Spreading Exotics Through Ballast Water

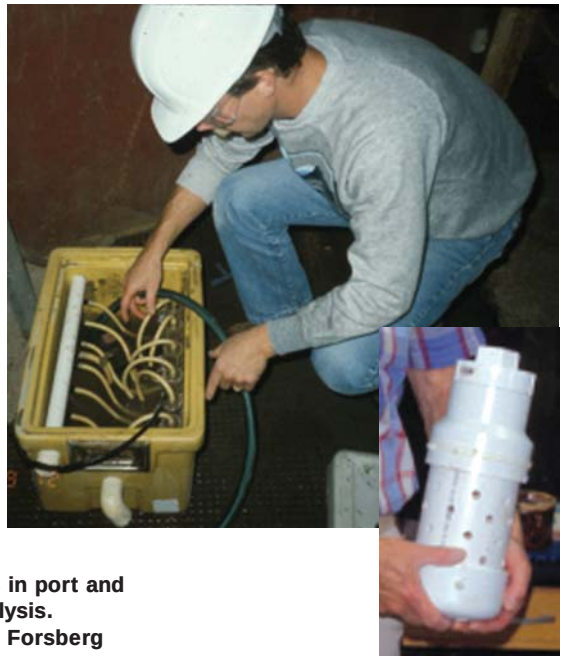
In the game of ecological roulette, it takes only one species to alter an ecosystem. And in the case of the Great Lakes Basin, 150 years of shipping has made it home to nearly as many invaders. The critical issue: ballast water. For stability, cargo ships overseas fill their ballast tanks with water from the shores of northern Europe, the Mediterranean, the Middle East, and Asia. This water is then unloaded into ports in America and other parts of the world. But, along with the cars, television sets, sofa beds, wine, and other products of global trade, are invaders from distant ecosystems also coming to America?

Last May, University at Buffalo Professor ***Robert Baier*** completed a NYSG-funded study on invasive species introductions by these ships. "The arrival of zebra mussels in the Great Lakes in the late 80s has forced long-overdue attention to the issue of transport of exotics from distant locations into our inland seas," says Baier.

Assisted by ***Anne Meyer***, a UB Research Associate Professor, and former Sea Grant scholar ***Robert Forsberg***, Baier developed and installed two kinds of samplers in the ballast water of several ships arriving in the U.S. from trans-Atlantic shipping. Both of these samplers collect biofilms on ballast water tank walls. A **biofilm** is a layer of organic slime made of microscopic larvae, bacteria, and other assorted bioinvasive organisms.

Ballast Organic Biofilm, or "BOB," units captured and analyzed ballast water on voyages without on-board research teams. These samplers don't need a power source, so they were suspended in the ballast tanks and easily retrieved to collect data. The Portable Biofouling Units, or "PBUs," require more hands-on monitoring, but their setup made it easier to search for microorganisms as ballast water left the sampler.

Most of the organisms in the ballast water detected by these samplers are barely visible: larval plankton and crustaceans such as barnacles and tiny crabs. Crossing overseas in ballast tanks have been zebra mussels from the Black Sea, shore crabs from Japan, mitten crabs from China, dinoflagellates from Africa, and *Cholera* bacteria from anywhere around the globe. "Following introduction, the probability of an exotic successfully establishing a self-sustaining population is uncertain," says **Chuck O'Neill,** NYSG ANS specialist.



What is the ballast water of ships leaving behind? Two samplers were used to find out. The small, sturdy BOB unit (in yellow) is easy to assemble and install on-board and retrieves data efficiently. The PBU (in white) has proven most useful for tests of bulk ballast water retrieved from ships in port and returned to the lab for analysis. Photos courtesy of Robert Forsberg

Stemming this invasion may hinge on regulating where and when ballast water is discharged. Biofilms, considered the 'dental plaque of the ocean,' are not being removed by current mandates of routine mid-ocean ballast water exchanges. When ships empty their ballast, many microscopic species can become airborne and inhaled by workers nearby or tourists downwind, possibly spreading disease to new locations. Other microbes stay behind encased in resistant sacs that keep them protected until re-suspended when the ballast tanks are refilled.

Researcher Bob Baier studies the impact ballast water carried on-board ships may have in the spread of invasive species. "We're concerned because ballast water and its residuals in ship tanks can seed new populations of microbes into harbors."

Having observed biofilms first-hand, Baier recommends inspecting ships entering the Great Lakes via the St. Lawrence Seaway system, even those in a declared 'No Ballast on Board' condition. "Inspecting these ships and sampling their ballast tank bottoms and interior structures will help us better understand bioinvasion pathways and create international policies for controlling aquatic nuisance species," says Baier.

Baier points to measures that can be taken to reduce the further spread of exotic species, like coating ballast water tanks with a non-toxic, non-polluting coating such as those used in cookware. "With this research, we've reached our goal of clarifying and emphasizing the role biofilms play in the transport of exotics in the ballast held by cargo vessels." Baier intends for information gathered in this study to be used by shipping and resource managers to help limit the spread of invasive microorganisms and protect the health of dock and ship personnel.

— Paul C. Focazio

How much ballast water can one ship carry? A single iron ore ship can hold 32 million gallons; one oil tanker, 74 million gallons.
Tanker photos courtesy of Michael W. Fincham, Maryland Sea Grant