



INTEGRATED PEST MANAGEMENT

Unit 3 Lesson 4 Alien Invaders

Focus Areas: Biodiversity - Invasive Species; Science, Social Studies, Language Arts

Focus Skills: Reading comprehension, map skills, critical thinking, creative writing

Level of Involvement: AVERAGE

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Unit 3 Lesson 4: Alien Invaders





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to Reducing
Pesticides*



University of
Connecticut
College of Agriculture
and Natural Resources
Cooperative Extension System

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H I P P O
= Invasive Species

Objectives

- * To identify and describe examples of invasive species that threaten biodiversity
- * To identify examples of alien species
- * To describe the impact alien species have on the environment
- * To understand how control methods can upset the balance of nature

Essential Questions

- * What are some animals and plants that are considered alien species?
- * Why are they considered part of the HIPPO dilemma?
- * What IPM biocontrol methods can be used to control alien species?
- * How can biological control methods backfire?

Essential Understandings

- * Invasive species can cause permanent disruption of habitats.
- * The balance of nature is upset by invasive species.
- * Methods of biological control can be disruptive to the environment.



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Background

Plant and animal species that invade habitats cause imbalances in the ecosystem. Recent research indicates that alien, introduced species are second only to habitat loss or degradation as leading causes of the loss of biodiversity on the planet. Over the past 200 years, several thousand foreign plant and animal species have become established in the United States. About one in seven has become invasive, pushing aside the native species.

An invasive species is defined as a foreign species whose introduction may cause economic or environmental harm or threaten human health. Invasive plants and animals, including aquatic organisms, have significantly reduced the economic productivity and ecological balance of U.S. agriculture and natural resources. Invasive organisms are always on the move. They must be identified and controlled in order to stop their negative impact on the environment.

Challenge

Research an invasive species that threatens your habitat

Logistics

Time: 45 minutes

Group size: 20 to 25

Space: a classroom

Materials

Not All Alien Invaders Are From Outer Space poster and flash cards *

Map of continents

Article *The World Around Us - Biocontrol* *

Overhead 1 Invasion Statistics *

Overhead 2 The Zebra Mussel *

Overhead 3 Purple Loosestrife *





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Materials

Handout 1 Alien Invaders Adaptations Chart *

posterboard

Internet access (optional)

Assessment for an Illustration/Poster *

* single copy provided

Preparations

1. Sort cards for different ability groups or pairs of participants.
2. Prepare multiple copies of Handout 1, and the article *The World Around Us - Biocontrol*.

Activity

Introduction

1. Write the phrase *Invasive Species* on the board and discuss its meaning.
2. Display overheads of zebra mussels and purple loosestrife as examples of invasive species.
3. Paraphrase or read as a group the article *The World Around Us - Biocontrol*.

Involvement

1. The instructor divides the group into teams of 3 or 4.
2. Distribute Alien Invader cards; 3 to 5 per group, and Handout 1 Alien Invaders Adaptations Chart , 1 per group.



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Activity

Involvement (continued)

3. Have the participants work in teams to read the Alien Invader cards.
4. The participants complete the Alien Invaders Adaptations Chart.
5. The participants plot the location that the animal or plant came from on the map provided and indicate the path the species traveled to its present location.
6. The participants research and design posters for a campaign to educate the public about the dangers of alien invaders. They should include how these hitchhikers got to their new location.
7. As a group, participants should select one of the following non-indigenous species that have invaded countries and caused extensive damage:

Animal Species

European green crab
Zebra mussel
Rosy wolfsnail
Flowerhead weevil
Red imported fire ant
Asian longhorned beetle
Asian gypsy moth

Large mouth bass
Bullfrog
Cane toad
Mexican fruit fly
Tropical bont tick
Gypsy moth
Hemlock woolly adelgid

Plant Species

Kudzu
Leafy spurge
Spotted knapweed
English ivy
Purple loosestrife
Mile-a-minute vine



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Follow Up

1. Display posters and have each group briefly explain the content.
2. Discuss the potential danger of each invasive species investigated.
3. Take a poll to determine which invasive species the group considers most dangerous, and discuss the reasons for their choices.

Answer Key

Accept any reasonable answer supported by facts.

Assessment

Evaluate visual using Assessment for an Illustration/Poster.

Follow Through

Focus Areas: Biodiversity, Language Arts, Science

Focus Skills: Researching a topic

1. Show Overhead 1 Invasion Statistics.



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Follow Through (continued)

2. Choose one of the options below:

- a. Using a minimum of three sources, research an example of a biocontrol that backfired (i.e., that began feeding on a non-target plant or insect) and develop a presentation on the topic. An example would be the *Cactoblastis* caterpillar that was introduced in the Caribbean from Argentina to control a more common species of cactus that was a nuisance to islanders. Now the caterpillar attacks all cacti, not merely the ones the humans sought to reduce. Biological control techniques can cause secondary problems. In this case, it resulted in attacks on species of cacti that humans wished to preserve. Find other examples where biocontrol techniques have further damaged the environment.
- b. Develop a list of Alien Invaders that threaten your specific area.



Resources

Internet Websites

University of Connecticut Integrated Pest Management
<http://www.hort.uconn.edu/ipm/>

Bio Control Network
<http://www.biconet.com>

Connecticut Invasive Plant Working Group
www.hort.uconn.edu/cipwg

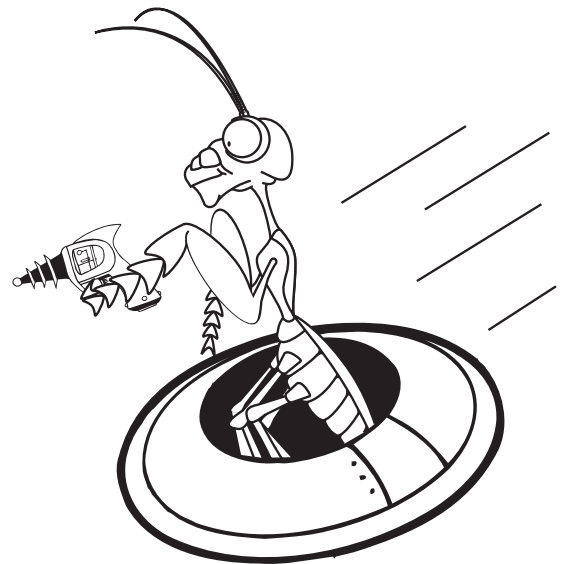
Invasive Plant Atlas of New England (IPANE)
<http://invasives.eeb.uconn.edu/ipane/>

The Nature Conservancy Connecticut Chapter
<http://www.nature.org/wherewework/northamerica/states/connecticut/science/art6477.htm>



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Notes





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Handout 1

Alien Invaders Adaptations Chart

Select five alien invaders that you are interested in learning about. Complete the chart by listing the name of the species and a description of the adaptations it has made that enables it to thrive in a new environment.

Name of Species	Description of Adaptation(s)	Function of Adaptation(s) in the New Environment	Economic or Environmental Harm



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Assessment for an Illustration/Poster

Criteria	Possible Points	Points Earned
1. The topic is clearly addressed in drawing.	_____	_____
2. All details contribute to the purpose and theme.	_____	_____
3. Appropriate details are shown accurately.	_____	_____
4. The drawing/poster is correctly labeled.	_____	_____
5. The drawing/poster is easily understood.	_____	_____
6. Space is used well.	_____	_____
7. The drawing/poster is neatly done.	_____	_____

Comments:

Assessment for an Illustration/Poster

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1. The topic is clearly addressed in drawing.	_____	_____
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5. The drawing/poster is easily understood.	_____	_____
6. Space is used well.	_____	_____
7. The drawing/poster is neatly done.	_____	_____

Comments:



Unit 3 Lesson 4: Alien Invaders

Overhead 1

Invasion Statistics

Some specific facts include:

- * Recent quantitative rankings indicate that alien species are second only to habitat degradation as today's leading cause of loss of biodiversity.
- * Between 1906 and 1991, 79 alien species alone caused \$97 billion dollars in damage to agriculture, industry, and health in the U.S. At least 4,500 species of alien origin have established free-living populations in the U.S. Around 15% of these species cause severe harm.
- * Weeds have invaded approximately 17 million acres of public rangeland in the west.
- * Calculating that the average weed spreads by 14 percent annually, weeds are expanding into 550 million acres of federal lands at roughly 4,600 acres per day.
- * One characteristic of a successful invader is the ability to reproduce in large numbers. For example, one yellow star thistle plant can produce 150,000 seeds. One mature purple loosestrife plant produces more than 2,500 flowers with 100 seeds per flower, equal to 250,000 seeds per plant per year (this plant is a perennial plant, producing these extremely high amounts of seed every year). One acre of purple loosestrife is estimated to produce 1 billion seeds per year.
- * Global changes may promote invasions and alter the fate of invasive species.

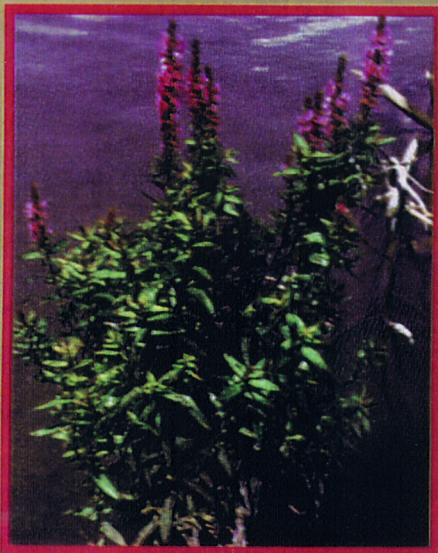
(Cambridge Educational 1999)

The ZEBRA MUSSEL



Zebra Mussel:
Small, fingernail-sized mussel with brown to black stripes native to Caspian Sea region of Asia. Likely brought to Great Lakes in ballast water. Clogs intake pipes of power and drinking water facilities. Can cause local extinction of native mussels. Filtering action may increase water clarity but can increase bioaccumulation in fish of pollutants like PCBs, PAHs, and heavy metals. Has spread from Great Lakes to the Mississippi and Hudson rivers and to over 200 inland lakes.

Purple Loosestrife:
Plant with purple-pink flowers
from Eurasia that grows 3' to
7' tall. Imported by settlers for
gardens and accidentally as seeds in
soil that was used as ballast. Dense,
impenetrable stands force out native
vegetation. Reduces biodiversity and food,



The PURPLE LOOSTRIFE

shelter, and nesting sites for
wildlife such as birds, turtles, and
frogs. Spreads along
wetlands, roadside
ditches, and from
ornamental gardens.
Found in almost all
continental states.



The World around Us

Bio-control

**Bio-control is a new label
for a practice that has
worked well in nature
since the creation of the
world.**

We have learned that life on planet Earth is controlled by the principle of survival of the fittest.

This has been brought to our attention through life science courses and also observed through documentaries on television, primarily with their focus on the animal kingdom.

As scientists have improved their collection and recording of biological events, they have learned that the introduction of new species, plant, animal and even human, can alter the balance in an established ecosystem.

Probably many are aware of the introduction of the rabbit to Australia and the starling to North America. The British settlers in Australia introduced the rabbit as a food source. Now the country has an estimated 300 million rabbits mulching and mating in the wild. In 150 years, these animals have moved from a food source to an estimated \$115 million a year loss to the Aus-

tralian meat and wool industries (Cambridge Educational, 1999). The wild rabbits are eating vegetation that would otherwise be consumed by sheep and cattle, while causing additional damage through topsoil losses in the agricultural sectors of the country.

Similarly, North America is struggling to control the starling (Figure 1). One hundred birds were introduced into New York's Central Park in 1890 as part of an ecological project to introduce into the park every bird ever mentioned in Shakespeare's plays. This act also helped to control insects in the park and city. Unfortunately, the birds survived too well in their new environment and they have reproduced and spread throughout the northeastern U.S. Often scaring other birds from their natural habitat, these alien invaders have reproduced beyond expectations and have become menaces with their increasingly large flocks. Starlings are messy (droppings), quarrelsome, aggressive, and noisy.

J O H N M . R I T Z



Figure 1. There are large populations of starlings across the continental U.S. and in the southern regions of Canada. Who would have thought 100 years ago that the introduction of a single species such as the starling would populate the country with numbers as exist today? (Patuxent Bird Identification InfoCenter. U.S. Geological Survey, a bureau of the U.S. Department of the Interior, photo by M. Iliiff).

Invasive species such as these have become known by a variety of names. These include non-native, exotic, non-indigenous, and alien invaders. Plants also fall into this category. They are better known as weeds.

Although little known by most, these invaders are damaging our environment through ravishing effects like those of their counterparts air and water pollution, urban development, and deforestation. These are topics that citizens of a technological world should understand.

Bio-control is a new label for a practice that has worked well in nature since the creation of the world. Farmers have used bio-control practices for centuries. Having a cat or two on the farm would naturally reduce rodents such as mice and rats. The cats would police the area and try to

keep the rodents from the house and supporting structures.

What is Bio-Control?

Today bio-control—the deliberate use of living organisms against humankind’s pests—is used in the agricultural and nature fields to control the expansion of unwanted animals and plants. It has gained momentum among scientists because of the deadly results that have arisen from the application of chemicals such as pesticides, i.e., herbicides and fungicides, to stop the invasion of pests and weeds. They have found that the application of chemicals may rid the area of weeds or pests, but will also kill other plant and animal species that were not intended as targets. Secondary effects of chemical usage also include seepage into ground water, pests becoming

resistant to the poisons, and the possible health risks to humans exposed to such chemicals.

As a result of these secondary effects, researchers in the fields of agriculture and nature conservation are exploring the increased application of biological control techniques and integrated pest management (a technique that reduces pest populations to levels no longer seriously impacting other species) to stabilize the spread of alien invaders. The reasons why these controlling techniques are so important today is that the rate at which alien invaders are appearing and spreading to other countries is staggering. Some of the major animal and plant species that are of concern include the European green crab, large mouth bass, zebra mussel, bullfrog, rosy wolf-snail, cane toad, and weevil. Examples of plant alien invaders

Some specific facts include:

Recent quantitative rankings indicate that alien species are second only to habitat degradation as today’s leading cause of loss of biodiversity.

Between 1906 and 1991, 79 alien species alone caused \$97 billion dollars in damage to agriculture, industry, and health in the U.S.

At least 4,500 species of alien origin have established free-living populations in the U.S. Around 15% of these species cause severe harm.

Weeds have invaded approximately 17 million acres of public rangeland in the west.

Calculating that the average weed spreads by 14 percent annually, weeds are expanding roughly 550 million acres of federal lands at roughly 4,600 acres per day.

One characteristic of a successful invader is the ability to reproduce in large numbers. For example, one yellow star thistle plant can produce 150,000 seeds.

Global changes may promote invasions and alter the fate of invasive species (Cambridge Educational, 1999).

include kudzu, leafy spurge, knapweed, and English ivy.

Surprising Hitchhikers!

Zebra mussels first gained publicity in the U.S. when they were found in the Great Lakes and St. Lawrence Seaway in 1988. The mussels found were traced to ships that traveled across from the Balkans, Poland, and the former Soviet Union through the Seaway into ports on the Great Lakes. The mussels grew in this new environment, liking the cool, humid conditions, and their presence is attributed to traveling to the Americas in the ballast waters of ocean-going vessels. Besides causing an imbalance in the ecosystem (eating microscopic plant and animal life), they clog the intake pipes to ships and industrial and water treatment facilities. (Be Aware of Zebra Mussels, www.anr.state.vt.us/dec/waterq/genzm.htm)

These mussels have caused major problems to the intake waters of the ship engines' cooling systems. Today, paints are used to control the mussels, but these again are found to be hazardous to other aquatic life and are outlawed in North America other than for military use (warships). These special anti-fouling paints contain tributyl tin compounds (TBT), which contain the metal "tin", among the most toxic of substances to marine life. Many believe TBT compounds are responsible for the deaths of thousands of dolphins and other mammals in the Gulf of Mexico and other areas around the world. These compounds were

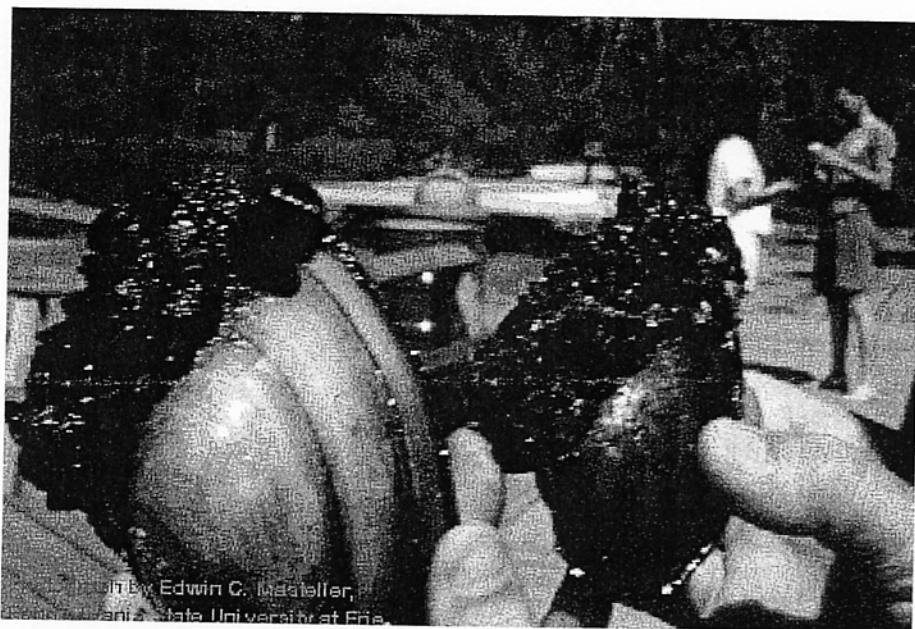


Figure 2. While human intervention has introduced many non-native species in various parts of the world, there are some species that are unsuspecting hitchhikers. The Zebra mussel traveled across the Atlantic in the ballast waters of ships. Other species such as insects have reached America and other continents in cargoes of fruits, vegetables, and plants (J. L. Ram, RAM Lab, Department of Physiology, Wayne State University. Photo by E. Masteller).

used as an active ingredient in anti-fouling paints on large vessels such as supertankers and container ships.

The large mouth bass and bullfrogs are causing similar problems to lakes around the world. Introduced for eating and recreational purposes, these species are feeding upon other plants and reducing them. As a result, ecosystems have been altered and can no longer support the life of their natural inhabitants (other fish and vegetation).

In the plant kingdom, the effects of the alien invaders are creating similar results. The semaphore cactus is an endangered species. Found in the Florida Keys, this rare plant has come under attack from the Cactoblastic caterpillar. The caterpillar was introduced to islands in the

Caribbean from Argentina to control more common species of cactus that were a nuisance to native islanders. However, the caterpillars are attacking all cacti, not just the one that humans sought to reduce. From this incident, you can see how bio-control techniques have secondary problems among themselves and can result in an attack on more prized species of cactus.

As these examples show, human intervention into nature can often multiply problems. The use of chemicals has been found to have many unexpected secondary events. The introduction of alien invaders can cause problems tenfold.

Scientists and naturalists are concerned about the application of bio-control practices to stop alien invaders. They have wit-

nessed backfires such as with the caterpillar and rosy wolfsnail used to control African snails in the Pacific Islands (Stolzenburg, 1999). The wolfsnail has eliminated 50 other species of snails.

Study of second and third level consequences of bio-control must be undertaken prior to the release of life forms outside of their natural environments. Selectivity is a key concept in the study of bio-control.

Recently naturalists began an experiment to control leafy spurge in the American West. Spurge was believed to have been accidentally brought to the western U.S. by Russian immigrants in the early 19th century (Stolzenburg, 1999). The immigrants did not know that the alien invader was mixed among grass seed they brought with them. Innocent as it may appear,

this is how a number of invaders arrive. The bubonic plague journeyed from China to California by way of a flea, a rat, and a ship (Cambridge Educational, 1999).

Since spurge arrived, it has spread without control, covering about five million acres in North America. In its spread, spurge has pushed aside native prairie plants and now this weed is choking out the grasses that have been traditionally used by ranchers to feed their cattle. Attempts to control spurge by mowing, pulling, burning, and disking have proved unsuccessful. Sheep and goats will eat the weed (bio-control technique), but they also cause damage to the native grasses needed as feed for cattle.

Today experiments are being conducted to determine the effects that flea beetles can have on controlling the spread and

destruction of leafy spurge. Knowing that bio-control can backfire and create secondary effects on other species, researchers like Dave Hanna at The Nature Conservancy's Pine Butte Preserve in Montana have studied the effects of releasing the flea beetle to eat the weed's roots and leaves. "Flea beetles are proving themselves worthy opponents against leafy spurge . . . whose rampant displacement of massive grasses and wildflowers forms a chain of threats extending all the way to the grizzly bear" (Stolzenburg, 1999). The preserve is one of the few remaining homes for the grizzly that forages on the grasses being taken over by the spurge.

Can other steps be taken to control the effects that alien invaders are having on our environments? As you have learned, most invaders are introduced into alien environments with no secondary impacts in mind. Some species arrive by accident. Others are introduced for bio-control purposes. What invaders are in your local environment? What means have been used to aid in their control?

Activities

CONTROLLING ALIEN SPECIES

Conduct Web searches to learn more about alien invaders. Search the topic of biological control and specific species cited in this Resource in Technology. A starting address might include the *Bio Control Network* Web site at www.biconet.com.

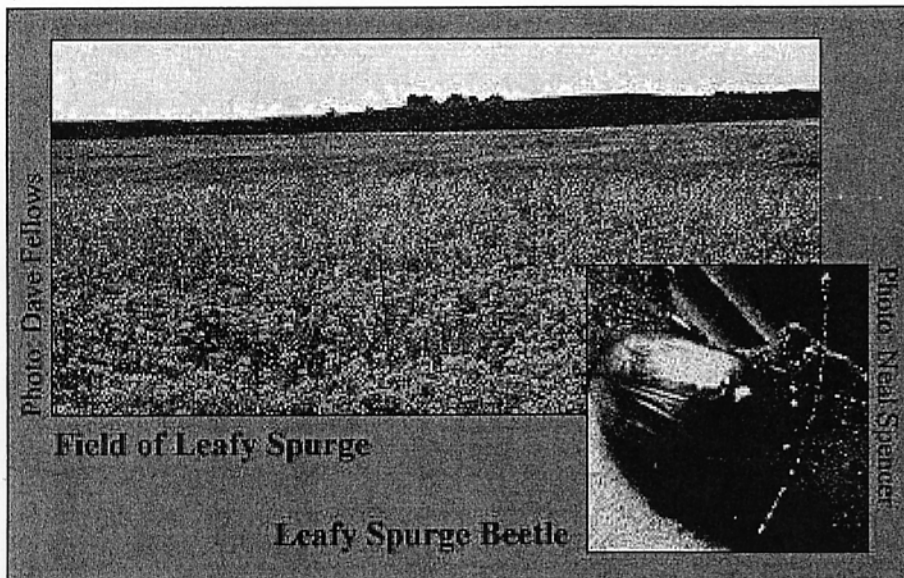


Figure 3. The growing conditions of the mid-western plains of the U.S. proved to be ideal for leafy spurge grasses. The fertile topsoil and moisture conditions enabled this plant species to thrive. "Traditional" weed control measures have proved unsuccessful. However, research studies have shown that flea beetles will attack the root system of the leafy spurge grasses (Leafy Spurge field photo Neal Spencer, USDA/Agricultural Research Service, inset photo of Leafy Spurge Beetle, Dave Fellows, National Biological Service).

SCIENCE/TECHNOLOGY GROUP PROJECT

Divide the class into groups of three. Have them select a bio-control alien specie and develop an illustrated paper and presentation on the topic. Use the projects for science and technology fairs or for giving competitive speeches.

Order and view the video *Alien Invaders: Invasive Species and the Threat to Biodiversity*. Use the teacher's guide to assist with class activities. This video is available from Cambridge Educational for \$79 (1-800-468-4227).

Summary

Caution is a key when one alters native environments. Secondary effects have been overlooked in the use of chemicals to control pests such as insects and weeds. Experimentation using bio-control techniques has proven successful in some cases and has further damaged the environment in others. Scientists and naturalists have both learned that testing is needed prior to the large-scale introduction of natural-born killers to new environments. As a result, "green" alternatives will be able to seek out alien invaders and pursue their targets without supervision. ☞

References

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<http://www.nbio.gov/invasive/ZebraMussel/zebramus.html>

Stolzenburg, W. (1999). *Double Agents*. *Nature Conservancy* 49(4), 18-24.

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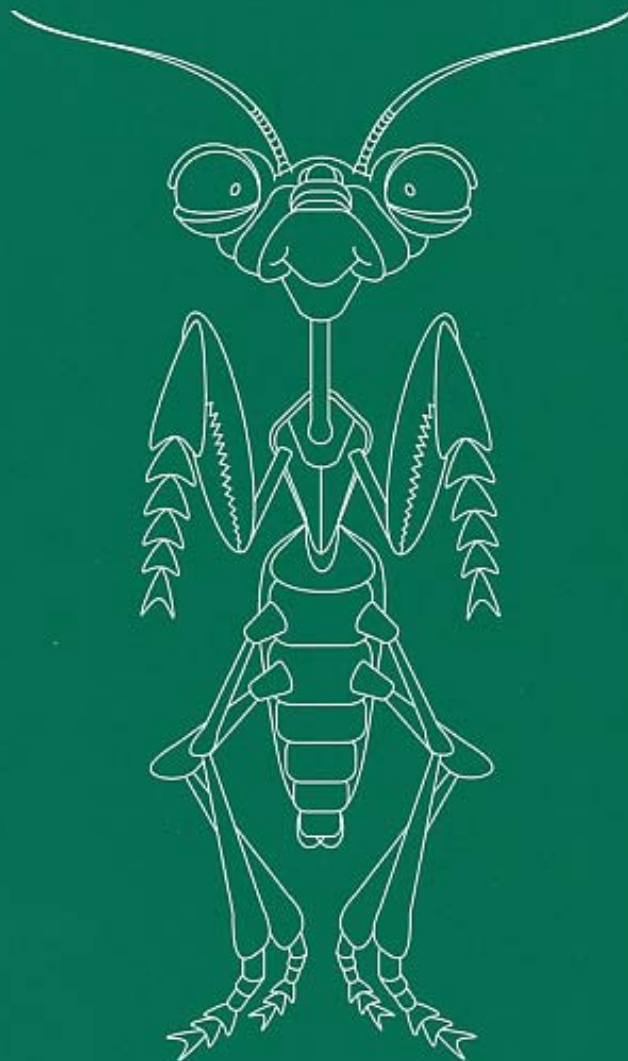


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