because of the continued discovery of new aquatic nonindigenous species (ANS) in the Great Lakes since 1993.

There are two problems with using the Great Lakes ANS discovery record to draw conclusions about the efficacy of BWE: 1. Dates of discovery do not necessarily equate to dates of introduction (invasion). The discovery of a new invader in an ecosystem is dependent on multiple factors, but in general, the more obvious and visible the invader, the more likely it is to be discovered. The species invasions of the 1980s, culminating with the discovery in June 1988 of the zebra mussel in Lake St. Clair, substantially increased awareness of ANS by the Great Lakes community and with that, the likelihood of greater scrutiny aimed at new ANS. 2. By the late 1990s it was apparent that 80-90 percent of the oceanic ships entering the Great Lakes do not carry pumpable ballast water and thus were not required to conduct BWE. These ships are typically referred to as "NOBOBs" (no-ballast-on-board).

Research on NOBOB ships as vectors for ANS introductions to the Great Lakes was conducted from 2001-2006 by a binational research team consisting of NOAA, University of Michigan, University of Windsor, Old Dominion University, Smithsonian Environmental Research Center (SERC), and Philip T. Jenkins and Associates Ltd. Results of the Great Lakes NOBOB Research Program ("NOBOB Assessment") were summarized in a 2005 Final Report showing that NOBOB vessels carry live invertebrates, viable phytoplankton, bacteria/viruses, and resting eggs and cysts in residual ballast water and sediment and thus are potential sources of ANS introductions to the Great Lakes Basin. The greatest risk was identified with ships containing fresh or low-salinity residual ballast water. It was also suggested that seawater flushing of empty tanks would reduce ANS risk, but this required further evaluation. (See also papers by Bailey et al. 2003, 2004, 2005a,b, 2006; Gray et al. 2005; Duggin et al. 2005 in Resource List.)

A study published in 2007 (NOBOB Best Management Practices) confirmed that many taxa from low-salinity ports could be eradicated from ballast tanks through exposure to full-strength seawater. Canada established new regulations in 2006 based on preliminary results from this study. The new regulations require that prior to entering the Great Lakes, all ballast tanks be exposed to full strength seawater through BWE or by saltwater flushing in the case of empty tanks. In March 2008 the St. Lawrence Seaway management agencies harmonized their rules with the 2006 Canadian regulations by also requiring saltwater flushing and a final water salinity ≥30 parts per thousand (ppt) in tanks containing only residual amounts of ballast water. This requirement now applies to all transoceanic ships, whether carrying pumpable ballast water or not.

While BWE is not completely effective at preventing new introductions, several recent research studies indicate that BWE can be highly effective at significantly reducing ballast-related risk to coastal ecosystems, especially for the Great Lakes, if performed carefully and consistently.

A 2007 report by NOAA and SERC concluded that properly conducted BWE can significantly reduce the supply of coastal organisms in ballast water discharge and should be considered a useful and beneficial management practice to reduce invasion risk. However, tank bottoms and hard surfaces would still likely harbor organisms like microorganisms and cysts that may pose some risk.

A study led by University of Windsor used on-board experiments to show that BWE can essentially eliminate (>99% loss) freshwater zooplankton and concluded that BWE can provide strong protection to freshwater ecosystems against invasions by both pelagic and benthic freshwater species.

Another study by SERC, University of Michigan and NOAA examined the salinity tolerance of 54 different taxa, predominantly larval and adult crustaceans from fresh and brackish water habitats of the Baltic Sea, North Sea, Great Lakes, Chesapeake Bay, and San Francisco Bay. Salinity tolerance varied according to the salinity range of the habitat from which the species were collected, with species from low salinity habitats (0-2) highly susceptible to salinity-induced mortality, while species from habitats with a broader salinity range (5-18) were more tolerant and required longer saltwater exposures for mortality. They concluded that "…these results indicate that the current management practices of BWE and saltwater flushing serve to reduce the ship-mediated transfer and subsequent risk of introduction of non-indigenous species to the Great Lakes and other low-salinity recipient systems." The University of Windsor also tested short-term salinity tolerance of eight recent invaders to the Great Lakes, with very similar results and conclusions.

While seawater is not effective against all potential invaders, evidence suggests that it is effective against many species that might pose a threat to the Great Lakes. The 1993 ballast management regulations, which applied to ships carrying pumpable ballast water, did not apply to NOBOBs, which carry only unpumpable residual ballast water at the time of entry. This large gap in the protection framework for the Great Lakes has been closed, or at least significantly narrowed, by the addition of saltwater flushing requirements for NOBOBs in new Great Lakes ballast management regulations and the inclusion of ballast management requirements for most coastal traffic in the 2006 Canadian regulations.

Until reliable alternative ballast management approaches have been fully tested, proven to work, and are available for all major ship classes, the continued mandatory and diligent use of saltwater is one of the best existing on-board management options for protecting the Great Lakes.

NOAA, SERC, Fisheries and Oceans Canada and Transport Canada are presently investigating the potential use of sodium chloride brine as an additional treatment approach. There is evidence that high concentration brine can be a very effective treatment tool, especially for individual tanks containing residual or small quantities of ballast water not in compliance with the minimum salinity requirement.

Resources: A list of publications used as sources of information for this article can be found at http://glc.org/ans/ansupdate. **Contact:** David Reid, Ph.D., NOAA Great Lakes Environmental Research Laboratory, 734-741-2019, david.reid@noaa.gov.

The ANS Update is a quarterly publication of Great Lakes Commission to address ANS issues in the Great Lakes basin. Please contact Katherine Glassner-Shwayder at the Great Lakes Commission, Eisenhower Corporate Park., 2805 S. Industrial Hwy., Suite 100, Ann Arbor, MI 48104-6791.
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Written contributions to this newsletter are encouraged.

Washington Watch

The House passed H.R. 2830, a Coast Guard reauthorization bill which includes a ballast water regulatory program for vessels operating in U.S. waters. It would require ships to install ballast water treatment equipment that meets the International Maritime Organization's standard as an interim measure, and later a standard that is 100 times more stringent, unless technology is not available. Ships traveling within the Great Lakes would be exempt from some requirements if they pose an insignificant risk of introducing species. The Coast Guard may require ballast treatment on vessels that would not otherwise need treatment at the request of the Secretary of Agriculture in order to stop the spread of diseases. States would be allowed to operate existing state ballast programs until the final treatment standard is required. The bill allows states to implement and enforce the federal program in the state's waters. The bill also addresses NOBOBs by requiring saltwater flushing. **Contact**: Joy Mulinex, Great Lakes Task Force Director, 202-224-1211, joy_mulinex@levin.senate.gov.

Around the Basin:

ILLINOIS: Illinois-Indiana Sea Grant (IISG) conducted a survey of water gardeners which will be used to inform future outreach efforts for this audience. IISG hosted an Asian carp cut and cook demonstration at Bass Pro in Bolingbrook, IL. The event featured a demonstration of filleting techniques and samples of fried carp. IISG also hosted the workshop "Predicting Impacts of Invasive Species on Lake Michigan Food Webs." The workshop allowed scientists and funding agencies to identify specific research questions, data gaps, and time and space considerations needed to conduct research on the AIS impacts on food webs in Lake Michigan. The DNR recently conducted an herbicide treatment of Mermet Lake (Massac County) intended to control curly leaf pondweed. The lake attracts thousands of waterfowl annually and is a top fishing destination, making the control of curly leaf pondweed of utmost importance to prevent its spread. **Contact:** Patrice Charlebois, IISG, 847-872-0140, charlebo@uiuc.edu.

INDIANA: The 2007 Lake Manitou hydrilla eradication project resulted in an estimated 86 percent reduction in the tuber population. The goal of eradication will take multiple years of treatment. Treatment resumed in May with a slight shift in application strategy to more selectively eliminate hydrilla while reducing damage to native plants. Work continues with a work group that involves businesses in the aquatic plant trade, aquatic plant enthusiasts, IISG, University of Notre Dame, and The Nature Conservancy. A screening tool was developed to trim the number of aquatic plants needing a formal risk assessment. The group has slightly modified the New Zealand Weed Risk Assessment to better fit the needs of Indiana. Assessment of aquatic plants through the modified risk assessment has just begun. Eventually the group will identify risky invasive species in trade and develop strategies to limit their use or prevent their release. **Contact**: Doug Keller, Indiana DNR, 317-234-3883, dkeller@dnr.in.gov.

MICHIGAN: The Office of the Great Lakes sponsored a stakeholder meeting in March entitled, Michigan's Call to Action on Aquatic Invasive Species to discuss the economic and environmental challenges facing the state of Michigan in regards to AIS. The meeting brought together over 80 stakeholders with a vested interest and/or concern for AIS prevention and control including environmental organizations, affected industry, riparians, anglers, boaters, resource managers, researchers, and other interested individuals. Participants were asked to recommend needed actions in areas of funding; early detection and monitoring; rapid response; and education and outreach. Discussions and recommendations will be summarized and will provide the foundation for the update of the state AIS management plan. See http://michigan.gov/deqaquaticinvasives for more information. Ninety-four permits have been issued to oceangoing vessels representing 37 different companies under Michigan's ballast water law. **Contact**: Emily Finnell, MDEQ, 517-241-7927, finnelle@michigan.gov.

MINNESOTA: In 2007, zebra mussels were found in a chain of lakes, likely from water pumped from the Mississippi River. Brazilian elodea was found in a Minneapolis lake, likely from an aquarium dumping. New populations of spiny water fleas were discovered in waters along the Minnesota-Canada border. DNR enforcement responded to a truck carrying pumping equipment with 5-10,000 zebra mussels attached, in transit from Vermont to North Dakota. In March the "Predicting Invasive Potential of Exotic Species" symposium was hosted by University of Minnesota. The MN Pollution Control Agency (MPCA) is developing new permit requirements for ballast discharges. A bill providing the DNR with more authority to deal with viral hemorrhagic septicema (VHS) is being considered by the state legislature. MN Sea Grant released a new pocket field guide to accompany AIS-HACCP training workshops and materials. DNR produced a new VHS brochure. The DNR 2007 invasive species annual report is available at http://files.dnr.state.mn.us/eco/invasives/annualreport.pdf. **Contact:** Doug Jensen, MN Sea Grant, 218-726-8712, djensen1@umn.edu; or Luke Skinner, DNR, 651-259-5140, luke.skinner@dnr.state.mn.us.

OHIO: The ODNR Division of Wildlife held its first AIS Committee meeting in April. Agenda items included the committee's mission, relevant issues, the revision of Ohio's State Management Plan for AIS, and the development of a Rapid Response Plan. Duane Chapman (USGS) presented the Asian Carp Story to nearly 1000 people at the March Wildlife Diversity Conference in Columbus, Ohio. Following a tip from the USFWS, the Division of Wildlife eradicated diploid grass carp from a golf course pond. Fifty percent of the fish were recovered and legal action is pending against the wholesaler in Texas. ODNR also assisted several local groups with the control of invasive plants along Lake Erie. **Contact**: John Navarro, ODNR Division of Wildlife, 614-265-6346, john.navarro@dnr.state.oh.us.

ONTARIO: In 2007, HACCP training occurred for bait harvesters, who are required to complete an Ontario Ministry of Natural Resources (OMNR) approved HACCP plan. Effective Jan. 2008, commercial bait dealers face the same requirement. In collaboration with Quebec and others, OMNR and the Ontario Federation of Anglers and Hunters (OFAH) are planning a water chestnut monitoring and removal program in the Ottawa River. Ontario Fishery Regulations placed new restrictions on bait dumping and angler use of rusty crayfish. A comprehensive AIS field guide is being distributed to Ontario field staff and a companion workshop series will be launched this summer. OFAH and OMNR coordinated a workshop on the potential of barriers to limit fish dispersal. OMNR is launching an online map-based database of AIS sightings. A school program for grade 6 will be launched this fall; the grade 4 program Making Waves was successful in 2007. **Contact:** Beth Brownson, OMNR, 705-755-1950, beth.brownson@mnr.gov.on.ca; or Francine MacDonald, OFAH, 705-748-6324, francinem@ofah.org.

PENNSYLVANIA: The AIS Workgroup of the Pennsylvania Invasive Species Council (PISC) has been working actively in the areas of developing an AIS Rapid Response Plan, developing a list of priority AIS, conducting outreach, and working to secure funding for PISC operations. The Council is currently interviewing candidates for the position of PISC Coordinator. PA Sea Grant hosted a Lower Great Lakes Ballast Water Management Workshop in March 2008, published a training video and manual for volunteers participating in the state zebra and quagga mussel monitoring network and produced four new AIS fact sheets. In partnership with USEPA, PA DEP is planning a mock AIS Rapid Response exercise to be conducted this summer. **Contact**: Jim Grazio, PA DEP, 814-217-9636, jagrazio@state.pa.us.

WISCONSIN: Wisconsin is continuing its rapid response to an isolated hydrilla population in an artificial pond in northeastern WI. The pond was drawn down over the winter to winter-kill tubers. Monitoring will be conducted this summer to detect any re-growth. The pond is not connected to any natural waterbodies, but nearby waters are being monitored. Emergency rules to limit the spread of VHS remain in effect statewide and have recently been revised to allow limited re-use of bait by anglers in non-VHS waters. Watercraft inspection and volunteer monitoring programs will be in full force during this year's boating season. **Contact:** Julia Solomon, WI DNR, 608-267-3531, julia.solomon@wisconsin.gov.

Great Lakes Panel Update

The fall 2007 meeting of the Panel was held Nov. 28-29 in Ypsilanti, Mich. The meeting focused on the development and use of risk assessment and screening tools to prevent aquatic invasions through pathways such as the aquarium trade, aquaculture, horticulture, and live food fish. The spring 2008 meeting was held jointly with the Mississippi River Basin Panel on June 17-19, 2008 in Milwaukee, Wisc. Meeting materials are available at http://glc.org/ans/panel.html#glpmeet. **Contact:** Kathe Glassner-Shwayder, 734-971-9135, shwayder@glc.org.

ANS Task Force

The Task Force met April 29 - May 1, 2008 in Charleston, SC. Meeting materials, including an agenda, are available at http://anstaskforce.gov. **Contact:** Darren Benjamin, USFWS, 703-358-1843, Darren_Benjamin@fws.gov.