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Ecosystems and Ecosystem Management

Joe Bonnell

School of Environment and Natural Resources

We are all dependent on ecosystems for environmental, social, and economic well-being. From the water we drink and the food we eat, to the air we breathe, all of the essential things humans need to live are in some way products of these ecosystems. Humans are an integral part of the ecosystems in which they live and virtually all human activities will impact the quality and kinds of services ecosystems can provide us.

The purpose of this fact sheet is to help readers gain a better understanding of ecosystems and ecosystem management so they will be able to participate effectively in efforts aimed at conserving and restoring ecosystem services. A reference list is provided at the end of this fact sheet for those seeking more in-depth information on various related topics.

What is an ecosystem?

The word ecosystem is made up of the prefix “eco-,” which refers to all living things (plants, animals, bacteria, fungi) and the physical environment (air, soil and water) in which they are found; and “system,” which refers to the interactions between the living and non-living components of the environment. The term “ecosystem,” therefore, refers not only to the living and non-living components found within a particular geographic area, but also the interactions that occur between those components.

For example, a pond is a relatively small but common ecosystem made up of the water, mud, plants, insects, fish, and all the other living and non-living things found in the pond. The pond ecosystem also consists of the interactions between all of these living and non-living

components. For example, algae provide nutrients and oxygen for insects and small fish. In turn, the insects and small fish may provide nutrients for larger fish, birds, and frogs. When the plants and animals die, they become part of the non-living component of the pond and feed certain kinds of insects and bacteria that live in the mud. Anything that enters the pond, such as sunlight, rain, or contaminants, becomes part of the pond ecosystem and can affect the organisms in the pond and how they interact.

Ecosystem types

There are many approaches to defining and classifying ecosystems. In general, however, ecosystems are defined based on the dominant plants, animals, land forms, and climatic conditions found within a particular geographic area. A desert ecosystem may be characterized by sparse succulent vegetation, sandy soils, and very little yearly rainfall. Wetland ecosystems, on the other hand, are low-lying areas that are frequently flooded with shallow waters and populated with hydrophytic (water-loving) plants. Types of ecosystems commonly found in Ohio include wetlands, deciduous forests, rivers, and lakes.

Some of the more rare and endangered ecosystems in Ohio have been designated as natural areas and are managed by the Ohio Department of Natural Resources and local park districts. These protected ecosystems include prairies (e.g., Bigelow Cemetery in Madison County), bogs (e.g., Cranberry Bog at Buckeye Lake), oak savanna (e.g., Oak Openings near Toledo), and freshwater estuaries (e.g., Old Woman Creek in Erie County).

Ecosystem boundaries

Where does one ecosystem end and another one begin? Ecosystem boundaries are not always clearly defined. In areas where two ecosystems meet, there may be a large area of transition called an ecotone, where physical and biological elements from both ecosystem types can be found. To further complicate matters, ecosystem boundaries tend to change over time due to natural impacts (e.g., floods, fire, changing climatic conditions, disease) and human impacts (e.g., urbanization, mining, agriculture) that alter the physical landscape and types and numbers of plants and animals that live in a particular location.

How one defines an ecosystem's boundary also depends on the geographic scale of concern. Ecosystems can be defined very specifically on a local scale (e.g., Cranberry Bog at Buckeye Lake) or more generally and on a much broader scale (e.g., northern deciduous forest) covering several million acres. Smaller ecosystems may be "nested" or geographically located within the boundaries of much larger ecosystems. For example, Clifton Gorge is a 268-acre preserve nested within the 1,757-square-mile Little Miami River watershed. In summary, determining where one ecosystem begins and another ends will depend not only on the physical and biological components of the landscape but also on the time frame and geographic scale of concern to the observer.

Why be concerned about ecosystems?

Like all organisms, humans are an integral part of the ecosystems in which they live and are dependent on ecosystems for survival. But far beyond the basic needs of water, air, and food, ecosystems provide Ohioans with many other essential goods and services (see Table 1). The quality and quantity of benefits that we derive from the environment depends to a large extent on the quality and quantity of Ohio's ecosystems.

Human impacts on ecosystems

Few, if any, ecosystems remain unaltered by human activities. In some cases, ecosystems are modified to enhance the production of a particular resource, as when forests are managed for timber or when a lake is stocked with game fish to improve recreational opportunities. In extreme cases, entire ecosystems are replaced with human-created systems such as housing developments, farmland, or golf courses. In Ohio, an estimated 85% of the state's pre-settlement forest cover had been cleared

Table 1. Categories and examples of ecosystem products and services

Economic	<ul style="list-style-type: none"> • Wood for construction and paper products • Reduce downstream flooding and related property damage • Unique and protected ecosystems attract tourism • Natural food products (e.g. herbs, mushrooms, nuts)
Health	<ul style="list-style-type: none"> • Filter toxic chemicals from air and water • Reduce summer temperatures in urban areas • Provide recreational opportunities
Cultural	<ul style="list-style-type: none"> • Preserve natural heritage • Serve as natural laboratories for research and education
Biological	<ul style="list-style-type: none"> • Refuge for wildlife and endangered species of plants and animals • Maintain overall diversity of plant and animal life • Recycle organic matter and nutrients otherwise lost through erosion

by 1939. Over 90% of Ohio's wetlands have been filled in or drained and only a few patches remain of the original prairie ecosystems. Table 2 presents examples of human activities affecting ecosystems.

While the activities listed in Table 2 emphasize ways in which humans *disrupt* ecosystem function, humans can also take steps to restore ecosystems that have been greatly modified by human activities. The challenge for everyone involved is to find creative ways to protect and restore Ohio's remaining ecosystems while accommodating and even enhancing the state's social and economic well-being. One approach to resolving conflicts between ecosystem protection and other societal goals is called ecosystem management.

What is ecosystem management?

Traditional approaches to natural resource management emphasized humans' ability to control natural processes, maximize production and extraction of renewable resources (e.g., timber and wildlife), or protect human populations from the hazards of natural disasters such as floods and droughts. These management strategies were often pursued without much concern for the long-term impacts on natural systems. However, once

Urbanization	<ul style="list-style-type: none"> • Clearing forests for homes and businesses • Road building • Creating landfills • Release of toxic chemicals from homes, businesses, and cars
Hydrologic alteration	<ul style="list-style-type: none"> • Draining wetlands for other land uses • Damming rivers for water storage and flood prevention • Straightening stream channels
Recreation	<ul style="list-style-type: none"> • Constructing roads and trails through natural areas • Stocking lakes and rivers with game fish • Eliminating predators to enhance populations of game animals
Agriculture	<ul style="list-style-type: none"> • Adding nutrients and pesticides to the soil • Clearing forests to create pasture and rangeland • Timber harvesting
Mining	<ul style="list-style-type: none"> • Oil and gas drilling • Surface mining for coal
Introduction of exotic species	<ul style="list-style-type: none"> • Accidental: e.g., Zebra Mussel, Purple Loosestrife, Emerald Ash Borer • Intentional: e.g., Multiflora Rose, European Starling, Japanese Honeysuckle

resource managers began to pursue a broader set of goals for natural resource management, such as biological diversity, their efforts were often met with resistance from those who felt their use and enjoyment of their natural heritage was being threatened.

The ecosystem approach to resource management incorporates an understanding of the interrelatedness of all living things, including humans, with their surrounding environment. In general, the purpose of ecosystem management is to restore and protect the health of ecosystems over the long term while accounting for the variety of social and economic benefits derived from those ecosystems. Ecosystem management is not a single strategy but rather a general approach to resource management that emphasizes cooperative decision-making combined with a broad perspective and understanding

of the ecosystem. Ecosystem management is a relatively new concept but some common strategies associated with this approach have emerged. These common strategies of education and collaborative management are discussed below.

Education

Education is both an end and a means to an end in ecosystem management. Resource managers and landowners alike must learn as much as possible about how ecosystems function and how human activities affect and are affected by ecological, economic, social, and cultural factors in order to make informed decisions about alternative management strategies. On the other hand, much can be learned about the effectiveness of different management strategies after they have been implemented.

Education programs are often aimed at promoting landowner adoption of so-called “best management practices.” Best management practices (BMPs) are actions that minimize the impact of human activities on the environment. For example, grassed waterways convey surface runoff during storms while anchoring the soil, thus reducing the amount of sediment entering streams. For nearly every human activity that can potentially impact the surrounding ecosystem, there are corresponding BMPs to help minimize impacts. Best management practices can be effective in controlling some forms of degradation to the ecosystem but they form only one part of the entire ecosystem management picture.

Collaborative management

Perhaps the most important innovation in ecosystem management versus traditional resource management is the central role of collaborative management. Resource management agencies, private landowners, government officials, non-profit organizations, businesses, and the general public are all potential partners in ecosystem management projects. Proponents of ecosystem management recognize that different groups and individuals can value the same ecosystem for different reasons. For example, a single patch of forest may be valued by hunters, loggers, hikers, and ecologists, all for different reasons. These different values are sometimes incompatible and can lead to conflicts over what constitutes the best use of an area. Proponents of ecosystem management try to involve all key stakeholders (those with a vested interest in the ecosystem) in the development of an ecosystem management plan so that conflicts can be resolved—or at least reduced—before a plan is implemented.

Getting involved

There are many ways that individuals can become involved in restoring and protecting ecosystems in and around their communities. Many parks have volunteer programs that train citizens to participate in restoration and maintenance projects and conduct educational programs for visitors. You can also contribute to healthier ecosystems by being a good steward of natural resources in your own home, backyard, or farm. Creating or protecting natural areas on your property can provide habitat for wildlife and an important buffer between human-built habitat and adjacent ecosystems. There are also legal tools such as conservation easements that allow property owners to restrict development rights on their land. The conservation easement remains in place in perpetuity, conserving the environmental benefits for future generations.

In many areas of Ohio, citizens and public agencies are working together to protect and restore local ecosystem services through collaborative watershed management. A watershed is all the land area that drains to a river. All the land uses that occur within a watershed, including agriculture, lawns, housing, parkland, industry, parking, and transportation, influence the health of rivers and streams that collect the water that runs off the land. Collaborative watershed management involves residents, government officials, and other key stakeholders working together to identify impacts on local rivers and streams, sources of those impacts, and strategies to address those sources. Citizens can participate in collaborative watershed management by attending planning meetings, becoming involved in or starting a local watershed protection group, or serving as a volunteer to help implement conservation projects, educate others about best management practices, and monitor the health of the river. Citizens may also become involved in ecosystem management efforts aimed at protecting endangered species, managing forests and wildlife, and enhancing recreational opportunities on public and private lands.

For more information about ecosystems and ecosystem management efforts in your community, contact your local park district, state park, nature center, Ohio Department of Natural Resources Division of Wildlife district office, or local Soil and Water Conservation District office.

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Keith L. Smith, Ph.D., Associate Vice President for Agricultural Administration and Director, Ohio State University Extension

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