**SHIPLOADS OF ALIENS**

Exotic stowaways travel far from home, launching aquatic invasions that wreak havoc on marine life

As every, history student knows, England s navy defeated the Spanish Armada in 1588, but few textbooks record that the victorious seamen may have had an invisible ally. Spain's famed fleet is believed to have been attacked first by invaders of the species Teredo navalis-commonly known as shipworms. The pesky critters could have chewed holes in the Armada's wooden hulls, making the ships a little easier to sink.

Four centuries later, tiny and not so tiny life-forms are still stowing away on ships, and while they cannot gnaw through modern metal hulls or change the course of military history, they can produce enormous ecological damage. Thousands of species of coastal flora and fauna-including crabs, clams and jellyfish-have become cosmopolitan, hopping from port to port aboard cargo ships. After the intruders settle down in adopted harbors, where they may face no natural predators, their population often explodes, disrupting the local habitat with nearly the ferocity of the aliens in the movie Independence Day.

Unfortunately for the health of marine ecosystems, nautical migration has never been easier. Every day the ballast water used to weigh down empty ships transports about 3,000 species globally, which are later released when the ships are loaded and the ballast is dumped at harbor. Though this practice dates back to the 1880s, present-day ballast tanks, able to accommodate as much water as 10 Olympic-size pools, carry many more sea creatures-most of which have better chances of survival because of quicker voyages. Hamburg zoologist Stephan Gollasch estimates that 90 specimens a second make their way into German harbors alone. In addition, the shallow, brackish waters of host ports have become more welcoming during the past 20 years, thanks in large part to environmental cleanup efforts. "If the water is cleaner," says James Carlton, an ecologist from Williams College-Mystic Seaport, Connecticut, "more species can jump onto the conveyor belt."

One species that has sailed the high seas with catastrophic results is the Eurasian zebra mussel, which was probably carried m the ballast tank of a lone ship sailing from the Black Sea to North America about a decade ago. By 1990 the striped mussels had reached densities of up to 100,000 per sq m in some parts of the Great Lakes, clogging municipal water pipes in several cities. By the year 2000, predicts U.S. Congressman Steven LaTourette of Ohio, "the zebra mussel will have cost the Great Lakes region more than $5 billion." This was

unwitting revenge for the fact that a few years earlier, North America exported to the Black Sea a dangerously prolific comb jelly, Mnemiopsis leidyi, which starved the local anchovy population by devouring more than a fair share of the plankton supply. While hitchhiking in ballast water is the primary source of alien species, aquaculture operations also damage habitats. In France, for example, imported Japanese shellfish infected indigenous animals with a deadly virus.

Not every exotic arrival tenorizes the natives in such a manner, but most prove to be unruly guests. The occasional benign export-such as Marenzelleria viridis, an Atlantic worm that is now a good food source for flounder in the Baltic Sea-is outnumbered by dozens of rogues. In 1986 a marine biology class in San Francisco discovered the first Chinese clam ever identified in the harbor. Four years later, the bay's phytoplankton failed to bloom, probably because billions of the 2.5-cm-long Chinese clams had blanketed the bay floor and consumed the minute plants. After first crossing the Atlantic to England in the 19th century, the American slipper limpet--a snail that begins life as a male and switches to female at maturity--has formed huge chains off French coasts, where it interferes with commercial scallop beds.

Prevention appears simple: focus on the ballast water. Some scientists suggest filtration, but the procedure is time consuming and expensive. Australia is considering heating the water in order to kill stowaways. Though it may pose a risk to crews, perhaps the most popular tactic-recommended by the International Maritime Organization-is to have ships dump their ballast far away from harbors. Out in the open sea, the invaders will have less of a chance to make themselves at home and wreck the habitat.

PHOTO (COLOR): UNWELCOME GUESTS Clockwise from top left--zebra mussels, the seaweed Caulerpa, comb jellyfish and European green crabs have provided tough competition for native species

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