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Ecosystem Management

Opportunities and Implications for Woodland Owners

OREGON STATE UNIVERSITY EXTENSION SERVICE

Ecosystem Management

Opportunities and Implications for Woodland Owners

M. Bennett

"Why are we getting so worked up over the term ecosystem management? We have the opportunity to influence what it means."

—*Charles Tarver*

Ecosystem management, or EM for short, is much debated among foresters and landowners. Some view EM as a threat to private property rights. Others see EM as the wave of the future, a broader approach to management in which landowners coordinate activities across property boundaries. Still others see EM as a less intensive approach to forestry that does away with clear-cutting and chemical use. Many people simply are confused by the term and its implications.

One reason for these differing perspectives is that there is no single, widely accepted definition of EM. Many individuals and organizations have proposed their own definitions, which differ in important ways.

Despite these differences, certain fundamental concepts underlie most current thinking about EM. This publication will help you better understand these concepts. It discusses the key elements of EM, some of its potential implications, and how forests can be managed on the basis of ecosystem principles.

Max Bennett, Extension forestry assistant, Oregon State University.

Origins of ecosystem management

An ecosystem is a community of organisms interacting with each other and their nonliving environment within a defined area. More informally, ecosystems are described as the "home places" where organisms—including humans—live, get their food, and dispose of wastes (Salwasser, 1994).

Ecosystems can be identified at many scales, depending on the issue or process of concern. A 40-acre woodland property may encompass several small-scale ecosystems, such as patches of forest, small ponds, or meadows. In turn, it is part of larger scale ecosystems that encompass **watersheds*** and **landscapes**. The planet earth is itself an ecosystem. At larger scales, ecosystems often cross property boundaries.

While the ecosystem concept has been around for decades, the idea of ecosystem management is relatively new. One catalyst for EM's development is the increasing number of plant and animal species threatened with extinction. In 1990

*Key terms are highlighted in bold type and are defined in the glossary on page 11.

alone, over 3,500 species were listed as candidates for protection under the federal Endangered Species Act (Edge, 1996)

Developing protection strategies for each species would be daunting. Instead, some proposed strategies involve conserving the habitat used by whole communities of organisms. Managing habitat at the community or ecosystem level, rather than species-by-species, would make endangered species preservation more effective and less costly, at least in theory.

Recent scientific advances also have played a role in the development of EM. In particular, the discipline of landscape ecology has led to increased emphasis on managing ecosystems at large geographic scales. Landscape ecology suggests that some management practices that are acceptable at the local scale might have unintended negative effects at larger scales.

For example, data from the eastern United States indicate that songbird populations are declining because of habitat **fragmentation**. In this case, fragmentation occurs when forest patches are isolated in areas dominated by a mixture of agricultural and urban lands.

Forest fragmentation usually is perceived as negative, but it also can have positive or neutral effects. The fragmentation issue is complicated and controversial.

A third factor leading to the emergence of EM is a change in public attitudes. According to many

Figure 1.—Ecosystem management definitions.

Ecosystem management has been defined by a variety of academics, public agencies, private organizations, and individuals. Some definitions include:

❝ The use of an ecological approach to resource management at the landscape level that blends social, physical, economic, and biological considerations to ensure the sustainability of healthy ecosystems while providing desired values, goods, and services.❞

Society of American Foresters Terminology Committee, 1995

❝ The application of biophysical and social information, options, and constraints to achieve desired social benefits within a defined geographic area and over a specified time period.❞

Robert Lackey, 1994

❝ The essence of ecosystem management lies in its objectives and its wider spatial and time scales, not in the particular management practices used to achieve these objectives. Protection and enhancement of ecosystem integrity and function are essential.❞

Lorimer and Frelich, 1994

❝ By ecosystem management, we mean an ecological approach that will be used to achieve the multiple-use management of the National Forests and Grasslands. It means that we must blend the needs of people and environmental values in such a way that the National Forests and Grasslands represent diverse, healthy, productive, and sustainable ecosystems.❞

Dale Robertson, former chief of the USDA Forest Service, 1992

❝ Ecosystem management is 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.❞

American Forest and Paper Association, 1994

❝ When small woodland owners manage their property, it isn't done solely for the purpose of producing timber. Rather, they manage for all the life which exists on the land. That is ecosystem management, and we've been doing it as long as I've been associated with small woodland owners.❞

Bill MacKenzie, Oregon Small Woodlands Association

recent public opinion polls, Americans increasingly favor a "holistic" approach to forest management over an approach focused on the production of commodities such as wood (Shindler, et al., 1993).

For example, in one recent national survey, 78 percent agreed or strongly agreed that greater protection should be given to fish and wildlife habitat on federal forest lands. Only 24 percent thought that federal forest management should emphasize timber products (Shindler, et al., 1993).

Whether or not these opinions reflect shifts in underlying values or behavior is another question (Adams, 1995). Many observers have noted that despite the shift in public opinion, wood consumption generally has been increasing.

Figure 2.—Key elements of ecosystem management.

- Seeks to maintain, improve, or restore forest health, biodiversity, and sustainability
- Focuses on large spatial scales—watersheds, landscapes, regions
- Considers very long time scales
- Uses management actions that attempt to imitate natural ecosystem processes
- Responds to society's growing emphasis on the non-timber values of forests

Key features

What, then, is ecosystem management? Ask five foresters, landowners, and scientists, and you're likely to get five different answers (Figure 1). Nevertheless, several common themes emerge (Figure 2):

*EM seeks to maintain or enhance **biodiversity**, **forest health**, and **sustainability***. Biodiversity refers to the variety of living organisms at all levels, from genetics to species. Species richness, the number of species in a particular area, is just one measure of biodiversity.

Forest health is the condition of a forest in relation to a particular set of management objectives. For many people, a healthy forest is one that is relatively free of insect and disease problems. To others, a healthy forest has a variety of plant and animal species and is resilient to change.

In fact, no "scientific" definition of forest health exists. What is "healthy" depends on what you're managing for.

Sustainability refers to the long-term maintenance of certain conditions or capacities. Maintaining a constant flow of timber or fish, the potential productivity of the ecosystem, or viable populations of native wildlife species are examples of sustainability.

As with forest health, sustainability is defined by management objectives. Unfortunately, discussions about "forest health" and "sustainability" aren't always clear about the values and objectives that underlie these terms.

EM emphasizes large geographic scales such as watersheds, landscapes, and regions. A landscape perspective is important in part because many species require large areas of habitat. A herd of Roosevelt elk, for example, may have a home range of 1,500–5,000 acres. A single grizzly bear may range over hundreds of square miles.

Additionally, no one type of forest structure, whether a clear-cut, a young stand, or an old-growth forest, provides optimal habitat for *all* forest-dwelling species. Thus, it may be necessary to provide a variety of conditions across a landscape or region to meet broad wildlife habitat goals (Oliver, 1993).

Watersheds are easily defined and often are a focus of landscape-level planning because of the simple fact that water flows downhill. Hence, water quality and fish habitat in one part of the watershed depend on the **cumulative effects** of upstream activities.

The focus on large geographic scales also stems from concerns about habitat fragmentation, especially in old-growth forests. Large, contiguous areas of old-growth forest may be needed to maintain viable populations of species such as spotted owls and marbled murrelets.

In addition, adjacent ecosystems often interact in important ways. For example, a forest next to a meadow produces edge habitat, which is favored by certain forms of wildlife. Similarly, riparian areas typically have high levels of plant and animal diversity because they are located at the intersection of upland forests and stream ecosystems.

Finally, a landscape focus may be helpful because natural processes such as fire, insect infestations, and disease don't recognize property boundaries.

EM considers both natural and management influences over very long periods of time. The effects of management activities on site productivity, for instance, may be considered over multiple rotations that encompass hundreds or even thousands of years.

EM emphasizes understanding, using, and imitating natural ***ecosystem processes*** *such as fire.* For example, in areas where frequent surface fires occurred naturally, prescribed fires could reduce fuel loads and stand densities, and promote desired species. Where natural fires were severe enough to kill some or most of the trees in a stand and create many snags, patches of snags and green trees could be retained in harvested areas.

At the scale of a watershed or landscape, harvest patterns could be based on the size, shape, intensity, and frequency of past fires or other disturbances such as windstorms.

EM reflects society's changing objectives. EM has emerged in part as a response to growing demands on forests for recreation, aesthetics, wildlife habitat, and other non-timber values. Some observers view this as a shift from a "utilitarian" to a "preservation" perspective. However, many proponents of EM also recognize that society consumes large quantities of wood products; thus, EM must balance the production of commodities such as wood with non-commodity objectives.

Unresolved issues

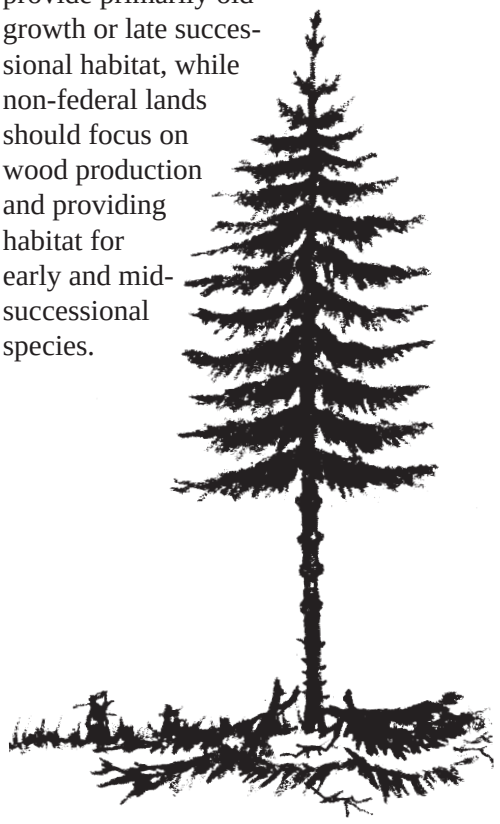
While many concepts and values are common to most views of EM, major differences also exist (Figure 1). Some EM advocates focus almost exclusively on ecological considerations. Others see EM as a way to reconcile human needs for wood products with environmental values.

Likewise, many proponents of EM view it as a way to achieve objectives such as "protection and enhancement of ecosystem integrity." But others see EM as an innovative *process* for meeting whatever objectives are defined by the landowner, community, or society. Other differences relate to definitions of sustainability and forest health.

In addition, some important issues remain unresolved:

Many discussions of EM are couched in terms of public lands or aren't specific about ownership types. But private lands, which account for 72 percent of the timber land in the United States (Haynes, 1990), typically are managed for different objectives and face different constraints.

What is the role, if any, of private lands in EM? Some have argued that federal lands should provide primarily old-growth or late successional habitat, while non-federal lands should focus on wood production and providing habitat for early and mid-successional species.



A related issue is the cross-ownership effects of management activities. For example, in some areas of the western United States, insect infestations and heavy fuel loads on federal lands have increased hazards to adjacent private lands.

EM involves managing watersheds and landscapes that cross property lines. How will this be accomplished? How much control will landowners retain? Will goals be achieved voluntarily through landowner partnerships or through legal requirements? Will new restrictions on forestry activities be instituted? What incentives will there be for participation?

The potential loss of private property rights is a major concern for landowners. Landscape management plans or regulations that limit what kinds of practices can be used and the timing and location of timber harvests are unwelcome to many. Efforts that allow for management flexibility and offer incentives for participation probably will get a more favorable response.

A variety of incentives could promote cross-ownership management, including tax breaks, trusts, and conservation easements; cost-share or stewardship funds; and market mechanisms such as tradable harvest rights.

Conservation easements in particular have played an important role in watershed-based efforts where private lands are common. In essence, a conservation easement allows a public or private organization such as a land trust to purchase development or other rights on a parcel of private land; the landowner still retains title and other exclusive rights to the parcel.

In some areas, tax breaks have been offered for preserving wildlife habitat. Cost-share and stewardship funds typically are offered to individual landowners but could be offered to groups of landowners to promote cooperative efforts.

There have been proposals to allow landowners to trade harvest rights, similar to the way some firms can buy and sell pollution rights, but a harvest-rights market has not yet been created.

Technical assistance and education also have been suggested as tools for promoting consideration of landscape-level concerns on private lands. Efforts underway in Minnesota provide one example (Rose and Phillips, 1993). There, landowners are given options for addressing landscape issues in stewardship management plans.

Each plan contains a state map of major ecological regions, a description of the ecoregion in which the property is located, a discussion of the issues of concern in the ecoregion (such as soil erosion and fragmentation of forest bird habitat), and recommendations for dealing with these issues. Following the recommendations is voluntary.

Meeting landscape-level goals thus begins with an effort to map and classify ecoregions and identify important issues. Ultimately, however, it depends on education, technical assistance, and the voluntary efforts of landowners.

What actions does EM call for? Even where there is agreement that EM "prescriptions" should be site-specific, most discussions of EM are sketchy on this point.

Some EM proponents emphasize preserving forests as wilderness. Others focus on modifying current silvicultural practices to more closely match natural processes. Still others call for retaining intensive management practices such as clear-cutting, fertilization, and herbicide use for promoting desirable forest characteristics.

EM emphasizes managing at large spatial scales, but most woodland properties are far smaller than watersheds or landscapes. What are the appropriate scales for management? Where do woodland owners fit in? This question is addressed below in the section "Using ecosystem science concepts to manage woodland properties."

The uncertainty about EM leads to much confusion, and sometimes frustration. However, it also presents an opportunity. As consulting forester Charles Tarver asks, ". . .why are we getting so worked up over the term ecosystem management? We have the opportunity to influence what it means" (Tarver, 1994). Woodland owners should be key players in the debate about EM, especially as it pertains to private forest lands.

Using ecosystem science concepts to manage woodland properties

Many landowners wish to enhance the health, diversity, and sustainability of their forests while maintaining economic value. You often can meet these objectives by managing on the basis of ecosystem science principles.

For instance, you can increase wildlife diversity by increasing habitat diversity. Examples of practices that increase habitat diversity include leaving snags, thinning to promote development of understory shrubs, underplanting with shade-tolerant species, and creating openings in dense stands through timber harvest. Similarly, you can enhance plant diversity by thinning, pruning, and replanting a variety of species in harvested areas.

Knowledge of forest succession and habitat relationships can lead you to favor a particular successional stage to encourage certain kinds of wildlife. For example, openings created through timber harvest may provide forage for deer and elk, while mature sawtimber stands provide habitat for woodpeckers and flying squirrels. These concepts are explained in greater detail in *Managing Wildlife Habitats in Forested Ecosystems,* EC 1470. (See "For further reading" on page 9.)

Figure 3.—What can you do?

Practices you can pursue on your own land

- Seek professional assistance
- Implement a forest management plan
- Maintain land in a forested condition
- Enhance fish and riparian habitat
- Follow Best Management Practices
- Protect sensitive or unique habitats
- Encourage native species
- Let more stands grow to old forest conditions
- Use thinning and other harvest practices to increase habitat diversity
- Pursue continuing education

Practices you can pursue with neighbors

- Identify adjoining landowners
- Identify shared landscape features
- Talk with your neighbors and identify common goals
- Encourage responsible stewardship
- Share natural resource professionals
- Join local woodland or watershed associations
- Be aware of landscape concerns in your region
- Connect woodlands where possible

Adapted from Anderson, 1995

You can maintain soil productivity—a key element in many definitions of sustainability—by using appropriate harvesting and site preparation techniques. Examples include minimizing the area disturbed by roads and compacted skid trails, conducting "cool" slash burns, harvesting only the boles of trees, leaving some woody debris, and other practices.

You can maintain healthy forests, defined as diverse, resilient to change, and relatively free of insect and disease problems, through a variety of silvicultural activities. For example, you can improve the vigor and resilience of many overstocked mixed conifer forests by thinning.

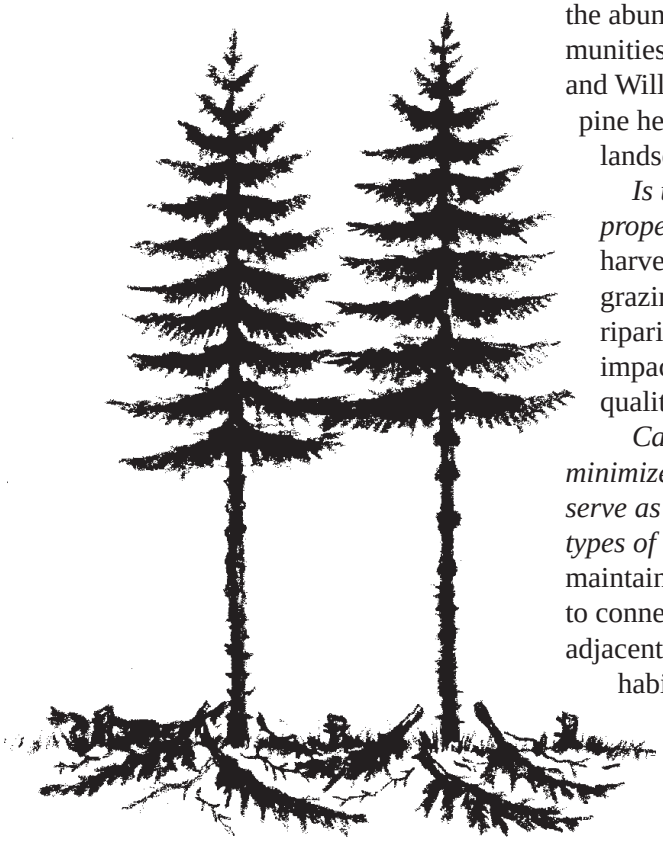


Figure 3 lists additional practices you can pursue to meet ecosystem goals. Many woodland owners already do these things, and in the process are meeting both their own objectives and many of the goals of ecosystem management.

You may want to look beyond your property to consider the role it plays in a larger watershed or landscape. Some important questions to ask include:

Does the property contain important habitats that are rare in the watershed or region? Landowners who maintain or increase the abundance of rare plant communities such as Oregon white oak and Willamette Valley ponderosa pine help promote regional landscape diversity.

Is there a stream on the property? By using proper harvesting, road building, and grazing practices, especially in riparian areas, you can minimize impacts on downstream water quality and fish habitat.

Can the property be treated to minimize habitat fragmentation, or serve as a corridor between other types of habitat? For instance, maintaining a mature forest stand to connect similar stands on adjacent properties would minimize habitat fragmentation.

Depending on your objectives and those of neighboring owners, adopting a landscape perspective will provide several management options. (See EC 1470 for more information.)

You can work with other landowners to address watershed or landscape-level issues (Figure 3). This can be as simple as talking to neighboring owners and identifying common concerns, or as complicated as joining with neighbors and public and private organizations to form a landscape or watershed association.

Many such associations have focused on water resource issues. In southwestern Oregon, forestry companies, small woodland owners, fishermen, and representatives from public agencies formed a watershed association with the goal of improving salmon runs (Anderson, 1995). The association focuses on education, outreach, and watershed restoration projects such as planting riparian zones and creating side channels for rearing habitat.

In South Carolina, the ACE basin project focuses on maintaining the natural character of a 300,000-acre estuary and wetland (Del Sesto, 1994). This is accomplished primarily by purchasing conservation easements from willing sellers. Traditional economic activities, including forestry, are maintained, and assistance is available to improve wildlife habitat. As with the Oregon project, many public and private organizations are involved.

Many other associations address specific natural resource issues within a defined watershed or landscape. Of course, some are more successful than others. Common features of more successful efforts include voluntary partnerships, identification of common goals, a focus on education and outreach, a concern for maintaining economic values, and the use of landscape analysis (Anderson, 1995).

Conclusions

Does ecosystem management really differ from "traditional" forest management? In some respects, EM embodies what many landowners already do—manage for healthy, diverse, and sustainable forests, while producing wood, an essential commodity. EM differs from past approaches chiefly in its focus on larger geographic areas and increased emphasis on non-timber-oriented objectives.

You don't have to embrace all of the elements of EM to benefit from the emerging science of ecosystems. Ecosystem concepts can be applied at a variety of scales—from an individual property, to the local watershed, to a larger landscape or region. Thinking about how your property fits in with your neighbors' may add a new dimension to your management.

In addition, you can act in concert to manage for landscape-scale objectives, such as watershed improvement. Such objectives need not be dictated from above, but can be developed through discussions with neighboring landowners and other affected parties, and can be focused on local issues.

"Ecosystem management will happen" (Irland, 1994). "The momentum of this natural resource [approach] is undeniable" (Tarver, 1995). "EM appears to be the wave of the future" (Jones, 1994).

These comments, all from individuals associated with the private forestry sector, suggest that, for better or worse, EM will be around for awhile. But what definition ultimately will emerge as the accepted one? How will EM be implemented on private lands, if at all? Who will be involved with concerns that cross ownerships? Forest landowners can and should play a key role in answering these questions.

For further reading

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Glossary

Biodiversity—The variety of living organisms considered at all levels, from genetics through species and higher taxonomic levels, and including the variety of habitats and ecosystems (Edge, 1996). Key terms associated with biodiversity (Edge, 1996):

Genetic diversity. The variety of genes within a particular species, variety, or breed.

Species richness. The number of species present in an area. One of the most common measures of biodiversity.

Within-stand or local diversity. The variety of organisms occurring in a particular place, habitat, or stand.

Between-stand diversity. The change in variety of organisms among habitats or stands in a particular region. This depends on the number of different habitats within a region and the contrast of adjacent habitats. For example, a clear-cut adjacent to an old-growth forest would have higher between-stand diversity than an old-growth stand next to a sawtimber stand.

Regional diversity. The variety of organisms summed over all the habitats within a region. This is similar to landscape-level diversity.

Structural diversity. The variation within a habitat that is a function of the structural complexity of the vegetation. Clear-cuts have low structural diversity, while uneven-age stands have higher structural diversity.

Cumulative effects—The environmental effects resulting from an activity such as road construction, when added to other past, present, and future incremental actions, regardless of ownership (Adams, 1994).

Ecosystem process—Some of the important processes that take place in ecosystems include: (1) the "flow" of genetic information among populations, (2) nutrient cycling, (3) the water cycle and watershed processes, (4) disturbance and succession, (5) energy flow and storage, and (6) food chains.

Forest health—The condition of a forest as evaluated by a given set of objectives (Filip, 1994). Forest health is a social-related, not a scientific term, so its definition depends on management objectives. For example, on a Christmas tree farm, health might be defined as disease present in 5 percent or less of the trees. In a high-yield plantation, 10 percent or less disease might be acceptable. In an old-growth forest, 25–50 percent disease/mortality is "normal" and could be considered "healthy." A healthy forest also has been defined as one that has all of its ecosystem processes fully functioning and has a high degree of resistance and resilience to disturbance (Filip, 1994).

Fragmentation—Breaking up large areas into progressively smaller patches that are increasingly isolated from one another (USDA, 1994). Staggering clear-cuts throughout a watershed covered by mature timber stands is an example. Fragmentation can be harmful to species requiring large contiguous areas of forest, but it also can have neutral or positive effects on diversity.

Landscape—A large regional unit of land consisting of many forest stands or patches, irrespective of political or other artificial boundaries. Landscapes vary in size from a few hundred acres to tens of thousands or more acres. Very large landscapes often are referred to as regions or provinces.

Sustainability—The ability to maintain a desired condition or flow of benefits over time (USDA, 1994). *Sustainable development* has been defined as the ability to meet the needs of the present without compromising the ability of future generations to meet their needs. However, *what* benefits should be sustained depends on human objectives and values and is not implied in the concept of sustainability itself. Measuring sustainability is an important issue. Ecosystem outputs such as mushrooms, recreational opportunities, and timber often can be readily measured; ecosystem conditions or states often are more difficult to quantify (Emmingham, 1995).

Watershed—A total area of land above a given point that contributes runoff water to the flow at that point (USDA, 1994). Watersheds vary in size from a few acres for a first-order stream to millions of acres for the Columbia and other large river systems.

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