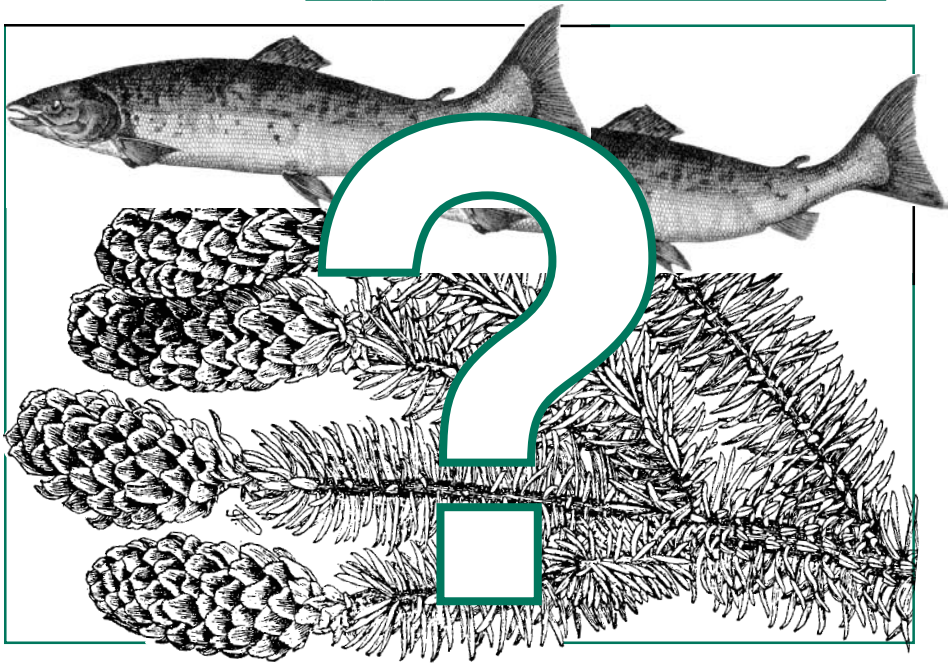
Forest Puzzlers

1 EXTENSION *ALERT: ALASKA ECOLOGY CARDS OPTIONAL*



Section 2
FOREST ACTIVITIES

Grade Level: 5-12
State Standard: S A-14
Subjects: Science, social studies
Skills: Reading, reasoning, analyzing
Duration: Two40minute lessons
Group Size: Smallandwhole class
Setting: Indoors
Vocabulary: Carnivore, commensalism, conifer, competition,detritivore,ecology, herbivore, herbicide, invertebrates,mutualism,parasitism, pesticide,populationexplosion, predation, predator, symbiotic/ symbiosis

Objectives:

1. Students will describe the effects and consequences of forest ecosystem changes.

2. Students will apply their knowledge of forest ecology to real ecological problems.

Teaching Strategy:

Students analyze forest ecology problems and present possible solutions.

Prerequisite:

Students should understand and be able to apply the concept of "habitat" before starting this activity. *For more background and teaching activities about wildlife habitat, refer to another book in this curriculum set,* Alaska's Wildlife Conservation, *Section* 1, *Home Sweet Habitat. Additional activities that teach habitat concepts are available in* Project WILD.

Materials:

Copies of "Forest Ecology Puzzlers" (*following pages*).

Background:

See INSIGHTS, *Section* 2, *Forest Ecosystems*.

Procedure:

DAY ONE:

1. Divide the class into three groups and give each a different puzzler.

2. Review the vocabulary words with the class. Ask students to read definitions from the glossary or dictionary and list them on the board.

3. In small groups, students read the facts given, then solve the puzzle at the bottom of the page. Each group makes a summary of the problem, the possible cause, and possible solutions.

4. If time allows, each group trades puzzlers.

DAY TWO:

1. Each group presents its puzzler and the possible solutions.

2. Students read the corresponding "What Ecologists Discovered" and compare their ideas to the ecologists' ideas.

3. Discuss the precautions people need to consider before changing an ecosystem.

Evaluation:

Students write a paragraph summarizing possible consequences of human changes to ecosystems. Students should also summarize ways to avoid or resolve problems that arise from changes.

EXTENSION:

Research local forest issues. Students research local forest issues and present them to the class. Each problem should have a student-designed solution. Students submit their final solution to a local forest agency.

Credits:

Adapted from Western Regional Environmental Education Council, Project WILD and Project WILD Aquatic Education Activity Guides, 1992. *For information on Project* WILD, *contact the Project* WILD *Coordinator, Alaska Department of Fish & Game* (*Address*: 333 *Raspberry Rd, Anchorage*, AK 99518).

Curriculum Connections:

(See appendix for full citations)

Books:

Alaska's Forest Resources (Alaska Geographic Society)

Alaska Wildlife Notebook Series (ADF&G)

Ancient Ones, The World of the Old-Growth Douglas Fir (Bash)

Journey Through the Northern Rain Forest (Pandell)

My Side of the Mountain (George)

Shrinking Forests (Tesar)

Taiga (Sayre)

Websites:

Alaska Science Forum <www.gi.alaska.edu/ScienceForum>

Staff-written Alaska newspaper articles: Anchorage *Daily News* Archives <www.adnsearch.com> or Fairbanks *Daily News-Miner* <www.newsminer.com>

Teacher Resources:

(See appendix)

Forest Ecology Puzzler

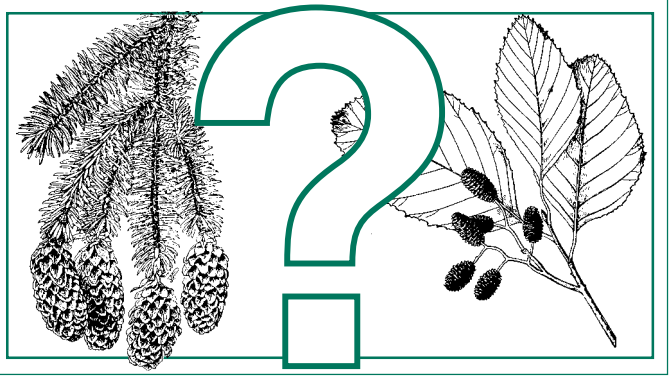
ALDERS AND CONIFERS

The Facts:

- Nitrogen is a mineral element needed by all living things, because it is a basic building block of the chemicals that form cells. Nitrogen is passed from the nonliving environment to plants and other **producers** and then through **food chains** and **food webs**.
- Most of the nitrogen available on earth is in a gas form in the atmosphere. In fact, 78% of the air we breathe is nitrogen.
- Plants cannot use nitrogen from the air; they must obtain it from the soil.
- **Symbiotic** fungi living in the roots of alders are able to take nitrogen from the air and change it to a form plants can use. The alders use this converted nitrogen to build alder leaves.
- When alder leaves are decayed by soil **detritivores**, the nitrogen in the leaves again becomes part of the soil and can be reused by alders or other plants. As a result, soil that is poor in nitrogen becomes enriched with nitrogen after several years of alder growth.

The Puzzler:

Forest researchers want to grow **conifer** trees more quickly. They know that conifers grow quickly if they have good supplies of minerals, sunlight, and water. They notice that slow-growing conifers are often shaded by faster-growing alders. So they decide to reduce the **competition** for sunlight by spraying some experimental sites with **herbicides** to kill alders without harming conifers. For a few years, all the conifers grow faster, but then, those growing on sites with less soil, begin to wither. What do you think caused these results?



Forest Ecology Puzzler

WOLVES, BEAVERS, AND SALMON

The Facts:

• In order to reproduce successfully, salmon require spawning grounds with gravel of a certain size, water with a particular temperature range and oxygen content, and aquatic **invertebrates** to feed their offspring. These conditions are only met in certain locations in a stream.

• Salmon must have clear access up streams in order to travel between the ocean and their spawning areas. Large waterfalls, log jams, or beaver dams can prevent salmon from reaching their spawning locations.

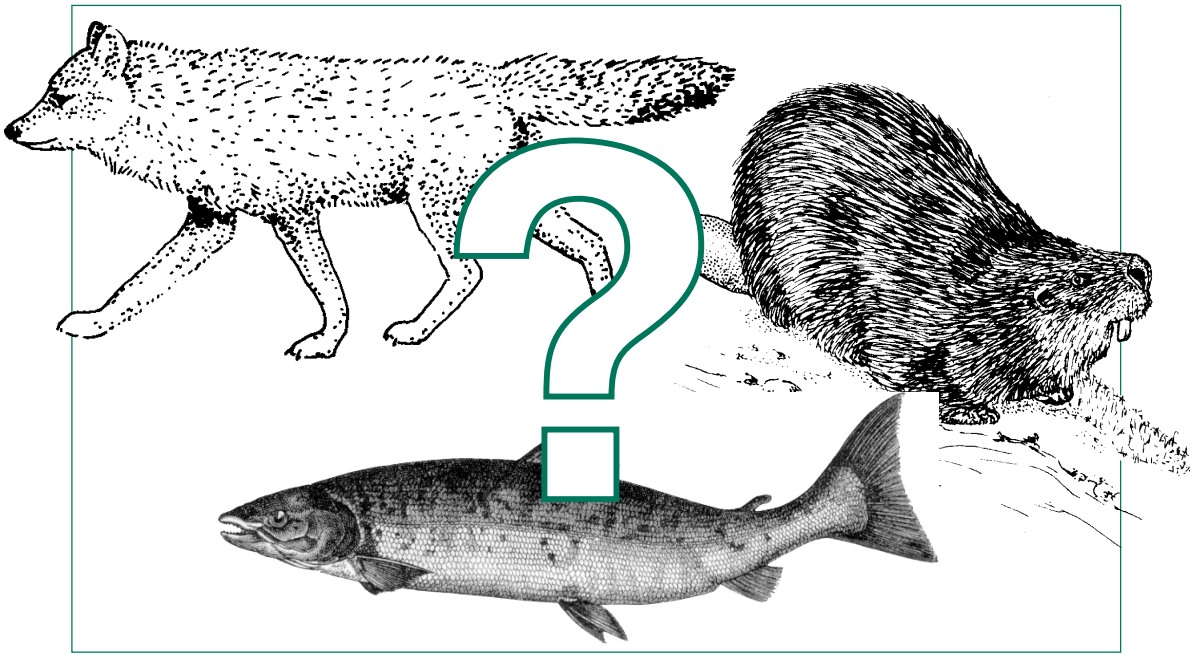
• Wolves prey on a variety of **herbivores**. In most areas, moose and caribou are their primary prey. But, when these prey are scarce, wolves switch to smaller prey such as spawned-out salmon, beaver, or muskrat.

• The **population** – number – is usually limited by a combination of factors, including **predators**, **parasites**, food supplies, and weather. The relative importance of these factors changes from year to year and place to place. For example, **predation** may be the most important factor limiting numbers in one place and time, while shortages of food may be the most important at another place and time.

The Puzzler:

In one part of Alaska several years ago, populations of deer were low and biologists wanted to do something to help the deer population. They determined that predation by wolves was an important factor limiting the deer population.

So, biologists put poison in some beaver carcasses and placed these as bait for the wolves. Because other prey were in short supply, the wolves readily fed on the carcasses and many died. With this reduction in wolf numbers, the deer population began to increase. A few years later, fisheries biologists were puzzled when salmon numbers dramatically decreased. What happened?



Forest Ecology Puzzler

FORESTS WITH ONLY ONE KIND OF TREE

The Facts:

• The numbers of insects feeding on the leaves or other tissues of trees normally goes up and down. In a natural forest, sometimes their numbers go way up. This is called a "**population explosion**." Such outbreaks are usually controlled by a combination of **predators**, **parasites**, food supplies, and weather.

• The numbers and kinds of animals living in a forest depend on the variety of habitats available. Generally, forests with many vegetation layers and a mixture of species of live and dead trees provide habitat for more kinds of animals.

• Just as some people do not become sick when a flu hits, some individual trees are better able to resist certain insect pests.

• The number of **carnivores** is always much smaller than the number of the **herbivores** they eat. Certain **pesticides** (such as DDT) are passed through food chains just like nutrients. Carnivores retain most of the pesticides stored in the bodies of all the **prey** they consume. As a result, carnivores accumulate higher doses of pesticides than do herbivores.

• Genetic variation in individuals in a population of insects or trees means that some individuals may be more resistant to a poison, disease, or parasite. This resistance is often passed to offspring.

The Puzzler:

In the past, when people wanted large, healthy trees suitable for timber harvest, they planted a forest of only the species desired. Foresters first selected a few individual trees that were tall, straight, fast-growing, and of high value for their wood. They collected seeds from these trees, cultivated seedlings, and planted a new forest. To reduce **competition** for sunlight and minerals , they removed other trees and shrubs.

The planted trees grew quickly at first, and it looked as though there would be plenty of timber to harvest when the trees were full-grown. Then one year, the forest was attacked by a mob of insects that ate the leaves of the trees. In some cases, nearly all the planted trees were attacked and began to die.

In order to save their forest, the owners sprayed DDT or other pesticides to kill the insects. This helped at first. The numbers of insect pests dropped, and the trees began to recover. Then, without warning, insect pest numbers rose higher than before. The pesticide used originally no longer worked. Most of the trees in the planted forest died.

Explain why the insect outbreak occurred, why nearly all the trees were killed, and why this would rarely happen in a natural forest.

Forest Ecology Puzzler

WHAT ECOLOGISTS DISCOVERED

Alders and Conifers

When the alders were killed, all the nitrogen in their leaves was returned to the soil. That recycled nitrogen and the nitrogen already present filled the needs of the conifers for a few years. With plenty of nitrogen and more sunlight, the conifers grew faster.

Eventually, those growing on sites with little soil took most of the nitrogen from the soil and stored it in their needles. Unable to use nitrogen from the air, and without alders and their **symbiotic** bacteria to enrich the soil, these conifers were unable to get the nitrogen they needed to grow. Indirectly, the conifers needed the alders, even though the alders competed with them for sunlight.

Wolves, Beavers, and Salmon

Without many large animals to eat, wolves turned to beavers for food. Soon there were fewer beavers. When the biologists poisoned the wolves, the beaver population grew. More beavers built more beaver dams and blocked fish passage to important spawning areas. Because salmon could not reach spawning areas, they could not reproduce. When the adults died, there were few young to replace them.

Forests With Only One Kind of Tree

Today, forest scientists know that the method of growing new trees described in the puzzler actually encourages outbreaks of insects and diseases that kill trees. Here's why.

With only a couple kinds of trees, all of the same age in this planted forest, only a few animals can find what they need to live. With fewer predators and parasites, insect populations are more likely to explode, given good weather and abundant food.

By planting tree seedlings from just a few selected trees, growers created a forest likely to get sick. If the trees were not immune, any insect or disease had an abundant, undefended, food supply. When weather conditions were right, the insect populations (no longer limited by food, predators, or parasites) exploded and overwhelmed the trees.

Spraying **pesticides** at first reduced the numbers of problem insects – and any natural predators and parasites present. If some of the insects survive, they're "resistant." They will pass on to their babies the ability to survive this kind of pesticide. Then that pesticide will no longer kill them.

The natural predators and parasites recover more slowly, if at all, because there were fewer of them before the pesticide was sprayed. Without natural controls, the next problem insect explosion occurs quickly. This explosion cannot be reduced with the same pesticide.