CHAPTER 6

POLICY QUESTIONS, EFFECTS OF SPECIFIC POLICY ACTIONS, AND PROCESS QUESTIONS

The Science Integration Team derived, and the Executive Steering Committee approved, eleven policy questions from the Charter. They also sought to determine the effects of the Northwest Forest Plan, and the effects on FS- and BLM-administered land of implementing the PACFISH strategy. Two broad process questions were also identified.

Policy Questions

1. What are the effects of current and potential FS and BLM land allocations on ecologic, economic, and social systems in the Basin?

Current land allocations result in the simplification of landscape mosaics and ecological conditions. This is true whether the allocation is for commodity or amenity outputs (see discussion of continuation of current management and reserve area emphasis management options). Allocations tend to emphasize one resource goal (such as timber harvests) that is sometimes constrained by competing resource goals (such as fish and wildlife). In contrast, ecosystem management may emphasize multiple goals under a flexible, adaptive management. These goals would be accomplished within the biophysical capabilities of the ecosystem by seeking outcomes related to landscape processes balanced over large spatial and temporal scales. Strict adherence to land allocations does not allow the flexibility to respond to changing environmental conditions.

Most past land allocations have favored either commodity production or wilderness set-asides. These aimed either at the predictability of economic or social outputs over short timeframes and localized areas or the resolution of specific wilderness issues. Predictability of economic and social outputs may temporarily be reduced or changed during the short-term transition between the existing situation and the more flexible approach, until management plans can be established for the new approach. The long-term economic outputs could be predicted, but outputs may take a different form (for example, different mix of size and species of trees harvested).

The implementation of ecosystem management builds on the legacies of past management (for example, roads and past harvesting) and tradeoffs in production of ecological, economic, and social outputs. For example, roads may be detrimental to some aquatic systems, but enable some types of economic, cultural practices, and recreation activities to take place. Past cutting practices and fires also created some desirable ecological attributes or patterns in our current landscapes.

2. What are the ecological, economic, and social system outcomes associated with current (defined as the early 1990s) FS and BLM levels of activities?

Relative to historic practices, current management practices have focused on minimizing and mitigating disruptions to aquatic environments. However, the net gain in aquatic habitat improvements has been slow and many fragmented and isolated habitats remain. This has resulted in continuation of local extirpations even without any additional habitat loss. Though riparian systems are beginning to recover, upland forest areas are currently at greater risk from certain diseases, insects, and catastrophic fires, owing to fire suppression and exclusion. Upland range areas have shown improvement over the past forty years, but the encroachment of exotic plants, especially legally declared noxious weeds, and grazing strategies that are inconsistent with ecological processes continue to be important problems.

A focus on ecological outcomes likely will have mixed effects on economic and social resiliency. There may be a short-term decline in traditional commodities, such as timber, but in the long-term, commodity production could stabilize. Under current management, social resiliency is expected to be lower than average in the more arid portions of the Basin, and higher than average in forested areas with higher productivity. Much of these findings are tied to water. Water is a common link to both social and biophysical resilience.

3. What is required to maintain long-term productivity (in terms of various systems)?

Management practices designed to sustain long-term productivity need to incorporate the full complement of ecological processes within the context of the biophysical conditions. In addition to understanding the biophysical conditions, managers will commonly need to react to unpredicted, unalterable, environmental conditions that are outside the limitations of the system by adjusting management practices. Managers will have to address conditions such as introduction of exotic biota, erosion of soil, concentration of toxic pollutants, loss of habitats to urban and agricultural development, and global climate change.

Indicators of long-term productivity can typically be measured from above- and below-ground structural components and patterns. However, the basic ecological processes that drive productivity are the critical baseline. There are some general management recommendations that when followed will reduce risk of loss of long-term productivity.

To protect soil productivity, managers can conserve surface organic matter by minimizing roads in the moderate-to-high-risk areas for erosion, sediment transport, and landslides. Managers can design roads to better fit the land surface, to avoid cut slopes that bring subsoil water flow to the surface, and locate them in lower-risk areas. In particular, roads in flood plains constrain channels and increase rates of flow. Where possible, roads could be removed from flood plains or other areas subject to events that may affect hydrologic flows, erosion, or sedimentation. Maintaining bank cover in riparian areas, and emphasizing woody cover would help, as would managing to minimize soil disturbance activities in areas susceptible to establishment of exotic plant species. These areas are typically in the dry forest, shrub, and grass potential vegetation groups. Where feasible, there is also the opportunity to manage to reduce risk of introduction of exotics and contain their spread.

Management practices can be designed to retain diversity of vegetation and soil patterns and structural components. Special emphasis can be placed on the cycling of the dead component of vegetation. Management practices can include provisions to maintain dead standing and down vegetation material, and litter.

Management practices can be designed to maintain long-term water retention characteristics of the landscape, especially in wetlands. This will improve aquifer characteristics, will provide a buffer for riparian conditions, and provide habitat for wildlife. Vegetation herbivory can be managed to conserve vegetation cover and resiliency of the system to drought.

Human populations in the Basin are increasing, which, in turn, results in increases in associated pressures on the land. Managers can work with stakeholders and scientists to continually share new understandings and views of long-term productivity.

4. What can the FS and BLM do to mimic disturbance elements on the landscape?

The FS and BLM can mimic natural disturbances, but it is essential for managers to consider that current conditions may be considerably different than those conditions that occurred historically. For example, reintroduction of native processes such as fire without modification of structural patterns, fuel loading, and spatial distributions can produce unpredictable and undesirable effects. Managers could use strategies of livestock grazing in forests and woodlands that would result in the accumulation of understory fine vegetation. This would provide fuel for prescribed fires that can be useful in maintaining conditions consistent with long-term disturbance processes.

In planning vegetation management, it is important to recognize that native disturbances and mechanical treatments do not necessarily create the same conditions. Oftentimes the structure can be replicated with a mechanical process. The results may be a community that is very different or generally equivalent to the native system. This is highly dependent on the design of the mechanical disturbance process. When possible, management treatments would be designed to produce a mosaic of both live and dead vegetation structures in a more complex array of patterns than exists today. Livestock grazing and other herbivory can be managed to be more consistent with those patterns and structures that represent long-term disturbance processes.

In aquatic systems there is less known about how to mimic disturbance to create appropriate structures and composition of components. Because of the high rates of energy concentration in the aquatic system, and the cumulative nature of smaller drainages to larger drainages, many aquatic restoration or development projects fail. This often occurs because of failure to consider structure placement in the context of the hydrologic and geomorphic conditions.

Managers need to apply disturbance processes appropriately through time and in space. Management activities that truncate the successional sequences can cause significant negative impacts to ecological processes. Seeding of perennial exotic grasses following wildfire commonly replaces the early-seral native shrub and/or herb stage. These seed mixes can contain exotic weed seeds. Because of the risks of exotics, seeding of cover to reduce erosion would focus mostly on areas where the seed bank in the surface soil has been lost. Where seeding is deemed necessary and appropriate, seeding with annuals that do not produce fertile seed is an option. Typical patch sizes and scheduling of harvest continually through time in the same watershed, often do not represent the size and interval of more natural disturbance events. Containment of livestock in specific pastures usually does not represent the seasonal variation of ranges that were available to native herbivores.

5. What is required to maintain sustainable and/or harvestable and/or minimum viable population levels?

The ultimate concern and requirement for species are long-term persistence, assessed and provided within the context of ecosystems. A population with a high level of viability is one with a high likelihood of continued existence throughout its range (on at least Federal lands within the Basin) over the long term, for example the next 100 years. In contrast, a harvestable population is one that is sustainable and that can also provide a portion for hunting or gathering uses. To reach this level requires understanding the long-term and off-site effects of our short-term and on-site actions, as affecting the kinds and distributions of habitats, environments, and populations. Such a viable population is sustainable, and can be said to have a high likelihood of long-term persistence.

The concept of “minimum” viable populations does not apply to our assessment and we strongly advocate not using the term in management direction. Current scientific literature largely discounts the use of the concept because there simply is no one threshold population size that just barely assures long-term viability and below which the population is doomed. Instead, the focus should be on ensuring adequate distribution and abundance of environments and of individuals within and among populations to assure sustainable levels and, for some species, harvest use.

Species that might need individual attention for viability management include those species that are threatened, endangered, candidate, or rare and potential candidates. Additionally, a quick, simple, and inexpensive monitoring system can be instituted to ensure that currently secure populations do not become viability concerns in the future; the best application of population viability assessments is to prevent future listings of species. Then, the rest of the species can be addressed in broader guidelines for maintaining biodiversity, ecosystem processes, and species ecological functions, in part by addressing species in ecological functional and community groups. In this way, critical species-specific issues *and* broader ecosystem management guidelines combine to ensure full conservation of both species and systems in one coherent approach.

Maintaining persistent populations requires well-distributed, well-connected, persistent high-quality habitat, and control of factors directly affecting mortality of individuals, such as harvesting, pollution, and competition or predation with domestic or introduced species. Well-distributed habitat will reduce the probability that disturbance or habitat loss, and consequent extirpation of the local population in any one area, will adversely affect overall population persistence. Connecting habitat patches with corridors or dispersal habitat, or eliminating barriers (such as roads and dams) will ensure that all parts of the regional population interact by allowing individuals to move between patches of habitat. That will allow for recovery of populations in areas that have been depleted by human or natural causes. Connectivity will also ensure adequate genetic interchange among segments of the population, which will promote vigorous populations with few genetic defects or reduced productivity resulting from inbreeding. Good connectivity generally is a goal, but in some cases persistence may be enhanced by restricting or controlling habitat connectivity where contagious disease or disturbances (such as crown fires) might be problems.

Not all species are naturally capable of persisting over the long-term; some are naturally scarce and rare. The best attainable goal for such species would be to maintain or restore their key environments and habitats and watch those habitats or populations for downward trends. However, if a species has become scarce because of human activities, much can likely be done to restore viability to higher levels.

All habitat is not created equal and the mere presence of individuals in a particular cover type or structural stage does not signal high-quality habitat. High-quality habitat consistently enables production and recruitment of young into the population, for example, where births equal or exceed deaths. Some habitats appear to be important, but are really “sinks” in the sense that those populations are not viable because mortality is higher than births. To persist, populations in sink patches need to be replenished from the high-quality “source” habitats. Habitat persistence could be assured by planning for habitat loss from disturbance, succession, or human encroachment and for its replacement through succession or active management.

Population viability can be managed by manipulating environments, habitats, other species, or sundry factors affecting demographic or genetic conditions and trends of the species of interest. Factors affecting population viability such as mortality differ among species. Mortality associated with human infrastructure and activities (such as roads, dams, irrigation systems, industrial pollution, residential and agricultural non-point pollution, and agricultural practices) can have large effects on some populations. Competition with domestic or feral livestock or introduced species can also lead to problems of habitat degradation or displacement of some organisms. Predation by domestic animals (dogs and cats) or introduced species can also be serious problems. For anadromous fish on-site and off-site (for example, ocean fishing, migratory species) harvest levels, stocking targets for some native and non-native species, and management of harvest (season, bag limits, methods) are critical issues for cooperation between land managers, state and tribal governments, and the public.

Finally, there needs to be the social will to maintain sustainable populations. Reasons for maintaining sustainable populations might be economic, social, religious, cultural, ethical, to provide for ecological services or ecological integrity, or to meet tribal treaty mandates. Cooperation among Federal, state, tribal, private, and public interest groups will be critical for achieving sustainable and harvestable populations.

6. What is required to maintain and restore biological diversity (biodiversity)?

The first step is insuring we have societal acceptance that biological diversity is a goal. If it is a goal, then maintaining and restoring biodiversity will require attending to several conditions in the Basin, including the following principal conditions:

- protecting or restoring seriously degraded and rare ecological communities,
- alignment of natural areas to represent ecosystems and to provide for rare and endemic species,
- conserving centers of species rarity, endemism, and richness,
- providing for a full array of historic vegetation conditions,
- providing the full array of key species ecological functions in an area,
- protecting type localities for rare plants,
- providing for full species' ranges, including disjunct populations, range margins, and endemic subspecies,
- maintaining soil structure and chemistry, and avoiding erosion,
- eradicating exotics or preventing further spread,
- and, modifying livestock-grazing strategies in some areas, particularly riparian areas,

To achieve these conditions, some high-quality environments or habitats need to be well-distributed, well-connected, and persistent, where biophysical conditions allow. Other environments or habitats associated with high biodiversity of unique or endemic plants and animals may be scarce and scattered; simple protection of such unique, sensitive sites (such as vernal pools) also may be needed.

Also, biodiversity can be in part maintained by providing for ecological processes. In the case of white pine blister rust and other exotic pathogens or insects, deployment of genetically resistant stock may be needed. In some instances, undesirable exotic species are now part of these ecosystems and cannot feasibly be eradicated or controlled with existing technology. Other exotic species have been deliberately introduced for purposes of biological control, erosion control, forage, productivity, and other purposes; they have become an inextricable part of the "naturalized" biodiversity of the area, but whether they are now a desirable component of biodiversity is a societal decision.

7. What is the effect of ecosystem management on major social issues and the maintenance of rural communities and economies?

Community and economic resilience—FS and BLM personnel are members of many rural communities, but the agencies are relatively minor players in fostering economic growth. Range and ranching communities are typically less resilient than those associated with forest products and logging. Some isolated communities or interests may be negatively affected by changes in conditions of the Basin brought on by new management strategies. If the desire is to alleviate these impacts, effective transition strategies could be designed and implemented.

Competing demands—Ecosystem management only partially reduces conflicts between competing uses of Federal lands. It may reduce conflicts between timber harvest and recreation uses by modifying harvesting techniques to allow harvest but reduce aesthetic impacts. Other conflicts such as between cross-country skiers and snowmobilers or between tribal and commercial gathering of mushrooms and huckleberries are not measurably affected. All conflicts will increase in the future with population growth.

Fire hazards in rural- and urban-forest zones—Residential development adjacent to Federal lands will continue, placing more people and property at risk from wildfires. Ecosystem management, appropriately targeted to these areas, can reduce these risks; ecosystem management cannot eliminate these risks.

Healthy ecosystems—Fire, flood, disease, decay, and production of commodities are all part of healthy ecosystems. Overall, ecosystem management can improve ecosystem health, although particular stands or landscapes may not appear attractive to some members of the public. Education about and commitment to the objectives of ecosystem management and what levels of fire, disease, and decay are within the parameters of ecosystem health are key to public acceptance.

Jobs—Ecosystem management will have a varied impact on the numbers of jobs in the Basin. When taken as a whole, the marginal impact on jobs of moving to new ecosystem management strategies will likely be neutral. Overall, the Basin economy is robust and changes in FS and BLM land management activities have little effect on overall economic growth. Timber-related jobs may increase slightly throughout the Basin for the next 50 years. Jobs associated with cattle grazing on Federal lands may decrease slightly, but the numbers affected are small relative to the total employment of the Basin. By producing more aesthetic landscapes, jobs created by attracting business to locations with a high quality of life will increase.

"Old-growth" forests—Ecosystem management will maintain "old-growth" forests in a number of ways. Timber harvesting practices will target smaller-diameter trees that will result in landscapes with larger trees, and increase recruitment into old-growth forests by accelerating growth rates of middle-aged stands. It will also reduce the risk of losing old-growth forests to fire, insect, and disease disturbances.

Quality of life—Ecosystem management has potential to improve the quality of life in the Basin by maintaining flows of both goods and services that can stimulate economic activity. In striving to meet the demands of competing interests it will also improve the quality of life by reducing conflict and strife.

Recreation—The effects of ecosystem management on recreation activity will be relatively minor, but can be positive or negative depending on how it is implemented. Closing roads in popular recreation areas will be controversial, as will building new roads into previously unroaded areas. Limiting recreation in riparian areas has the potential to disrupt a major resource use in many areas. On the other hand, ecosystem management can improve recreation by increasing aesthetic qualities.

Scenic integrity—Ecosystem management has potential to improve the visual condition of previously modified landscapes by increasing vegetative variety. It can also reduce the risk of losing highly aesthetic landscapes to wide-scale disturbances and human activity.

Unroaded areas—One of the major social issues in the Basin concerns "unroaded" areas. Building roads into an unroaded area presents a paradox; on one hand new roads provide access for recreation and other resource use, on the other they remove opportunities to experience back-country settings and cause potential risk to some ecological resources. If the desire is to reduce conflict over land management, ecosystem management would explicitly consider the balance of recreation access and unroaded areas through a variety of tools including analytical methods, survey instruments, and an open public process.

8. What is the effect of ecosystem management on maintenance of late-successional and old-growth systems?

Management has the potential to improve both the area and connectivity of late-successional and old-forest structures on landscapes where such structures would occur under natural disturbance regimes. Where the natural disturbance regime does not support late-successional and old-growth systems, it will be difficult to maintain these structures on the site.

The term old-growth has both a social and ecological connotation in this assessment. In ecological terms it refers to forests that are described as late-seral forests or old forests and have important characteristics and functions for native species habitats and ecological systems. They are often a small, but important component on many forested landscapes. The amount, structure, composition, and patterns of late-seral forests are variable. In the Basin late-seral forests are often found in specific settings that are correlated with low-intensity surface fire regimes, mixed fire regimes, or very long intervals (that is, 200 years or greater) between fires.

Late-seral forests are found in all forest potential vegetation groups, but differ in their structure and composition. Surface fire regimes are typically found in the dry forest or in the cold forests with herb and low shrub understories. Mixed fire regimes are typically found in the moist forest or in riparian areas. Very long-interval fire regimes are typically found in very wet areas.

This understanding of the biophysical setting and associated disturbance regimes provides a basic template for application of ecosystem management. Past harvest practices have typically reduced, fragmented, and/or changed structures of much of the late-seral forest. Ecosystem management would reverse these trends.

In many areas of the dry and moist forests, the suppression of surface and mixed fire regimes have allowed many single-layer late-seral forests (such as ponderosa pine), to succeed into multiple-layer forests (such as, Douglas-fir and grand fir). These late-seral forests usually have increased risks for high-intensity crown fires. To address these risks, these multiple-layer communities can be converted to single-layer communities through mechanically thinning understory trees and using prescribed fires. Where harvest has removed the long-interval, late-seral, multiple-layer forests, ecosystem management would actively promote restoration for rapid growth of similar structures. Wildlife species associated with these late-seral forests are cavity excavators and those with large home ranges.

It is important to point out that in the Basin a dominant forest structure described was scattered, large, residual, trees in a mid-seral forest. This forest structure occurs in a mixed fire regime where surface and crown fires left large residual dead or live trees and younger trees grew beneath the scattered residuals. The residual large live trees are usually the shade-intolerant, and insect- and disease-resistant trees that provide seed for the next forest. Removal of these trees has often resulted in conversion of the seed source from shade-intolerant species to shade-tolerant fire-, insect-, and disease-susceptible species, as well as losing the diverse structure. Harvest of the large live or dead residual trees from these types results in the loss of important habitats as well as components in long-term nutrient cycles. Management practices can promote the maintenance of these large residual trees where they exist and where they have been harvested or otherwise lost, management can focus on rapid growth of selected young trees with similar characteristics.

In cases where the long-term disturbance regimes do not support late-seral forests, management actions to maintain late-seral forests may be required to create short-term habitats for rare species. However, the risks of this strategy would need to be assessed and adequate investments made in fire suppression and other management activities to maintain the forest for the short term.

9. What management actions will restore and maintain ecosystem health (forest, rangeland, riparian, and aquatic health)?

If the goal is to restore and maintain ecosystem structure, composition, and disturbance regimes working toward a healthier system, there are several broad actions that are recommended. The *Component Assessment* provides an assessment of the conditions and trends of the Basin at a broad resolution over regional and sub-regional areas. Assessments having finer resolution will also be needed for management to recommend more specific actions. Tiering assessment information from broad to fine through more detailed and site-specific analyses will result in consistent management activities that address risks to resources as well as meeting broadly defined and site-specific objectives.

To assess ecological processes and the condition of viable populations, land managers need to consider strategies that match forest and range vegetation structure, composition, and patterns to the Basin's biophysical templates. For example, land type phases that are specific to small geographic areas and land type associations that are specific to large geographic areas could be used to develop descriptions of biophysical templates. It is critical that managers consider long-term (as well as short-term) effects on species viability, biodiversity, and ecological functions.

For aquatic and riparian systems, there are several opportunities to work toward a healthier system. Conservation and restoration of small watersheds will ensure short-term persistence of important aquatic populations, while conservation and restoration of habitat networks throughout large basins will provide for long-term stability, productivity, and biological diversity. If managers want to connect isolated clusters of watersheds, watershed restoration and exotic fish containment will be required with emphasis placed on those watersheds containing strong native populations and high aquatic integrity. Riparian areas function to filter sediment transport to streams, introduce woody debris for in-stream structure, provide structure and cover for terrestrial species, and water temperature regulation. Maintaining riparian areas to accommodate these functions will be important to aquatic systems.

If the objective is to have a full array of historic vegetation conditions, the ecosystems most in need of restoration are native grasslands, native shrublands, and old forests. In these ecosystems, a concern is woodland establishment and conversion of shrub-grasslands where fire-regimes have minimized tree establishment, and tree species have excluded understory species or have known potential to eventually exclude understory species. There is a need to curb expansion of exotic grasses and forbs and to prevent invasion and establishment of new exotic grasses and forbs.

10. What can the FS and the BLM do to implement adaptive management, and what are the consequences on ecologic, economic, and social systems in the Basin?

A variety of approaches are required to implement adaptive management. It will be necessary to regularly define what society wants from the Federal lands through a variety of methods including economic and sociological analytical methods, surveys, mutual learning, and collaborative planning. It will also be necessary to develop a process for regular input of knowledge and evaluation from the scientific community; to develop protocols for long-term research and learning; and, to develop the internal skills in agency personnel to operate effectively in the public and political environment.

In conducting adaptive management, agencies should use quantifiable experimental methods, including clear statements of hypotheses, initial inventory and characterization, establish experimental controls, replicated observations, and monitoring. Experiments should be allowed to be completed so that learning takes place. Ecosystem integrity is steadily improved with informed management decisions.

The consequence of adaptive management on economic, cultural, and social systems will be quite positive in that management will be more closely aligned with people's expectations. By being so aligned, adaptive management reduces rapid changes in management direction. The public will be more invested in land management decisions and activities.

11. What can the FS and the BLM do to protect endangered species (such as salmon, grizzly bear, gray wolf, caribou) and to insure the viability of native and desired non-native plant and animal species?

The material and cultural legacy of the past has presented some difficult or immovable barriers to protection of endangered species; some likely will not change appreciably. Dams, major highways, power corridors, and irretrievable habitat loss to agricultural, industrial, and residential developments will set limits to protection of some endangered species. Public attitudes in some sectors toward wildlife, especially predators, and wildlife conservation relative to economic development are barriers to conservation of some species. Proposals for basing species conservation on economic gains or losses are not encouraging because traditional patterns of resource extraction, local culture and custom, and private property use favor consumptive uses of forest and rangeland ecosystems. Intensive management for consumptive uses often results in simplified ecosystems with unusual dynamics and exotic species that simplify diverse natural ecosystems. International issues of ocean fishing and land use north and south of the United States relative to neotropical migrating birds or wide-ranging terrestrial species (such as grizzly bear, wolf, woodland caribou) complicate effectiveness of local initiatives.

Agencies can work toward protecting species type localities and scarce, critical habitats; maintaining well-distributed, well-connected, persistent high-quality habitat; reducing mortality from human activities; and reducing or controlling exotic species (See response to Policy Question 5 for a discussion of managing habitat and populations for sustainable or viable populations). In some cases, habitat may be less important than direct negative effects on populations. Many wide-ranging threatened, endangered, or sensitive species (such as grizzly bear, gray wolf, wolverine) are relatively general in habitat use (that is, use many habitat types), but are limited mainly by human displacement or poaching. The solution for such species is isolation from humans, which may mean land-use allocations and control of road access. Roads also can degrade aquatic habitat quality. Introduction of non-native or exotic fish (such as rainbow trout and brook trout, bass, and walleye), plants (such as exotic weeds) and animal species (now well controlled) can complicate, and in some cases limit, efforts to improve populations of endangered species.

Conservation agreements and recovery plans among states, Tribes, and Federal agencies encourage cooperation in addressing these issues and offer an effective approach for Federal land management. These agreements require close cooperation between the FS, BLM, and the U.S. Fish and Wildlife Service (USFWS). Some cooperation would be enhanced by joint field offices. Coordination with the public can facilitate mutual learning.

Effects of Specific Policy Actions

1. Within the context of the Northwest Forest Plan (NWFP), what are the options for achieving the objectives where the NWFP overlaps the Eastside strategies?

Land allocations from the NWFP included emphasis to achieve integrity of the late-successional, "old-growth," and riparian systems. However, the late-succession and old forest reserves do not consider disturbance regimes of the biophysical settings they occupy. These reserves may not be maintainable in their existing state. For example, old forest structures typical of dry forest settings would be comprised primarily of open park-like stands of large trees of early-seral species such as ponderosa pine and western larch. Frequent underburns would maintain wide spacings and would eliminate shade-tolerant understories. Currently dry forest settings such as these are generally densely-stocked and multi-layered, with understories dominated by shade-tolerant species. In contrast, old forest structures of mesic settings occur in mosaics; a result of mixed severity fires having underburning and stand-replacement components. Old forest structures in mesic environments are both single- and multi-story structures. Current mesic setting late-successional and old-forest structures within the NWFP area are predominantly multi-story, lacking regular underburning. In the cool and moist settings, high-severity fire regimes predominated as they do today. Old forest structures in these areas are relatively unchanged, and current NWFP direction appears consistent.

The NWFP identifies key watersheds on the east side of the Cascade Mountains. The ICBEMP Assessment identified watersheds with high aquatic integrity (high species diversity, strong populations, and a high ratio of native to exotic species). Key watersheds identified in the NWFP correspond well with current watersheds of high aquatic integrity. These watersheds are well placed and will perform ecologically as intended; that is, they provide important anchor points or focal watersheds for maintaining strong salmonid populations and habitats.

In the NWFP, to identify management options requires local action (and site specific analysis). This poses problems for agencies used to prescribed planning methods and poses opportunities for those capable of institutional change.

2. What is the effect of implementing the interim direction of the PACFISH and/or other proposed aquatic conservation strategies on FS and BLM lands in the Basin?

The effect is positive on the Basin because it changes the focus from stands and specific project sites to conditions of whole watersheds. Where specific information about the riparian system and watershed exists, default buffers can be adjusted with better information about entire watersheds and site-specific conditions. If forced to manage by detailed metrics (for example, pools per mile, or number of large woody pieces per mile), standards and guides should be derived from general planning processes and inventory information that considers specific biophysical environments rather than rigid quantifiable thresholds. Overly prescriptive protocols will often lead to unachievable objectives.

The social and economic effects of implementing PACFISH are mixed and negative in the short-term. Short-term negative effects include temporary closure of developed recreation sites during spawning and critical fish migration periods. Longer-term negative effects potentially include some timber and range program reductions in localized areas prone to high surface erosion.

Process Questions

1. What are the principles and processes that can be used for ecosystem management?

The *Framework* outlines the principles and processes that can be used for implementing ecosystem management. A brief summary of these is provided here.

The Ecological Society of America (1995) defines ecosystem management as "...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." It is the application of management practices considering multiple geographic areas and multiple timeframes.

The BLM and FS can use four ecosystem principles as a foundation for developing ecosystem management strategies: ecosystems (1) are dynamic; (2) can be viewed hierarchically with spatial and temporal dimensions; (3) have limits; (4) and are not completely predictable. These principles can be used within a general planning process to achieve desired outcomes and conditions. Ecosystem processes, structures, and functions are constantly changing, requiring management strategies to constantly monitor outcomes and conditions. Interagency coordination and intergovernmental cooperation are desired as is the active involvement of stakeholders. Foremost for adaptive management strategies to succeed is that cumulative risks need to be managed to retain management options at all decision levels, from national to individual site. Such an approach necessitates that management activities be devised as testable hypotheses at the onset; monitoring is integral, not added as an after thought. Adaptive management strategies are iterative, where monitoring leads to continuous adjustments in land management decisions and implementation plans.

Goals for natural resource management of the FS and BLM are set at multiple administrative levels and geographic extents. Through policy statements, directives, budget decisions, executive orders, congressional direction, and National Environmental Policy Act (NEPA) process goals are set for national, regional, sub-regional, landscape, and site levels.

Ecosystem management goals can be achieved through developing an understanding of the conditions at each geographic extent, and determining the capability of the land through understanding the ecological processes now and in the future ("biophysical template"). These are influenced, in turn, by our actions. Examples include landtype phases, which are specific to small geographic areas, and landtype associations, which pertain to larger areas. For example, the ability of the land to produce fish is determined by conditions both "on site" (such as habitat, cover, and food sources) and "off site" (such as dams, harvesting, and disease). Thus, the biophysical template is both the basic capability of the land and the changes in capacity as influenced by past and future activities. In order to provide context, management actions need to be linked consistently within a hierarchy. To achieve ecological goals such as maintaining ecological processes, viable populations of native and desired non-native species, and the full set of key ecological functions of species, Federal land managers would match changes in forest and range vegetation structure, composition, and pattern to biophysical templates.

Assessments at larger geographic extents using broad data resolution provide context for smaller geographic extent assessments and regional decisions. These latter assessments provide context for watershed assessments and related decisions. In addition, mid-geographic extent assessments describe processes and functions not evident in large (that is, regional) assessments while the small (that is, watershed) geographic extent assessments reveal processes undetected with mid-geographic extent assessments.

An ecosystem management strategy can involve three levels of analysis: region and/or sub-regional assessments, landscape assessments, and site or project analysis. Ecoregion assessments can be used to develop Regional Guides and Forest Plan Amendments, BLM statewide direction and BLM district plans at regional geographic extents. Assessments provide understanding of the ecological systems within watersheds and incorporate concerns at the landscape geographic extent. Project or site analysis deals with specific land management actions. The FS and BLM, through the ICBEMP, will have at their disposal both a broad-regional assessment and mid-sub-regional assessment for some issues/questions. These data can be used to give context to the watershed assessments being conducted throughout the Basin and to set priorities within larger subbasins. It also will provide increased understanding of biophysical and social-economic systems to evaluate specific management actions at specific sites, through environmental impact statement processes.

Management flexibility is attained to the extent risks can be managed at the lowest level possible. For example, a risk would be considered a "regional risk" if the risk could not be adequately addressed by making incremental, individual decisions at lower levels. An example is activities that threaten anadromous fish populations. Insuring the viability of a wide-ranging fish species includes providing adequate connectivity, distribution, and abundance through high-quality suitable habitat for the species. Taking a piecemeal approach to where the species habitat will be emphasized will not ensure the habitat is connected, abundant, or well-distributed. Taking a systems approach to decisions regarding which portions of all potential habitats will be managed will help ensure quality habitat is well distributed for the species. The alternative would be to conservatively manage all habitat by not permitting any of it to be adversely altered, thus, reducing flexibility for management. By strategically making the decision of where, in specific, the species habitat would be emphasized, management has potentially more options to consider as new decisions are made.

Managing directly to achieve opportunities, desired outcomes, and the provision of goods and services might result in new risks to achieving the goals. There is nothing inherently wrong with setting out to achieve some goals that are output oriented toward commodities. Managing the full complement of risks associated with all management goals dictates that the new risks to ecological objectives, created through achieving the outcomes (outputs) be evaluated to determine how these affect the cumulative risks to the ecological goals for the area. This evaluation could result in changes in the way the practices are applied, the provision of other goods and services, or the total risks to the ecological objectives being analyzed. It becomes an iterative process, analyzing risks associated with not achieving ecological goals, determining the effects on outputs (outcomes), modifying actions that result in new projections of output levels, determining effects on risks to ecological goals, adjusting as appropriate, and cycling through the analysis until the risks to ecological goals are acceptable and the output levels are achieved to the extent possible.

The key components of a monitoring program include:

- management goals and objectives that clearly define the information needed in a monitoring program and reflects different geographic extents and timeframes,
- both biophysical and social components,
- an experimental design including a hypothesis, methods, and indicator variables with adequate sample size to insure inferences are made with sound statistical analysis,
- and, robust indicator variables that reflect changes before they become problems, so they can act as an early warning system for management activities.

In the general planning model, we identified four types of monitoring: implementation, effectiveness, validation, and baseline monitoring. How managers apply each type depends on the management objectives and goals developed within an ecosystem strategy.

2. How can we use the assessment to identify emerging policy issues that relate to ecosystem management within the Basin?

The assessment identifies a number of emerging ecosystem trends and conditions that could be addressed though various policy actions. In general the assessment did not propose policy actions, but its databases and models could be used to measure the consequences of proposed actions.

3. How can we deal with uncertainty in ecological processes, social values, predicting outcomes, and scientific understanding?

Uncertainty is present in virtually all management activities and scientific understandings. The real strength of statistical analysis is in being able to reject a hypothesis that was proposed as true, thus uncertainty is removed, not by proving the hypothesis is true, but by demonstrating that it is false. When we cannot disprove a hypothesis, we are really saying we do not yet have enough information to disprove it. Uncertainty then is present in each relation proposed in ecosystem management approaches. Perhaps the best way to address uncertainty is to reveal the level of confidence one has in predicting outcomes. High levels of uncertainty might lead to very conservative management approaches.

Each SIT product attempted to reveal the level of uncertainty associated with the information provided.

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CHAPTER 7

EMERGING MANAGEMENT ISSUES AND SCIENCE GAPS

In developing the integrated assessment, the SIT encountered a number of science gaps and emerging management issues. Some of the science gaps reflect a lack of information, while others reflect lack of data at the geographic extents used in an ecoregion assessment. Some of the emerging issues are new findings; others confirm long-standing, but not documented, land management concepts.

Management Issues

In this section, we summarize new management issues that we identified in the course of our work.

◆ To what degree, and under what circumstances should ecosystem restoration be active or passive?

Ecosystem restoration activities should be assessed on a case-by-case basis for potential short- and long-term effects of restoring each ecosystem. There are instances where long-term benefits may not exceed short-term environmental costs or adverse ecosystem impacts, making a passive restoration approach more appropriate. Differences in geographic areas and the biophysical template may dictate when active or passive restoration is appropriate. For example, restoring a watershed that has stable channel types, has minimal erosion and sediment transport, and modest precipitation but which is highly sensitive, may cause detrimental effects. In other areas, active restoration is required to decrease the risk of catastrophic events. In addition, the timing of restoration work is also important for reducing adverse effects or risk from other disturbances. Finally, ecosystem restoration efforts--both passive and active--need to be appropriate and within the capability of the ecosystem being restored.

◆ How will ecosystem management contribute to meeting treaty and trust responsibilities to American Indian tribes?

Ecosystem-based management will enhance the Federal Government's opportunities to meet its trust responsibilities by (1) restoring (where possible) ecological processes, and (2) enhancing our recognition of the significance of the environment in American Indian culture and therefore our ability to protect specific places of significance. One goal for the restoration of ecological processes, including the restoration of aquatic and riparian habitats, could be to enhance the abundance and distribution of plants and animals important to tribes, especially in those places with social and traditional significance.

The intense interest in natural resource management by the Indian population in the Basin is based in their long-term cultural attachment to the land. Although the American Indian societies in the region differ in many ways, they hold shared beliefs and values about their relationship with the land and water. All tribes attach cultural and religious significance to various places especially within their aboriginal territories. The long-standing presence of Indian peoples and the totality of landscape and resource importance have contributed to strong attachments to place. Ecosystem-based management recognizes the important cultural links American Indian people have with the environment.

Recognition of special forest products, such as beargrass, mushrooms, and berries also can be an important element of ecosystem-based management. We would expect that ecosystem management would provide enhanced opportunities for harvest of these products, particularly for their traditional cultural uses. Consultation with tribal governments would be an integral part of ecosystem management.

Basin treaties provide for reserved tribal rights to pasture livestock, and to fish, hunt, gather and trap the products of the land. Many places where harvest activities occur also have strong sociocultural place meanings and attachments. These traditional activities have developed together with the cultural and symbolic significance of place. Restoration and conservation of culturally significant places and species would contribute to the biophysical template and ecosystem structures, patterns, and processes.

◆ Can salvage timber sales be compatible with ecosystem-based management?

They can be, but much depends on the types of stand structures that are harvested. As currently defined (in Public Law 104-19, see U.S. Laws and Statutes 1995), salvage emphasizes the extraction of specified volumes of dead and green trees at risk of dying. As such, harvest will emphasize larger trees, both green and recent dead, of desirable species (ponderosa pine, Douglas-fir). Our findings suggest that this type of harvesting is not compatible with contemporary ecosystem-based management. Ecosystem-based management would emphasize removing smaller green trees with greater attention to prevention of mortality rather than removal of large dead trees.

The landscape ecology assessment found a substantial increase from historic to current times in the area of dense multi-story forest structures. For the most part, these types of stand structures originated as a result of past selective harvesting and the exclusion of fire, and generally now have elevated fuel loads, susceptibility to bark beetles, defoliators, and stand-replacing fires. In these landscapes because of past selective harvesting, more rather than fewer large or potentially large trees are needed to sustain ecosystem processes, and some medium-sized trees (16 in/41 cm in diameter or larger) are needed for large tree recruitment.

Tree harvesting can be a useful tool to promote desired stand structure and composition, but often (as in the Taylor Salvage Law, PL 104-19) harvesting appears to emphasize volume extraction. It is also a useful tool in managing fuel loads where the emphasis is on removing small and medium-size material, which comprises the bulk of the current fuel hazard. Cutting of small and medium-size trees can minimize these concerns, while harvesting of larger trees has little effect on reducing fuel loads. High-density stands dominated by small and medium-diameter trees are the focus of many current ecosystem health concerns.

Prevention strategies are more effective than corrective strategies at improving forest health; that is, it is preferable to make adjustments in the structure, composition, and pattern of living vegetation within a watershed than to work with what remains of living and dead vegetation after fire or pest outbreaks. Prevention strategies are best applied to whole watersheds. Traditional approaches to salvage are also less advantageous in an economic sense because they emphasize extraction of dead rather than green trees. They also tend to emphasize stand rather than watershed treatments. In an ecosystem sense, the highest priority treatment areas for salvage are the low- and mid-montane forests, and the dry and mesic forest settings where the greatest changes in structure, composition, and disturbance regimes have occurred. Within those settings, currently roaded areas should be treated first because they are already accessible for salvage without additional road-building expense and effects. Salvage operations in already roaded areas can, in many cases, generate funds to reduce the adverse effects associated with roads. There is a lower ecological risk to anadromous and cold water fish and hydrologic systems associated with salvage operations in already roaded watersheds. Addition of new roads for salvage would in many areas further reduce and fragment existing fish strongholds. Salvage harvest methods in burned areas will also need to consider minimizing surface soil disturbance and reducing road-related sediment problems.

Science Gaps

Future research can be focused to address science and information gaps, including the design of monitoring protocols and data collection activities. The science gaps the SIT identified are within three areas: biophysical, socioeconomic, and methods.

Biophysical Science and Information Gaps

- There are currently no standardized sampling and monitoring methods. This includes population measurements, species distributions, and physical variables such as stream morphology or stream sediment geochemistry.
- Monitoring programs need revision, because monitoring programs typically measure easily determined variables, such as tree diameter, rather than focusing on rate- or process-determining variables. Monitoring programs typically are long-term activities and may require repeated measurements to obtain the needed information.
- Methods for archiving, accessing, and updating databases are inconsistent or uncoordinated.
- Additional information is needed to understand ecological processes and the interactions between processes.
- Studies are needed to determine species viability, population dynamics, and habitat relations in all environments.
- Empirical studies are needed to understand ecological functions of organisms.
- Studies are needed to understand how people access wildlands (for example, roads, trails, and their condition).
- More information is needed to determine how changes in climate affect vegetation and habitat changes, locally and over large geographic areas.
- More information is needed on the effects of geology on landscape, aquatic, and terrestrial patterns and processes. Over multiple geographic areas, such information can help predict range and habitats for aquatic and terrestrial species.
- Information is needed to help understand the interactions between terrestrial and aquatic systems.
- Improved engineering techniques are required so that future road building minimizes aquatic disturbance. This requires research on a variety of biophysical factors.
- Information is needed on how livestock grazing affects encroachment of woody species and invasion of exotic species.

Socioeconomic Science and Information Gaps

- Methods are needed for identifying places and their meanings, and more information is needed on these places, in order to help understand a community's and society's relationship with and value for places.
- Methods are needed to determine what values society places on healthy ecosystems.
- Methods are needed to help determine how people perceive risks associated with natural catastrophes. An important related issue is developing a broader understanding of the urban/rural interface, specifically concerning issues such as wildfire and wildlife.

Gaps in Scientific Methods

- Methods for determining ecological risk need to be improved.
- Information is needed on using information with different data resolutions and geographic extents. In particular, how can information from smaller geographic areas be applied at larger geographic areas; tree diameter, restoration, and recreation information do not translate to large landscapes.
- Methods are needed to determine public acceptance of ecosystem management strategies and disturbance regimes.
- Information is needed to link between ecological process models and spatial tools (Geographic Information System).
- More accurate computer models are needed for predicting effects of management practices on ecosystems and refining the role that computer models play in relating assumptions. This is particularly true on burned area salvage projects. For example, predictions are needed on what kind of trees and how many would be left to achieve different management objectives.
- More systematic integrative frameworks are needed. This includes protocols and methods for using data derived from expert opinion and the need for systematic databases that incorporate information from many sources.
- We need to learn how to make decisions on issues for which we have no data, determine which data is important, and learn how to most effectively collect the right data to provide the best information possible for decision makers.

Emerging Science Issues

Five main issues surfaced concerning how to implement ecosystem management on FS- and BLM-administered lands in the Basin. They are:

- We did not fully understand the extent or role of exotics in the Basin. There are several ecosystems where exotics--both desired and noxious--dominate ecosystems. This is especially true of some of the range and range/forestland ecosystems.
- We did not fully consider the correlation between roads and social desires. We found conflicting reasons, for example, for entering or not entering “roadless areas.” We need to consider the balance between roaded natural and unroaded recreation settings, while considering the risks to aquatic strongholds and terrestrial habitats from road building.
- We had not anticipated the data indicating the extensive loss of large trees in the landscapes over much of the Basin. The harvest legacy has been more extensive than we thought. This raises questions about needed improvements in databases and monitoring of both harvest levels and stand conditions.
- There are several National Forests and BLM Districts where projected human population growth will change the mix of outputs. The Boise National Forest and others will likely become “recreation” forests like the westside forests near Seattle, Washington, or the front range forests near Denver, Colorado. The ERUs likely affected most will be the North and South Cascades, Columbia Plateau, Upper and Lower Clark Fork, Central Idaho Mountains, Snake Headwaters, and the Northern Glaciated Mountains.
- Ecosystem management advocates need to be more forward-looking. They need to anticipate how demands on resources from the public lands will change in coming decades. The tendency has been to judge ecosystem management by what has happened in the past two decades, rather than focus on how ecosystem management and conditions will evolve into the future.

CHAPTER 8
FINDINGS

The following findings draw from our experience in developing all the ICBEMP Assessment products (the *Framework*, detailed assessments of ecosystem components, *Evaluation of the EIS Alternatives* by the SIT, and this I*ntegrated Assessment*). More detailed findings specific to individual science areas and those related to trends, conditions, or processes are in each document. Findings are in three main categories—general issues, those specific to achieving goals, and those of an organizational nature.

Overall Findings

We found that an active approach to ecosystem management within an adaptive framework could lead to higher ecological integrity and social and economic resiliency within ecosystems of the Columbia basin and portions of the Klamath and Great basins. This approach would recognize the dynamic nature of the interior ecosystems, their current ecological status, and the demands placed on interior ecosystems to provide for human values and uses.

The highlighted findings are:

1. There has been a 27 percent decline in multi-layer and 60 percent decline in single-layer old-forest structures, predominantly in forest types used commercially.
2. Aquatic biodiversity has declined through local extirpations, extinctions, and introduction of exotic species, and the threat to riparian-associated species has increased.
3. Watershed disturbances, both natural and human induced, have caused and continue to cause risks to ecological integrity, especially owing to isolation and fragmentation of habitat.
4. The threat of severe fire has increased; 18 percent more of the fires that burn are in the lethal fire severity class now than historically. In the forest PVGs lethal fires have increased by 30 percent.
5. Rangeland health and diversity have declined owing to exotic species introductions, changing fire regimes, and increasing woody vegetation.
6. Rapid change is taking place in the communities and economies of the Basin although the rates of change are not uniform.

Landscape Ecology Findings

Continuing to manage vegetation using historical levels and approaches of stand management is unlikely to reverse trends in vegetation conditions. In the last 100 years fire suppression hazards and costs, fire intensity, and firefighter fatalities have doubled; insect, disease, and fire susceptibility have increased by 60 percent; white pine and whitebark pine have decreased in moist and cold forested vegetation types owing to blister rust (see photos 14a and 14b); native grasslands have decreased by 70 percent; native shrublands have decreased by 30 percent; large residual trees and snags have decreased by 20 percent; and old forest structures have decreased by 27 to 60 percent.

Photos by R. Graham

Photos 14a and 14b—Due to wide-spread infestation of white pine blister rust (*Cronartium ribicola*), white pine and whitebark pine have decreased in moist and cold forest vegetation types in the Basin. These photos show before and after effects of blister rust on forest stands dominated by western white pine.

The greatest changes in landscape patterns and processes have been in roaded areas historically managed with intensive treatments. Landscape patterns have changed on 97 percent of the landscapes basin-wide. Vegetation patterns have changed, thus altering the risks associated with their persistence.

Terrestrial Ecology Findings

There are 264 species within the Basin with Federal listing status under the Endangered Species Act of which 27 are threatened or endangered species. Some threatened and endangered species are dependent on habitat components that were not evaluated at the Basin level. Habitat conditions for nearly all species were found to be more favorable historically as compared to now. Continuing current management approaches would result in more species with declining habitat and more species of potential concern than would managing with restoration or reserve emphasis. Management options aimed at restoration are projected to result in only moderate improvements in habitat outcomes for species of potential concern. The overall likelihood of extirpations has increased from historic to current conditions and is projected to continue increasing under current management approaches; fewer extirpations are likely under the restoration approach to management than under the reserve approach. Species that are likely in decline are associated with landscape and habitat components that are declining, specifically old-forest structures, native shrublands, and native grasslands. Habitat degradation is more pronounced in lower elevation watersheds. The core pieces remain for rebuilding and maintaining quality native terrestrial species habitat. We mapped 7 centers of biodiversity and 12 hot spots of species rarity and endemism within the Basin.

Aquatic Ecology Findings

Key salmon species have seen declines in habitat, abundance, and life histories. Population strongholds for the key salmonids range from less than 1 percent to 32 percent of the occupied range of the species. The occupied range varies between 28 percent and 85 percent of the historic range. Declines for anadromous species have been the greatest; even if habitat stabilizes, fragmentation, isolation, and off-site hazards put remaining populations at risk. Habitat degradation is greatest in lower elevation watersheds, which include private lands. Though much of the native ecosystem has been altered, the core pieces remain for rebuilding and maintaining functioning native aquatic systems. Rehabilitating depressed populations of anadromous salmonids cannot rely on habitat improvement alone but requires a concerted effort to address causes of mortality in all life stages. These include freshwater spawning and rearing, juvenile migration, ocean survival, and adult migration.

Social Findings

People and communities within the Basin are undergoing rapid change. Social resiliency varies; drier climates are generally associated with lower resiliency, such as in ranching- and agriculture-based communities. Communities that have weathered recent economic or social disruptions are generally more resilient. Human attachments to places are important in determining the acceptability of management actions. Ecosystem management will require strong cross-jurisdictional cooperation, yet is still evolving. Overall scenic quality within the Basin is high.

Economic Findings

Overall, Basin economies are experiencing growth, especially in metropolitan and recreation counties. Regional economies are diverse and have high resiliency, but resiliency varies by size of the economic sectors. FS and BLM activities account for 13 percent of the regional economies of the Basin. The importance of FS and BLM activities varies within the Basin, with activities in eastern Oregon having the most importance. Recreation is highly valued as a regional, national, and international resource. At current growth rates recreation use will double in the next 31 years.

Geographic Information Findings

Consistent databases at the Basin level are scarce. An interagency approach could greatly improve the quality of information and support continuing assessments that are part of the adaptive management process.

Findings for Selected Issues

This section summarizes our general findings around major issues identified through our various public interactions.

Accessibility—We found a great deal of ambiguity about the amount of road access needed to satisfy public needs. Issues include the ecological consequences of roading, and the effects (both good and bad) on different kinds of public recreation. Many people oppose extensive road closures, while at the same time many people support improving habitats and reducing erosion. Management strategies include reducing road densities and redesigning and improving maintenance of road networks.

Communities—Communities are more complex than labels such as “timber dependent” would imply. Most communities in the Basin have mixed economies and their vitality is linked to factors broader than resource flows from FS- and BLM-administered lands. In the Basin, both communities and economies associated with agricultural or ranching operations are less resilient than other types.

Fire—It is not possible to "fireproof" ecosystems in the Basin, but the potential of severe fire can be reduced by proactive land management. In terms of social and economic outcomes, the greatest potential management concerns are likely to be in the rural/urban wildland interface. Severe fires do put ecological integrity at risk. Management treatments aimed at reducing severe fire are not without risk to ecological integrity and concern to humans, pointing to the need for an integrated approach to risk management.

Fish—The identification of aquatic strongholds and areas of high fish community integrity and other aquatic information provides a basis for the conservation and restoration of aquatic ecosystems. Such information also provides a basis for building effective strategies that can simultaneously benefit terrestrial and aquatic ecosystems. This strategy could include protection of high-integrity areas and restoration of areas with lower integrity.

Forest Health—We found that forested ecosystems have become more susceptible to severe fire and outbreaks of insects and diseases. Reducing these risks and hazards involves maintaining forest cover and structure within a range consistent with long-term disturbance processes.

Rangeland Health—Rangeland ecosystems have been affected by historic overgrazing, woody species encroachment, changes in fire regimes, and exotic species invasion. Integrated weed management strategies, use of prescribed fire, and managing the season and intensity of grazing use can result in improved rangeland health. Grazing strategies with specific objectives for riparian areas within aquatic strongholds and habitats identified for threatened and endangered species would address many of the concerns of rangeland health related to species diversity.

Managing Risk to Ecological Integrity—We found that the management of risks to ecological integrity involves maintenance of high integrity and enhancement of areas with low integrity. We found that an integrated approach will be necessary because risks to integrity arise from many sources (hydrologic, forest, rangeland, aquatic, as well as economic and social). Reducing risks from one source may increase risks to another ecological component. The strategy for risk management will need to be both integrated and adaptive.

Restoration—We found that there are substantial opportunities to restore and improve ecological integrity on forest and rangeland areas with 74 percent of the FS- and BLM-administered lands of low or moderate integrity. There are opportunities to restore landscape patterns, improve connectivity in aquatic and terrestrial habitats, restore vegetation cover types and structure, and restore hydrologic functions within subbasins. There are opportunities to restore these patterns, structures, and vegetation types to be more consistent with those occurring under disturbance regimes more typical of biophysical environments. We found that opportunities exist, albeit at a different scale, for restoration in virtually every subbasin in the Basin.

Salvage—We found that salvage activities could contribute to achievement of long-term ecological integrity by emphasizing prevention of insect and disease outbreaks rather than focussing on the removal of large, recently dead trees. Such an approach would include removing smaller green trees as part of the overall management regime that emphasizes stand structure and composition at the watershed level (rather than the stand level). Low risks to ecological integrity would exist from treating areas currently roaded, where companion efforts might include reducing adverse effects associated with roads. Such approaches can be consistent with attainment of economic objectives for salvage activities.

Special Forest Products—We found increasing conflicts between recreational, cultural, and subsistence collection of products such as huckleberries, mushrooms, and firewood and the growing commercial collection on Federal lands. Land management strategies will be complicated by the local commercial and cultural importance of these products.

Timber—An ecosystem-based approach to timber harvest places greater emphasis on areas treated than volumes of timber extracted (that is, a focus on area rather than volume regulation). The implication is that the volumes and mix of species removed can become a by-product of achieving goals of structure and landscape patterns. Under this approach, volumes may be more variable than past forest management approaches.

Findings From the Future Management Options

Projections of the future are mostly a result of evaluating options proposed by the FS and BLM as alternatives in the EIS. Three options were considered: (1) continuation of current approaches; (2) restoration emphasis; (3) and, reserve area emphasis.

Managing FS and BLM resources under an approach that continues current management generally results in the lowest ratings compared to other approaches. Results would include declines in species habitat and population outcomes, increases in fire severity, continued declines in fish habitat and population strongholds, and continued departures from long-term disturbance processes. Trends would generally be decreasing in composite integrity and increasing risks in terms of people and ecological integrity interactions. From a social and economic perspective this option would continue, even accelerate, many of the conflicts in resource use present today.

Managing FS and BLM resources under a reserve area option within the Basin generally results in mixed outcomes against the ecosystem management goals. This approach provides improvements in aquatic and terrestrial habitat conditions as compared to continuing current management approaches, yet large severe fires are projected to have detrimental affects on landscape patterns and processes. Currently degraded systems within the reserve areas would recover very slowly, some may not recover for hundreds of years. Trends in composite integrity and the risks in terms of people and ecological integrity interactions will, for the most part, be improving (decreasing risk) or stable, albeit at a slightly lower level than for the restoration management emphasis. The social and economic effects associated with a large reserve system will be highly variable, mostly depending on the resiliency of the communities and counties in close proximity to the reserves.

Managing FS and BLM resources under a restoration emphasis option within the Basin generally results in more favorable outcomes than continuing the current approaches or managing with a network of reserves. This approach is more consistent with long-term disturbance processes, has fewer species with declining habitat outcomes, and generally halts the decline of salmonid fish habitats. It results in stable or improving trends in composite integrity, and also results in decreasing or stable trends in the risk to people and ecological integrity for most of the area. While having some negative effects on social and economic elements, it appears to be the most responsive to American Indian tribal concerns, public acceptability objectives, and contributes to overall economic and social resiliency.

Finally, one feature that these management options share is that long-term sustainability of resources and environments, resiliency of social and economic systems, and meeting socially desired resource conditions cannot be predicted without continually assessing results of management activities and adjusting management activities accordingly. When compared with traditional approaches, active management appears to have the greatest chance of producing the mix of goods and services that people want from ecosystems, as well as maintaining or enhancing the long-term ecological integrity of the Basin.

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CHAPTER 9
LESSONS LEARNED

We described and measured ecosystem integrity in terms of ecological integrity and socioeconomic resiliency. We found that proactive management generally improved ecological integrity but had little effect on socioeconomic resiliency. We found that the social and natural resources of the Basin offer a heritage of exceptional significance to the nation and the world. Maintaining the integrity and resiliency of these resources for present and future generations depends on understanding how society values these resources, and understanding the natural and human processes occurring in the Basin. Conservation and management of these dynamic ecosystems within an ever-changing social setting are vitally important to the people who live within the Basin and throughout the United States.

But we also found (like in FEMAT) that political and budget realities will be the final deciding factor in the extent to which these findings will result in substantive changes in management. There are also practical lessons that we learned about the conduct of large multi-scale assessments. Foremost is the need for clear questions from decision makers. What decisions do they face and what information will improve those decisions? The issue is not so much about defining (and then limiting) the types of questions, but the science need is for clarity about types and nature of information needed. Given the cost of an assessment, we can ill afford to embark on a data hunt. Second, we need to find and then commit scientists to the assessment who are integrative, comfortable in the policy arena, and able to understand broad issues and concerns. The tendency in science communities to reward functional work over integrative work limits the pool of potential participants. Third, we learned to pay greater attention to the timeline and the balance between timelines, data quantity and quality, and emerging decision issues. We found it difficult as scientists to accept that existing information presented in a timely fashion had more influence than detailed data brought forward later. Fourth, we needed to identify goals early. In the ICBEMP, we closed on the goals for ecosystem management in the last quarter of the project. Fifth, we need a greater focus on cause and effect types of information (rather than just descriptive material) and the risks to achieving various effects.

In the end, though, we are reminded that public land management is really an issue of stewardship. One aspect of that stewardship is the responsibility to meet a wide array of societal needs such as wood fiber, beef, recreation activities, and places of spiritual and cultural significance. Another aspect is to seek a balance between today's needs and those expected in the future. The emergence of ecosystem management is but one step in the evolving process that attempts to balance current and future relationships between people and their environment. We have provided information that we hope will enlighten and motivate the debate about the balancing process. We have exposed strengths as well as weaknesses in the Basin's ecological and socioeconomic systems. We as scientists provide this information so the political/decision process can continue in a more transparent fashion with outcomes, consequences, and interactions more visible and, we hope, understood.

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