COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

An Ecosystems Approach to Natural Resources Management

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Our nation—and especially Kentucky—has an abundance of renewable natural resources, including timber, wildlife, and water. These resources have allowed us to build a strong nation and economy, creating one of the highest standards of living in the world. As our nation grew and prospered during the past 200 years, we extracted those natural resources through agriculture, forestry, mining, urban or industrial expansion, and other developments. Ultimately, we affected the amount of wild lands that native plants and animals need for survival.

In the past, natural resources agencies have rallied public support for declining wildlife populations. In the 1930s, Congress passed the Federal Aid to Wildlife Restoration Act, also called the Pittman-Robertson Act, and state wildlife agencies received funding to restore numerous wildlife species that were in trouble, including white-tailed deer, wild turkeys, wood ducks, elk, and pronghorn antelope. During the late 1960s, the plight of bald eagles, whooping cranes, and grizzly bears—all in danger of extinction—caught the public's attention. The Endangered Species Act, passed in 1973, followed a groundswell of public support for protecting rare and threatened organisms.

Table 1. Selected Ecosystem Declines in the United States

Ecosystem or Community	% Decline (loss) or Degradation
Pacific Northwest Old Growth Forest	90
Northeastern Pine Barrens	48
Tall Grass Prairie	96[1]
Palouse Prairie	98
Blackbelt Prairies	98
Midwestern Oak Savanna	98[1]
Bluegrass Savanna (unique to Kentucky)	100
Long-leaf Pine Forest/Savanna	98
Southeastern Coastal Plain Canebreaks	98
Riparian or Streamside Forests	70 to 90
Northeastern Coastal Heathlands	90
Wetlands	50[2]

[1]99% in Kentucky
[2]80% in Kentucky

Natural resources agencies and conservation organizations developed bold, innovative programs designed to stem the tide of extinctions and make conservation the responsibility of the entire nation. Consequently, several endangered species, including the bald eagle, brown pelican, peregrine falcon, and American alligator, have recovered from the brink of extinction. However, numerous other species and unique habitats are declining, and the list of endangered and threatened organisms continues to grow every year. Why are these additional species in trouble, while other species are increasing their populations and ranges?

The glade cress

The glade cress grows in Jefferson and Bullitt counties and nowhere else in the world.

Where did we go wrong? Why, almost immediately after passage of the Endangered Species Act, did controversies develop that pitted the environment against the economy? It began with the snail darter in Tennessee and continues today with the Northern spotted owl in the Pacific Northwest, the red-cockaded woodpecker in the Southeast, and the golden-cheeked warbler in Texas. It can be argued that these wildlife species, and endangered species in general, are only indicators of the general decline of the ecosystems in which they exist. The owl is an indicator of the loss of mature "old growth" temperate rainforest, the red-cockaded woodpecker is an indicator of the loss of mature long-leaf pine forests, and the golden-cheeked warbler is an indicator of the loss of mature cedar thickets in the Texas hill country. Other examples of significant ecosystem decline or destruction are listed in Table 1.

From these examples, we are not surprised to find that more than 50 percent of all endangered and threatened wildlife species are found in wetlands or aquatic habitats (Table 2) or that the upland sandpiper and bob-o-link populations have seriously declined in prairie ecosystems. Historically, much of this destruction was probably inevitable and not meant to harm native plants and wildlife.

Great change occurred in ecosystems during the first hundred years of European settlement in North America. These changes had a positive effect on some wildlife species and a negative effect on others. If the species in question was not a game or "highly prized, charismatic, or popular" species, resource management agencies reacted only if the species was being considered for listing on the official endangered/threatened list. In a sense, these resource agencies attempted to save these organisms much as physicians attempt to save human life in the emergency room of a hospital: by reacting to a crisis. Unfortunately, this approach is time consuming and expensive.

In addition, Americans have a tendency to place a high value on our favorite places—Yellowstone, the Grand Canyon, Alaska—and our favorite or "charismatic" species—the gray wolf, grizzly bear, or whooping crane. We tend not to worry about the remainder of species unless they are endangered or game animals. Currently, approximately 12.5 percent of vertebrate wildlife are considered game species, and a small percent are endangered. This represents only a small percentage of the known organisms. How do we manage or care for the largest percentage of species in the natural world? In other words, how can we manage for all organisms that keep the ecosystem healthy? This publication attempts to raise the consciousness of the public about a new philosophy and method of managing our natural resources—the ecosystems approach—that has emerged during the early 1990s.

Table 2. Native U.S. Species at Risk

Major Group	Percent
Freshwater Mussels	67.1
Crayfishes	64.8
Amphibians	37.9
Freshwater Fishes	37.2
Flowering Plants	33.0
Conifers	27.5
Butterflies/Skippers	21.8
Ferns	21.5
Tiger Beetles	20.2
Dragonflies/Damselflies	18.3
Mammals	16.1
Birds	13.9

A Holistic Approach to Wildlife and Natural Resources Conservation

We stand at the threshold of a revolution in wildlife and natural resource conservation in America. Today, proactive management is emphasized. We are moving away from the approach of saving endangered species only when they are in the "emergency room" at the brink of crisis. We are moving away from the viewpoint that if we are to save our favorite places and animals, we must conserve and manage the ecosystems upon which they depend for their survival. Instead of humans dictating how natural systems are managed, we are now looking to the natural system itself for insight and guidance to the management of that system.

Defining Ecosystems Management

What is ecosystems management? Various terms have been coined to describe this new management philosophy, including managing for biodiversity, ecosystems management, an ecosystems approach to management, holistic management, or an ecological approach to management. Whatever term is used, the focus is centered around a philosophical switch from Gifford Pinchot's ideas of sustained yield to Aldo Leopold's and John Muir's ideas of land or environmental ethics. Leopold eloquently summarized the concept: "If the land mechanism as a whole is good, then every part of it is good, whether we understand it or not. If the biota, in the course of eons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."

Various groups have also sought to define the term and establish that the objective of an ecosystems approach to management is to conserve and protect biodiversity.

EDWARD GRUMBINE: "Ecosystems management integrates scientific knowledge of ecological relationships within a complex sociopolitical and value framework toward the general goal of protecting native ecosystem integrity over the long term."

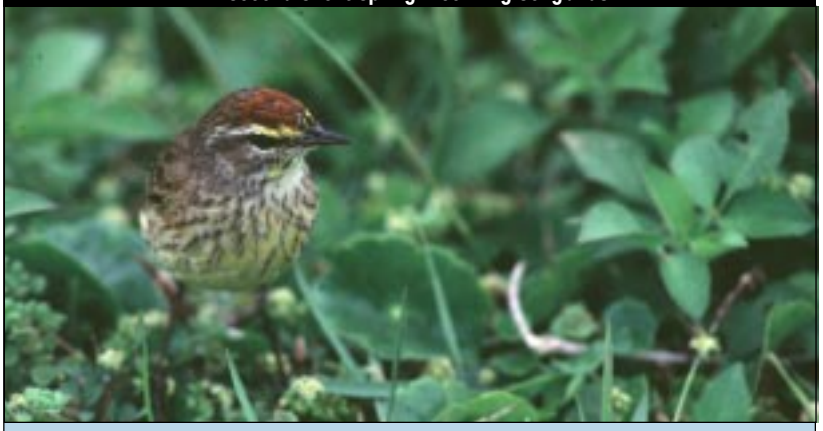
U.S. FOREST SERVICE: "the use of an ecological approach to achieve multiple-use management of the national forests and grasslands by blending the needs of people and environmental values in such a way that the national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems."

U.S. FISH AND WILDLIFE SERVICE: "a new way of managing natural resources that takes into account the entire ecosystem and balances recreational use, economic development, and conservation of wildlife so each is sustainable." The U.S. Fish and Wildlife Service's stated objective for an ecosystems approach to management is 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.

BUREAU OF LAND MANAGEMENT: "the integration of ecological, economic, and social principles to manage biological and physical systems in a manner that safeguards the long-term ecological sustainability, natural diversity, and productivity of the landscape." The Bureau states that the primary goal of ecosystems management is to conserve, restore, and maintain the ecological integrity, productivity, and biological diversity of public lands.

The ultimate goal of managing land at this level is provide for sustainable use of our natural resources. This means that the desired ecological conditions or flow of benefits from the land can be maintained over time, recognizing a fundamental need to sustain high-quality soils, pure air and water, and vigorous native plant and animal populations. It follows that sustainable development is development that meets the needs of the present population without compromising the ability of future generations to meet their own needs. Ecosystems management is not about taking private property or diminishing private property rights. It is also not about stopping timber harvesting, hunting, or other management activities. It is simply about protecting our biological heritage.

A Second Silent Spring: Declining Songbirds



Migratory songbirds herald the arrival of spring throughout much of Kentucky. Each year the warbles, chips, and trills of songbirds greet warming weather and, in concert with blooming dogwoods and redbuds, tell us summer has almost arrived. In recent years, spring has grown noticeably quieter, and the skies more still. According to the breeding bird survey, a number of species are in serious trouble. For example, rose-breasted grosbeaks have declined by more than 40 percent, and blackpoll warblers have declined by more than 60 percent. Scientists and the general public are mostly concerned with the neotropical, or New World, migratory birds. Neotropical migrant songbirds are birds that breed in North America and winter in Mexico, the Caribbean, and Central and South America. Many people recognize these birds as warblers, swifts, hummingbirds, tanagers, shorebirds, and thrushes. The other group of migratory songbirds are the short-distance migrants that include bluebirds, robins, hawks, and other species.

Complex Causes for Decline

Why are the neotropical birds declining? There are numerous complex, and perhaps not completely understood, reasons. However, we do know that tropical deforestation is a problem where more than 80 percent of the lowland forest in Mexico and Central America has been converted to other land uses.

Other reasons include the fragmentation of large forested tracts into ever smaller and smaller patches on the breeding grounds in this country. Although these small woodlots may look good to the birds, they are easily accessible to predators that destroy the eggs and young and to brown-headed cowbirds, which lay their eggs in the nests of other birds.

Other factors include indiscriminate pesticide usage and coastline development that destroys the first stopover points as the birds arrive from the tropics and the last stopover point prior to departing across the Gulf of Mexico.

A good solution to slowing or halting these declines is to implement an ecosystems approach to management at the landscape level to limit further habitat fragmentation.

Although this new viewpoint originated with Aldo Leopold in the 1930s, the ecological knowledge base and technology did not exist to truly integrate resource management until recently. The U.S. Forest Service has been a leader in the emergence of the ecosystems management concept. Its management principle through the 1950s and 1960s was for multiple use and values that could be derived from our national forests. This initial attempt toward recognizing nontimber values still emphasized the output of goods and services. This policy was replaced by "New Forestry" in the 1980s and "New Perspectives" in the late 1980s when major policy changes challenged traditional forest clearcutting and the production of timber on federal Forest Service lands. These policy shifts moved the agency to adopt the concept of ecosystems management.

Lloyd Irland has summarized the essential elements of this new thinking as:

- the maintenance and enhancement of biodiversity
- a wider spatial and temporal scale used for the protection and enhancement of ecosystem integrity
- management using landscape attributes, including connectivity of habitats, avoidance of fragmentation, protection of waterways, and identification and protection of critical habitats
- more intensive planning and coordination (cooperation between partners), more spatially detailed data obtained through Geographic Information Systems (GIS) and Gap Analysis Programs (GAP), and more sophisticated silvicultural techniques (low-impact logging)
- a shift in species composition to mature forest benchmarks
- development of older forest stands or extensive units of mature forest that will have few, if any, roads, and
- providing for larger populations of scarce creatures such as top-level carnivores (cougars), forest or grassland interior species (neotropical migrant songbirds), and species that require old growth forests (red-cockaded woodpeckers).

Understanding the Concepts and Principles of an Ecosystems Approach to Management

The focal point of this new system is examining and understanding the interdependent relationship of plants, animals, and ecological processes (such as gene flow, fire, etc.) that link them with the physical environment and the needs of people. In essence, this new approach to management is being guided by an understanding of the natural forces of change in ecosystems and how human activities affect those forces. Whether we like it or not, people are here to stay, and people are part of ecosystems. If we do not consider people in our management practices, we will ultimately fail to conserve natural resources.

Social Science and Ecosystems Management

Historical definitions of an ecosystem excluded human beings. We now know that both natural processes and human activities over time shape the diversity and productivity of any ecological system. An ecosystems approach recognizes that humans, as a part of ecosystems, need to be included in the decision-making process.

There appear to be two components of integrating social science into ecosystems management. The first one includes obtaining greater public involvement in the decision-making process that results in management policies and implementation strategies. Thus, managers need to recognize and be aware of the diversity of public opinion about various management options and the need to weigh the opinions of all constituents. This means we must forge partnerships to create opportunities for public participation and work more effectively with diverse audiences, other agencies, and nongovernmental organizations in their attempts to manage ecosystems that cross land ownership and jurisdictional boundaries.

The second component integrates social science information into an understanding of ecosystems. This includes using demographic analyses and projections to help understand population changes and distribution and using this information to make resource management decisions. It also includes analyzing human behavioral and cultural systems to see how resource uses, needs, and values differ by community. It means examining how social beliefs and values have developed from cultural traditions and group experiences and the resulting management and use of resources. Finally, it involves incorporating social science research information that might provide insight into how different social groups or communities form attachments to natural areas, which can in turn provide information on how or why certain resource uses occur.

Biology and Ecosystems Management

In order to view an ecosystems approach to management from a biological perspective, four basic concepts are necessary for understanding ecological systems: space, time, diversity, and disturbance (change).

Space

Ecosystems range in size from a drop of water to the North American continent. Ecosystems are highly variable across a wide range of spatial scales, based on the geographic context of local stands, sites, watersheds, or regions. What happens at one scale is going to determine what happens at other scales. If we examine and manage an individual site that is embedded in a larger landscape, what happens at that landscape level is going to affect the individual stand site. Furthermore, ecosystems do not respect human, political, or social boundaries. Ecosystems management occurs at all these ecological scales.

Time

Natural processes and human actions over time shaped the diversity and productivity of ecological systems. The one constant in ecological systems is change through time. No ecosystem is static; ecosystems are dynamic and always changing. Even if we locate the patches—as well as the gaps—of forest in the landscape today, these will change over the next 50 to 100 or 200 years. It is an ever-shifting mosaic of systems out there, and people or nature will determine those changes in the natural environment. For instance, a recent U.S. Forest Service report indicates that Native Americans altered sandstone ridgetop forests in Eastern Kentucky from hardwood-dominated to pine-dominated by the use of fire. During the era of active fire suppression by the U.S. Forest Service, "fire-adapted" tree species have been declining and are being replaced by black gum, red maple, and white pine. To restore these sites (and to make them suitable habitat for the red-cockaded woodpecker), the U.S. Forest Service has reintroduced fire and the use of timber harvesting to alter forest composition once again.

Disturbance

Most ecosystems are subjected to periodic or regular disturbance in the forms of fire, wind or ice storms, tornadoes, and forest canopy gaps created by falling trees, etc. Many species are not only adapted to disturbances but also depend on them for survival. The Kirkland's warbler is a classic ex-

Our Most Imperiled Organisms: Freshwater Mussels

The Nature Conservancy has indicated that freshwater mussels (clams) are the most imperiled organisms in the United States (see Table 2). The U.S. Fish and Wildlife Service considers 40 percent of the North American mussel fauna to be extinct, endangered or threatened, or rare. In Kentucky, 18 percent of the mussel fauna are extinct, and an additional 43 percent are considered to be imperiled.

Why are mussels the most endangered group of organisms? There are numerous reasons, including a sedentary biology (i.e., they can't swim away from pollution), a complicated and specialized life history strategy (they grow slowly and live long), habitat destruction and degradation, including impounding or channelizing rivers, nonpoint source pollution (particularly sedimentation and siltation from coal mining, forestry, agriculture, and urban development), pollution by toxic chemicals, introduction of nonnative fish (these alter the ecology of the system and affect host fish populations), and the introduction of two exotic mussels (the Asian clam and the zebra mussel).

An ecosystems approach to management represents the best opportunity to protect the remaining mussel fauna in Kentucky and through the United States because what happens in an entire watershed ultimately affects the mussels that live in the stream. The best example of using this approach is the Horse Lick Creek Bioreserve in eastern Kentucky. The Kentucky Chapter of The Nature Conservancy—working in cooperation with the U.S. Forest Service, U.S. Fish and Wildlife Service, Natural Resources Conservation Service, Cooperative Extension Service, Kentucky State Nature Preserves Commission, Kentucky Department of Fish and Wildlife Resources, Kentucky Division of Waste Management, Kentucky Division of Water, and the county health departments—has created a 40,000-acre unit to protect and manage for five federally endangered species (two mussels, two bats, and one plant) and a host of other rare mussels, bats, fishes, and plants. Fewer than 17,000 acres of the bioreserve are owned by the U.S. Forest Service or The Nature Conservancy; the rest remain in private ownership. The director works with the local community to educate and assist citizens in understanding the importance of the resource and the ways in which their actions affect the watershed. The program monitors activities in the watershed and assists in developing recycling programs, programs to clean up dumps, forestry and agricultural best management practices, pesticide and nutrient management programs, and other conservation programs.

The dominant feature in this landscape is the forest matrix. The hayland pastures are called patches. Patches differ in structure and function from the landscape matrix.

Corridors, like the forest along this stream, serve to link patches. Corridors can be a double-edged sword because they can serve as conduits for genetic exchange or as a travel route for exotic organisms that could invade the matrix.

ample of a species that needs thickets of five- to six-year-old jack pine interspersed with grasslands. This system is maintained by intense periodic fires. Managing the forest by harvesting timber does not appear to mimic the natural disturbance regime, so fire is required to maintain this system. An ecosystems approach to management recognizes that ecological systems are dynamic, fluid, and constantly adapting to change, whether minor or major.

An ecosystems approach also recognizes that humans disturb ecosystems through their management decisions. With an ecosystems management approach, we now look to the natural system for our management clues. These clues provide guidance to our management decisions to attempt to use human-induced disturbances to mimic natural disturbances.

It is important to look to the future to examine the cumulative effects of disturbance regimes or management. For example, if you had a 100-acre forest and decided to clearcut ten acres each year for ten years, the majority of the resulting forest would be in the pole stage (small trees), which contains the least amount of biodiversity, at the same time.

Diversity

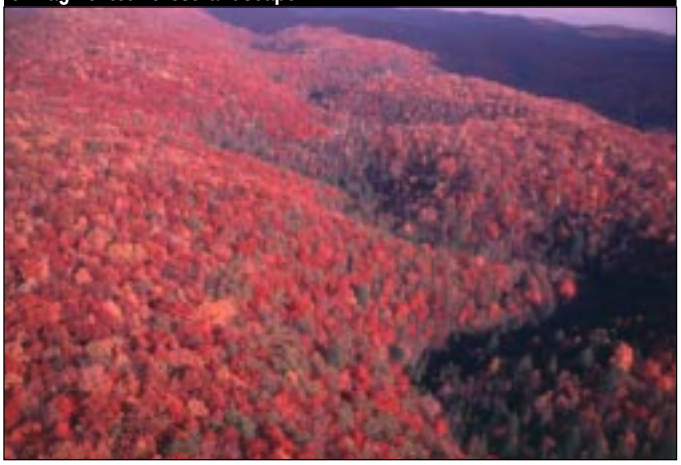
Ecological communities are groups or assemblages of interacting species and/or populations of species in any given area. We often refer to terrestrial communities by their dominant plants, like the mixed mesophytic forest, the beech-maple forest, or the oak-pine forest. Ecosystems are ecological communities and the physical environment that supports those living organisms. The myriad of different plants, animals, microbes, and fungi found in ecological communities gives rise to the concept of diversity or variety of different communities, species that make up communities, and the genetics that make up individual species. This is a core element in understanding ecosystems management and is different from managing for production of a particular game or tree species.

Ecosystems management at this level pays close attention to ecological processes, including the role of fire and other natural disturbances, hydrologic cycles, nutrient cycling, predation, and plant-herbivore interactions.

The Coarse Filter Approach

Managing for community diversity is a complement to, rather than a replacement for, species-level management. This has been referred to as applying a coarse management filter. The idea behind using a coarse filter for ecosystems management is that if we maintain intact functioning ecological communities, the species living in those communities will thrive. It has been estimated that 85 to 90 percent of all species can be protected using this coarse filter approach. For example, the grass pink orchid is known from one location on private land in Kentucky. This species requires a moist, acid soil, and open forest habitat to survive. Other unique or rare species that live in this community include the yellow fringed orchid, spiked blazing star, wood lily, and spreading pogonia orchid. By protecting and subsequently managing this ecological community, all these species thrive.

Unfragmented forest landscape



Unfragmented forest landscape—an important habitat for "forest interior" species.

Open-land matrix with patches and corridors

Historically this landscape was forested. It has been converted to an open-land matrix with forested patches and corridors. These small forest "islands" may serve as ecological traps for forest-interior species. This landscape favors generalist wildlife species like white-tailed deer.

This is not to suggest that we no longer need to manage individual species. It has been suggested that we should focus our species-level management on "keystone" or "umbrella" species. Keystone species—like the beaver—are organisms that are disproportionally important compared to their biomass in the community. They play a pivotal role in the ecosystem, and a large part of the community dynamics of the system depends on that species. Umbrella species— like the grizzly bear or grey wolf—are often charismatic species that have large ranges and act as a "flagship" or "symbol" for conservation. These species require vast amounts of habitat in which to live. The argument is that by managing for these species, we can include, by default, less "charismatic" species in the large reserves.

The Fine Filter Approach

Unfortunately, this approach does not always work, particularly for endemic plants (plants that have a unique and restricted range), and we need to apply a fine filter approach (managing for individual species) in managing rare or unique species that do not fall under the "umbrella" or "keystone" species or the community management approach. For instance, the glade cress grows on dolomite glades in Jefferson and Bullitt counties and nowhere else in the world. This annual plant is adapted to growing in shallow soils with disturbance and is thought to have evolved with bison, which created patches of bare ground in which the seeds of the plant could find the proper growing conditions. If we are to protect this highly specialized species, we have no other option but to manage or create its habitat because the government can never purchase enough land to protect the entire ecosystem for this plant. The future of this plant lies in the hands of the private landowner.

At the genetic level, the goal of an ecosystems approach to management should be to maintain genetic variation within and among populations of species, assuring that various processes such as genetic differentiation and genetic drift occur at normal rates. Each individual organism is a unique chemical and genetic factory unlike any other of its species. This reservoir of information has taken long periods of time to develop as a result of natural processes, including natural selection. This information cannot be duplicated or retrieved once it is lost.

The greater threat to biodiversity is to lose the unique genetic material contained within a species rather than to lose an entire species because rare species may have little genetic diversity. Furthermore, an individual organism may show no outward expression or appearance of genetic diversity, and we could lose that diversity without even knowing we lost it. It follows that a diverse or varied gene pool provides a hedge against an unknown future. It allows a species to adapt to constantly changing environments.

Perhaps the newest element in an ecosystems approach to management is understanding how all these layers fit together to form a landscape. At this level, the goal of ecosystems management should be to maintain complete, unfragmented environmental gradients. This means extending the

Table 3: Tools and Mechanisms for Achieving an Ecosystems Approach to Management

- An enlightened and educated public
- Adaptive management (fusion of science and management to improve and care for natural resources)
- Partnerships and cooperation (among federal, state, and local governments, non-governmental organizations, private landowners)
- Geographic Information Systems (a combination of computer hardware and software that stores geographic information)
- Gap Analysis Programs (a comprehensive effort to inventory and computerize the kinds and geographic distributions of plant and animal species)
- Private landowner incentives (including the wetland reserve program, conservation reserve program, forest stewardship program, and others)
- Landscape planning and zoning (using UNESCO's "Man and Biosphere" example or the concept of the "Multiple Use Module")
- Land trusts (use of conservation easements, purchasing development rights, land brokering)

management unit across different ecosystem types. Ecosystems vary in plant and animal species, structure, and ecological processes due to a response in various environmental gradients such as geomorphology, elevation, soil moisture, topography, and climate. For instance, in the southeastern mountains of Kentucky, forest community types in one watershed or hill can range from pine-oak communities on the ridge tops to cove hardwoods on north-facing lower slopes to oak-hickory forests on drier, sunnier slopes and riparian forests in the bottoms. These are then intermixed with oldfields, pastures, tobacco fields, and communities to make up a landscape.[1]

Guidelines for Implementing an Ecological Approach to Wildlife Management at the Landscape Level

It would be a nice luxury if you could just look at ecological components and systems and manage for the plants and animals. It would also be much simpler. However, the reality is that people live in the landscape, and people have needs. In the end, if we are to truly manage ecosystems, we cannot ignore people; we have to consider them as an integral component of ecological systems. We must look at their social and economic needs such as agriculture and forest products and try to provide those within the ecological capabilities of that area. If we accomplish this, the more we can pull everything together, and the more sustainable our ecosystems will be. However, we will be much more successful in managing wildlife if we manage at the broader scale using the landscape. This is certainly a reasonable scale for integrating diverse and sometimes competing resource values, for maintaining and conserving biodiversity, and for managing habitats including timber harvesting. Ultimately, we will have a greater opportunity for maintaining wildlife while still using the land for human needs.

The time has come to carefully examine traditional management and move to more holistic management. But how can this be accomplished? There are no simple answers, but remember that ecosystems management is a dynamic process and requires a strategy that develops, enhances, and protects the ecological and socioeconomic values of the resource while maintaining private ownership. For this system to work, it will require a variety of tools (Table 3) and must address these spatial and temporal concepts:

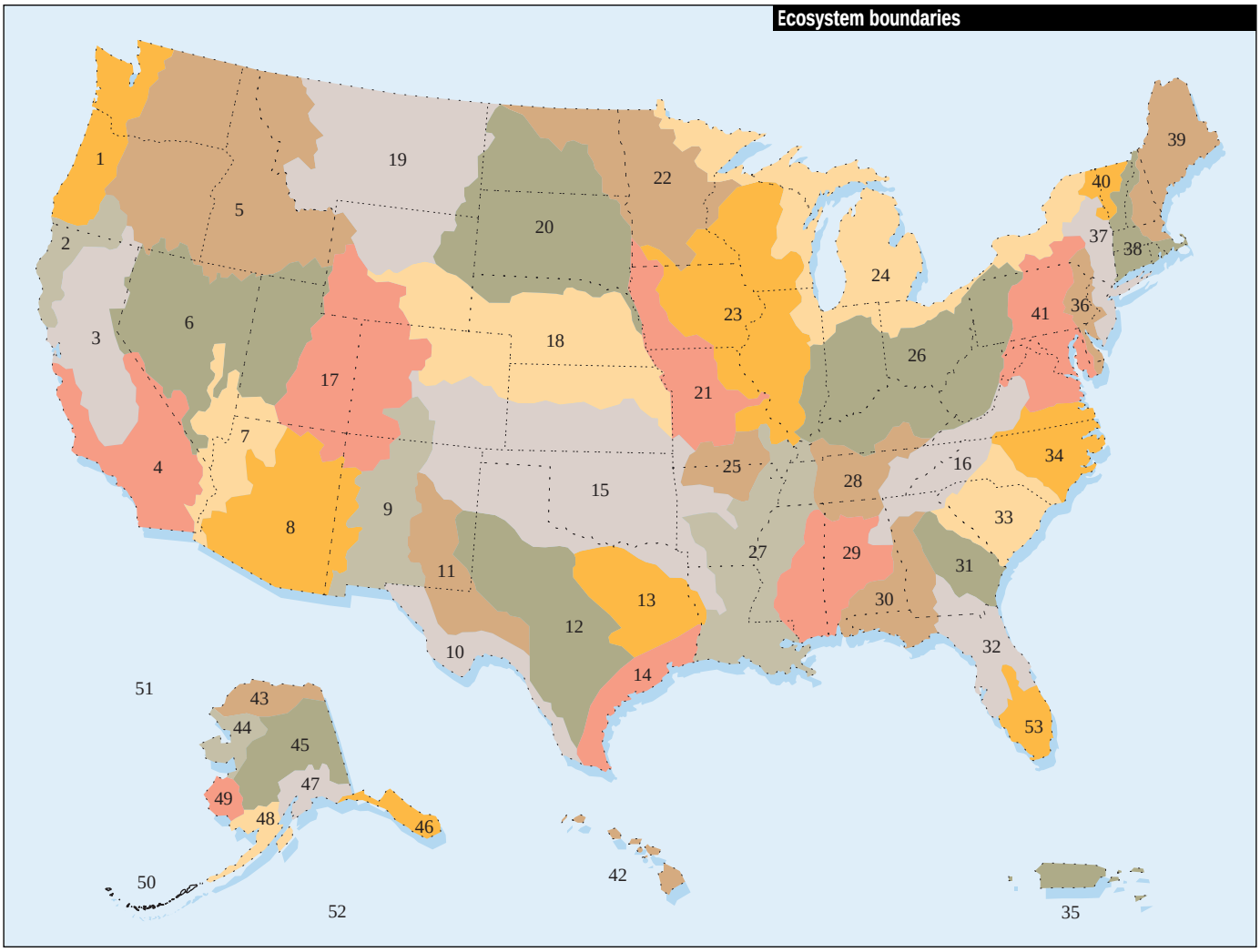
- ecosystems management is a perpetual process
- management goals may not be reached during an individual's lifetime or period of land ownership
- ecosystems management is most effective at the landscape level
- management goals and objectives should remain constant and consistent throughout time.

The Challenge of Ecosystems Management

The challenge is how to implement this new management approach that allows for humans to occupy the land and provides for the needs of humans and still makes a place for nature. Further complicating the issue is that most land is privately owned, and it is therefore the responsibility of individuals to manage their property sustainably.

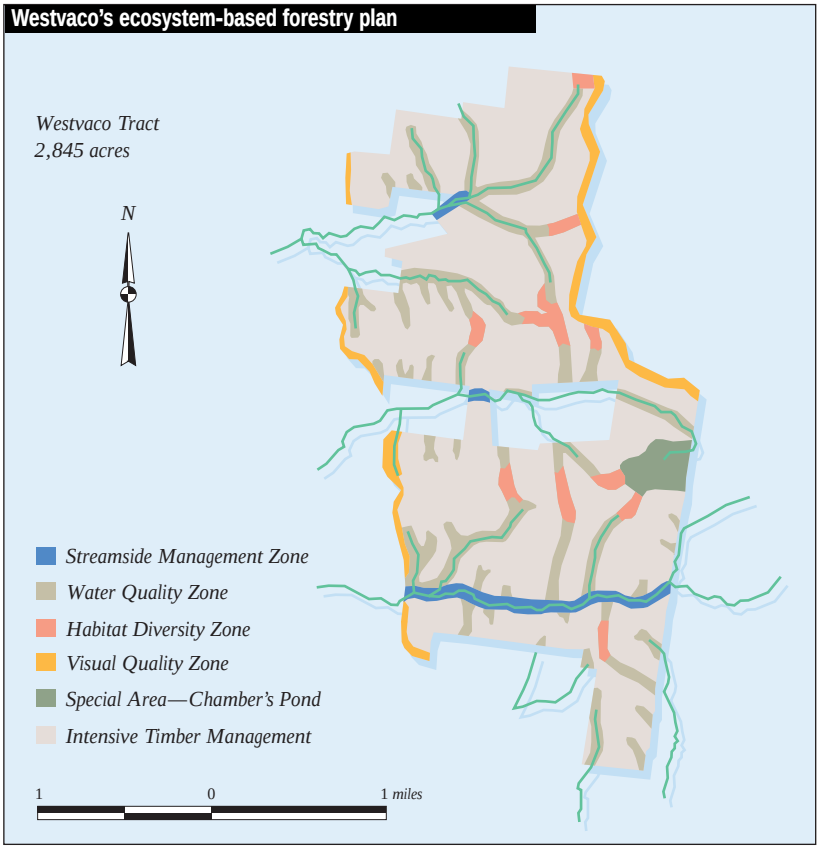
The funding required for government to own and protect all natural resources and to afford both public and private benefits does not exist and will never exist. When landowners combine their private values with responsible stewardship, a landscape-level private stewardship plan can work. The basic ingredients for a landscape stewardship program include the following integrated components that help individual landowners:

- share a common vision of stewardship
- educate themselves, each other, and their children about the ecological and economic needs of the area
- celebrate and show pride in the area
- participate in a total program
- respect private property rights
- give up maximum short-term economic gains or profits to achieve long-term goals for the community.



Unit Name*	Lead Region
1. North Pacific Coast	1
2. Klamath/Central Pacific Coast	1
3. Central Valley of California/San Francisco Bay	1
4. South Pacific Coast	1
5. Columbia River Basin	1
6. Interior Basins	1
7. Lower Colorado River	2
8. Gila/Salt/Verde River	2
9. Middle and Upper Rio Grande	2
10. Lower Rio Grande	2
11. Pecos River	2
12. Edwards Plateau	2
13. East Texas	2
14. Texas Gulf Coast	2
15. Arkansas/Red Rivers	2
16. Southern Appalachians	4
17. Upper Colorado River	6
18. Platte/Kansas Rivers	6
19. Upper Missouri/Yellowstone Rivers	6
20. Main Stem Missouri River	6
21. Lower Missouri River	3
22. Mississippi Headwaters/Tallgrass Prairie	3
23. Upper Mississippi River/Tallgrass Prairie	3
24. Great Lakes	3
25. Ozark Watersheds	3
26. Ohio River Valley	5
27. Lower Mississippi River	4
28. Tennessee River	4
29. Central Gulf Watersheds	4
30. Florida Panhandle Watersheds	4
31. Altamaha Watershed	4
32. Peninsula Florida	4
33. Savannah/Santee/Pee Dee Rivers	4
34. Roanoke/Tar/Neuse/Cape Fear Rivers	4
35. Caribbean	4
36. Delaware River/Delmarva Coastal Area	5
37. Hudson River/New York Bight	5
38. Connecticut River/Long Island Sound	5
39. Gulf of Maine Rivers	5
40. Lake Champlain	5
41. Chesapeake Bay/Susquehanna River	5
42. Pacific Islands	1
43. Arctic Alaska	7
44. Northwest Alaska	7
45. Interior Alaska	7
46. Southeast Alaska	7
47. South Central Alaska	7
48. Bristol Bay/Kodiak	7
49. Yukon—Kuskokwim Delta	7
50. Bering Sea/Aleutian Islands	7
51. Beaufort/Chukchi Seas	7
52. North Pacific/Gulf of Alaska	7
53. South Florida	4

**U.S. Fish and Wildlife Service*



These components also enable policies whereby:

- protection is afforded to critical land through a land trust, private conservation organization, or government agency
- landowners receive tax deductions for conservation easements
- property taxes are reduced on land managed by a land trust
- forests are not further fragmented by development
- riparian forests and corridors are enlarged and restored to connect tracts of contiguous forests
- values of stewardship are handed down from generation to generation.

Individual actions dictate the future of the forest. Consider that if everyone does what I am doing to the forest, will we be able to maintain a high-quality forest resource?

Thus, if individuals have no knowledge of how their neighbors are using the forest, it is hard for an individual to decide what actions may be necessary to protect the forest. If both neighbors decide to harvest all the old trees, the forest is changed for many years to come. Without communication, coordination, and cooperation, it is impossible to know what your neighbors are doing and to engage in long-term planning. The stewardship plan should integrate all the principles of managing forests, wildlife, soil, and water resources.

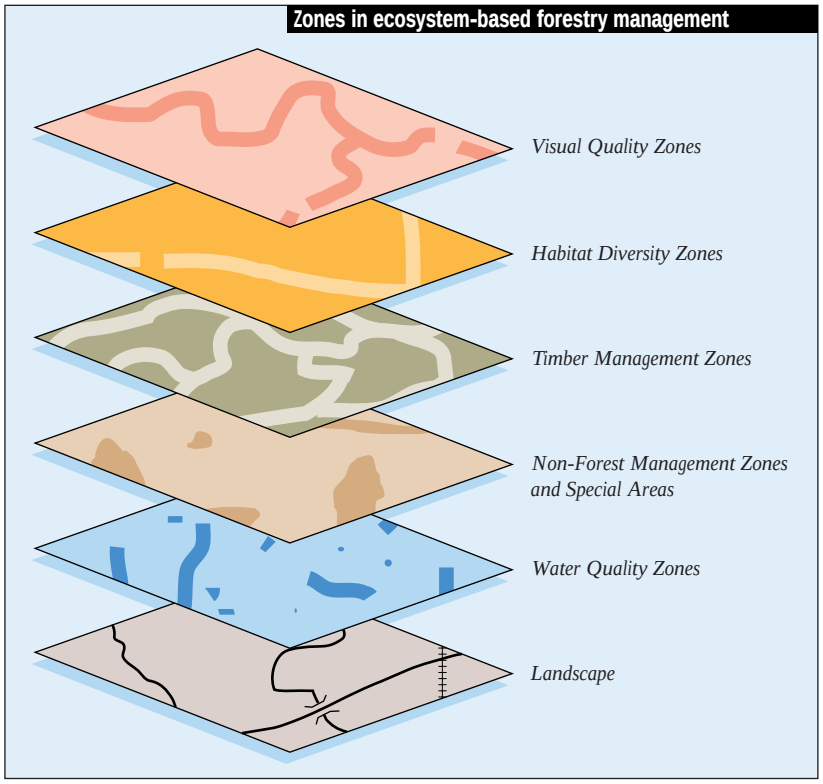
Several examples will illustrate how ecosystems management is being used by the federal government and the private forest industry. The U.S. Fish and Wildlife Service approach has been to develop cross-program (discipline) teams that focus on specific resource issues, to delineate 53 ecosystem units based on U.S. Geological Survey watersheds that will provide a framework for cooperation within and outside the agency, to realign the organization so Program Assistant Regional Directors became Geographic Assistant Regional Directors, and to provide information and education about ecosystems management at all organization levels. This should result in meeting fish and wildlife needs within a context of their natural environments while meeting human or social needs, increasing cooperation within the U.S. Fish and Wildlife Service, and communicating, coordinating, and collaborating more effectively with partners, affected stakeholders, and the public.

It is important to realize that the U.S. Fish and Wildlife Service is not abandoning its traditional activities; it will continue to establish and manage wildlife refuges, restore habitats, reduce environmental degradation and contamination, regulate the harvest of migratory birds, protect endangered and threatened species and their habitats, and provide technical assistance to private landowners. The U.S. Fish and Wildlife Service hopes an ecosystems approach to management will assist in accomplishing its objectives in a more coordinated fashion with more input from stakeholders and partners and will include the integration of information across all levels of organization. For instance, the U.S. Fish and Wildlife Service will still take necessary steps to save a species from extinction but will also examine the causes that led to endangerment which should ultimately help limit the number of species that would need to be listed in the future.

The forest industry has been quick to embrace the concepts of ecosystems management, and the Sustainable Forestry Initiative is the official program developed by the American Forest and Paper Association. It has defined ecosystems management as "a resource management system designed to maintain or enhance ecosystem health and productivity while producing essential commodities and other values to meet human needs and desires within the limits of socially, biologically, and economically acceptable risk." Westvaco, a private forest industry with a paper mill in western Kentucky, provides an example of how the forest industry is applying the concepts of ecosystems management.

Westvaco's ecosystem-based forestry uses a mixture of six zones to maintain diverse forest types and ages on their land. Each zone has one primary and numerous secondary functions designed to protect and maintain water quality, site productivity, wildlife habitat, visual quality, biodiversity, and areas of special significance. On the landscape, these zones and areas fit together like a jigsaw puzzle to form a complete picture. This is also an example of how a GIS can be used to create an ecosystems approach to management.

The ecosystem-based forest management planning at Westvaco begins with identification of areas to be included in Streamside Management and Water Quality Zones. Since watercourse location and topography are fixed, zones related to water are the base, or primary, GIS layer. Special areas are the second layer of information and include nature trails, endangered species locations, and old iron-ore furnaces. The third layer is the non-forest management zone that includes areas where forest management is not possible or practical. This includes road and utility right-of-ways, lakes, marshes, and non-forested wetlands. The fourth layer is the timber management zones that are used for intensive production of fiber to meet the paper mill's demand. They use an even-aged forest management and plantations to meet fiber demands. The fifth layer is the habitat diversity zone. These zones are strategically located across the landscape to enhance biodiversity and wildlife habitat. They often connect Streamside Management and Water Quality Zones to provide a continuous web of wildlife habitat. The final layer is the Visual Quality Zone. These are identified to maintain aesthetics and visual integrity.



Is ecosystems management used in practical settings, and can it succeed? The answer is absolutely yes—it has to for the survival of wildlife, wildlands, and humans.

[1]Because understanding landscape ecology is paramount to implementing an ecosystems approach to management, please read the companion publication, FOR-74, *Landscape Ecology and Ecosystems Management*, available through the Kentucky Cooperative Extension Service.

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