

COLONIZING A COAST NEAR YOU: Attack Of The Marine Aliens

BY JAMES SCHULTZ

They come from afar. Borders do not deter them. Unseen, undetected, they slip past all sentinels and watchtowers. They are usually tiny. They are almost always relentless. Their goals are simple: colonize and prosper. Could these be creatures invading from a distant star system? Not at all. These hardy microorganisms and marine animals have never seen a spaceship, much less ridden one. Their journey is more prosaic and, these days, all too commonplace: non-native hitchhikers catching rides in the ballast water of ocean-traversing vessels. When the ships dock, so do their sojourning organisms, all of whom are given a quick lift to a sometimes receptive habitat courtesy of port-side pumping.

Throughout human history new species have somehow managed to find their way to distant locales, with impacts both major and subtle (witness, for instance, the 17th-century reintroduction of the horse to North America by the Spanish after a 10,000-year absence). The difference today, according to Old Dominion researchers Fred Dobbs and Lisa Drake, is the sheer numbers and arrival speed of non-native species in marine environments, and the extent to which they're able to dominate or kill local flora and fauna. Caught unprepared and defenseless, native systems are strained to the breaking point, unable to cope.

"There are examples of things gone wrong that we now know are the result of ballast-water introductions. It can result in severe ecological damage," says Drake, a research scientist in Old Dominion's Department of Ocean, Earth and Atmospheric Sciences. "We're artificially introducing things where they'd never be otherwise. We transport organisms, even an entire food web, from one area of the world to another. All of a sudden, we change the natural order."

Dobbs and Drake point out that roughly 79 million metric tons of ballast water are discharged annually into U.S. coastal waters, including the Great Lakes. Compared to the often leisurely tread of evolution, the pace of change is break-neck and the effect immediate. In the new homes into which they are literally plunged, seemingly benign plant and animal species from other parts of the world can wreak havoc in ways that cannot often be anticipated.

No One Solution

According to the Nature Conservancy, alien species now are one of the leading threats to U.S. species and ecosystems. While few of the approximately 4,000 exotic plant species and 2,300 non-native animal species in the United States cause severe problems, the Conservancy says just 79 imported species

have so far cost the national economy \$97 billion. Infestations of introduced pest species are pushing endangered species even closer to the brink of extinction, asserts the Conservancy, contributing to the decline of 42 percent of U.S. threatened and endangered species.

In marine environments, the threat can be more insidious. It's not only the possibility that non-native clams, crab, carp, snails, shipworms and waterfleas can set up house. Some animals, at least in their juvenile stages, are impossible to see with the naked eye. Even as they grow they remain small. Yet having reproduced in the hundreds of thousands, or millions, they can be every bit as damaging as their larger counterparts.

Take the case of the fingernail-size zebra mussels, which rarely grow beyond two inches in length. Apparently transported in ballast discharged in the mid-1980s in the Great Lakes, the mussels rapidly reproduced. According to a report commissioned by the Ohio Sea Grant College Program, by autumn 1989 the mussels had colonized the surfaces of nearly every firm object in and around Lake Erie, including rock, metal, wood, vinyl, glass, rubber, fiberglass, paper, plants, other mussels, even the shoreline. The big problem came when the critters covered



Old Dominion researchers prepare to lower a plankton net to the bottom of a ballast-water tank. Once there, the net will be hauled straight up, capturing zooplankton for subsequent analyses in the laboratory.

cooling water intakes at power plants: Removal was essential if electricity was to flow to customers.

“Ecological catastrophe is not what catapulted ballast-water issues into public awareness. It’s the economic damage that non-indigenous species cause,” says Fred Dobbs, an Old Dominion associate professor in the University’s Department of Ocean, Earth and Atmospheric Sciences, and leader of the University’s non-native marine invasions studies. “Lights go out — went out, in fact, in Great Lakes communities because intake pipes at power plants were so obstructed by zebra mussels.”

No one approach has solved the zebra-mussel problem. A variety of strategies are employed to reduce numbers, including natural predation and chemicals. A species so prolific cannot be killed en masse, and to inflict even high casualties may require either huge financial expenditures or unacceptable collateral damage to marine ecosystems. Nevertheless, the price for coexistence can be high.

In the case of the Chesapeake Bay watershed, living side-by-side with newly introduced species — in particular, marine-borne bacteria and viruses — could conceivably breed disease in humans. Fred Dobbs is keenly aware of the potential risks.

“Ours was the first study to explicitly document viruses and bacteria in ballast water [released] in the Bay. We’ve seen bacteria that cause cholera,” he says. “It’s not only cholera, but other microbes as well. In other words, ballast water can transmit the microbes that cause human disease. And not only human disease, but plant and animal disease as well.”

Correcting The Problem

Dobbs, Drake and the Old Dominion research technicians and graduate students working with them have gathered water samples from 26 coal-carrying vessels that have docked in the Port of Hampton Roads. In one case, Drake and two other scientists traveled on board a coal carrier from Hadera, Israel, to the Port of Baltimore, collecting samples throughout by lowering sampling bottles into vents or cargo holds carrying ballast water. Virtually all samples contained potentially harmful microbes.



Fred Dobbs



Lisa Drake

“Humans have been doing this stuff for 30,000 years,” Dobbs says. “But it’s now on a global scale, and that’s unprecedented. It’s a crapshoot as to what will invade where.”

Controlling the invaders is also difficult. What may work for one species may not affect another. And there is the question of cost, both in terms of money and of environmental impact. Containment isn’t easy, especially considering that the hitchhikers that survive a trans-global trek are by nature hardy and therefore may survive, even thrive in alien environments despite the inherent dangers.

In 1996, the Congress crafted the National Invasive Species Act mandating protocols to control how ballast water can and should be released in order to prevent introduction or spread of non-indigenous species. By 1999, the Coast Guard requested that all ships entering U.S. waters from foreign ports exchange their original ballast water in the open ocean, at least 200 miles from shore, in waters a mile or more deep, minimizing the threat of new colonizers. Captains are required to submit reports documenting ballast-water management practices. Nevertheless, while reporting and exchange or treatment of ballast water has been mandatory for vessels entering the Great Lakes and upper Hudson River since 1994, and with the exception of some states like California, there is no enforcement mechanism, no means of verifying ballast exchange on the thousands of ships that yearly ply waters in and around the American coast.

“Our conjecture is that things will improve as ships exchange their ballast or get their ballast treated,” Drake says. “Treatment may become mandatory. Then law enforcement will become involved, and there will be penalties for non-compliance. But the laws won’t be put into effect until the science is done.”

So Dobbs and Drake continue their studies, which are largely funded by the National Sea Grant College Program, a division of the National Oceanic and Atmospheric Administration (NOAA). Dobbs and Old Dominion colleague Mounir Laroussi, a research assistant professor of electrical and computer engineering, are exploring methods of treating ballast water using ultraviolet light, with a deceptively simple device that could be plugged in to an ordinary wall socket. If they are successful, the alien invaders may finally have something more to fear than a long ride across the wide oceans.

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