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ABSTRACT

Is the topic of endangered species an add-on or enrichment content for your delivery of curriculum? As every teacher knows, it is easier to engage students if there is an interest. With the news reporting of climate change and its impact on living things, conservation of endangered species has become a familiar topic that can easily fit into many topics within the biology curriculum. This article provides background information, suggested curriculum approaches, and a list of resources to enhance your biology instruction. Examples from high school and college educators provide tested approaches to use in your classroom.

Key Words: *Endangered species; curriculum integration; biodiversity; ecology; environmental science.*

How does the conservation of endangered species fit into your biology curriculum? While it is a familiar topic to many students, there is a great opportunity to expand awareness at all grade levels. It has become especially timely, considering the frequent news coverage of climate change and increases in the number of endangered species worldwide.

Endangered-species conservation can be taught in many curricula, including the life sciences, general science, environmental science, ecology, and social science courses. Incorporating this vital subject is an opportunity for teachers to offer cross-disciplinary or interdisciplinary lessons in elementary and middle schools. At the high school and college level, endangered species provides students a chance to explore the interrelationships of science, technology, and society.

Endangered-species conservation can be taught throughout the year, although early spring is the traditional time when many teachers include it in their lesson plan. This also coincides with national Endangered Species Day (20 May 2011). Below, I provide biology teachers with some basic knowledge, a few classroom activities, and resource material to help enrich biology curricula.

○ The Basic Facts

Under the Endangered Species Act (ESA), species can be listed as either endangered or threatened. Currently, 1200 species are so

designated by the U.S. Fish and Wildlife Service (FWS). “Endangered” means that a species is in danger of extinction throughout all or a significant portion of its range. “Threatened” species are those likely to become endangered within the “foreseeable future.” All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened. “For the purposes of the Endangered Species Act, Congress defined species to include subspecies, varieties, and, for vertebrates, distinct population segments” (FWS).

○ Causes

While species naturally go extinct at a steady rate, human actions have greatly increased the rate of extinction. In 2004, the International Union for the Conservation of Nature (IUCN) estimated that extinction rates increased by 100–1,000 times since humans first appeared. Renowned Harvard biologist E.O. Wilson now estimates that the rate will reach 10,000 times higher than background extinction by 2030. Scientists call this the “sixth great wave” of extinction—the greatest die-off of species since the dinosaurs. Recent, likely species extinctions in the wild are: the Yangtze River dolphin, Hawaiian crow, Western black rhino, Scimitar-horned oryx and Spix’s macaw. A number of human activities lead to extinction.

Plant and animal species become threatened or endangered for one of several primary reasons:

- **Habitat destruction.** Loss of habitat to commercial development and natural resource extraction, as well as flooding, fire, and other natural causes, has been a major reason. More recently, global warming has had a significant impact on habitat loss.
- **Commercial exploitation.** Many species have become endangered because of overfishing and hunting.
- **Poisoning.** Pesticide and herbicide chemicals often take a long time to degrade, and build up in the soils or throughout the food chain. Some groups of animals such as amphibians are especially vulnerable to these chemical pollutants. In addition, predators such as hawks, owls, and coyotes can be harmed if they eat poisoned animals.

How does the conservation of endangered species fit into your biology curriculum?

- *Introduced species.* The spread of non-native species has greatly affected native populations around the world. Invasive species compete with native species for resources and habitat. They can even prey on native species directly, forcing native species toward extinction.

○ Why Should Students Learn about This Topic?

The problem of endangered species is significant for many reasons. Students should be aware of the following:

- *Ecological importance.* Healthy ecosystems depend on plant and animal species as their foundations. When a species becomes endangered, it is a sign that the ecosystem is slowly falling apart.
- *Medical value.* More than 50% of the 150 most prescribed medicines were originally derived from a plant or other natural product. Only about 5% of known plant species have been tested for medicinal uses, and there are thousands of plant species that have yet to be identified.
- *Agricultural significance.* Farmers are often viewed as the original conservationists. Many farmers set aside portions of their land as wildlife habitat and also work in partnership with groups such as Trout Unlimited to restore river and stream habitats for endangered and threatened fish and reptiles. Preserving biodiversity and functioning ecosystems is essential in protecting the health of our country's pollinators, without which we would be unable to maintain our abundant crops.
- *Aesthetic and recreational concerns.* The multibillion-dollar, job-intensive American tourism industry is dependent on plant and animal species and their ecosystems. Every year, millions of people visit natural areas in the United States and participate in wildlife-related activities. The conservation of our nation's biological diversity is an extremely important facet of the travel industry's well-being.

○ Local Examples

Students generally have a greater appreciation of this topic if they can relate it to their local area. While teaching at Emmaus High School in Emmaus, Pennsylvania, I used the state Department of Conservation and Natural Resources website as a source to find a list of Pennsylvania endangered species.

"I want students to know about the species in their own backyard," said Dave Cox, a biology teacher at Land Community College in Springfield, Illinois. "They develop a good appreciation when there is a focus on species with which they are familiar."

You can obtain information regarding local threatened and endangered species from your museum, zoo, library, or Sierra Club chapter, and by checking with FWS's endangered species listing (<http://www.fws.gov>).

○ Recovery Success Stories

It is also important to emphasize the "good news," the success stories of the ESA and species recovery. Between its passage in 1973 and 2004, the ESA has kept an estimated 227 species from potentially going extinct. Of the approximately 1800 species ever listed under the Act, only nine have been declared extinct – a 99% save rate. Here are four good examples of species recovery:

- *Bald eagle:* The bald eagle was once on the brink of extinction as a result of habitat loss and the use of pesticides such as DDT. In 1963, there were less than 500 breeding pairs in the lower 48 states. The bald eagle recovered very well in the years following the ban on domestic use of DDT in 1972. Nevertheless, it was listed as endangered in 1976. Since that time, the eagle has benefited greatly from that protection and was reclassified from endangered to threatened in 1995. It has since recovered sufficiently that it was delisted entirely on 28 June 2007.
- *Peregrine falcon:* Once listed as endangered, the peregrine falcon population has increased in response to reintroduction and habitat protection, as well as the elimination of other threats such as pesticide use. There are currently an estimated 1650 breeding pairs in North America. The peregrine falcon is found on every continent except Antarctica and lives in a variety of habitats.
- *Sea turtles:* All seven species of marine sea turtles are listed as either threatened or endangered, in part because of the enormous level of capture by shrimp trawlers in the Gulf of Mexico and the Atlantic Ocean. Through the enactment of regulations to protect sea turtles, including the protection of nesting beaches and mandatory installation of turtle-excluder devices on shrimp boats, there has been a steady increase in annual nest counts of most species.
- *Southern sea otter:* Recognized as an umbrella species for the conservation of California's near-shore coastal ecosystem, the southern sea otter was listed as threatened under the ESA in 1977. Its population had once numbered over a million, but it had been hunted to near extinction by the fur trade. Since the listing, sea otter numbers have greatly increased. Although it is considered one of the best marine conservation success stories, the otter remains listed as threatened because some of its population numbers have plateaued or declined. There are now about 2800 otters on the California Coast.

○ How All of Us Can Help

There are several ways that individuals can assist in species recovery:

- *Learn more about endangered species.* The first step to protecting endangered species is learning about how interesting and important they are. Teach your friends and family about the wonderful wildlife, birds, fish, and plants that live near you. For more information, visit <http://www.stopextinction.org>.
- *Assist with habitat restoration.* Each year, Endangered Species Day events include habitat restorations. Check <http://www.endangeredspeciesday.org> for an event near you. Also, check with your local Sierra Club (<http://www.sierraclub.org/chapters/>) and Audubon chapters (<http://www.audubon.org>) or other organizations to see if they have such an activity planned.
- *Minimize the use of herbicides and pesticides on crops and home gardens.* For alternatives to pesticides, visit <http://www.beyondpesticides.org>.
- *Develop a backyard wildlife habitat.* Provide habitat for wildlife by planting native vegetation in your yard. Native plants provide food and shelter for native wildlife; see the National Wildlife Federation's Garden for Wildlife program at <http://www.nwf.org/in-your-backyard>. Attracting native insects like bees and butterflies can help pollinate your plants; see the Pollinator Partnership's planting guides for your region: <http://www.pollinator.org/guides.htm>. Find details about native plants at <http://www.plantsocieties.org>.

- *Avoid purchasing products made from threatened and endangered species.* Often sold as souvenirs or gifts; these include jewelry and ornamental items made from tortoise shell, ivory, and coral.

○ Class Activities

There are a variety of activities to complement your class instruction on endangered species, including the following:

- *Class speaker.* Invite a biologist or naturalist from your state department of natural resources/fish and wildlife service, extension service, local zoo, natural history museum, or Sierra Club/Audubon chapter to speak about endangered species and their habitats.
- *Zoo, aquarium, wildlife refuge visit.* You could arrange a “behind the scenes” tour of endangered/threatened species exhibits. For a list of zoos and aquariums, see the Association of Zoos and Aquariums website (<http://www.aza.org>).
- *Student presentations.* In addition to writing essays about local threatened/endangered species, students can prepare and give oral presentations. Hold a class discussion about how a local site that is home to a native species is being threatened by a development. Steve Baier, an environmental science teacher in Emmaus High School, involves his students in the production of i-movies about endangered species, with the focus on the importance of biodiversity.
- *Class lab.* Dave Cox has developed an effective exercise for his biology students. “I ask them to visit the Illinois Department of Natural Resources and select two endangered species to research, including their life history and reproductive strategy” he explained. “Then they suggest a conservation plan to help rebuild their endangered species’ population.”
- *Participate in Endangered Species Day.* Every year there are hundreds of events throughout the country. You can develop one of the above or other activities during the week of Endangered Species Day or use the curriculum materials on the Endangered Species Day website. In addition, there is a nationwide Endangered Species Day Art Contest in which K–12 students can participate (see <http://www.endangeredspeciesday.org>).

○ Format Options

Look at your curriculum through the lens of endangered-species conservation. There are a variety of ways you can teach this subject:

- *Within lessons throughout the year.* Endangered species can be examples in a single lesson. For instance, you can use the wording in the ESA during your classification lessons to assess students’ understanding of the concept. It’s wise to think beyond the ecology unit. Keith Butler, a biology teacher in Emmaus High School, uses examples of endangered species as he finishes his evolution unit. “Talking about endangered species within the context of evolution provides students with the opportunity to apply what they have learned about changes in species over time” he explained. In your Genetics Unit, you can use examples of threatened species to help

students understand the gene pool, the importance of diversity, and population genetics. In the molecular genetics unit, you can highlight some of the examples of the successful use of biotechnology to increase the populations of endangered species.

- *One-day discussion:* The conservation of endangered species is certainly a broad topic to cover in one class, so you might want to concentrate on a specific area, such as the value of species diversity. Generate a class discussion about the importance of helping to restore endangered species and what steps students can take to help. (See previous suggestions.) This lesson could be given on Endangered Species Day.
- *Multiple-day:* Expanding the discussion to several days will enable you to incorporate a series of related topics, including ecosystems and local habitats. You could focus on a single or multiple species. Also include how economics, legal issues, and the environment have played a role in the problem and solutions. “I include a thread of the endangered species topic throughout the semester in my biology courses, with a special emphasis in the genetics, evolution and ecology units,” said Cox.

○ Resource Material

To complement the resource material that you already have, check with these organizations:

- Fish and Wildlife Service (<http://www.fws.gov>): Background information, glossary, poster, and endangered species coloring books are a few of the available materials.
- Endangered Species Coalition (<http://www.stopextinction.org>): The ESC provides background information and extensive support materials (and also sponsors Endangered Species Day).
- Defenders of Wildlife (<http://www.defenders.org>): This organization works to protect endangered species such as the wolf, and offers publications and material aimed at young people and teachers.
- The International Union for Conservation of Nature (<http://www.iucn.org>): The IUCN is the international body that classifies species as endangered, producing a “red list” of endangered species throughout the world.

○ Conclusion

Incorporating endangered-species conservation in your curriculum will definitely enhance your instruction in biology and other science courses. The long-term survival of endangered species depends largely on actions taken by students – and their teachers.

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