The Purple Problem
Students learn about Lythrum salicaria, commonly referred to as purple loosestrife, and use their new knowledge, maps and their observation skills to identify changes to the land. They also identify threats to the ecosystem because of those changes, including biodiversity of native species, ecosystem functioning, and economic issues.

SUBJECTS
Geography, Language Arts, Science

GRADE LEVEL
Grades 6 through 8

TIME
Two to three class periods

OBJECTIVES
Students will be able to
• make observations dealing with maps.
• describe changes to the land over the years, and how those changes have affected the biodiversity of native plant and animal species, ecosystem functioning, and economic costs.
• analyze maps and construct hypotheses as to how or why this problem exists today.
• compare and contrast methods of control.
• synthesize old and new background knowledge and also specific map information.
• communicate the problem and corresponding solution to peers.
• debate and defend their decision and reasoning.

Purple loosestrife is currently found in every state except Florida and also in many countries around the world. It is an invasive species that originated in Europe and was brought to North America in the ballast of ships. People also brought this plant to North America because they treasured purple loosestrife’s medicinal purposes and beauty.

As with all invasive species, purple loosestrife displaces native flora due to its fast growth rates, effective seed dispersal mechanisms, and its tolerance of a wide range of conditions.

Purple loosestrife lacks the natural predators and diseases in our country that controlled the species in its native habitat. This plant has the ability to disrupt and alter the structure and function of wetland ecosystems. Once this occurs, decreases in native vegetation follows, which leads to decreases in native wildlife in that region. It also costs millions of dollars to control loosestrife and also millions of dollars in economic loss for landowners.

PROCEDURE
1. Introducing Invasive Species: Use ideas from the Voyage to Kure Viewing Guide to set the scene. Pay particular attention to the Segment Suggestions for the invasive species theme (use film clips from Laysan Island). If you do not have access to the Voyage to Kure episode, try to find examples of invasive species in your area and lead a discussion about the dangers to native ecosystems.

2. Assign Readings: Divide the students into seven small cooperative groups. Give each group one section of PurpleLoosstrife: Background Information to read. (Example: Habitat, Movement, Description).
3. **Group Reports:** Have each group present their information to the rest of the class. In this way, the students will learn about all aspects of purple loosestrife without having to read each page.

4. **Distribute Maps:** Give each group one of the five map sets. Several groups may work on the same sets. You may need to make multiple copies of some sets.

5. **Distribute Focus Questions:** Distribute the Focus Questions.

6. **Investigate Maps, Worksheet:** Ask students to investigate these maps in more detail and complete the Part 1 of the Focus Questions handout. They will describe the changes that have taken place over the course of five to ten years. They will also explain the cause of these changes, and how they affect the biodiversity of the native plants and animal species in this area. (Example: new housing will cause loss of habitat for native animals.)

7. **Focus on Purple Loosestrife:** Using their specific map set, ask students to focus on the purple loosestrife in their area. They can use the Purple Loosestrife: Background Information for more information. On the Focus Questions handout, students describe the changes that have occurred over the years concerning this exotic plant addressing the issues of biodiversity of native species, ecosystem functioning, and economic costs.

8. **Hypothesize Origin of Problem:** Using their new background knowledge and any previous knowledge, students will hypothesize how the purple loosestrife problem originated in their area.

9. **Consider Methods of Control:** Ask students to read the Methods of Control handout and review the three methods available to deal with this problem. Using the information gathered concerning their map, students will address all three methods of control for this plant. They must consider all factors and write down, on Part 2 of the Focus Questions handout, the advantages, disadvantages, and special challenges that they might encounter when trying to implement each type of control mechanism.

They must also consider and describe what they believe would happen if this plant is allowed to continue growing unchecked in that particular area.

Finally, as a group they must decide on a method of control and will present their information and decision to the class for discussion.
10. **Discussion Questions:**
- What are some of the challenges that face wetland owners in our state?
- How can you help preserve the native and endangered species in our wetlands?
- What organizations can you turn to for more information or help in dealing with this issue?

**FURTHER RESOURCES**
Additional educator resources for *Jean-Michel Cousteau: Ocean Adventures* can be found at [pbs.org/oceanadventures](http://pbs.org/oceanadventures).

For additional information, try:
- Ducks Unlimited Canada, Purple Loosestrife Info Centre [http://www.ducks.ca/purple](http://www.ducks.ca/purple)
- National Park Service [http://www2.nature.nps.gov/views/KCs/Invasives/Invasives_Index.htm](http://www2.nature.nps.gov/views/KCs/Invasives/Invasives_Index.htm)
- U.S. Fish and Wildlife Service [http://invasives.FWS.gov](http://invasives.FWS.gov)
- Wisconsin Department of Natural Resources - EE For Kids “Alien Profile—Purple Loosestrife” [http://dnr.wi.gov/org/caer/ce/eek/earth/aliens.htm](http://dnr.wi.gov/org/caer/ce/eek/earth/aliens.htm)

**CREDITS**
Adapted with permission from Washington Sea Grant Program, University of Washington, publisher. The lesson plan was originally authored by Jeanine Meyer Staab, Medford Middle School, Medford, Wisconsin for inclusion in Exotic Aquatics on the Move: Lesson Plans, a project coordinated by Robin Goettel, Communications Coordinator, Illinois-Indiana Sea Grant Program. For more information, visit [http://www.iisgcp.org/EXOTICSP/index.html](http://www.iisgcp.org/EXOTICSP/index.html).

*Jean-Michel Cousteau: Ocean Adventures* is produced by KQED Public Broadcasting and Ocean Futures Society.

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Purple Problem
Student Handout

Purple Loosestrife: Background Information

Historical Movement and Migration of Purple Loosestrife
Purple loosestrife is a perennial herb that originated in Eurasia. It was accidentally brought to North America in the ballast of ships back in the 1800s. The seeds from this plant quickly invaded northeastern port cities. As with most invasive species, it had a tolerance of a wide range of conditions. It could also reproduce prolifically through both seed dispersal as well as vegetative propagation. In its homeland, disease and insects kept the plant in check. With no native predators here in North America, such as the herbivorous beetles of Europe, this pioneer seed quickly adapted to disturbed wetlands, such as the newly constructed inland canals and waterways. During the next 100 years, it became well established along the St. Lawrence River Valley.

Immigrants on board these ships also brought the plant with them to the U.S. They valued purple loosestrife as a medicinal herb that was used for treatment of ulcers, wounds, sores, dysentery, and diarrhea. They also brought it as a perennial for their flower gardens and for bee forage.

Once established on the eastern seaboard, the herb then took an east-to-west migration route. The ground disturbance that accompanied the construction of our modern highway system spurred the distribution and growth of this plant. Wind currents, created by traffic and construction, carried these seeds to nearby waterways or drainage systems.

Native Range
Purple loosestrife’s origin is thought to be Europe or Asia. Today, purple loosestrife is found to cover much of Europe. This plant is found in China, over the main islands of Japan, mainland Australia, the island of Tasmania, northern India, eastern Africa, and southeastern Asia. It continued to spread in North America as well, and as of 1996 it was found to inhabit all Canadian provinces, as well as every state (except Florida) in the Union.

For example, purple loosestrife has been recorded in 70 of Wisconsin’s 72 counties. Many of these counties report low densities, which suggest that it is still in the pioneering stage of establishing itself. Areas reporting the densest populations of loosestrife are in the southeastern part of the state, and along sections of the Wisconsin, Wolf, and Fox River drainage systems.

In Wisconsin, only about 5% of the wetlands have purple loosestrife. Of the colonies surveyed in 1988, half of the purple loosestrife colonies have fewer than 20 plants. Eighty percent of the colonies have fewer than 100 plants.
Purple Loosestrife:
Background Information

Habitat
Purple loosestrife can occur in both freshwater and brackish water (water that has mixed with salt water). The plants are shade intolerant. Loosestrife can invade most types of moist soils or shallow wetlands. It favors water levels that fluctuate and also areas with disturbed soil. Areas where heavy machinery has been used caused a favorable environment for this plant and also weakens other native vegetation.

Those areas include: ditches, pond edges, river and stream banks, lake margins, tidal and non-tidal marshes, freshwater wet meadows, reservoirs, alluvial flood plains, sedge meadows, pastures, and wet prairies. It is unable to invade saline wetlands.

Older plants can tolerate drier conditions and can grow on upland sites. Purple loosestrife can also flourish in lawn and gardens. This is one of the ways that seeds have been introduced into wetland areas, rivers, and local lakes.

Disturbances, including water drawdowns and exposed soil, greatly accelerate the growth rate of loosestrife germination. Loosestrife seeds germinate best in soil temperatures that are between 15°C and 20°C. Day length does not seem to affect this process.

Purple loosestrife has a broad pH range. Seeds have germinated anywhere between pH of 4.0 to 9.1. When conditions are favorable, germination occurs in 8 to 10 weeks.

Description
Purple loosestrife is an herb, though it grows like a weed. It is called a perennial, emergent aquatic plant. This means it comes back year after year and that it is a water plant that grows above the water.

Small flowers with five or six petals grow on spikes. These flowers can be white to red to purple to dark pink. There can be 1 to 50 spikes on each plant. These short slender stems branch out to form wide-topped crowns that compete for the sun. It will shade everything else out. The flowers are pollinated by bees and butterflies and bloom early July into early September.

The stalks have four to six sides. They grow from 4 to 10 feet high. The leaves of purple loosestrife are long and are opposite each other on the stalk. Young plants can produce 100,000 seeds per year, with mature plants producing as many as 2.7 million seeds. Seed survival is approximately 60% to 70%. These seeds are thin and flat in appearance. Although seeds only germinate in wet soils at high temperatures, the seeds can lay dormant in the soil for many years and can even live in water for approximately 20 months.
Other plants are often mistaken for purple loosestrife. Some of those are: blazing star, winged loosestrife, blue vervain, swamp loosestrife, fireweed, and gayfeather. The large, woody taproot of loosestrife has rhizomes that form dense mats. These submerged stems develop the tissue characteristics of aquatic plants. Each year, they produce about one new foot of stem underground.

**How Seeds Move**

Loosestrife seeds are light enough (weight 0.5–0.6 mg) that the wind can carry and disperse them. Most seeds fall close to the parent plant though, usually within 34 feet. They are usually moved downslope rather than downwind.

Seeds fall into the wetland mud, where they can adhere to aquatic wildlife, livestock, machinery, boats, and people. These seeds are then transported to other areas, boat landings, and wetlands unknowingly. Both the seedlings and the ungerminated seeds can float.

Seeds are eaten by some animals and are then deposited via feces in a different area.

Purple loosestrife is also spread vegetatively. This means that if you break off a stem, or just try to stomp a plant to death, new buds will appear. If a piece of purple loosestrife is on your boat trailer, you could be transporting this alien to a new place where it might resprout.

Some people plant loosestrife in their gardens. It has long been a favored, showy perennial in flower gardens. Although this might seem harmless, this is one of the ways in which the seed has spread to area lakes, rivers, and wetlands.

In some states, including Wisconsin, it is illegal to sell, offer for sale, distribute, plant, or cultivate purple loosestrife. It can still be purchased legally in some states. Violators should be reported to the Dept. of Agriculture, Trade and Consumer Protection at Bureau of Plant Industry. A fine of $100 can be imposed on the violators. It is good to be aware that some wildflower or seed mixtures contain purple loosestrife seed. Always check the label to see if your mixture contains this species.
Purple Loosestrife: Background Information

Problems
Purple loosestrife disrupts the normal structure and function of an ecosystem. The herb will displace or completely take over native vegetation and plants. It will eliminate native sedges, other flowering plants, and natural grasses. It competes with reed canary grass and Japanese millet. It can expand over thousands of acres.

This is because purple loosestrife has no natural predators or disease here in the United States to keep the plant in check. As with many invasive species, purple loosestrife is tolerant of many environmental conditions and thus can grow rapidly. It becomes a problem for fish, fur bearing animals, and birds that are looking for food, shelter, a place to nest, reproduce, and raise their young.

Often the first species to be eliminated are the rare and endangered species of the area. For example, the bog turtle in the northeastern U.S. is severely impacted as its source of food is eliminated. For example, a species of orchid is also endangered because of purple loosestrife.

As purple loosestrife spreads its thick mat of vegetation over an area, it often becomes a monoculture (only species in the area.) Having a variety of plants and vegetation is important in wetland areas. Most waterfowl, fur bearing animals, and birds depend on these other plants for their food. The purple loosestrife is not eaten, nor is it a nutritious source of food for most animals.

Purple loosestrife can take over thousands of acres. Once a wetland is dominated by purple loosestrife, traditional residents such as muskrat and waterfowl decline in numbers significantly. Besides losing their food source, they are also losing their nesting material and ground cover due to this native vegetation loss and loosestrife replacement. The root mats create a 3-ft opening between plants in the water. This eliminates cover for nesting ducks. Other birds or waterfowl, such as marsh wrens and least bitterns, are displaced completely from the wetland.

Purple loosestrife interrupts food chains. The red-winged blackbird nests in this foliage. The long-billed marsh wren is the blackbird’s greatest threat concerning nesting mortality, but avoids purple loosestrife. One can easily see how this could affect the population of the red-winged blackbirds. This increased population of blackbirds will also need to look to other areas for a source of food, as they do not eat purple loosestrife seeds as part of their diet.

Purple loosestrife can also choke recreational waterways. This can be detrimental to wildlife refugee users and managers. Recreational hunting grounds and trapping grounds also disappear.
Purple Loosestrife: Background Information

This plant can also cause thousands of dollars of damage in agricultural communities by clogging irrigation systems, thus impeding the water flow. Often wetland pastures are completely lost to grazing because of the monoculture takeover. It was recorded in 1942 as a problem weed in the pastures of Quebec, stating that this land, which once supported 800 head of cattle, was since declared useless. It is also becoming more of a concern in areas where wild rice is grown and cultivated, such as northern California.

Economics
Purple loosestrife does have several economic benefits. Beekeepers look to purple loosestrife as a source of nectar and pollen for their colonies of bees. It is estimated they will experience a loss of 1.3 million in honey sales over the next 20 years due to the purple loosestrife control. If traditional wetland plants were allowed to reestablish themselves, bee colonies would then return to their original source of forage.

Purple loosestrife seed was sold around the world. Gardeners worldwide have long looked to purple loosestrife as a source of beauty for flower gardens. It is mentioned as far back as the Middle Ages. The plant was also used for medicinal purposes. Its flowers, roots, and branches were used for tonics that were used to treat ailments such as dysentery, internal and external bleeding, and the healing of wounds and ulcers.

The detrimental impacts of this plant clearly outweigh any economic gain. The plant continues to alter wetlands and disrupts ecosystem functioning. As hunting, trapping, and recreational grounds are lost to this plant, there is an accompanying decrease in the value of those lands. That can add up to large sums of money for landowners and managers of operational wetlands.

Purple loosestrife is known to clog irrigation systems, impeding water flow. It can also overrun meadows leaving the land useless for grazing. These agricultural losses are estimated to exceed $2.6 million annually.
Legend
Roads...
Houses ■
Stream ~
Wetlands ⨳ ⨳ ⨳
Purple Loosestrife plant ○ = 5 plants
Purple Problem
Student Handout

Legend
Roads —
Houses •
Wetlands ✰✰✰
Purple Loosestrife plants ⚪ ⚪ ⚪ = 5 plants
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Legend

Hiking Trails • • •
Campground ▲
Wetlands × ×
Purple Loosestrife plant ●
Forest  ●
Boat Landing ▼

Lake Ada 1990

Lake Ada 2000
Focus Questions

Names of group members
___________________________________________________
___________________________________________________
___________________________________________________
___________________________________________________
___________________________________________________

Map name
___________________________________________________

Part 1
1. Look at your set of maps from now and then. Investigate these maps in more detail.

2. What changes to the land have taken place over the course of the years?

3. Who or what has caused these changes? Describe those changes in the space provided.

4. How have the changes you described affected the biodiversity of the native plant and animal species in this area? Explain those changes here.

5. Center your attention on the purple loosestrife on each map. Describe the changes that have occurred over the years concerning this plant addressing the following issues:
   a. Biodiversity of native species
   b. Ecosystem functioning
   c. Economic costs

6. Using your background knowledge of purple loosestrife, hypothesize how this problem originated in your area.
Focus Questions

Part 2

1. Review the methods available to deal with this problem by reading the “Methods of Control” handout. Using the information gathered concerning your area, address all three methods of control for purple loosestrife. What would be the advantages and disadvantages of using each of the following methods to control purple loosestrife in your area?

**MECHANICAL CONTROL**
Advantages:

Disadvantages:

Special Challenges:

**CHEMICAL CONTROL**
Advantages:

Disadvantages:

Special Challenges:

**BIOLOGICAL CONTROL**
Advantages:

Disadvantages:

Special Challenges:

2. What will happen to this area if the problem goes unchecked? Focus especially on the economic costs and ecosystem functioning.

3. As a group, decide on the method of control that you will want to implement in your specific map area. Be prepared to present this information to the class and to support your decision.
Methods of Control

Mechanical Control
Mechanical control works best for small populations of purple loosestrife. Because it takes many people to monitor for new pioneering plants trying to take root and also to remove plants by hand, this method can become extremely costly.

If an area of infestation is extremely large, flooding is sometimes recommended. When flooding an area, the water must be drawn down or reduced until the loosestrife has sprouted. Then water levels must be increased to drown the stems. Problems can arise when trying to maintain a constant water level. When flooding an area, often many other native plants are impacted.

Time of flooding is of utmost importance. Flooding must be done before the onset of seed in early August, or you could be transporting thousands of seeds to a new location. Also, if the water drawdown is done too late in the spring or early summer, purple loosestrife growth is encouraged. For these reasons, flooding is not often recommended.

Mowing is another type of mechanical control. The purple loosestrife plants are cut below a level that the water will cover for approximately 12 months. Mowing does not prevent seed production! Cut plants must be picked up. These plants can still produce seeds. Also, small pieces of plants can develop new shoots and roots that will bud into new plants. Cutting late in the season will help hinder this process.

If the colony of purple loosestrife is relatively small, hand pulling of the plants might be successful. Young plants are easily removed in this manner. Older plants will be more difficult to pull. You must be sure to get the entire root or it will resprout. You may need to use a pitchfork or shovel. Stomping or breaking underground stems in removal initiates new bud growth. If any of the root remains, new shoots will resprout. You should try to handle the plants prior to the onset of seed in early August. Once the petals begin to fall from the bottom of the spike, seed production will begin.

If the plants are in seed when you remove them, care must be taken in bagging seed heads to avoid spreading the seed further. Also, the removed plants and seeds should be dried and disposed of properly. If you are bagging the seed, make sure the landfill you are taking it to does not require the bags to be broken. Do not throw the plants into a compost pile. Those seeds may not be destroyed and may take root. Also it takes the thick woody stems a long time to decompose. If there is an incineration facility in your area, this is an effective way to dispose of the plants.
Be aware that your clothes, boat, boots, and equipment used during this process may also serve as transport units for these tiny seeds. Brush off your clothes, footwear, and equipment before moving to uninfested areas. If you are using a boat, make sure you rinse all trailers and boats as well.

Also remember that purple loosestrife favors disturbed soil, so try not to disturb the soil. Burning is not effective because the plant has high moisture content. Also be careful not to disrupt the habitat for the other amphibians, mammals, waterfowl, etc. that live in the same area. Take care not to destroy wetland vegetation and other delicate plants when mechanically removing the purple loosestrife.

**Chemical Control**

You will need a permit when applying any herbicides to Wisconsin waters. Teachers in other states should check local regulations. This permit helps to protect people and the environment.

This method of control is best used for small populations or individual plants. When used carefully, herbicides can be effective and efficient on spot treating large, older plants (e.g., Rodeo for wetlands, Roundup for uplands). These herbicides can be costly and also require continued long-term monitoring and maintenance. Also in the case of herbicides, many are non-selective and environmentally degrading.

The use of glyphosate (Rodeo) can be used for killing loosestrife. This chemical must be used in late July or August to be effective, as this is when the plant is preparing for dormancy. It may also be advantageous to do a mid-summer and late season treatment. This will help reduce the amount of seeds that could be produced. It should be applied to 25% of the plant in a 1% active ingredient solution. It is designed for use on wet or standing water sites.

Glyphosate mixed to 3%–10% can be used on freshly cut stems. This has been proven to be effective on larger plants in areas of low densities. You cut the stem near the ground and then paint a dab of the chemical on the fresh cut surface with a 50% solution. Remove the cut stems from the wetland or they may take root.

Glyphosate will also kill any other green foliage that it comes in contact with, so great care must be taken to avoid treating non-target plants. Another chemical that can be used is triclopyr or Garlon 3A (Roundup). This chemical is broad leaf specific, meaning that it will not harm grasses, sedges, cattails, rushes, reeds, etc. or monocots. You must cover nearly the entire foliage. It is only for use on dry sites. It is not yet approved for over-water use (as of 1997).

Backpack sprayers are used by applicators to apply the herbicide to each plant. This is time consuming and expensive. It also requires multi-year applications to manage those plants that survived.
Biological controls are seen as the most likely candidate for effective long-term control where purple loosestrife has taken over large areas of land. Biological controls are other plants and animals that feed on a specific plant.

When a plant is accidentally introduced into a new continent or area, it often leaves its natural predators and disease behind. The purpose of a biological control is to reestablish this connection in order to reduce and control the number of plants in an area. These biological controls will never eradicate the problem, but will help to bring about a healthier balance in the ecosystem.

Consideration must be taken when introducing one organism to control another. Prior to any introductions of a biological control species, extensive testing is conducted. In this case, a beetle was tested to see that it was a safe and effective agent in controlling loosestrife. These tests are also important so that the new species does not also become a pest, feeding on plants that we don’t want it to.

Over 100 European insects were tested to feed on purple loosestrife. Special feeding trials were conducted where these insects were exposed to approximately 50 species, both wetland plants and upland vegetation. Of those tested, five were selected for approval for release in North America. These were introduced without fear of negative impacts. These beetles do adapt to a wide range of ecological and climatic conditions. The U.S. and Canada have released three beetles listed below.

Galerucella pusilla and G. calmariensis are two leaf-eating beetles that seriously affected the growth and seed production of purple loosestrife. The adult beetles defoliate the plant by feeding on the leaves, flowers, and new shoot growth. You can see evidence of this damage by examining the round holes in the leaves.

Female beetles can produce up to 500 eggs during a 45 day period. Four to six eggs are laid on the stems, axils, or underside of the leaves. These larvae feed on the leaf’s underside, leaving just a thin cuticle on the topside of the leaf. Plants can be destroyed or weakened if the insect population per plant is over 200. Just ten larvae, though, can prevent seed production by killing the terminal buds.
Hylobius transversovittatus is the other beetle that has been imported to control purple loosestrife. This beetle will bore into the lower 2 to 3 inches of the plant stem where she will lay 1 to 3 eggs daily from July to September. Some beetles will burrow into the soil and will deposit their eggs near the root of the plant. The newly hatched larvae then burrow to the root where they enter and severely damage the pithy xylem and phloem tissue. This reduces the carbohydrate reserves for the plant, depleting it of its energy. The plant does not have the energy source to develop new leaves. The mature plant will then die. A zigzag pattern in the root is evidence of this beetle damage.

As of 1996, 25 states have introduced these beetles as a control device for this plant. Pertinent data is taken during the time of release. This includes: soil type, size of infestation, water levels. Monitoring is again conducted later in the season and in following years, so that the survival rate of the beetle can be assessed, as well as the impact on the plant population.

It is believed that once these insects have become established at these plant sites, the insect populations will increase and will reduce the density of this plant. As the loosestrife colonies begin to die, the beetle will need to find a new source of food. The beetles do not spread to new sites easily. People physically move beetles to new locations. Because the beetle will never be able to completely eradicate the plant, there will always be a food source for the remaining insects.

Here in North America, it is estimated that the beetle will help to eradicate approximately 80% of the loosestrife population. It may take 10 to 20 years before insect populations will become established enough to accomplish this goal.