MYSTIC SEAPORT THE MUSEUM OF AMERICA AND THE SEA TM

Mystic Seaport for Educators
Science on the 38th Voyage of the *Charles W. Morgan*
Lesson 6 of 6: North Atlantic Aliens- A Study of Marine Bioinvasions
Student Reading

For centuries, ships and boats have unknowingly distributed thousands of species throughout the world's oceans, contributing to bioinvasions. Bioinvasions occur when an invasive (non-native) species is introduced to an ecosystem, most often through human transportation. These species can become the dominant organism in many communities, replacing and displacing native species.

Many species attach themselves to the hulls, or bottoms, of our vessels and often cause damage. This process is known as biofouling. Other species are contained in ballast water. Ballast water is water carried in containers onboard, known as ballast tanks, to help the ship remain stable. When ships gather ballast water in one port, the plants and animals in that area can also be picked up. Those species are then released along with the ballast water when the ship reaches the next port. Both hull fouling and ballast water are now the leading sources of all marine bioinvasions.

Dr. Jim Carlton is a well-known expert on global marine bioinvasions. In this interview, he shares three examples of invasions that have occurred in New England. The European "common" periwinkle (*Littorina littorea)* arrived in the early 1800s in Canada with ballast rocks, which were rocks used to stabilize the ship before we began to use ballast water. This species may also have been intentionally released for food, and spread down the coast to New England in the 1860s. Many other species followed in the next two centuries, including the Asian shore crab (*Hemigrapsus sanguineus*) in the 1990s. Most recently, in the 2000s scientists discovered the arrival of two species of shrimp, one from Asia and one from Europe (*Palaemon macrodactylus* and *Palaemon elegans*).

Photo: *A ship releases ballast water while docked (Source: Wikimedia Commons).*

Since the 1800s, what has been the impact of these three species on the ecosystem in New England?

“The impact of the common periwinkle has been very large. Because these are grazing herbivores, they have had a huge effect on the native seaweed. Furthermore, they may have displaced some of the native snails. Most of the snails that you now find in tidal pools in New England are actually this invasive species. The Asian shore crab, which arrived in ballast water, is an omnivore and feeds on native mussels and many other species. It has also displaced native crabs. We do not yet know how much the shrimp species will affect the native ecosystem.”

What is the economic, or monetary, cost of a bioinvasion?

“While invasive species may have a very large impact on the environment and ecosystem, it is often difficult to determine how much they affect the human economy. For example, a new invader may impact the food chain and affect the survival of an expensive and tasty fish, but these changes may take some time for us to notice. Non-native phytoplankton have been known to cause poisonous phytoplankton blooms, while ballast water may release organisms that can cause human disease. Furthermore, fouling organisms may cause millions of dollars of damage annually to ships in the United States alone.

Is there anything about the life cycles of invasive species that allow them to invade a different ecosystem more easily?

“All of these examples in the Gulf of Maine – the common periwinkle, the Asian shore crab, and the European and Asian shrimp – have planktonic larvae, which means they can spread widely and quickly.”

Can we stop or control bioinvasions?

“Right now, most invasive species are too hard to remove with current technology. On land, the easiest way to get rid of an agricultural pest, for example, may be to burn the environment in which it was found. Unfortunately, we cannot accomplish this underwater. Our best weapon is prevention. Because there are so few post-invasion management strategies at the moment, we want to focus on the ways that these invasive species are transported around the world, such as ballast water in ships.”

Photo: *Dr. Carlton examines biofouling on the hull of the Charles W. Morgan (Source: Mystic Seaport Museum)*

How can we help?

"Much of the responsibility for controlling bioinvasions rests in the hands of ordinary citizens and students. We are among the first to notice new invasions in our daily environments. The next time you are outside or on a field-trip, take a look around. Through books and the internet, familiarize yourself with the native species in the area. Write down your observations, take photographs, and let someone know if you see something unusual. Biologists cannot be everywhere, so we rely on you to become our eyes."

Key Words:

Ballast Water: Water carried in containers inside of ships to allow the ships to balance more easily. This water may be gathered from the surrounding water of an ocean, lake, or river.

Hull fouling: The process of organisms attaching themselves to the bottom (hull) of a ship.

Phytoplankton: Microscopic marine plants.

Phytoplankton Blooms: An increase in the population of phytoplankton in a certain area.