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Science and ecosystem management in the interior Columbia basin

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Abstract

Significant changes over the past 150 years in aquatic, terrestrial, landscape, and socioeconomic systems have altered biophysical systems in the interior Columbia basin. Changes and conflict in public policy concerns, such as resource use vs. restoration vs. conservation are especially evident in more than 34% of total forest and rangeland in the United States that are federally administered. In the last decade, design and implementation of complex land management strategies has become an issue for public land managers. In turn, the scientific community is often challenged to develop approaches for management of complete ecosystems. This paper discusses the use of science in the assessment and evaluation phases of one large-scale (multi-region) ecosystem management effort on federal lands in the Columbia river basin, the Interior Columbia Basin Ecosystem Management Project (ICBEMP), and briefly describes the evaluations of three alternative management strategies which are detailed by other papers in this issue. This paper contends that understanding the context of land management decisions is essential to defining the veracity or applicability of alternative land management strategies. Evaluating the alternatives is a complicated science process, which requires understanding the effects of each set of direction over both the short and long term, projecting the effects of those directions, making assumptions about pieces not yet developed, and modeling resource change. Published by Elsevier Science B.V.

Keywords: Forest management; Ecosystems; Land management planning

1. Introduction

The United States is one-third forest and an additional one-fourth is considered grassland pasture and rangeland. Its 737 million acres of forestland are highly diverse both in land tenure and species. About 20% of this forestland is grazed. The United States also has a rich legacy of public forests comprising about 34% of all forestland (Powell et al., 1992).

The public lands have been managed under evolving sets of goals that in the 20th century invoked both conservation and industrial utilization principles of stewardship. However, late in the 20th century, the complementarity between these dual goals eroded as conservation goals expanded to include ecological stewardship concerns (Sexton et al., 1999) and recently renewed concerns over sustainability (Johnson et al., 1999a). These concerns challenge federal land managers to design and implement complex land management strategies that are explicitly based on science. In turn, the science community is challenged to develop hierarchical approaches for management of complete ecosystems including both biophysical and socioeconomic systems (Johnson et al., 1999b). This special issue reveals the science used in the

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assessment and evaluation phases of one large-scale (multi-ecoregion) effort to design such a land management strategy for federal lands within the interior Columbia river basin.

The remainder of this paper is divided into the following sections: an introduction to the Interior Columbia Basin Ecosystem Management Project (ICBEMP); a discussion of the implicit science context that underlies successful land management, the elusive issue of goals, and the problems of addressing variable spatial and temporal scales; a review of current conditions within the area of concern; a brief description of the alternative land management strategies considered; a discussion about the development of an effects analysis, and the questions of risk assessment and management; and, a summary and description of the wide variety of articles that follow in this issue.

2. The Interior Columbia Basin Ecosystem Management Project

The ICBEMP, chartered in 1993, is a joint effort of the US Department of Agriculture, Forest Service (FS) and the US Department of the Interior, Bureau of Land Management (BLM). The project's explicit charge is to develop a scientifically based ecosystem management strategy for lands administered by the FS and BLM within the interior Columbia river basin (hereafter referred to as the basin[1]). The ICBEMP study area (Fig. 1) covers approximately 58 million ha in Washington, Oregon, Idaho, Montana, Wyoming, Nevada and Utah, an area about as large as France. Public lands managed by the FS and BLM account for 53% of the Basin area.

Early in 1994, an interagency team of federal scientists (known as the Science Integration Team) with assistance from a variety of university scientists and other resource professionals, began a broad-scale assessment of current conditions across the entire basin. This assessment addressed biophysical properties such as soils, climate, and hydrologic regimes; vegetative characteristics and patterns of change; species habitat, status and viability; and human social and economic concerns. The assessment also attempted to estimate the extent to which ecosystem diversity and resiliency had been altered, in order to better understand the relation between various management practices and system sustainability. Results of this assessment were released in a summary publication in 1997 (Quigley and Arbelbide, 1997). The Science Integration Team also released a framework for ecosystem management (Haynes et al., 1996), and generated an integrated assessment linking landscape, aquatic, terrestrial, social, and economic characterizations to describe biological, physical, and social systems (Quigley et al., 1996). This body of work highlighted connections and possible causal relations across disciplines, and provided both spatial understanding and temporal depth for many critical issues concerning Basin ecosystems.

In a concurrent effort, land management teams composed of specialists and land managers developed a series of land management alternatives for FS- and BLM-administered lands in the basin. These teams followed the formal process in the United States that uses an environmental impact statement (EIS) based on public and agency input to develop alternative management decisions. Two draft environmental impact statements (DEISs) were released for public comment in late summer 1997 that contained seven distinct land management alternatives (USDA and USDI, 1997a,b). The Science Integration Team attempted to evaluate these alternatives to assess how well they would meet their stated goals, and to highlight any underlying tradeoffs or unintended effects which may have been inherent within the strategies (Quigley et al., 1997). After extensive public review, the land management (EIS) teams developed a supplemental draft EIS (SDEIS) which included three additional alternatives that were responsive to the public's expressed concerns over land management issues in the basin. These three alternatives cover FS and BLM lands across the entire project area - some 25.4 million ha. The supplemental alternatives were released for public comment in March 2000 (USDA and USDI, 2000). The Science Advisory Group, core members of the Science Integration Team, were asked to conduct an evaluation of these supplemental alternatives from a 1999 review draft (Science Advisory

[1] The Basin is defined as those portions of the Columbia river basin inside the United States and east of the crest of the Cascade Range, and those portions of the Klamath river basin and the Great Basin in Oregon (see Fig. 1).

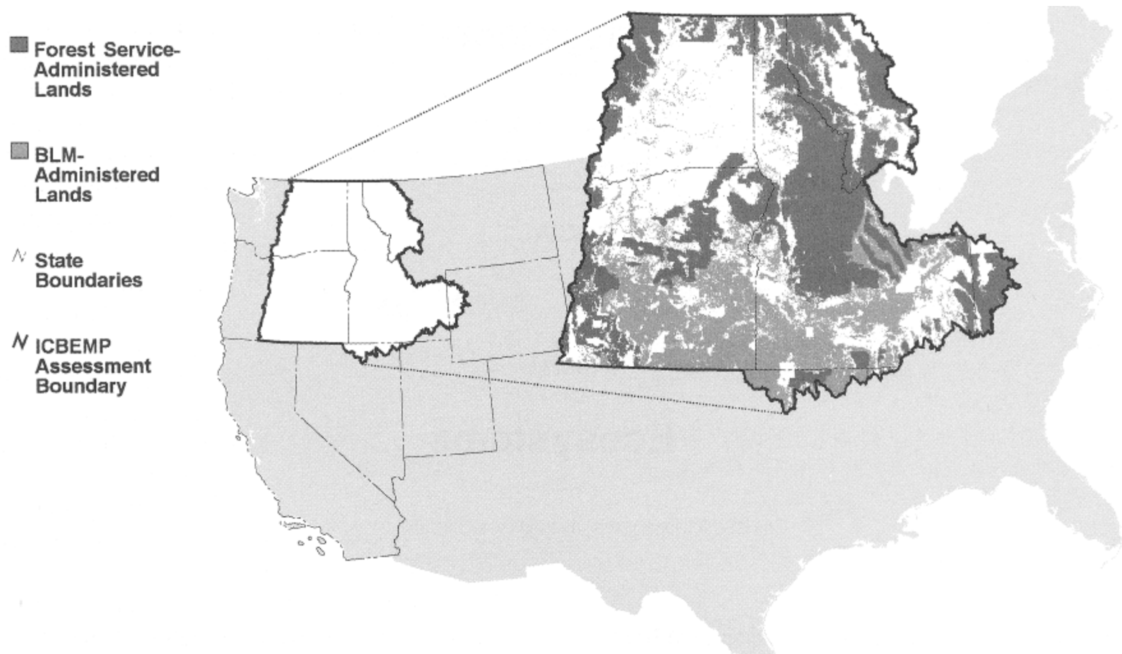

Fig. 1. Location of the Interior Columbia Basin Ecosystem Management Project study area within the continental United States.

Group, 2000; USDA and USDI, 2000). Some cogent procedures and findings from that evaluation are highlighted in this special issue.

In the evaluation of these broad-scale land management strategies, the Science Integration Team focused on the effects of implementing the ICBEMP SDEIS alternatives over the first 100 years on landscape ecology, terrestrial and aquatic ecosystems, and social and economic conditions. The alternatives are ranked to address how well each meets stated criteria for effective ecosystem management. Many of the papers in this issue demonstrate how the different alternatives result in different future trajectories, given the historical and current range of conditions across the landscape and the way those conditions are likely to develop over time. Several of the papers will lend an appreciation for the robustness of certain aspects of the ecosystem.

3. Conducting science for managing ecosystems

The Science Integration Team of the ICBEMP sought to place information within a broad, proactive planning process that considered the social, economic, and biophysical components of ecosystems at the earliest stages of policy design. To do this, it was necessary to adopt a concept of a functioning ecological system that integrated a wide variety of often conflicting species, habitat, and viability concerns with social and economic considerations consistent with the multiple use mandates of the two lead agencies (National Forest Management Act, 1976; Federal Land Policy and Management Act, 1976; among others). The scientific assessments were greatly influenced by contemporary discussions about the broad goals of ecosystem management, although these discussions have not produced general agreement on appropriate goals (Johnson et al., 1999a). The Science Integration Team worked within a framework (detailed in Haynes et al., 1996), that addressed current ecological understandings as well as natural and cultural relationships between system components (Fig. 2). They adopted a concept of ecological integrity that reflects human values (Grumbine, 1992, 1994; Regier, 1993), and a set of biophysical and social characteristics that could be monitored for change (Kay, 1993).

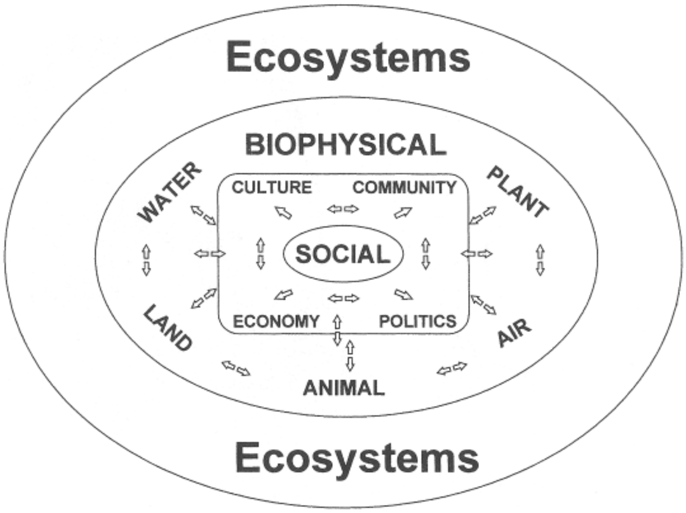

Fig. 2. Ecosystem management summary.

Such an ecosystem management concept explicitly includes the issue of scale - both temporal and spatial. Often, there is confusion between geographic extent (area assessed) and data resolution (amount of detail incorporated in the data). Lack of specificity about scales also lends to the confusion. Regional scientific assessments like the ICBEMP show trends and describe general conditions for biophysical, economic, and social systems for a region and its various subregional components. Such assessments usually contain broad resolution information on spatial patterns of resources, associated risks to resource values, and trends that reflect changes over time. Subregional assessments 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 individual landscape features, watersheds, project sites, or specific human communities, provide the greatest detail. Fig. 3 illustrates the concept of spatial scale within a hydrological system. Much of the ICBEMP assessment data was reported at the subwatershed or subbasin level.

The context is set by a management approach that attempts to manage disparate ecosystem components at multiple, integrated scales. This approach allows for shifts in patterns due to disturbance, and adaptation and monitoring through time. Anadromous fish and wide-ranging carnivores like the grizzly, e.g., require a broad-scale approach. Managing to conserve habitat for certain aquatic invertebrates or rare plants might be best handled at a finer scale, but broad-scale processes, such as the hydrology of the region, must often be considered for fine-scale management to be successful. Similarly, several generations of humans, and their land management practices exist in the time necessary for a forest stand to reach maturity as “old growth”. Adopting these concepts, we assumed that a living system would exhibit integrity if, when subjected to disturbance, it sustained an organizing, self-correcting capability to maintain resiliency. We also assumed that maintaining the integrity of ecosystems and the resiliency of socioeconomic systems could be achieved using the following six goals (Haynes et al., 1996):

1. maintain evolutionary and ecological processes,
2. manage using multiple ecological domains and evolutionary time frames (scale),
3. maintain viable populations of native and desired non-native species,
4. manage to enhance social resiliency,
5. manage for the human sense of “place”, and
6. manage to maintain the mix of ecosystem goods, function, and conditions that society wants.

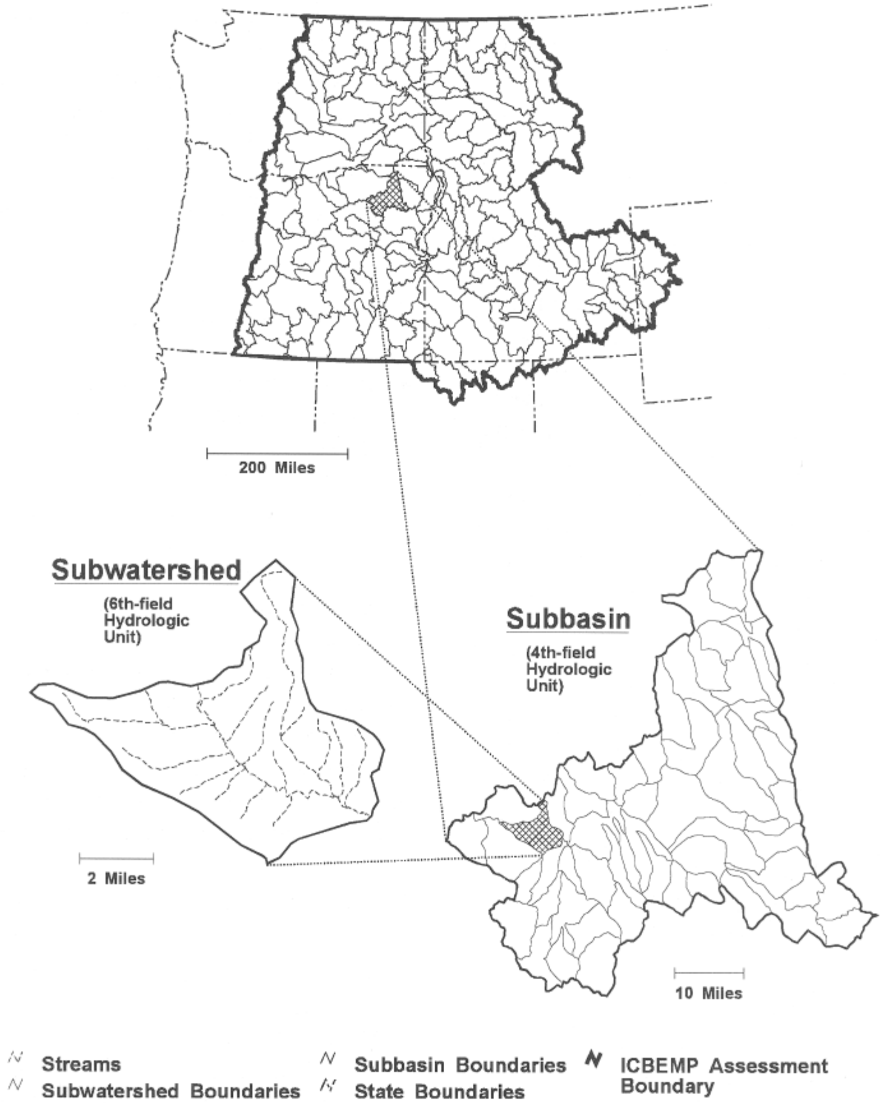

Fig. 3. Hydrological hierarchy

These goals helped us, as scientists, to form normative judgements about what best indicates "wholeness", resiliency, and diversity in their most universal and meaningful senses. The mix of goals acknowledges important social values derived from both commodity and non-commodity uses of natural resources. These goals helped us to provide information to decision-makers that made explicit the extensive range of values and choices involved in managing public land.

We recognize that the integrity of ecosystems is more an expression of environmental policy than scientific theory. Our experience has taught us to acknowledge the reluctance of land managers to include societal issues and values in the definition (and evaluation) of ecological integrity. This complicates the use of ecosystem integrity since its definition reflects the values of both managers and users. However, we have found that discussing scientific findings within the context of management decisions allow us to highlight very real social choices and their consequences, both intended and unintended.

4. Current conditions in the basin

The ecological systems across the Basin are highly variable. Elevations range from less than 150 m to more than 3000 m. The average annual precipitation values range from more than 250 cm in the Cascade range to less than 20 cm per year in the central lowelevation basins and plains (Quigley and Arbelbide, 1997). The various soils and seasonal climates of the Basin support a diversity of plant species and plant communities. These, in turn, provide habitats for a number of fish and wildlife species, including many listed as nationally threatened or endangered. The Basin is quite dynamic, with overall diverse and resilient socioeconomic systems, highly productive agricultural systems, and large contiguous blocks of wilderness and roadless areas. The Basin is also still home to several key populations of anadromous fish. These individual system components are highly interlinked and disturbances or risks to one component often have unintended effects elsewhere in the system. The assessment of current conditions in the Basin (Quigley and Arbelbide, 1997) found a variety of conditions in the Basin have changed over the last century.

4.1. Landscape conditions

- Wildland fire has generally increased in intensity and severity, though not necessarily in extent. Suppression costs and risks to human life and property have also grown.
- Changed vegetation patterns have increased susceptibility to severe fire, and insect and disease disturbances of forests.
- Native grasslands, shrublands, large residual trees, large snags, and old forests have decreased due to human uses of land and resources, and invasive non-native plant species.
- Tree species mix and age classes have changed. Uniform stands of middle-aged trees predominate. Greatest change in landscape conditions has occurred in areas associated with agriculture, human residences, roading, intensive logging and livestock grazing.
- Recent levels of management are unlikely to reverse declining or altered trends in landscape patterns and watershed conditions. Reversal will require a combined conservation and restoration strategy which refocuses current management activity.

4.2. Terrestrial ecosystems

- Species that show declining trends are those associated with old forest structures, shrublands, and grasslands.
- Habitat alteration is more pronounced in lower elevation watersheds due to human influences that have altered disturbance and hydrologic regimes. Habitat remnants and ecological processes remain for rebuilding and maintaining terrestrial ecosystems.
- Some threatened or endangered species are dependent on habitat components not evaluated at the Basin level; they can only be addressed through site and watershed analysis.
- Non-native plants (including legally defined “noxious” weeds) are a significant threat to rangelands.

4.3. Aquatic ecosystems

- Key native salmon species have experienced declines in ideal salmon habitat and abundance. Most of these species occupy only a fraction of their historical range. These species are especially vulnerable at certain stages of their life cycle.
- Anadromous species have declined more than resident fisheries. Even if habitat stabilizes, fragmentation, isolation, and non-habitat threats put remaining populations at risk.
- Non-native fish, important for recreation and other purposes, have established thriving populations, compete with native fish for high quality habitat, and often interbreed with native stock.
- Habitat alteration is greatest in lower watersheds. Core remnants and ecological processes remain for rebuilding and maintaining systems, but the effects of dams, hatcheries, fish harvest and introduced fish

4.4. Social conditions

- Successful ecosystem management requires active co-operation among local governments and agencies.
- People are concerned about how natural resource management impacts the social conditions in the communities where they live.
- Various stakeholders interpret ecosystem management differently depending on their concerns and interests.

4.5. Economic conditions

- Regional economies are experiencing economic growth, especially counties with metropolitan areas or recreation opportunities.
- Regional economies are diverse and have high resiliency. At the county level, economic resiliency varies.
- Over half of the counties have low resiliency.
- Recreation on federal lands is highly valued.
- On National Forest and BLM lands, timber, grazing, and recreation uses are important to local and regional economies.

5. The land management alternatives

As explained above, the FS and BLM released two EISs for lands they administer within the Basin (see Fig. 4) for public comment (USDA and USDI, 1997a,b) and based on the public response to those documents prepared an SDEIS (USDA and USDI,

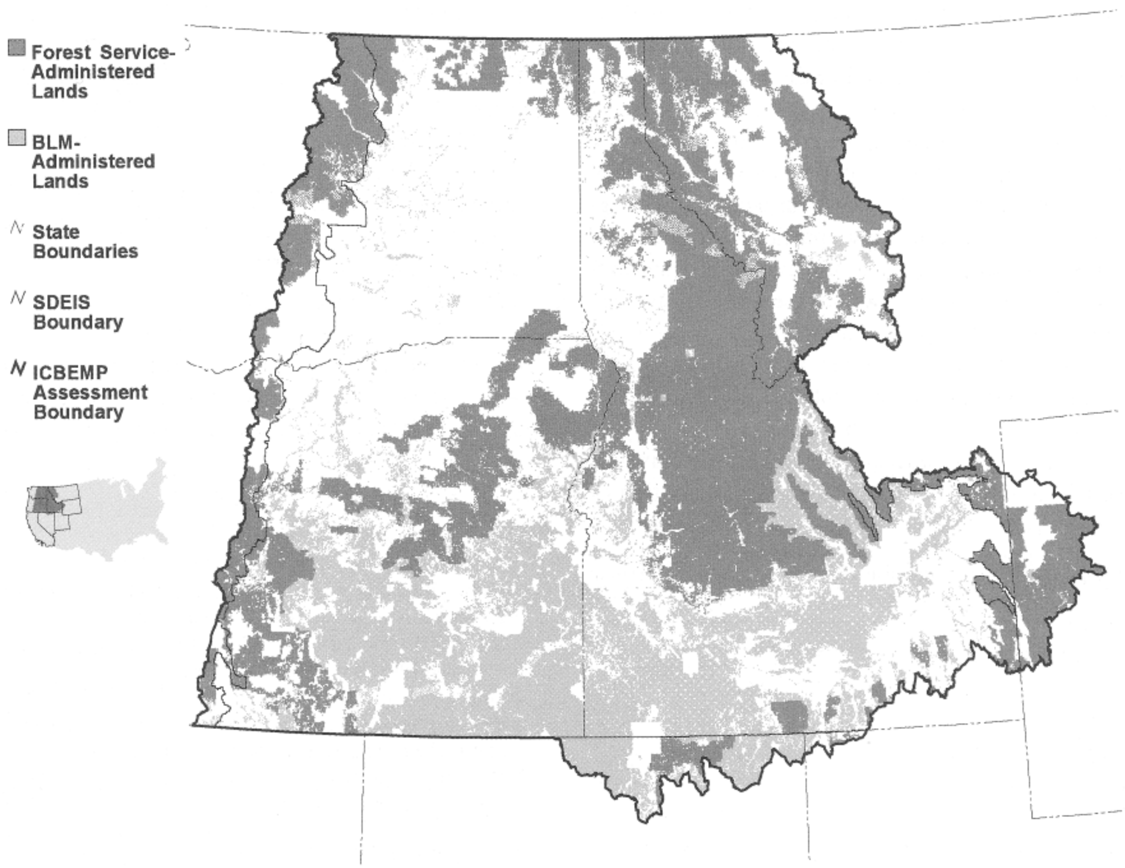

Fig. 4. FS- and BLM-administered lands affected by the Interior Columbia Basin SDEIS.

2000). The ICBEMP SDEIS focuses on critical needs at the broad scale, landscape health, aquatic habitats, human needs, products and services, and terrestrial habitats. The direction of the SDEIS is outcome-based and uses a spatially designated network of important areas from which to anchor conservation and restoration efforts. The estimated cost of implementing the alternatives is significantly reduced from the level assumed in previous alternatives, and assumes only a moderate level of increased funding.

The scientists associated with the ICBEMP were asked to review the draft SDEIS alternatives (S1, S2 and S3). The following papers describe various efforts to determine effects of implementation of the draft alternatives described in the SDEIS. While it was necessary to analyze species and ecosystem components individually, because of the integrated nature of the broad-scale alternatives they also were evaluated in terms of how well they maximized the complex set of ecosystem components and resources. Each alternative was ranked relative to the other two, under the parameters set forth here and in the other discussions in this issue.

All three of the alternatives considered here were designed to fit within the broad purpose and need of restoring or maintaining ecosystem health and integrity over the long term or supporting economic and social needs, and providing predictable and sustainable levels of products and services, including fish, wildlife and native plant communities, from lands administered by the FS or the BLM in the project area. These goals are consistent with the legal mandates and directives of both agencies. One way to understand the differences among the alternatives is illustrated in Table 1, which shows the proportion of federally administered lands split among the four primary types of management activities. Differences like the emphasis on restoration in the second and third alternatives are clear. The management alternatives were evaluated from working drafts. Specifics on each alternative can be found in USDA and USDI (2000).[2] The alternatives are described generally below.

Table 1
Percentage of federally administrated land assigned to different management prescriptions[a]

	Alternatives (%)		
	S1	S2	S3
Management prescription			
Ecological restoration	0	34.5	20.8
Traditional reserve	22.7	19.8	25.1
Traditional commodity	21.7	7.5	10.5
Traditional management	55.6	38.2	43.6

[a]Only for federal lands affected by decisions made as part of the Interior Columbia Basin Ecosystem Management Project.

5.1. Alternative S1

Alternative S1, often called the “no action” alternative because it continues practices already in place, represents the land use management practices currently in use within the project area. Over 60 land management plans, each specific to an FS or BLM administrative unit and each developed using somewhat different management definitions and policies, are currently in use. The alternative continues management specified under each plan, as amended or modified by interim direction,[3] as the long-term strategy for project area lands managed by the FS or BLM. Final standards for rangeland health and guidelines for livestock grazing management (USDA and USDI, 2000; USDI BLM, 1995, 1997a-c, 1999) currently being implemented on BLM-managed lands are continued on the same lands, as are recommendations from other biological opinions (USDA and USDI, 2000; USDC and NMFS, 1995, 1998; USDI Fish and Wildlife Service, 1998).

Many of the existing land use plans are based on the assumption that ecological conditions are currently within an acceptable range and that disturbances such as fire, or insects and disease, would not substantially

[2]USDA and USDI (2000) is also available on-line at http://www.icbemp.gov.

[3]Interim direction includes PACFISH, 11VF7SH, and Eastside Screens. PACFISH was a comprehensive strategy for improved management of habitat for Pacific salmon and steelhead on FS- and BLM-administered lands. The FS and BLM developed the strategy in 1992 and 1993 (PACFISH, 1994, 1995). The USDA FS issued an environmental assessment in 1995 for a proposal to protect habitat and populations of native inland fish. This became known as the inland native fish strategy or INFISH (INF7SH, 1995). A Decision Notice for the “continuation of the Interim Management Direction establishing riparian, ecosystem, and wildlife standards for timber sales” (also known as Eastside Screens) was signed by the Regional Forester of FS Region 6 in 1994. It amended all eastside (Oregon and Washington) Forest Plans to include the direction as new standards and guidelines (USDA FS, 1994).

affect planned actions or desired outcomes. Because it is a continuation of the current management direction, alternative S1 does not have a comprehensive restoration strategy within administrative units, and various system components, i.e., timber, rangeland, wildlife species, are generally managed as individual resource issues (USDA and USDI, 2000). This often results in conflicts in management direction, habitat fragmentation, reduction in species diversity, and a concomitant decline in resource sustainability over the long term.

5.2. Alternatives S2 and S3

Alternatives S2 and S3 "focus on restoring and maintaining ecosystems across the project areas and providing for the social and economic needs of people, while reducing short- and long-term risks to natural resources from human and natural disturbances" (USDA and USDI, 2000). Both alternatives provide four key elements. (1) Integrated management direction addresses the dynamics of change across entire landscapes and highlights possible broad-scale causal relations among ecosystem components including vegetation dynamics, terrestrial species habitats, aquatic species, and riparian and hydrological processes, socioeconomic systems and tribal concerns. (2) A process that uses these broad-scale conditions to set context and focus issues at the management unit level (step down). (3) An adaptive management strategy allows modification of management direction as new information and new experiential data is collected and understood. (4) Monitoring and evaluation ensure management activities are achieving desired results.

Alternatives S2 and S3 identify subwatersheds containing key aquatic resources or terrestrial species habitats to focus management resources in those areas most likely to benefit from maintenance or restorative actions. Management intent is to protect the resources or habitats in the short term and to enhance them in the long term. Short-term protection and long-term enhancement of key resources and habitats in these areas are designed to optimize results within realistic agency budget levels. Alternatives S2 and S3 were also designed to "support the economic and social needs of people, cultures, and communities (in the project area) . . . and to provide sustainable levels of products and services from lands administered by the FS and BLM, consistent with other ecological and restoration goals" (USDA and USDI, 2000). The alternatives promote agency support for collaboration with local communities and tribal governments, particularly those that are isolated and economically specialized, as those entities develop methods that support their long-range goals of economic development and diversification. Federal trust responsibilities, and tribal rights and interests are addressed as fully as possible within the scope of the direction (USDA and USDI, 2000).

Alternative S2 contains greater emphasis on conducting step-down analysis at intermediate and fine scales[4] to connect local decision and management actions to broad-scale issues and conditions. This attempts to minimize short-term risk from activities and assists in determining the most appropriate location and sequence of activities (USDA and USDI, 2000).

Alternative S3 places a greater emphasis on conducting management actions immediately to address "long-term risks to resources from unnaturally severe disturbance" (USDA and USDI, 2000). Alternative S3 has fewer acres delineated as priority areas for aquatic and riparian conservation areas. Alternative S3 also promotes economic participation by the local workforce by prioritizing activities near communities that are economically specialized in outputs from FS- and BLM-administered lands, and near tribal communities (USDA and USDI, 2000).

6. The development of an effects analysis

The use of various scientific information to estimate biological, ecological, and socioeconomic effects of proposed land management strategies is briefly introduced in the following section. These effects are then used to estimate environmental consequences of the proposed management alternatives, which deal with

[4]Step-down processes take broad-scale directions and translate them to finer geographic scales. In our use of the terms, *broadscale* landscapes and analyses cover large drainage basins (millions of hectares) and used 1 km2 square pixel resolution. *Intermediate (or mid-)scales* cover subbasins to subwatersheds (tens of thousands to millions of ha) and mapped features on 1:24 000 aerial photographs. *Fine-scale* analyses and maps cover subwatersheds to individual vegetation stands (tens of hectares to tens of thousands of hectares) and involved data ranging from aerial photographs at 1:24 000 to 1:12 000 and stand-level plot data.

geographically broad-scale land management direction for federal lands within the Basin. Outcomes of these proposed alternatives are projected at the Basin level, are set in the context of broader conditions and trends, and reflect differences within the Basin among major geographic divisions.

6.1. Dealing with uncertainty in ecosystem management

The understandings of natural and human processes that are key to ecosystem management are often based on imperfect knowledge leading to uncertain outcomes. One role of science is to provide improved information that helps decision-makers understand relative risks and how alternative management approaches can mitigate risks to biologically and socially acceptable levels. The type and extent of this information helps to clarify feasible boundaries, options within the boundaries, consequences of those options, and tradeoffs between options. By explicitly assessing risks and the effectiveness of management actions to reduce risks, we increase the probability of societal acceptance of our management actions. However, choosing among options is the normative domain of the decision-maker, it is not the domain of the scientist.

Ecosystem management, with its emphasis on levels of spatial and temporal hierarchy, facilitates risk management by focusing discussions and management responses at the level the risks occur. That is, the greatest flexibility for management is attained when risks can be managed at the lowest level possible. Decision-makers continually choose among different types and amounts of risk whenever they choose a course of action that attempts to reconcile disparate objectives. Their decisions reveal individual differences in willingness to accept risk. In the Pacific Northwest, we seem to be in a time when public land managers are often risk averse as revealed by frequent recommendations for large reserve sites that minimize risk of species extirpation. In this sense, our scientific assessments and evaluations of management direction are risks assessments. The results help managers to understand how, and how effectively, different management strategies mitigate risks. They also provide a means to consider additional options that potentially could lead to greater flexibility in management approaches at the field level.

[5]In this case, risk refers to situations in which the outcome is not certain but the likelihoods of alternative outcomes are known or can be estimated.

6.2. Methods

A variety of models was used to evaluate the management direction, as it would reasonably be implemented during the next decade and the next century. Most of these models were developed as part of the scientific assessment (see Quigley and Arbelbide, 1997) or the analyses of effects used in the evaluations of the land management strategies as part of a formal EIS (see Quigley et al., 1997). Models of the relations between habitat and population viability of selected at-risk fish and wildlife species have been recently developed (see Marcot et al., 2001) to meet the specific needs of estimating the potential population responses to land management planning that affects habitats.

Because of the complexity of the problems, many of the models used simulation techniques or Bayesian belief networks. Both types of models were developed considering the hierarchical nature of various processes and relied on a mix of empirical and judgmental relations. These models were used to develop estimates of how changes in input condition, especially those related to federal land management, changed output measures of performance. Reviewing both the soundness of the process relations and the robustness of projected outcomes when subject to sensitivity analysis validated these models.

The primary landscape model outputs simulated forest and range vegetation, disturbances, activity levels, and key variables related to landscape condition. Various outcomes were then used as input into other analyses directed toward aquatic, terrestrial, and socioeconomic consequences. In the case of both aquatic and terrestrial wildlife species, simulated forest and range vegetation conditions were inputs to causal relations among factors that influenced wildlife species viability.

6.3. Caveats

Numerous assumptions are both necessary and critical since all projected outcomes depend on them.

Some assumptions deal mostly with clarity of direction/intent/rationale. Other deal with establishing common frameworks among the disparate science efforts. Still others, within each individual assessment, link functionally specific management direction with empirical information or models (that in turn rest on assumptions) and result in projected outcomes.

Examples of the first category of assumptions include a wide range of very general assumptions often dealing with institutional and process issues such as whether regulatory agencies have adequate expertise and resources to participate in a timely and effective manner as interagency partners in implementation and monitoring. The second category of assumptions ensures consistency across the various science evaluations. Example landscape modeling assumptions such as activity levels reflect land use plans and existing habitat conservation strategies. The third category of assumptions includes those specific to individual science efforts. These assumptions, particularly the ones related to models, will be discussed in more detail where appropriate. The intent of the assumptions is not to artificially restrict management to achieve the most favorable of outcomes - it is to establish the clarity necessary for analysis purposes in the evaluation of SDEIS alternatives.

7. Summary

These large-scale ecoregion assessments pose significant challenges for the scientific community including the need for an effective partnership between it and managers, and others engaged in the political tasks of governing. From the perspective of the scientific community, the lack of clarity in the socioecological problems that lead to the need for comprehensive broad-scale strategies is frustrating. It creates a barrier to distinguishing issues reflecting different policy preferences among the governing partnership from those attributable to the lack of information. Furthermore, this lack of clarity around the questions leads to confusion about the appropriate spatial and temporal scale of response to various issues.

This issue contains 11 additional papers. The next two deal with methodological issues. In the first, McIver and Starr examine the proposition that active restoration will be effective in improving the condition of lands. Marcot et al. (2001) discuss the use of Bayesian belief models to project abundance and distribution of potential terrestrial vertebrate populations and to model the influence of landscape characteristics on the conditions of aquatic habitat. Rieman et al., Raphael et al., and Lehmkuhl et al. deal with the status and trends in terrestrial and aquatic species communities and habitats in relation to different broad-scale land management strategies. Then, Hemstrom et al. and Hann et al. emphasize the dynamic nature of broad landscapes. Crone and Haynes deal with the status and trends in social and economic systems in relation to different broad-scale land management strategies. Quigley et al. develop broad-scale measures of composite ecological integrity from various component measures. Haynes and Quigley, and Mills and Clark deal with broad policy issues: management and policy inferences from the science-based evaluations, and the important but highly debated issue of the interface between science and policy, respectively.

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