2002 Current Issue:
Introduced Species and Their Effect on Biodiversity

Ecosystems are dynamic structures characterized by natural fluctuations in population, immigration and emigration of organisms, extinction, and evolution of a species. While change is a constant, rapid change can make a system more fragile and less resilient. One human activity that can place strains on an ecosystem is the introduction of new species. Many ecologists believe that the spread of introduced or exotic species is one of the most serious, yet least appreciated threats to biodiversity. Across North America, bacteria, plants, insects or other members of the animal kingdom have been purposely or inadvertently transplanted (often, but not always, by humans) to an area where they have not previously been living.

Humans intentionally introduce species to new regions in a number of ways and for a variety of reasons. Certain wildlife species were introduced to provide for recreational fishing and hunting opportunities. Others were introduced as predators to control species that people perceived as causing a human or biological problem. Some plants were introduced for their food value or because their vigorous growth habits assisted in controlling soil erosion and windbreaks. On this continent, some organisms were introduced because people wanted a physical reminder of the homes they left. In some cases, species have been re-introduced into areas where they were historically present in the ecosystem but for a variety of reasons were extirpated. Examples include the bald eagle, beaver, peregrine falcon, and more recently, wolves in Yellowstone National Park.

Some introductions were accidental. The Norway rat is a famous example of an old-world stowaway on ships bound for America. Gypsy moths escaped from research laboratories. The chestnut blight fungus, and now the Asian longhorn beetle, was transported on plant material shipped from another continent. Some scientists postulate that some species of birds have moved from one region to another due to the presence of backyard bird feeding stations. All these introductions affected the biodiversity of the region in which they occurred.

"Biodiversity" is a key idea in the consideration of the effects of introduced species. The term refers to *the variety of all living things*. Scientists measure biodiversity in several ways: (1) the numbers of species, (2) the genetic differences among living things, (3) the variety of natural communities and ecosystems in which living things occur, and (4) the ecological processes that sustain living things and keep them ever-changing and adapting. As a general rule, the more biodiverse an ecosystem is, the healthier it is. Less diverse ecosystems are more fragile and less resilient in the face of threats like the introduction of new species.

In some cases, the introduction of a species has resulted in profound effects on a North American ecosystem. These effects often happen when the introduced organisms leave behind the factors limiting their effects in their native areas (immunities, diseases, and natural predators) or when they possess advantages in new territories that may crowd out or even kill native organisms that fill important roles in the ecosystem. Such species are termed "invasive" and "aggressive" because their presence disrupts the native processes, populations, and variety of species that have been operating with certain checks and balances, creating a sustainable system. One example of an invasive species first noticed in the Great Lakes region, and now

traveling throughout other connecting water systems by way of boats**,** is the zebra mussel. It grows so prolifically that it changes the habitat and native mollusks are literally crowded out. This bio-invasive "hitchhiker" has caused problems for people and ecosystems, carpeting swimming beaches with millions of small mussels and clogging water intake pipes of electrical utilities**.** In some cases, the zebra mussels have shut down power plants.

In other cases it appears that the introduction of new species has little or no negative effect on the environment in which they were introduced, as far as humans are concerned. The European honeybee is one of the most valuable introduced species in North America; many crops and flowers are dependent on this species. The nightcrawler was an unintentional but apparently harmless introduction. In urban areas, introduced plants and trees are sometimes the best adapted for life in compacted soils and lower air quality while "native" species would suffer and die. Food crops also offer many examples of benign introductions from the human perspective. One debate expected to intensify in the near future concerns the environmental effects of genetically modified "bio-engineered" organisms.

Historically, there have been a variety of efforts to control "invasive" species, in some cases by introducing predator species. In other cases, species eradication methods have been used on a site-by-site basis. Most efforts have met with mixed success at best, and in some cases have caused worse problems for the area's biodiversity.

What is our responsibility with regard to introduced species, from ecological and natural resource stewardship perspectives? When do we need to intervene, and when can we let the situation take its own course? What management strategies can successfully protect the ecosystem? What precautions should we take? How do we set priorities on managing introduced species? Who sets these priorities, and how are different public interests involved in decisions? What are the acceptable costs of action or inaction? These are all questions to be considered while students are learning about this topic.

The 2002 Envirothon current issue background resources offer case studies of introduced species from across the continent to serve as a springboard for Envirothon teams as they begin their exploration of this topic and how it relates to their own community, state, province or country. Consideration of this topic must begin with a scientific understanding of what we know and do not know about the ecological characteristics and potential effects of the individual species in question. The topic also provides an opportunity to learn about the differing attitudes and points of view toward introduced species and their management. There will be many opportunities to tie this topic to natural resource management questions in forestry, wildlife, soils, and aquatic ecosystems. A variety of government agencies and non-governmental organizations across the continent are working on this topic at the international, federal, state/provincial, and local levels.

2002 Current Issue
Available Teaching Resources

A variety of organizations can offer helpful information and perspectives on this topic, including:

Conservation Districts

State/Provincial Natural Resource Departments

US. Fish & Wildlife Service

The Nature Conservancy

World Wildlife Fund

Project WILD, Project Learning Tree, Project WET (Educational Resources)

US Dept of Agriculture

National Oceanic & Atmospheric Administration (NOAA)

US Forest Service

Farm Service Area

Geological Survey (USGS)

Office of Surface Mining Reclamation and Enforcement (OSM)

National Park Service

Bureau of Land Management

Environmental Protection Agency

State Garden Club Groups

Nurserymen's Association

Ranching Groups

IUCN—now known as the World Conservation Union www.invasives.org