Jacquelyn Fallon

SECTION 2

Natural Systems

Subjects:
reading, biology

Approximate lesson time:
1 hour

Materials:
a set of evidence cards for each student or group of students

Ripple Effect?

Students draw a conclusion about the wolf's effect on its ecosystem by building a logical argument.

STUDENT OBJECTIVES:

At the end of this lesson, the student should be able to

1. Construct pieces of biological evidence into a logical sequence to build a defensible conclusion.
2. Infer the wolf's influence on biodiversity.

VOCABULARY:

biodiversity • ecosystem • scavenger • prey • predator • mesocarnivore

TEACHER BACKGROUND:

Most scientists agree that wolves constitute a major ecological force in ecosystems where they are present. Like any species, wolves influence other species and ecological processes. But does the presence of the wolf in an ecosystem have an effect on neotropical migratory songbirds? How can we know?

Research continues to be conducted on wolf behavior, prey selection, the influence of prey on ecosystems, and the correlations between and among all ecosystem components. While the primary impact of one species on another (wolves killing prey) is comparatively easy to measure, the domino effect of multiple species affecting each other over time in varying weather conditions makes identifying secondary and tertiary effects more difficult to measure and therefore less certain.

Proponents of wolf recovery often argue that wolves benefit their ecosystems. Science can establish that wolves have an impact, but the extent of the impact is largely unproven. In addition, the judgment of whether wolves constitute a positive or negative effect on the ecosystem is a purely human determination.

In this lesson, students are challenged to do the same synthesis work that scientists do. They will assemble scientific claims and evaluate whether a conclusion can be drawn. Before this activity it may be helpful to review with students how components of an ecosystem affect each other.

For example, various studies demonstrate the wolf's influence on prey, such as deer, moose and elk. Other studies measure the influence of deer, moose and elk on vegetation. Yet further studies identify the importance of vegetation for migratory songbird habitat. So, if more wolves mean fewer elk, and if fewer elk mean more vegetation, and more vegetation means more songbirds, then does more wolves mean more songbirds? What if the study on birds was conducted in a

Lynn and Donna Rogers /www.bearstudy.org

different ecosystem than the study on prey? In some cases, research findings may be transferable, but in other cases transferability is limited. Here, students must think like scientists and build a logical argument and identify flaws in logic.

To complete this activity, students will need to understand the concept of biodiversity. Please refer to the "Biodiversity Case Studies" activity on page 46 for further information.

This lesson also refers to the wolf's influence on a group of animals called "mesocarnivores." These are medium-size carnivores, including coyotes, marten, fishers, red foxes, river otters, lynx and others whose livelihood usually consists of small prey such as rabbits, hare, insects, mice and other rodents.

ACTIVITY:

1. Pose this question to students: "Wolves have a significant effect on their ecosystems. True or false?" Regardless of student answers, challenge students to defend what *significant* means. How can the wolf's impact be measured?
2. Arrive at some conclusion about what *significant effect* means. It should involve a total ecosystem perspective. For example, a significant effect could be that wolves cause obvious change at every trophic level. Or the students may choose a more subtle "wolves have a proven influence on at least 10 other ecosystem components."
3. Challenge students, either individually or in groups, to build a logical argument that defends this conclusion using the scientific evidence provided on pages 57–59. Students should arrange the evidence cards in a logical sequence that builds to the conclusion defined in number 2 above. Suggest that students look for sequences that establish the wolf's effect on prey, vegetation, scavengers, other large carnivores or mesocarnivores.

Discuss:

- From this information, can you prove that wolves have a significant effect on their ecosystems?
- What limitations are there given that most studies are done in different ecosystems: Minnesota, Yellowstone National Park, Isle Royale and other places?
- What new research is needed to fill in logic gaps?
- Which effects that a wolf has on the ecosystem can be considered "good," and which are "bad"?
- Compare and contrast the wolf's effects on the ecosystem with the effects humans have on the environment.

ASSESSMENT:

Students may turn in their logical sequences by transferring the ideas to paper or simply taping the evidence cards to a large piece of paper. Students should articulate why they believe their sequences make sense.

EXTENSIONS:

Another way to understand the evidence cards and demonstrate their relationship to each other is to create a concept map with the cards, arranging them graphically to demonstrate their relationships instead of being limited to linear sequences of cause and effect.

National Science Education Standards

Unifying Concepts and Processes

Systems, order, and organization

Evidence, models, and explanation

Change, constancy, and measurement

Evolution and equilibrium

Form and Function

Science as Inquiry

Abilities necessary to do scientific inquiry

Understanding about scientific inquiry

Life Science (5–8)

Structure and function in living systems

Population and ecosystems

Diversity and adaptations of organisms

For more correlations, please see Appendix IV.

EVIDENCE CARDS
(cut apart)

When wolves and coyotes are present in the same ecosystem, coyote numbers may be reduced or eliminated due to competition

(Mech 1966, Crabtree and Sheldon 1999).

Wolves have the following effects on the ecosystem: "sanitation effect" by culling of inferior prey individuals, control or limitation of prey numbers, stimulation of prey productivity, increase in food for scavengers, predation on non-prey species

(Mech 1970).

Deep snow conditions over three or more years restrict deer and moose mobility and food intake, thus reducing maternal nutrition. This results in decreased fawn and calf survival in successive years

(Mech, McRoberts et al. 1987).

Mesocarnivores such as coyotes, foxes and wolverines are considered ecologically important because they reduce and may limit some rodents/small mammals

(Buskirk 1999).

Ungulates increase biodiversity by reducing the influence of the dominant plants, thus increasing the diversity of other plants

(Boyce 1998).

When wolves are in the ecosystem, herds of prey tend to have individuals who are healthier because wolves usually kill the older or otherwise weaker individuals

(Mech 1966, Bubenik 1972, Schwartz et al. 1992).

When wolves are in the ecosystem, various prey species may demonstrate "antipredator behavior." They may seek forest cover, may avoid deep snow areas, may hide in terrain more treacherous for wolves

(Singer and Mach 1999).

Depending on the ecosystem, a variety of scavengers may feed on a wolf-killed carcass: brown bears, black bears, coyotes, cougars, red foxes, arctic foxes, lynx, bobcats, wolverines, golden eagles, bald eagles, turkey vultures, gray jays and 400 species of beetles

(various studies).

Historical evidence indicates that after wolves were removed from Yellowstone National Park, fewer new aspen trees began growth

(Ripple and Larson 2000).

As a result of food competition, wolves, bears and cougars sometimes kill each other, which may influence the number and social structure of these predators

(Palomares and Caro 1999).

In deep snow conditions on Isle Royale, moose are less mobile, less able to forage for food, and more vulnerable to wolves

(Peterson and Allen 1974).

When wolves reduce a prey population, they also reduce the total number of prey that would have died every year from other deaths (disease, starvation) and been available for scavengers.

EVIDENCE CARDS
(cut apart)

Wolves reduce coyote numbers
(Ballard et al., chapter 10, in Mech and Boitani 2004).

Ravens benefit from the presence of wolves in the ecosystem by scavenging on wolf kills
(Murie 1944, Mech 1966, Peterson 1977, Carbyn et al. 1993).

Prey live only on vegetation.

Ravens could consume up to 66 percent of the available food on a kill made by a lone wolf
(Promberger 1992).

Without wolves in the ecosystem, coyotes interfere (compete) more with red foxes
(Crabtree and Sheldon 1999, Singer and Mack 1999).

Fir constitutes 60 percent of a moose's diet in winter on Isle Royale
(McLaren and Peterson 1994).

Mesocarnivores probably cause a decrease in ground-nesting birds and other small vertebrates
(Terborgh et al. 1999).

The amount that a fir tree can grow is dependant on how heavily the moose feed on it
(McLaren and Peterson 1994).

Wolves provide a year-round supply of carcasses for scavengers to feed on.

Wolves probably promote scavenging birds: ravens, eagles, jays, chickadees etc.
(Stahler 2000).

Wolves promote scavenging insects, dung beetles etc.
(Sikes 1994).

Ungulates reduce biodiversity by feeding on or eliminating various types of low-growing vegetation
(Wagner 1994).

Brown bears easily take ownership of wolf-killed carcasses
(Murie 1944).

Reduced coyote numbers may lead to increases in the number of other mesocarnivore species
(Buskirk 1999).

When wolves have enough food, they may not interfere with scavengers who are eating from the same kill
(Peterson 1995).

EVIDENCE CARDS
(cut apart)

When wolves reduce prey numbers, then fewer prey remain for competing predators such as cougars, bears and coyotes.

Higher prey numbers lead to a bigger wolf population
(Fuller 1989).

Large predators such as cougars, bears and coyotes usually access a shared prey base, thus causing competition.

Good quantity and quality of vegetation bring more and healthier ungulates
(W. H. Mautz 1978).

When resources are restricted (e.g., not enough food), competition for limited resources is increased.

Deep snow prevents ungulates from getting a good quantity of good-quality vegetation
(Mautz 1978).

Wolves are an important predator on large mammals because they can change numbers of them drastically
(Mech and Karns 1977).

Wolves decrease prey numbers through predation. Those deaths might have occurred from starvation or disease if the wolf had not killed the deer.

Deer population decreases with a colder, deeper snow winter because they have a reduced ability to find food.

Aspen growth increased after wolf restoration in Yellowstone
(Ripple et al. 2001).

When species compete for resources, the individuals may change their habitat selection and travel patterns
(Connor and Bowers 1987).

Wolves living in packs can eat more meat faster than scavengers such as ravens can eat
(Vucetich et al. 2004).