



Biotic Resistance

What can stop invasive species?

Overview

Biotic resistance is the ability of a native community to repel invasive species. Land managers want to promote biotic resistance because of the harmful effects of invasive species once they have established. Several aspects of a community might make it better able to resist invasion such as high diversity, low nutrient levels, and low disturbance. In this activity, students will be able to make and test hypothesis based on invasive species success and biotic resistance. Factors promoting biotic resistance are manipulated in our BEST Bioenergy Plots and so similar questions can be asked through this activity and the data that we will be collecting through the entire GK-12 district network.

Objectives

At the conclusion of the lesson, students will be able to:

- Discuss several examples of invasive species in Michigan, and why biologists are concerned about their introduction.
- Define biotic resistance and qualities of a community that can repel or facilitate invasion.
- Link biotic resistance to the treatments that are being applied to the BEST Bioenergy plots at their school district.
- Make predictions about where we'll find the most invasive species in the plots.
- Graph and interpret data, using evidence to support their claims.

Length of Lesson

This lesson takes one class period. The introduction takes 30 minutes, activity 20 minutes, and graphing takes 10 minutes. Additional time may be needed to pool and graph class data, and to add a discussion of findings once all the data is in. This lesson would be a great introduction before going out to complete the Biodiversity Protocol – students could then test these same hypotheses with real experimental data the way they tested them with data from this exercise.

Grade Levels

The lesson is appropriate for middle school, and could be adapted for a variety of grades.

Standards covered

S.IA.00.12 Share ideas about science through purposeful conversation.

S.IA.00.13 Communicate and present findings of observations.

L.OL.02.14 Identify the needs of plants.

L.EV.03.11 Relate characteristics and functions of observable parts in a variety of plants that allow them to live in their environment (leaf shape, thorns, odor, color).

E.ES.03.51 Describe ways humans are dependent on the natural environment (forests, water, clean air, Earth materials) and constructed environments (homes, neighborhoods, shopping malls, factories, and industry).

E.ES.03.52 Describe helpful or harmful effects of humans on the environment (garbage, habitat destruction, land management, renewable, and non-renewable resources).

L.EV.04.22 Identify how variations in physical characteristics of individual organisms give them an advantage for survival and reproduction.

L.EV.05.12 Describe the physical characteristics (traits) of organisms that help them survive in their environment.

L.EC.06.11 Identify and describe examples of populations, communities, and ecosystems including the Great Lakes region.

L.EC.06.23 Predict how changes in one population might affect other populations based upon their relationships in the food web.

L.EC.06.32 Identify the factors in an ecosystem that influence changes in population size.

L.EC.06.41 Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems.

Materials

- PowerPoint presentation (*provided*)
- Worksheet and graph paper (*provided*)
- "Treatment" plots – printed sheets with treatments paralleling the plots (*provided*)
- Small stones or seeds to imitate invasive species seeds
- Cups to hold small stones
- Calculators

Background

Humans have moved many species across the globe, and some have become invasive. Many more, however, never become invasive and have a hard time establishing in a new range. Scientists have noticed that some habitats/communities tend to be invaded very often (islands, wetlands) while some hardly ever become invaded (forests, undisturbed prairies). What makes some species successful as invaders while others fail? What causes some communities to be invaded while others are not?

Biotic resistance is the ability of a native community to prevent invasive species success. Factors that promote biotic resistance include diversity, low nutrient levels, and low disturbance. High diversity communities are able to repel invasion by using available space and resources more completely than a low diversity community. Habitats that have low nutrient levels and low disturbance have very little available resources for an invasive species to use, as most are consumed by native species and stored in their tissues.

Activities of the Session

1. Present PowerPoint and introduce topic of biotic resistance. Remind students about the treatments we have out in the plots and have them link them to ways we can test biotic resistance. Do students expect high or low diversity plots to be invaded more? Fertilized or not fertilized? Mowed or not mowed?
2. Introduce activity and show how the treatments in the activity are parallel to the treatments in the plots.
3. Describe steps of the activity:
 - a. Each group of 2-3 students will receive 4 pieces of paper – each paper has a plot that has received a different treatment (high diversity, low diversity, disturbed, fertilized)
 - b. Each group will count out 20 invasive species “seeds” (can be small stones or other small objects) to drop onto their pieces of paper
 - c. To begin the activity, students will drop the seeds onto each paper. Every seed that lands on an “N” space (empty space with resource available) will be successful. Every seed that lands on either a “P” space (native species resource) or a space where there is already a plant growing will be unsuccessful.
 - d. Students will count up the number of successful invasive species seeds, and repeat the process 5 times for each treatment. These 5 replicates will be averaged for each treatment.
 - e. Students will then graph their data in a bar chart, and use it to support a claim about biotic resistance. This claim should relate directly to their data – what does their data say? Which treatment is best able to repel invasive species?
 - f. The teacher can choose to average all the class data to increase replication further, or just ask students to share their graphs and claims.
4. Share with students that these same questions can now be asked with the plots. Ask if they expect to see the same patterns once we head outside.

Resources

- Paper on native blue crab vs. invasive green crab:
<http://www.clr.pdx.edu/people/faculty/derivera/pubs/deRiveraEtCmCs2005.pdf>
- Native and exotic/invasive plants of Michigan: <http://michiganflora.net/>
- Michigan Invasive Plant Field Guide:
<http://web4.msue.msu.edu/mnfi/education/fieldguide.cfm>
- List of invasive plants of Michigan: <http://www.wildtypeplants.com/invasive.html>

Extensions and Modifications

To extend the lesson, bring students outside to the BEST Plots and have them address and test similar hypotheses.

Assessment

The graphs that students draw to summarize their data can be used as a good assessment of students’ understanding of the activity. Have students present their data to the class, and support their claims with their graphs. Further assessment can come from doing a similar activity on the plots outdoors.