Aliens, Unwanted Invaders, and Biogeography

Overview

Using three classic alien invaders, an animal and two plants, students use mapable data to track the spread of these organisms across the United States and answer questions concerning their distributions.

Title

Aliens, Unwanted Invaders, and Biogeography

Investigative Question

What are alien invaders, why are they such a problem, and how do they relate to biogeography?

Overview

Using three classic alien invaders, an animal and two plants, students use mapable data to track the spread of these organisms across the United States and answer questions concerning their distributions.

Objective

Students reconstruct the invasion course in the United States of three invaders, speculate about why aliens present a serious problem and answer questions from the data.

Materials

Copies of Student Pages 1, 2, 3, 4, 5 and 6; colored pencils; a bag of dry beans.

Time

One 50-minute class period

Advance Preparation

Copy the Student Pages and assemble the materials.

Introducing the Activity

Grab a handful of dry beans and toss them on a table. Observe that the distribution of the beans across the table is due to a number of factors: the friction between the table and the beans, the force with which the beans were thrown, the direction of the toss, and the size and weight of the beans. Where these beans are now found is called their distribution. Plants and animals also have distributions, and these are the result of any number of factors: climate, soil type, competition from other species, and extreme environmental events (e.g., floods, volcanic eruptions, droughts). These distributions have developed over a very long time and each organism is adapted to the particular set of conditions that determined where it now lives.

Procedure

Gypsy Moth: Mapping Its Spread in the United States

1. Distribute copies of Student Page 1 and share the stories of the three invader species: the gypsy moth, garlic mustard, and purple loosestrife.

2. Distribute Student Pages 2 and 3 and direct students to color in the states listed on Student Page 2 in which the gypsy moth is now found. Students should use three colors to indicate the population density levels. Spot introductions (populations that are too small to warrant calling an entire area infested) may be shown by a dot or star of a fourth color placed in the infested area of a state, e.g., Northeastern Illinois. Students should provide a title for their maps.

3. What can students infer about the distribution of gypsy moths in the United States? Why has the gypsy moth appeared to stop in the central United States?

Garlic Mustard: Mapping Its Spread in the United States

1. Divide the class into pairs. Distribute Student Page 4 and four copies of Student Page 5 to each pair.

2. Students will transfer the distribution data from the master map (Student Page 4) to the eight blank maps. Each of the eight distribution maps created by the students will show the spread of garlic mustard during only one of the year ranges indicated on the master map. Students must carefully determine the number of dots to be entered and the precise location for each. Partners should monitor each other's work as the data are transferred. Each map should be given a title and labeled to indicate the years when the data were collected.

3. Students conclude the activity by graphing their data on x-y axes. The x-axis represents the number of sites where garlic mustard was found; the y-axis indicates the year range in which those sites were identified. What patterns are evident, if any? Is garlic mustard increasing in abundance or decreasing? In what direction or directions is it spreading? Did any range of years indicate a spurt of spread or a decline?

Purple Loosestrife: Interpreting the Spread.

1. Divide the class into pairs. Distribute Student Page 6 and have pairs study the map for a few minutes. To aid in interpretation, you may allow students to color the map relative to the distribution of the various levels of loosestrife infestation.

2. Have students answer the questions on Page 6 as completely as possible.

Assessing the Activity

Prepare an overhead of all three maps of the distribution of the alien species. In what states or portions of states do the distributions of all three species coincide? Are there common factors that might account for this? What could possibly be the main factor in the overall spread of all three species of alien invaders?

Extending the Activity

Each student chooses a species of plant or animal in which he or she is particularly interested, researches its distribution, and constructs a distribution map. Your school librarian should be alerted in advance because adequate references may not be available in the school library. Your librarian may be willing to assemble appropriate materials from the library on a special shelf and supplement that collection from interlibrary loans. Share the distribution maps in class. What animal or plant the students investigated had the largest worldwide distribution? the smallest? What factors appear to keep the organisms with the smallest distributions in limited areas?

State Goals

11, 12, 13 (Objective 12.7.27)

Concept

The distribution and abundance of organisms in various ecosystems are limited and influenced by many factors. When these organisms are moved (accidentally or intentionally) to a new area they are called aliens or exotics. They may be released from biological pressures (predators, diseases, etc.) that kept their numbers in check and experience population explosions. If this occurs, these alien invaders often become serious pests in their new homes.

Safety and Disposal

No dangerous or hazardous materials are used.

Student Page 1: Background Information

Organisms are adapted to a set of conditions that meet minimal physiological needs: among these are sufficient moisture, heat, oxygen, and food. The requirements of organisms have an important influence on where they live and how they are distributed. These requirements, and larger features of the environment, are recognized as significant in plant and animal distribution. These larger features include mountain ranges, river valleys, rift valleys, oceans, seas, islands, continents, and the spatial relationships among these geographical features. The study of the where's and why's of plant and animal distribution is called biogeography.

Imbalances can occur in nature by the accidental transport of plants and animals from one location to another without their array of natural enemies (organisms that use those species for food) that served to regulate their population sizes. Humans are more often than not the culprits, sometimes accidentally, but often intentionally, bringing in organisms for their perceived values. Many introduced organisms cause little disruption; they do not greatly increase in numbers or outcompete native species and may actually be beneficial. A good example is the soybean, now one of the main crops of Midwestern agriculture. But many aliens cause serious problems and become pests in both agricultural and natural systems. We are going to look closely at two organisms, an insect (the gypsy moth) and a plant (garlic mustard), and the problems associated with their introduction into the United States. Both are forest dwellers, but the same principles apply to any ecosystem.

Gypsy moths were introduced into Massachusetts in 1869 and now commonly occur within many of the eastern, southern, midwestern, and far western states. This insect is a major defoliator (leaf feeder) of forest trees and is likely the number one forest pest in much of the United States. The dispersal of gypsy moths is most often accomplished by humans. Although the gypsy moth can be a pest in its native habitat (Eurasia), outbreaks are less frequent and of shorter duration than those in the United States because many natural enemies in its native habitat use the gypsy moth as a food source. These enemies include insects, such as predatory beetles and parasitic wasps, and birds and small mammals. The gypsy moth became a serious pest in our country because it was introduced without any of its natural checks (enemies). In addition, gypsy moths are extremely prolific (a female can lay up to 1000 eggs) and it was introduced into an area of the United States (eastern deciduous forest) that had an ample supply of food and favorable climatic conditions.

Student Page 1: Background Information continued

The first collection of garlic mustard in the United States was made on Long Island, New York, in 1868. Scientists speculate that well-intentioned European settlers brought the plant with them for food or medicine when they came to America. Garlic mustard is native to northern Europe and into Eurasia. It is an extremely aggressive species that has invaded our northern and central woodland communities, showing a preference for disturbed, shaded habitats. This plant is able to grow or reproduce before and after the growth and reproductive periods of most other plants. Within ten years after invasion by garlic mustard, the native species of a site decline. Garlic mustard is a major threat to Illinois woodlands and to the plants and animals that live there.

Purple loosestrife is an introduced plant that is threatening our native wetland communities. The seeds of this European native were stowaways in ships' ballast and on livestock or were intentionally brought to the United States by immigrants. By the 1830s this perennial had become established in the Northeast. With none of its insect or disease enemies from Europe to regulate its growth, purple loosestrife rapidly marched across the wetlands of the continent, replacing the native vegetation.

As purple loosestrife multiplies, it aggressively crowds out other vegetation required by wildlife. In addition, purple loosestrife has very little wildlife value of its own. Songbirds do not eat its small hard seed; muskrats prefer cattail for their homes and for food; ducks shun wetlands that have become dominated by loosestrife; and the plant is too compact to offer much cover for wildlife. When loosestrife invades, wetlands once rich in native plants and animals can suddenly become a single-species stand of little value to humans or wildlife.

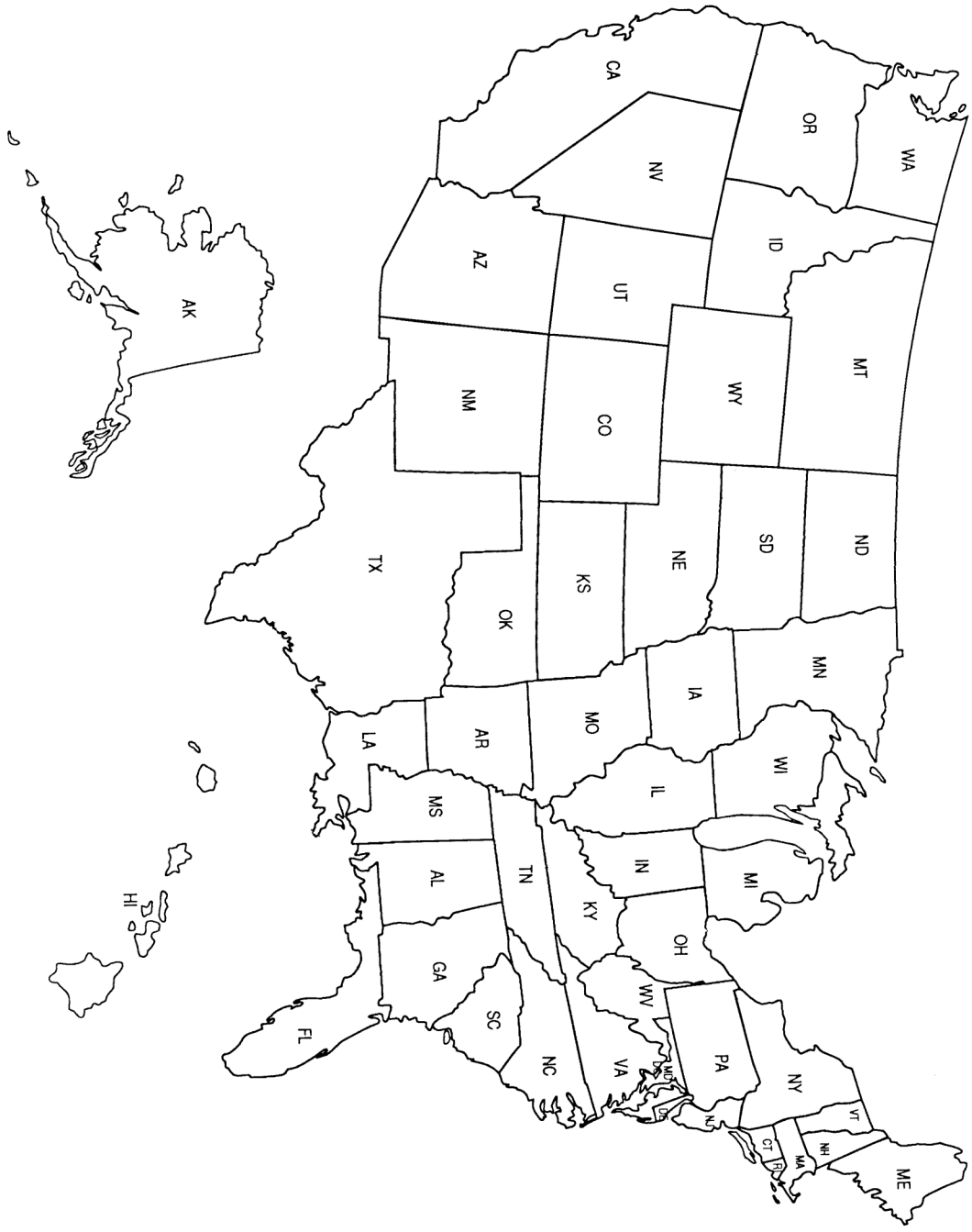
Student Page 2: Gypsy Moth Populations in the United States

States with Widespread Gypsy Moth Populations	Population Density of Gypsy Moths
Connecticut (CT)	High
Massachusetts (MA)	High
New Jersey (NJ)	High
New York (NY)	High
Pennsylvania (PA)	High
Delaware (DE)	Medium
Maryland (MD)	Medium
Michigan (MI)	Medium
Maine (ME)	Low
New Hampshire (NH)	Low
Ohio (OH)	Low
Vermont (VT)	Low
Virginia (VA)	Low

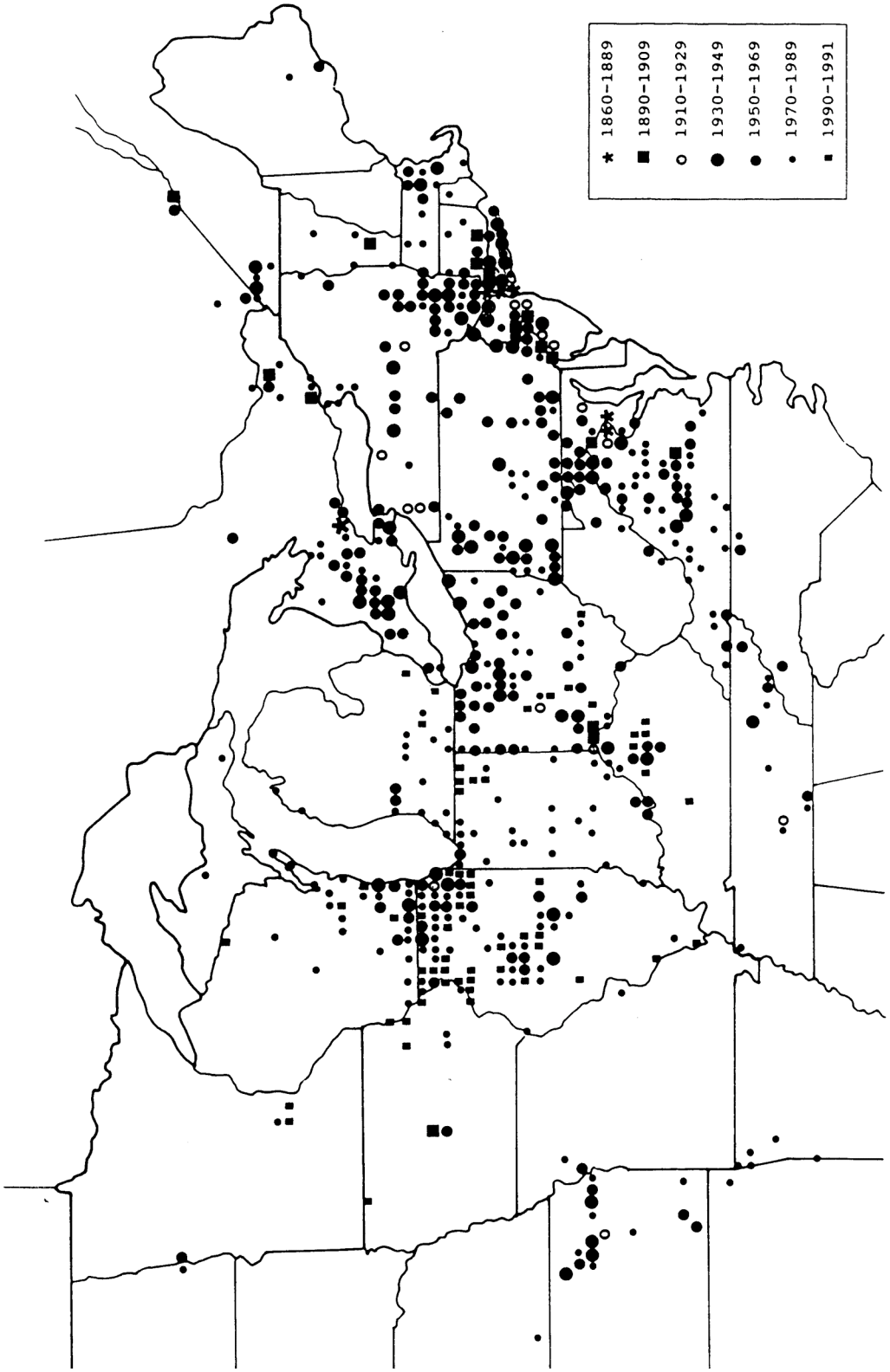
Isolated Areas Where Gypsy Moths Have Been Found (Spot Introductions)

State	Area of State
Illinois (IL)	Northeast
Indiana (IN)	Southwest
Oregon (OR)	Northwest
Washington (WA)	South
Wisconsin (WI)	North Central
Minnesota (MN)	Southeast

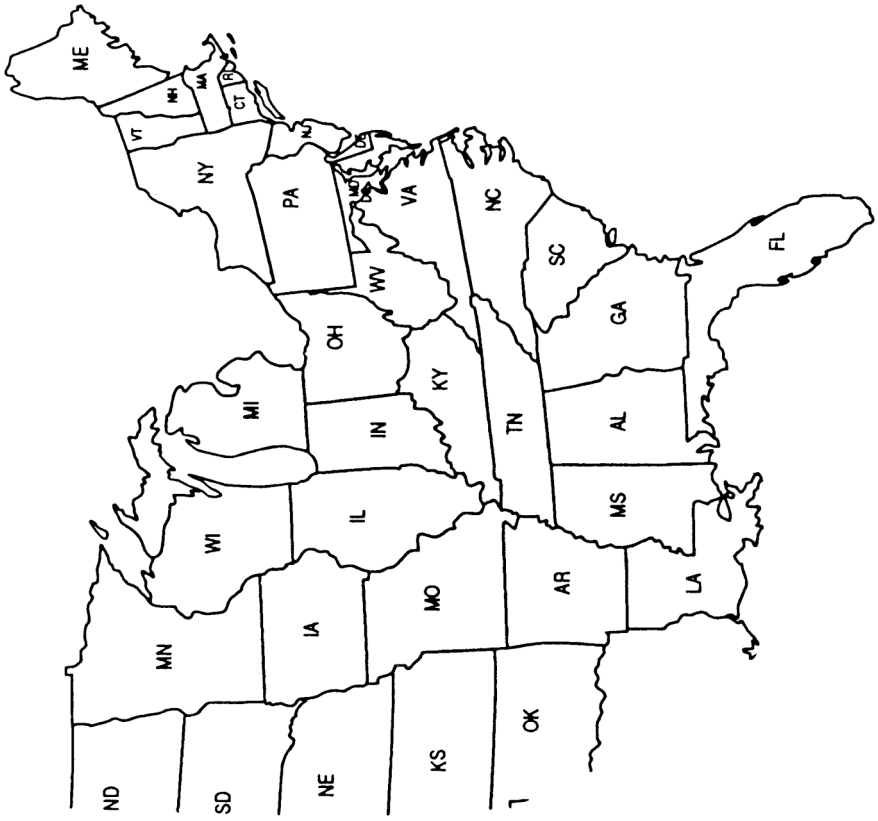
Student Page 3: United States Map

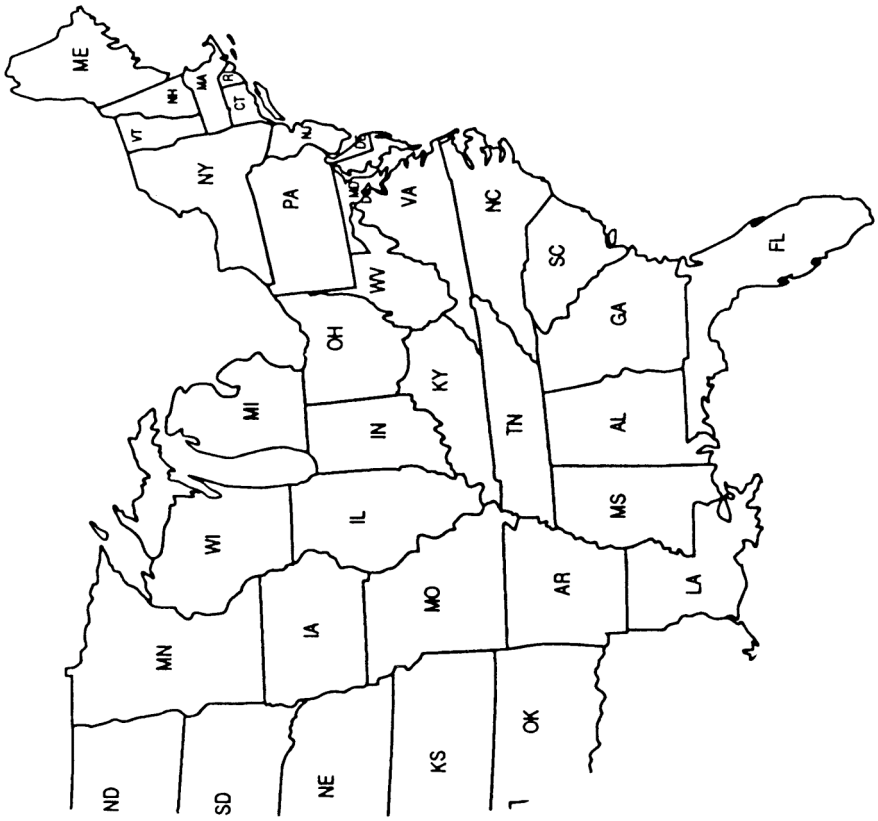


Student Page 4: The Spread of Garlic Mustard in the United States

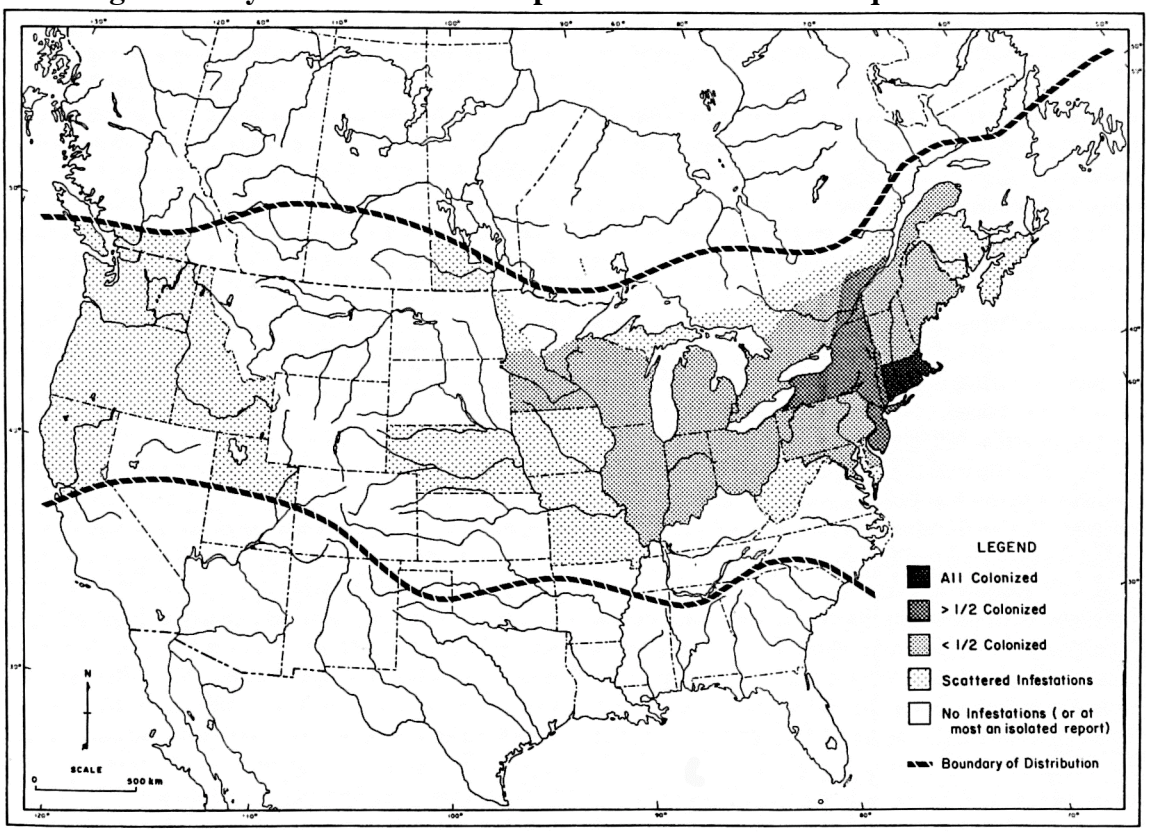


Student Page 5: Map of Eastern United States





Student Page 6: Study the distribution map below and answer the questions that follow



1. What is the meaning of the following sentence? "Purple loosestrife is an invasive, temperate zone, hydrophilic, perennial, exotic macrophyte."

2. High purple loosestrife population levels appear to more or less coincide with high _____population levels. Why?

3. What three states have purple loosestrife in every available wetland?

4. How many states that could potentially be colonized by purple loosestrife had no infestations as of 1980? List three possible reasons for its absence.

5. Which states would you guess might be colonized by 1998. Why?