Think Outside the Box

Predicting the spread of Invasive Species

Meet the scientists

Dr. Tom Crist, Terrestrial Ecologist: My favorite science experience was conducting field studies on the **biodiversity** of forest canopy insects in Ohio.

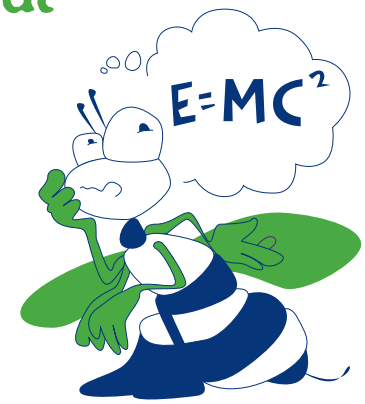
Dr. Bob Parmenter, Wildlife Ecologist: My favorite science experience has been working on the Mount St. Helens volcano since its explosive eruption in 1980. In the early years after the eruption, the roads were destroyed. My crews and I helicoptered into our study sites, where we examined the diversity and **population** sizes of the surviving plant and animal **species.** Over the last three decades, we've returned many times to witness and record the remarkable recovery of the plants and animals. This recovery provides evidence of Nature's **resilience.** I'm looking forward to going back in 2010 for the 30-year reunion of scientists that have worked there since the eruption—along with new generations of science students!

Dr. Ariel Lugo, Tropical Ecologist: My favorite science experience is trying to understand the functioning of natural ecosystems in **collaboration** with bright people, including high school students.

Glossary

biodiversity (**bi** o duh **vür** suh te): A measure of the differences between the types and numbers of living things in a natural area.
population (päp yoo **la** shun): The whole number of individuals of the same type occupying an area.
species (**spe** sez): Groups of organisms that resemble one another in appearance, behavior, chemical processes, and genetic structure.
resilience (re **zil** yentz): The ability to recover from or adjust easily to change.
collaboration (ku **la** bür a shun): Working together with others.
data (**da** tuh): Facts or figures studied in order to make a conclusion.
invasive species (in **va** siv **spe** sez): Native or nonnative species that, by expanding their populations very rapidly, modify the environment and affect the economy or human health.
nonnative (nän **na** tiv): Not naturally occurring in an area.
economy (e **kôn** o me): A system of interactions and exchanges sometimes involving money.
ecosystem (**e** ko sis tem): Community of plant and animal species interacting with one another and with the nonliving environment.
scale (skal): Distinct series of levels or measured areas.
invertebrate (in **vür** tuh bret): Lacking a backbone.
globalization (**glob** ul i **za** shun): Becoming more worldwide in scope.

Thinking About Science



Sometimes scientists examine existing **data** in a new way to figure out a problem or understand what should be done next. They might also look at the way other scientists have done research in the past to see if trying a new way might provide more useful information. One way scientists do these things is to read, discuss, and observe what has already been done.

In this study, scientists wanted to better understand and predict the spread of **invasive species**. Invasive species are usually **nonnative** species that change the environment, the **economy**, or human health. To make better predictions about where invasive species will spread, the scientists looked at how scientists currently predict the spread of invasive species. After the scientists studied how predictions are currently made, they made suggestions for improving the method. Making

Pronunciation Guide

a	as in ape
ä	as in car
e	as in me
i	as in ice
o	as in go
ô	as in for
u	as in use
ü	as in fur
oo	as in tool
ng	as in sing

Accented syllables are in bold.

more accurate predictions about the future will help scientists better understand the environment, manage **ecosystems** and the economy, and protect human health. No matter what they are studying, scientists always look for better ways to do their research.

Thinking About the Environment

The scientists in this study were concerned with the spread of invasive species and their impact on the natural environment. To understand the spread of invasive species, the scientists needed to study the problem at many different levels in the natural environment. In science, we call the different levels **scales**.

Studying invasive species in a local community would be an example of a small scale study. In a small scale study, scientists study the habitat immediately surrounding the plant or animal. Studying invasive species by State, region, or the whole world would be a much larger scale study. As the scale of a study gets larger, less detail is examined. Environmental scientists sometimes focus on the larger scale to examine how large areas containing plants and animals interact with the land. Think of something you have studied in school that could be examined at several different scales.

What are Ecosystem Services?

Ecosystem services result in benefits that people receive from ecosystems. Ecosystem services are often put into four categories. These categories are (1) those that provide, (2) those that regulate, (3) those that support, and (4) those that help people culturally. Ecosystem services that provide, for example, include the products of trees. This is because trees provide food, wood products, and fuel. Ecosystem services that regulate include, for example, processes that help slow the spread of invasive species. Supporting ecosystem services refer to things like the continual cycling of carbon and nitrogen from Earth to the atmosphere and back. This is because these elements support life. Cultural services are provided by places for educational or recreational activities, such as streams for canoeing. For more information on these four categories, read the "Welcome" at the beginning of this journal on page 6 or visit http://www.fs.fed.us/ecosystemservices/About_ES/index.shtml.

In this research, the scientists wanted to do a better job of predicting the spread of invasive species. When invasive species spread to new areas, the plants and animals that naturally live there are affected and even die. The normal ecosystem services that these native plants and animals provide are then no longer available unless other organisms replace them.

Introduction

People can now travel to most places because transportation has greatly improved. Countries can easily trade with many different countries across the planet. This process is called **globalization**. Globalization causes many things to happen. For the scientists in this study, globalization has increased the spread of invasive species. With more people, animals, and plants moving back and forth between places, it is easier for invasive species to move from place to place. If scientists can predict the spread of invasive species, the spread may be slowed or stopped. The question the scientists in this study wanted to answer is: How can scientists better predict the spread of invasive species?

Reflection Section

- Think of one advantage of globalization for you or your community. Think of one disadvantage of globalization for you or your community.
- In your own words, state the problem that the scientists wanted to study.

Method

The method scientists used to study this problem was interesting and fun. About 100 scientists met in New Mexico at a conference. The scientists met in small groups based on topics of interest. For example, some of the topics included hurricanes, sea level rise, and coastal wetlands. Each group of scientists decided to write papers about their own topic. Because the scientists lived all over the United States, they had to use technology to communicate with each other. The scientists communicated on the phone, in person, and through emails.

To answer their question, the scientists examined the research that had already been done on invasive species. The scientists examined the methods other scientists used to make predictions about the spread of these invasive species. When a particular example is studied, this is called a case study. An example of a case studied was the zebra mussel.

The zebra mussel invaded the Great Lakes and has moved into rivers surrounding the Great Lakes (**figure 1**). The zebra mussel affects the lakes' ecosystem in many ways (**figure 2**). Zebra mussels change the environment by disrupting food webs and causing native mussels to die. To predict the movement of a plant or animal such as zebra mussels, scientists sometimes create models of what might happen. These models are built on computers, and they represent what might happen in real life. Models are used to make predictions about many different things. When you see a prediction of the path that rain, snow, or a hurricane might take in the future, you are looking at the results of a computer model.

The scientists looked at many predictions and the computer models upon which they were based. Then, they worked together to evaluate which predictions were the most successful.

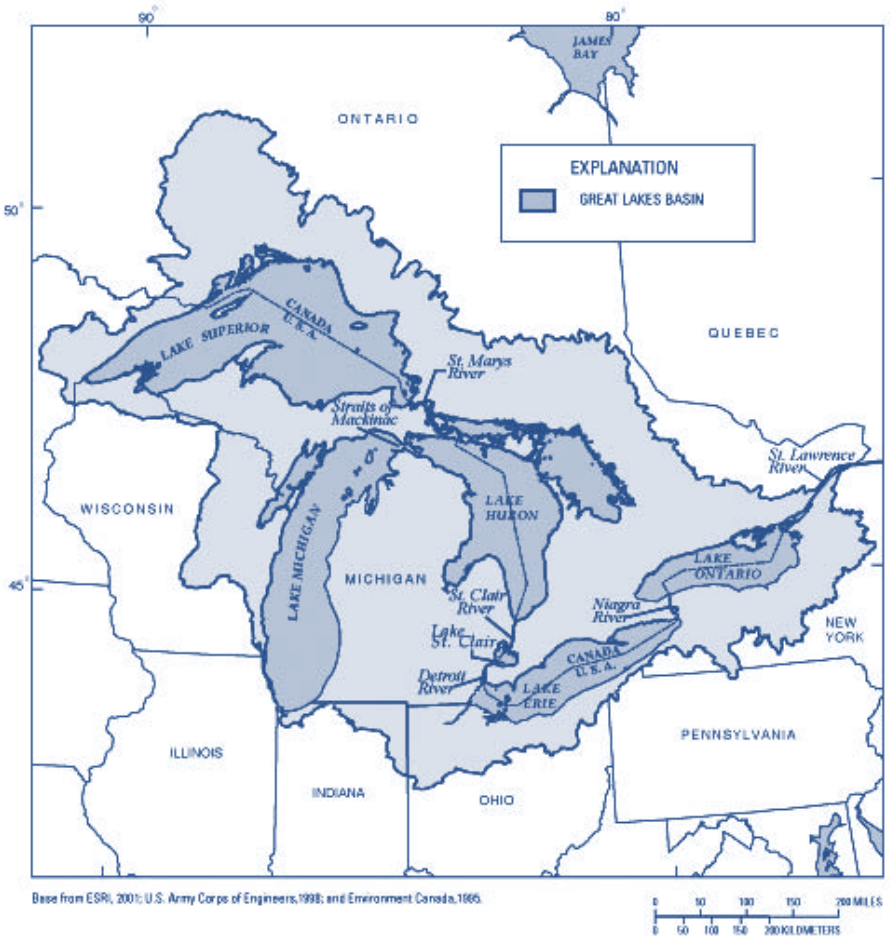


Figure 1. The Great Lakes and the States that surround the Great Lakes. Do you live near the Great Lakes?

Figure 2. The adult zebra mussel can attach itself to a boat. Sometimes the zebra mussel moves into a new area because it has attached itself to a boat. Photo courtesy of USGS, http://nas.er.usgs.gov/taxgroup/mollusks/images/zebramussel9.jpg

Reflection Section

- After reading the Method Section, how do you think technology helps scientists to work together?
- Why do you think scientists examined a lot of different case studies before they made a decision about the best way to track the spread of invasive species?

Findings

Five scientists worked together to develop a paper on invasive species. The scientists had different views on the spread of invasive species. The scientists had to have many discussions to come to an agreement about their different points of view. Each scientist had to think carefully and consider the ideas of the other scientists.

The paper the scientists wrote about predicting the spread of invasive species combines different ideas about invasive species into one story. Once the invasive species paper had been written, the paper was passed back and forth between all the scientists for editing and comments.

After the scientists agreed with what was written, the paper was sent out for peer review. Peer review is a process involving others who are considered an equal in knowledge or skill. In this case, other scientists read the paper and provided comments and suggestions. These other scientists had not been involved with the project before then, but they knew about invasive species. After this review, the paper was published in a journal.

In their paper, the scientists discussed their findings about predicting the spread of invasive species. The scientists found that some models of the spread of invasive species were more successful at prediction than others. They were more successful if they examined larger geographic scales. The scientists recommended that in the future, scientists should examine the spread of invasive species at all geographic scales.

Reflection Section

- Think of a time when you benefited from a discussion with someone else. How did it help you?
- Why do you think scientists want to more accurately predict the spread of invasive species?

Discussion

The scientists who wrote this article on invasive species benefited from examining the issue of invasive species from different perspectives. Science benefits from lively discussion with different points of view on the same topic. Progress is made in science when different points of view can be combined into one story. The scientists had different ideas but were able to come to an agreement on how the spread of invasive species should be predicted. The efforts of these scientists allowed the study of ecosystem services and invasive species to advance.

The importance of studying invasive species at different geographical scales was highlighted in the scientists' paper. Understanding the impact of invasive species on the local level as well as the impact at a larger geographical scale is important. Examining the possible impact at the larger geographical scale will help scientists make better predictions. The scientists suggested that this larger geographical study needs to be a coordinated effort among scientists across the globe.

Reflection Section

- How do you think sharing different opinions on a topic would help scientists better understand invasive species? Use an example from your own life to help you explain.
- Why do you think it is important for scientists to coordinate their efforts?

This article was adapted from Crowl, T.A.; Crist, T.O.; Parmenter, R.R.; Belovsky, G.; and Lugo, A.E. (2008). The spread of invasive species and infectious disease as drivers of ecosystem change. *Frontiers in Ecology and Environment*. 6(5): 238-246. Available online at http://www.fs.fed.us/global/iitf/pubs/ja_iitf_2008_crowl001.pdf.

FACTivity

In this activity, students will explore their schoolyard at different scales. The question students will answer is:
What are the similarities and differences of the schoolyard ecosystem at different scales?

Materials Needed:
Yarn/string, scissors, clipboard, paper

Examining Scale in the Schoolyard
Procedure:
Split students into 10 groups of three students each. These groups will study the schoolyard at different scales. Each group will measure an amount of string and cut it. Two groups will cut a 4 foot length of string or yarn. Two groups will cut an 8 foot length of string or yarn. Two groups will cut a 15 foot length of string or yarn. Two groups will cut a 30 foot length of string or yarn. Tie the ends of each length together, so that each group has a circular piece of string or yarn. You may need to adjust the sizes depending on the amount of outdoor area you have at your school.

Assign each group a notetaker and give them each a clipboard and paper.

Before heading outside, tell the students that they are to examine an area of land in the school yard that fits within the circle their yarn makes. Ask them to brainstorm categories of things they might find in the schoolyard. Examples include insects, plants, animals, nonliving natural things, and nonliving man-made items.

Each group will have 20 minutes to explore their area and make notes.

Once students have had time to gather their information, they will present to the class what they found.

As a class, create a four-column chart to write down what students found at different scales. Discuss the chart once all the columns have been filled in. Some discussion questions might include the following:

1. **What do you notice about the items that were found in the different scales?**
2. **What are some similarities and differences between what people found?**
3. **How do you think this activity represents what scientists did in the article we just read?**

If you are a Project Learning Tree-trained educator, you may use PLT Activity #88, "Life on the Edge" as an additional resource.

Additional Web Resources:

Zebra Mussel Distribution Map: http://www.nationalatlas.gov/articles/biology/a_zm.html

Forest Service Ecosystem Services Page: http://www.fs.fed.us/ecosystemservices/usgs.gov/

USGS Zebra Mussel Information Page: http://www.glsc.usgs.gov/main.php?content=research_invasive_zebramussel&title=Invasive%20Invertebrates0&menu=research_invasive_invertebrates