

7 Decision Making: ECOLOGICAL RISK, WILDFIRES, AND NATURAL HAZARDS

Subjects

Biology, Communications, Earth Sciences, Ecology, Economics, Environmental Science, Geography, Language Arts, Math, Social Studies

Concepts

- ▶ Human-built environments, if planned, constructed, and landscaped to be compatible with the environment in which they will be located, can conserve resources, enhance environmental quality, and promote the comfort and well-being of those who will live within them. (11.3)
- ▶ Although species become extinct naturally, the increasing number of extinctions in recent history may be linked to the rapid increase in human population. (13.2)
- ▶ Ecosystems change over time through patterns of growth and succession. They are also affected by other phenomena such as disease, insects, fire, weather, and human intervention. (13.4)
- ▶ Leisure and recreational pursuits can have an impact on forests and other resource-producing areas. (15.4)

Skills

Analyzing, Calculating, Comparing and Contrasting, Decision Making, Establishing Criteria, Organizing Information, Problem Solving

Objectives

Students will (1) develop an understanding of ecological risk, (2) apply various decision-making methods to environmental risk reduction options, and (3) try making decisions under conditions of uncertainty.

Materials

Copies of the Student Pages "Coral Reefs and Mangrove Swamps," "Coral Reef Case Study: Part I," "Coral Reef Case Study: Part II," "Sample List of Endangered and Threatened Species," "Aerial Map," "Wildfire Events," "Wildfire Decision Tree," "Wildfire Decision Matrix," "Map of the United States," "Natural Hazards," "Location Option Details," and "Natural Hazard References" on pages 104–108 and 110–124. Option: Copies of the Student Page "Wildland/Urban Interface Fire Safety Checklist" on page 109.

Time Considerations

Preparation: 30 minutes

Activity:

Part A—two 50-minute class periods, plus outside research

Part B—two 50-minute class periods

Part C—two 50-minute class periods

Overview

In this activity students will develop and apply decision-making skills to various environmental risk scenarios including wildland fires, natural hazards, and threats to coral reefs and mangrove swamps.

Background

SETTING PRIORITIES

We can all relate to this saying, "So much to do, so little time." In addition to time, other resources such as money and technology are often factors that force us to choose which things we can do now and which things we put aside for later.

We also use personal values to make decisions about how to set priorities for our responsibilities, as well as how to address them.



The need to create a list of priorities for our responsibilities also applies to agencies that manage environmental problems and set environmental policy. All levels of government (federal, state, local) face an ever-growing number of environmental issues, from cleaning up toxic waste sites to preventing habitat destruction, from improving water and air quality to preserving the stratospheric ozone layer. How do the responsible parties decide where to allocate their limited resources so they can reduce those risks? What values will help answer those questions, and whose values should be used?

Increasingly, government agencies are turning toward risk assessments to help make decisions regarding threats to the environment and human health (Reichhardt 1996, B). In 1987, the U.S. Environmental Protection Agency (U.S. EPA) issued a report, *Unfinished Business: A Comparative Assessment of Environmental Problems*, that indicated that the U.S. EPA's priorities were more aligned with public perception than with expert opinion regarding the most pressing environmental risks (U.S. EPA 1987, C). This report was one of the initial steps taken by the U.S. EPA to refocus its resources to address environmental problems while using scientific data concerning risk.

So how do we determine which risks are the most serious? One solution has been to rank risks according to the results of their risk assessment. **Comparative risk assessment** is a method that is used to help agencies set priorities for the many issues that require their attention. Applying this technique involves evaluating two or more risks simultaneously, examining the

Part A

CORAL REEFS AND MANGROVE SWAMPS

results, and deciding whether the effort devoted to each risk should be changed. Although this process helps to organize the issues, challenges to the use of risk-based priority setting include the following arguments:

- ▶ There may be too much uncertainty in the estimates from risk assessments to reliably make a judgment regarding the relative impact of two or more risks.
- ▶ A quantitative risk analysis alone cannot encompass the social, political, or perceptual factors that are part of environmental risks.
- ▶ Ranking risks is not necessarily the most effective solution for deciding priorities.

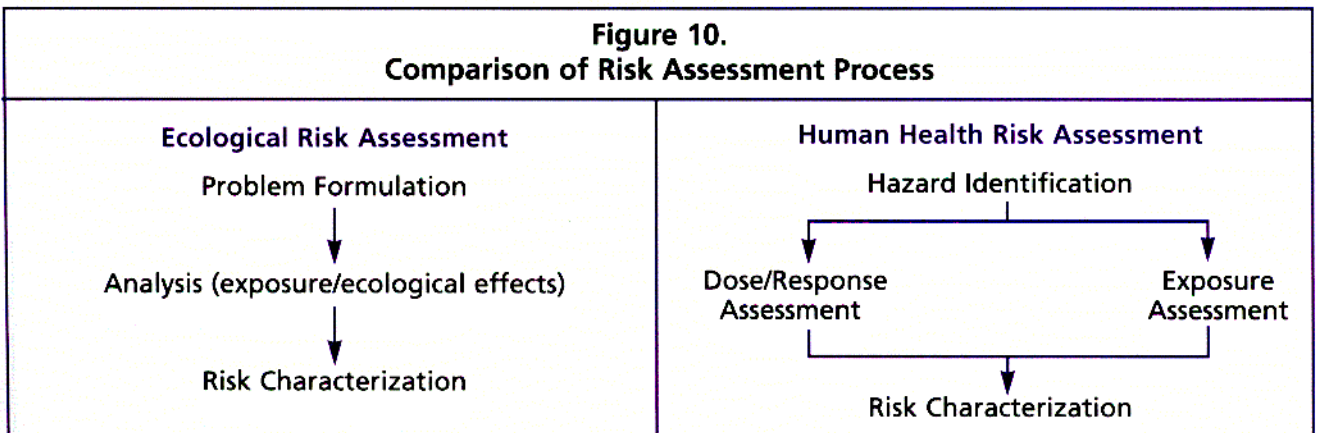
MAKING DECISIONS

Making decisions is an essential part of managing risks. A key part of making decisions is the ability to think critically about the issues at hand. Critical thinking is a skill that can be developed through decision analysis exercises that use techniques such as decision trees. Decision analysis exercises provide a framework for identifying and organizing the issues, understanding uncertainties, and recognizing trade-offs. This activity provides students with an opportunity to analyze three different risk scenarios with the goal of making a decision about how to manage each risk. The scenarios include the degradation of an ecosystem, the risk of wildfires, and the occurrence of natural hazards.

Ecological risk assessment is a measure of the nature, magnitude, and probability of harm to systems of living things (it does not include humans). Although the ecological risk assessment process is similar to the **human health risk assessment** process (see Figure 10), they differ in three ways:

1. In ecological risk assessments, the effects of a stressor are not limited to a single species (such as humans) but may have an impact on a population, community, or ecosystem.
2. The ecological risk that the assessment endpoints address may be one or more potentially affected resources (such as ecological processes and animal populations as opposed to only human health).
3. The interaction of chemical and nonchemical factors (for example, a toxin and habitat loss) is considered in ecological risk assessment (International Environmental Technology Centre 1996, C; U.S. EPA Office of Research and Development 1998, E).

Figure 10.
Comparison of Risk Assessment Process



Recognizing the need to focus on ecological risk issues as well as on human health issues, the U.S. EPA initiated efforts in 1991 to develop ecological risk assessment guidelines (U.S. EPA 1991, C). In 1997, the U.S. EPA Office of Research and Development identified ecological risk assessment as one of its top six research priorities (U.S. EPA 1997b, C). However, finding solutions that reduce risks to ecological resources need not be the sole responsibility of government agencies or special interest organizations. The general public can help reduce ecological risks, but we are often not aware of the existence or significance of ecological risks, especially when faced simultaneously with public health risks. This part of the activity introduces students to two ecosystems at risk and challenges the students to analyze the situation and make a management decision.

GETTING READY

Review and make copies of the Student Pages "Coral Reefs and Mangrove Swamps," "Coral Reef Case Study: Part I," and "Coral Reef Case Study: Part II" for each member of the class.

DOING THE ACTIVITY

1. Ask students to offer definitions of **ecological risk** and visually record their responses. Explain to the class that while we are constantly exposed to hazards, other species (such as tigers, right whales, panda bears, manatees, and African elephants) and ecosystems (such as tropical rain forests, coastal regions, and wetlands) also face various risks.
2. Ask students what they think are some of the risks and sources of risk that other species and natural resources face? (Possible risks include extinction, reduced biodiversity, reduced productivity, and so forth. Possible sources of risk include overfishing or overhunting, dumping of hazardous wastes, certain tourist activities, natural hazards, and so forth. See box for more examples.)

Examples of Ecological Risks:

Species extinction and overall loss of biodiversity
Reduced sustainability
Reduced reproductive ability

Examples of Sources of Ecological Risks:

Stratospheric ozone depletion
Habitat alteration and destruction
Global climate change
Improper use of herbicides/pesticides
Toxins, nutrients, biological oxygen demand, and turbidity in surface waters
Acid rain and acid runoff to surface waters
Airborne toxins
Oil spills
Groundwater pollution
Radioactive decay

3. Distribute the Student Page "Coral Reefs and Mangrove Swamps." Have students read the information either in class or for homework. If time permits, encourage students to conduct outside research to supplement the given information.
4. Next, show an overhead of the Student Page "Coral Reef Case Study: Part I." As a class, read through the paragraph and have students discuss the following (see answers that follow):
 - a. Identify the risks to the ecosystem.
 - b. Identify the sources of the risks.
 - c. Identify the parties who would be interested in a risk management plan.

Answers to "Coral Reef Case Study"

- a. Reef destruction and fish harvesting
- b. Reef-destroying fishing practices such as blast fishing
- c. Villagers, government officials, commercial users, nongovernmental organizations