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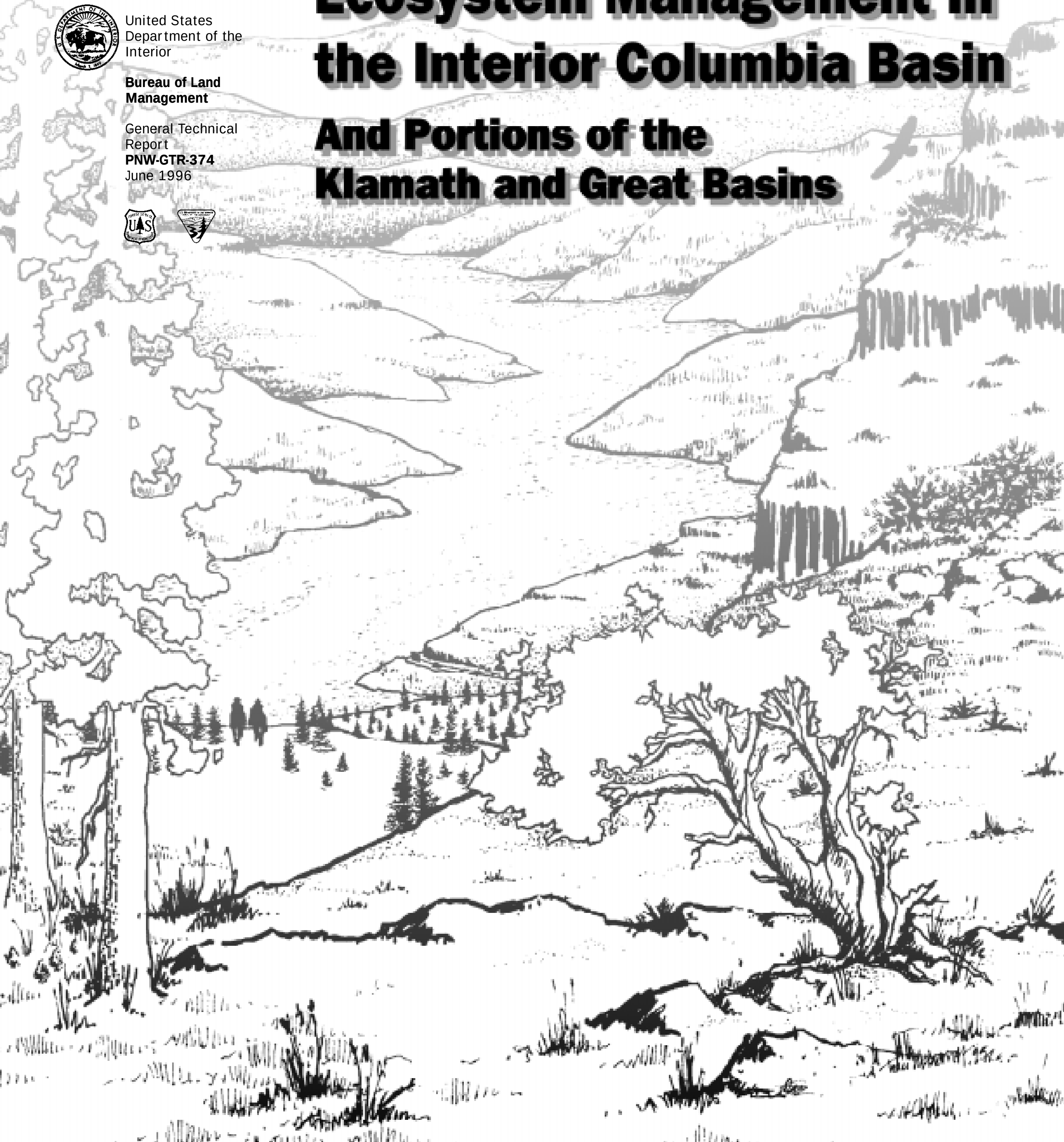
A Framework for Ecosystem Management In the Interior Columbia Basin

And Portions of the Klamath and Great Basins



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Interior Columbia Basin Ecosystem Management Project

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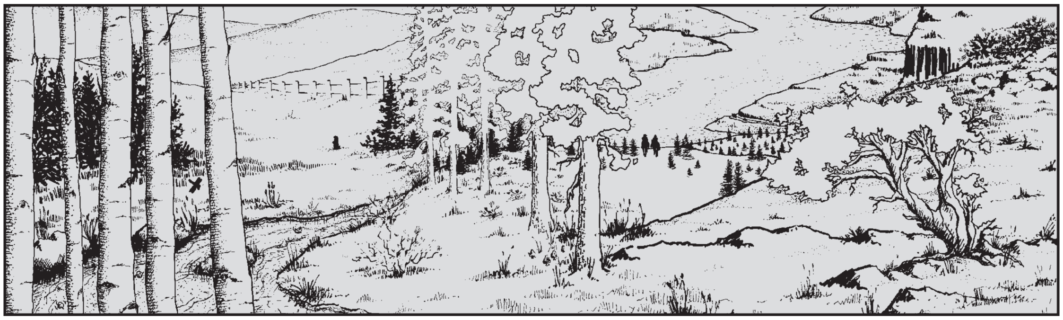

A Framework for Ecosystem Management In the Interior Columbia Basin

And Portions of the Klamath and Great Basins

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ABSTRACT

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A framework for ecosystem management is proposed. This framework assumes the purpose of ecosystem management is to maintain the integrity of ecosystems over time and space. It is based on four ecosystem principles: ecosystems are dynamic, can be viewed as hierarchies with temporal and spatial dimensions, have limits, and are relatively unpredictable. This approach recognizes that people are part of ecosystems and that stewardship must be able to resolve tough challenges including how to meet multiple demands with finite resources. The framework describes a general planning model for ecosystem management that has four iterative steps: monitoring, assessment, decision-making, and implementation. Since ecosystems cross jurisdictional lines, the implementation of the framework depends on partnerships among land managers, the scientific community, and stakeholders. It proposes that decision-making be based on information provided by the best available science and the most appropriate technologies for land management.

Keywords: Ecosystem assessment, ecosystem principles, ecosystem management, planning models, management goals, risk analysis.

PREFACE

Preparing this framework involved many people. Much of the early work involved the entire Science Integration Team and the Eastside Environmental Impact Statement Team. Jim Morrison and Russ Graham led a small group (Terrie Jain, Tom Quigley, Mark Jensen, and Gene Lessard) that drafted the second version of this framework. Richard Haynes and Russ Graham led another small group (Terrie Jain, Chris DeForest, Bruce Marcot, Steve McCool, and Tom Quigley) that eventually produced the third draft. The final version was prepared by Richard Haynes, Russ Graham, and Tom Quigley.

The Interior Columbia Basin Ecosystem Management Project received extensive comments (including anonymous peer reviews) on previous versions of the "Framework for Ecosystem Management in the Interior Columbia Basin." Lack of clarity was the main complaint. Earlier versions were too vague, conceptual, technical, and contained too much jargon. At the same time, many people requested more detail, and mechanisms for implementing ecosystem management. People wanted to know how to link science and land management planning, how this process would be translated into action, how ecosystem management could be incorporated into existing planning processes and decisions, and how a more effective means of stakeholder participation could be developed. In response to these comments, we prepared a new introduction defining the objectives of ecosystem management and the framework. We expanded the discussion of the science concepts underlying ecosystem management. We expanded the discussion of the general planning model and included a discussion of risk assessments. We expanded the discussion on planning and decision-making to explain the connection between assessments and land-use planning processes. The section also attempts to define broader and more effective mechanisms for stakeholder participation.

LIST OF ACRONYMS

BLM	Bureau of Land Management
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
FEMAT	Forest Ecosystem Management Assessment Team
FLPMA	Federal Land Policy and Management Act
FS	Forest Service
GIS	Geographic information system
GPM	General Planning Model
ICBEMP	Interior Columbia Basin Ecosystem Management Project
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
RPA	Forest and Rangeland Renewable Resources Planning Act
USDA	United States Department of Agriculture
USDI	United States Department of the Interior

METRIC CONVERSION

Mile (mi)=1.61 Kilometers (km)

Kilometer (km)=.62 Miles (mi)

Square Kilometers (km^2) =.39 Sq. Miles (mi^2)

Meter (m)=3.28 Feet (ft)

Hectare (ha)=10,000 Square Meters (m^2)

Hectare (ha)=2.47 Acres (ac)

Acre (ac)=43,560 Square Feet (ft^2)

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EXECUTIVE SUMMARY

Concepts and principles underlying ecosystem management are evolving. This framework for ecosystem management is one product of the Interior Columbia Basin Ecosystem Management Project. It is a discussion of principles, concepts, processes, relationships, and methods that may be useful in implementing ecosystem management. This framework seeks to place planning procedures within a broad, proactive process that considers the social, economic, and biophysical components of ecosystems at the earliest stages of policy design. It is designed for application on lands administered by the United States Department of Agriculture (USDA) Forest Service and the United States Department of the Interior (USDI) Bureau of Land Management, but it could also be used by tribes, state agencies, and private land owners.

The Interior Columbia Basin Ecosystem Management Project is a combined science and management effort of the Forest Service (FS) and Bureau of Land Management (BLM). The project is charged to develop a scientifically-based ecosystem management strategy for lands administered by the FS and BLM within the Basin.[1] It assesses over 58 million hectares[2] (145 million acres) in portions of seven western states and considers management of over 31 million hectares (75 million acres) of FS- and BLM- administered lands (fig. 1).

The framework suggests that ecosystem management requires: 1) goals to establish a direction and purpose; 2) an assessment of resources at multiple resolutions and geographic extents; 3) some decision variables and decisions; 4) a strategy for implementing these decisions; 5) a monitoring program to evaluate the outcomes of decisions; and 6) adaptive management approaches. These elements require integration among biophysical and social disciplines.

In the framework, ecosystem management is based on scientific knowledge and an understanding of the social acceptability of management actions. Scientific approaches can be used to characterize biophysical and social processes and measure outcomes. Public participation processes can be used to help determine the acceptance of management actions used to achieve specific goals. Monitoring can be used to determine baseline conditions, whether implementation achieves its objectives, and whether assumed relationships are true.

This framework defines the role of science in ecosystem management as providing information for the decision-making process. This information helps clarify feasible boundaries, options within

[1]The Basin is defined as those portions of the Columbia River basin inside the United States east of the crest of the Cascades and those portions of the Klamath River basin and the Great Basin in Oregon.

[2]hectare (ha) = 2.47 acres. See metric conversion table.

the boundaries, consequences of those options, and trade-offs between options. The role of decision-makers is to choose among options; it is not the role of science.

A portion of this framework focuses on the role federal agencies have in administering public lands. The FS and BLM are charged with developing an ecosystem approach to guide assessment, planning, and management of forest, shrubland, grassland, and aquatic ecosystems on FS- and BLM-administered lands within the Basin. This framework describes approaches that can be used to manage Federal lands in the Basin in response to changing societal values, new information, and the assumed goal of maintaining the integrity of ecosystems. Ecosystem integrity is assumed to be a socially acceptable goal for ecosystem management, but the agencies have not yet made formal decisions on specific goals. Ecosystem integrity includes maintaining long-term ecosystem health and providing products and services within an ecosystem's capabilities.

Federal land management agencies have legal and social obligations to sustain the health, diversity, and productivity of ecosystems for the benefit of present and future generations. In addition, they are obligated to fulfill the responsibilities assumed from treaties with American Indian tribes. This may include maintaining or restoring viable, and in some cases harvestable, populations of plants and animals, or ecological processes. Satisfying all of these obligations is often complicated by changing and competing public values, the constant march of science, and land ownership and jurisdictional patterns that do not correspond to ecosystem patterns. Ecosystem management, in this sense, is another stage in the agencies' evolving efforts to satisfy their obligation to stakeholders while striving to resolve these complications. In this framework, stakeholders are defined as tribal, state, county, and local governments, and private land holders; as well as individuals and groups representing local and national interests in Federal land management. Stakeholders also include all of the citizens of the United States who use, value, and depend upon the goods, services, and amenities produced by federally administered public lands.

Four broad principles have guided the development of this framework. These principles are: ecosystems are dynamic, evolutionary, and resilient; ecosystems can be viewed spatially and temporally within organizational levels; ecosystems have biophysical, economic, and social limits; and ecosystem patterns and processes are not completely predictable. Ecosystems are dynamic; they change with or without human influence. Existing ecosystem conditions are a product of natural and human history--including fire, flood, and other disturbances, climatic shifts, and geological events such as landslides and volcanic eruptions. Although ecosystems are dynamic, there are limits to their ability to withstand change and still maintain their integrity, diversity, and productivity. Our efforts are guided by an increasing understanding of how larger ecosystem patterns and processes relate to smaller ecosystem patterns and processes. Finally, there are limits to our ability to predict how ecosystems may change. These principles suggest the need for an adaptive approach to management, one that can be adjusted in response to new information.

A general planning model is proposed for ecosystem management that has four iterative steps: monitoring, assessment, decision-making, and implementation. It is an adaptive model and is based upon an appreciation that people are part of, not separate from, ecosystems. Determining societal expectations for outputs (goods and services) and ecological conditions is a key feature of the framework. There are differences between public, tribal, and private lands. For private lands, individual owners differ in land management objectives and how they respond to various market and non-market (including regulatory) incentives.

Assessments describe the status and trends of key aspects of airsheds, aquatic ecosystems, vegetation and wildlife, economic activities, and social values and interests. An exercise of iterative "what if" questions, called scenario planning, can explore the trade-offs and relative compatibility of a wide spectrum of potential management goals.

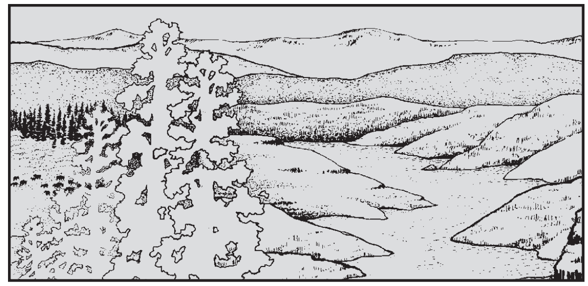
For Federal lands, stakeholder participation is an essential element. The framework seeks to change the previous approach where public participation often consisted of reacting to predetermined agency proposals. These proposed changes are driven by a desire to improve understanding and confidence in agency policies and actions, including ecosystem management, among stakeholders.

Interagency coordination and intergovernmental (and sometimes international) cooperation are essential to the success of an ecosystem approach to Federal land management. This framework also seeks to help reconcile the mismatch between jurisdictional boundaries and ecosystem patterns. It proposes greater coordination and consistency in Federal land management. The framework should improve the ability of the BLM and FS to apply ecosystem principles in their planning and decision-making processes, while still complying with treaties with American Indian tribes and pertinent Federal acts, including the Federal Land Policy and Management Act, the National Forest Management Act, and the Endangered Species Act.

The framework suggests a strategy for implementing ecosystem management on Federal lands. This strategy is based on dynamic assessments that provide characterizations at different levels (a higher level for context and a lower level to understand processes). It partitions risks to the level where they are observed and where they impact decisions. It provides for hierarchical decisions that are consistent with both the context set at higher levels and an understanding of specific processes. This strategy depends on an adaptive management approach that itself depends on partnerships and effective stakeholder involvement.

Figure 1

Figure 1—Interior Columbia River basin of the United States and portions of the Klamath River basin and the Great Basin that will be assessed in developing an ecosystem approach for managing public land administered by the Forest Service and Bureau of Land Management in the interior Northwest.



INTRODUCTION

Ecosystem Management Mandate

In July 1993, as part of his plan for ecosystem management in the Pacific Northwest, President Clinton directed the Forest Service (FS) to "develop a scientifically sound and ecosystem-based strategy for management of Eastside forests." The President further stated that the strategy should be based on the *Eastside Forest Ecosystem Health Assessment* (Everett and others 1994a), recently completed by agency scientists, as well as other studies. To do so, the Chief of the Forest Service and the Director of the Bureau of Land Management jointly directed (see appendices A and B) that an ecosystem management framework and assessment be developed for lands administered by the FS and the Bureau of Land Management (BLM) east of the crest of the Cascades in Washington and Oregon and other lands in the United States within the Basin[3] (fig. 1). Moreover, this ecosystem management approach should be founded on basic natural resource management ethics (Thomas 1994b). The FS and BLM have stated their intentions to use the framework and assessment in decision-making processes. Responsible officials from both agencies will develop ecosystem management direction using the framework and assessment, as well as other information. The framework and assessment are not decision-making documents nor do they set policy for the agencies. These documents contain information that can be used in decision-making processes.

Ecosystems are the focus of ecosystem management. According to Salwasser and others (1993 p. 73):

> *Ecosystems are communities of organisms working together with their environments as integrated units. They are places where all plants, animals, soils, waters, climate, people, and processes of life interact as a whole* [see fig. 2]. *These ecosystems/places may be small, such as a rotting log, or large, such as a continent or the biosphere. The smaller ecosystems are subsets of the larger ecosystems; that is, a pond is a subset of a watershed, which is a subset of a landscape, and so forth. All ecosystems have flows of things—organisms, energy, water, air, nutrients—moving among them. And all ecosystems change over space and time. Therefore, it is not possible to draw a line around an ecosystem and mandate that it stay the same or stay in place for all time. Managing ecosystems means working with the processes that cause them to vary and to change.*

Successfully implementing ecosystem management requires working within the political and legal

[3]The Basin is defined as those portions of the Columbia River basin inside the United States east of the crest of the Cascades and those portions of the Klamath River basin and the Great Basin in Oregon.

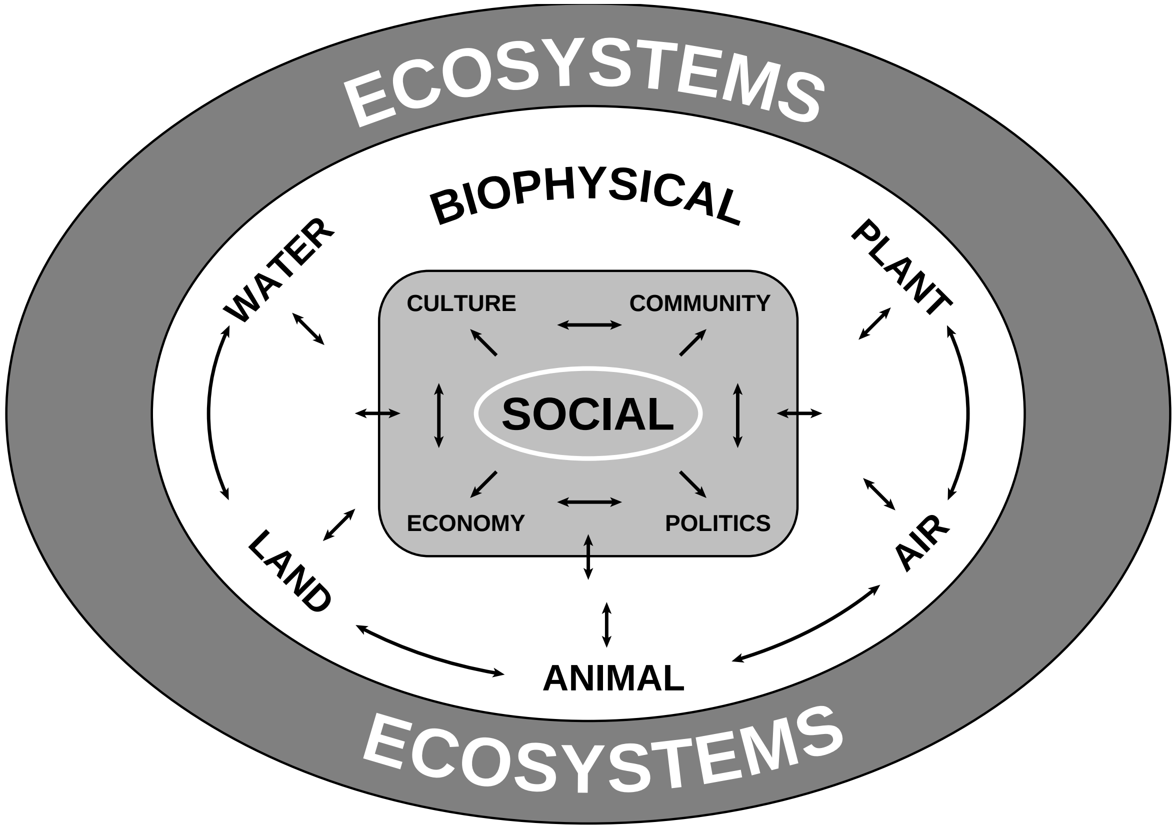


Figure 2—Ecosystems are places where biophysical and social components interact as a whole. All ecosystems have flows of energy, organisms, water, air, and nutrients and each element is affected by other elements. All ecosystems change over space and time.

framework. Policies and laws directly addressing ecosystem management have recently been adopted and are still evolving. FS and BLM policies regarding the implementation of ecosystem management can be summarized as follows:

> *Ecosystem management will use an ecological approach to achieve the multiple-use management of the FS and BLM administered forests and grasslands. A key to ecosystem management is maintaining the integrity of ecosystems over time and space. Ecosystems cross jurisdictional lines, making cooperation, coordination, and partnerships necessary while respecting stakeholders' rights. Effective stakeholder involvement to incorporate people's needs and desires into management decisions is an integral part of ecosystem management. Within ecosystem management, decision-making will be based on information provided by the best available science and the most appropriate technologies for land management. To provide this information, research needs to be promoted over a broad range of natural and social sciences (USDA 1994a, USDA 1994b).*

Framework Definition and Objectives

A framework is a description of steps and components necessary to achieve some desired goals. These steps and components might include criteria, principles, concepts, processes, interactions, fundamentals, relationships, methods, and rules (Kauffmann and others 1994). This framework seeks to place planning procedures within a broad, proactive process that considers the social, economic, and biophysical components of ecosystems at the earliest stages of policy design. It describes how scientific information can contribute to informed decisions, decisions that consider the broad goals of ecosystem management.

Specifically this framework is based on an ecosystem approach to management that:

- strives to maintain the integrity of ecosystems including long-term ecosystem health and the resiliency and vitality of social and economic systems;
- recommends procedures for examining relations between the biophysical (land, air, water, plant, and animal) and social (community, economic, cultural, and political) ecosystem components of the Basin;
- considers people's expectations, management and ecological capabilities, scientific methods, and current scientific literature;
- describes temporal and spatial dimensions for planning and risk assessment, assessment approaches, monitoring and evaluation needs, and stakeholder[4] participation processes; and
- identifies ecosystem principles that can be used to develop agency procedures for interagency coordination, planning, stakeholder involvement, and management.

Implementing ecosystem management in the Basin is one approach that can help to restore, maintain, and enhance the integrity of the regional environment, where millions of people, plants, animals, and other organisms reside and interact. The Basin is a land of extremes--from the depths of Hells Canyon to the heights of alpine peaks; from inland deserts to lush cedar forests; and from small rural communities to sprawling urban areas. These social and natural resources offer a heritage of exceptional significance to the Nation and the world. Maintaining the diversity, long-term health, and resilience of these resources for future generations depends on an understanding of how society values these resources and how natural and human processes affect the ecology of the Basin. Conservation and management of these dynamic ecosystems within an ever-changing social setting are of vital importance to the people who live within and outside the Basin.

Shifts in resource flows in the Basin and changing expectations about the goods and services that ecosystems provide require changes in how natural resources are managed. There are growing concerns about wildfire, forest insects and diseases, exotic plant and animal species, and resource management practices and their potential effects on the health and productivity of forest, grassland, shrubland, and aquatic ecosystems. Declining populations of some species, such as western white pine and salmon, are disrupting traditional activities. Moreover, these changing conditions and values raise concerns about the ability of communities, cultures, and economies to persist over time.

The BLM and FS recognize that ecosystems cross political, jurisdictional, and ownership boundaries. Ecosystem management strategies should include a shared commitment between agencies and communities of interest. Therefore, this framework provides information on assessing ecosystem conditions irrespective of jurisdiction and shows how assessments provide context for implementing ecosystem management within FS- and BLM-administered boundaries.

The Role of Science in Ecosystem Management

This framework defines the role of science in ecosystem management as providing information for the decision-making process. This information helps clarify feasible boundaries, options within

[4]In this framework, stakeholders are defined as tribal, state, county, and local governments, and private land holders; as well as individuals and groups representing local and national interests in Federal land management. This is meant to be inclusive of all organizations and individuals with an interest in Federal lands. This includes all United States citizens who use, value, and depend upon the goods, services, and amenities produced by federally administered public lands.

the boundaries, consequences of those options, and trade-offs between options. It is the role of the decision-maker to choose among options; it is not the role of science.

Science provides information on potential changes in ecosystem structures and functions caused by management actions (Bormann and others 1994). This information helps decision-makers understand the relative risks involved in alternative management approaches so they may develop reasonable methods to manage risks at biologically and socially acceptable levels. In this way, current scientific understanding of forest, grassland, and other related ecosystems might influence management policies. Fundamental to land management is the recognition that the management of natural and human processes is based on incomplete knowledge. Some of this knowledge includes expert judgement — which is helpful as long as it is identified as judgement. The challenge for resource managers, of course, is to balance biological science with social science and with the philosophical views of how society values renewable and non-renewable natural resources.

There is a debate over whether principles guiding ecosystem management are derived from scientific theory or whether they reflect general ethical values drawn from contemporary views of social behavior, professional conduct and responsibilities, and societal values. This debate has surfaced in the Society of American Foresters over the adoption of new language in its Code of Ethics (Cornett and others 1994). From a scientific perspective, most agree with Grumbine (1994) who argues that many of the scientific concepts elevated to the status of principles are in fact judgements reflecting the values of the scientists who define the principles. The change to ecosystem management incorporates a struggle about changing values.

Often, many of the scientific concerns that are listed as "ecosystem management principles" (for example, forest health, biodiversity, population viability) are actually goals that may be selected in ecosystem management. This framework attempts to bring forward principles that are not goal statements. It is acknowledged that all scientists have their personal values, but scientists should leave important value choices to duly recognized decision-makers. Normative judgements about desired outcomes and goals are determined through the established democratic and institutional processes.

ECOSYSTEM PRINCIPLES AND CONCEPTS

Ecosystem Principles and their Implications for Management

Four broad principles guided the development of this framework. These principles are:

1. Ecosystems are dynamic, evolutionary, and resilient.
2. Ecosystems can be viewed spatially and temporally within organizational levels.
3. Ecosystems have biophysical, economic, and social limits.
4. Ecosystem patterns and processes are not completely predictable.

Ecosystems are dynamic, evolutionary, and resilient—Change is inherent in ecosystems; they develop along many pathways (O'Neill and others 1986, Urban and others 1987). An ecosystem is said to be resilient if when disturbed or otherwise changed, it tends to return to some developmental pathway or it is cyclic such that its state is always changing within some definable bounds (Hilborn and Walters 1992). Ecosystems are the products of their history (Barret and others 1991). Natural fires, volcanic eruptions, floods, and wind events, along with people setting fires, clearing land, and introducing new (exotic) species have been sources of ecosystem disturbance (Agee 1994, Robbins and Wolf 1994). Forest and grassland ecosystems are generally resilient to a variety of disturbances. Just as past disturbances and the actions of past human generations shaped the ecosystems of today, actions of this generation will transform ecosystems of the future. Past management decisions, combined with natural environmental disturbances and conditions have influenced future options (O'Laughlin and others 1993, Maser 1994).

Historical and potential disturbance regimes have influenced the patterns and processes on today's landscapes (Oliver and others 1994). Ecosystems are constantly changing and cannot be kept indefinitely in any given state. While ecosystem management can recognize the inherent resiliency of natural systems, it should also recognize that maintaining the status quo is difficult and not necessarily a goal. It should consider the outcomes of management activities and how they influence ecosystem development. Scientific knowledge can be used to help public and private natural resource managers make choices about dynamic ecosystems in the face of uncertainty. In addition, assessments and monitoring programs can be used to evaluate and track changes in outcomes related to biophysical, social, and economic structures and functions.

Within ecological limits, a wide range of sound management options, providing different mixes of goods and services, will exist. No one landscape condition will be "best". Selecting the desired condition is a social decision that can be made by understanding ecological limits. Fortunately, the inherent resiliency of ecosystems provides opportunities to test various management approaches, and adaptive management will allow managers to learn from experience and make appropriate changes without significant risk of irreversible environmental damage. The dynamic nature of ecosystems requires a dynamic planning process.

Ecosystems can be viewed spatially and temporally within organizational levels— To describe the dynamic nature of ecosystems, it is useful to view them as having multiple organizational levels varying over time and space. These levels can be organized within hierarchies, in which every level has discrete ecological functions but at the same time is part of a larger whole (Allen and Starr 1982, Allen and others 1984, Koestler 1967). Higher levels usually occupy larger areas and are usually characterized by longer time frames (Delcourt and Delcourt 1988, King and others 1990, King 1993).

As applied to landscape ecology, hierarchy theory allows for the definition of ecosystems and the linkages between the different levels of ecological organization. Ecosystem descriptions (Rosen 1975) and ecosystem processes, structures, and functions are all defined by the observer (Pattee 1978). Within the vegetation component of ecosystems, trees can be nested within forests, forests can be nested within series, and series nested within formations (fig. 3a). There are a multitude of environmental constraints, vegetation patterns, human behaviors, and disturbance processes that can be described for each level, time frame, and area (Pickett and others 1989, Robbins and Wolf 1994). Spatial extent can range from a few square meters to millions of square meters, and time frames can range from less than one year to millions of years.

Social and economic components of ecosystems may be defined spatially and temporally as well, along an organizational or institutional continuum (fig. 3b). Organizational levels, time frames, and spatial extents that are significant to human decision-making often overlap and do not correspond to the same time frames and spatial extents as biophysical systems. For example, ecosystem processes (such as soil formation) that occur over long time frames (centuries or millennia) hold little meaning for political processes that operate biennially. In addition, people respond to environments symbolically, and places important to people cannot typically be defined by using biophysical hierarchies alone. To some extent, the selection of hierarchies represents a compromise among the various disciplines involved in an assessment.

Viewing ecosystems hierarchically with varying time frames and spatial extents has several implications for assessments and management. This approach provides managers with a way to orga-

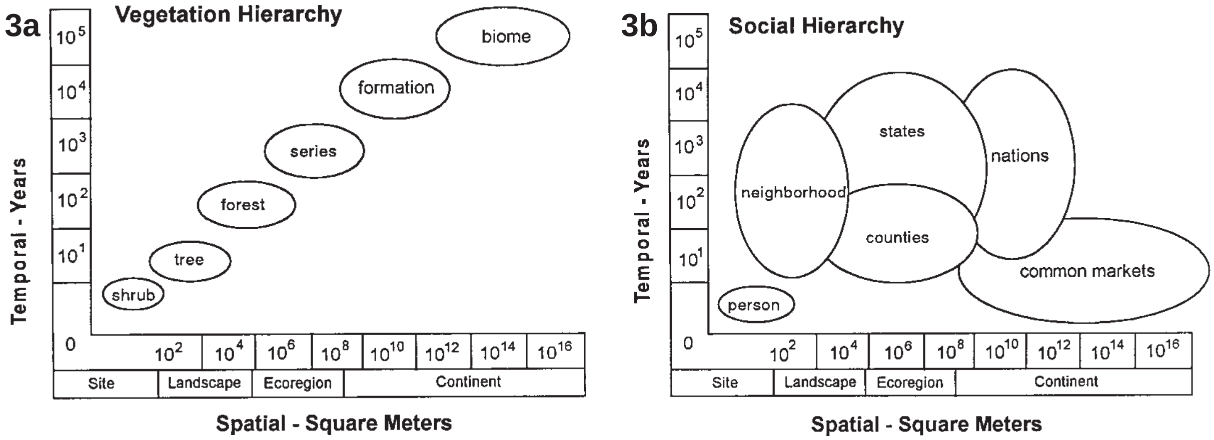


Figure 3—Ecosystem organization can be viewed as a hierarchy. Each level of the hierarchy has both time frames and spatial extents. A vegetation hierarchy is shown in 3a and a social hierarchy is shown in 3b.

nize the analysis of effects of management practices that take place over multiple time frames and spatial extents. In addition, it provides for the recognition that decisions made at one level of the hierarchy are likely linked to other levels. Viewing ecosystems as hierarchies ensures that monitoring programs (measurements, analysis, synthesis, and evaluation) track ecosystem development or change over multiple levels, spatial extents, and time frames.

Ecosystems have biophysical, economic, and social limits— In all ecosystems, there are limits to the rate of production and accumulation of biomass (plant, animal, and human) (Kay 1991, McCune and Allen 1985). In addition, the environment is constantly in a state of flux, causing ecosystems to change. Given this, human populations need to recognize that the ability of an ecosystem to provide goods and services has limitations. Unfortunately, people often make demands on ecosystems that exceed their biological or physical capabilities (Robbins 1982, Young and Sparks 1985).

Science provides information about ecosystem limits; land managers use this information as they develop ways to allocate finite resources. Society uses this shared information to make choices about its behavior. People can choose to modify their behavior and organize their institutions to be consistent with the capabilities of ecosystems, or they can pursue actions inconsistent with the capabilities of ecosystems. People can also improve ecosystem productivity on some sites through investments in management practices. Societal choices regarding the use and allocation of resources have implications for inter-generational equity and trade-offs. For example, investments in ecosystem restoration made by this generation will provide benefits and options for future generations.

Ecosystem patterns and processes are not completely predictable— The events that influence ecosystem patterns and processes usually are unpredictable (Holling 1986). Predictability varies over temporal and spatial organizational levels (Bourgeron and Jensen 1994). For example, from year to year wildfire occurrences are associated with particular seasons and environmental conditions, but a fire may occur in any season and under different environmental conditions. Similarly, eruptions of volcanos in the Cascade Mountain Range have occurred, on average, twice each century for the past 4,000 years (Dzurisin and others 1994); however, neither when the next eruption will occur, nor its size and effects can be predicted. In the social dimension, it is possible to predict crime rates at the regional or community level, but it is much more difficult to predict the occurrence of a crime at a particular household.

While people generally prefer predictability, adept ecosystem managers acknowledge and prepare for surprise (Kay 1991). The limited predictability of ecosystem outcomes has several important implications. Land management policies and practices should provide sufficient flexibility for managers to respond effectively to any unanticipated effects of previous decisions. For example, knowledge gained from adaptive management and monitoring programs may help managers prepare for and respond to surprise events. As knowledge increases, managers are better able to predict outcomes. Yet, long-term yields of goods and services may remain unpredictable. Although models are simplistic representations of real world systems, they may improve the predictability of outcomes. Models are never error free, but through adaptive management their generality, accuracy, and realism can be improved (Slocombe 1993).

Ecosystem Management Concepts

Boundaries—Delineation of assessment boundaries should be based on a combination of biophysical, economic, and social attributes. On Federal lands these boundaries should be delineated to facilitate national strategic planning as well as to set the context of management areas for local planning and decision-making. Assessment boundaries should strive to delineate specific measures of homogeneity. These measures and the associated boundaries will vary depending on the perspectives of those defining them. For example, areas delineated based on biophysical patterns and processes may not coincide with those based on hydrologic and aquatic processes, economic trade areas, or social settings.

Delineation of boundaries internal to an assessment area involves multiple approaches. Economists tend to view an area in terms of economic regions or counties, hydrologists view an area in term of watersheds, while ecologists may view an area in terms of patches of vegetation. These different approaches result in internal boundaries that challenge the integration process. It is important to recognize multiple boundaries, but also to compromise on a common internal boundary set for analysis and description.

Scales— There are different notions of what scale means in the literature and often there is confusion between geographic extent and data resolution. An approach clarifying the use of scale is shown in tables 1, 2, and 3, where geographic extent refers to the area assessed and resolution describes the amount of detail incorporated in the data. Assessments can be described by two-part names designating both the geographic extent and the resolution of the data.

In regional and sub-regional assessments, some ecosystem components cannot be adequately addressed using broad resolution data. For example, habitat conditions for species with small home ranges cannot be adequately assessed with broad resolution data (O'Neill and others 1986). Similarly, assessments of economic patterns in rural communities may be more appropriate at the landscape rather than the regional extent.

Regional assessments (table 1) show trends and describe general conditions for biophysical, economic, and social components. These assessments describe social characteristics such as state and county trends in human populations and urban versus rural economic growth. They usually contain broad resolution information on spatial patterns of resources and associated risks to resource values. Sub-regional assessments (table 2) typically rely on mid-resolution data to provide information on patterns of vegetation composition and structure, trends in social well-being for human communities of interest, and trends in basic conditions of communities (places). Assessments of landscapes or specific sites provide the greatest detail (table 3). These assessments may cover landscapes, watersheds, or individual project sites and specific

Table 1. Attributes and characteristics typically associated with broad resolution, regional assessments.[1]

Attributes	Landscape ecology	Terrestrial	Aquatic	Social/Economic
Geographic extent	River basin	River basin	River basin	States
Data resolution[2]	≥ 100 ha	≥ 100 ha	≥ 400,000 ha Sub-basins	State, County
Organizational hierarchy	Multiple watersheds	Community & species associations	Watersheds, communities of species	State, County
Map scale	≥ 1:100,000	1:2,000,000 1:1,000,000	1:100,000	1:1,000,000
Time period[3]				
Short term	1-10 years	1-10 years	1-10 years	1-5 years
Long term	10-300 years	10-100 years	10-100 years	5-50 years

[1]The general size of these assessments is millions to billions of km^2 and the general use is for national and regional planning and policy-making.
[2]Defining vegetation components is typically on a resolution of 100 ha while the aquatic components are defined by river systems (≥ 400,000 ha).
[3]Short- and long-term time periods for historical and projected patterns and processes differ between types of assessments.

Table 2. Attributes and characteristics typically associated with mid-resolution, sub-regional assessments.[1]

Attributes	Landscape ecology	Terrestrial	Aquatic	Social/Economic
Geographic extent	Multiple watersheds	Province	Multiple	County watersheds
Data resolution	≤ 100 ha	1-5 ha watershed	15,000 ha	County
Organizational hierarchy	Watershed	Species groups	Species groups	County
Map scale	1:100,000 1:24,000	1:100,000 1:24,000	1:100,000 1:24,000	1:100,000
Time period[2]				
Short term	1-10 years	1-10 years	1-10 years	1-5 years
Long term	10-300 years	10-100 years	10-100 years	5-50 years

[1]The general size of these assessments is thousands to millions of km^2 and the general use is for state, regional, and local planning and policy-making.
[2]Short- and long-term time periods for historical and projected patterns and processes differ between types of assessments.

Table 3. Attributes and characteristics typically associated with fine resolution, landscape assessments.[1]

Attributes	Landscape ecology	Terrestrial	Aquatic	Social/Economic
Geographic extent	Watershed	Watershed	Watershed	Household
Data resolution	$\leq$ 25 ha	1-5 ha	Streams	Household
Organizational hierarchy	Streams and vegetation patterns	Species	Species	Household
Map scale	1:24,000	1:24,000	1:24,000	1:100,000
Time period[2]				
Short term	1-10 years	1-10 years	1-10 years	Months-5 years
Long term	10-100 years			

[1]The general size of these assessments is tens to hundreds of km^2 and the general use is for multi-forest/district, forest/district, or area planning and policy-making.
[2]Short- and long-term time periods for historical and projected patterns and processes differ between types of assessments.

human communities. They typically rely on fine-resolution data regarding vegetation patches, stands, meadows, streams, and social and economic data. Landscape assessments, as described here, are essentially the same as "ecosystem analysis at the watershed scale" as used in implementing the Northwest Forest Plan (USDA 1994a).

No single assessment will adequately address the complex issues facing resource managers today. Higher level assessments set context while lower level assessments help understand processes. Assessments of landscapes or sites cannot adequately address broad patterns and processes, such as habitat conditions for wide-ranging species or global climatic processes. Regional and sub-regional assessments provide a necessary context for landscape and site assessments. Together, multiple assessments (site specific to global) provide a comprehensive basis for land management decision-making.

Conducting assessments at different geographic extents also can promote more effective stakeholder participation and learning. Many people see their interests affected primarily at the local level. They may choose not to participate in sub-regional or larger assessments because they might feel their local concerns will be diluted or unnoticed. Without sub-regional and regional assessments, stakeholders and decision-makers may have difficulty assimilating the cumulative magnitude and complexity of many highly detailed, or localized, landscape and site-specific assessments. Conversely, stakeholders whose interests are national or regional may find it difficult to participate effectively in numerous landscape assessments based on fine-resolution data.

Undertaking assessments at multiple geographic extents promotes the inclusion of more interests into the assessment process. It also serves to provide decision-makers with the appropriate information for particular levels of decision-making. Therefore, depending on the issues and policies being addressed, the type of assessment (data resolution and geographic extent) to conduct can be specified (see tables 1, 2, and 3).

ECOSYSTEM MANAGEMENT GOALS

In the broadest context, humans manage ecosystems for a diverse range of goals that reflect different cultural perspectives. Costanza and others (1991) use the two terms anthropocentric and biocentric to describe two broad cultural perspectives about how society makes decisions affecting growth (economic and physical), species (for identification and protection), and habitat (for humans and other species). The anthropocentric, or utilitarian, perspective is often reflected in the view where natural resources are thought to exist to meet the needs of people. The biocentric perspective views humans as just one of many species that coexist. Neither perspective offers entirely satisfactory solutions to resource allocation issues.

The obvious challenge is to make difficult resource decisions in light of diverse and sometimes contradictory views held by members of society. We live in a society that seeks the simultaneous achievement of ecological and economic goals. Rather than a simple anthropocentric or biocentric representation of society's cultural perspective, a more complex representation acknowledges that people sometimes respond in a very anthropocentric manner, but in another circumstance behave in a biocentric way. This diversity that exists in individuals also manifests itself in society, and one challenge for ecosystem management is dealing with diverse values as part of the process of arriving at goals for land management. The question becomes how to manage the land to meet these values and expectations.

Society makes choices through the actions of individuals and institutions. Ecosystem management is one step in an evolutionary process of land stewardship. As the understanding of ecology, economics, and cultural perspectives increases, the capacity to move toward broad-based goals should increase also.

The goals of management are in the domain of public choice and not science. The goals that drive the management of ecosystems are the result of decisions that follow from democratic and institutional processes. Goals are stated or inferred in laws, regulations, policy statements, decisions, and budget direction. The legislation guiding the management of FS- and BLM-administered lands in the early 1900s centered on protecting resources and reducing flooding. Goals shifted more toward providing commodities and stabilizing employment during the middle of the century. Concurrent with the environmental movement of the 1960s and 1970s, the emphasis shifted away from implicit goals toward establishing a planning process that developed specific goals (see Cubbage and others 1993). This is illustrated in current procedural laws requiring federal agencies to identify and disclose the effects of management activities on Federal land (NEPA 1969), and to develop long-range land use or general management plans (RPA 1974, NFMA 1976, and FLPMA 1976).

Currently, land and resource management plans, which establish detailed goals, objectives, and standards are developed by the FS and BLM for each administrative unit (generally a FS national forest or BLM resource area). Legal mandates require Federal land managers to manage habitat to maintain viable populations of existing native and desired non-native vertebrate species (36 CFR 219.19). Regulations also require Federal land managers to provide for diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species consistent with the overall multiple use objectives of the planning area (36 CFR 219.26 and 219.17(g)). Managers are also required to consider the American Indian treaties and the trust responsibilities that follow. The Chief of the Forest Service recently emphasized the importance of managing the national forests to maintain the integrity of ecosystems (Thomas 1994b).

This direction provides insights into the goals of ecosystem management for the agencies managing Federal lands, but it does not provide a formal, clear statement of ecosystem management goals. Further, developing a framework for ecosystem management requires a clearly stated and defined set of goals. The normative process of setting goals is ongoing. In the absence of explicitly defined goals by the agencies and society, working assumptions about goals were developed that facilitated the completion of the framework.

It might be assumed that the general purpose for ecosystem management is to maintain ecosystem integrity or system integrity, where system integrity is defined as the degree to which all components and their interactions are represented and functioning. Ecosystem, here, is being used in its broadest form, where it encompasses social as well as biophysical components.

The general purpose for ecosystem management is derived from the notion of ecological integrity and is rooted in scientific concepts that reflect human values (Grumbine 1992, 1994; Regier 1993). These human values include the normative goal of maintaining the integrity of a combined natural and cultural ecosystem. The purpose assumes ecological understandings and an ethic that guides the search for proper relationships. In this sense, a living system would exhibit integrity if, when subjected to disturbance, it sustains an organizing, self-correcting capability to maintain resiliency. The resulting end states may be desired by management and the public but may not be pristine or naturally whole. Thus, there is a social context to ecological integrity.

The concern about ecological integrity stems from Aldo Leopold (1991) who in 1944 equated the integrity of land with the continuity of stable biotic communities over long periods of time. Several years later Leopold stated his intentions more broadly when he said "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends to do otherwise" (Leopold 1949). Ecologists in the next several decades further clarified aspects of these concepts raised by Leopold. Spurr (1964), for example, focused on the constantly changing nature of forest ecosystems. Bormann and Likens (1981) focused on stability and resilience of forest ecosystems. Norton (1992) defined ecosystem integrity by saying that an ecological system has maintained its integrity if it retains (1) the total diversity of the system and (2) the systematic organization that maintains diversity.

Leopold (1991) provided one view to ecological integrity. As Kay (1991) points out, "the science of ecology can, in principle, inform us about the kind of ecosystem response or reorganization to expect from a given situation. But it does not provide us with a scientific basis for deciding that one change is better than another." Judgements about what is desired about ecological conditions should be made within the context of social values encompassed within the ecological system under study. Finally, the notion of integrity with its emphasis on wholeness does not lend itself to social and economic systems. For those systems, the emphasis is on resiliency or the degree to which those systems can adapt.

Measures of integrity or resiliency require judgements of wholeness which rest on comparisons of subjectively chosen indicators. In that sense, the integrity of ecosystems is more an expression of environmental policy than scientific theory. Many environmental managers may be reluctant to include societal issues and values in the definition (and evaluation) of ecological integrity. However, assuming that maintaining the integrity of ecosystems is a management purpose, its definition needs to reflect the values of both managers and users. Finally, to define the integrity of ecosystems is to define a set of biophysical and social characteristics that could be monitored for change from specified values (Kay 1993).

For purposes of this framework, maintaining ecosystem integrity is composed of two parts: maintaining ecological integrity and maintaining the resiliency of social and economic systems. The six goals listed below are assumed to provide important benchmarks against which to measure progress. These assumed goals, like the overall purpose, represent normative judgements about what best indicates integrity of ecosystems and social and economic resiliency. They include notions of "wholeness", resiliency, and diversity in their most universal and meaningful senses. These goals explicitly recognize the ways in which humans depend on and interact with the environment in our modern world. They seek to reduce risks from ecological surprises. They acknowledge important social values derived from commodity and non-commodity use of natural resources. If adopted, these goals would force decision-makers to explicitly consider the extensive range of values and choices involved in managing for integrity of ecosystems and societal resiliency.

Specific goals are assumed to be:

- maintain evolutionary and ecological processes such as ecological functions, disturbance, water cycling, energy flow, and nutrient cycling;
- manage ecosystems using multiple ecological domains and evolutionary time frames;
- maintain viable populations of native and desired non-native species;
- manage ecosystems to encourage social resiliency;
- manage ecosystems for the human sense of "place"; and
- manage ecosystems to maintain the mix of ecosystem goods, functions, and conditions that society wants.

Maintain Evolutionary and Ecological Processes

Maintaining evolutionary processes should ensure that populations remain genetically diverse and are given ample opportunity for adaptation in the face of changing environments (Soulé 1980). In part, this entails maintaining species throughout their geographic or ecological ranges, especially at the edge of their range. Under such conditions, adaptation sometimes proceeds most rapidly. For example, maintaining montane plant communities at the upper edges of their elevational range might facilitate the upslope migration of species in the face of regional warming and drying (Hansen and others 1990).

Ecological processes pertain to abiotic and biotic distributions of nutrients, materials, and energy throughout an ecological community (Noss 1990). Species affect sustainability and productivity of their ecological communities through their ecological roles or functions, which range from producing and consuming biomass to cycling nutrients. This goal assumes conditions that allow key ecological functions to be maintained over time.

Other important ecological processes include disturbance, water cycling, nutrient cycling, and energy flow within ecosystems. Maintaining these processes is sometimes problematic. For example, Agee (1994) points out that maintaining disturbance regimes is difficult as many types of disturbances occur at different spatial extents and time frames.

The goal to maintain evolutionary and ecological processes also involves maintaining native ecosystems across a range of conditions. The overall concern is that genetic material and important ecological processes require representation in many environments to ensure long-term viability. Certainly, this raises questions of what is native or natural to an ecosystem and how to represent or conserve it. For some, natural means pre-European settlement, allowing for the sometimes intensive effects of use by American Indian populations (such as intentional burning of grasslands and hunting effects on prehistoric ungulates). Conservation of such conditions in disturbance-prone landscapes, such as the forests of the inland Pacific Northwest, may entail relying on several kinds of management ranging from strict protection (Greene 1988) to more active management (Everett and others 1994b).

To maintain evolutionary and ecological processes, managers need to identify locations of rare or declining ecological communities, locally endemic species (species found nowhere else), areas of unusually high species concentrations (sometimes called "biodiversity hot spots"), and areas least disturbed by human activities. Then, it is possible to assess whether existing or proposed management activities and land allocations, such as wilderness, research natural areas, and botanical waysides, suffice for long-term conservation of such locations. Attainment of this goal would be facilitated if consideration were given to expected environmental disturbances such as stand-replacing fire, wind storms, and even short-term fluctuations in weather patterns.

Manage in the Context of Multiple Ecological Domains and Evolutionary Time Frames

This goal reflects on the process of ecosystem management where managers should be cognizant of different spatial extents and time frames. For example, ecological succession is typically described at a local level and for several centuries. Climatic and biome trends are typically studied over large areas and centuries. Evolutionary ecology can be studied over small or large areas and generally covers very long time frames.

There is also a space and time dimension for land management issues. For example, maintaining long-term productivity of forests and grasslands is often a site-specific question ranging from the present to centuries into the future. Eventually this issue should consider long-term soil protection and renewal. On the other hand, understanding and guiding future biome effects of climate change, acid precipitation, and ozone depletion are issues forcing consideration over areas on the order of 10,000 hectares[5] or more and over time periods ranging from tens to hundreds of years into the future.

Several levels of planning can be used to address issues over space and time. For example, project planning is typically done for specific sites or small areas (less than 15,000 ha) and short time frames (1-5 years). Landscape analysis provides context for project planning and is typically done on areas over 15,000 hectares in size with planning horizons up to 10 years. National Forest or National Grassland Plans, or BLM District Resource Management Plans cover areas hundreds of thousands of hectares in size and extend up to 10 years in duration. Finally, broad-based policy planning, such as for the interior Columbia River basin, is done for areas over one million hectares in size.

For each planning level, past conditions and future cumulative effects can be considered. Broadly based planning levels can extend further into the past and into the future. Thus, plans that typically extend beyond a decade can address cumulative effects, historical conditions, and future effects with an understanding of the uncertainty inherent in predicting outcomes and of social value shifts.

Broad-based plans like those for the Basin cannot be expected to address site-specific conditions and issues, such as the fate of a particular mushroom-gathering site. Conversely, site-specific project plans cannot address large-area and long-time-frame conditions and issues, for example effects on the viability of a wide-ranging species such as the northern goshawk (Reynolds and others 1992). Instead, the various tiers of assessment, land management issues, and planning efforts should be threaded together into a consistent whole, so that site-specific, ecoregion, and broad geographic conditions and issues can all be treated.

Tying together these multiple tiers of conditions and issues will be difficult. Factors such as considering the rights and interests of stakeholders will complicate the decision process, especially regarding potential economic and social effects from management of threatened and endangered species. Off-site conditions, even if not manageable by federal agencies, can also affect species and can be considered when making management decisions. For example, the impacts of reducing timber harvest on federally administered public lands can be disclosed along with the impacts of such reductions on other lands.

Maintain Viable Populations of Native and Desired Non-Native Species

There is public concern that ecosystem management maintain viable populations of native and desired non-native species. The legal definition of population viability is given in the glossary. In a broad sense, though, viability can be considered as the likelihood of continued existence of well-

[5]Hectare (ha)= 2.47 acres; See metric conversion table.

distributed populations of a species throughout its current range, to specified future time periods (Marcot and Murphy, in press). A population can be defined as a set of plant or animal organisms of a given species, occurring in the same area, that could interbreed. A population with high viability persists in well-distributed patterns for long periods (a century or longer). A viable population is able to survive fluctuations in demographic, genetic, and environmental conditions and maintain its vigor and potential for evolutionary adaptation over a long period of time (Soulé 1987).

There is no single population size that acts as a universal "minimum viable population", and thus for which simple, universal decisions can be made to ensure viability of all species. Therefore, it is useful to distinguish between (1) viability risk analysis, which estimates the likelihood of population persistence or extinction for a specified time in a specified area, and (2) viability risk management that selects a course of action in which the risk attitude of the decision-maker plays a major role. Viability risk analysis and viability risk management are both appropriate parts of scenario and alternative planning.

Because some species are naturally uncommon or rare, managing for populations with higher viability, in part, is determined by the ecological capability of the species and its environment. Viability risk analysis can help to determine such capability by evaluating species' key environmental correlates and how such factors change under management options, and by projecting future population responses. Furthermore, management of FS- and BLM-administered lands entails meeting multiple objectives, so viability risk management can help articulate the best social, managerial, and even political balances that are also ecologically feasible.

Two facets of viability are abundance and distribution. A population must be of sufficient size to withstand variations in demographic, genetic, and environmental factors so that births exceed deaths. Likewise, populations generally should be distributed in space and time to ensure interaction of individuals and to avoid demographic and genetic isolation. Because of limited information about most species, quantitative modeling approaches to assessing risks of extinction or persistence likelihoods are impossible. For such species, a more qualitative, "first approximation" approach to evaluating potential effects on viability may be appropriate (Boyce and others 1994, Irwin 1994).

The discussion of viability addresses the issue of continued persistence but does not directly address the issue of harvestability. Satisfying human needs often involves harvesting and is particularly important when such harvest has cultural or regional significance. To be harvestable, there needs to be a surplus population that exceeds the minimum viable level. Because of limited information about most species, quantitative estimates of harvestable populations are not possible.

Encourage Social and Economic Resiliency

Ecosystems provide a wide variety of goods and services. Some are commodities that serve important social and economic functions, others are necessities for life, and still others provide a higher quality of life. Ecosystems not only provide economic opportunity, but also provide for our natural and cultural heritage. In the past, one emphasis of Federal land management was to develop and maintain the economic status of human communities.

A human community consists of cultural, social, economic, and institutional components that are melded together in a more or less cohesive and compatible way. This structure provides for a level of predictability and stability for the community's citizens that helps them organize their lives. Yet, some smaller rural communities, dependent on natural resources, are subject to an assortment of exogenous processes that challenge their stability. The ability of governments to maintain economic stability at the local level is often constrained. Communities are often in a state of change, but smaller rural ones frequently do not have the capacity to respond proactively to exogenously induced change. Taking a static view of community stability results in the failure to recognize that communities evolve and change over time in response to a variety of processes and factors. A static view often overlooks community adaptability, variations in the types of community dependencies, influences of exogenous forces on economic stability, and the important roles of non-commodity ecosystem goods and services.

One aspect of this goal is to facilitate enhancement of community resiliency. Natural resource agencies may have several roles in this process. One role might be to increase community understanding about the nature and causes of change. Another role might be to assist communities in adjusting to change, whether that involves accommodation or exploitation of change. A particularly challenging role for federal agencies would be to attempt to balance national interests with local community needs.

Manage for the Human Sense of "Place"

This goal acknowledges that cultural values and beliefs are often linked to specific landscapes and their symbolic meanings. Changes in the landscape that intrude upon sense of place might result in a decline of cultural attraction, particularly for groups that maintain strong ties to the natural environment. Land management, while directed toward maintenance of ecosystem process and function, could lead to changes in site attributes. These attributes and specific human cultures intertwine to create distinctive places (Flores 1994). This goal requires that ecosystem management be oriented toward recognition of a wider variety of human needs and desires than past management practices. Increasing recognition is given to spiritual, cultural, and even human health services provided by natural environments.

There are at least four ways that people attach meanings to place: scenic/aesthetic, activity/goal, social/cultural, and individual/expressive (Williams 1995). Procedures and processes for understanding the first two types of meanings are fairly well established (such as the FS scenery management system); however, little research has occurred on the latter two meanings of place. Williams (1993) noted that one approach for explaining place attachment is to examine the concept of place-identity, which is the importance of the physical environment in maintaining self-identity. Natural environments and landscapes can be important to individuals and cultures because they may be attached to them emotionally. These delineations are different from approaches used by ecologists who define landscapes using biophysical criteria. Because of these differences, there are often different views about how landscapes should be managed (Lewis 1993).

Managing for the human sense of place requires the recognition that ecosystems and the spaces and places within them are social constructs (Williams 1995). Place meanings can be organized within a hierarchy. Understanding the values people have for "place" is important because it permits managers to fully map and display the complete array of values people place on their environment. By incorporating the sense of place, land managers may also be able to increase the social acceptability of specific land management actions.

There are implications in defining locations as places rather than spaces. First, explicitly identifying places recognizes that areas can be defined because of their social significance. Thus, all spaces become places. Second, the meaning of place is influenced by the dominant social group using a location. For example, Lee (1972) showed how the social meaning of an urban park changed diurnally as the patterns of social groups using the park changed. Lee's (1972) definition of place includes how groups define boundaries, the acceptability of certain behaviors, and how violations of norms would be handled by the dominant social group. Thus, one location becomes several places from a human viewpoint. Understanding this implication can help managers identify who will be impacted by changes in resource management.

Sense of place has a special meaning for American Indians. Their traditional beliefs often project the perspective that all things are part of a whole, that nothing is separate. That is, the land or earth is not dead, it is alive and sacred (U.S. Department of Interior 1994). The reverence for place is ingrained in all their actions and thoughts.

Manage to Maintain the Mix of Ecosystem Goods, Functions, and Conditions that Society Wants

A fundamental notion of stewardship is that land managers work to direct and maintain ecosystems so as to best fulfill the objectives of owners. Different owners have different preferences for benefit flows ranging from daily to four times a year to intergenerational time spans. Owners also vary in the composition and amount of ecosystem goods, functions, and conditions that they desire. Some owners may desire a narrow set of outputs: timber and deer, for example. Others may desire a broad set of outputs. The broadest set is appropriate to publicly-owned lands because constituencies are likely the broadest and most diverse, and because some types of outputs will only be available from public lands (Hyman 1973).

Societal interests are broad regarding the provision of ecosystem goods, functions, and conditions. Some goods are extracted when used, whether or not for conventional commodity markets: examples include minerals, timber, cattle and sheep grazing, mushrooms and huckleberries, hunting, and fishing. Other goods are not extracted when used and remain to be enjoyed by more than one person--for example, viewing wildlife, back country trail use, and the existence of salmonids, grizzly bears, grey wolves, and large, old trees. Ecosystem functions include beneficial processes such as those that produce the goods listed previously plus services such as carbon sequestration, and recycling of air, water, and nutrients. Ecosystem conditions that people desire include “old-growth” characteristics, clean air, clean water, roadless areas, scenery, and healthy ecosystems.

Society’s view of ecosystem values, in total, provides an integrated concept of what can possibly be achieved from specific lands. In this way, land managers can clarify the limits of ecosystem production and the trade-offs associated with choosing one management direction over another. Implicit in land managers’ response to social values is adaptive management, as objectives shift and increased understanding of ecosystem processes and functions occurs.

This goal requires an understanding of how management actions might reduce or expand options and values for future generations since intergenerational questions are embedded in the time preferences of landowners. A frequent criticism of current land management is that it focuses on the current generation and on short-term benefits. In public land management this is seen as favoring people who live nearby or are associated with consumptive uses. All of this is part of a broader question of who benefits and who gains from management of FS- and BLM-administered lands. Understanding this provides a basis for assigning costs of land management.

Questions and Implications Raised by the Goals

The discussions leading to these six goals raised a number of questions about and implications for attaining ecosystem integrity. First, are all species (and biodiversity elements) equal? Current Federal land management, for example, attempts to maintain viable populations of native and desired non-native vertebrate species and considers biodiversity to include endemic and desirable naturalized plant and animal species. As components of biodiversity, current scientific literature includes species in all taxonomic groups, as well as ecosystems, communities, and ecological processes; any and all of these components can potentially affect integrity of ecosystems. Moreover, in some environments exotic species— typically grasses and grass-like plants and forbs— dominate many areas (Hobbs and Huenneke 1992). Thus, specific goals for ecosystem management might need to address this full range of components, including species in all taxonomic groups.

It is impossible to maximize all populations of plants and animals simultaneously. One approach to stating goals that relate to species populations might be to ensure an adequate likelihood of viable populations of individual species and/or species groups (species such as some invertebrates and lower plants are so poorly known that they are best assessed in ecological species groups).

There are limits to viability of species and the productivity of ecosystems. The human population of the planet is predicted to double within the next century, and these people will use ecosystems to satisfy their needs and desires. Specific goals may need to describe how people want to affect the ecosystems in which they reside and what conditions they want to pass on to the future.

Describing goals for the future is difficult in that ecosystems are dynamic and ever-changing over time and space. In disturbance-prone environments like those in the Basin, static conditions cannot be expected to be maintained in perpetuity. The very concept of maintaining desired future conditions might appropriately be supplanted by one of maintaining desired future dynamics. The goal, in this case, might be to maintain or restore disturbance regimes, species, ecological functions, and processes, while also using the land for a range of human interests.

The problem of exotic species raises other questions. In those environments where there is little hope of restoring "natural" conditions, risk assessments can help to determine what is feasible for future restoration or conservation, and risk management could determine the best course of action to meet social and biological goals.

There are limits to ecosystems. The total land area is limited, there are limits to the resources that can be extracted from any particular place, and thus there are limits to the capacity of ecosystems to support and sustain people. Recognizing that there are bounds is an important consideration as long-term goals are discussed for large areas.

To be successful, goals will be respectful of human needs. Humans assign a sense of place to their environment through personal, cultural, and societal values. They derive their livelihoods from ecosystem outputs. These need not be completely competitive views, but priorities may need to be set when developing goals that will both respect the sense of place and allow resource use to satisfy human needs.

GENERAL PLANNING MODEL

Planning in ecosystem management is the process of "writing the ecosystem owner's manual" (to describe ecosystems and how they work) and for creating the "road map" of destinations and alternative routes. This section describes a general planning model (GPM) approach to ecosystem management.

The simplest planning model asks a single question and answers it. Better models devote more attention to the questions and to the choice of answers. A well-rounded, multi-objective planning model can be used to continually evaluate the consequences of the answer chosen. The GPM for ecosystem management has four iterative steps: monitoring, assessment, decision-making, and implementation (fig. 4).

Specific goals drive the planning process. Each iteration is motivated by actions related to goals: goal attainment, the perceived or actual lack of goal attainment, or the desire to modify or confirm goals. External influences may initiate actions within the planning cycle. Examples include emerging issues, changing societal values and goals, and new scientific understanding (fig. 4). Monitoring is the method through which these outside influences can be recognized. The FS and BLM could monitor traditional effects of their management actions, as well as emerging issues, societal values, and advances in scientific understanding. These monitoring efforts need not be formal and highly visible, however, they could be the catalyst that initiates an expensive and time consuming planning process.

The objective of the GPM is to set a course for managing ecosystems to achieve specific goals. It describes the basic planning procedures and defines the linkages among the planning steps. It is also notable that each step has considerable room for complexity, integration, and participation including both formal and informal public participation. This approach is described to address FS and BLM management approaches, but concepts and processes could be used by other landowners and resource managers. It draws on a basic policy model laid out by Weimer and Vining (1992).

Monitoring

Monitoring is the process of collecting and evaluating information both to determine baseline conditions, and to determine if planned activities have been accomplished, if assumptions are correct, and whether management objectives have been met. This information can then be used to reassess, alter decisions, change implementation, or maintain current management direction. Successful ecosystem management will require a monitoring program. An effective monitoring program should reduce uncertainties, test major assumptions, and possibly result in changes in management direction (Noss and Cooperrider 1994).

There are four types of monitoring (Noss and Cooperrider 1994). Implementation monitoring determines if a planned activity was accomplished. Effectiveness monitoring determines if the activity achieved its objective or goal. Validation monitoring determines to what degree assumptions and models used in developing the plan or assessment are correct. Baseline monitoring measures a process or element that may be affected by management activities. Each monitoring type has a specific set of objectives that are applied differently depending on the questions addressed.

Definitions of issues and problems are needed to determine monitoring data needs (Jones 1986). In ecosystem management, management goals and objectives should identify the information that will be gathered in the monitoring program. Objectives of the monitoring program should address the appropriate spatial extents and time frames within a hierarchy of biophysical or social organization (Bourgeron and others 1994). For instance, if one anticipates change in vegetation structure to take 10 years, monitoring on an annual basis would not be warranted. In this way, monitoring information from local efforts can be applied at multiple spatial extents and time frames.

A monitoring program should be founded on experimental designs allowing inferences to be made through statistical analysis. Information gained from a monitoring program should be useful for identifying changes in conditions, predicting impacts, testing cause and effect relationships, and providing information to managers for future goal-setting.

Biophysical and social indicators that measure the element or surrogate of the element being monitored should reflect changes before the changes become problems. Indicators act as early warning systems for management activities that are not producing the desired effects. With an early warning system, management activities could be changed prior to causing damage or changes that are irreversible. Indicators, for example air quality and employment, should be based on adequate sample sizes to ensure powerful and confident statistical analyses. However, some populations, such as threatened and endangered species, may be too small to allow for replications and statistical analysis. In social monitoring some variables are not amenable to measurement, such as community well-being.

Monitoring is essential to ecosystem management. Without a monitoring program, management activity effectiveness, progress toward achieving objectives, or funding allocation efficiency is unknown. Monitoring requires commitment from managers, scientists, decision- and policy-makers, the Congress, and society. One benefit of an effective monitoring program can be effective adaptive management. Monitoring is expensive.

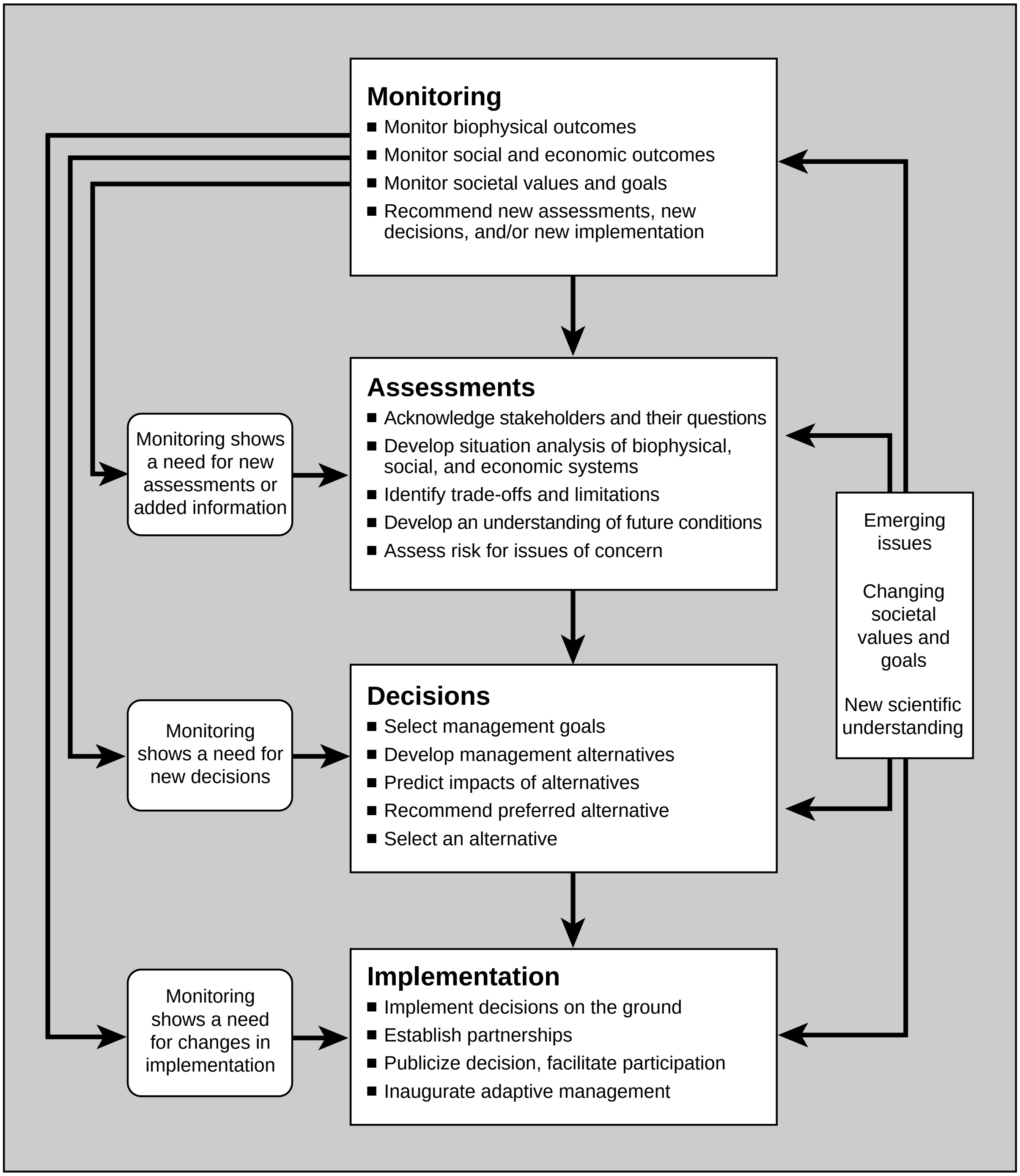


Figure 4—Each step of the General Planning Model for ecosystem management has several parts. Because the model is iterative, external or internal influences can initiate any step in the process and the process never ends.

In the absence of clearly defined goals and objectives for monitoring strategies, monitoring can consume an agency's entire budget. Establishing priorities, designing the sampling, and linking monitoring with inventory approaches would be essential to cost containment.

Assessments

Planners and managers often quickly identify a problem and then devote the bulk of their efforts to designing and analyzing solutions. Effective ecosystem management implementation requires a clear problem definition, a clear understanding of management goals and objectives, and a clear and solid assessment of biophysical and social conditions, trends, and management opportunities before the creation and selection of possible solutions. The assessment process begins by recognizing who the clients are and what their questions are. The questions may or may not be clear at the outset of the process.

Assessments should characterize the biophysical and social ecosystem components at various time frames and spatial extents. Assessments can provide comprehensive descriptions of ecosystem structures, processes, and functions that are critical to understanding the present conditions and for projecting future trends. Understanding the past, present, and possible future of environments including vegetation, communities, cultures, fish, wildlife, and other ecosystem components, can help identify the biophysical, economic, and social limits of ecosystems. Moreover, assessments can explicitly depict and model ecosystem components and their interactions. This is done, in part, through scenario planning and risk assessments. Assessing ecosystem components at various time frames and spatial extents provides the foundation for making better and more accepted decisions on the management of natural resources.

Assessments represent a synthesis of current scientific knowledge including a description of uncertainties and assumptions. For Federal land managers, assessments are not decision documents. They do not resolve issues or provide direct answers to specific problems. Rather, assessments provide the foundation for proposed additions or changes to existing land management direction. They provide necessary information for policy discussions and decisions. The geographic area of the assessment and the data resolution depend on the systems and the issues being addressed.

Decision-Making

The decision step in the GPM involves developing management paths for achieving goals and objectives, and developing management alternatives. In decision-making, alternatives can be explored that may require changes in laws, regulations, or policies before they can be implemented. Feasible alternatives have generally been consistent with available resources and legal and political constraints. Alternatives describe explicit sets of actions. The ultimate purpose of alternative development is to help decision-makers and stakeholders understand the realistic and potentially implementable management options available for assuring ecosystem integrity. Alternatives should include realistic funding and implementation assumptions.

Another step in the decision-making process is to predict the impacts of each alternative. In ecosystem management, it is particularly important to represent the diversity of ecosystem goods and services and all other outcomes of each alternative clearly. It is important not to reduce the comparison to a single factor (for example, annual timber harvests).

Using the GPM, decisions can be as broad as policy statements or as specific as a decision to close or to develop a recreation site. Decisions can establish management standards and guidelines, make land and resource allocations, establish priorities, and set goals and objectives. They also enable partnerships and define participation processes. This step is given great attention in Federal land management under the National Environmental Policy Act (NEPA) process in the development of alternatives for Environmental Impact

Statements. In Federal land planning, preferred alternatives are those actions the agency initially judges as the most feasible method of achieving desired ends, in a technical and social sense. In the context of federally administered land, the decision-maker is the responsible official, such as the Regional Forester or BLM State Director, who makes the formal decision from among the alternatives.

Implementation

Implementing decisions usually results in changes in resource conditions, as well as in establishment and maintenance of partnerships and participation processes. Adaptive management can often be inaugurated during this step. Bormann and others (1994) describe a systematic approach to adaptive management that includes expanded decision-making; linked, not single actions; feed-back, including monitoring; and information synthesis. Linked actions that integrate management and research could be used to generate information to make adjustments, and facilitate and inform future decisions. Decisions should be consistent and integrated with higher-or lower-level management decisions affecting the same piece of ground (in keeping with the notion that ecosystem levels interact). The private sector can be positively influenced by this process. For example, one forest products company has noted that "in many respects, our company due to its geographic breadth, diversity of activities, and economic role, has been faced with application of biophysical, economic, and social planning at different spatial extents and time frames similar to those used by the [Basin project]."[6]

Implementation is the process of turning plans and decisions into projects and practices on the ground; establishing mutual learning experiences for stakeholders, planners, and scientists; and realizing the projected outcomes of planning.

[6]Comments on the *Scientific Framework for Ecosystem Management in the Interior Columbia Basin* (Working Draft--Version 2). 1995. Tom Goodall, Assistant Timberland Manager, Boise Cascade Corporation, Timber and Wood Products Division, Northeast Oregon Region. 15 p.

This phase of the GPM represents what many stakeholders refer to as "real work". It is where inputs are transformed to outputs and where communities dependent on the flow of goods and services place emphasis.

MANAGING INFORMATION AND INVOLVEMENT

Implementing ecosystem management depends on institutional changes regarding intergovernment cooperation, expanded needs for stakeholder participation, and new approaches for data management. Most of these changes involve modifying existing approaches to respond to the complexity introduced by larger geographic extents.

Tribal Consultation

A special relationship exists between the American Indian tribal governments and the United States Government. The sovereign status of the American Indian tribes is recognized through treaties and executive orders with those tribes and special provisions of law. These treaties and laws set the tribes apart from all other United States populations and define a special set of federal agency responsibilities. Each tribe is a separate entity and relationships need to be established with each tribe. Tribal government involvement revolves around government-to-government relations that vary in format among tribes. The central feature of consultation is face-to-face meetings of the respective decision-makers of the agencies and the tribes. In addition, tribal involvement contributes additional expertise and information on assessing biophysical and social components of ecosystems.

Governmental Coordination

Because ecosystems seldom conform to jurisdictional boundaries, effective ecosystem management requires coordination among different levels of government. For example, in the Basin there are tribal interests, and federal, state, and local governments. This particular ecoregion also crosses national boundaries. Approximately 15 percent of the Columbia River basin is in Canada.

The FS and BLM are required by the National Forest Management Act (NFMA) and the Federal Land Policy and Management Act (FLPMA) to coordinate planning activities with these governments. For many ecosystem components, decision-making authorities are closely related, further necessitating coordinated planning. Increased trust among agencies would be one result of such cooperation.

Strategies for Information Management

As resource managers consider changes in management paradigms that focus on complete systems rather than individual ecosystem components, information needs change. Focusing on complete systems also may require changes in traditional approaches to both broad policy-making and on-the-ground management. Where past management was rule-driven based on relatively static, functional, steady-state types of information and management approaches, managers now need to consider evolutionary trends, relationships, dynamic types of information and flexible approaches to policy-making and land management that allow constant learning and adaptation.

The collection, maintenance, analysis, and sharing of information regarding the conditions and potentials of ecosystems are integral parts of ecosystem management. Few, if any, activities have more comprehensive implications for the successful implementation of ecosystem management than information management: the inventory, acquisition, storage, maintenance, use, and dissemination of data and information. The degree of success with which resource managers develop and evaluate options has significant implications for the quality and cost-effectiveness of the work they perform.

Although the terms information and data are often used interchangeably, the distinction between them is important. Data are facts that result from the observation of physical phenomena. Information is the interpretation of data used in decision-making. Depending on the analysis, different information can be obtained from similar data. The importance of information depends on the decision, that is, what is of considerable importance in one situation or decision may be useless in another. In addition, information and decision-making are closely intertwined. Information management is critical in each step of the planning process (fig. 4).

An inter-organizational approach will facilitate the integrated management of information and effective evaluation across all types of assessments and plans. Specific outcomes could include:

- define appropriate information requirements for various types of analyses including the interrelations between data and processes;
- strive to provide consistent and continuous information across all ownerships or analytical units;
- provide linkages between types of assessments;
- develop consistent standards including definitions of terms and procedures for information management collection;
- provide a uniform database that is usable for many disciplines;
- develop a process for transition from implementation of short-term strategies to achievement of long-term goals for integrated information management;
- recognize information as an essential resource and provide for its quality control and maintenance;
- promote partnerships between organizations for data acquisition, storage, sharing, maintenance, and analysis;
- evaluate and implement the use of analytical tools to the extent practical; and
- develop flexible information management systems capable of accommodating changing needs (FEMAT 1993).

To accomplish these outcomes, the agencies need to establish a current, consistent, and accessible information network and coordinate analytical processes to support ecosystem management.

Resource issues have shifted from being primarily local to being regional, national, and global in scope. Traditional approaches to information management, as with land management in general, often focused on local needs. To meet a broader focus, an inter-organizational approach is required where people, data, and technology are all part of product development and solutions. A key attribute of such an approach is full participation: all participants at all levels share the responsibility for building this information infrastructure. Land management agencies will need to seek out non-traditional sources of information from the full spectrum of participants involved in ecosystem management including other federal or state information/interpretive agencies (such as the United States Geological Survey and National Biological Service); universities; environmental, labor, and industry organizations; tribes; and other interested parties.

Although spatial data and evaluation models are essential resources, other types of information will be valuable for implementing ecosystem management. There is a need to develop a plan for managing these additional sources of information. The plan could address information sources such as tribal, public, and private libraries; online catalogs; historical archives; and electronic bulletin boards. Additional information includes books, articles, reports, proceedings, workshop summaries, legislation, historical accounts, maps, and administrative and regulatory guidance.

Effort needs to be placed on raising awareness and shifting attitudes about the importance of information management itself and in fostering a more broad-based, multi-functional, multi-organizational approach. Multiple sources for similar information can be found within and across organizations, sometimes with data being incompatible or inconsistent.

A key ingredient for information management is the importance of having a work force well trained in using and applying resource information, geographic information systems (GIS), and associated technologies. Resource specialists, managers, scientists, and stakeholders all need to understand the value of shared, coordinated data and information to the decision-making process. The environment that often promoted the development of "my database" should be guided to an environment in which it is desirable to think of "our databases".

Traditionally, integrating data has been difficult because their utility and long-term use were not considered outside the purpose for which they were collected. This often resulted in disparate data with gaps in information. Data collection is also commonly conducted over different spatial extents and time frames. A large portion of the effort put into the Basin assessments involved collecting data to fill gaps or processing existing data to make them compatible.

Currently, no source exists that inventories and catalogs all available data for agencies and organizations. In most instances, data documentation is poor or lacks quality control. In an integrated approach, all data would be documented with well-defined update and maintenance processes. This integration process would be vertical as well as horizontal by linking types of assessments and organizations. Data would be distributed, maintained, and used at the local level but available and useful at higher levels. This strategy would include consistent methodologies and a core set of common data.

Inventory and mapping need to be consistent and integrated across the Basin and be consistent with other ecoregions. A multi-value, inter-organizational inventory strategy could be implemented and available to all interested parties. The characteristics of such a strategy would include (FEMAT 1993):

- common protocols;
- coordinated database management;
- coordinated quality control;
- boundary neutrality;
- multi-scale outputs--useful at all scales;
- social, economic, biological and physical components;
- component trends;
- spatially explicit;
- cost efficient; and
- adequate protection of proprietary and sensitive information.

Traditionally, technology has been agency-specific with limited access. Appropriate technology should be accessible to the people who need it, when they need it. Appropriate technology might include:

- geographic information systems;
- global positioning satellite information;
- image analysis (remote sensing);
- database technologies (relational, object-oriented);
- decision support systems/expert systems;
- models (such as spatial, simulation, optimization, growth); and
- virtual systems, dynamic linkages, and systems modeling.

Unless data, information, and routine communications are shared between the various organizations, it will be a struggle to implement ecosystem management. Using a fully integrated information management strategy will have broad application beyond the Basin.

Stakeholder Participation

Planning can be viewed as an intervention in ongoing management processes designed to achieve a future that otherwise might not occur (Wildavsky 1973). Defining a desired future is fundamentally a value choice, a choice best explored interactively with stakeholders before managers make decisions on federally administered land. Selecting among alternatives becomes difficult because (1) resources to achieve desired futures are finite, and therefore subject to allocation to different, and usually competing, uses, and (2) there is often confusion between means and desired ends in the policy process. Ecosystem management explicitly recognizes that planners are confronted with situations where not only are there differences with regard to preferred outcomes, but differences in beliefs about causation, resulting in the need for varying organizational strategies and structures (Lee 1993, Thompson and Tuden 1959).

Natural resource planning occurs within a political context, where “veto power” over implementation of plans is frequently held by stakeholders outside the Federal Government and expressed through litigation and political means. Traditional forms of rational, comprehensive planning have operated poorly in these settings because they often failed to accomplish meaningful stakeholder involvement. Meeting legal requirements of planning processes has tended to lead to stakeholder involvement at a point where it is too late to develop widespread understanding (FEMAT 1993).

Stakeholder participation, then, provides a channel through which planners are informed of important issues and the social acceptability/desirability of means and ends. It helps planners conduct analyses about the things people care about; it is the gyroscope that maintains the planning course (Lee 1993). Stakeholder participation can also be an important source of substantive knowledge about the planning issue as well. Involving stakeholders in the planning process allows the planner to receive significant information in the form of personal knowledge (Freidmann 1987). Finally, stakeholder participation processes may result in consensus among competing interests on shared values, permitting action to proceed and building a feeling of ownership in planning decisions.

Stakeholder participation can be as essential to successful planning as data collection, model building, and hypothesis testing. The objective of stakeholder participation is mutual learning through the sharing of information, interests, and values among tribes, scientists, managers, the interested public, and policy-makers.

Stakeholder participation in ecosystem management is built upon fundamental and sequential concepts (Freidmann 1973). The first concept is that of dialogue. Dialogue is characterized by meaningful interaction among those affected by planning decisions, including the planners. Dialogue allows communication of important information, such as values, beliefs, preferences, acceptability, and personal knowledge. The second concept is mutual learning that allows diverse stakeholders to understand others' positions and beliefs. It suggests that agency planners communicate the missions and constraints under which they operate and incorporate preferences, beliefs, and knowledge into the planning process. Societal guidance means that affected stakeholders can come to terms with the planning issue, resolve (not necessarily agree to) questions about desired futures, and organize resources to pursue appropriate courses of action: they have "ownership" in the decision and have come to some agreement about the acceptability of management practices. Societal guidance is based on the premise that action within society is linked to many different groups and organizational levels, and is not just the responsibility of a centralized agency (Freidmann 1969).

The GPM can incorporate stakeholder participation in each of its steps. The amount of participation sought from stakeholders depends on the landowner, and on the management objectives and legal requirements. A private land manager might have very specific objectives and do the planning in-house without much external stakeholder participation. A Federal land manager has different "clients" and operates under more explicit mandates for stakeholder participation. For example, NEPA requires participation in decisions at several different points in the process. The FS and BLM, however, recognize that stakeholder participation extends beyond the scoping and comment phases of the NEPA process; indeed, ecosystem management might mean more stakeholder participation in all steps of the GPM.

Stakeholder participation methods vary. For example, projects conducted under the auspices of NEPA permit stakeholders to attend public meetings, write letters, and comment on draft documents. People may also participate through interest groups and government bodies that may attempt to sway ecosystem policies and practices. Stakeholder participation may also take subtler forms. People can and do influence Federal land management by the officials they elect and by what consumer products they buy. During each session of Congress there are numerous public land reform measures proposed, and in the Northwest, state laws govern many management activities on state and private lands. Since mid-1995, many state and federal environmental laws have come under scrutiny by the Congress and western State legislatures. Another subtle form of stakeholder participation is through consumer preferences (such as for recycled paper, vegetarianism, or motorized recreation). These preferences can, through the market, influence the assessment, decision, implementation and monitoring steps of the GPM.

Stakeholder participation can be highly visible at the assessment step. Stakeholders can provide substantive knowledge about the ecosystems under discussion as well as about external effects of management options. They also provide opinions about different management options, either speaking for themselves or as members of groups.

Risk and Uncertainty

Much of our contemporary notions of risk and uncertainty follow Knight's (1921) definitions. Risk refers to situations in which the outcome is not certain but the likelihoods of alternative outcomes are known or can be estimated. Uncertainty refers to situations where outcomes cannot be predicted in probabilistic terms. Decision theory has evolved to deal with risk likelihoods and alternative outcomes (Baumol 1965). There is also the crucial distinction between risk/uncertainty and ignorance where ignorance describes situations where possible outcomes may not be all recognized (or known) prior to their occurrence [see Faber and others 1992 for an explanation of surprise and ignorance].

Considering risks is important in ecosystem management because of the stochastic nature of ecosystem processes and the likelihood of outcomes and because of the lack of complete information. Risks associated with predicting outcomes can be partially mitigated by revealing the underlying cause and effect relationships. Science plays a large role in disclosing these relationships. There is also the need to consider how much risk is acceptable to decision-makers. This is revealed in the nature of decisions. Finally there is the broad question of how much risk society wants to bear.

Risk Assessments— Risk assessments help managers develop a sense of the risks about the outcomes of various management strategies. For example, risk assessments have been used to rate the susceptibility of forest stands to insects, diseases or fire. In addition, they can be broadened to estimate the uncertainty regarding ecosystem response to forest, grassland, or shrubland management (Marcot 1992). The United States Environmental Protection Agency (EPA) (1992) defines an ecological risk assessment as a process that evaluates the likelihood that adverse ecological effects may occur as a result of an event large enough and of a sufficient intensity to elicit adverse effects. A variation of the EPA ecological risk assessment model is shown in figure 5.

The first step in risk assessment is problem formulation. This includes three sub-steps: (1) identifying the nature and array of management decisions, (2) identifying and specifying the elements (biophysical, social, economic) of the system, and (3) describing the desired futures (the biophysical, social, and economic values to be enhanced, maintained, or protected). The second step is analysis, and has two phases: (1) characterizing how a disturbance (natural or planned) interacts with the biophysical, social, and economic elements of an ecosystem, and (2) characterizing how the selected variable or process causes adverse effects under particular circumstances. The third step is risk characterization, where the variable or process in question (for example, risk of fire) interacts with the elements of an ecosystem (such as production of specific mushrooms for gathering). The effect of this analysis is to evaluate the likelihood of various outcomes associated with management activities.

When decision-makers choose a course of action, they are engaged in risk management because in so doing, they balance often disparate objectives by choosing among different types and amounts of risks. Individuals differ in their willingness to accept risk; so too do professions and disciplines. As an example, risk averse behavior might lead to recommendations for large ecological reserves for local plant or animal populations to minimize the risk of extirpation. Lack of explicit action also involves risk. For example, not managing for fire risk may result in increased reserve size for maintaining selected plant communities. The degree of risk that people will accept is difficult to estimate; however, methods exist to help disclose risk attitudes of decision-makers. More difficult still is estimating the risk preference of the American people, who own the public lands. Risk attitudes of professionals and the public alike span a wide range in the arena of ecosystem management on federally administered public lands. This is true whether one considers the local, direct risk of wildfire resulting from management; the risk of salmon extinction as felt by any number of interested groups; or the risk of mill closures when impressed on elected officials.

Scenario Planning— The process of risk analysis and risk management of federally administered public lands is iterative, and the emphasis is on the significance of the (adverse and positive) effects in terms of their types, magnitudes, spatial and temporal patterns, and the likelihood of ecosystem recovery without mitigation. Since uncertain events dominate ecosystem change, scenario planning can be used to describe the extent and nature of risks from different ecosystem management actions. Although risk assessments and scenario planning do not determine a "right answer", in that they do not determine society's acceptance of risks, they do describe those risks.

Scenario planning helps describe possible futures, as opposed to a desired future. This process has three main functions: it provides a mechanism for understanding the integration of management options, it allows people to evaluate the merits, pitfalls, and trade-offs of ecosystem management choices, and it shapes broad perceptions.

It is not limited to the resource maximization or cost minimization approaches typical of some multi-resource planning projects. There are two general approaches to scenario planning. The first approach considers varying mixes of inputs and determines the resulting outcomes. This approach provides a mechanism for understanding trade-offs involved in achieving different management goals. Considering the outcomes of several different management scenarios helps managers and stakeholders define what might be possible. Scenario planning in the assessment process uses this approach. The second approach begins with a desired outcome and evaluates different "scenarios" (alternate routes) to reaching the desired outcome. This approach is useful in the decision-making process where differing approaches can be explored to achieve a desired goal or objective. In a sense, scenario planning is desktop adaptive management that allows managers to experiment without incurring real impacts.

Risk Management— Ecosystem management, with its emphasis on levels of spatial and temporal hierarchy, facilitates risk management in the sense that it focuses discussions and management responses at the level the risks occur. The use of risk in this discussion is technically not risk in the sense of Knight's (1921) definition but rather the characterization of the risks associated with a set of outcomes and some notion of the societal acceptability of those risks. Risks in this context are events or activities that pertain to the likelihood of not reaching desired goals. The process for risk management uses the framework for ecological risk assessments presented in figure 5.

In the context of spatial hierarchy, the greatest flexibility for management is attained when risks can be managed at the lowest level possible. For example, in figure 6a the relative contribution of risk to ecological integrity at regional, sub-regional, landscape, and site levels is shown. A risk would not be considered a "regional risk" if it could be adequately addressed by making incremental, individual decisions at lower levels such as sites.

An example of a regional risk is activities that threaten anadromous fish populations. Providing high quality habitat for wide ranging fish species is a regional concern. Making habitat decisions on a site or landscape level would not necessarily ensure that the required habitat was well distributed throughout the species' range. Managing the risk at the regional level would be accomplished through decisions about where, within the species' range, quality habitat would be provided, with site-specific implementation. The alternative would be to manage the risk as though it were a risk at every site and prohibit habitat alteration at any site, which would reduce management flexibility. By strategically selecting where in a region high quality anadromous fish habitat would be emphasized, management would have more options.

A method of partitioning risks through an active risk management approach can retain flexibility at the site level (fig. 6a). Figure 6b shows relative cumulative risks for these same levels. Ovoid A depicts assessments and/or decisions that address region and sub-region associated risks; ovoid B depicts assessments and/or decisions that address landscape associated risks; and ovoid C depicts assessments and/or decisions that address site associated risks. Decisions that address region and sub-region associated risks (ovoid A) might include regional guides, forest plans, and BLM district plans and/or revisions. The next level focuses on risks at the landscape level (ovoid B in fig. 6b). The most detailed analyses are conducted at the site level (ovoid C in fig. 6b) and could include project analyses and planning. Under this approach regional and landscape analyses and decisions provide context for the remaining risks to be addressed at the site level. Through a multi-level analysis and decision process all levels of risk would be addressed, with management activities focused on risks at the lowest level possible for each component of risk.

One purpose of risk management is to allow flexibility at the site and landscape level to the

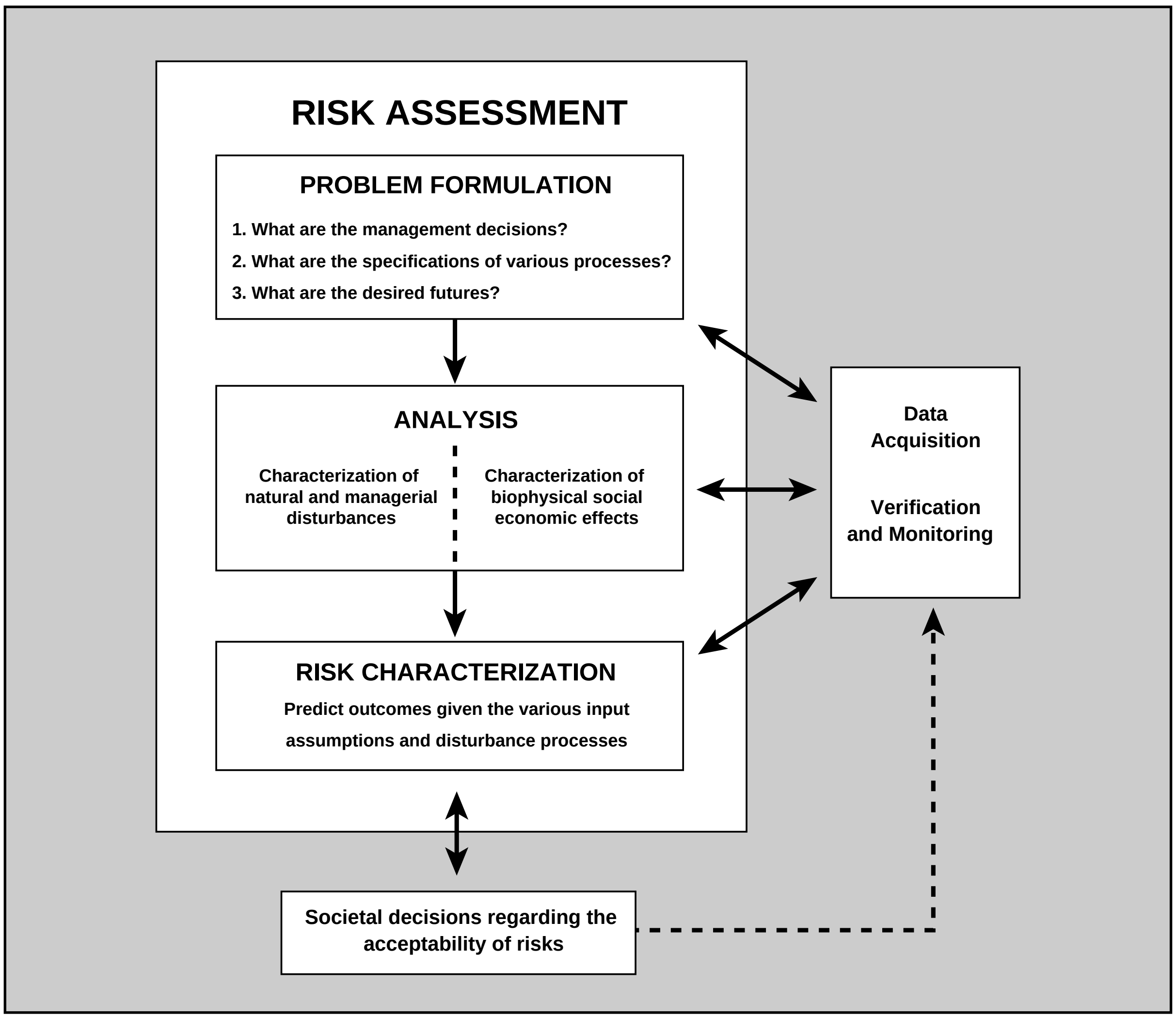


Figure 5—Ecological risk assessment framework for ecosystem management.

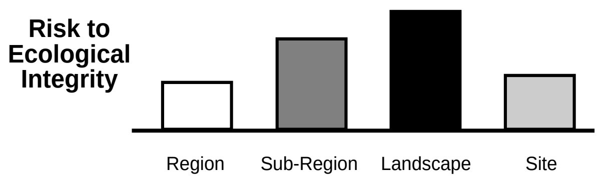


Figure 6a—Example of partitioning risk to ecological integrity across multiple geographic extents.

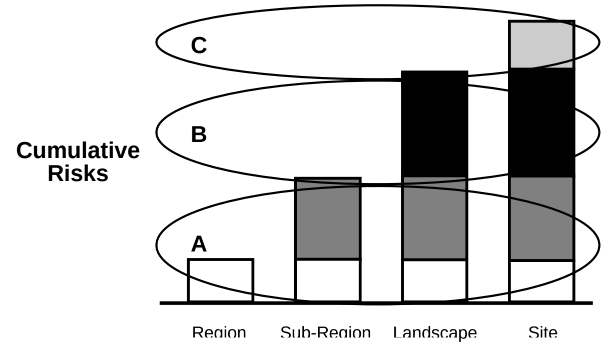


Figure 6b—An example of cumulative risks to ecological integrity at multiple geographic extents. Ovoids A, B, and C represent analysis and decision levels that address risks associated with those levels.

extent compatible with managing risks. For example, establishing standards and guidelines at levels above site level would require "averaging" across a wide array of site conditions. For some sites the standards would be too restrictive, while for other sites they would not be restrictive enough. Managing risks at multiple levels reduces the possibility that a "miss" might occur and increases the probability that outcomes will be achieved. For example, managing streams for quality habitat might involve setting objectives for the number of large pools per stream reach. Averaging across the entire Basin will result in objectives too high for some areas and too low for others. Basing the objectives on landscapes and sites greatly reduces the possibility of a "miss". The higher in decision hierarchy one tries to address the total risks, the fewer options management will likely have and the greater the probability that a decision will be "wrong" for a particular site. This can best be reduced by managing the risks at the lowest level, thus allowing the greatest flexibility at the local level.

Managing to achieve opportunities, desired outcomes, and the provision of goods and services might result in new risks to ecological objectives. These new risks could be created through achieving the outcomes (outputs) and should be evaluated to determine how they affect the cumulative risks associated with not achieving ecological goals in the area. Addressing these risks might require additional analyses and could result in changes in the provision of other goods and services, or in the total risks to the systems being analyzed. It becomes an iterative process, analyzing risks to resources, determining the effects on outcomes (outputs), modifying actions that result in new projections of output levels, determining effects on risks to ecological goals, adjusting expectations or management approaches as appropriate, and cycling through the analysis until the risks to ecosystem management are acceptable and the output levels are achieved to the extent possible.

The final step in risk assessment involves determining societal acceptability. For example, a high degree of risk of species extinction may not be societally acceptable. On the other hand, reducing risks to future generations of, say, catastrophic fire might be highly desirable. Given the cumulative nature of these risks, there is danger that society's acceptance of land management actions may be taken for granted. By attempting to manage the risks, the probability of societal acceptance of management actions is increased.

INTEGRATED PLANNING FOR ECOSYSTEM MANAGEMENT ON FEDERAL LANDS

To this point the framework has: described why the FS and BLM are moving forward with implementing ecosystem management; described ecosystem principles and concepts that set the backdrop for ecosystem management approaches; outlined a set of assumed goals that may be appropriate for ecosystem management; proposed a general planning model; and described strategies for managing information and involvement. But the question now arises as to how these components of ecosystem management link together to create an integrated approach for planning on federally administered lands.

The framework suggests a strategy for implementing ecosystem management on federally administered lands. This strategy is based on dynamic assessments that provide characterizations at different levels (a higher level for context and a lower level to understand processes). It partitions risks to the level where they are observed and where they impact decisions. It provides for hierarchical decisions that are consistent with both the context set at higher levels and an understanding of specific process. This strategy depends on an adaptive management approach that itself depends on partnerships and effective stakeholder involvement. The adaptive approach also depends on the evolving nature of federal planning processes.

One key partnership is the relationship between science and management. For example, monitoring that is tiered to focus on specific goals and objectives at each level provides feedback to both decision processes and to the scientific community where it validates existing information or motivates new research development and technology transfer efforts. Science and management partnerships can better manage the rapid evolution and application of new information.

The strategy suggested in this framework would support decisions at the level that the issue, ecosystem process, or risk to ecosystem integrity occurs. In this context decisions would not be restricted to those mandated through NEPA processes, but could include policy statements, directives, budget direction, executive orders, and congressional direction as well as NEPA decision processes.

Consistency among the various planning levels could be ensured through assessments and monitoring. Assessments of large areas would provide context for assessments of small areas. Monitoring would be used to determine whether the specific goals were met at various planning levels. Assessments covering smaller areas would describe ecosystem processes and risks to ecosystem integrity that exist within the smaller areas. Thus, the combined information from assessments and monitoring could be evaluated to determine if local goals were consistent with higher level goals and if the total risk to ecosystem integrity was addressed prior to project implementation on the ground.

The flexibility of management to apply the practices that are most suited to each particular site would be retained with this strategy. It would be consistent with the NEPA, NFMA, RPA, and FLPMA processes that currently exist. Where necessary the implementing mechanism can be appropriate NEPA documents and FS and BLM land management plan amendments or revisions. Thus, a sub-regional assessment might provide information used to address risks to viability of selected species across a multi-forest/BLM district area. An EIS might be prepared to amend the plans within the sub-regional area consistent with the goals from the regional and national level. These plans would include specific management direction, derived from a broader context, to address the risks of viability within the sub-region.

Ecosystem principles illustrated in this framework point to the need for flexibility in the management of ecosystems. Also, they stress the need for using a process that increases knowledge as management continues. This translates to an adaptive approach where monitoring and inventory information can be shared through management/research partnerships to increase understanding of ecosystems and potential management outcomes. As management practices are applied, monitoring and inventory data are gathered to test the assumptions about projected outcomes, consequences, and trade-offs. Through a research/management partnership, the information allows testing of hypotheses across regions and landscapes not possible in traditional research environments. Questions regarding ecosystem processes and functions often cannot be answered through experiments conducted on small areas with strict controls.

This strategy depends on clearly defined goals. Ecosystem management is not an end in itself, it is a means to achieving goals. Defining the goals for ecosystem management also defines the purposes for which federally administered lands are managed. The discussion presented here regarding potential goals and current debates about private property rights and Federal land management, highlight how difficult it may be to select goals that are acceptable to the Congress and the public. Yet, the selection of goals is fundamental to moving forward with ecosystem management on federally administered lands. Additional development of processes related to implementing ecosystem management cannot supplant the need to confront the issue of goal selection and priority setting.

EPILOGUE

A primary issue in land management is stewardship. As Solomon wrote some 2600 years ago, “one generation comes and another passes but the land remains.” Our task as land stewards is to reconcile the new goal of maintaining the integrity of ecosystems and the resiliency of social and economic systems with the traditional goal of providing goods and services. In one sense, this framework provides a platform that merges science with changing societal values to help make choices about dynamic systems in the face of uncertainty. It acknowledges that the shift to ecosystem management incorporates a struggle about values that influence land management.

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GLOSSARY

Adaptive management—Feedback which consists of knowledge or data on the effects or results of an action. Information is purposely collected and used to improve future management actions.[1]

Biodiversity (biological diversity)—The diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species.

Biomass—The total mass of living matter within a given volume of environment.[2]

Biome—An entire community of living organisms in a single major ecological region.[2]

Biophysical—The combination of biological and physical components in an ecosystem.

Biotic—Living; relating to life or specific life conditions.[2]

Decision-maker—In federal land management, the person authorized to make land management decisions.

Desired future condition—A portrayal of the land or resource conditions that are expected to result if goals and objectives are fully achieved (36 CFR 219).

Disturbance—Any event that alters the structure, composition, or function of terrestrial or aquatic habitats; fire, flood, and timber harvest are examples of large-scale disturbances.

Disturbance regime—Natural pattern of periodic disturbances, such as fire or flood, followed by a period of recovery from the disturbance, such as regrowth of a forest after fire.

Diversity—The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan (36 CFR 219.3).

Ecoregion—A continuous geographic area with similar climate that permits the development of similar ecosystems on sites with similar properties.

Ecosystem—A community of organisms and their physical environment interacting as an ecological unit.[3]

Ecosystem integrity—System integrity where the system is defined as the degree to which all components and their interactions are represented and functioning within an ecosystem. Integrity is the quality or state of being complete, a sense of wholeness.

Ecosystem management—"...management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function."[8]

Endemic species—Plants or animals that occur naturally in a certain region and whose distribution is limited to a particular locality.

Exotic—Not native; an organism or species that has been introduced into an area.

Hierarchy—A general integrated system comprising two or more levels, the higher controlling to some extent the activities of the lower levels; a series of consecutively subordinate categories forming a system of classification.[3]

Hypothesis—An assertion or working explanation that leads to testable predictions; an assumption providing an explanation of observed facts, proposed in order to test its consequences.[3]

Landscape—A heterogeneous land area with interacting ecosystems that are repeated in similar form throughout.[4]

Monitor—to check systematically or scrutinize for the purpose of collecting specified categories of data.

Monitoring—A process of collecting information to evaluate whether or not objectives of a project are being realized. In land management, monitoring is used to describe continuous or regular measurement of conditions that can be used to validate assumptions, alter decisions, change implementation or maintain current management direction.

Montane—of, growing in, or inhabiting mountain areas.[2]

Native—Indigenous; living naturally within a given area.[3]

Population viability—Relative measure of the estimated numbers and distribution of reproductive individuals in a species population necessary for that species' continued existence; a minimum number of reproductive individuals in a habitat that will both support them and enable them to interact is necessary for a species' maintenance [adapted from 36 CFR 219.9].

Resiliency- the degree to which systems adapt to change.

Resolution—Separation or reduction of something into its constituent parts; here, the degree of detail incorporated in the data; finer data resolution provides greater detail.[2]

Scale—Defined in this framework as geographic extent; for example, regional, sub-regional, or landscape scale.

Scenario planning—Planning that focuses on an outline of a hypothesized or projected chain of events.[2]

Seral stage—The developmental stages of a plant community not including the climax community; typically, young-seral forest refers to seedling or sapling growth stages; mid-seral forest refers to pole or medium sawtimber growth stages; and old or late-seral forests refer to mature and old-growth stages.

Spatial—of, relating to, or having the nature of space.[2]

Species—The lowest principal category of a biological classification distinct from other groups.[3]

Stakeholders—Tribal, state, county, local governments, and private landholders; as well as individuals and groups representing local and national interests in Federal land management. This is meant to be inclusive of all organizations and individuals with an interest in Federal lands. This includes all United States citizens who use, value, and depend upon the goods, services, and amenities produced by federally administered public lands.

Succession— The more or less predictable changes in species composition in an ecosystem over time, often in a predictable order, following a natural or human disturbance. An example is the development of a series of plant communities (called seral stages) following a major disturbance.[5]

Systems modeling— Using a model of a system to study (or experiment) with the system itself.[7]

Temporal—Related to, concerned with, or limited by time.[2]

Viable—Having the capacity to live, grow, germinate, or develop.

Virtual system—A system that is the essence of reality but not actual fact, or form.

Watershed—The region draining into a river, river system, or body of water.[2]

Weed—Any plant growing where it is not wanted.[3]

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[1] Bormann and others 1994

[2] New Riverside Publishing Company c1988

[3] Lincoln and others 1982

[4] Noss and Cooperrider 1994

[5] Waring and Schlesinger 1985

[6] Thomas 1994a

[7] Gordon 1978

[8] Ecological Society of America. 1995. The scientific basis for ecosystem management: An assessment by the ecological society of America. Prepublication copy. Not paged.

United States Department of Agriculture | **Forest Service** | **R-6** | **OSO** | **Bureau of Land Management**

Reply To: FS-1230, BLM-1203 Date: July 18, 1994

Subject: Delegation of Authority

To: Jeff Blackwood, Project Manager, EEMP
Steve Mealey, Project Manager, UCRB EIS
BLM and FS Field Offices in the Columbia River Basin

<u>Products, Roles, and Expectations</u>

As further explained in the Charter for the Eastside Ecosystem Management Project (EEMP), the expected products for the Project are a broad-scale, basin-wide scientific assessment, a mid-scale scientific assessment to support the eastern Oregon/Washington EIS, and a scientific evaluation of EIS alternatives. As a result of the decision to prepare an ecosystem management EIS for the Upper Columbia River Basin, the mid-scale scientific assessment will be expanded to cover the entire basin.

Jeff Blackwood will continue as Project Manager of EEMP and, on a contract basis, administer the preparation of all EEMP science products with Tom Quigley, Science Integration Team (SIT) Leader. In addition, Jeff is responsible for overall preparation of the eastern Oregon/Washington EIS. Steve Mealey will be Project Manager for completing the Upper Columbia River Basin (UCRB) EIS. Steve will communicate issues and concerns about science and science products to Tom. Issues of consistency or major impacts to the SIT will be negotiated between Jeff and Tom. Jeff and Steve will assure effective communications between Boise and Walla Walla resulting in similar EIS's completed in about the same time.

<u>Delegation of Authority and Data Requests</u>

Jeff Blackwood is delegated full authority to bring to bear all appropriate resources to successfully and in a timely manner complete the basin-wide and mid-scale Scientific Assessments and the Eastern Oregon/Washington EIS. Steve Mealey has similar authority for the Upper Columbia River Basin EIS. This includes authority to request personnel skills and to request data from offices within the study area. Jeff and Steve will establish procedures with each Regional Office and State Office for requesting personnel and data to accomplish Project objectives.

Jeff Blackwood Page 2

The success of the Assessments and the two EIS's is most critical to our long-term opportunities to implement ecosystem management. At the same time, it is important that we achieve other plans and targets. Therefore, when trade-offs in other program accomplishment needs to occur to provide support to the EEMP, they should be discussed with the appropriate line officers in order that work priorities can be adjusted.

JOHN E. LOWE
Regional Forester
Forest Service R-6

for DALE BOSWORTH
Regional Forester
Forest Service R-4

DAVID F. JOLLY
Regional Forester
Forest Service R-1

FRAN CHERRY
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CHARLES W. PHILPOT
Station Director
Pacific Northwest Forest and
Range Experiment Station

for DENVER P. BURNS
Station Director
Rocky Mountain/Intermountain
Experiment Stations

Charter

Eastside Ecosystem Management Project

112 East Poplar Street
Walla Walla, Washington 99362

phone: (509) 522-4030

Date: Jan. 21, 1994

Reply to: BLM: 1736
FS: 1400, 1900

Subject: Eastside Ecosystem Management Strategy Charter

To: BLM: State Directors, OR/WA, ID, MT
FS: Regional Foresters, R-1, R-4,
R-6 Station Directors, PNW, INT/RM

In May 1993, a team led by Forest Service scientist Dr. Richard Everett completed an "Eastside Forest Ecosystem Health Assessment." In July, as part of his plan for ecosystem management in the Pacific Northwest, President Clinton directed "the Forest Service to develop a scientifically sound and ecosystem-based strategy for management of eastside forests", and further stated that the "strategy" should be based on the forest health study recently completed by agency scientists as well as other studies. To further elaborate and extend this charge, we are jointly directing that an ecosystem management framework and assessment be developed for lands administered by the Forest Service (FS) and Bureau of Land Management (BLM) on those lands east of the Cascade crest in Washington and Oregon and within the interior Columbia River Basin (CRB).

We have jointly decided that the processes outlined in the Interim CRB Assessment and Eastside Ecosystems Management Strategy Project Charter are essential steps leading to sound man age ment decisions. We, and our respective line officers, will use the science products (framework, assessment, and evaluation of alternative EM Strategies) derived from this process as input into our decision making processes. Line officers within the BLM and FS will develop management direction using the science products as a portion of the total input considered in developing such direction.

We have been motivated to request these products because management of the public resources within the interior CRB require new direction that is based on ecosystem concepts within the context of the larger Basin. Recent advances in our understanding of ecosystem principles, cumulative effects, biophysical interactions, and concerns of ecosystem integrity and species viability, point to the need to undertake the studies outlined in the Charter. Since current land and resource plans were signed, new information and changing conditions require a re-evaluation of management direction.

Therefore, updated management directions are needed for the Eastside National Forests and some lands administered by the Bureau of Land Management. From an ecosystem standpoint, an overall assessment is needed for the interior Columbia River Basin, so that manage ment decisions can be made within this larger context.

Recognizing that ecosystems encompass lands that cross jurisdictions, and actions taken on lands administered by one agency affect outcomes on lands administered by another, there must be shared vision, commitment, and leadership among agencies in development of ecosystem management strategies and their implementation. The Forest Service is to take the lead responsibility in assembling the appropriate interagency structures and processes to accomplish this assignment. This includes invitations to State governors and tribal government leaders, local govern ments, key interested parties and affected parties, and other Federal and State agencies to participate in the process.

As part of this assignment, Jeff Blackwood, Forest Supervisor on the Umatilla National Forest, will assume the responsibilities of Project Manager for the project. Patrick Geehan will be the BLM Project Coordinator. Thomas M. Quigley, Manager, Blue Mountains Natural Resources Institute, will be the Science Team Leader, and George Pozzuto, District Ranger on the Lake Wenatchee Ranger District, will be the EIS Team Leader. Patty Burel, Public Affairs Officer for the Blue Mountain Narural Resource Institute, will be the Communications Team Leader. Kay Pennel and Cathy Weise will provide administrative support. Teams and activities will be located in Walla Walla, Washington. Team leaders will need your cooperation and support in filling needed positions and completing the project.

As further direction, we refer to several key points made by Assistant Secretary James Lyons in announcing the intent of the Forest Service to develop a new management strategy for national forests in eastern Oregon and Washington. The strategy will:

- be based on ecosystem management concepts;
- focus on restoring the health of forest ecosystems;
- be scientifically sound and ecosystem based;
- be based on the forest health study recently completed by agency scientists and other studies;
- be a multi-agency effort involving the public in an open process; and link with the development of a draft environmental impact statement
- to be completed by spring or summer of 1994.

Development of a scientifically sound and ecosystem-based management strategy for eastern Oregon and Washington will require (1) a framework for ecosystem management for the entire interior Columbia River Basin, and (2) a broad assessment of ecosystem processes and functions, species, social systems, and economic systems within the Basin.

This should lead to the development of an EIS useful to both the Forest Service and Bureau of Land Management that would result in decisions for implementing the strategy. The EIS would include the development of a wide array of alternative strategies for eastern Oregon and Washington and an evaluation of the consequences of each alternative based on the best technical and scientific information available. The EIS will be presented to the responsible federal decisionmakers for appropriate action.

Upon completion of each product, line officers within the Forest Service and BLM will consider the recommendations and make decisions to modify or retain existing management direction. The ultimate decision to adopt or reject the recommendations resides with us and our appropriate line officers. We will use the scientific information to enhance our understanding of trade-offs, interactions, consequences, and potential results. We will be issuing decision documents, policy statements, andother policy direction as we deem appropriate through the life of the Charter and following its completion.

Attached is the initial charter and summary of products we expect the team to produce over the next 9-12 months.

/s/ Jack Ward Thomas
JACK WARD THOMAS
Chief, Forest Service

/s/ Jim Baca
JIM BACA
Director, USDI Bureau of Land Management

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT

FRAMEWORK AND ASSESSMENT

and

EASTSIDE OREGON AND WASHINGTON

ECOSYSTEM MANAGEMENT STRATEGY PROJECT CHARTER

"Eastside Ecosystem Management Charter"

Definitions

"Interior Columbia River Basin" includes lands in the continental United States tributary to the Columbia River east of the crest of the Cascade Mountain Range. For purposes of this Charter, the terms "Basin-wide" and "Basin" are interchangeable with "Interior Columbia River Basin". This will include portions of Forest Service Regions 1,4, & 6 and portions of lands administered by the Bureau of Land Management (BLM) in Oregon, Washington, Idaho, and Montana.

"Eastside," in this charter, refers to the National Forests and appropriate BLM administered lands in eastern Washington and Oregon lying east of the crest of the Cascade Mountain Range. This may also include lands managed by other federal agencies within this geographic area.

Situation

Since forest plans were established in eastern Washington and Oregon in 1989 and 1990, a number of scientific and administrative studies have been conducted generating new information relevant to National Forest management. In July 1993, as part of his plan for ecosystem management in the Pacific Northwest, President Clinton directed "the Forest Service to develop a scientifically sound and ecosystem-based strategy for management of eastside forests," and further stated that the "strategy" should be based on the forest health study recently completed by agency scientists as well as other studies.

The Forest Service and BLM are considering implementing the interim direction to conserve Pacific Salmon throughout their range in Oregon, Washington, Idaho, and California. This interim directionwill be followed by development of a long-term management strategy to address this issue in these states as well as Alaska. This Charter identifies, as a minimum, initial studies and plans appropriate to implement the Anadromous Fish Habitat and Watershed Conservation Strategy (formally called "PACFISH") within the interior Columbia River Basin.

The combined tasks of developing an ecosystem management strategy and implementing the Anadromous Fish Habitat and Watershed Conservation Strategy, necessitate an overall frame work to guide planning for ecosystem management within the Interior Columbia River Basin. Additionally, a Basin-wide scientific assessment is needed. It should examine the ecologic, economic, and social systems, looking at current as well as historic conditions, and the prob a bil i ty that outcomes associated with current practices and trends will result in change within the systems it will provide essential information for evaluating and implementing ecosystem man age ment within the Basin.

Ecosystems transcend administrative boundaries. The evaluations undertaken will use available data where appropriate or applicable. This effort is not intended to request new data from private land owners, enter their lands, or otherwise establish direction for management of those lands.

Project Expectations

Implementing an ecosystem management strategy will require the development of several products. Two initial studies will include a Basin-wide scientific framework and a Basin-wide scientific assessment. The interior Columbia River Basin (CRB) ecosystem management scientific framework will provide the broad concepts and analytical processes recommended for ecosystem analysis, planning, and management. The interior CRB scientific assessment will examine historic and current ecologic, economic, and social systems and discuss probable outcomes if current management practices and trends continue.

Drawing from the concepts and principles of the Basin-wide scientific framework and in for ma tion from the Basin-wide scientific assessment and the environmental impact statement (EIS) scoping response, an EIS will be developed for the eastside National Forests that will array a variety of ecosystem management strategies for management of lands administered by the Forest Service and a portion of the Bureau of Land Management lands in eastern Oregon and Wash ing ton. The EIS will, as a minimum, address the Anadromous Fish Habitat and Watershed Con ser va tion Strategy recommendations. This EIS will be supported by a scientific evaluation of the issues and alternatives identified by the National Environmental Policy Act (NEPA) scoping and public involvement process. The decision document(s) resulting will address the management of affected BLM and Forest Service managed lands. It is anticipated that similar decision doc u ments will be issued in Idaho and portions of California, although the nature of the decisions in addition to the Anadromous Fish Habitat and Watershed Conservation Strategy for those states has not yet been determined. The Anadromous Fish Habitat and Watershed Conservation Strat e gy will be considered in Forest plan revisions and BLM resource management plans in Alaska. The decision documents and processes for those states will be done in a coordinated manner among the Regions and Districts involved. Through these activities, a Basin-wide framework forecosystem management and a Basin-wide assessment of resource conditions should result in a comprehensive, coordinated approach to resource management within the Basin.

The Forest Service and Bureau of Land Management are proceeding as outlined in this Charter with the full expectation of bringing in other federal agencies (for example, Environmental Protection Agency, Fish and Wildlife Service, National Marine Fisheries Service, and Soil Con ser va tion Service) as cooperators in the process.

The EIS process proposed in this Charter will provide a basis for the Forest Service and BLM to make decisions to amend or revise current land management plans for ecosystem management strategies on the National Forests and participating Bureau of Land Management lands of eastern Oregon and Washington. It is assumed that scientific expertise will be assembled from a wide array of disciplines, agencies, universities, and other organizations to evaluate the issues and alternatives.

The role of the scientists in this regard is to assess, based on the best information available, the tradeoffs, consequences, outcomes, and interactions that are associated with each alternative. It is the Federal EIS team members’ role to develop the array of alternatives and to critically review the science products for possible use within the EIS. Any land management decisions based upon the EIS will be made by the appropriate line officers in BLM and the Forest Service.

Key Participants and Roles

Chief, USDA Forest Service, and Director, Bureau of Land Management: Authorize an Executive Steering Committee to oversee the processes outlined in the Charter. Any subsequent changes to the Charter will be with the concurrence of the Chief and the Director.

Columbia Basin WO Coordinators: Director, Land Management Planning, Forest Service, and the Science Advisor to the Director, Washington Office, BLM, shall receive progress reports and arrange for resolution of issues that exceed the scope of the Charter.

Columbia Basin Executive Steering Committee: Shall oversee the implementation of the Charter, monitor and report progress, propose needed amendments, ensure other appropriate participants are involved in its implementation, propose resolution to issues within the Charter, elevate issues and suggested resolutions to the Chief and Director for resolutions. The Executive Committee shall include:

Regional Forester, R-6	Regional Forester, R-1
Regional Forester, R-4	Station Director, PNW
Station Director, RM/INT	State BLM Director, Oregon-Washington
State BLM Director, Idaho	State BLM Director, Montana

The Executive Steering Committee will solicit the participation of other potential partners (e.g., National Marine Fisheries Service, Fish and Wildlife Service, Environmental Protection Agency, and Soil Conservation Service). They will be added to the Executive Committee as appropriate through amendment to this Charter.

Eastside Project Managers: Are responsible to the Executive Steering Committee for ac com plish ing the actions and products outlined in the Charter. The Project Manager is Jeff Blackwood; Science Team Leader is Thomas M. Quigley; and the Bureau of Land Management Project Coordinator is Patrick Geehan.

Coordination with States, Tribal Governments, and Key Interested Parties

An essential element of this process will be to coordinate with, and seek involvement of, af fect ed State governors and tribal government leaders. In addition, local governments, key interested and affected parties, and other federal and state agencies will also be encouraged to participate.

Key Actions, Products and Timelines

Updated management directions are needed for the Eastside National Forests and lands administered by the Bureau of Land Management. Since current land and resource plans were signed, new information and changing conditions suggest a re-evaluation of management direction. From an ecosystem standpoint, an overall assessment is needed for the interior Columbia River Basin, so that management decisions can be made within this larger context. All products developed from this charter will be presented to the responsible federal decisionmakers. The expected actions, timelines, and products for the Columbia Basin Project are summarized below. The Eastside Project Managers will take the lead in developing the four primary products under the direction of the Executive Steering Committee. Primary direction for the Eastside EIS and Scientific Evaluation of alternative ecosystem management strategies will be provided by a subgroup of the Executive Steering Committee consisting of the R-6 Regional Forester, PNW Station Director, and State BLM Director for Oregon and Washington.

(1) SCIENTIFIC FRAMEWORK FOR ECOSYSTEM MANAGEMENT IN THE INTERIOR COLUMBIA RIVER BASIN

Objective:

Develop an ecosystem management framework that includes principles and processes which may be used in a NEPA process to develop management direction for federal agency ecosystem analysis, planning, and management at all levels within the Basin. Concepts and principles from the framework will link to subsequent products.

Framework Components:

The framework will be based on an ecosystem approach to management with emphasis on biological and human ecosystems. It will examine the interrelationships of the biophysical, social, and economic systems. It will consider public expectations, management capabilities, biological/ecologicalcapabilities, science processes, and current scientific literature (e.g., Eastside Forest Health Assessment, the product of the Forest Ecosystem Management Team (FEMAT), Eastside Forests Scientific Society Panel Report, and other material). The result will be principles and processes that can be used to develop management direction (consistent with NEPA, National Forest Management Act (NFMA), Federal Land Policy and

(1) SCIENTIFIC FRAMEWORK FOR ECOSYSTEM MANAGEMENT IN THE INTERIOR COLUMBIA RIVER BASIN (continued)

> Management Act (FLPMA), and applicable laws) for planning ecosystem management at all levels on federal public lands within the interior Columbia Basin.

These preliminary planning actions will identify the scale, coarse filters, viability and risk assessments, economic and social assessments, monitoring and evaluation, technology needs, and public participation processes that may be useful in implementing ecosystem management on these lands within the Basin.

Framework Product and Timeline:

> A Basin-wide scientific framework for ecosystem management on lands administered by the Forest Service and Bureau of Land Management in the form of a scientific, peer-reviewed doc u ment that will be made available for public comment prior to final pub li ca tion. It provides rec om men da tions on linking science processes and products with plan ning on Federal lands. It is not a decision document. The draft scientific framework will take approximately 3 months from the date the Charter is effective.

(2) SCIENTIFIC ASSESSMENT FOR ECOSYSTEM MANAGEMENT IN THE INTERIOR COLUMBIA RIVER BASIN

Objective:

> The broad scientific assessment of the resources within the interior Columbia River Basin will characterize and assess landscape, ecosystem, social, and economic processes and functions and describe probable outcomes of continued management practices and trends. It will identify the primary social and ecologic values and functions that will be addressed through the additional planning and implementation processes outlined within the ecosystem management framework for the Basin. Information generated through this as sess ment will be used, as a minimum, in the NEPA process which will be conducted to provide a basis for management direction to modify and implement the Anadromous Fish Habitat and Watershed Conservation Strategy within the Basin.

(2) SCIENTIFIC ASSESSMENT FOR ECOSYSTEM MANAGEMENT IN THE INTERIOR COLUMBIA RIVER BASIN (continued)

Scientific Assessment Components:

The broad scientific assessment of the natural resources within the interior Columbia Basin will characterize and assess landscape, ecosystem, social, cultural, and economic processes and func tions. The assessment will describe relationships within and among ecologic, social, cul tur al, and economic systems and interpret effects of past human interactions. Primary com po nents of the evaluation will include:

a. landscape, economic, cultural, and social characterization;

b. identify the probability that change may occur in the components of diversity (landscape, ecosystem processes and functions, species);

c. identify social, cultural, and economic systems;

d. identify emerging issues that relate to ecosystem management within the Basin;

e. identify the social and cultural values of natural resources.

f. identify technology gaps, research needs and opportunities to advance the state of knowledge.

Assessment Product and Timeline:

A Basin-wide narrative report on the ecologic, economic, cultural, and social systems, describing the relationship within and among systems while interpreting effects of past human interactions. In addition, a research, development, and application plan will be developed to fill knowledge gaps and advance technology. This will be published as a scientific, peer-reviewed document in a format useful to other public and private land managers and policy makers. The draft scientific assessment will take approximately 9 months from the date the Charter is effective. The Assessment will be made available for public comment prior to finalizing. This is not a decision document.

(3) EASTSIDE ENVIRONMENTAL IMPACT STATEMENT

Objective:

Develop an Eastside EIS proposing a broad array of alternative strategies that encompasses up to 10 eastside Washington and Oregon National Forests and portions of 4 BLM Districts. The EIS process will be consistent with the principles of the scientific ecosys tem framework, incorporate information from the scientific assessment of the interior Columbia River Basin, and draw from the scientific evaluation described below. The scope of the EIS will include, as a minimum, all lands administered by the Forest Service east of the Cascade crest in the states of Oregon and Washington. It will also include eastside Bureau of Land Management lands within the existing range of the Pacific Salmon, forested lands, and bull trout habitat. The EIS process must include an open scoping process with the public.

EIS Components:

A NEPA scoping process will be used to identify issues. From that scoping and other in for ma tion, a range of management alternatives will be developed that integrates con sid er ations of sustained long-term economic, social, and ecological values of the region and issues identified in scoping. Analysis of alternatives for managing forest and rangelands will consider the Eastside Forest Ecosystem Health Assessment, recommendations of the Eastside Forests' Scientific So ci ety Panel, and other information. A broad array of potential strategies will be developed. This array should reflect societal expectations for public lands within the planning area.

As a minimum, each alternative will take into account the following factors:

- effects on cultural, historic, and current public uses and values, including scenic quality, recreation, subsistence, and tourism;
- concepts of adaptive management;
- effects on environmental and ecological values, including air and water quality, habitat conservation, sustainability, threatened and endangered species, biodiversity, and long-term productivity;
- jobs attributable to natural resource management, both commodity and non-commodity oriented, including jobs attributable to investment and restoration associated with each alternative;

(3) EASTSIDE ENVIRONMENTAL IMPACT STATEMENT (continued)

- economic and social effects on local communities and other governments including tribes, and effects on revenues to counties and the national treasury;
- economic and social effects associated with the protection and use of forest resources that
- might aid in transition of the Region's industries and communities to sustainable economies;
- economic and social benefits from ecological services within each alternative;
- regional, national, and international effects as they relate to timber supply, wood product prices, and other key economic and social variables;
- practicality of and barriers to implementation.

EIS Product and Timeline:

A legally sufficient EIS developed through an open public process from which a Record of Decision can be developed that may include adjustments to land and resource plans. The draft Eastside EIS will take approximately 9-12 months from the date the Charter is effective. The final EIS will follow as soon as public review and evaluation is complete. From the final EIS, a Record of Decision can then be issued by the responsible federal decision maker.

(4) EASTSIDE ECOSYSTEM MANAGEMENT SCIENTIFIC EVALUATION OF PLAN NING ALTERNATIVES

Objective:

The Eastside Ecosystem Management Evaluation is a scientific evaluation of issues and alternatives identified through the NEPA scoping process for the Eastside EIS. This evaluation will be done in conjunction with an analysis of the effects of implementation on tribal values and rights. It will address the practicality of implementation of each alternative strategy.

Evaluation Components:

The evaluation should analyze each alternative in terms useful for analysis of costs and benefits, to the extent possible, and consider, as a minimum, the criteria listed under the EIS component of this charter.

The evaluation will be based on concepts documented in the ecosystem framework with consideration for maintenance and restoration of biological diversity, particularly that of late-successional and old-growth forest ecosystems; maintenance of long-term productivity; maintenance of sustainable levels of renewable natural resources, including timber, other forest products, grazing, fish, and other resource-related values of forests and rangelands; and maintenance of rural economies and communities. To the extent possible, the evaluations will link the biological, cultural, social, and economic concerns at each hierarchical scale.

Outcomes associated with each alternative should be evaluated relative to maintaining and/or restoring productivity, maintaining economic, social, and cultural systems, and maintaining and/or restoring forest and rangeland resources (commodity and non-commodity). The levels of protection, investment, and use that will be necessary to achieve the stated outcomes for each alternative will be described.

The evaluation should provide an integrated landscape characterization within a structural database. This should include terrestrial and aquatic systems and, to the extent possible, social and cultural systems.

The evaluation should include implementing adaptive management within an ecosystem frame work. The specific linkages to research, inventory, monitoring, and other ownerships should be highlighted, and ways should be discussed for transitioning to adaptive management.

4) EASTSIDE ECOSYSTEM MANAGEMENT SCIENTIFIC EVALUATION OF PLAN NING ALTERNATIVES (continued)

The evaluation will consider long-term ecosystem health. It will carefully examine the role that natural processes and human activities have played in shaping the eastside ecosystems, landscape patterns, patch sizes, productive potentials, and resource changes. It will consider the variability nature has provided through these disturbance and change elements, the implications these elements have on sustainable long-term ecosystems, and ways disturbances and change can be accounted for in the overall management scheme. Also it will examine the alternative means by which disturbance elements can be mimicked on the landscape and the role these management activities might play providing ecological and social benefits.

In addressing biological diversity, consideration should not be limited to any one species and, to the extent possible, each alternative should be assessed for long-term management against viability. On eastside spotted owl Forests, the assessment should examine al ter na tive measures to maintain spotted owl habitat within the FEMAT framework on those areas where such habitat is temporally highly dynamic and may be lost to natural suc ces sion al and disturbance processes.

The evaluation will consider social and cultural diversity as well as elements of ecological diversity. Changes in social and cultural diversity associated with shifts in resource flows, avail abil i ties, access, and conditions will be specifically addressed. Probable impacts on lifestyles, social interactions, and interdependencies will be described.

4) EASTSIDE ECOSYSTEM MANAGEMENT SCIENTIFIC EVALUATION OF PLAN NING ALTERNATIVES (continued)

Product and Timeline:

A scientific peer-reviewed document evaluating the effects of implementing a variety of ecosystem management strategies on eastside National Forests. The draft scientific evaluation will be available for consideration by the Eastside EIS Team about 9 months from the date this charter is effective. It is anticipated the EIS Team will consider the Scientific Evaluation along with other information it considers relevant to preparing the draft EIS. This evaluation is not a decision document - it is a scientific evaluation of the effects of implementing the various ecosystem management strategies. It will be made available for review.

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Notes

Haynes, Richard W.; Graham, Russell T.; Quigley, Thomas M., tech. eds. 1996. A framework for ecosystem management in the Interior Columbia Basin including portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-374. Portland, OR; U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 66 p.

A framework for ecosystem management is proposed. This framework assumes the purpose of ecosystem management is to maintain the integrity of ecosystems over time and space. It is based on four ecosystem principles: ecosystems are dynamic, can be viewed as hierarchies with temporal and spatial dimensions, have limits, and are relatively unpredictable. This approach recognizes that people are part of ecosystems and that stewardship must be able to resolve tough challenges including how to meet multiple demands with finite resources. The framework describes a general planning model for ecosystem management that has four iterative steps: monitoring, assessment, decision-making, and implementation. Since ecosystems cross jurisdictional lines, the implementation of the framework depends on partnerships among land managers, the scientific community, and stakeholders. It proposes that decision-making be based on information provided by the best available science and the most appropriate technologies for land management.

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