

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
Teacher Worksheet

Name: _____

Questions

1. Based on the interview with Dr. Carlton, there have been several sources of transportation for marine bioinvasions.
 - a. How did the three invasive species travel to the Gulf of Maine?
 - i. The common periwinkle (*L. littorea*):
Because this is a fouling organism (snail) that was introduced in the 1800s, this species most likely traveled on the hulls of historic vessels.
 - ii. The Asian shore crab (*H. sanguineus*):
This crab traveled in the 1990s, likely in the ballast water of shipping vessels.
 - iii. The Asian and European shrimp (*P. macrodactylus* and *P. elegans*):
Like the crab, these species would not be capable of remaining attached to a hull on a trans-Atlantic voyage. They also likely traveled in the ballast water of shipping vessels.
 - b. Modern ships are now often covered in anti-fouling paint in order to prevent bioinvasions by organisms that “foul,” or attach themselves to the ship’s hull. Is this an effective method of preventing *all* marine bioinvasions? Support your answer with evidence from the interview with Dr. Carlton. *This question is relevant to MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*

Dr. Carlton discusses two major shipping vectors for bioinvasions: biofouling and ballast water. While anti-fouling paint addresses the first issue, it is not an effective method of eradicating all marine bioinvasions, because many organisms travel via ballast water. Students should remember that ballast water is the leading source of all marine bioinvasions.

- c. Based on your answer in part b., design an additional method for preventing spread of bioinvasions by the modern shipping industry in the Gulf of Maine. *This question addresses MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*

Students are invited to be creative but realistic in their answers. However, according to their answers in part b, most of the design should center around minimizing the

spread of bioinvasions through ballast water. Some current management policies include regulation of ballast water discharge, which is permitted in deeper water, away from fragile coastal ecosystems, but illegal within a harbor or coastal zone.

2. In his interview, Dr. Carlton explains that all three of the invasive species in New England are easily dispersed because they have “planktonic larvae.”

- a. What does Dr. Carlton mean when he describes the larvae as “planktonic”?

The term “planktonic” refers to “plankton.” In other words, the larvae are dispersed among the plankton as they travel.

- b. At what stage in the life cycle (juvenile, young, adult) are these species most likely to travel to a different ecosystem?

Students should understand that “larvae” refers to juveniles, which is the stage at which these species are easily dispersed.

3. **Challenge Question:** Imagine that you are in Rhode Island, where you have decided to explore the tide pools, or the small puddles of ocean water, that you found along the rocky beach. In order to take a better look at the organisms, you bring a few water samples back to the lab at your school. Upon further examination, you identify an invasive species of European shrimp. *This question addresses MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems.*

- a. Based on the time period in which it arrived in New England, what is the likely source of transportation for this invasive species?

Students should note that the European shrimp was first observed in the Gulf of Maine in 2014. Because of the widespread use of anti-fouling paint and the fact that a shrimp is not a fouling organism, the most likely vector for this bioinvasion is ballast water. Students may also remember that ballast water is the leading source of marine bioinvasions.

- b. Given the current increases in the worldwide human population, which leads to more global trade of goods and products, what would you expect to observe in a water sample gathered two years in the future? Why?

As the human population increases, students should predict that shipping traffic will also increase. Because these ships rely on ballast water for stability, this will lead to a higher rate of ballast water uptake and discharge, which has the potential to increase the number of bioinvasions in coastal ecosystems. Students would therefore expect to see a greater number of the same invasive species and/or a more diverse population of invasive species.