Exploring Marine Transportation

Weeds in the Waterways

Designed by: Livia Montone & Laura Palamara

Synopsis of the Activity

Participants will explore how aquatic invasive species are transported in the ballast water of ships using a hands-on activity. This activity involves solving the problem of transporting a ship and its goods across the "ocean" without also transmitting invasive species. In addition to this hands-on activity, we will present information on local invasive species and their ecological, economical, and health impacts using a poster, pamphlet, and touch-specimens (as appropriate).

Audience

The audience is the general public. The hands-on activity involving the transport of species in ship's ballast would be aimed more toward children, but the poster and touch specimens/examples of invasive species will be targeted for both children and adults.

Concepts being addressed:

- Some species are able to survive outside their native environment, and some can even thrive.
- Usually these species arrive in new places because humans bring them there, often unintentionally (eg. transportation in ship's ballast).
- If a species is able to survive in a new environment, it might be detrimental to the native species in that area.

Misconceptions:

- Invasive species do not exist in the ocean (not true: just like on land, there are invasive species in the ocean habitats).
- Only the exterior of ships can transport invasive species. (not true: water that is taken in for ballast may contain organisms that are then carried and dumped in another place).
- People always intentionally introduce invasive species. (not true: often the organism is accidentally relocated ~ carried in packing materials, caught in ballast water)
- Invasive species intentionally have a negative impact on native species. (not true: invasive species are not malicious, they are just surviving in their new environment which often has a negative effect on the native species).

Ocean Literacy Principles

- The Earth has one big ocean with many features.
- The ocean supports a great diversity of life and ecosystems.

Vocabulary

- **Invasive species**- species that cause harm to the new habitats they invade
- **Native species**- species that are original to a specific area or region

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Ship's ballast- water that is used to add weight to a ship for balance

Guiding Questions

- Have you ever seen weeds growing on a lawn?
- How did those weeds get there?
- Why do they grow and spread quickly?
- What impact do you think the weeds have on the lawn?
- Do you think that the ocean has organisms that behave similarly?
- Where do you think these species came from?
- If I told you they came from places all over the world, how would you think they got to the NJ coast?
- Do you know what ballast is?
- What can happen when a ship dumps ballast from one place into a different environment? Is it only dumping water? What else can be in the water? What do you observe [during activity]?
- Would introducing new species to an environment be good or bad? Why?
- Can a new species affect the species that are native to an environment? How?
- Have you ever heard of zebra mussels? Did you know sometimes a new species can take over an ecosystem and cause local extinction of native species?
- Why do you think certain species are able to do this?
- How can we help prevent the introduction of invasive species? What could you do to avoid contaminating the other tub as your boat moves across the channel?
- Are invasive species carried exclusively by large ships?

Additional Teaching Strategies

We are addressing all parts of the learning cycle. During the invitation stage, visitors will draw on their prior experience with invasive species (eg. weeds growing on lawns). Then, they will be asked whether anything in the ocean can grow similarly to the weeds. During the exploration stage, visitors will freely explore what happens when you move a boat with ballast "contaminated" with invasive species from one harbor to the next. During the concept invention stage, the docent will present some information about local invasive species and their ecological, economical, and human health impacts. During the application stage, the docent will present a challenge to the visitors—how to get the boat from one harbor to the other without contaminating the new harbor. Finally, for the reflection stage, docents will ask the visitors how they can actively prevent the spread of invasive species and provide a pamphlet to take home.

This activity is inquiry-based mainly in the exploration and application stages of the learning cycle where the participants are actively exploring the concept of ship's ballast and its role in the transportation of invasive species. They will observe what happens when they are not careful about emptying contaminated ship's ballast, and they will be charged with the task of preventing contamination of the new harbor.

Materials

- 1 wide, clear plastic tub (decorated at the two ends to be harbors with the ocean in the middle)
- Water
- Boat models (plastic) that can take in ballast
- Velcro
- Embroidery thread- cut into 2-3" pieces
- 1 bag of sunflower seeds
- 1 bag of pumpkin seeds

- Food dye
- 8.5" x 11" laminated cards with examples of invasive species
- Toothbrushes
- Invasive species touch specimens

Set-up

Decorate the outside of the tub so that the two opposite ends (lengthwise) are the harbors and between them is the ocean. Fill the tub with water. Take the plastic model boats and place some thin strips of Velcro to the sides and stern of the boat. Place a handful of unshelled sunflower seeds (invasive species) in one harbor and pumpkin seeds (native species) in the opposite harbor. Place some embroidery threads in one of the harbors as well (also invasive species that will stick to the Velcro).

Note: the size of the tub with water relative to the amount of dye added to the small boat's ballast should be sufficient so as to prevent completely coloring the water. This allows us to avoid dumping the large tub of water each time. Also, the sunflower seeds, pumpkin seeds, and embroidery thread are easily moved back to their appropriate sides, allowing the activity to be easily reset between visitors.

Activity Description

Begin by asking if the visitors recognize any of the local invasive species, and where they think they came from. If they don't know, tell them they come from several different places. Lead into the activity by asking how the species might have gotten there. Use the 8.5" x 11" cards as references to show photographs of the organisms themselves as well as the ways they impact their environment. Some of the most striking examples of invasive species will be provided (eg. zebra mussels, European rabbits in Australia, and Salvinia molesta (water fern)), and information including their name, a picture, where it is originally from, where it became invasive, how it got there, and how it took over. There will also be local examples of invasive species (common periwinkle, green crab, green fleece, red lionfish, MSX oyster disease, and Dermo), with information including their name, a picture, where it is originally from, and how it got to our area (see powerpoint). Flipping each picture up will reveal native species that might be affected by these invasives, and information including their name, a picture, and how they are likely to be affected by the invasive species.

Explain ballast if they don't know what it is.

Allow the participants to fill the ship with ballast from one harbor by slightly submerging the plastic boat near the floating sunflower seeds. As the boat takes on water, the sunflower seeds will also be pulled into the hull of the boat. Then, explain to the participants that not all invasive species are visible to the naked eye like the sunflower seeds are, and drop a few drops of food dye into the boat's ballast water to represent larval organisms or microorganisms. Have the participant transport the ship from one harbor to the next and dump the ballast water in the new harbor. What do they notice about the species in the new harbor (it is now a mixture of native and invasives)?

Ask visitors what is happening – is it only water being dumped? Could anything else be in the water? If yes, where are these other things coming from? etc. See if they can think of other ways species can be transported between different places. Ask if they think introducing new species would be good or bad and why. Have them

think about what might happen to the native species. Lead them to look at the examples of major invasive species to show that sometimes it can have very bad effects.

Then, challenge participants to transport their ship without contaminating the new harbor. Provide them with a toothbrush to physically remove any invasive species that may stick to the outside of the boat. This is symbolic of removing marine debris that may become stuck to small boats before they leave the boat launch ramp. Also encourage them to think of other ways in which they might prevent the spread of invasives from one harbor to the next (eg. dumping of ballast water mid-ocean as commercial vessels are required to do rather than in the harbors).

Additional resources

Invasive Species Update (http://www.harborestuary.org/TEspring04.htm#2)

Hitchhikers Guide to Exotic Species (http://massbay.mit.edu/exoticspecies/hitchhikers/index.html)

An Overview of Non-indigenous Plants of New Jersey (http://www.state.nj.us/dep/parksandforests/natural/heritage/InvasiveReport.pdf)

Non-Native Animal and Pathogen Species in New Jersey, Central Jersey Invasive Species Strike Team, March 2010 (http://www.cjisst.org/pdf/2010_CJISST_Animals_Pests__Pathogens_2010_03_12.pdf)

Stop Aquatic Hitchhikers (http://www.protectyourwaters.net/)

NY DEC Stop the Spread pamphlet

National Invasive Species Information Center (http://www.invasivespeciesinfo.gov/aquatics/main.shtml)

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This activity was developed by students in the Spring 2010 Communicating Ocean Science for Informal Audiences (COSIA) class at Rutgers University.