

Ecosystems

Ecosystems may be thought of in structural terms—as a systematic collection of species and processes that have a recognizable form, such as tallgrass prairies, coastal salt marshes, redwood forests, or high desert. Ecosystems sometimes are described as geographically defined ecological units, consisting of groupings of plants and animals and their surrounding environment, with characteristics shared in common. Watersheds, for example, are useful representations of ecosystems.

In a 1995 report, Defenders of Wildlife describes ecosystems as “a characteristic community of interdependent plants, animals and microorganisms associated with particular kinds of soil, temperature, rainfall and disturbance patterns.” To identify at-risk ecosystems (see Figure 7.1), Defenders of Wildlife categorizes plant-animal communities in an easily recognizable manner, e.g., grasslands, forests, and wetlands.

The Interagency Ecosystem Management Task Force defined an ecosystem as “an interconnected community of living things, including humans, and the physical environment within which they interact.” The task force did not, however, identify specific types of ecosystems, nor did it delineate ecosystem boundaries on a

map. Instead, it acknowledged that geographic boundaries appropriate for addressing one issue may not work for another. It concluded that, in most ecosystem protection efforts, a practical definition of the ecosystem can be determined by the participants themselves. The boundaries should have an ecological basis, and should encompass the problem for which a solution is being sought.

Ecosystems and ecological communities are the underpinning for the health, vitality, and diversity of all of the individual species that inhabit the ecosystems. Conservation efforts must be applied with broader scope than traditional species-by-species focus allows.

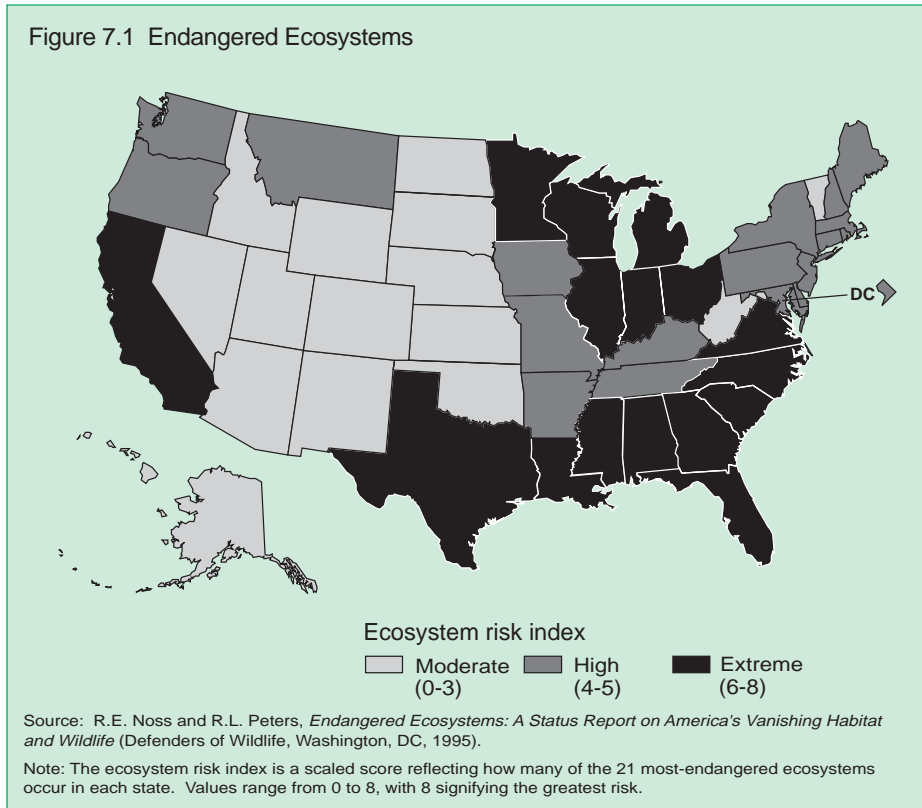
BACKGROUND

Categories and Current Status of Ecosystems

The National Biological Service of the Interior Department organizes ecosystems into four broad categories: terrestrial, aquatic, coastal and marine, and riparian. The following paragraphs summarize the current status of these ecosystems.

- **Terrestrial Ecosystems.** Change has been a natural part of terrestrial ecosystems throughout history; in recent

Figure 7.1 Endangered Ecosystems

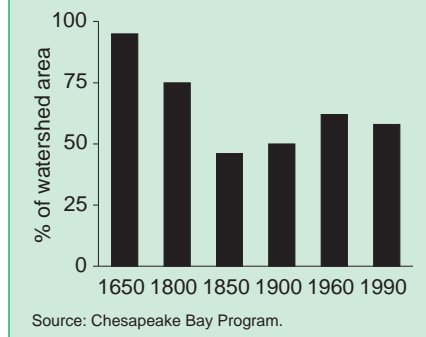


years, human intervention has been the principal agent of change. Disease, fire suppression, pollution, conversions to other uses, exotic species, noxious weeds, harvesting activities such as logging, and global climate change are among the numerous variables that can affect terrestrial ecosystems.

- **Aquatic Ecosystems.** Aquatic ecosystems have been severely degraded in the last century in the United States. Natural aquatic systems have been altered for transportation, diverted for agricultural and municipal needs, straightened, dammed, and polluted.

- **Coastal and Marine Ecosystems.** The quantity and health of the nation's coastal and marine resources have declined over time at the species,

Figure 7.2 Chesapeake Bay Watershed Forests, 1650-1990



community, and ecosystem levels. Urbanization, shoreline modification, overfishing, high-density recreational use, and other human activities have been the major factors contributing to this decline. (See Figure 7.2 for an example of this phenomenon.)

- **Riparian Ecosystems.** Stream bank and floodplain ecosystems, particularly in the West, have been greatly altered over the last 200 years, largely as a result of water development projects, clearing of trees, overgrazing by livestock, agricultural conversion, urban growth, and invasions of non-native plants. (See Figure 7.3 for an example of alteration in this ecosystem category over time.)

Assessing Ecosystems

Within these four broad categories are many smaller ecological units. The relative condition of these units has been examined recently by Defenders of Wildlife, the World Wildlife Fund, and The Nature Conservancy.

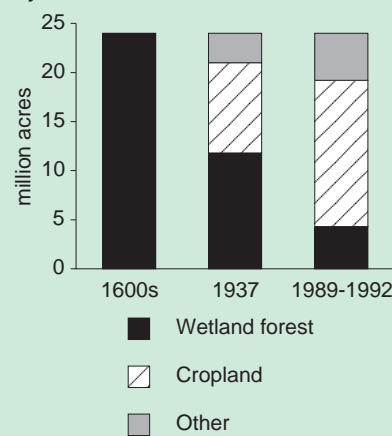
In its 1995 report, Defenders of Wildlife listed the 21 “most-endangered” ecosystems in the United States (see Figure 7.1). The three highest ranking ecosystems were the South Florida landscape, Southern Appalachian spruce-fir forest, and longleaf pine forest and savanna. The sources of threat to these ecosystem types vary, ranging from human population growth in Florida to acid fog and an insect pest in the Southern Appalachians; the longleaf pine and savanna communities have been replaced by agricul-

ture, tree farms, and by the invasion of hardwood forests (Table 7.1).

The ranking used by Defenders of Wildlife was based on four criteria: decline in original area since European settlement, present area (rarity), imminence of threat, and number of federally listed threatened and endangered species. But the report acknowledges that there may be a need to supplement risk with other criteria, including ecological value, scientific value, and the economic and political feasibility of conservation (Figure 7.4).

The World Wildlife Fund is also working to identify high-priority ecoregions in the United States; it is doing so as part of a North American conservation assessment. This project seeks to set priorities on national, continental, and global scales. It considers not only the conservation status but also the biological distinc-

Figure 7.3 LMRAP Bottomlands, by Land Use, 1600s to 1990s



Source: U.S. Fish and Wildlife Service.
Note: LMRAP = Lower Mississippi River Alluvial Plain.

Table 7.1
The 21 Most Endangered
Ecosystems of the United States

South Florida Landscape
 Southern Appalachian Spruce-Fir Forest
 Longleaf Pine Forest and Savanna
 Eastern Grasslands, Savannas, and Barrens
 Northwestern Grasslands and Savannas
 California Native Grasslands
 Coastal Communities in the Lower 48 States and Hawaii
 Southwestern Riparian Forests
 Southern California Coastal Sage Shrub
 Hawaiian Dry Forest
 Large Streams and Rivers in the Lower 48 States and Hawaii
 Cave and Karst Systems
 Tallgrass Prairie
 California Riparian Forests and Wetlands
 Florida Scrub
 Ancient Eastern Deciduous Forest
 Ancient Forest of Pacific Northwest
 Ancient Red and White Pine Forest, Great Lakes States
 Ancient Ponderosa Pine Forest
 Midwestern Wetlands
 Southern Forested Wetlands

Source: Reed F Noss and Robert L. Peters, *Endangered Ecosystems: A Status Report on America's Vanishing Habitat and Wildlife* (Defenders of Wildlife, Washington, DC, 1995).

tiveness of ecoregions. The World Wildlife Fund's biological distinctiveness criteria include species richness, endemism, presence of rare ecological and evolutionary phenomena, and rarity of habitat type. Conservation status criteria include the percentage of native original habitat lost, presence of large blocks of original habitat, degree of habitat fragmentation and degradation, and degree of protection. The World Wildlife Fund has preliminarily identified 19 high-priority ecoregions for terrestrial biodiversity conservation and 7 areas for freshwater biodiversity conservation.

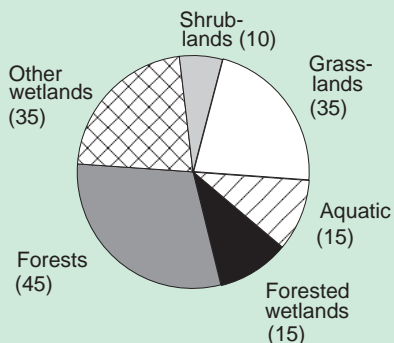
Vegetation structure and plant species composition are being used by The Nature Conservancy and Network of



South Florida Landscape. This vanishing habitat is one of America's 21 most-endangered ecosystems.

Photo Credit:
 National Park Service

Figure 7.4 Ecosystems With Losses of 70% of Original Area



Source: Noss, et al. *Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation* (NBS, Washington, DC, 1995).

Note: Number of ecosystems are in parenthesis.

Natural Heritage Programs in collaboration with the Federal Geographic Data Committee to develop a framework for the classification of ecological communities in the United States. Approximately 4,000 ecological communities have been identified using this framework. The conservation status of each is being assessed based on rarity and threat.

More specifically, within the lower 48 states, 371 globally rare terrestrial vegetated communities have been identified and described. An additional 300 such rare communities are anticipated to be documented through this process. More than half of these rare or threatened types occur in the West (Figure 7.5). Most are in the forest class, followed by the woodland, shrubland, and herbaceous classes. The Nature Conservancy cites fire suppression as having pushed many forest types to this level of rarity; flood-control and water diversion projects have similar-

ly affected many of the forest and woodland riparian types. Herbaceous communities have been adversely affected by overgrazing and—to a lesser degree—direct agricultural conversion.

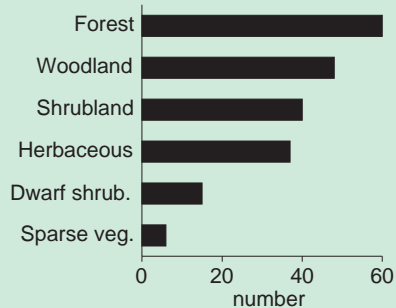
WHAT CAN BE DONE?

Collaboration Is Key

Protecting ecosystems and ecoregions is not something any single landowner can accomplish alone, since in most cases these areas may encompass many different political jurisdictions and patterns of land ownership. An important part of any ecosystem protection strategy, therefore, is to bring together all affected parties to build new cooperative agreements. We already can point to a few models, such as the cooperative effort to improve conditions in the Chesapeake Bay.

Cooperative ecosystem efforts are supported and enhanced by advances in

Figure 7.5 Rare Terrestrial Communities, Western Region, 1994



Source: Grossman, et al., *Rare Plant Communities of the Conterminous United States: An Initial Survey* (The Nature Conservancy, Arlington, VA, 1995).

technology. When the National Environmental Policy Act was passed in 1969, only a few rudimentary maps were available to facilitate broad-scale analysis of large expanses of land. Most map overlays were done manually with transparent sheets. There were no easy ways to integrate, analyze, and compare the enormous volumes of data needed for large-scale analysis. With the advent of modern computers, data systems, geographic information systems, and networks, the technological means are now widely available to support the partnerships that are required for evaluation and cooperative management of large land areas. Science and management, so often strangers, can now be effective partners.

The Ecosystem Approach

The Clinton Administration has taken a strong stand in favor of an *ecosystem approach* to resource management in concert with sustainable development. This stance has its roots in the Vice President's National Performance Review, which called for federal government agencies to adopt "a proactive approach to ensuring a sustainable economy and a sustainable environment through ecosystem management."

An Interagency Ecosystem Management Task Force was established in August 1993. One of its first accomplishments was to establish a goal for the ecosystem approach:

To restore and sustain the health, productivity, and biological diversity of ecosystems and the overall quality of life through a natural resource

management approach that is fully integrated with social and economic goals.

As articulated by the task force, the ecosystem approach emphasizes the following:

- Ensure that all relevant and identifiable ecological and economic consequences (long term as well as short term) are considered.
- Improve coordination among federal agencies.
- Form partnerships among federal, state, and local governments; Indian tribes; landowners; and other stakeholders.
- Improve communication with the general public.
- Carry out federal responsibilities more efficiently and cost effectively.
- Use the best science.
- Improve information and data management.
- Adjust management direction as new information becomes available.

The task force conducted case studies to learn about ecosystem efforts, identify barriers to implementing the ecosystem approach, and identify ways the federal government could help overcome barriers. Seven areas were used as case studies: Anacostia River watershed, Coastal Louisiana, Great Lakes Basin, Pacific Northwest forests, Prince William Sound, South Florida, and the Southern Appalachians. The results of these case studies have been published in three volumes.

To support the science underpinnings of the ecosystem approach, the federal interagency Committee on Environment and Natural Resources is developing science-based principles for ecosystem management and a predicting ecological impacts of environmental change. This will require that federal research and development programs take a broader, ecosystem approach, that the approach be multidisciplinary, and that research increase our understanding of the structure, function, and dynamics of ecological processes, as well as the consequences of societal action or inaction.

Barriers to the Ecosystem Approach

The Interagency Ecosystem Management Task Force identified several persistent barriers that federal agencies face in implementing the ecosystem approach and in participating in ecosystem partnership efforts initiated by others.

1. Federal Agency Coordination. A coordinated and comprehensive framework is essential to implementing the ecosystem approach. Federal resource management has traditionally been characterized by specific missions, rigidly stratified and specialized organizational structures, and the subdivision of problems into narrowly defined tasks.

2. Partnerships with Nonfederal Stakeholders. The ecosystem approach requires active partnerships and collaboration with nonfederal parties, particularly state, local, and tribal governments; neighboring landown-

ers; nongovernmental organizations; and universities. Although partnerships between the federal government and nonfederal entities are not uncommon, agencies need to strengthen their own outreach programs and improve the ability of nonfederal entities to participate. Together, they must also project and articulate a desired ecosystem outcome with a shared vision for the future.

3. Communication between Federal Agencies and the Public. Current outreach activities must be strengthened. Coordination with the public is generally perceived to be secondary to the “normal” work of the agencies. Regional offices typically lack specialized staff with experience in working with the public. Most federal employees who should be interacting with the public are not trained in the skills needed for the public participation aspects of the ecosystem approach—educating the public, motivating people to become involved, facilitating public discussion, building consensus, and resolving conflict.

4. Resource Allocation and Management. Agency coordination in ecosystem efforts can be improved by recognizing the interdependency of agency budgets. The ability of each agency to take an ecosystem approach is affected by its ability to budget for long-term goals, organize around and fund interdisciplinary activities, and quickly modify programs in response to new information. Agency budget priorities and structures, however, often reflect

narrow, program-specific perspectives; are driven by immediate concerns; and are sometimes linked primarily to the production of tangible outputs such as commodities. Furthermore, Congress makes funding decisions on an agency-by-agency basis, making it difficult to coordinate the funding of interagency programs.

5. Knowledge Base and the Role of Science. The existing *information* base—what we know about what exists in a place—and the existing *knowledge* base—how well we understand how ecological and economic components function—are both inadequate for many systemwide ecosystem analyses. The linkage between scientists and managers, and between natural resource agencies and other agencies and entities, is essential in establishing a shared vision of desired ecosystem conditions, specifying how the vision can be achieved, and monitoring and measuring progress toward goals.

6. Information and Data Management. No single entity has the resources or mandate to develop all relevant information on any ecosystem—or even the capability for locating and accessing information pertinent to an ecosystem that is available from other sources. Some agencies are sources for ecological data, others for social and economic data. Managers must have coherent and complete information from all sources in order to make reasonable decisions on actions that affect the ecosystem.

7. Flexibility for Adaptive Management. Adaptive management requires a willingness to undertake prudent experimentation consistent with sound scientific and economic principles, and to accept occasional failures. This contrasts with the strongly risk-averse nature of most agencies and managers. Agencies are hampered in their efforts to adapt management practices to new circumstances. As a result, innovation is discouraged, new knowledge is applied too slowly, and inefficiencies persist to the detriment of both resources and communities.

The Federal Advisory Committee Act. In addition, the Federal Advisory Committee Act (FACA) has caused some problems in implementing the ecosystem approach. FACA was passed by Congress in 1972 to control the growth and operation of what was perceived to be a proliferation of advisory groups of all kinds. The act was designed to eliminate unnecessary advisory committees, limit the establishment of new ones, and hold existing committees to uniform standards and procedures.

In most of the seven ecosystem case studies, FACA was identified as an impediment to adopting an ecosystem approach. Interviewees reported, for example, that citizen groups—even those already established—do not meet because of confusion over FACA requirements. Furthermore, agencies resist forming groups that are necessary for planning, especially in the scientific area, because the burden of FACA compliance is greater than the benefit gained. In gen-

eral, there was a great deal of confusion over what kinds of communication were allowed with whom, and the extent to which these communications were regulated by FACA.

Because stakeholder participation in government decisionmaking and improved coordination among federal, state, and local decisionmakers are so crucial to the ecosystem approach, the issue of FACA compliance is likely to arise with increasing frequency as federal managers adopt an ecosystem approach.

Breaking Down and Getting Around the Barriers. In most cases, the Intera-gency Ecosystem Management Task Force did not choose to recommend changes to laws. It does, however, present a series of recommendations in its report to resolve many of problems identified. Task force member agencies also have signed a memorandum of understanding committing their agencies to work toward implementing the recommendations.

Regarding FACA, the task force recommended that the Administration revise its policies to ensure that federal land managers have adequate latitude to form advisory committees in certain situations. It also noted that FACA has been amended to create exemptions for state and tribal consultations (Unfunded Mandates Reform Act, Title II, Section 204, signed by the President on March 22, 1995). Additionally, in its three-volume report, the task force recommended that interagency training programs be established that help government employees understand how to maximize communication and consultation with stakeholders and the public within the context of FACA;

and discusses some “do’s and don’ts” regarding FACA.

WHAT IS BEING DONE?

The Ecosystem Approach in Action

One of the real values of the ecosystem approach is that it brings together the parties that have an interest in a particular region, regardless of what side they are on. All too often, people who care about the region’s destiny have simply never sat together and talked about where the region was going, what changes they would like to see, or what tools were available to shape the future. Yet, people often live in particular areas precisely because its ecological amenities provide a special quality of life. The ecosystem approach provides a forum for working with others in the region to ensure the conservation of important ecological values.

Different groups bring varying resources to the table. Land managers have the ability to manipulate habitat and land resources. Regulatory agencies have authorities derived from their statutory mandates. Local governments have zoning authority to influence development patterns and practices. Private landowners have their own set of incentives and opportunities. Other groups rely on the power of public opinion to influence a result. The ecosystem approach requires advocates of many positions to seek common ground and work together on areas of common agreement. The

Ecosystems



Riparian Zone Restoration. An ecosystem approach to regional resource management can bring about powerful results when all stakeholders seek common ground and work together on areas of common agreement.

Photo Credit:
U.S. Department of the Interior

Box 7.1

The Ecosystem Approach in the Pacific Northwest

In the Pacific Northwest, we have, over the past century, acted as though cutting some of the oldest trees on earth and suppressing fires would not have a long-term effect on the ability of forests to continue to produce large amounts of harvestable timber—or that activities associated with timber harvests would not compound the problem for salmon and other anadromous fish. The economic consequences of our actions have been profound. A number of salmon stocks are now on the endangered species list. Forests have fire, insect, and disease problems and cannot sustain historical levels of timber harvest. Individuals, companies, and local economies have suffered the effects of boom-and-bust cycles, with no long-term stability.

The Clinton Administration has established an ecosystem effort in the Pacific Northwest forests based on five principles: (1) protecting the long-term sustainability of forests, wildlife, and waterways; (2) never forgetting the human and economic dimensions of the problems; (3) making efforts that are scientifically sound, ecologically credible, and legally responsible; (4) producing a predictable and sustainable level of timber sales and nontimber resources that will not degrade or destroy the environment; and (5) making the federal government work together with and for the people.

The Administration's Forest Plan represents an entirely new way of doing business. It features an ecosystem-based management plan for 25 million acres of federal land in the region, an economic assistance plan, and a blueprint for improved agency coordination. Such a comprehensive approach was probably the only viable alternative for breaking the impasse caused by years of competition and conflict in the region. In response to legal challenges, Judge Dwyer pointed out the unprecedented nature of the Administration's effort and noted: "Given the current condition of the forests, there is no way the agencies could comply with the environmental laws without planning on an ecosystem basis."

results of their efforts can be simple and powerful (see Box 7.1).

Habitat Conservation Plans

The Administration has also used flexibilities written into the Endangered Species Act to promote conservation in the context of broader ecosystems. This has been accomplished by using habitat conservation plans (HCPs) instead of taking the traditional species-by-species approach. Increasingly, HCPs originally intended to deal with a single listed species are being expanded to include

other rare or declining species and the habitat that supports them all.

The issues involved in HCPs can be technical and legally complex. State and local governments are often involved in HCP planning and implementation. HCPs provide a way of allowing economic use of private lands while conserving endangered species. Under the "no surprises" policy of the Secretary of the Interior, landowners who develop HCPs will not be subject to later demands for more money or land to conserve those species, even if circumstances change. "A deal is a deal," and development can proceed

without the prospect of additional mitigation requirements for covered species. Thus, the use of HCPs helps minimize socioeconomic effects, ensures fair treatment for landowners, and strengthens partnerships between federal and nonfederal entities.

A highly visible and widely publicized example of an HCP is under way in Orange County, California. The coastal sage scrub vegetation of the area is habitat for the endangered California gnatcatcher, as well as many other species. However, development pressures in the area are intense, and land values are high. A significant amount of this land is owned by the Irvine Corporation, which has acted as the major partner with the Fish and Wildlife Service and the California Department of Fish and Game in developing a regional land-use and conservation plan. This plan provides for subregional planning by landowners and local governments, with guidance from an independent state scientific review panel and approval by state and federal agencies.

Another HCP example comes from the Southeastern states, where private timber firms were becoming increasingly frustrated by harvest limitations resulting from the need to protect habitat for the red-cockaded woodpecker. The companies felt that they often would not know in advance what the restrictions would be, and could not take the constraints into account in their planning. Led by firms such as Georgia-Pacific Corporation and International Paper, plans are being developed that provide much greater certainty for timber managers as

to what they can and cannot do, and where this applies.

Partnerships

In many cases, the ecosystem approach has emerged spontaneously as landowners and other interested parties attempt to deal with local resource issues. For example:

- On the Henry's Fork of the Snake River in Idaho, ranchers sat down with fishermen and environmentalists to determine how their apparently conflicting needs could be resolved while mutually held goals could be achieved.
- In the Anacostia River watershed in the Washington, D.C., area, a group of state and local governments established a six-point action plan for watershed restoration.
- In southeast Arizona and southwest New Mexico, ranchers worked with The Nature Conservancy to form an unofficial million acre planning area to coordinate fire and ecosystem management across political boundaries. The Forest Service and Natural Resources Conservation Service are providing technical assistance to support these efforts; the Bureau of Land Management is also participating.
- In 1994, a unique partnership was created to manage 21,000 acres of diverse bottomland hardwoods and cypress gum swamp wetlands along North Carolina's Lower Roanoke River. Georgia-Pacific Corporation owns the land, but a joint commit-

tee—including representatives from The Nature Conservancy and Georgia-Pacific—establish criteria for where and under what conditions timber harvesting can occur.

- Efforts are currently under way to protect the San Francisco Bay/Delta Estuary. This 1,620 square mile area spans 12 counties, is a source of freshwater for 20 million people, and irrigates 4.5 million acres of farmland. In recent years, however, the estuary's ability to support a diverse ecosystem has declined because of near-total destruction of wetlands, altered hydrologic and salinity conditions, and urban and agricultural runoff. After 12 months of intense negotiations, a historic agreement on Bay/Delta environmental protection was signed in December 1994. The agreement, endorsed by a wide range of stakeholders, contains water quality standards for the Bay/Delta as well as measures to protect the habitats of currently listed endangered or threatened species.
- Within the San Francisco Bay estuary region, the North Bay contains the largest area of historic baylands and associated wetlands. Much of the area has been diked and is now used mostly for agriculture. The North Bay Initiative is a joint effort involving 13 local, state, and federal agencies working to restore the area. For example, the Sonoma County Resource Conservation District is contacting landowners in an effort to integrate agricultural and environmental goals into the long-term development of the reclaimed wetlands in San Pablo Bay.

The Napa County Resource Conservation District coordinated development of the *Napa River Watershed Owner's Manual*, which addresses agricultural activities, urban storm runoff, residential land management, nonpoint source pollution, wildlife habitat, and ways to increase watershed biodiversity.

- In South Florida, a number of federal, state, tribal, and local agencies have coordinated efforts to restore the Everglades ecosystem, stretching from north of Lake Okeechobee to the Florida Keys. The Governor's Commission for a Sustainable South Florida recently brought together representatives of agricultural, environmental, urban water user, and other interests, to develop a consensus plan for managing water resources. That plan will expedite efforts by the Army Corps of Engineers to redesign the Central and Southern Florida Project so that waters flowing through this unique ecosystem are managed in a more sustainable manner. The South Florida Ecosystem Restoration Task Force will continue to coordinate the many restoration efforts at various levels of government.

Management Strategies

Using the ecosystem approach presents a host of management challenges. It requires a high degree of interagency cooperation, a multidisciplinary approach, and sophisticated information and technology systems. Three current



Protecting the Upper Mississippi Flyway. Ecosystem management strategies at work.

Photo Credit: J.G Wiener.
National Biological Service

examples include large marine ecosystems, National Estuary Programs, and habitat management in the Upper Mississippi River.

The National Oceanic and Atmospheric Administration has recognized that ecosystem-level programs are required for many coastal and marine areas. The agency is implementing a broad-based, multidisciplinary approach to marine monitoring, modeling, and management, which it calls the Large Marine Ecosystem Initiative. Large marine ecosystems are characterized by unique bathymetry, hydrography, and productivity, within which marine populations have adapted reproductive, growth, and feeding strategies. The initia-

tive is designed to reflect the complexities of these marine systems.

The National Biological Service, Fish and Wildlife Service, Army Corps of Engineers, and five affected states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) are working cooperatively to develop an ecosystem approach to managing the upper Mississippi River. As wildlife habitat continues to decline in both abundance and quality in the upper Midwest, the upper Mississippi River and its adjacent habitats have assumed even greater significance for many migrating bird species. With its north-south orientation, the Great River Flyway functions as a pathway between breeding and wintering areas for some 292 bird species.

Their approach exploits the latest advances in technology and information, including aerial and satellite images which can then be digitized and stored in a geographic information system database. Detailed land cover maps can depict areas of specific vegetation types or communities. Using these maps to describe migratory bird habitats provides a link to relate the migratory bird corridor to other natural resource priorities and to look at threats to bird habitat from a broader perspective. The approach can be used at any scale, allowing development and evaluation of models for individual species, groups, communities, and entire ecosystems. The approach also uses maps of changes in habitat and vegetation over the past century, and maps of

areas that can potentially support many species.

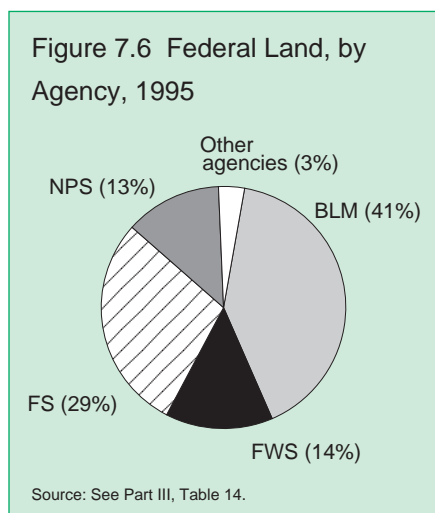
By tracking and predicting habitat changes and the causes of those changes, this approach can determine where habitats should be protected, created, or restored to meet the needs of migratory birds. The management strategy will serve as a vehicle to coordinate and consolidate river-based management plans for migratory birds and to develop specific management objectives. As a process, the Upper Mississippi River management strategy can be a valuable prototype for managing other ecological systems.

The U.S. Environmental Protection Agency (EPA) is actively using the ecosystem approach in protecting the environment. For example, EPA's National Estu-



A Conservation Reserve Program (CRP) Success. Pothole conservation in the upper midwest.

Photo Credit: Tim McCabe/SCS
U.S. Fish and Wildlife



ary Program (NEP) promotes an ecosystem approach to protecting and restoring the health of estuaries while supporting economic and recreational activities. To date, the program encompasses 28 local NEPs including Casco Bay in Maine, Galveston Bay in Texas, and Tillamook Bay in Oregon. EPA helps each local NEP develop partnerships between government agencies that oversee estuarine resources and the people who depend upon the estuaries for their livelihood and quality of life. Together, these participants identify an estuary's problems, recommend solutions, and make financial commitments in a Comprehensive Conservation and Management Plan. EPA provides each NEP with grants and technical assistance. In implementing solutions, these local NEPs are demonstrating practical and innovative ways to rejuvenate and protect their estuaries (see also Chapter 14, "Coastal and Marine Resources").

Private Lands

Many opportunities exist to increase incentives for biodiversity and habitat conservation on private lands. In July 1995, a diverse group of 30 experts met at The Keystone Center in Colorado to compile a list of such opportunities. The group developed 18 proposals on which there was general consensus.

The Keystone Group noted a current lack of voluntary, incentive-based programs for restoring or conserving endangered species habitat. The participants suggested that the existing Conservation Reserve Program (CRP) could provide a model for developing a private-land endangered species conservation program. CRP pays farmers to retire highly erodible croplands and other environmentally sensitive lands from commodity production for 10 years and establish a protective vegetative cover. About two thirds of CRP lands are in the Great Plains. Though not intended as an endangered species protection program, the large new areas of grassland habitat created by CRP have contributed to the recovery of several state-listed endangered species and helped reverse declining populations of numerous endemic grassland birds.

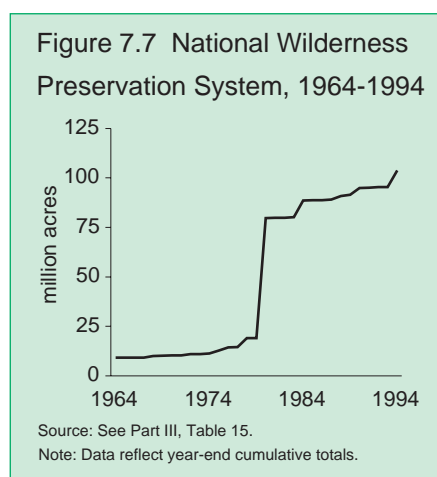
The Keystone Group proposed an endangered species protection program modeled after CRP that would be voluntary, of limited duration (5 to 10 years, with a right to renew), provide assurance to landowners that the land could be placed in another use after the program's end, provide assured funding for annual

contract payments, and use a competitive bid system to maintain cost effectiveness.

Federal Protected Areas

The federal government has designated large blocks of lands for special protection, thereby contributing to a broad conservation effort. Four federal agencies administer about 95 percent of these federal lands. (See Figure 7.6.) In the Department of Agriculture, the Forest Service manages 187.3 million acres. In the Department of Interior, the Bureau of Land Management manages 264.7 million acres, the Fish and Wildlife Service 92.3 million acres, and the National Park Service 83.2 million acres.

Protection is also provided for the national wilderness system and the national wild and scenic rivers system. Since passage of the Wilderness Act in 1964, the national wilderness system has grown from about 9 million acres to about 103.7 million acres—or about 4.5 percent of the nation's land (Figure 7.7).



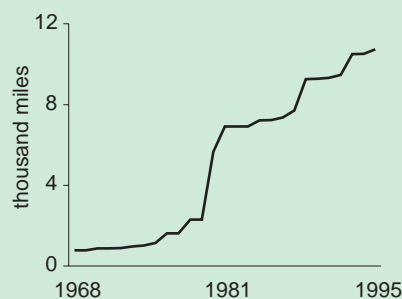
Red-cockaded Woodpecker. Resident of the endangered Longleaf Pine Forest and Savanna ecosystem.

Photo Credit: J.Hanula and K. Franzreb
U.S. Forest Service

The wild and scenic rivers system, which preserves rivers or stretches of rivers in a free-flowing condition, now protects about 10,734 river miles (Figure 7.8). Wild and scenic rivers are administered by federal or state agencies; if a protected river runs through privately owned land, it is maintained by the private landowner.

Congress established a National Trails system in 1968; in 1991, it established the National Recreational Trails Fund and the National Recreational Trails Trust Fund. Congress appropriated \$7.5 million for the program in fiscal year 1993. The National Highway System Designation Act of 1995 authorized \$15

Figure 7.8 National Wild and Scenic Rivers, 1968-1995



Source: See Part III, Table 15.

Note: Data reflect year-end cumulative totals.

million for fiscal years 1996 and 1997 for the national recreational trails program.

The Department of Energy has established seven national environmental research parks, located within six major ecoregions of the United States. The pro-

gram was begun in the 1970s, and the Savannah River Site in South Carolina was designated the first research park in 1972. Over the years, these large protected land holdings became, in some cases, the last remaining refuges of what had once been extensive naturally balanced ecosystems. Most of the land in the research parks is undeveloped, with minimal cultivation and almost no human residents. Environmental research projects are carried out with little interference, and a long history of environmental research and monitoring data are consequently available for these areas.

The Department of Defense (DOD) is steward to approximately 25 million acres of public lands. While these lands support military training and readiness capabilities, they also offer pristine habitats for a wide variety of unique species, as

Box 7.2

Protecting the California Desert

In December 1994 Congress passed the California Desert Protection Act, climaxing a decade-long struggle among environmentalists, ranchers, landowners, and others over land protections in the Southern California Desert. The law transferred about 3 million acres from the Bureau of Land Management to the National Park Service, upgraded Death Valley and Joshua Tree National Monuments to national park status, and established the 1.4 million acre Mojave National Preserve. In addition, the law provided wilderness status for 69 Bureau of Land Management areas totaling 3.6 million acres and 4 million acres in the two parks and the preserve.

In a single stroke, the act provided protection for almost one third of the land stretching across the Sonoran, Mojave, and Great Basin Desert systems of the Southwest. The area includes some of the oldest trees in the world, the hottest place on the entire planet, and California's only known dinosaur tracks.

The act was a difficult compromise among competing interests. Hunting, which is prohibited in most units of the National Park system, will be allowed in the Mojave National Preserve. Grazing of domestic cattle, now permitted on a limited basis in only one small park in Nevada, will be permitted throughout much of the protected desert area. A small number of working mines will also continue operations.

well as a wealth of opportunities for recreational and other renewable uses. DOD strives to apply wise conservation practices to ensure that natural resources are not degraded from overuse. In 1996, the department issued a directive on environmental conservation that provides—among other things—for managing natural resources consistent with the military mission while protecting and enhancing resources for multiple use, sustainable yield, and biological integrity. Special provisions are made for biologically or geographically significant or sensitive natural resources, such as wetlands or coastal barrier islands, and for threatened and endangered species.

For example, at 11 installations in the Southeast, DOD is protecting and enhancing populations of the endangered red-cockaded woodpecker. Resource managers are maintaining the mature longleaf pine forest upon which the woodpecker depends by simulating natural fires that control invasive hardwood trees and by controlling timber harvests. Troops that train in the forests treat nesting trees as biologically contaminated sites or mines to avoid disturbance to woodpecker colonies.

DOD also manages about 10 percent of the lands of the Mojave Desert. It has teamed up with the Department of the Interior to manage these lands so that biological integrity can be addressed across their jurisdictional boundaries.

(See Box 7.2 for information on other efforts to protect federally owned desert land.)

FUTURE CHALLENGES

While there is increasing recognition of the value of ecosystems and the need to preserve biodiversity, achieving these ends presents many difficult challenges. Our knowledge of how ecosystems function is still limited, making comprehensive analyses difficult. Furthermore, the ecosystem approach requires interdisciplinary, cooperative, holistic, and adaptive efforts that are new to our resource management and political institutions.

Concerted efforts are being made to overcome these problems. What is most promising is that conservation efforts are increasingly based on cooperation, negotiation, and partnerships among landowners—both governmental and nongovernmental. Also, a growing number of efforts are aimed at improving incentives to private landowners to conserve ecosystems. In the face of increasing population growth and development, we must seize these new opportunities quickly, try to minimize conflicts with development interests, and generate creative new approaches to protect and restore ecosystems.

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