NOAA's Great Lakes NOBOB Research Program

Established in 2001 with funding from the Great Lakes Protection Fund, NOAA's Invasive Species Program, the US Coast Guard, the USEPA, and the participating research institutions.

Background

NOBOB (no-ballast-on-board) vessels are loaded with cargo, and thus their ballast tanks have been pumped out to the extent possible for given deballasting conditions. NOBOBs constitute the majority of saltwater vessel entries to the Great Lakes. Until August 2005 they entered without any management policy (such as ballast water exchange) aimed at reducing the risk of nonindigenous species introductions via ballast water discharge, since theoretically they do not carry and therefore would not be discharging foreign ballast water. However, many of these ships add Great Lakes water as ballast at ports within the Great Lakes ecosystem until they have a cargo to load. When new cargo is loaded, the discharge of ballast water added in the Great Lakes can include organisms that were in the unpumpable residual ballast water and sediment in the ballast tanks when the ship entered the system, thus providing an unregulated avenue for new species introductions within the Great Lakes.

NOBOB-A (Assessment): 2001-2005

Collaborators: NOAA-GLERL, Univ. of Mich., Univ. of Windsor (Canada), Old Dominion Univ., Jenkins & Associates (Canada).

The NOBOB Assessment was the first detailed integrated evaluation of the biological content of residual ballast water and sediment, vessel traffic characteristics, and ballast management practices of salt water ships entering the Great Lakes. The Final Report, published in April 2005, provides a complete project summary and new information for regulatory and/or management agencies. It includes a detailed analysis of ballast management practices used by cargo ships (Chapter 2), a detailed biological characterization of NOBOB residuals and an assessment of the risks associated with those residuals (Chapters 3 and 4), and an assessment of the efficacy of BWE for removing coastal water and of "salinity shock" as a protective mechanism against coastal species (Chapter 5). The final report can be downloaded at http://www.glerl.noaa.gov/res/projects/nobob/products/NOBOBFinalReport.pdf

Outcomes: NOBOB-A results showed that the residual ballast water and sediment in NOBOB vessels house large numbers of live or viable (eggs, cysts) organisms, a portion of which are both nonindigenous and not yet present in the Great Lakes. Results also suggested that the risk of NOBOB-related nonindigenous species introductions may be lowered with conscientious and consistent application of good management practices, especially flushing NOBOB tanks with saltwater on the open ocean whenever possible unless ballast water exchange has occurred since the last uptake of coastal ballast water. In August 2005 the U.S. Coast Guard implemented a new policy aimed at NOBOB ships entering the Great Lakes to encourage the use of ballast water exchange or ballast tank flushing on the high seas to assure that the salinity of all water in their ballast tanks, including residual water, is at or above 30 ppt (Federal Register / Vol. 70, No. 168 / Wednesday, August 31, 2005, pp 51831-51836; see also http://www.uscg.mil/hq/g-m/mso/nobob.htm). A similar policy was established in Canadian Regulations in June 2006.

Ballast water and sediment residuals in ballast tanks.

NOBOB-B (Best Management Practices): 2004–2007

Collaborators: NOAA-GLERL, Univ. of Mich., Univ. of Windsor (Canada), Old Dominion Univ., Jenkins & Associates (Canada).

In September 2002, the St. Lawrence Seaway established a policy requiring compliance with the "Code of Best Practices for Ballast Water Management" (Shipping Federation of Canada, 2001) by foreign ships in order for them to obtain clearance to transit the Seaway. The Code was endorsed by the Shipping Federation of Canada, the Great Lakes Shipping Association, and the State of Michigan with the expectation that by following the specified practices, ships will minimize sediment accumulations in ballast tanks, expose coastal and

freshwater organisms to saltwater, and minimize the risk of new species introductions to coastal ecosystems such as the Great Lakes.

There has been no scientific or technical verification as to how regularly these practices can be or are implemented under actual operating conditions nor of their effectiveness against organisms in residual ballast material carried in NOBOB tanks. This project attempts to examine the effectiveness of a selected and enhanced suite of ballast management practices for reducing the abundance of both residual ballast sediment and live organisms. The goals of the projects are to assess the following practices:

(1) avoidance, when possible, of loading ballast water with high turbidity or algal blooms,

(2) flushing muddy water out of tanks as soon as possible, and

(3) regular use of saltwater flushing during oceanic transits.

Goals 1 and 2 require experiments conducted on operational cargo vessels and thus the cooperation of the shipping industry, while Goal 3 involves lab-based salinity exposure experiments on organisms from various fresh and low-salinity coastal waters.

NOBOB-S (Salinity and Brine Tolerance Studies): 2006 – 2007

Collaborators: NOAA-GLERL, Univ. of Mich., Smithsonian Environmental Research Center.

A ship entering the St. Lawrence Seaway bound for the Great Lakes with residual ballast water of salinity less than the required 30 ppt could potentially add relatively small amounts of sodium chloride brine at the first port of call. Residual water is generally only a few centimeters deep and thus the typical volume needed to flood a ballast tank with enough brine to raise the effective salinity to >30 ppt is also relatively small. However, NOBOB ships generally offload cargo at their initial ports of call in the Great Lakes and then must ballast with local Great Lakes water. This can make the window of opportunity for exposure (time from addition of brine until ballast tank is flooded with freshwater, thus diluting the salinity) as short as a few hours. This project will explore the use of sodium chloride brines, which can be produced with an effective "salinity" of many times that of seawater, as a quick-acting biocide suitable for use as a back-up strategy to open-ocean saltwater flushing that could be applied to ships not able to safely conduct the open-ocean flushing management practice at sea.

The goals of this project are to (1) determine the exposure times and sodium chloride concentrations required to kill representative freshwater benthic invertebrates and zooplankton species using organisms commonly found in the Great Lakes, and (2) determine the exposure times and sodium chloride concentrations required to kill halotolerant species identified by previous experiments (under NOBOB-B) conducted by the Marine Invasions Laboratory of Smithsonian Environmental Research Center from the low salinity ports of the Chesapeake Bay, San Francisco Bay, and the Baltic Sea.

Brine solutions may be available at many, if not most ports for delivery to ships in tank trucks. Brines have long been used for preservation of food, and few organisms (halophiles) are adapted to highly saline environments. Those that are able to survive in brines are not likely to survive in the freshwater environment of the Great Lakes.

In order for informed recommendations to be made about the best strategy for saltwater flushing and the possible use of brine, experiments are being conducted under the NOBOB-B and NOBOB-S projects on the brine and salinity tolerances of planktonic and benthic taxa typically found in coastal waters or ports of the Great Lakes, the North Sea, and the Baltic Sea.

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