Understanding and Managing the Assessment Process

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Key questions addressed in this chapter

- ♦ *Why conduct ecological assessments?*
- ♦ *What are the barriers to conducting assessments?*
- ♦ *What is the role of public involvement and participation in assessments?*
- ♦ *What approach to information management should be taken?*
- ♦ *How do you incorporate assessments in natural resource planning?*

Keywords: Assessment, scales of analysis, information management, scenario planning

1 INTRODUCTION

Taking an ecological approach to management, or ecosystem management, is a developing approach for managing natural resources within the context of large geographic scales and over multiple time frames. Recently, the Council on Environmental Quality (CEQ) (IEMTF 1995) defined an ecosystem as "...an interconnected community of living things, including humans, and the physical environment within which they interact." Understanding how humans affect, and are affected by, ecosystems is critical to understanding how these systems function. The CEQ defined the ecosystem approach as "... a method for sustaining or restoring natural systems and their functions and values. This approach is goal driven, and it is based on collaboratively developed vision of desired future conditions that integrates ecological, economic, and social factors." A fundamental challenge to taking an ecological approach, then, is the need to understand and manage complex ecosystems simultaneously across large and small temporal and spatial scales.

Natural resource managers are faced more and more with the need to make decisions concerning complex interrelated social, economic, and environmental issues. These complex decisions bring with them an inherent level of uncertainty for decision-makers and stakeholders alike. Managers and stakeholders need to recognize this inherent uncertainty and be flexible enough to adjust decisions in the face of surprise. Planning must not be too precise if all parties to decisions are to be able and willing to accommodate change and to adapt to goals that may not completely suit their own desires. Decision-making must be by consensus, and be reached by addressing what is scientifically possible, what diverse stakeholders want, and overall public policy (see Haynes and Clark, and Bormann et al., this volume). A formal process of adaptive management will be required to maximize the benefits of any option for land and natural resource management, and to achieve long-term objectives through implementation of ecosystem management.

Kai Lee (1993) defines adaptive management as "... treating economic uses of nature as experiments, so that we may learn efficiently from experience." The process itself is straightforward and simple: goals and objectives are identified, evaluated, and a determination made whether to adjust strategy or goals. Adaptive management (Figure 1, Graham et al., this volume) is a continuing process of action-based assessing, planning, monitoring, researching and adjusting with the objective of improving the implementation and achieving the desired goals and outcomes (ROD 1994). This approach (Walters and Holling 1990) provides a basis for immediate implementation of ecosystem management. In this process goals and objectives are clearly stated, an initial hypothesis of ecosystem behavior is described, and ongoing assessment (monitoring) is conducted to provide rapid feedback for redirection of management experiments. Kai Lee (1993) equates politics and conflict ("bounded conflict is politics") in combination with adaptive management in a process he calls "social learning." He notes that "social learning explores the human niche in the natural world as rapidly as knowledge can be gained, on terms that are governable though not always orderly. It expands our awareness of effects across scales of space, time, and function."

It is within this context of ecosystem management, uncertainty, adaptive management, and social learning that various agencies are engaging in large-scale integrated ecological assessments. We need to learn from these efforts and continuously adapt the assessment process to ensure that assessments are useful to decision-makers and stakeholders, and they provide a basic understanding of how social, economic, and ecologic systems function. Assessments are a cornerstone in managing towards the goal of the ecosystem approach: "to restore and sustain the health, productivity, and biological diversity of ecosystems and the overall quality of life through a natural resource management approach that is fully integrated with social and economic goals" (IEMTF 1995).

The purpose of this chapter is to alert decision-makers and assessment program managers to the lessons learned in the first round of ecoregional assessments. It is a "how to" with respect to managing the assessment process. A book is in progress that will provide the "how to" for the science needed to conduct an assessment (Bourgeron et al., in preparation).

2 WHY DO ASSESSMENTS?

Resource management and regulatory agencies conduct assessments as part of their business to determine supply and demand for various goods and services, resource conditions, risk to humans from pollution and fire, habitat or population status for endangered species, and numerous other issues. These assessments are normally narrow in scope and single-issue specific. Single-issue assessments also may ignore important short- or long-term consequences of management activities that may be removed in time and space from the managed site. Traditional assessments focusing on timber supply or endangered species habitat, for example, have not addressed human needs for the full range of resource use and implications for sustainability.

Because of the inadequacy of traditional assessments to address the larger ecological, social, and economic context, natural resource assessments, or ecoregional assessments, have become broader in their scope of geography and in the number of issues addressed. Therefore, the primary reason for doing assessments is to provide a framework for decision-makers and stakeholders to help understand and evaluate the consequences of actions and inactions with respect to regulation and/or allocation of natural resources within this larger context. However, the need for traditional, single-issue assessments will continue within the context of the larger ecoregional assessment.

Secondly, assessments done at appropriate scope and scale provide higher-quality, more cost- effective, longer-lasting decisions than more limited perspectives. A quality assessment can provide a scientific synthesis of integrated relationships for social and natural resource issues. This broad-scale, comprehensive view of resource issues allows for spatial allocation of limited resources for diverse public demands and values. It can provide the bounds within which a desired future condition can be formulated.

Thirdly, collaboratively conducted assessments facilitate mutual dialogue between managers and citizens, and among diverse public and private groups. Citizens have an opportunity to participate in agency decision-making and voice concerns and desires about resource management, as well as learn about diverse values of other citizens. Assessments provide a forum for implementing social learning; an opportunity for "bounded conflict." The public can receive information about the relevance of social, economic, physical, and biological conditions to various management alternatives, as well as long-term consequences of actions and inactions. Assessments have also facilitated interactions between scientists and managers, both within and among government agencies and universities. Many of the current ecoregion assessments are under the co-leadership of scientists and managers.

Whether conducting a traditional assessment or an ecoregional assessment, the scope, goals, objectives, and endpoints should be clearly defined. Such assessment "pre-planning" does not preclude a series of step-wise assessments, with a series of endpoints reached and decisions made that depend on the degree of resolution desired at a given time.

Where an assessment is done is determined by the issues under consideration. The solution to complex, interrelated issues involves multiple scales of analysis. The geographic scope, or boundary, of the assessment is almost always initially fixed using some physical properties (i.e., state lines or the location of watersheds within an issue area). Curiously, the geographic limits of an assessment are one of the few things that are carefully defined for assessments initially, when, in fact, the issues should be defined and variable scales chosen to establish an appropriate context for solutions to multiple issues. Assessment teams soon recognize that multiple issues and multiple human, biological, and physical dimensions make a single assessment boundary relatively trivial with respect to such issues as air pollution effects on forest health, habitat needs of neo-tropical birds, religious needs of indigenous cultures, and erosion and sediment deposition both on and removed from timber sales.

Typically, assessments have been done by state, federal, or provincial agencies with variable interaction with businesses and the public. Increasingly, all interested parties are included in the early stages of planning so that diverse interests are closer to consensus as assessment progresses to (1) planning, (2) development of desired future condition, (3) implementation, and (4) survey and monitoring. Furthermore, pooling talents and resources is becoming critical at a time when public and private institutions have fewer resources and specialists to conduct their own assessments. Finally, broad participation is necessary to (1) address the full range of issues and consequences at hand, (2) plan at appropriate scales, and (3) avoid costly and often confusing duplication.

3 BARRIERS TO ASSESSMENTS

Major barriers to assessment include institutional barriers, confusion about degrees of detail and precision required, and poorly defined objectives, approaches and tools needed to accomplish the mission. Common institutional barriers include concerns about over-commitment of personnel, as well as misconceptions about conflicting missions and priorities. Administrative boundaries rarely conform to biophysical boundaries, and it is difficult to get administrators to support activities beyond the borders for which they have jurisdiction.

The Federal Geographic Data Committee (1995) recognized the need to establish common information themes for geospatial data: "Because of a lack of investment, coordination, and common approaches, these needs are not being met. As a result, important information is not available for many areas, and multiple organizations support duplicate data for other areas. A means to maintain and manage the common information being collected by the public and private sector does not exist. This results in increased costs and reduced efficiency for individual organizations, as well as for the nation." Their report notes the following consequences:

In many parts of the country, there are no data, or the data are incomplete and not maintained. Where appropriate data exists, it is often inaccessible due to lack of information about its existence, inappropriate format, or usability. Investment is needed to collect and maintain even a basic level of framework data. Interagency cooperation and collaboration is needed to establish the characteristics of data sets that are available.

In other parts of the country, high resolution data that could contribute to a framework are being collected but not generally usable for the following reasons:

1. a lack of arrangements by which these data routinely can be located and made available to others.

2. a lack of institutions to coordinate data collection and maintenance; accept, certify, and incorporate data contributions; and receive and act on reports of errors.

3. a lack of means or interest to disseminate data routinely to organizations not participating in a project.

4. a lack of standards that would simplify the integration of data across local boundaries or for a large area.

5. a lack of standards and techniques that enable data to be integrated into other organizations' data holdings without endangering their existing investments in spacial and attribute data.

6. a lack of a certification process for data, which hinders data sharing efforts, especially in cases where a number of organizations are involved.

7. a lack of plans, or knowledge of plans, to maintain data.

Many organizations are collecting data, but relatively few routinely maintain or make available these data. In the long term, the issue of duplicate data collection and maintenance efforts could be by far the largest cost issue. This lack of cohesion and evenness of data availability suggests problems with coordination of focus, and goal and objective setting at relevant scales.

4 PUBLIC PARTICIPATION AND INVOLVEMENT

The diversity of expectations by stakeholders, public, and private group for the goods and services that lands and waters provide makes public participation and involvement essential in ecosystem management. Only through extended public input can appropriate strategies be developed that meet as many needs of sustainable ecosystems as possible and diverse expectations of the different stakeholders and users of these ecosystems (see Bliss, and Cordell et al., this volume). Early public involvement creates an environment for understanding, acceptance, and support for the assessment. More importantly, this environment facilitates mutual learning, fosters cooperation and mutual trust, and establishes clear expectations from both the public and the agencies as to the conduct and use of ecosystem assessments (see K. Johnson et al., this volume). It results in improved communication between agencies and the public, which results in improved resource management decisions.

Early involvement begins with the framing of issues. It is imperative that those conducting an assessment work closely with individuals, organizations, and agencies who have a stake in the development and use of assessments. The old paradigm where agencies formulate issues, assume they represent the values of the public, and develop and implement a program to address these issues will no longer work. The number of appeals and litigation is a good indicator of this unsuccessful approach. Rather, agencies must come to the table early on in the public participation process with a "clean slate", an ability and desire to listen and learn, and the humility to admit past mistakes.

For most resource specialists and scientists, the public arena is a very uncomfortable place to operate; managing "bounded conflict" is not something most resource specialists were taught in college. However, it is the one arena where time spent up front can save time and dollars in the end and have a significant benefit of building trust with others. Kai Lee (1993) notes that we need to have a better understanding of "the relationship between humans and nature." And we need to understand the relationships among people. We do this through politics. Conflict must be bounded or limited in order to sustain the foundations upon which the society is built. Bounded conflict therefore is politics (Lee 1993). Social learning (Lee 1993) is the combination of adaptive management and political change (see Bormann et al., this volume).

Understanding human motivation is relevant to conducting effective public involvement (see Cordell et al., this volume). Human needs theory offers a common construct for differentiating those motivations that are socially and politically significant — motivations that are universal in the human species, that are cultural, and those that are transitory. The three categories are commonly referred to as needs, values, and interests. Needs will usually be pursued by all means possible. Values are those ideas, habits, customs, and beliefs that are characteristic of particular social groups. Interests (and positions) refer to the occupational, social, political, and economic aspirations of the individual. A key feature of interests is that they are negotiable; it is possible to trade an individual interest for a social gain. Values are much less negotiable, and needs are most often not negotiable. A good test of where you stand with the publics you are working with can be found in your response to public discussions. If you or your colleagues state that "if they only understood our science, they would see things our way," it's an indication that the discussions have been one of "value or need." If your solution is to embark on an "education" program, you can be assured you are in the "value or needs" arena. If your goal is to change social values while you get on with "doing what you know is right," you've lost before you've started.

Once issues are determined and consensus arrived at, an information needs assessment is conducted (see Hummel et al., this volume). It is imperative to match the scale of the issue with the scale of the information.

5 UNDERSTANDING CONTEXT WITHIN THE LARGER SYSTEM

Ecological assessments require the synthesis of information across many disciplines (e.g., biological, social, economic, and physical sciences). Such assessments address both the biophysical and human components and biophysical processes of ecosystems (Slocombe 1993, Grumbine 1993) (see Concannon et al., Gosz et al., Paustian et al., Lugo et al., and Haufler et al., in Vol. II of this book, and Sedjo et al., this volume). Aggregation of information up and down scales is used in combination with integration models and techniques to maximize the use of current information. The value of information changes through this aggregation process and should be documented during the assessment process.

To facilitate improved ecosystem-based management, integrated ecological assessments describe the following:

1. The present condition: A description of the current and recent historic composition, structure, processes, and function of an ecosystem.

2. The past: How the ecosystem evolved to its current state. Ideally, this includes an understanding of the biophysical processes and their interactions, perhaps as far back as the Pleistocene ice ages. Understanding the changes in the system through time allows for better understanding of the current state and what desired future conditions may be possible. The 'context' of the ecosystem needs to be evaluated.

3. Possible futures: A description of probable futures.

The ecological principles described throughout these proceedings emphasize that ecosystems are dynamic and evolutionary, which suggests that the current status of an ecosystem is a function of its evolutionary and ecological history. Accordingly, assessments of ecosystem condition and management potential describe existing and historic ecosystem composition, structure, and function in the context of specific biophysical and human processes associated with a variety of time periods. This includes conditions as far back as the Pleistocene ice ages, which can be considered the last major 'reset' of many currently existing ecosystems. Characterization of existing conditions gives quantitative evidence of current structure and function. Historical (meaning the history of the ecosystem, not just human history) characterizations provide insight into the kinds, magnitudes, and rates of change in ecosystem processes, structure, and function. They provide insight into possible future ecosystem development pathways by providing evidence of dominant disturbance types and regimes, resultant vegetation patterns, typical environmental constraints, and variability of biotic patterns and processes.

In addition, ecosystems are organized into spatial and temporal hierarchies, which demonstrates the need to characterize ecosystems at multiple scales of space and time (see Concannon et al. and Gosz et al., Vol. II of this book). Trends across time and space in disturbance processes, and physical and biotic patterns and processes, provide insight into past and current ecosystem development trajectories, and the potential for development along a given or alternate pathway. It is important that the scales of assessment are connected in terms of context and process. That is, the processes of a smaller scale are assessed in the context of the larger scale processes (see Caraher et al. and Haufler et al., Vol. II of this book).

Also, ecological principles suggest there are limits to ecosystem functioning, which are dictated by climate and other environmental variables. Given that there are real limitations, assessments characterize plausible ranges of potential future ecosystem conditions considering climatic trends, biophysical environmental conditions, historical development, current structure and organization, and disturbance regimes. Additionally, given the fact that ecosystem patterns and processes are not always predictable, the accuracy, resolution, and specificity of planning and management expectations should be conditional. Desired conditions for planning should reflect desired dynamics, and management prescriptions should describe a quantifiable range of plausible conditions rather than a single, narrowly defined target condition.

The type of issues or policy questions addressed in an assessment dictate the appropriate scales of analysis. A common requirement in most assessment work is that continuous coverage of ecosystem component information themes be developed for all lands within the area being assessed. Such information themes and related map products and tabular material provide a basis for consistently describing ecological relations across the assessment area. Geographic information systems (GIS) greatly facilitate compilation, analysis, model building, and development of integrated and derivative maps for the diverse spatial data types that are required for assessments.

The scaled relations of information used in assessments also have major implications to the design of monitoring programs for detecting ecosystem change. Given the fact that inventory costs generally increase exponentially as the scale of description becomes finer, it is important to describe ecosystem pattern and process relations at as coarse a scale as is appropriate to reduce costs. This can often be done by identifying the pattern of interest, and moving up one scale in selecting the pattern that will be described in assessment or monitoring efforts. For example, if one is interested in the change of vegetation at the plant association level (e.g., Douglas-fir/Idaho fescue, Douglas-fir/snowberry), sampling strategies are designed to detect change at the series level (e.g., Douglas-fir forests) as an initial screening mechanism to identify potential areas of plant association change. The spatial area described by this approach, for the same level of funding, is much larger than that which is described continuously at the plant association level. In this example, areas that exhibit change at the series level are then prioritized for more detailed study to better understand plant association pattern relations. This type of approach to ecosystem assessment follows the "coarse-filter" strategy for biodiversity conservation (Hunter 1991).

Watersheds may be classified into similar hydrologic functional groups within the context of the terrestrial biophysical environment in which they are nested (e.g., land type association composition). This classification helps integrate terrestrial and aquatic issues in an assessment by accounting for similarities between watersheds with respect to climate, geology, landform, and soils. Lithologic units and the geomorphic processes that operate within a given climatic regime profoundly influence valley bottom, stream reach, and channel unit characteristics (USDA Forest Service 1994). Additionally, nutrients derived from different lithologic units constrain aquatic conditions (Johnson and Raines 1995). Description of the scaled relations between and among physical and biological processes facilitates improved predictions of aquatic patterns and processes, and provides a logical method for stratified sampling designs.

Assessments of aquatic condition may also be assisted through an explicit understanding of the scaled relations between various aquatic and landscape system components (USDA Forest Service 1994). In riverine systems, for example, watersheds and their underlying lithologic units and soils control the form and function of the physical aquatic habitats which, along with their biota, control the form and function of aquatic communities (Frissell et al. 1986, Minshall 1994). Finer scale systems (e.g., valley bottom sections, stream reaches, channel units) develop within constraints set by the coarser scale systems (e.g., watersheds) in which they are nested. This relationship is significant to the classification, mapping, and inventory of aquatic systems.

Ecological assessments commonly involve the aggregation of site specific information to form classifications used to describe the composition of resource maps (vegetation, geology, soils, watersheds) at various spatial scales. Classifications group similar items to provide a framework for organizing our knowledge about ecosystems (Driscoll et al 1984). Conversely, hierarchical systems tier down from general regional attributes to subregional to local differences. Each spatial scale is defined in terms of the dominant controlling factors. For example, course scale systems may be defined in terms of climate and regional physiography, whereas fine scales are defined in terms of soil, local topography, and vegetation. Ecological mapping units, therefore, circumscribe a population of sites with similar characteristics (e.g., potential vegetation or lithologic units, soil types, or stream characteristics). If data on site characteristics are assembled and evaluated statistically, the validity of the map is objectively evaluated. Gradient-oriented sampling and generalized linear analysis models are especially useful for validating ecological map units (Margules and Stein 1989, Bourgeron et al. 1994).

6 INFORMATION MANAGEMENT

This section is designed to touch on some aspects of information management. For an in-depth discussion see Cooperrider et al. and Correll et al., this volume.

An assessment should be developed to assure that common protocols and methods are used, and inter-

Table 1. Major information themes and typical components.

Theme	Typical Components
Vegetation	Composition and pattern; relative abundance; range of natural variation
Fauna	Habitat and animal species; rare and endangered species
Land cover	Land cover classes
Disturbance	Fire; insects; disease; severe weather events; volcanic activity; land use; contaminants; hydrologic modification; exotic species
Geology	Geologic hazards; special interest sites; stratigraphy; structure; lithology; mineral resources
Geomorphology	Descriptive landform; geomorphic process; geomorphometry
Paleontology	Key fossils
Ground water	Ground water geology
Soils and topography	Distribution; physical parameters; organic parameters; location
Watersheds	Multiple levels of hydrologic unit codes HUCs; watershed index of activity
Water	Water quality; hydrography; physical parameters
Air quality	pollution/toxic sources
Climate	Temperature; precipitation; relative humidity; barometric pressure; solar radiation; climate and climatic disturbances
Demography	human and social demographies; health statistics; institutions
Economics	economic health; economic dependency; economic value of resources; human interactions with resources
Culture	Land use; transportation; resource use patterns; land ownership

disciplinary training is provided for all team members. Standards and common protocols and methods are desirable so that data bases can be combined and relevant conclusions reached. The use of standard formats, scales, and procedures is essential to producing products that can be readily combined and for producing data that are internally consistent. The time spent in initial planning is far less than would be required later to redo or recollect data, or to obtain data that were not recognized as important at the outset. Protocols and methods should be flexible enough that assessments can be designed to address specific issues in the most efficient and effective manner, and allow innovative approaches that could save time and money. In addition, they should assure compatibility of data bases that are likely to be combined, and allow creation of data bases that will be applicable for other uses beyond the specific assessment.

The use of non-standard methods for inventory and description of ecological systems is an obstacle to ecological assessments. Inventories of taxa, whether invertebrates, vertebrates, or plants can differ widely in standards and protocols. Different sampling methods and study purposes make research results incompatible (Margules and Austin 1991, Pfister and Arno 1980). Without extrapolation, such data cannot be shared across studies, and, therefore, cannot be used in broad-scale regional analysis.

Different data collection methods inhibit coordinated analysis of resource assessment between different disciplines. To alleviate these problems, common purposes for resource information are identified early in the assessment process. The appropriate scale for resource analysis is identified to ensure that relevant information is used. Once the purpose and scale of information are identified, sampling designs across agencies can meet multi-agency analysis needs (Bourgeron et al. 1994). A set of common information themes was developed by assessment leaders from the Columbia River Basin Assessment, Sierra Nevada Ecosystem Project, Great Lakes Assessment, Southern Appalachian Assessment, and the Mid-Atlantic Integrated Assessment. The validity of the themes (Table 1) was then augmented by peer review.

Current assessment teams continue to coordinate and cooperate on development of common information themes. In addition, assessment leaders are working with the FGDC subcommittees (Federal Geographic Data Committee 1991) listed in Table 2.

7 INTERDISCIPLINARY APPROACH TO ANALYSIS

The goal of integrating information into a coherent analysis is both desirable and difficult. The basis of an integrated analysis should be the review, synthesis, and interpretation of the interdisciplinary resource information related to issues affecting management decisions. Integrated assessments must define the most important data and information from the contributing disciplines. If this is not done, an assessment team may become overwhelmed with data that, while important, are not critical to the issues at hand. The payoff is that integration yields knowledge of system functioning

Table 2. Geographic data coordination responsibility

Base cartography	Geologic Survey, Department of the Interior
Cadastral	Bureau of Land Management, Department of the Interior
Cultural and demographic	Bureau of Census, Department of Commerce
Geodetic	Coast and Geodetic Survey, Department of Commerce
Geologic	Geologic Survey, Department of the Interior
Hydrologic	Geologic Survey, Department of the Interior
Remote sensing	USGS, National Mapping Division, Department of the Interior
Ground transportation	Federal Highway Administration, Department of Transportation
Portrayal of certain international boundaries	Office of the Geographer, Department of State
Soils	Natural Resource Conservation Service, US Department of Agriculture
Vegetation	Forest Service, US Department of Agriculture
Wetlands	Fish and Wildlife Service, Department of the Interior

that is greater than the sum of the individual disciplinary parts.

Integration among disciplines as diverse as biology, botany, forestry, geology, soil science, hydrology, sociology, economics, climatology, remote sensing, and many others is difficult. Current data sets initially were collected for different reasons, at different scales, by different methodologies, to address different issues. Each data set, and the implications of that data set, may be understood by the specialist familiar with it, but these same specialists may not understand the implications of data sets of other disciplines. These implications mean more, for example, than overlaying mylar maps of forest cover type with geology to see if there is a relationship. They require understanding of the causes of observed relationships, and they require understanding of the interactions among the various processes that operate at different spatial and temporal scales. Also, the interdisciplinary team needs to use clear language relentlessly whenever describing individual resource characteristics. Finally, all aspects of an integrated analysis must be understandable by technical specialists, managers, and the general public. Collaboration among specialists is required to provide this understanding.

Several strategies are being used and developed to facilitate improved interdisciplinary analysis. The primary strategy is to enhance interdisciplinary, rather than multi-disciplinary, analysis. This is often accomplished by identifying and supporting a "great" team leader, an individual who personally understands the benefits of involving all suitable technical disciplines early on in the process, and can persuade the individual resource specialists to interact. Current assessment approaches use management/research co-leaders to improve understanding and communication among the disciplines.

Integrated ecosystem management analysis requires a diverse, interdisciplinary staff. The development process should enhance individual creativity for the collective benefit of an integrated report. Management should be judicious when preparing schedules and assignments to avoid individual burnout, and collective "group think." When preparing assignments, factors such as staff availability, background, where the teams will be stationed, and how to nurture and care for an interdisciplinary team require particular attention. Also, interdisciplinary involvement can be enhanced through general team building and individual commitment. The team should recognize the goals and purposes of the assessment, the spatial and temporal scales, the interrelationships among members, and be committed to continual dialog throughout the assessment process.

The best future hope for integration lies in the use of decision support tools (see Reynolds et al. and Oliver and Twery, this volume), such as knowledge based systems similar to EMDS (Ecosystem Management Decision Support), to provide complex integrated analysis. EMDS is currently being beta tested on three ecoregional assessments: The Great Lakes, the Northern Great Plains, and the Ozark/Ouachita Highlands Assessments.

8 SCENARIO PLANNING

Scenarios provide the linkage between assessment information and the decision-making process. "Scenarios deal with two worlds: the world of facts and the world of perceptions. They explore for facts but they aim at perceptions inside the heads of the decision-makers. Their purpose is to gather and transform information of strategic significance into fresh perceptions (Wack 1985b)." Scenarios are tools for ordering perception about alternative future environments in which decisions might be played out (Schwartz 1991). Scenarios are not alternative management strategies, but should help to design alternative management strategies within the capability of the ecological systems being managed. Scenarios are not predictions and should not be assigned probability estimates. They should all be equally probable.

The purpose of scenarios is "to gather and transform information of strategic significance into fresh perceptions. Scenarios help you (or your managers) suspend disbelief in possible futures" (Schwartz 1991). Historically, the major focus has been on science and technology in the biophysical realm. However, as Schwartz (1991) notes "changing public beliefs can pivot direction of history more swiftly and irrevocably than money or military power." Therefore, scenarios need to pay attention to perception-shaping events, trends in music, and beliefs and behavior of fringe groups and activities as well.

Because there is no such thing as perfect information, there is always a level of uncertainty in any decision. The concept of adaptive management acknowledges the need to manage resources under circumstances that contain varying degrees of uncertainty, and the need to adjust to new information (ROD 1994) (see Haynes and Cleaves, Cleaves and Haynes, and Bormann et al., this volume). Even the best decisions may have unacceptable or unanticipated outcomes. To reduce the level and impact of unacceptable outcomes, the decision-maker needs to focus on critical uncertainties. Obtaining the best information on these uncertainties in the assessment and designing inventory, monitoring, and evaluation to track decisions are therefore essential steps in the process. Holling (1978) notes that "some systems are inherently more capable than others of absorbing insults and changes without losing their integrity." He describes an "axiom that underlies any design for uncertainty ... There exists a serious tradeoff between designs aimed at preventing failure and designs that respond and survive when that failure does occur." It's the latter that needs to be incorporated into an adaptive approach.

Scenarios help managers provide structure to uncertainty and to change the decision-makers assumptions about how the world works (Wack 1985a). The process involves an "exploration and expansion of predetermined elements" (Wack 1985b) to shed as much light as possible on critical uncertainties. There are three major elements (Schwartz 1991) in creating scenario building blocks:

1. *Driving Forces* are the elements that move the plot of a scenario. They hone your initial judgment, help you decide which factors will be significant and which factors will not. Often, identifying driving forces reveals the presence of deeper, more fundamental forces behind them.
2. *Predetermined Elements,* which always carry a level of uncertainty, are those events which are most likely to happen but whose consequences have not yet been felt. Wack (1985b) notes that "scenarios rule out impossible developments; they deny much more than they affirm."
3. *Critical Uncertainties* are intimately related to predetermined elements. You find them by questioning your assumptions about predetermined elements: what events or combination of events and processes might cause the next fire event in the West similar to those in Yellowstone in 1988?

Good scenarios are both plausible and surprising.

9 INCORPORATING THE ASSESSMENTS INTO STEWARDSHIP PLANNING

There is currently a move underway to develop continuous planning systems that emphasize the benefits to be found in the development and use of adaptive assessment, and management developed nearly 20 years ago by Holling (1978). In some respects, the emphasis on large-scale ecosystem analysis represents an opportunity to bring knowledge bases up to date on the structure, composition, and function of ecosystems. This includes the human use and impact on these systems. Monitoring programs are needed to update these knowledge bases. Continuous planning demands the development of monitoring systems to continuously assess and evaluate implementation of project, landscape, regional, and national plans. However, monitoring must also be developed to track human needs, values, and interests. These needs, values, and interests are directly related to the development of desired future condition.

Ecoregion assessments and future scenarios set the context for developing the desired future condition. They provide the most up-to-date scientific knowledge about how these systems work, and the potential of the systems to provide a sustainable supply of goods and services while maintaining ecosystem integrity, resiliency, and sustainability.

Desired future condition must be developed in the public arena, in the realm of "bounded conflict" describe by Kai Lee (1993). Decision-makers most actively participate in the development of the desired future condition to ensure understanding, acceptance, and support for future decisions involved in implementation of management regimes to achieve them. Decision-makers can no longer afford to delegate, or abdicate, their responsibility to "planning teams."

In short, agencies must embrace the concepts of adaptive management.

10 CONCLUSIONS

A series of "lessons learned" workshops, designed as an adaptive learning approach to ecoregional assessments, are being conducted to discuss and document the knowledge gained by various assessment teams throughout the country. The first in this series, conducted in June 1995 to establish basic information themes common to all assessments, developed information themes in the biological, physical, chemical, and social sciences. The Forest Service Ecological Characterization and Analysis Team is currently working on each of these themes to determine the data base requirements at various spatial scales needed to support assessments, and subsequent monitoring and evaluation.

The second workshop (the one discussed in this chapter), was conducted in July 1996. Its purposes were:

1. To capture and transfer the lessons learned from the conduct of ecoregion assessments with regard to policy and process.
2. To develop a draft purpose statement linking assessments (information) to planning and decision-making.
3. To formulate a process for maintaining and updating assessment information and linkages to monitoring and evaluation.

Teams were formed during the workshop to address each of the five discussion topics listed in Table 3.

Teams contained personnel with a mix of skills, including assessment leadership, technical staff, regional planners, WO staff specialists and leaders in Ecosystem Management Coordination, and staff from the Office of General Council (OGC) and Government Accounting Office (GAO). Each team discussed three separate topics in rotation. After substantial discussion, a report outline was developed and information relevant to each topic area was incorporated into the various chapters in the report. Separate author teams were then assembled from the participants, based on interest in a chapter heading, to write the chapter reports. Each chapter report was reviewed by all participants, with comments incorporated into a second draft report.

Table 3. Workshop questions on role of assessments.

Topic 1	"If I had it to do over again ..."
Topic 2	What is the role of assessments in resource planning and decision-making?
	How are assessment products and information integrated?
	What tools are available to develop a knowledge-based system for continuous forest planning?
Topic 3	What is the role of public involvement in the assessment process?
	How do assessments develop and use partnerships?
Topic 4	How are assessments linked to RPA (Forest and Rangeland Renewable Resources Act of 1974), national and regional monitoring, etc...?
	What are the linkages between or among assessments?
	What are the roles of Research, State, and Private Forestry, and National Forest Systems in ecoregion assessments?
Topic 5	How are the products of the assessments being utilized?
	What would users like to see changed in the assessment products?
	What do users believe are the most valuable benefits they have received or will receive from assessments?

10.1 Key Findings

Key findings from this process are summarized below:

The Assessment Process

1. Assessments are not decision-making documents. However, they do provide a synthesis of information in support of multiple scales of resource planning and decision-making.
2. Assessments should be issue driven.
3. A recurring theme is needed to keep data synthesis and acquisition strongly focused on the assessment issues.
4. Pre-assessment planning is critical.
5. Process, structure, and function are the ecosystem components evaluated during the assessment process. These components need to be analyzed at multiple spatial and temporal scales.
6. Broad-scale assessments are a rich source of new information. Recognition of emergent properties of ecosystems at broader scales is an important part of this new information.

Linkages to Other Assessments and Programs

7. Each Forest Service Deputy Area has a key role to play in conducting ecological assessments.
8. Ecoregional assessments need to be linked at the national level to the RPA assessment, and at the regional and local levels to regional guides, forest plans, landscape-scale assessments, and project level analyses.
9. There is a corporate need to develop implementation, effectiveness, and validation monitoring programs at multiple scales. These programs should update assessment information over time.
10. Ecoregional assessments can be linked using common information themes and protocols (currently the effort of the Forest Service Ecological Characterization and Analysis Team).
11. Cooperation with the Federal Geographic Data Committee will help ensure data linkages among other national, regional, and landscape assessments.

Public Involvement and Partnerships

12. Public participation for ecoregional assessments should be based on adaptive principles focused on achieving awareness and active involvement of a diverse array of stakeholders.
13. Public involvement is crucial to the success of assessments and provides benefits in later decision-making forums.
14. Due to their sheer size and to the complexity of ownership patterns, ecoregional assessments have a greater need for partnerships than any other planning process.

Assessment Products

15. Assessments produce various tangible and intangible products including: findings; data, maps, references, ...changed relationships with participating agencies and the public; and, institutional and organizational change.
16. Products that address immediate needs and issues are most likely to get immediate use.

Information Management

17. An interagency commitment needs to be made to ensure maintenance of data, maps, meta data, etc... for future assessment and monitoring efforts.
18. Establishing an information management infrastructure in place prior to the assessment should be a high priority.

10.2 Next Steps

We need to continue to learn and adapt through development and implementation of ecological assessments. Development of standard information themes and data at various scales, linking assessment protocols with monitoring protocols, and development of decision support systems are key areas for future development and testing. This work must occur in an atmosphere of cooperation among all those who have a stake in the outcome.

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