Chapter 4

Environmental Consequences

Contents

Introduction to Chapter 4

Key Terms Used in This Section

Cumulative Effects — Environmental consequences that result from the incremental effects of an activity when added to other impacts of past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. For this EIS, potential cumulative effects include those that were assessed for all land ownerships including lands administered by other federal agencies and non-federal lands, especially regarding terrestrial and aquatic species.

Direct Effects — Impacts on the environment that are caused by an action and occur at the same time and place as the action.

High Restoration Priority Subbasins — Subbasins in the project area identified by the EIS Team as having broad-scale priority for restoration. The intent for high restoration priority subbasins is to concentrate restoration efforts and make restoration activities effective and efficient. Restoration efforts in these subbasins would be directed toward several purposes concurrently so as to make restoration activities more ecosystem-based and to achieve improvement in several resources at the same time. See Appendix 15 for details.

Historical Range of Variability (HRV) — The natural fluctuation of ecological and physical processes and functions that would have occurred in an ecosystem during a specified previous period of time. In this EIS, refers to the range of conditions that are likely to have occurred prior to settlement of the project area by Euroamericans (approximately the mid 1800s). Historical range of variability is discussed in this document as a reference point only. It establishes a baseline set of conditions for which sufficient scientific or historical information is available, and enables comparison to current conditions.

Indirect Effects — Impacts on the environment that are caused by an action but occur later than or distant from the action, but are still reasonably foreseeable.

Irretrievable Commitments — A term that applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.

Irreversible Commitments — A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

Programmatic EIS — An EIS that provides a broad overview when a large-scale plan is being prepared for the management of federally administered lands on a regional or multi-regional basis. A programmatic EIS provides a valuable and necessary analysis of the affected environment and potential cumulative effects of the reasonably foreseeable actions under that program or within that geographical area. Analyses of lesser scope or more site-specificity may be tiered to the analysis in a programmatic EIS.

Stewardship Harvest — Commercial timber harvest where the primary reason for harvesting timber is to obtain a land use plan objective that requires vegetation manipulation. Therefore, even if the timber could not be sold, the harvest would still take place or be accomplished through other means, such as prescribed fire.

Thinning — An operation to remove stems from a forest for the purpose of reducing fuel, maintaining stand vigor, regulating stand density/composition, or for other resource benefits. Although thinning can result in commercial products,for the purposes of this EIS, thinning generally refers to non-commercial operations.

Traditional Timber Harvest — A commercial operation to remove stems from a forest for the primary purpose of economic gain, with mitigation for other resources (such as forest health or wildlife) secondary in priority.

How the Chapter is Organized

This chapter discloses the environmental consequences of implementing each alternative (described in Chapter 3). It evaluates direct, indirect, and cumulative effects of Forest Service and BLM management on the existing conditions and affected environment (described in Chapter 2). The environmental consequences displayed here are based on the *Science Advisory Group Effects Analysis for the SDEIS Alternatives* (referred to here as *SAG Effects Analysis*, Quigley 1999), along with professional judgement and expertise of the appropriate EIS Team member(s). This chapter forms the scientific and analytical basis for a relative comparison of effects.

For each major component (landscape dynamics [physical setting and terrestrial / upland vegetation], terrestrial species, aquatic–riparian–hydrologic, and social–economic– tribal), key effects and conclusions are presented first, followed by methods of conducting the analysis. Expected direct, indirect, and cumulative effects of the alternatives constitute the major portions of each component discussion. Effects of the four major components are followed by a discussion of effects on factors that influence health of ecosystems, such as fire suppression, insects, and disease. The last section in the chapter provides a cost analysis of the alternatives.

The analysis of effects for each component depends on the scale at which the data were collected and analyzed, and / or the scale most appropriate for displaying differences among alternatives. Consequently, effects are described by one or more of the following:

- Interior Columbia Basin (basin-wide; all lands);
- ICBEMP Project Area (Forest Service- and BLM-administered lands in the project area);
- Ecological Reporting Units (ERUs);
- Resource Advisory Councils (RACs) / Provincial Advisory Committees (PACs);
- Terrestrial Vegetation Communities;
- Potential Vegetation Groups (PVGs);
- Terrestrial Families;
- Counties; or
- Community types.

How the Effects of the Alternatives Were Estimated

Scale of Decision

This analysis addresses large, regional-scale trends and / or major changes in: ecological processes; landscape patterns and structures; succession and disturbance regimes; and habitat availability for threatened, endangered, and sensitive plant and animal species and communities. The analysis specifically focuses on issues that require integrated management across broad landscapes. It also addresses regional-scale trends and changes in the social and economic needs of people, cultures, and communities—both tribal and non-tribal—related to ecological trends and changes. The analysis does not identify site-specific effects, in part because of the level of specificity in broad-scale managment direction, which affects the ability to project effects at that scale; furthermore, site-specific information is not essential to determining broad-scale management direction. Further information on the decisions to be made can be found in Chapter 1 of this EIS.

General Analysis Approach

The EIS Team developed the array of alternatives. The SAG assessed the projected biological, ecological, and socio-economic effects of the Supplemental Draft EIS alternatives, based on a draft (April 1999)of the Supplemental Draft EIS management direction. Their analysis is documented in the *Science Advisory Group Effects Analysis for the SDEIS Alternatives* (Draft, June 25, 1999) (*SAG Effects Analysis*) (Quigley 1999).

To develop their analysis, the SAG developed a set of assumptions, which they coordinated with the EIS Team. Where empirical relationships did not exist to link inputs to outcomes, additional assumptions were developed about those relationships. Assumptions are discussed later in this section and in more detail in Appendix 16.

Major Changes from the Draft EISs

Broad-scale Focus

While the organization of Chapter 4 closely parallels that in the Draft EISs, the content in some places has been changed to reflect the refined focus of the project as described in Chapters 1, 2, and 3; new information from science; comments on the Draft EISs; and/or discussions with tribal and interagency partners. The refined focus addresses a limited number of issues which must be resolved at the basin level. Therefore, some Chapter 4 analyses from the Draft EISs have been dropped if they were determined to be more fine-scale than would be appropriate for the broad-scale focus of this project. All information has been updated and revised as appropriate.

General Analysis Methods

For the Draft EISs, the Science Integration Team (SIT) analyzed the effects of the draft alternatives using, in part, a series of computer models constructed to simulate historical, current, and projected future conditions of the project area. For the Supplemental Draft EIS, the Science Advisory Group (SAG) analyzed the effects of the draft alternatives using, in part, a series of models to simulate the management direction as it would reasonably be implemented during the next decade (short-term) and the next century (long-term). Many of the same models were used in the analysis of both the Draft and Supplemental Draft EISs, but some new models were developed specifically for the analysis of the Supplemental Draft EIS.

No-action Alternative Baseline

In the Draft EISs, the action alternatives (Alternatives 3 through 7) were evaluated against two no-action alternatives (Alternatives 1 and 2) as the baseline condition. Draft EIS Alternative 1 characterized implementation of the pre-1990 Forest and Resource Management Plan; Alternative 2 represented a first characterization of amendments, Eastside Screens, PACFISH, and other interim direction of the 1990s. In the Supplemental Draft EIS, the action alternatives (Alternatives S2 and S3) were evaluated against one no-action alternative (Alternative S1), which is based on the Draft EIS Alternative 2. The Supplemental Draft EIS Alternative S1 represents an updated characterization of interim direction and other amendments of the 1990s based on 10 years of activity data. This resulted in a substantial reduction in many of the activity levels compared to the Draft EISs.

Reporting Units

Effects in the Draft EISs were reported in a variety of units including forest and range clusters and the individual Eastside or UCRB planning areas. The Supplemental Draft EIS does not report effects by clusters or by individual planning areas, but it does include RAC/PACs and Terrestrial Families, which were not used in the Draft EISs. Other reporting units are also used, as appropriate.

Additional changes from the Draft EISs are noted in the individual sections of this chapter.

The SAG and the EIS Team evaluated alternatives on the basis of the data and relationships described in the *Assessment of Ecosystem Components* (Quigley and Arbelbide 1997), which included published research, studies, and reports. Conclusions regarding future conditions were based partly on a series of computer models to simulate the management direction as it would reasonably be implemented during the next decade (short-term) and the next century (long-term). Many of the models were developed as a part of the *Assessment of Ecosystem Components in the Interior Columbia Basin* (Quigley and Arbelbide 1997) or the *SIT Evaluation of EIS Alternatives* (Quigley, Lee, and Arbelbide 1997). Some new models were developed specifically for the analysis of the Supplemental Draft EIS. Inferences were based on available information and model results.

The primary computer simulations were for vegetation, disturbances, activities, and key variables related to landscape conditions. These outcomes and variables were then used as input into other analyses directed toward aquatic, terrestrial, and socio-economic outcomes.

In their *Effects Analysis*, the SAG focused primarily on effects associated with Forest Service- and BLM-administered lands in the project area. The levels of detail presented are the following: at the interior Columbia Basin level (to gain some insights into potential cumulative effects), the ICBEMP project area level (National Forest System and BLM-administered lands to which the EIS and Record of Decision would apply), the Resource Advisory Council (RAC)/Provincial Advisory Committee (PAC) area level, and/or areas designated for specific purposes (for example, evolutionarily significant units for anadromous fish). For non-Forest Service- and BLM-administered lands in the basin, simulations assumed continuation of existing management direction and

Computer Models

The computer models used in this analysis—like all models of complex biological, physical, social, or economic systems—generally simplify reality because they cannot accommodate all of the interactions between organisms and their environment. Lack of input data stemming from minimal knowledge of many interactions is typically a reason why models must simplify reality. Despite this apparent shortcoming, computer models generally are useful because they can accommodate and analyze many more interactions between organisms and their environment than humans can. Results are repeatable, and models also provide a logic track that scientists and managers can evaluate. Models make it possible to analyze complex alternative management direction, with corresponding changes in model input variables, and to explain the probable biophysical and socio-economic effects of those alternatives.

activity levels. Thus, changes reflect only the effects from implementing the direction contained in the Supplemental Draft EIS.

The *SAG Effects Analysis* describes the likely outcomes and cumulative effects (all lands) from the alternatives across the entire project area and was the basis for this chapter. In those cases where SAG assumptions, models, or simulations were not able to accurately reflect the intent or management direction of the alternatives, the EIS Team further analyzed and disclosed the effects of the alternatives and provided rationale for supplementing or deviating from the SAG evaluation.

Unless otherwise specified, the tables in this chapter were adapted from the *SAG Effects Analysis for the SDEIS Alternatives.*

Incomplete and Unavailable Information

Requirements and Conclusions

The Council on Environmental Quality (CEQ) regulations for implementing procedural provisions of the National Environmental Policy Act (NEPA; 40 CFR 1502.22) require federal agencies to identify relevant information that may be incomplete or unavailable for an evaluation of reasonably foreseeable significant adverse effects in an EIS. If the information is essential to a reasoned choice among alternatives and the cost is of gathering it is not excessive, it must be included or addressed in the EIS.

No missing information was deemed essential to making a reasoned choice among the alternatives being considered at this scale and at this time.

Knowledge is, and always will be, incomplete regarding many aspects of terrestrial and aquatic species, forestlands, rangelands, the economy, and communities and their interrelationships. The ecology, inventory, and management of ecosystems is a complex and developing discipline. However, central ecological relationships are well established, and a substantial amount of credible information about ecosystems in the project area is known. The alternatives were evaluated using the best available information.

The data collection effort for this decision is unprecedented and can generally be categorized into five basic groups (see Appendix 2):

- Databases (more than 20 were acquired or developed);
- GIS themes (more than 180 were compiled or created);
- Expert panels / workshops (approximately 40 were convened for terrestrial, aquatic, and / or landscape science information);
- Contract reports (more than 130 were used); and
- Current literature reviews.

While additional information may add precision to estimates or better specify relationships, new information is unlikely to significantly change the understanding of relationships that form the basis of the evaluation of effects. Although new information is welcome, no missing information was deemed essential to making a reasoned choice among the alternatives being considered at this scale and at this time.

Subsequent Analysis Before Projects

This EIS displays management alternatives and likely outcomes for broad-scale management direction. Before site-specific actions are implemented and an irreversible commitment of resources made, information essential to those fine-scale decisions will be obtained by the local managers. Localized data and information will be used to supplement or refine regional-level data and identify methods and procedures best suited to local conditions in order to achieve the objectives in this EIS. Further analyses may be necessary to deal with site-specific conditions and processes. These subsequent analyses will be used to bridge the gap between broad-scale direction and site-specific decisions. These analyses are described in this EIS as “step-down” and are discussed in detail in Chapter 3 and in the Implementation Appendix (Appendix 10).

Monitoring and Review

Appendix 10 provides frameworks for implementation, monitoring, and adaptive management. Should there be new scientific information or a change in conditions not projected under the selected alternative, there are provisions for changing programmatic management decisions to reflect new information and management practices. This process is part of adaptive management and is guided by monitoring, research, and interagency oversight. Adaptive management and monitoring, combined with the NEPA requirement to consider significant new information related to the effects of ongoing actions, reduces the likelihood that incomplete or unavailable information at any point in time would either lead to unacceptable consequences or be considered essential.

Cumulative Effects

Cumulative effects, also called cumulative impacts, are those environmental consequences that result from the incremental effects of an activity when added to other past, present, and reasonably foreseeable future actions regardless of which agency or person undertakes them (see 40 CFR 1508.7). For this EIS, potential cumulative effects include those that were assessed for all land ownerships including lands administered by other federal agencies and non-federal lands, especially regarding terrestrial and aquatic species.

The analysis and disclosure of cumulative effects alert decision-makers and the public to the context within which effects are occurring, and to the environmental implications of the interactions of known and likely management activities. Similarly, programmatic EISs such as this one provide a broad analysis of large areas that encompass many environmental interactions, which would be disclosed as cumulative effects in more site-specific NEPA documents. During subsequent analyses for site-specific activities, local cumulative effects should be important considerations in the design of site-specific alternatives and mitigation measures.

Cumulative Effects on Federal Lands

The alternatives analyzed in this EIS would establish management direction that allows for many activities across lands administered by the Forest Service or the BLM. The consistent management direction of Alternatives S2 or S3 within the project area, combined with subsequent site-specific NEPA analysis and planning, would provide a coordinated land and resource management structure, which itself accounts for cumulative effects of future activities on Forest Service- and BLM-administered lands. In light of the broad geographic scope and spatial resolution of this EIS, the analysis of alternatives could not and does not address all possible cumulative effects that may result at specific sites on federally administered lands.

Subsequent analyses will help to assure that the incremental and interactive effects on Forest Service- and BLM-administered lands in the project area would continue to be considered when implementing the selected alternative. Ground-disturbing actions will be conducted only after site-specific NEPA analysis, if required, which also must analyze the effects of the activity on adjacent lands and resources. Thus, the intent is that managers will design, analyze, and choose the locations and types of site-specific activities that minimize cumulative environmental effects which cannot be described at the broad scale of this EIS.

Cumulative Effects on Non-Federal Lands

For the purposes of this analysis, non-federal lands include lands owned and/or managed by individuals, corporations, American Indian tribes, states, counties, or other agencies. The lead agencies in this EIS (the Forest Service and BLM) do not have the authority to regulate any activities or their timing on lands other than those they administer. However, when an action takes place on BLM- and Forest Service-administered federal land, it may cause direct, indirect, or cumulative effects on non-federal lands. For example, a wildfire that begins on federal land may burn to adjacent private land, or noxious weed infestations that began on private land may infest adjacent federal land; for these examples, direction in this EIS could benefit adjacent landowners indirectly from better controls on noxious weeds and less severe forest fires.

The *SAG Effects Analysis* focused primarily on effects associated with lands administered by the Forest Service and the BLM in the project area. However, analysis was also presented at the basin level, for all land ownerships including lands administered by other federal agencies and non-federal lands, to assess potential cumulative effects, especially regarding terrestrial and aquatic species. These effects are disclosed in individual sections of this chapter.

Cumulative Effects from Non-Federal Actions

This EIS also considers the likely effects on Forest Service- or BLM-administered lands from reasonably foreseeable management actions occurring on non-federal land. For example, management of non-federal land may have potentially direct impacts on terrestrial and aquatic wildlife species that move between federal and non-federal habitats during the year or during their life cycle. The role of management of non-federal lands was considered in the *SAG Effects Analysis* on those species and ecosystems, and is presented in the Terrestrial Species and Aquatics sections of this chapter.

Localized actions on non-federal lands often affect local environmental conditions on nearby federal land and may also affect federal management decisions. For example, non-federal road construction and harvest in a watershed with both federal and non-federal lands could result in a decision by federal managers to postpone harvest to avoid potential watershed degradation. Access to timber on non-federal land may require roads on federal land. However, such actions and their impacts cannot be accurately identified or mitigated in this EIS given its broad scope.

Cumulative Effects in Subsequent Environmental Analysis

Ground-disturbing activities on federally managed lands are conducted only after any necessary site-specific NEPA analysis has been completed. Such analyses are required to describe the cumulative impacts of the site-specific alternatives on adjacent lands and resources, and on the watershed. This provides opportunities to detect and minimize cumulative environmental effects that cannot be specifically determined at the broad level of this EIS.

Other Environmental Consequences

Council on Environmental Quality regulations require discussion of adverse environmental effects that cannot be avoided should the proposal be implemented, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented (40 CFR 1502.16). These topics are addressed in this EIS, as necessary, as part of the discussion of environmental consequences for each component of the environment.

Assumptions

As in any analysis predicting the effects of management direction, judgements must be made about the logic that links objectives and direction with actions implemented, monitoring undertaken, and effects projected. The judgements are simpler in small analyses of single, specific projects; judgements grow more complicated when the analysis encompasses millions of diverse acres and when subsequent analyses and decisions will be made before projects are implemented and effects realized. Assumptions about implementation of direction contained in this Supplemental Draft EIS were developed to reflect consequences of subsequent decisions and effects. As in the analysis of the Draft EIS alternatives, assumptions constitute a given and important facet of the environmental analysis of effects.

The projection of effects by the Science Advisory Group (SAG) was based, in part, on a variety of assumptions about future management conditions that were developed jointly with the EIS Team. This subset of assumptions is included in Appendix 16.

In addition, the SAG made assumptions regarding relationships among ecosystem components where definitive empirical studies do not exist, and concerning probable outcomes from implementing management activities or from succession / disturbance processes. The models that were used by SAG have additional inherent assumptions. Some of those assumptions are included in Appendix 16, and the rest are documented in the *Science Advisory Group Effects Analysis for the SDEIS ALternatives* (Quigley 1999).

Included in Appendix 16 are those assumptions that clarified interpretation of direction, intent, and / or rationale; provided enough detail to derive outcomes for viability determinations for species of broad-scale concern; and described reasonable implementation for elements not fully described in the supplemental Draft EIS, such as implementation strategy, step-down processes, monitoring strategy, data management, and technology transfer.
The EIS Team provided storylines, budget estimates, and allocation priorities that were not part of the Supplemental Draft EIS direction but were key to the modeling exercise. The assumptions draw directly from the intent; process descriptions; specific standards, objectives, goals, guidelines; and storylines associated with each Supplemental Draft EIS alternative. The intent of assumptions is not to artificially restrict management to achieve the most favorable of outcomes; rather, the intent is to establish the clarity necessary for analysis purposes in the evaluation of the alternatives.

Because of the full suite of assumptions necessary to project effects (including those presented in Appendix 16 and those documented in the *SAG Effects Analysis*), a level of uncertainty is associated with the projected effects. As in any analysis, there is risk associated with the projections of effects if the assumptions are in error and / or if the assumptions do not hold into implementation. Adaptive management and monitoring (particularly validation and effectiveness monitoring) are designed to ensure that managers are able to adjust if effects were not accurately portrayed for a variety of reasons, including errors in assumptions.

Key general assumptions included the following:

- Regulatory agencies will be staffed with adequate expertise and resources to participate in a timely and effective manner as interagency partners in implementation and monitoring.
- The manner in which available funds are allocated across the project area and among possible treatments affects the degree to which the achieved outcomes reflect the outcomes projected in this chapter. Implementation of the action alternatives presumes funds are focused on the restoration work identified as priority, through management direction (such as specific objectives) or designation (such as in an A2 subwatershed). It is assumed that changes from current practices for handling funding allocations will occur, with priorities for funding requests and allocations collaboratively set at the regional and subregional scales. Any projected improvements in ecological conditions in this chapter associated with Alternatives S2 and S3 presume a change to a more broad-scale approach that considers priorities among and between administrative units.
- BLM and Forest Service administrative units will have appropriate expertise and experience in-house (through service centers) or through contracting available to them to effectively implement and monitor the EIS direction. Line officers will ensure necessary training, including technology transfer, is provided in a timely manner and as needed, through mechanisms such as those already in place (for example, certification programs, RIS teams) or through new mechanisms designed to fill training gaps.
- Practices used to implement Alternatives S2 and S3 of the Supplemental Draft EIS are based on ecological goals and objectives. Current practices (Alternative S1) have moved toward more ecological practices but still are more focused on traditional practices.
- Subbasin review / analysis and / or ecosystem analysis will be the primary vehicle(s) for setting landscape / project goals and objectives for Alternatives S2 and S3, although in some cases similar results can be achieved through programmatic processes such as range allotment planning or large-scale prescribed fire planning. Subbasin review / analysis and / or ecosystem analysis combined with NEPA analyses will be used to determine acceptable practices to achieve the objectives.

- An implementation strategy will provide more definitive guidance to the field regarding how to implement the selected alternative.
- A monitoring strategy will be developed to accompany the implementation strategy. It will include a hierarchical approach.
- The prescription emphasis as brought forward in the Landscape Ecology modeling for the alternatives represents a reasonable simulation of the alternatives. This modeling was based on the Chapter 3 direction package and the EIS Team storylines.
- Several assumptions regarding road management and road density changes were necessary to predict effects. It was assumed that the current national process for road policy being conducted by the Forest Service will be brought to a conclusion in the next several years. The outcome will be analysis requirements and the need for additional justification for constructing new roads. The SAG assumed that it will slow the rate of growth of new roads on Forest Service-administered lands in both the short and long terms. The SAG assumed that the existing minimal level of road construction on BLM-administered lands will continue.
- It is estimated that very little change in road density classes will result for any of the alternatives for the first decade (because of the large number of road closures or new roads it would take to move a road density class from its current class).
- The project has compiled activity level data (prescribed fire, wildfire, timber harvest, timber volume, and authorized AUMs) for each administrative unit in the project area for 1988 through 1997. These data are used to assign a base landscape modeling prescription that is calibrated to the current level of activity by administrative unit. These data are assumed to reflect current management levels and are based on individual land use plans, recovery plans, and eastside screens.
- It is assumed that there will be an organizational structure in place for implementation of the Record of Decision (ROD). The actual structure is yet to be defined, but will be based on the preliminary decisions of the ESC. It is expected to include structures appropriate to address basin oversight, monitoring, data management, subregional analysis, coordination, dispute resolution, science advice, and technology transfer. Details on location, membership, and duties of implementation teams are assumed to be developed prior to beginning actual implementation. The subregional organization is expected to align with modified RAC/PAC areas.

Budget Assumptions

Modeling the effects of the management direction of Chapter 3 required an assumption of certain amounts of restoration activities. Accomplishment of restoration actions (such as precommercial thinning or prescribed burning) requires funding. The total funding available for the land management agencies within the project area is estimated to be $540 million for both BLM ($70 million) and the Forest Service ($470 million). While the total funding available to BLM and Forest Service managers in the project area is subject to the influence of EIS direction, some of that funding is directly expended on restoration activities to move existing resource conditions toward a more desirable condition. This is the amount of funding used in the models to project outputs (such as board feet) and outcomes (such as ecosystem condition) for the effects section of this EIS. Alternative S1, the no-action alternative, assumes the availability of current funding for on-the-ground restoration actions ($135 million per year). Alternative S2 assumes approximately $202 million in funds expended on restoration actions each year. Alternative S3 assumes $182 million in funds expended on restoration actions each year.

Each alternative also estimates the cost of newly required step-down analyses (in addition to those already accomplished through programmatic planning processes and/or through compliance with NEPA and project consultation under Section 7 of the Endangered Species Act). These adjustments would reduce the annual funding to support restoration actions by $18 million for Alternative S1, by $13 million for Alternative S2, and by $9.5 million for Alternative S3.

The allocation of funding among management actions and among administrative areas is responsive to the integrated broad-scale management direction for each alternative at any funding level. The funding allocation varies with the management strategies within each alternative and is particularly affected by the differential management priorities within each alternative. The intent of the budget allocations within Alternatives S2 and S3 differs from that of Alternative S1. In particular, the funding allocation in Alternatives S2 and S3 is focused by the management priorities expressed in the terrestrial T watersheds, the aquatic A1/A2 subwatersheds, and high restoration priority subbasins and other priority designations. As noted in the previous assumptions section, the projected improvements in ecological conditions presume an ability to focus funding to priority areas.

Management Strategies and Budget Sensitivities

To facilitate selection of a preferred alternative for the Supplemental Draft EIS, the EIS Team and SAG analyzed the sensitivity of the three alternatives to varying levels of funding for restoration activities. The alternatives are compared at two funding levels: "current" and "increased." *Current* funding is approximately what the land management agencies have been spending for on-the-ground restoration activities in recent years (Alternative S1). This is a subset of the total budget for Forest Service and Bureau of Land Management administrative units in the project area as discussed in the previous section. *Increased* funding is a $67 million (Alternative S2) and $47 million (Alternative S3) increase over the total funding for these land management agencies in the basin.

For each of the three alternatives, sensitivity to funding was evaluated for strategies that address: landscape health, wildfire, old forest protection and restoration, livestock grazing, terrestrial species habitat protection and restoration, aquatic and riparian habitat protection and restoration, county and community socio-economic outcomes, tribal treaty and trust responsibilities, road management, and noxious weeds management. These management strategies were analyzed at current and increased funding levels.

The analysis of the sensitivity of management strategies came to the following general conclusions:

- All outcomes are significantly affected by the differences in the design of the management strategies for each alternative. This is not an unexpected conclusion. Each alternative is designed to address the critical and compelling basin-wide issues in a different way. This becomes most clear when alternatives are compared at the same funding level. Projected outcomes also vary by budget level. The strategies used in each alternative to address various issues are not uniformly sensitive to budget levels.
- There are two situations wherein outcomes generally *are not* affected by funding:

  First, outcomes are *least responsive* to shifts in budget levels where management direction restricts human actions. This holds when the existing condition can be maintained and / or the desired future condition achieved through restrictions rather than management analysis or activities to achieve desired outcomes.

  Second, outcomes for some management strategy components are not sensitive to budget levels if effective treatments are not available to reverse trends at the landscape level or if interactions among other management strategy components keep the overall outcome from changing significantly. In other words, outcomes are not sensitive to budget where no reasonable investment could change trends or current status. Alternatives S2 and S3 strive to avoid this situation by prioritizing restoration activities intended to reverse trends in places where there is the opportunity to "make a difference." Alternative S1 does not have that prioritization strategy at the basin scale.
- Considering critical and compelling issues within the basin, investments in on-the-ground management activities change outcomes but rarely shift the ranking of outcomes across the alternatives. If a strategy is ranked "better" or "more effective" at current funding for an alternative, it is also ranked "better" or "more effective" with increased funding. In some cases, expending more funds to accomplish "xx" activity may result in more of "yy" outcome. Such outcomes *are* considered sensitive to budget levels. However, even when this is the case, the ranking of alternatives for any given outcome or issue does not change.
- Increased budget levels result in substantially improved conditions for those issues that benefit from active restoration. The level of benefit achieved is strongly related to the strategy underlying each issue within an alternative. Thus, from an ecological perspective, the underlying strategies for the various issues are a stronger determinant of ranking among the alternatives than is budget level.
- The underlying socio-economic strategies and outcomes of the alternatives are also a stronger determinant of ranking among the alternatives than is budget level.
- Generally, passive approaches to restoration do not lead to the highest degree of attainment of most Supplemental Draft EIS objectives in the short or long term. Because of current conditions and the dynamic nature of the ecosystems and their inherent disturbances, ecological restoration objectives depend on investments in management actions aimed at achieving desired outcomes that are not likely to occur through natural processes (for example, wildfires may reset vegetation densities but in ways that adversely affect forest productivity, sediment, and species habitats).

Landscape Dynamics Component: Physical Setting

This section presents the effects of alternatives on soils, hydrology and watershed processes, and air quality. A summary of key effects for all sections is presented first. Each subject area then presents methods for determining effects, and effects of the alternatives.

Summary of Key Effects and Conclusions

Over the long term, Alternative S2 would better maintain and restore soil productivity, hydrologic functions, and watershed processes than Alternative S3, followed by Alternative S1. Alternative S2 would also maintain riparian ecological functions better than Alternatives S3 and S1. Alternative S1 would have greater total impact on air quality because of smoke from large wildfires; prescribed fire activity under Alternatives S2 and S3 would generate more frequent but lesser amounts of smoke in the short term and would have lower total air quality impact in both the long and the short term than Alternative S1.

Soil Functions and Processes, including Soil Productivity

- The majority of Forest Service- and BLM-administered lands would be in the low and very low soil disturbance category for all alternatives over the next 100 years. No decreases in long-term soil productivity would result from implementing any of the alternatives.
- Activities in the high restoration priority subbasins for Alternatives S2 and S3 are predicted to cause a slight change of land from none, very low, or low soil disturbance to moderate levels. These increases would not result in decreases to long-term soil productivity because restoration activities are designed to resemble soil disturbance effects that would be expected under natural disturbance processes.
- In the high restoration priority subbasins, reductions in negative effects from uncharacteristic wildfire and livestock grazing would provide benefits to soil productivity over the next 100 years.
- Snags and large downed wood are key components in maintaining and restoring soil functions and providing for soil productivity over the long term. Alternative S2 places the most emphasis on increasing snag numbers for the long term. Large downed wood is currently above historical levels on most forested lands and would increase under all alternatives. Alternative S2 is predicted to be slighly more effective than Alternatives S3 and S1 in using prescribed fire to manage for desirable concentrations of large downed wood.
- Over the next 100 years Alternative S2 would provide more maintenance and restoration of soil productivity than either Alternative S3 or Alternative S1 because of its decreased rate of departure from historical range of variability (HRV).
- Predicted decreases in road-related adverse effects would be beneficial for the long-term recovery of soil productivity by re-establishing soil functions and processes. Benefits to soil productivity would be highest under the intensive restoration emphasis of Alternative S2, followed by Alternative S3 then Alternative S1.

Hydrology and Watershed Processes

- Alternative S2 would maintain or slightly restore hydrologic functions and watershed processes better than Alternative S3 as a result of activities implemented to decrease the rate of HRV departure. Alternative S1 is not expected to decrease the rate of HRV departure; therefore, trends for hydrologic function and watershed processes are predicted to gradually worsen over the long term.
- Alternative S2 would reduce adverse effects from uncharacteristic wildfire, slightly better than Alternative S3, and would provide higher protection and maintenance of hydrologic function and watershed processes. The management approach to wildfire in Alternative S1 would do little to protect and maintain hydrologic function and watershed processes.
- Livestock grazing effects would trend toward historical, the strongest in Alternative S2 and slightly less so in Alternative S3; this would lead to increased maintenance and restoration of hydrologic function and watershed processes. With regard to effects from livestock grazing, Alternative S1 would not provide the same level of improvements to hydrologic function and watershed processes compared to Alternatives S2 and S3.

- The predicted trends in soil disturbance indicate that current levels and conditions for hydrologic function and watershed processes would be maintained for all alternatives over the next 100 years.
- Road density trends for Alternative S1 are estimated to remain static in the long term. The restoration emphasis of Alternatives S2 and S3 would result in higher decreases in road densities than Alternative S1. Decreases in adverse road effects with short- and long-term benefits to hydrologic function and watershed processes would be highest for Alternative S2, then Alternative S3 and Alternative S1, respectively.
- Higher levels of landscape restoration would occur in the high restoration priority subbasins in Alternatives S2 and S3. Activities would contribute to the restoration of integrated ecological processes. Activities such as those planned under the high restoration strategy are more likely to be successful in protection, maintenance, and restoration of watershed processes at the broad scale compared to Alternative S1.
- Alternative S2 would maintain riparian ecological processes through time and would contribute most to protecting, maintaining, or restoring watershed processes and hydrologic function, more so than Alternatives S3 and S1.
- The higher rate and frequency of hierarchical step-down analysis under Alternatives S2 would be more likely than Alternatives S3 and S1 to protect and restore hydrologic function and watershed processes, using an integrated landscape approach.

Air Quality

- The dispersion modeling assessment indicates that there may be significantly greater impacts on the National Ambient Air Quality Standards (NAAQS) from wildfires than from prescribed burning.
- Modeling of emissions from prescribed burning suggests that at a coarse scale (20 km and 4 km grids) NAAQS would not be violated (averaged across the 20 km grid). However, compliance with the NAAQS at a local level must be evaluated at subsequent planning levels to assure they are not violated.
- Increased short-term haziness (a reduction in viewing distance and ability to detect finer features on the landscape) would likely result from the increased use of prescribed burning in Alternatives S2 and S3. It can be inferred that because of higher concentrations of emissions associated with wildfires, the magnitude of visibility impairment from wildfires would be greater than the highest levels of prescribed fire used in Alternatives S2 and S3. However, a higher frequency of lower visibility impacts can be expected from prescribed fire than wildfire.
- Other criteria pollutants produced from prescribed fire are not likely to have an impact on public health because of the small levels produced, distances to populated areas, and the rapid dilution or modification of these substances within relatively short time frames.
- The dispersion modeling suggests that, in a relative sense, the magnitude of the short-term impacts from wildfire emissions will likely be greater than impacts from prescribed burning emissions, although the frequency of prescribed burning impacts may be greater than the frequency of wildfire impacts.
- Alternatives S2 and S3 would allow an opportunity to reduce fuel accumulations across the landscape and lessen the impacts from wildfire. An analogy would be that prescribed fire acts as a "pressure relief valve" for wildfire.

Soil Functions and Processes, Including Soil Productivity

Methodology: How Effects on Soils and Soil Productivity were Estimated

The Science Advisory Group (SAG) modeled the effects of the alternatives by developing management prescription scenarios. The EIS Team evaluated modeled outputs for certain landscape variables to provide both quantitative outcomes and qualitative interpretations for effects on soils and soil productivity. Quantitative outcomes were derived from modeled variables that are directly related to soil productivity. Qualitative interpretations were made for variables that were not directly modeled for effects on soils. The qualitative interpretations provide an estimate of the effects on soil productivity based on the trends of the variable. Effects for each alternative are described by comparing the relative changes expected from either of the action alternatives (S2 and S3) to the no-action alternative (S1).

Landscape variables as indicators of soil productivity are not reported at levels below the subbasin scale. Application of the interpretations and findings below the subbasin scale are not appropriate in determining effects of the broad-scale management direction. For further information on disturbances, assumptions, and methodology, refer to the *Landscape Effects Analysis of the SDEIS Alternatives* (Hemstrom et al. 1999). Additional information and assistance in interpretation of the *SAG Effects Analysis* was acquired through discussions with Forest Service research scientists (personal communications, J. Clayton, Soil Scientist, Intermountain Research Station; and A. Barta, Geomorphologist, Intermountain Research Station).

The following variables were selected to describe the potential effects of the alternatives on soil functions and processes, including soil productivity.

Quantitative Outcomes

Soil Disturbance

The term ‘soil disturbance’ will be used to describe the effects of the alternatives on soil productivity. The quantitative data used to characterize soil disturbance effects are derived from the uncharacteristic soil disturbance variable developed by the SAG.

In the *SAG Effects Analysis,* uncharacteristic soil disturbance is defined as an effect caused by reduced vegetation / litter cover, loss of root binding capability, and increased erosion, compaction, and stream bank failure. Disturbances that create these effects can result in loss of upland and riparian soil productivity and accelerated sediment delivery to aquatic systems. The occurrence of actual surface soil disturbance and erosion depends on the combination of the type of soil disturbance with sensitive soil and watershed conditions, and the associated cumulative effects over time. Modeled outcomes for the uncharacteristic soil disturbance variable are based on the likelihood of prescribed activities (timber harvest, thinning, prescribed natural fire, and prescribed fire) to cause uncharacteristic, detrimental effects that can lead to loss of soil function and soil productivity. Soil disturbance effects caused by livestock grazing, roads, and wildfire are purposely excluded from uncharacteristic soil disturbance because those effects are predicted in those respective variables.

The model puts Forest Service- and BLM-administered lands into one of six classes describing different levels of uncharacteristic soil disturbance (none, very low, low, moderate, high, or very high).

According to the definitions for the uncharacteristic soil disturbance categories, the none, very low, and low classes result from infrequent to frequent, low impact disturbances and soils recover to normal conditions in a relatively short time. It is unlikely that extensive cumulative effects would ensue; therefore, these soil disturbance effects generally would not negatively affect soil productivity. Soil disturbance effects in the none, very low, and low classes equate to effects that would be expected under natural disturbance regimes and events for most landscapes in the project area. Conversely, uncharacteristic soil disturbance in the moderate or higher classes is associated with frequent, high impacts which are likely to cause cumulative effects. These soil disturbance effects would be detrimental to the physical and biological soil properties and functions that can lead to the loss of soil productivity. Complete definitions of uncharacteristic soil disturbance classes can be found in Hemstrom et al. (1999).

Because of potential for confusion or inconsistencies in the presentation of the outcomes for uncharacteristic soil disturbance, the term soil disturbance will be used in the remainder of this environmental consequences section to describe the effects of the alternatives on soil productivity, hydrology and watershed process, and water quality.

Rationale for Qualitative Interpretations of Modeling of Management Alternatives

Livestock Grazing and Uncharacteristic Wildfire

Effects from these variables are likely to occur across large areas and could result in loss of vegetation, litter cover, and root binding capability, increased soil erosion and streambank failures that lead to reductions in riparian and aquatic habitat conditions. Trends for these management-related variables were interpreted to qualitatively estimate potential or expected effects on soil functions and processes, and long-term changes in soil productivity.

Large Snags and Large Downed Wood

Standing snags and downed woody material are necessary components of ecosystem function and sustainability. Activities that remove organic matter, large snags, and large downed wood below levels under which soils evolved on that site can cause declines in soil productivity. For soils to be productive at a particular site, downed woody material and organic matter must be maintained, and where necessary restored, to levels under which those soils evolved.

This variable was not modeled to directly determine effects on soils; however, snags and large downed wood play a key role in maintaining and restoring soil productivity on forested lands. Modeled outcomes that predict changes in trends for the large snag and large downed wood variable were qualitatively evaluated for each alternative to estimate long-term effects on soil productivity.

Historical Range of Variability (HRV) Departure

This variable integrates the collective departure (or change) of vegetation pattern, composition, and structure, and disturbance regimes from historical ranges, providing outcomes for both forest and rangelands. Long-term changes in vegetation pattern, composition, and structure, and disturbance regimes have modified the ecological function and natural properties of upland and riparian soils. Activities designed to decrease the rate of change from HRV would provide benefits to upland and riparian soil resources.

Landscape conditions representative of those under which soils evolved determine the likelihood for soil nutrients to be available and sustainable through time. Landscape patterns and conditions that are within or trending toward the historical range of variability are more likely to have intact soil functions and processes that provide for long-term sustainable soil and site productivity. The modeled outcomes describing the trends in HRV departure from historical conditions were qualitatively evaluated for each alternative and used to describe long-term trends for soil productivity.

Predicted Road Density Classes and Trends

Past and current road construction and maintenance activities (or their lack) have increased surface erosion and contributed to persistent declines in long-term soil productivity. Road closure and removal and similar restoration activities can reduce erosion from existing roads and provide a healthy medium for plant growth. Modeled changes in road density trends resulting from implementing ICBEMP road management direction are predicted to aid in the restoration and protection of soil functions and processes and result in the long-term restoration and maintenance of soil productivity. Qualitative interpretation of these trends was used to estimate the restoration and maintenance of soil functions and processes and long-term trends for soil productivity.

Effects of the Alternatives on Soil Functions, Processes, and Productivity

Effects of the alternatives on soil functions and process, including soil productivity, are most directly related to the uncharacteristic soil disturbance variable; therefore, a quantitative evaluation for those outcomes is presented first. Following that are qualitative interpretations for effects on soil productivity based on predicted trends for uncharacteristic wildfire and livestock grazing effects; large snags and large downed wood; departure from historical range of variability; and trends in road densities.

Soil Disturbance

The relative changes in soil disturbance classes comparing each alternative to current conditions are displayed graphically in Figure 4-1. Long-term estimates for acres in each soil disturbance class are listed in Table 4-1. The acre values are presented graphically as a percent of the total Forest Service- and BLM-administered land in Figure 4-2.

There is a significant decrease in the amount of land in the *none* class for all alternatives compared to current conditions. When compared to current conditions, the none class for Alternative S1 (-81 percent) would decrease approximately five percent more than Alternatives S2 and S3 (-76 percent). For Alternative S1 this decrease would be from the continuation of traditional management approaches that do not incorporate integrated restoration concepts. The decrease in the none class for Alternative S1 corresponds primarily to increases in the very low and low disturbance classes. For Alternatives S2 and S3 the decrease in the none class would be less than Alternative S1, likely the result of implementing intensive restoration activities. For Alternatives S2 and S3 the projected decrease in the none class corresponds to the increase in acres in the low disturbance class.

Alternative S1 is predicted to increase in the *very low* and *low* classes. Alternatives S2 and S3 are predicted to have decreases in the very low class and increases in the low class. According to SAG, changes of less than two percent are insignificant, which applies to outcomes for the moderate, high, and very high classes for all alternatives. Overall, these data indicate that Alternatives S2 and S3 would have similar trends in soil disturbance. Figure 4-3 illustrates soil disturbance in Alternatives S2 and S3 as percent change from Alternative S1.

Activities implemented in Alternatives S2 and S3 would be mitigated to not generate soil disturbance effects above the low class. Similarly, activities implemented under Alternative S1 would mostly result in low and very low soil disturbance effects. A key finding from the *SAG Effects Analysis* is that very low and low classes for soil disturbance are associated with infrequent, low-to-moderate-impact activities. The recovery time to return the soil surface to pre-activity conditions for these classes is relatively short, and disturbances are unlikely to cause extensive cumulative effects.

Table 4-1. Soil Disturbance Class, Acres,[1] and Percent Change from Alternative S1.

Soil Disturbance Class	Current Acres	Alternative S1 Acres	Projected Condition at 100 Years: Alternative S2 Acres	Alternative S2 % Change from S1	Alternative S3 Acres	Alternative S3 % Change from S1
None	1,520,000	248,000	314,000	27	314,000	27
Very Low	40,734,000	40,912,000	38,960,000	-5	39,060,000	-5
Low	16,439,000	17,495,000	19,368,000	11	19,268,000	10
Moderate	3,659,000	3,700,000	3,701,000	<1	3,707,000	<1
High	1,155,000	1,151,000	1,162,000	1	1,157,000	<1
Very High	59,000	60,000	60,000	no change	60,000	no change

[1] Forest Service- and BLM-administered lands in the project area, rounded to nearest 1,000.

Source: Hemstrom et al. 1999

High Restoration Priority Subbasins

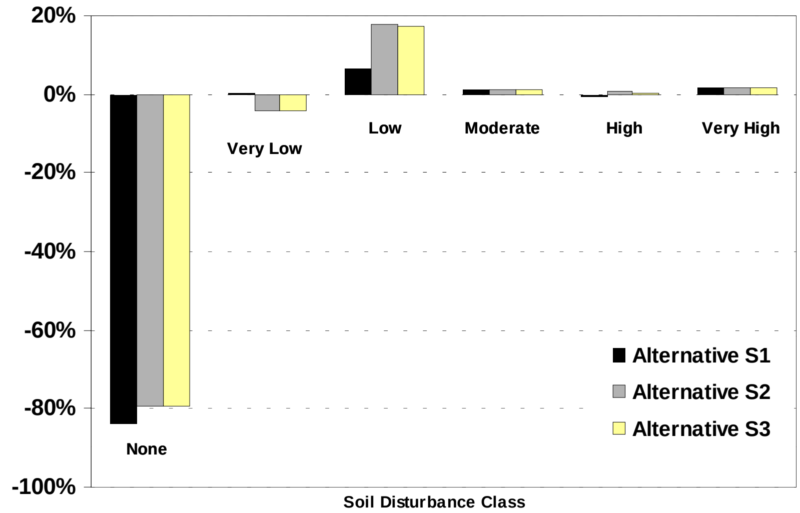


Figure 4-1. Soil Disturbance, Percent Change from Current at 100 Years.

For Alternatives S2 and S3, the planned amounts of harvest and restoration, thinning, and prescribed fire would increase by two- to ten-fold in the high restoration priority subbasins. This is logical considering the high restoration priority subbasins are not a component of Alternative S1. The level of disturbance in Alternative S2 is predicted to be higher than in Alternative S3. This may suggest a higher degree of impairment to soil functions and processes and soil productivity. However, the design and implementation of landscape level restoration treatments are assumed to achieve effects similar to those occurring under historical disturbance patterns. The disturbance effects resulting from priority restoration activities are predicted to have less impact and be less severe than fire effects and erosion caused by past fire exclusion and traditional management activities. Furthermore, monitoring and evaluation, integrated with an adaptive management approach, would result in adjustment of treatment design and imple-mentation to reduce soil disturbance to levels similar to historical conditions.

The restoration strategy identifies more area as priority for restoration in Alternative S3 than Alternative S2; however, fewer acres are actually treated in Alternative S3 than in Alternative S2. Integrated landscape restoration activities in both alternatives are predicted to cause a slight change of category from none, very low, or low soil disturbance to moderate levels. The total amount of Forest Service- and BLM-administered lands in these subbasins that experience an increase in soil disturbance would remain below one percent for Alternatives S2 and S3.

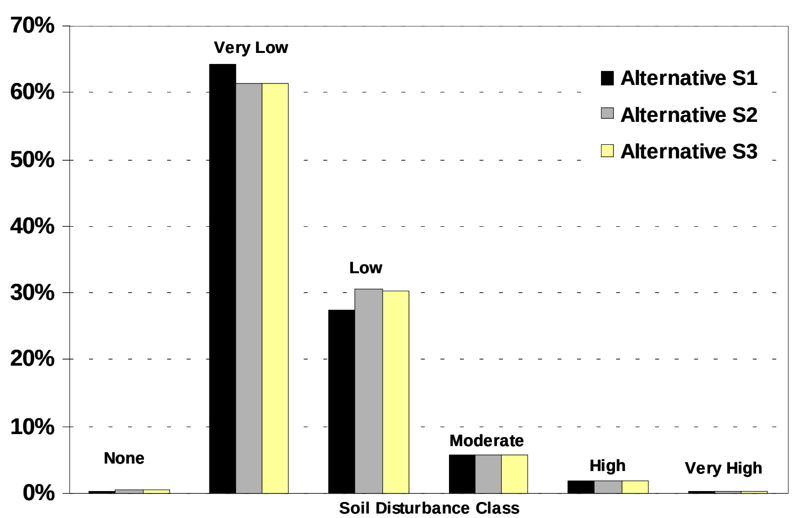


Figure 4-2. Soil Disturbance, Percent of Project Area at 100 Years.

In the long term the majority of Forest Service- and BLM-administered land would remain in the very low and low soil disturbance categories for all alternatives, and effects from prescribed activities would remain relatively constant over the next 100 years (Figure 4-2). Using the quantitative outcomes for soil disturbance, it can be concluded that effects on soil functions and processes would be very similar, almost non-detectable at the broad scale, for all alternatives. No adverse effects on soil processes are predicted and no decreases in long-term soil productivity would result from implementing any of the alternatives.

Uncharacteristic Wildfire and Livestock Grazing Effects

Not all disturbances that have potential to negatively affect soil productivity are evaluated in the preceding analysis, and not all disturbances have the same effect on soil properties. Effects from uncharacteristic wildfire and livestock grazing can result in varying amounts and distributions of soil disturbance that can affect soil productivity.

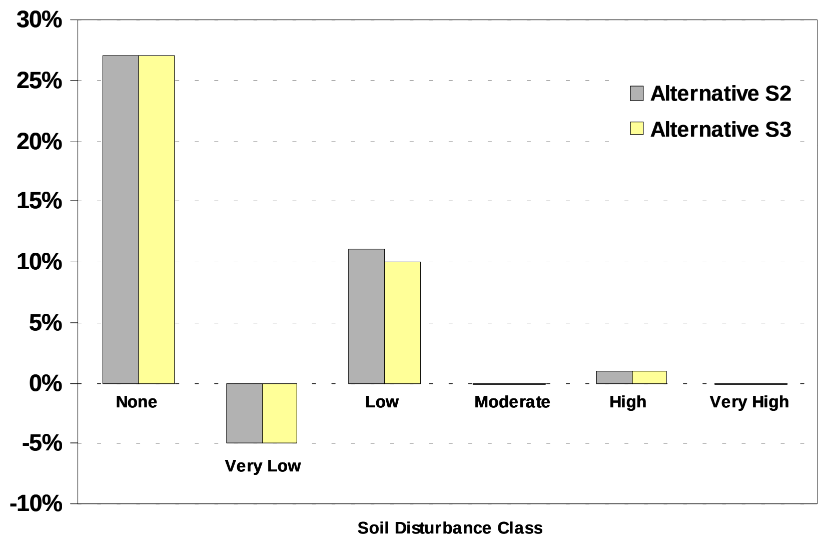


Figure 4-3. Soil Disturbance, Percent Change from Alternative S1.

Uncharacteristic Wildfire

Wildfire can profoundly reduce soil productivity when burned areas have a high percentage of water-repellent soil conditions, and high rates of increased soil erosion will ultimately occur if intense rainstorms follow. Forest and rangeland fuels reduction activities are predicted to have similar effects for all alternatives in reducing the percentage of uncharacteristic wildfire on Forest Service- and BLM-administered lands from very high and high to a low probability.

When comparing the alternatives relative to the high restoration priority subbasins, Alternatives S2 and S3 should reduce the area of Forest Service- and BLM-administered lands that experience uncharacteristic wildfire over 100 years by 57 percent and 40 percent respectively. Because Alternative S1 does not have an integrated restoration strategy, this alternative would do little to alter the pattern and amount of uncharacteristic wildfire. Effects on soil functions and processes as a result of wildfire, including increased levels of soil erosion, are estimated to return to near historical ranges in the high restoration priority subbasins under Alternatives S2 and S3.

Livestock Grazing Effects

Soil disturbance from livestock grazing effects (see definitions in livestock grazing section) was qualitatively assessed by looking at reductions in native species habitat quality, vegetation and litter cover, root binding capacity, and riparian conditions.

Loss of soil productivity as a result of livestock grazing effects can be caused by:

- Compaction of soils in areas of high use or on water-saturated soils;
- Removal of vegetation and litter and the spread of exotic plant species, which can increase susceptibility of soil loss from wind and water erosion; and
- Increased fire frequency on rangelands dominated by the exotic annual grasses, cheatgrass, and medusahead; this increases the frequency with which soil is unprotected and susceptible to erosive events.

Livestock grazing effects that trend toward historical on Forest Service- and BLM-administered lands through implementation of Healthy Rangeland strategies and integrated restoration priorities suggest protection and improvements to soil productivity. Livestock grazing effects that trend toward historical the strongest, in Alternative S2, would provide higher benefits to soils than Alternative S3, followed by Alternative S1.

Over the next 100 years, livestock grazing effects that trend toward historical in the high restoration priority subbasins would occur primarily because of improvements in livestock management combined with forest and rangeland restoration activities. These changes would be more aggressively implemented in Alternative S2; therefore, the trend in livestock grazing effects toward historical would be slightly stronger for Alternative S2 than for Alternative S3. Although these trends in livstock grazing effects were not directly modeled for changes in soil functions and processes, these trends do correlate to long-term improvements in soil productivity.

Large Snags and Large Downed Wood

Large snags and large downed wood are used in this analysis to qualitatively evaluate the effects of the alternatives in providing long-term soil productivity. For soil productivity, large downed wood is defined as any woody residue larger than three inches in diameter. Excessive amounts of large downed wood can result in undesirable effects when consumed by wildfire. Unnaturally high concentrations of large downed wood can increase the burning duration and can result in severe adverse effects on soil properties. Desired volumes of coarse woody debris to maintain or restore preferred levels of organic matter for soil productivity vary and are based on research conducted on selected forest types within the Rocky Mountains (Graham et al. 1994). Management of snags and downed wood, both in the amount and size distribution that would be expected under historical conditions, can protect and restore soil productivity.

Large Snags

All alternatives would increase the amount of large snags above current levels on BLM- and Forest Service-administered lands. In the long term, Alternative S1 would nearly reach historical levels, while Alternatives S2 and S3 would result in slightly higher than historical amounts. The predicted increases in snags are likely the effects of protection for and restoration of late seral forests and snag requirements for management activities on Forest Service- and BLM-administered lands. All alternatives would result in projected snag densities that would provide favorable conditions for future recruitment of large downed wood, with a high likelihood of restoring and maintaining organic matter levels necessary for soil productivity and function.

Large Downed Wood

Overall, levels of large downed wood remain above historical amounts at 100 years for all alternatives. Amounts of large downed wood on Forest Service- and BLM-administered lands would decrease after 100 years for Alternatives S2 and S3 because of the increased use of prescribed fire. Amounts of large downed wood would continue to increase in Alternative S1.

For the riparian woodland vegetation group, all alternatives would increase the amount of large woody material, but only Alternatives S2 and S3 would return to historical levels. Alternative S2, better than Alternatives S3 and S1, would more likely contribute to long-term soil productivity by providing for recruitment of future large downed wood, while addressing the short-term concern by treating high fuel concentrations with prescribed fire.

Historical Range of Variability (HRV) Departure

Findings and comparisons of studies in forested and rangeland environments by Munn et al. (1978), Cannon and Nielsen (1984), and Hole and Nielsen (1970), conclude that forest and range landscapes that resemble conditions within historical ranges of variability (that is, they contain native plant communities in natural mosaic patterns and have relatively uninterrupted disturbance regimes) provide favorable conditions for soil functions and processes that contribute to long-term sustainability of soil productivity.

In addition, reduction in the spread of exotic vegetation (as defined in the *Landscape Dynamics* [Hann, Jones, Karl, et al. 1997] chapter of the *Assessment of Ecosystem Components* [Quigley and Arbelbide 1997]) is also expected to improve soil productivity and function. Observations from these studies further indicate that forests and rangelands with conditions outside the historical range of variability are most vulnerable to accelerated nutrient loss from management activities or wildfire.

Substantial changes in disturbance regimes—especially changes resulting from fire suppression, timber management practices, and livestock grazing over the past 100 years—have resulted in moderate to high departure of vegetation composition and structure and landscape mosaic patterns from historical ranges. Restoration activities that move forests and rangelands toward historical ranges of variability would provide favorable conditions for soil functions and processes that contribute to long-term soil productivity levels at the broad scale.

All alternatives would have a relatively small effect on slowing the movement toward moderate and high HRV departure on Forest Service- and BLM-administered lands over the next 100 years. In high restoration priority subbasins, localized effects of Alternatives S2 and S3 would tend to have lower overall increases in HRV departure for the long term when compared to Alternative S1. Alternative S2 would provide more protection and maintenance in soil productivity than either Alternative S3 or Alternative S1, because of the slight decrease in the rate of HRV departure.

Decreases in adverse road-related effects on soil productivity were qualitatively estimated based on the modeled outputs for road density trends.

Predicted Road Density Classes and Trends

Roading activities remove land from productivity and decrease soil functions that, depending on sensitive soil and watershed types, can result in long-lasting direct and indirect adverse effects in significant percentages of some watersheds. Adverse effects of roads were not directly assessed for effects on soil productivity. Decreases in adverse road-related effects were qualitatively estimated based on the modeled outputs for road density trends. Decreases in road density can correlate to reductions in surface erosion and mass wasting, which provide for the protection and restoration of long-term soil productivity. For all alternatives, analysis requirements are expected to decrease the amount of disturbance resulting from roads in the short- and long-term on Forest Service-administered lands. The rate of new construction would be slowed on Forest Service lands; the current, minimal amount of construction on BLM lands would likely be maintained.

Long-term reductions in road density are predicted to occur under all alternatives. For Alternative S1, road densities within the priority watersheds for bulltrout, steelhead trout, and chinook salmon are estimated to remain static or slightly decrease in the long term. The intensive restoration emphasis of Alternatives S2 and S3 would likely result in higher decreases in road densities than Alternative S1. The largest reductions in adverse road effects are mostly due to improved road maintenance and road closure and removal within the aquatic A2 network in the high restoration priority subbasins for Alternative S2. The downward trends in road densities and decreases in road-related disturbances would contribute to reductions in surface erosion and mass wasting, channel elongation, and gully development. As a result, decreases in adverse road effects with short- and long-term benefits to soil productivity are predicted to be highest for Alternative S2, followed by Alternative S3, then Alternative S1.

Conclusions

The quantitative evaluation that uses soil disturbance to describe effects on soil productivity indicates there would be no fundamental differences in effects among the alternatives. While the effects of the alternatives on soil productivity using a quantitative approach are inconclusive, long-term trends for soil productivity are more discernible using qualitative interpretations of outcomes for landscape variables that influence soil functions and processes.

When integrating the outcomes of the landscape variables, Alternative S2 would have the highest likelihood of improving landscape conditions for soil functions and processes that would sustain soil productivity for the long term. In the long term, Alternative S2 would provide: higher levels of fuels treatment to reduce uncharacteristic wildfire effects; stronger trends in livestock grazing effects toward historical, which connote improvements in rangeland conditions; higher emphasis on large snags for long-term recruitment and management of large downed wood; landscape restoration activities intended to slow the rate of HRV departure; and more emphasis on reducing road-related adverse effects.

Alternative S3 would be comparable to Alternative S2 for maintaining soil productivity levels, but lower levels of restoration activities combined with lower rates of hierarchical analysis preceding restoration activities decreases the likelihood for success. Alternative S1 primarily features continuation of traditional management approaches without an intensive restoration emphasis. Alternative S1 contains the least amount of direction among the three alternatives for providing landscape conditions that would maintain current levels of soil productivity over the long term.

Hydrology and Watershed Processes

Methodology: How Effects on Hydrology and Watershed Processes were Estimated

Detailed descriptions of the landscape and aquatic habitat variables are in Hemstrom et al. (1999) and Rieman et al. (1999), in the *Science Advisory Group Effects Analysis for the SDEIS Alternatives* (Quigley 1999).

The Science Advisory Group (SAG) did not directly model the effects on stream channel processes and water quantity, because quantitative predictions of outcomes for delivery and routing of water, sediment, and woody debris and their effects on streams and river systems are not possible at the broad scale. Use of finer scale outcomes that are not consistent with the landscape context of this Supplemental Draft EIS is not appropriate. Therefore, broad-scale outcomes were qualitatively estimated for effects on hydrologic function and watershed processes for BLM- and Forest Service-administered lands in the project area.

Rationale for Qualitative Interpretations of Modeling of Management Alternatives

Qualitative estimates of effects are inferred from predicted outcomes for certain landscape and aquatic variables that evaluated vegetation, disturbances, and varying activity levels with considerations to specific land allocations and analysis requirements. The rationale for using these outcomes is that they are key processes or activities that influence hydrologic systems and contribute to the protection and maintenance of ecological functions required for healthy watersheds.

The effects on hydrologic function and watershed processes are qualitatively described as they are influenced by:

- Trends for historical range of variability (HRV) departure, uncharacteristic wildfire events, livestock grazing effects, uncharacteristic soil disturbance, predicted road densities;
- The high restoration priority subbasin strategy;
- Protection of riparian areas and aquatic habitats through designation of riparian conservation areas (RCAs); and
- Requirements for and application of finer-scale analysis processes.

Effects of the Alternatives on Hydrology and Watershed Processes

Restoration activities that move forests and rangelands toward historical ranges of variability (HRV) will provide favorable conditions for hydrologic functions and watershed processes.

Historical Range of Variability (HRV) Departure

A key principle of the HRV concept is that restoration activities that move forests and rangelands toward historical ranges of variability (that is, they contain native plant communities in natural mosaic patterns and have relatively uninterrupted disturbance regimes) will provide favorable conditions for hydrologic functions and watershed processes.

All alternatives would have a relatively small effect on slowing the movement toward moderate and high HRV departure on Forest Service- and BLM-administered lands over the next 100 years. Within the high restoration priority subbasins, Alternatives S2 and S3 would tend to have lower overall increases in HRV departure for the long term when compared to Alternative S1. Based on these trends, the restoration emphasis in Alternative S2 combined with hierarchical analysis requirements would provide higher benefits to hydrologic functions and watershed processes than Alternative S3. It is likely that Alternative S1 would not decrease the rate of HRV departure; therefore, trends in hydrologic function and watershed processes are predicted to gradually worsen over the long term under that alternative.

Uncharacteristic Wildfire Events

Uncharacteristic effects from wildfire across large areas have long-lasting impacts on hydrologic functions and watershed processes. Increasing levels of severity and intensity that remove excessive amounts of plant and litter cover increase the potential for surface soil erosion and mass failures, with short-term increases in stream flows (Debano et al. 1996). The trends for uncharacteristic wildfire effects for the Supplemental Draft EIS alternatives were used to qualitatively estimate effects on hydrologic function and watershed processes.

Forest and rangeland fuels reduction activities are predicted to have similar effects for all alternatives in reducing the percentage of uncharacteristic wildfire. On Forest Service- and BLM-administered lands, uncharacteristic wildfire effects trend from very high and high to a low probability, with a general reduction of 16 percent.

However, within the high restoration priority subbasins in Alternatives S2 and S3, uncharacteristic wildfire effects would be reduced by 57 percent and 40 percent, respectively, over the long term. No similar pattern is observed with Alternative S1. With respect to effects from uncharacteristic wildfire, Alternative S2 would be slightly better than Alternative S3 in protecting and maintaining hydrologic function and watershed processes. The management direction for addressing uncharacteristic wildfire in Alternative S1 would do little to protect and maintain hydrologic function and watershed processes.

Livestock Grazing Effects

Livestock grazing effects (see definition in livestock grazing section) across large areas would result in loss of vegetation, litter cover, and root binding capability, and increased soil erosion and streambank failures. The trends for livestock grazing effects were used to qualitatively estimate effects on hydrologic function and watershed processes.

The *SAG Effects Analysis* suggests that livestock grazing effects would trend toward historical the strongest in Alternatives S2 and slightly less so in Alternative S3, and would lead to increased maintenance and restoration of hydrologic function and watershed processes. This is caused by implementation of Healthy Rangeland strategies and restoration priorities within these alternatives. Alternative S1 also would implement Healthy Rangeland strategies that would cause livestock grazing effects to trend toward historical, but the lack of restoration activities would not provide the same level of improvements to hydrologic function and watershed processes that would be achieved by Alternatives S2 and S3.

Soil Disturbance

Trends for soil disturbance are based on the likelihood of prescribed activities (timber harvest, thinning, “wildland fire use for resource benefit” [formerly called prescribed natural fire], and prescribed fire) to cause detrimental effects to surface soils (see soil productivity section). The prescribed activities and subsequent disturbances that create these effects can affect hydrologic functions and watershed processes by altering stream flows and sediment supply-transport regimes.

Most Forest Service- and BLM-administered land is projected to be in the very low and low soil disturbance categories for all alternatives over the long term. (See the Effects on Soil Functions and Processes section.) This trend indicates there would be very little difference among the alternatives; based on these outcomes, hydrologic function and watershed processes would likely be maintained for all alternatives over the next 100 years.

Predicted Road Densities and Trends

Road-related disturbances disrupt hydrologic function by modifying the surface and subsurface water flowing within a watershed. In addition to an increased potential for surface erosion and mass wasting, roads and roadside ditches increase the efficiency for the delivery of water, sediment, and other pollutants to nearby stream channels (Montgomery 1994). Trends in road densities and road-related adverse effects were used to estimate conditions for hydrologic function and watershed processes. For all alternatives the Forest Service national roads policy and associated analysis requirements are expected to decrease the amount of disturbance resulting from roads in the short- and long-term on Forest Service-administered lands. The rate of new construction would be slowed on National Forest System lands; the current, minimal amount of construction on BLM lands would likely be maintained.

Road density trends for Alternative S1 are estimated to remain static in the long term. Some road closure and removal is likely to occur within priority watersheds for bull trout, steelhead, and chinook salmon. The restoration emphasis of Alternatives S2 and S3 would result in higher decreases in road densities than Alternative S1. The largest reductions in adverse road effects would result from improved road maintenance and road closure and removal under Alternative S2. The downward trends for road densities and decreases in road-related disturbances would contribute to reductions in surface erosion and mass wasting, channel elongation, and gully development. As a result, decreases in adverse road effects with short- and long-term benefits to hydrologic function and watershed processes would be highest for Alternative S2, then Alternative S3 and Alternative S1, respectively.

High Restoration Priority Subbasins

Alternative S1 would continue PACFISH / INFISH direction and associated Biological Opinions (BOs), with outcomes emphasizing protection of riparian and aquatic systems. Alternative S1 management direction and activities would include some restoration of hydrologic function and watershed processes, but they would be accomplished under an aquatic theme, primarily in priority watersheds identified under PACFISH / INFISH and the BOs. Alternative S1 would not implement a broad-scale landscape restoration program. Focusing on the protection and restoration of hydrologic processes may provide immediate improvements to aquatic habitat quantity and quality; however, without considering an integrated, ecological strategy at the broad scale these efforts are assumed to have little bearing on larger scale watershed and ecosystem processes that create and maintain habitats through time (Reeves et al. 1995).

In Alternatives S2 and S3, aquatic and riparian systems would be fully integrated with watershed and upland processes to gain an understanding of the ecological interactions occurring at the broad scale. This would foster integration of multiple watershed components, including hydrologic function and watershed processes, to promote landscape restoration for long-term ecological health. Activities that have a landscape emphasis, such as those that would be implemented under the integrated restoration strategy, are more likely to be successful in protection, maintenance, and restoration of hydrologic processes at the watershed scale (Naiman et al. 1992). Furthermore, the ecosystem management direction in Alternatives S2 and S3 would more readily encourage implementation of adaptive management and analysis of cumulative effects than Alternative S1.

The high restoration priority subbasins identified in Alternatives S2 and S3 would provide a mechanism to prioritize activities that contribute to maintenance and restoration of integrated ecological processes at the broad scale. Higher levels of landscape restoration would occur in high restoration priority subbasins. Restoration opportunities would be identified and prioritized during Subbasin Review and Ecosystem Analysis at the Watershed Scale (EAWS), with the expectation of higher success in restoration and reductions in short-term risks. Alternatives S2 and S3 would use the Subbasin Review and EAWS for prioritization, with Alternative S2 using more context-setting hierarchical analysis than Alternative S3.

Although Alternative S1 does not incorporate the high restoration priority subbasins, activities are expected to be implemented using a restoration emphasis. However, these activities would be distributed over a much larger landscape, and effectiveness in meeting broad-scale ecological objectives would be questionable. Alternative S3 would pose greater short-term risk to hydrologic function and watershed processes than either Alternative S2 or the more protective and restrictive approach of Alternative S1. Consequently, the benefits to hydrologic function and watershed processes are predicted to be highest with Alternative S2, followed by Alternative S1, then Alternative S3.

Riparian Conservation Area Protection and Management

Intact and functioning riparian areas are critical components in the landscape that integrate aquatic systems with uplands, forming the basic ecological system (Lotspeich and Platts 1982, Naiman et al. 1992). All alternatives in the Supplemental Draft EIS have goals, objectives, and standards that would manage for the protection and restoration of riparian conservation areas (RCAs) on National Forest System and most BLM-administered lands in the project area. The ecological functions of riparian areas occur at varying distances depending on the range and character of riparian and wetland vegetation (Lee et al. 1997, FEMAT 1993). The extent of the areas under riparian consideration and emphasis varies by alternative (see Aquatics section). Key differences among the alternatives include elements that provide flexibility in RCA delineation criteria, which determine the amount of area within RCAs. However, these differences could generate local risks to ecological function of riparian and aquatic ecosystems.

Alternative S1 requires specific criteria for delineating RCAs with an emphasis on the protection of riparian areas. Alternatives S2 and S3 emphasize ecological conditions as the underlying criteria for managing RCAs to maintain riparian processes. Using broad-scale information, Alternative S2 would result in the largest area within RCAs, followed by Alternatives S1 and S3. Alternatives S2 and S3 have designated areas, based on hillslope steepness, that are intended to minimize sediment delivery into RCAs. In Alternative S2 this area applies to all RCAs; in Alternative S3 this criterion applies only to intermittent stream RCAs, while Alternative S1 does not have criteria for an influence area (see the RCA Delineation section in Chapter 3, and the Effects on Riparian Habitats section, later in this chapter).

Alternative S2 would maintain riparian ecological processes through time and would contribute most to protecting, maintaining, or restoring watershed processes and hydrologic function. Some uncertainty would exist with Alternatives S1 and S3 because of interim delineation criteria for intermittent streams and reduced emphasis on sediment delivery influence areas. These two alternatives may not provide for full protection of riparian ecological processes and, therefore, may not be as effective in maintaining watershed processes and hydrologic function as Alternative S2.

Hierarchical Analysis Requirements

The role of hierarchical analysis is to increase the likelihood of ecologically appropriate outcomes, in two ways: (1) by providing a context for management actions that are within the capabilities and limitations of a specific hydrologic unit, and (2) by serving as an effective mechanism for prioritizing actions and weighing multiple risks to specific resources within the ecosystem. Completing hierarchical analysis at the subbasin and watershed scales allows for appropriate identification and assessment of the ecological interactions that are integral components of healthy watersheds.

The requirements for Subbasin Review and Ecosystem Analysis at the Watershed Scale (EAWS) vary among the alternatives. For Alternative S1, the biological opinions on the land and resource management plans for chinook, sockeye, and steelhead (NMFS 1995, 1998) require one subbasin assessment and one EAWS be completed by each Forest Service and BLM unit per year within the portion of the basin encompassed by the biological opinions. In addition, Alternative S1 requires EAWS prior to project implementation for some activities within priority watersheds (as directed by existing biological opinions). These requirements contain limited mechanisms for directing hierarchical analyses in an ecological context that would appropriately examine watershed-scale processes and functions.

Alternatives S2 and S3 require hierarchical analysis to provide the context for watershed-scale processes and functions, for efficient and effective prioritization of base-level and restoration activities. Application of hierarchical analysis under Alternatives S2 and S3 would more adequately than Alternative S1 incorporate hydrologic function and watershed processes and restore watershed health using an integrated landscape approach. For Alternative S1 the uncertainty is related to the lack of ecological context-setting relationships from disconnected subbasin assessment-to-EAWS step-down analyses; that leads to less emphasis for integrated ecological outcomes associated with finer-scale planning. Alternative S2 would potentially have a higher rate and frequency of Subbasin Review and EAWS than Alternative S3, followed by Alternative S1. The reduced rate and frequency of context-setting analyses for Alternatives S3 and S1 may lead to less effective restoration activities than Alternative S2. Overall, the hierarchical analysis requirements in Alternative S2 would provide higher benefits to hydrologic function and watershed processes, followed by Alternative S3 and Alternative S1, respectively.

Conclusions

When blending the qualitative outcomes for processes and activities that influence hydrologic systems, Alternative S2 is most likely to generate landscape conditions that would contribute to the maintenance and restoration of hydrologic functions and watershed processes. Alternative S2 contains a more aggressive restoration approach by implementing higher amounts of prescribed activities designed to correct or minimize adverse effects resulting from wildfire, livestock grazing, and roads. In addition, a higher rate and frequency of context-setting hierarchical analyses and integration of riparian, aquatic, and upland restoration needs at the landscape scale are predicted to increase the effectiveness and success of the prescribed activities. Overall, these components in Alternative S2 are expected to best provide for restoration, maintenance, and protection of hydrologic function and processes for the long term.

Alternative S3 is predicted to have similar outcomes in terms of correcting or minimizing adverse effects. However, Alternative S3 would have reduced levels of restoration activities. Combined with lower rates of context-setting hierarchical analysis, which would lead to less emphasis on integration of landscape-scale processes, Alternative S3 would not be as effective as Alternative S2 in restoring or maintaining hydrologic functions and watershed processes.

Alternative S1 has very minimal requirements for context-setting hierarchical analysis. Compared to Alternatives S2 and S3, the emphasis of Alternative S1 is focused primarily on aquatic resources by providing higher levels of protection to current riparian and aquatic conditions. With little recognition of the need for restoration of integrated landscape processes, Alternative S1 would least adequately provide for short- and long-term protection and maintenance of hydrologic function and watershed processes at the broad scale.

Air Quality

Methodology: How Effects on Air Quality were Estimated

The general approach used in constructing this air quality impact effects analysis was to portray typical air quality impacts from various levels of prescribed fire and wildfire. The modeling effort used meteorological data that was representative of the prescribed fire and wildfire season. This was done since all states in the project area have implemented smoke management programs to manage the smoke from prescribed fires. Figure 4-4, later in this section, shows the area covered by the modeling domain.

The analysis assumed that prescribed fires are ignited at 11:00 am, which results in the release of the bulk of the emissions during the unstable daytime hours when vertical mixing is enhanced and the smoke plume is likely to be diluted relatively quickly. Some prescribed fires are active during the stable nighttime hours and have the potential to produce higher ground-level impacts due to lower plume heights and less favorable dispersion conditions.

It was also assumed that the size of the source area is equal to the acreage burned, which may tend to overestimate the local dilution of pollutants, particularly during the early portion of the fire. However, since populated areas are usually many miles from range and forest land prescribed burning, this underestimate at the early stages of prescribed fires should be minimal. Figures 4-5 and 4-6 show a scenario of a 16-fold increase of a prescribed fire program over the 1990 level and should compensate for some of the shortcomings of the modeling effort.

This analysis suggests that wildfire impacts are significantly greater in magnitude than prescribed burning impacts. Although the relative frequency of such impacts was not modeled, it can be assumed the frequency of impacts will follow the episodic nature of wildfire or prescribed fire.

The projection of effects on air quality was based on additional assumptions made by the EIS Team:

- Wildfires and prescribed fires do not occur at regular intervals throughout the year, but rather occur in patterns of varying intervals between fires or groups of fire events (episodes).
- For wildfires, a combination of weather conditions and ignition sources (usually lightning) need to occur. When weather associated with intense fire behavior and multiple ignitions occur, the result can be multiple large fires, which account for most of the acres burned by wildfire.
- In the case of management-ignited prescribed fire, weather is a primary factor in determining if an area can be burned under conditions that will meet the objectives of the fire and management of the smoke. When weather conditions become favorable for prescribed burning, the result is usually an episode in which large amounts of prescribed fire are occurring simultaneously but are managed under the guidance of state smoke management forecasters.
- All prescribed burning will be done under the auspices of state-operated or sanctioned smoke management plans which are part of State Implementation Plans (SIP) for the Clean Air Act. If a state currently does not have a smoke management plan that covers both range and forestland prescribed burning, efforts will be made to work with the state to develop one.
- When appropriate, near real time monitoring of wildland fire smoke will be provided to smoke management forecasters by the federal land management agencies to help meet the objectives of the smoke management plan.

Models (CALPUFF, CALMET [Scire et al. 1995, Scire and Tino 1996], and Emissions Production Model (EPM [Sandberg and Peterson 1985]) were used to assess the impacts of wildfire and prescribed fire smoke on air quality within the project area. Estimates were made for the effects on health standards and visibility as a result of particulate matter emitted from wildfires and from a range of prescribed fires that would result from the strategies under consideration for the EIS.

The emission rates for understory burns were estimated with the Emissions Production Model (EPM). This model was developed by the Forest Service to predict particulate emissions from pile and broadcast burning of harvest residues, not from understory burning. While the application of EPM to understory burning introduces additional uncertainty to the analysis, experts believe the Emissions Production Model is the best tool available for estimating emissions from understory burning.

Wildfires and prescribed fires were compared because aggressive fuel treatment can significantly reduce the likelihood of large damaging wildfires, and because prescribed fire is proposed as a major fuel treatment alternative and restoration tool in the project area. The belief that fuel treatment can reduce the impacts of wildfires has been common among fire managers for years, has been witnessed in the field, and was

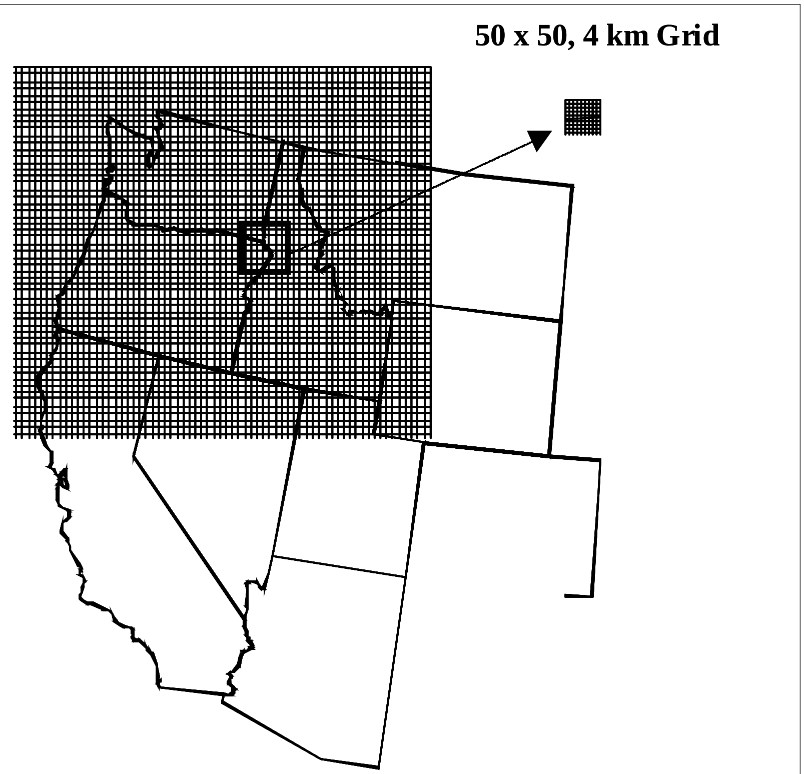


Figure 4-4. The Regional Columbia River Basin Air Quality Modeling Domain. The grid cell size is 20 km. The grid of 65 x 53 cells covers 1,300 km x 1,600 km. The 10 km x 10 km grid was used in the fine-scale modeling. Source: Scire and Tino 1996.

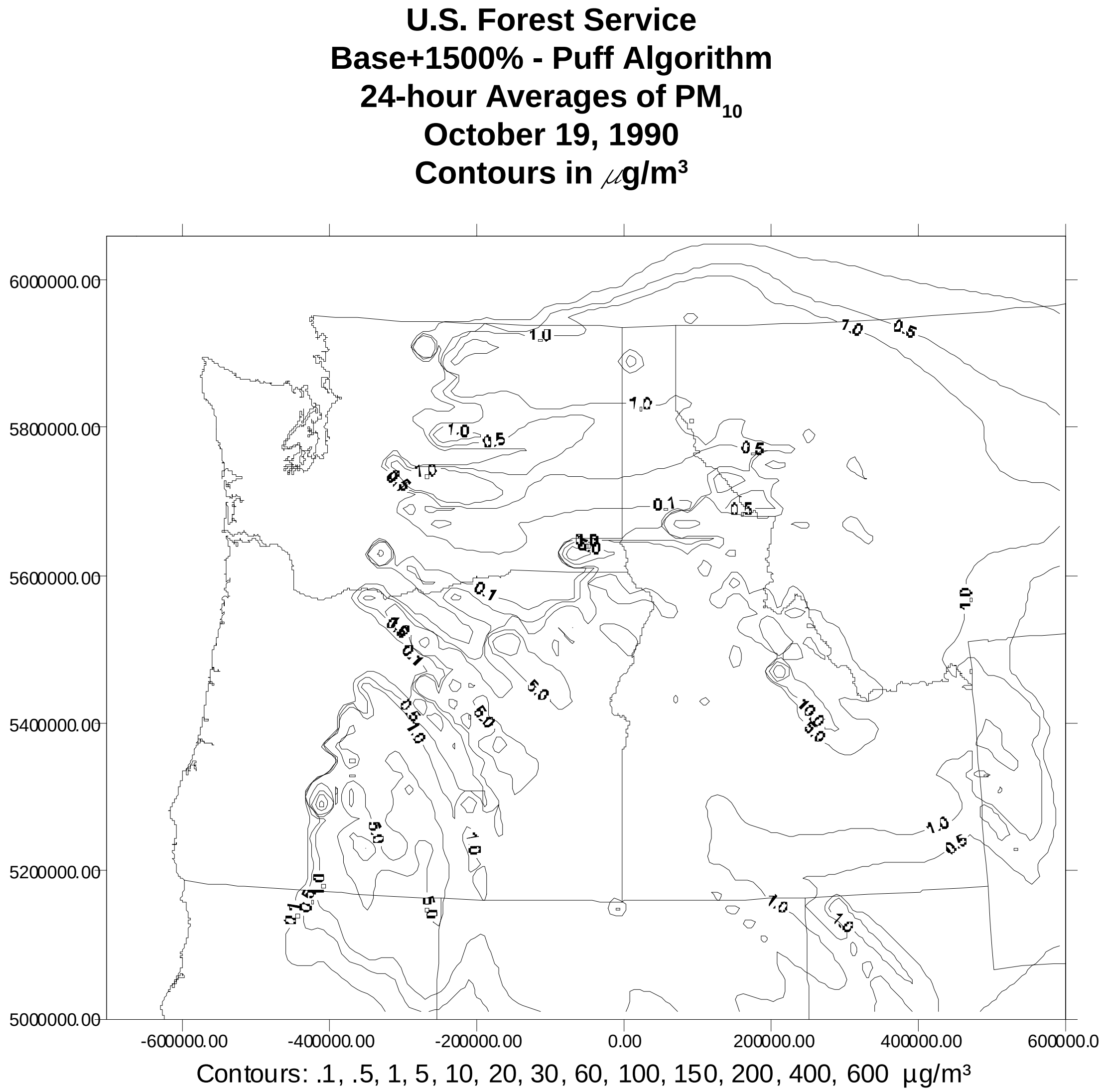


Figure 4-5. Prescribed Fire PM_{10} Emissions After Six Days of Continuous Burning Using 20 Km Grid. This scenario is based on levels 16 times the 1990 level (contours in $\mu G/m^3$).

initially demonstrated by a study completed in northeast Oregon (Schaaf 1996).

Modeling of smoke emission dispersion was dependent on a meterological database of gridded hourly wind fields for 1990 developed by the U.S. EPA (Scire and Tino 1996). In order to run the models, four meteorological databases were constructed by integrating terrain with actual atmospheric conditions experienced during four separate time periods in 1990. These time periods represented typical weather and smoke dispersion conditions for two spring periods and one fall period for prescribed fire and one summer period for wildfires. The databases included wind fields and other meteorological information that affect smoke dispersion. The time periods, or modeling episodes, were as follows:

- An early spring episode (March 27 through 31) representing typical prescribed burning conditions in the southern part of the project area below the 46th parallel.

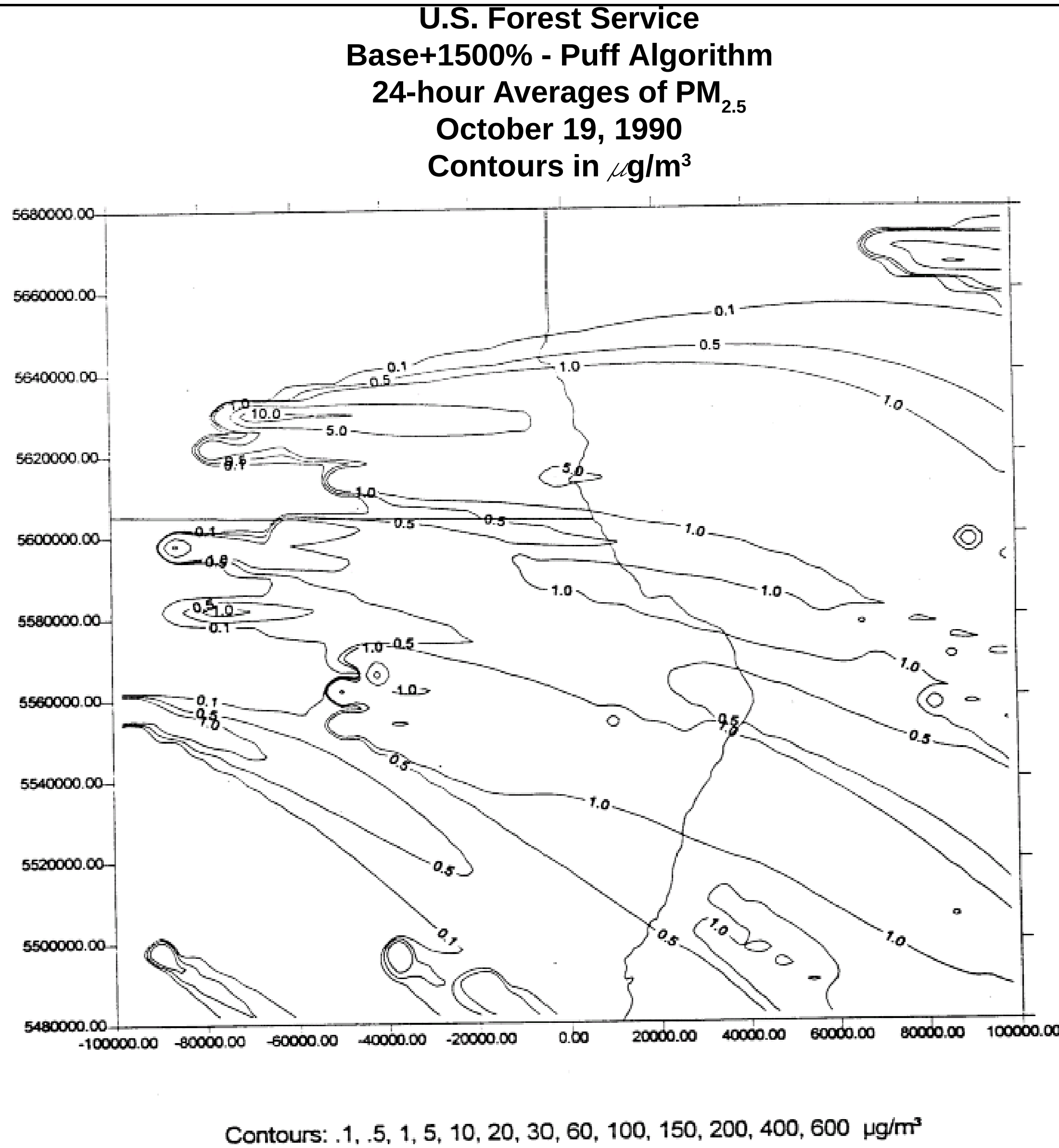


Figure 4-6. Prescribed Fire $PM_{2.5}$ Emissions After Six Days of Continuous Burning Using a 4 Km Grid. This scenario is based on levels 16 times the 1990 level (contours in $\mu G/m^3$). Source: Scire and Tino 1996.

- A late spring episode (May 4 through 11) representing prescribed burning conditions in the northern part of the project area above the 46th parallel.
- A summer episode (August 6 through 13) during which a large number of wildfire acres burned.
- A fall episode (October 14 through 19) representing prescribed burning conditions for both the northern and southern parts of the project area.

The sum of the acres burned during the spring and fall modeling episodes represents about 12 percent of the annual burning being proposed in the project area for Alternatives S2 and S3. To make estimates of annual emissions from these episodes, emissions were expanded arithmetically to represent the total acres being planned for burning under the three management strategies.

Prescribed Fire Scenarios

For the analysis of spring and fall prescribed fire smoke, different emission scenarios were evaluated — a base level (Alternative S1) representing current prescribed fire activities, base +300 percent representing the acres being burned for Alternative S2, and base +200 percent representing the acres being burned for Alternative S3. The estimate of the baseline level of prescribed fire was made from a count of all the management-ignited prescribed fires in 1990 from Forest Service and BLM units in the project area. Although accurate locations and vegetation types burned were generally unavailable, previous work (Peterson and Ward 1992) estimated the proportion of all prescribed fires that occurred in each of four general fuel types (mixed conifer, ponderosa pine, shrub / grass, and grass) in spring and fall. The base prescribed fires were allocated to these four fuel types according to the proportions estimated by Peterson and Ward (1992) and shown in Table 4-2. Using Geographic Information System (GIS), fires were placed on the landscape by randomly selecting locations of the assigned fuel type.

The efficiency of combustion and hence the amount of smoke produced is characteristically different for pile burns, underburns, and broadcast burns. Every prescribed fire was therefore coded to one of these three fire types according to the proportion of each of these fire types that typically occurs. The fuel loading (volume of downed woody material by size classes, litter, and duff) used for the four fuel types represented average loadings. Sizes of burns varied based on data collected for each of the three types of burns.

The base level of prescribed fire included the amount and distribution of fire among fire types and cover types that represent peak levels of weekly prescribed fire activity during early spring, late spring, and fall of 1990. The base scenarios that characterize each period include the number of burned units, unit sizes, fuel types, and fire types (underburns, broadcast burns, and pile burns). In each of the two base spring scenarios, 1,586 prescribed fire acres were modeled; for the base fall prescribed burning period, 13,883 acres were modeled. Total prescribed fires modeled for the base level was (2 x 1,586 + 13,883) 17,055 acres. These acreages were increased proportionally to represent the acres being planned for Alternatives S2 and S3 (Table 4-6, later in this section).

Wildfire Scenarios

For the summer weather period, an actual wildfire scenario was used, based on an estimate of daily acreage and types of fuels burned by wildfires from August 8 to August 13, 1990. Data on location, size, and acres burned per day for fires on all state and federally protected lands were obtained from records kept at the National Interagency Coordination Center (daily “incident management situation reports” [Boise, Idaho]). Only those wildfires 100 acres and larger were used in this analysis because these larger fires made up the vast majority of the wildfire acres burned. Based on information about location and plant community where the wildfires occurred, each fire was classified as burning in one of the four fuel types (mixed conifer, ponderosa pine, shrub / grass, and grass). The origin of the actual fire was used to place the fire for modeling purposes, and acres burned per day were used in the emission calculations. Cumulative impacts of emissions were modeled for eight days of meteorological data. The estimated emissions from the 1990 wildfires were then proportionally applied to the estimated wildfires acres burned (from CRBSUM) shown in Table 4-3, which are based on a 10-year administrative average (1988–1997).

Use of Models

The modeling domain (Figure 4-4) covers an area that is approximately 800 miles by 660 miles.

This area includes all of the project area and an appropriate buffer zone around the edges of the area of interest to allow the consideration of recirculating wind flows and boundary effects. The area was divided into 3,445 cells that were 154 square miles each (or 400 square kilometers [km] with 20 square kilometer grids). Particulate matter (PM) concentrations and changes in visibility were estimated for each of the 20 square kilometer grid cells.

To help assess the impacts on air quality from smoke at a more local level, a scenario was run using a fine-scale domain of 50 x 50 4-km grid cells covering a 200 km x 200 km area (Figure 4-4), which was a 10 x 10 grid cell subset of the 20 km grid cells used in regional domain. This fine-scale domain covered northeastern Oregon, southeastern Washington, and west central Idaho.

Table 4-2. Percentage of Prescribed Fires by Fuel Type[1] Used in the Air Quality Analysis.

Fuel Type	Spring Prescribed Fire	Fall Prescribed Fire
	Percent	
Grass	13	1
Shrub	19	8
Ponderosa Pine	5	7
Mixed Conifer	62	84

[1] This table shows the estimated percentage of prescribed fire for four general vegetation types for the project area.

Source: Scire and Tino 1996.

Particulate matter emissions and heat release rates were calculated for each prescribed fire and wildfire, using the Emissions Production Model (Sandberg and Peterson 1985). CALPUFF, an advanced Lagrangian puff model (Scire et al. 1995), was used to produce estimates of ambient concentrations of particulate matter smaller than 10 microns (PM_{10}), estimates of particulate matter less than 2.5 microns ($PM_{2.5}$), and estimates of related visibility impacts. The concentration estimates were averaged over 24 hours to correspond to the National Ambient Air Quality Standards (NAAQS) daily averaging period and the prevention of Significant Deterioration increments for PM_{10} developed under the Clean Air Act. The 24-hour NAAQS for PM_{10} is 150 micrograms per cubic meter ($\mu g/m^3$), and for $PM_{2.5}$ it is 65 $\mu g/m^3$. When modeling was done for the EIS, the $PM_{2.5}$ NAAQS had not been established but was anticipated, and a conservative estimate of 60 $\mu g/m^3$ was used.

To evaluate the air quality impacts of prescribed burning and wildfire emissions, threshold values of 150 $\mu g/m^3$ and 60 $\mu g/m^3$ were used, not to serve as an assessment of compliance with the NAAQS, but to

Table 4-3. Estimated Acres[1] Burned from Wildfires, by Resource Advisory Council/ Provincial Advisory Committee (RAC/PAC) and Alternative.

	Alternative S1		Alternative S2		Alternative S3	
RAC/PAC	**Year 10**	**Year 100**	**Year 10**	**Year 100**	**Year 10**	**Year 100**
Butte RAC	33,588	26,147	35,107	17,935	36,702	19,480
Deschutes PAC	8,465	9,284	8,297	5,652	9,112	6,803
Eastern Washington Cascades PAC	4,174	4,929	2,996	3,261	3,133	3,365
Eastern Washington RAC	7,873	5,108	8,909	4,628	9,276	4,747
John Day-Snake RAC	76,757	71,463	58,639	48,430	60,577	47,970
Klamath PAC	3,627	4,608	3,424	4,288	3,293	4,202
Lower Snake River RAC	112,863	98,091	105,655	81,164	120,460	87,519
Southeastern Oregon RAC	58,105	49,218	61,145	41,823	60,591	41,790
Upper Columbia/Salmon-Clearwater RAC R1	21,757	17,954	22,007	13,611	24,181	15,209
Upper Columbia/Salmon-Clearwater RAC R4	111,456	118,872	108,757	97,847	107,012	94,093
Upper Snake River RAC	88,312	74,905	89,118	62,950	83,703	55,350
Yakima PAC	226	185	228	172	251	177
Totals	527,203	480,764	504,282	381,761	518,291	380,705
Percent Change from Current	16%	6%	11%	-16%	14%	-16%

Abbreviations used in this table:
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] These numbers are acres of Forest Service- and BLM-administered lands in the portion of the RAC or PAC area in the project area.

Source: J. A. K. Snell, personal communication, 1999.

provide an indication of whether or not the forest and rangeland burning emissions by themselves may be expected to lead to widespread, regional-scale exceedances of the NAAQS.

From a regulatory perspective, an evaluation of ambient air and compliance with the NAAQS is based on the cumulative impacts from all sources of air pollution on ambient air. Since this study was done at a 20 km resolution, and ambient air (that is, background) concentrations were not available for the project area (monitored or modeled), this analysis did not include the cumulative impacts from other sources of particulate matter pollution. However, to assist readers, Figures 4-5 and 4-6 are included to help determine whether emissions from the prescribed fire scenarios would potentially cause an area to exceed NAAQS.

Using a 20 km cell grid, Figure 4-5 shows the impact on air quality for PM_{10} on the sixth day of continuous burning using the meteorological data from October 19, 1990. To be conservative, and to compensate for some of the uncertainties in the modeling process, Figure 4-5 shows a scenario that represents 16 times the acres burned during the 1990 fall prescribed fire modeling period. Caution must be used in interpreting these data, since the background level still must be added. Sources for most background particulates are blowing dust and winter woodstove smoke, which generally occur during a time when little, if any, prescribed fire activity can be expected from any of the management strategies. Even at this high level of prescribed burning, however, the amount of $PM_{2.5}$ that the reader must add to the background is still relatively small. Although only October 19, 1990 is shown, the modeling included prescribed fires that burned from October 14 through October 19, 1990. This was done to make estimates of the cumulative impacts of smoke from prescribed fires burning across multiple days.

Using the 4 km cell fine-scale domain, Figure 4-6 shows the impact on air quality for $PM_{2.5}$ on the sixth day of continuous burning using the meteorological data from October 19, 1990. The figure shows a scenario that increases the acres burned by 16 times over the base level during the fall burning season where the competition for the airshed is the highest. Even at this high level of prescribed burning, the amount of $PM_{2.5}$ that the reader must add to the background is still relatively small.

Tables for each prescribed fire and wildfire scenario depict the number of grid cells that exceed the 150 $\mu g/m^3$ and 60 $\mu g/m^3$ thresholds set for PM_{10} and $PM_{2.5}$ respectively (Tables 4-4 and 4-5). There were no exceedances of these thresholds for the prescribed fire scenarios; however, if background had been added there may have been additional exceedances. There were significant exceedances for the wildfire scenarios. The wildfire scenario is based on the actual location and acres burned from August 6 through 13, 1990. The results shown in the tables show that 190 and 443 grid cells exceeded the PM_{10} and $PM_{2.5}$ thresholds respectively.

Effects on visibility from smoke production by the various scenarios were assessed using a haziness index, expressed in deciviews (Pitchford and Malm 1994). A change in one deciview corresponds to an approximate 10 percent change in the light extinction coefficient, which is considered a small but perceptible decrease in visibility. When considering the impacts of smoke production on visibility, it should be noted that in areas where the air is clean and visibility is good, a relatively small amount of smoke can be perceptible. If an area has relatively poor visibility, more smoke is required to create a perceptible change.

The air quality dispersion model used in this analysis, CALPUFF, was recommended for regional-scale analysis by the Interagency Work Group on Air Quality Modeling. This Interagency Work Group on Air Quality Modeling is composed of representatives from the Environmental Protection Agency, the Forest Service, the National Park Service, and the U.S. Fish and Wildlife Service. Composed of air modeling experts, the Interagency Work Group was formed to review, identify, and recommend candidate air quality simulation modeling techniques that can be used to estimate pollutant concentrations over long transport distances.

CALPUFF was selected for its capabilities to simulate temporally and spatially vary emissions and meteorological conditions, features that make it superior to more commonly used regulatory models. With these features, CALPUFF has the potential to more realistically simulate complex wind flows associated with the mountainous terrain of the project area.

Limitations of Modeling

To understand the significance and proper application of the results of this modeling analysis, it is essential to note the limitations of the analysis conducted. CALPUFF's sensitivity and performance have not been evaluated, and the accuracy and potential biases of the model relative to its application to forestry burning sources are unknown. Because no thorough

Table 4-4. PM_{10} Particulate Emissions, Wildfire Scenario, August 6–13, 1990.

	Number of Grid Cells with PM_{10} Concentrations Above 150 g/m^3								
Acres Burned	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Total[1]
171,180	0	0	2	5	25	49	28	1	110

Abbreviations used in this table:
PM_{10} - Particulate matter smaller than 10 microns.
g/m^3 - Micrograms per cubic meter.

[1] If background had been added, more grid cells might have exceeded the 150 g/m^3 threshold

Source: Scire and Tino (1996).

model evaluation has been conducted, the results from this modeling exercise are expected to be less reliable than those developed in typical regulatory evaluations of National Ambient Air Quality Standards attainment. Care should be taken when comparing these modeling results with those conducted for evaluating non-attainment areas. Standard particulate matter NAAQS modeling for non-attainment areas uses worst-case assumptions to provide certainty that health-based standards will not be violated.

This modeling analysis evaluated impacts of wildfires and management-ignited prescribed fires on a regional scale. Use of a coarse 20 kilometer (km) receptor grid was required to provide coverage over the entire project area. While this regional approach is appropriate for a programmatic EIS, it cannot be used to assess impacts of burning on causing exceedances of the NAAQS at any individual location.

Furthermore, while the fine-scale domain used to help assess the impacts on air quality from smoke at a more local level (described earlier, see Figure 4-2) is appropriate for a programmatic EIS, this modeling method cannot be used to assess whether the effects of burning would cause the NAAQS to be exceeded at any individual location.

The quality of ambient air is defined by the cumulative effect from all sources; because neither monitored nor modeled data at the 20 km or 4 km resolution were available for the analysis, ambient air concentrations need to be added to the results of this analysis. For example, the impacts from stationary sources such as factories and pulp mills, and major area sources such as automobiles, should be added. Estimates of cumulative impacts must be made by adding the concentrations shown in Figures 4-5 and 4-6 to the local concentrations of concern. This will give only a very coarse estimate of PM_{10} or $PM_{2.5}$ concentrations.

Table 4-5. $PM_{2.5}$ Particulate Emissions, Widlfire Scenario, August 6–13, 1990.

	Number of Grid Cells with $PM_{2.5}$ Concentrations Above 60 g/m^3								
Acres Burned	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Total[1]
171,180	0	0	5	41	65	130	157	45	443

Abbreviations used in this table:
$PM_{2.5}$ - Particulate matter smaller than 2.5 microns.
g/m^3 - Micrograms per cubic meter.

[1] If background had been added, more grid cells might have exceeded the 60 g/m^3 threshold

Source: Scire and Tino (1996).

The question of NAAQS attainment at the 20 km or 4 km resolution is not very useful, because NAAQS attainment must be addressed at the local level when more site-specific information is available.

Emissions produced from smoldering fuels were included in the modeling. The emission factors (that is, the amount of emissions produced per unit of fuel consumed per unit of time) for smoldering are not as precise as those used for other phases of burning. Emission factors for smoldering are currently being refined by research and were not available for use in this Supplemental Draft EIS.

Effects of the Alternatives on Air Quality

Prescribed and Wildland Fire

Prescribed fire is the only planned management action that would affect air quality at the broad scale.

Prescribed fire is the only planned management action that would affect air quality at the broad scale. When wildfires occur the magnitude of visibility reduction would be substantially more than during prescribed burning. However, prescribed burning would affect air quality more frequently. In the long term, wildfires are expected to decrease in frequency for both Alternatives S2 and S3. Results of the analysis of prescribed fire are compared to the effects of wildfire on air quality. The effects of the alternatives on two different aspects of air quality were assessed: effects on the amount of particulate matter released (a component of the National Ambient Air Quality Standards), and effects on visibility.

Table 4-6 shows the expected *annual acres being burned* for each alternative by RAC / PAC area.

Tables 4-7 and 4-8 show the expected *annual emissions for PM_{10} and $PM_{2.5}$* from prescribed fire by RAC / PACs respectively for each alternative. The acres shown in Table 4-6 increase at a faster rate than the emissions shown in Tables 4-6 and 4-7 because of two factors: (1) the average size of the burns would increase from 27 acres for Alternative S1 to 137 acres for Alternatives S2 and S3, and (2) the amount of fuel consumed per acres would be less per acre for Alternatives S2 and S3 compared to Alternative S1 because of a change to a more mosaic pattern of fire (patches of burned and unburned areas) in the unit under the action alternatives compared to Alternative S1 where nearly all the acres within the unit were burned. Figures 4-7 and 4-8 show the average annual $PM_{2.5}$ emissions from prescribed fire and wildfire, re-spectively, by RAC / PAC area for each alternative.

The modeling conducted for this analysis was intended to compare the regional impacts of different land management practices over millions of acres of land. The size of the area of concern and the scope of the programmatic changes discussed in this EIS dictated that a large modeling domain and a relatively coarse grid of receptors be used. Because many air quality impacts, such as compliance with the NAAQS, are chiefly determined by localized conditions, a modeling analysis used to evaluate programmatic changes cannot really answer whether NAAQS would be attained or violated. At best, analysis at this level can give a general assessment of relative impacts from prescribed burning and wildfires, by management strategy.

None of the 3,445 20 km grid cells in the modeling domain exceeded threshold values (150 Fg / m^3) for 24-hour averages of PM_{10} concentrations in any of the prescribed fire scenarios. None of the prescribed fire scenarios exceeded the threshold of 60 Fg / m^3 for $PM_{2.5}$. However, for the wildfire scenario, 110 and 443 of the 20 km grids exceeded the thresholds of PM_{10} and $PM_{2.5}$ respectively (see Tables 4-4 and 4-5, earlier in this section). However, if background concentrations could have been added, the results may have varied.

The predicted concentrations of particulate matter for the prescribed fire scenarios are substantially lower than the wildfire scenarios for several reasons: (1) higher fuel moisture levels during management-ignited prescribed fires compared to wildfires generally result in less fuel consumed per acre of prescribed fire than per acre of wildfire; (2) smoke dispersion conditions (determined by state smoke management forecasters) during the spring and fall prescribed burn episodes are better; and (3) prescribed fires are dispersed across the landscape spatially and temporally, rather than being concentrated in a few locations. Although a compensating factor for large wildfires is

Table 4-6. Acres of Prescribed Fire Activity,[1] by Resource Advisory Council/Provincial Advisory Committee (RAC/PAC) and Alternative.

RAC/PAC	Alternative S1 Year 10	Alternative S1 Year 100	Alternative S2 Year 10	Alternative S2 Year 100	Alternative S3 Year 10	Alternative S3 Year 100
Butte RAC	22,514	16,598	78,250	64,185	74,615	59,829
Deschutes PAC	18,235	13,568	27,852	26,518	28,147	27,237
Eastern Washington Cascades PAC	571	539	5,099	8,551	3,892	6,164
Eastern Washington RAC	1,959	2,128	12,084	9,356	9,614	7,318
John Day-Snake RAC	34,806	34,112	170,826	168,428	129,428	130,472
Klamath PAC	9,803	7,394	15,149	19,807	13,036	16,552
Lower Snake River RAC	3,151	2,849	9,474	8,568	4,089	4,230
Southeastern Oregon RAC	25,660	23,782	109,996	134,376	64,191	74,000
Upper Columbia/Salmon-Clearwater RAC R1	10,931	10,358	49,092	39,568	34,121	27,516
Upper Columbia/Salmon-Clearwater RAC R4	17,244	12,358	38,866	33,753	33,997	26,660
Upper Snake River RAC	2,741	2,221	6,338	4,823	6,742	5,232
Yakima PAC	5	4	22	24	17	18
Totals	147,619	125,910	523,049	517,956	401,889	385,227
Percent Change from Current	2%	-13%	260%	257%	177%	165%

Abbreviations used in this table:
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] Net annual smoke-producing acres (Forest Service- and BLM-administered lands in the portion of the RAC or PAC area in the project area) from prescribed fire and “wildland fire use for resource benefit.” These figures estimate net smoke-producing acres by first subtracting out the mechanical fuel reduction acreage from the acres of prescribed fire and fuels management (landscape variable PRS) and second by applying a reduction factor to the remaining total acres treated with prescribed fire to account for actual acres burned.

Source: J. A. K. Snell, personal communication, 1999.

Table 4-7. Expected Annual PM_{10} Emissions from Prescribed Fire Activity,[1] by Alternative and Resource Advisory Council/Provincial Advisory Committee (RAC/PAC).

Average Annual PM_{10} Emissions (Tons) for Prescribed Fire and “Wildland Fire Use for Resource Benefit” Acres Burned[2]

RAC/PAC	Alternative S1 Year 10	Alternative S1 Year 100	Alternative S2 Year 10	Alternative S2 Year 100	Alternative S3 Year 10	Alternative S3 Year 100
Butte RAC	4,203	3,098	8,192	6,720	7,908	6,341
Deschutes PAC	3,404	2,533	2,916	2,776	2,983	2,887
Eastern Washington-Cascades PAC	107	101	534	895	413	653
Eastern Washington RAC	366	397	1,265	980	1,019	776
John Day-Snake RAC	6,498	6,368	17,884	17,633	13,717	13,828
Klamath PAC	1,830	1,380	1,586	2,074	1,382	1,754
Lower Snake River RAC	588	532	992	897	433	448
Southeastern Oregon RAC	4,790	4,440	11,516	14,068	6,803	7,843
Upper Columbia/Salmon-Clearwater RAC R1	2,041	1,934	5,140	4,142	3,616	2,916
Upper Columbia/Salmon-Clearwater RAC R4	3,219	2,307	4,069	3,534	3,603	2,825
Upper Snake River RAC	512	415	664	505	715	555
Yakima PAC	1	1	2	3	2	2
Totals	27,558	23,505	54,758	54,225	42,594	40,828

Abbreviations used in this table:
PM_{10} - Particulate matter smaller than 10 microns.

[1] These numbers are acres of Forest Service- and BLM-administered lands in the portion of the RAC or PAC area in the project area.
[2] “Wildland fire use for resource benefit” was previously called prescribed natural fire.

Source: J. A. K. Snell, personal communication, 1999.

Table 4-8. Expected Annual $PM_{2.5}$ Emissions from Prescribed Fire Activity,[1] by Alternative and Resource Advisory Council/Provincial Advisory Committee (RAC/PAC).

RAC/PAC	Alternative S1 Year 10	Alternative S1 Year 100	Alternative S2 Year 10	Alternative S2 Year 100	Alternative S3 Year 10	Alternative S3 Year 100
	Average Annual $PM_{2.5}$ Emissions (Tons) for Prescribed Fire and "Wildland Fire Use for Resource Benefit" Acres Burned[2]					
Butte RAC	3,611	2,662	7,147	5,863	6,901	5,533
Deschutes PAC	2,925	2,176	2,544	2,422	2,603	2,519
Eastern Washington-Cascades PAC	92	86	466	781	360	570
Eastern Washington RAC	314	341	1,104	855	889	677
John Day-Snake RAC	5,583	5,471	15,603	15,384	11,970	12,067
Klamath PAC	1,572	1,186	1,384	1,809	1,206	1,531
Lower Snake River RAC	505	457	865	783	378	391
Southeastern Oregon RAC	4,116	3,814	10,047	12,274	5,937	6,844
Upper Columbia/Salmon-Clearwater RAC R1	1,753	1,661	4,484	3,614	3,156	2,545
Upper Columbia/Salmon-Clearwater RAC R4	2,766	1,982	3,550	3,083	3,144	2,466
Upper Snake River RAC	440	356	579	440	624	484
Yakima PAC	1	1	2	2	2	2
Totals	23,677	20,195	47,775	47,310	37,169	35,628

Abbreviations used in this table:
$PM_{2.5}$ - Particulate matter smaller than 2.5 microns.
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] These numbers are acres of Forest Service- and BLM-administered lands in the portion of the RAC or PAC area in the project area.
[2] "Wildland fire use for resource benefit" was previously called prescribed natural fire.

Source: J. A. K. Snell, personal communication, 1999.

the larger buoyancy and potentially higher plume rise compared to the smaller prescribed fire plumes, the wildfire plumes eventually mix down to the ground and result in higher ground-level concentrations of particulate matter.

Figures 4-9 and 4-10 show by alternative the expected annual PM_{10} and $PM_{2.5}$ emissions for both prescribed fire and wildfire.

Criteria Pollutants

Ozone and carbon monoxide are criteria pollutants also produced by wildland fire. Ozone is a byproduct of prescribed burning, but these fires are generally spatially and temporally dispersed, so potential ozone exposures from prescribed fire are infrequent (Sandberg and Dost 1990). Carbon monoxide is rapidly diluted at short distances from a prescribed burn and poses little or no risk to community health (Sandberg and Dost 1990). Other non-criteria, but potentially toxic, pollutants are emitted by prescribed burning.

Effects of pollutants from sources off public lands were evaluated based on: the review in the *Landscape Dynamics* chapter (Hann, Jones, Karl, et al. 1997) of the *Assessment of Ecosystem Components* (Quigley and Arbelbide 1997); correlation with landscape health; and emphasis on monitoring and prediction. In particular, management strategies that would provide management emphasis on a diversity of habitats and species that would be less susceptible as a biotic community to air pollutant effects were given higher ratings.

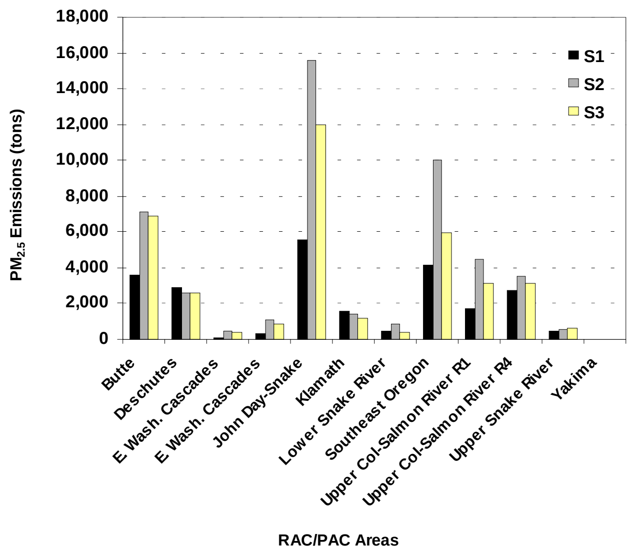


Figure 4-7. Average Annual $PM_{2.5}$ Emissions (Tons) Expected From Prescribed Fire, by RAC/PAC and Alternative. Source: J.A.K. Snell, personal communication,

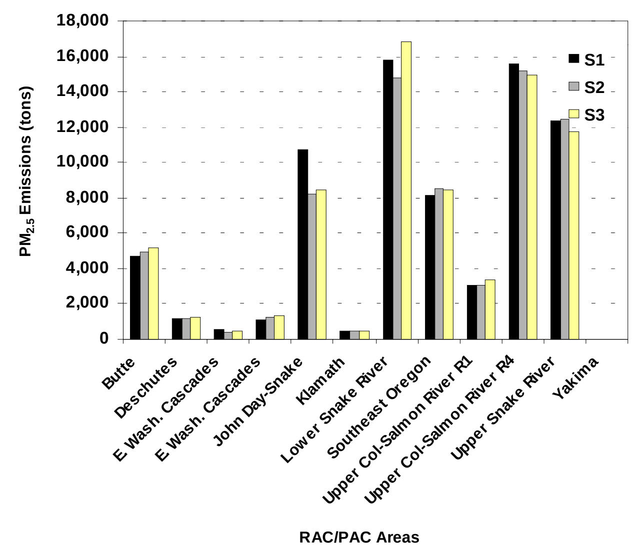


Figure 4-8. Average Annual $PM_{2.5}$ Emissions (Tons) Expected From Wildfire, by RAC/PAC and Alternative.

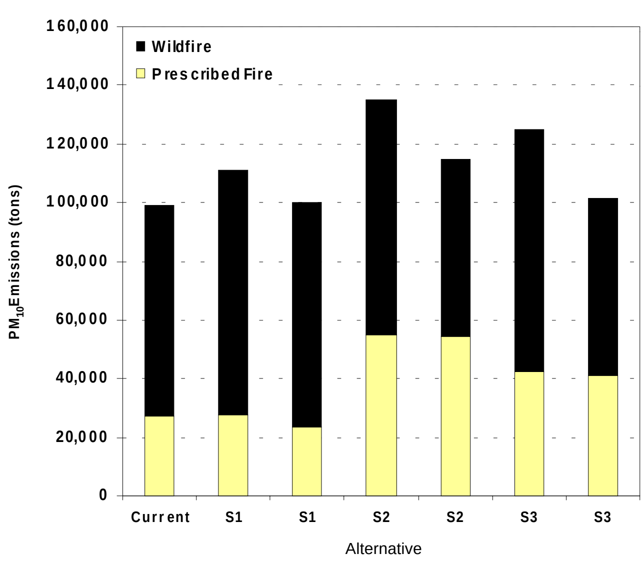


Figure 4-9. Expected Average Annual Emissions (Tons) of PM_{10} for Prescribed Fire and Wildfire, by Alternative. Source: J.A.K. Snell, personal communication, 1999.

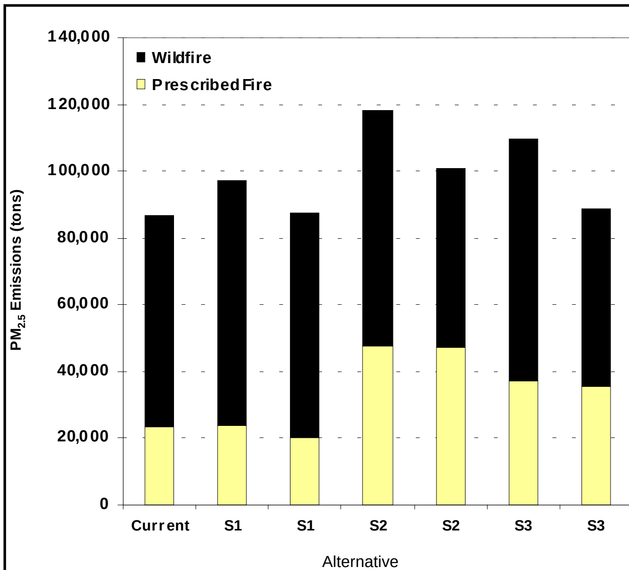


Figure 4-10. Expected Average Annual Emissions (Tons) of $PM_{2.5}$ for Prescribed Fire and Wildfire, by Alternative. Source: J.A.K. Snell, personal communication, 1999.

Visibility

The number of grid cells where the increase in haziness (decrease in visibility) exceeded one deciview (a 10 percent change in visibility equals 1 deciview) was computed for each alternative (Table 4-9) and for a wildfire scenario (Table 4-11).

A prescribed fire scenario was run to compare equivalent number of acres being burned between a prescribed fire event (152,713 acres; see Table 4-10) and a wildfire event (171,180 acres; see Table 4-11).

The modeling suggests two things: (1) when significant number of acres are being burned during an episode, whether by prescribed fire or wildfire, there will be visibility impacts; and (2) visibility impacts of at least 1 deciview will be about the same when comparing wildfire and prescribed fire assuming a similar number of acres are being burned.

The modeling did not address the magnitude of visibility impairment, such as how many deciview changes can be expected for a given episode. Based on the differences in concentrations for a given episode, comparing Figures 4-3 and 4-4 for prescribed fire (earlier in this section) with Figure 4-11 for wildfires, large wildfires can be expected to cause a greater magnitude of visibility impairment than prescribed fire. However, visibility impacts from prescribed fire are expected to occur more frequently than visibility impacts from wildfire, because the number and size of wildfires varies considerably among years, while prescribed fire activities occur annually, during early to late spring and in the fall.

Table 4-9. Number of 20-km Grid Cells with Impaired Visibility, by Alternative.

		Prescribed Fire	20-km Grid Cells with Perceptible Change in Visibility by Day							
Alternative	**Time of Year**	**Acres Modeled**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Total**
Base (S1)	Early Spring	1,586	21	17	17	5	12			72
	Late Spring	1,586	11	13	9	12	16	14	13	88
	Fall	13,883	109	40	76	80	64	147		516
	Total	17,055	141	70	102	97	92	161	13	676
Base+200% (S3)	Early Spring	4,680	28	38	59	46	28			199
	Late Spring	4,680	44	61	33	35	50	15	0	238
	Fall	41,330	295	166	248	224	241	355		1529
	Total	50,690	367	265	340	305	319	370	0	1966
Base+300% (S2)	Early Spring	6,595	46	42	64	37	44			233
	Late Spring	6,595	56	52	38	68	58	15	9	296
	Fall	55,515	399	320	332	334	312	475		2172
	Total	68,705	501	414	434	439	414	490	9	2701

Source: Scire and Tino 1996.

Table 4-10. Visibility Impairment, Prescribed Fire Scenarios.[1]

		Prescribed Fire	20-km Grid Cells with Perceptible Change in Visibility by Day						
Modeled Event	**Time of Year**	**Acres Modeled**	**Day 14**	**Day 15**	**Day 16**	**Day 17**	**Day 18**	**Day 19**	**Total**
Base+1000%	Oct 14-19, 1990	152,713	782	805	1,176	941	729	1,038	5,471

[1] This scenario was modeled only for the purposes of comparing wildfire and prescribed fire impacts on visibility when a similar number of acres were burned over a similar number of days, but under different fire intensities and meteorological conditions.

Source: Scire and Tino 1996.

Table 4-11. Visibility Impairment, Wildfire Scenario.[1]

Actual Event	Time of Year	Prescribed Fire Acres Modeled	20 km Grid Cells with Perceptible Change in Visibility by Day Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Total
100%	Aug 8-13, 1990	171,180	332	402	757	1,077	1,541	1,900	6,009

[1] This scenario was modeled only for the purposes of comparing wildfire and prescribed fire impacts on visibility when a similar number of acres were burned over a similar number of days, but under different fire intensities and meteorological conditions.

Source: Scire and Tino 1996.

Conclusions

Alternatives S2 and S3 would increase the amount of prescribed burning conducted for forest and rangeland management, and over the 100-year planning period could be expected to reduce the amount of wildfire activity for the project area by about 16 percent (Table 4-3, earlier in this section). The differences between predicted acres burned for Alternatives S2 and S3 are within the variation of error expected from the air quality analysis and would not support suggesting difference in impacts on air quality between the two alternatives. However, over the 100-year planning period, Alternatives S2 and S3, compared to Alternative S1, should be able to reduce the impacts of wildfire.

In general, this analysis reveals that wildfire impacts on air quality may be significantly greater in magnitude than emissions from prescribed burning. This can be attributed to prescribed burning techniques that reduce emissions and to smoke management plans that states and federal agencies have implemented that permit prescribed fires only during meteorological periods favorable to dispersion and avoidance of population centers of smoke.

This analysis provides only a relative assessment of the impacts from wildfire and prescribed fire on air quality. Frequency of the impacts will follow the episodic nature of both wildfire and prescribed fire. For all management strategies, prescribed fire impacts can be expected to occur annually, but only when meteorological conditions allow for good dispersion and under the auspices of state smoke management plans. Significant wildfire impacts would be less frequent; however, when they do occur, violation of NAAQS and significant impact visibility can be expected. Alternatives S2 and S3 would allow an opportunity to reduce fuel accumulations across the landscape and lessen the impacts from wildfire. An analogy would be that prescribed fire acts as a “pressure relief valve” for wildfire.

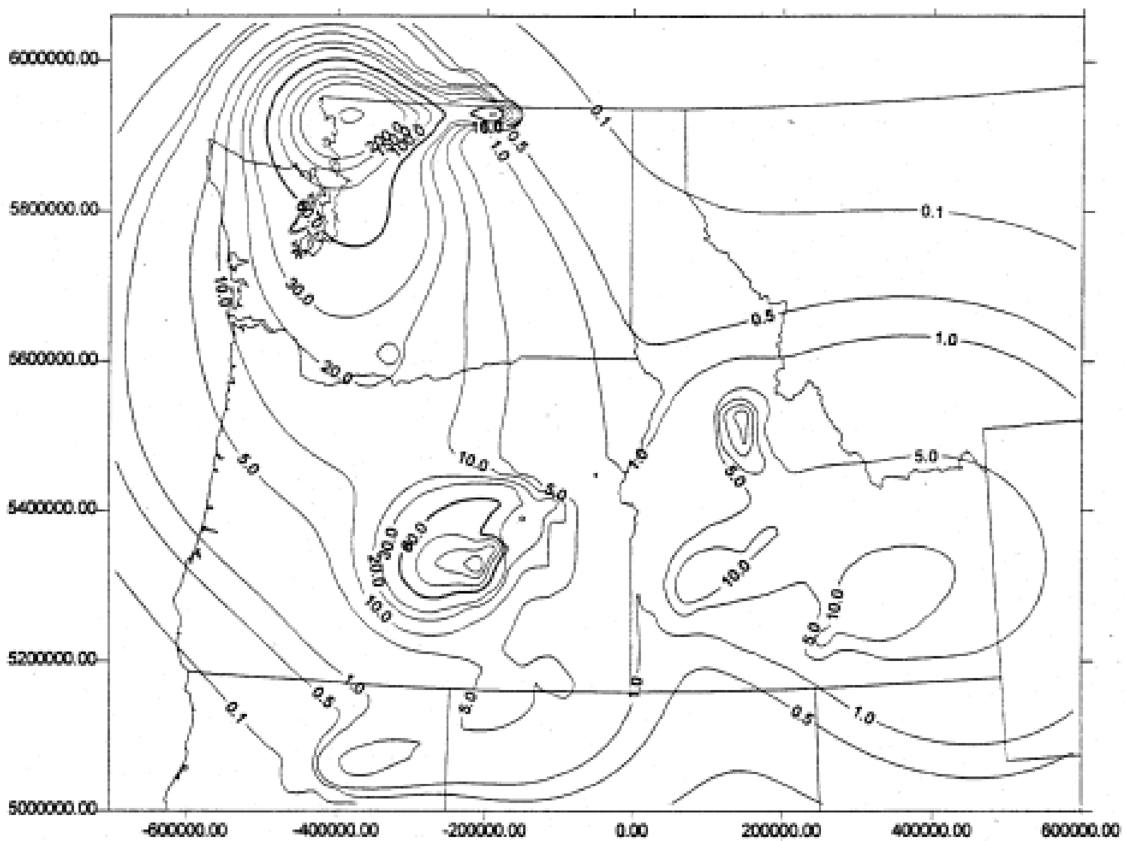
The air quality modeling suggests that prescribed burning particulate emissions, when considered alone for both Alternatives S2 and S3, may not cause widespread regional-scale exceedances of the National Ambient Air Quality Standards. However, evaluation of ambient air and compliance with the NAAQS is based on the cumulative impacts from all sources of air pollution on ambient air. This study was done at a 20 km and 4 km resolution, and ambient air (background) concentrations were not used. Thus, conclusions of NAAQS compliance cannot be made of this programmatic EIS.

This modeling analysis assumes that local analysis will be done to assess the possibility for localized exceedances of the NAAQS caused by prescribed burning emissions.

It may also be assumed that state smoke management meteorologists consider the cumulative effects of emissions from other sources (such as road dust and agricultural dust and burning) during the development of daily smoke management instructions, and that state smoke management program managers will consider these sources during development of the smoke management plan submitted for approval (as a component of the state Smoke Implementation Plan) to the EPA.

The modeling results do suggest that regional-scale degradation of visibility is possible because of prescribed burning emissions.

The increased use of prescribed fire described in Alternatives S2 and S3 parallels national trends. The National Wildfire Coordinating Group (NWCG) Fire Use Working Team sanctioned an interdisciplinary and interagency working framework for coordinating development of modeling and data systems to support balancing the increased use of prescribed fire in the context of reducing local and regional impacts of fires on air quality (Sandberg et al. 1999). A number of modeling and data system enhancements are currently under development by the Joint Fire Sciences Program of the USDA Forest Service and the U. S. Department of Interior. These systems include the modeling of meteorological conditions and smoke dispersion. The Forest Service and BLM also have developed a data system to support prescribed burning and to assist the states of Oregon and Washington with emission tracking under their respective state smoke management plans. This data system is available for use over a much broader geographic scope. The use of more sophisticated models during the implementation of prescribed burning, together with enhanced monitoring of emissions, will help minimize possible impacts from the use of prescribed fire. The inherent limitations of any model used at the programmatic scale highlight the importance of the cooperative development and use of operational smoke management models by the states, with assistance by the Forest Service, BLM, and EPA.



Contours: .1, .5, 1, 5, 10, 20, 30, 60, 100, 150, 200, 400, 600 μg/m³

Figure 4-11. $PM_{2.5}$ Emission From Wildfires, August 11, 1990. (Using a 20 km grid; contours in $\mu G/m^3$). Source: Scire and Tino 1996.

Landscape Dynamics Component: Terrestrial (Upland) Vegetation

This section presents the effects of the alternatives on succession / disturbance regimes and potential vegetation groups. A summary of key effects for succession / disturbance and vegetation composition and structure is presented first, followed by methods for estimating effects on terrestrial (upland) vegetation. Effects of the alternatives are then presented for succession / disturbance and for potential vegetation groups.

Summary of Key Effects and Conclusions

It has taken more than a hundred years to reach the present condition of the terrestrial uplands characterized by increasingly larger and more severe wildfire, increased invasion of noxious weeds, more insect and disease problems, and changes in the mix of vegetation types on the landscape that once provided for a balance of wildlife species that use them. Although these changes came on slowly at first, the movement away from historical succession and disturbance regimes increased over time; currently the movement away from historical regimes is proceeding rapidly with a great momentum.

Because it took a long time to reach this condition, remedies will not be easy, inexpensive, or quickly achieved. In general there is little difference among the long-term effects of the Supplemental Draft EIS alternatives at the basin-wide scale. On BLM- and Forest Service-administered lands alone, the differences among alternatives are generally still small. When restoration activities are concentrated into high restoration priority subbasins, then Alternative S2 emerges as the most effective alternative, followed by Alternative S3 and lastly, Alternative S1. However, even in the high restoration priority subbasins there is a considerable time lag involved in moving vegetation closer to historical conditions. To further complicate the situation, the drier parts of the project area seem to take even longer to restore because the vegetation responds more slowly and the methodology is less refined in more arid ecosystems. Higher amounts of restoration activities applied to forest and rangelands alike would be expected to result in greater differences between Alternatives S2 and S3 and Alternative S1.

Succession/Disturbance

- Alternative S2 is expected to do a better job of **repatterning vegetation on the landscape** to provide a proper mix of habitats and so that vegetation would be resilient to disturbance and sustainable in the long term.
- Effects from **uncharacteristic wildfire** are expected to increase slightly under Alternative S1 and decrease in Alternatives S2 and S3, with Alternative S2 slightly better on Forest Service- and BLM-administered lands in the long term.
- **Uncharacteristic insect and disease effects** are expected to remain near current levels on Forest Service- and BLM-administered lands in the long term. Alternative S2 should be slightly better than Alternatives S1 and S3 would likely be in between.
- The higher concentration of restoration activities in **high restoration priority subbasins** is expected to lead to a more healthy landscape in those areas under Alternatives S2 and S3.

Vegetation Composition and Structure

- Alternative S2 is expected to increase the extent of old forests to near historical levels, slightly more than Alternative S3, followed by Alternative S1 on Forest Service- and BLM-administered lands in the long term.
- Alternative S2 is expected to increase the extent of **old forests in the single story structural stage** more than Alternative S3. Both are expected to fall short of historical levels. Alternative S1 would also increase the extent but fall far short of historical on Forest Service- and BLM-administered lands in the long term.
- All alternatives are expected to increase extent of **ponderosa pine.** Alternatives S2 and S3 would increase extent to near historical levels, while Alternative S1 would result in above historical levels (go too far). Alternatives S2 and S3 would do a better job of increasing the vegetation types that have declined substantially from historical to current periods within this cover type.

- Alternatives S2 and S3 are expected to increase the extent of **western white pine** to slightly below historical levels. Alternative S1 would result in levels lower than Alternatives S2 and S3.
- All alternatives are expected to increase the extent of **whitebark pine**, but none would be able to prevent the future decline of the late seral single story structure.
- Over the long term, all three alternatives are projected to reverse the major vegetation changes within the woodland and cool shrub PVGs (that is, woody species encroachment and increasing density in shrublands and / or herblands) on BLM- and Forest Service-administered lands. Reversal would be more pronounced in Alternatives S2 and S3 than in Alternative S1.
- Vegetation types that have declined substantially in geographic extent from historical to current periods in the project area (for example, mountain big sagebrush, fescue-bunchgrass, and wheatgrass bunchgrass) would increase in the woodland and cool shrub PVGs as a result of the reversal in trend for encroachment of woody species.
- The rate of expansion of noxious weeds and other exotic undesirable plants on BLM- and Forest Service- administered lands in the project area as a whole would be slowed in Alternatives S2 and S3 more so than in Alternative S1. However, for all alternatives the extent of noxious weeds and other exotic undesirable plants would continue to increase.
- The wheatgrass bunchgrass and fescue-bunchgrass vegetation types within the dry grass PVG, and the big sagebrush vegetation type within the dry shrub PVG, all of which have declined substantially in geographic extent from historical to current periods, would continue to decline in their respective PVGs and trend away from historical amounts.

Methodology: How Effects on Terrestrial (Upland) Vegetation were Estimated

Effects of the alternatives on the terrestrial (upland) environment hinged to a great degree, but not solely, on a series of models created by the Science Advisory Group (SAG). These models were designed to simulate the management direction as it would reasonably be implemented during the next decade and the next century. Many of these models were developed previously during the formulation of the *Scientific Assessment* (Quigley and Arbelbide 1997) and during the *SIT Evaluation of the Draft EIS Alternatives* (Quigley, Lee, and Arbelbide 1997). Some new models, such as the Terrestrial Species Bayesian Belief Network Models (see sidebar in the Terrestrial Species section of this chapter and Quigley 1999 for description of the models), were created specifically for the science evaluation of the Supplemental Draft EIS alternatives.

Models simulated vegetation, succession / disturbances (such as livestock grazing pressure, wildfire, insect and disease mortality, and drought), management activities (such as prescribed burning, thinning, wildfire rehabilitation seedings), and other processes, which collectively operate across landscapes. The models integrated these variables so that disturbances were able to influence vegetation change and management activities. Vegetation conditions influence the frequency and intensity of disturbances, which influence the complexity of how lands respond to climate and human activities and uses in the interior

Columbia Basin. Outcomes of these simulation models were used as inputs to the Terrestrial Species Bayesian Belief Network (BBN) Models.

Landscape modeling methods used to evaluate effects of the management direction in the Supplemental Draft EIS were similar to the methods used to evaluate effects of the Draft EIS management direction. In both instances, a large part of what drove the landscape modeling was the assignment of management prescriptions, which varied in emphasis from traditional commodity management to emphasis on conservation with little commodity management, to active ecological restoration. Some key differences in the two evaluations are noted here:

- In the Draft EIS evaluation of effects (Quigley, Lee, and Arbelbide 1997), the selection and assignment of management prescriptions was performed by the Science Integration Team (SIT). In the Supplemental Draft EIS analysis of effects, management prescription selection was more of a joint Science Advisory Group (SAG)-EIS Team task, with the EIS team providing input as to management prescriptions that best fit the intent of the management direction. Similar to the Draft EIS evaluation, management prescription assignment for the Supplemental Draft EIS evaluation was ultimately performed by SAG.
- In the Supplemental Draft EIS evaluation, underlying land use plans and existing recovery plans were considered in the modeling of all alternatives, and biological opinions were considered to the extent possible given the coarseness of the data and analysis in the modeling of Alternative S1 (no-action alternative). Selection and assignment of management prescriptions for modeling Alternative S1 were changed to reflect these considerations.
- The "starting line" for Alternative S1, which was a reasonable reflection of current conditions, incorporated the 1988–1997 trend in certain activities (for example, timber harvest, livestock grazing levels) reported by BLM and Forest Service administrative units within the project area.

SAG information additional to model outcomes focus on several key rangeland issues and an independent review of the management direction and landscape variables by Johnson and Kingery (1999). Professional judgement in Johnson and Kingery (1999) proved particularly useful for issues such as biological crusts. These issues were difficult to model because of lack of inventory information on their condition in the project area.

The identification of and reporting of effects for cover type–structural stage combinations that have declined substantially from historical to current periods (that is, landscape vegetation types in the Terrestrial [Upland] Vegetation section, and terrestrial source habitats in the Terrestrial Species Component section) were based on the cover types and structural stages used in both the landscape and terrestrial modeling and was an EIS team-developed analysis. The premise used by the EIS team in identifying landscape vegetation types and terrestrial source habitats that have declined substantially from historical to current was that decline in these vegetation types or source habitats was associated with uncharacteristic succession / disturbance regimes and land use changes. In general, for the landscape vegetation types or terrestrial source habitats, for which restoration management direction was written, the EIS team used the cover type analyses and noxious weed / exotic undesirable plant analyses in Hann, Jones, Karl, et al. (1997) as support for the premise and as support for the inclusion of these vegetation types or source habitats in the Supplemental Draft EIS.

For further information on landscape effects analysis see Hemstrom et al. (1999).

Rationale for Qualitative Interpretations of Modeling of Management Alternatives

The models developed by the SAG provide overall predictions which are useful in evaluating the effects of the alternatives. The SAG and the EIS Team evaluated the predictions of the models and identified a few instances where model predictions could be improved. These instances are discussed in the following paragraphs.

Restoration to Historical Levels

The intent of management direction in Alternatives S2 and S3 is to manage toward or within the range of historical variability and to repattern vegetation to match the landscape. These alternatives also include direction to restore certain source habitats that have declined substantially in geographic extent from historical to current periods, which would realistically stop as repatterning was completed. However, it was not possible to program the landscape model to stop the conversions if appropriate levels were reached. This led to some terrestrial communities possibly being increased above the level that should occur on the landscape, which caused others to be decreased below that level, both of which could adversely affect the assessment of departure from historical levels (HRV departure).

Late Seral Forest Development

The model moved most mid seral forest toward late seral forest. However, not all of the mid seral forest is expected to become late seral forest. In the cool and dry portions of these environments, an absence of disturbance results in some of the mid seral forest becoming over stocked and stagnated, thus slowing development to the late seral stage. A recent analysis on the Salmon-Challis National Forest (Bassford and Long, personal communication, 1999) indicates that stagnation of mid seral stands may have led to the over-estimation of levels of late seral forest in Alternative S1. Alternatives S2 and S3, which apply more disturbances (such as thinning and prescribed fire), would likely overcome the stagnation of mid seral forests in areas with more intensive restoration than Alternative S1.

Rangeland Condition/Livestock Management

The prescriptions available in the landscape model do not completely reflect the rangeland direction related to livestock management in Alternatives S2 and S3. Therefore, the predicted effects probably do not completely reflect the results of implementing direction in Alternatives S2 and S3. It was estimated by the SAG that rangeland conditions would probably be better under Alternatives S2 and S3 than predicted as changes in livestock grazing management were implemented. (See the Livestock Grazing section, under Factors Influencing Ecosystem Health.)

Exotic Undesirable Plants, including Legally Declared Noxious Weeds

The predicted reduction in extent of infestation of exotic undesirable plants was overestimated in the modeling effort. This is a result of the current extent of infestations of exotic undesirable plants within native plant communities being underestimated for the project area. Accurate extent could not be estimated with aerial photography and remote sensing, because exotic undesirable plants could not with certainty be distinguished from native vegetation in all cases. The effects in this section will discuss predicted trends and should portray the relative degree of differences between alternatives.

Succession and Disturbance Processes

Effects of the Alternatives on Succession and Disturbance Processes

Historically, valley, foothill, and mountainous terrain within the project area was dominated by patterns of vegetation that were driven and maintained by variable, yet generally predictable, succession / disturbance regimes on the landscape (see Chapter 2). Since that time, traditional commodity and reserve management strategies, coupled with fire suppression, have substantially changed the patterns of succession and disturbance regimes. A result is large increases in effects from uncharacteristic disturbances compared to historical times. Alternative S1, the no-action alternative, would not go as far in changing this traditional management direction as Alternatives S2 and S3.

The intent of Alternatives S2 and S3 is to repattern the vegetation on the landscape to make it more consistent with the historical landscape patterns and resilient to natural and human-caused disturbances such as wildfire, insects and disease, livestock grazing, and timber harvest. One of the yardsticks that will be used to judge which alternative is best, from an ecological perspective, is which alternative would come closest to repatterning the mix of habitats on the landscape to be similar to the range of vegetation and disturbance regimes that existed before European settlement. This is called the historical range, referred to as "historical" in subsequent sections. Another measuring stick is how well the alternatives would reduce the effects from uncharacteristic disturbances.

Forest Species Composition and Structure

This section provides a summary of how the alternatives would affect the species composition and structure of forestlands over the long term. It describes how the extent of species would increase or decrease over time and how structural stage (the developmental stage of the species) has to be considered when evaluating the effectiveness of the alternatives in restoring the patterns of habitats across the landscape.

Although the total extent of a particular species may have increased or declined from historical to current periods, not all structural stages (see Table 2-6a, Forest Structural Stages, in Chapter 2) within that species would have necessarily shown corresponding increases or declines. In many cases, a decline in one structural stage has resulted in increases in one or more other structural stages for that species. For example, the total amount of ponderosa pine might have increased in numbers of acres, but it may contain less old forest single story ponderosa pine forest and a lot more young forest. Therefore, it is important to consider not only the trend of the species as a whole under all alternatives, but also how the alternatives would address individual structural stages within that species, particularly the species / structural stage combinations that have declined substantially in geographic extent from historical to current periods.

Species Composition

This section describes the mix of different species of trees that would be expected over the long term under the different alternatives. Types of trees growing in a forest can be classified as shade-intolerant and shade-tolerant. Shade-intolerant species need full sunlight to establish and grow; shade-tolerant species do not. (See Chapter 2 for discussion of shade tolerance and intolerance, with lists of common tree species in each category.)

Basin-wide, the total extent of *shade-intolerant* species has declined substantially from historical to current periods. Overall, under any of the alternatives, the extent of these shade-intolerant species would expand on Forest Service- and BLM-administered lands in the long term. The decreasing trend in ponderosa pine is expected to reverse under all alternatives and would increase in extent to above historical levels, with the largest increase in Alternative S1. However, Alternatives S2 and S3 would increase the structural stages of ponderosa pine that have declined substantially in geographical extent from historical to current periods more than Alternative S1. Likewise, all alternatives are expected to increase the extent of western white pine, with greater increases in Alternatives S2 and S3 than Alternative S1, although none of the alternatives would reach historical levels. Alternative S1 is expected to expand the extent of the western larch the most, with little difference between Alternatives S2 and S3. Alternative S1 would be above historical levels while Alternatives S2 and S3 would be slightly below and closer to historical levels. Lodgepole pine would decrease in extent below historical levels for all alternatives because of severe disturbances such as bark beetles and / or wildfire. Alternative S1 would decrease lodgepole pine the most, with Alternatives S2 and S3 remaining closer to historical levels.

Increases in the extent of shade-intolerant species would result from natural disturbance (wildfire) reducing the extent of shade-tolerant species under all alternatives (because shade-tolerant species are fire sensitive), and from extensive restoration activities (human-caused disturbance such as thinning, prescribed fire, stewardship harvest) called for in Alternatives S2 and S3. Also, Alternatives S2 and S3 would benefit from direction to increase the extent of vegetation types that have declined substantially in geographic extent from historical to current periods, which often consist of shade-intolerant species.

Shade-tolerant cover types have generally increased from historical to current. All alternatives would reduce the extent of Douglas-fir below historical levels, with Alternatives S2 and S3 at slightly higher levels and closer to historical than Alternative S1. All alternatives, with little difference among them, would reduce the grand fir / white fir cover type below current levels, but none would approach historical ranges. However, there would be differences among alternatives in high restoration priority subbasins because of the higher emphasis on and concentration of restoration activities in Alternatives S2 and S3. The Engelmann spruce / subalpine fir cover type is expected to decline substantially under all alternatives, with all alternatives expected to go slightly below historical levels. There should be little difference among alternatives. The reason for no difference in the Engelmann spruce / subalpine fir cover type among alternatives is the low priority for restoration in the cold environments where these species grow.

Increases in the extent of shade-tolerant species would result from a lack of low-level disturbances that would have removed shade-tolerant species (which are also fire sensitive) and would have promoted more fire-resistant shade-intolerant species.

Stand Structure

Stands of trees can be classified based on their stage of development. This section describes for the alternatives the structural stages of forest and their extent that can be expected over the long term. (See Chapter 2 for further discussion.)

Old Forests

Old forests are of special concern because of their current scarcity. All alternatives are expected to increase the extent of old forests basin-wide, on Forest Service- and BLM-administered lands, in the long term (Map 4-1).

The extent of shade-intolerant old forest species, such as ponderosa pine, lodgepole pine, western larch, and western white pine, are expected to increase under all alternatives. Alternative S2 would likely increase in extent slightly more than Alternative S3, followed by Alternative S1. However, none of the alternatives would result in the shade-intolerant old-forest species, as a whole, reaching the historical extent in 100 years. The extent of shade-intolerant old forest in the *multi-story* structure would go above historical levels in the long term with little difference among alternatives. In the scarcer shade-intolerant *single story* structure, however, none of the alternatives would achieve historical levels. Alternative S2 is expected to increase the extent slightly more than Alternative S3, which should come out substantially better than Alternative S1. The reason that none of the alternatives would achieve historical levels of shade-intolerant, single story structure in 100 years is because of the long timeframes required to establish old-forest characteristics and the lack of high enough concentrations of restoration activities in much of the project area.

The differences among alternatives are due to the increased amount of thinning, prescribed fire, stewardship harvest, and direction to protect and increase the extent of old forest types that have declined substantially in geographical extent from historical to current periods found in Alternatives S2 and S3 compared to Alternative S1.

The current overall trend of increasing extent of shade-tolerant old-forest species such as Douglas-fir, grand fir / white fir, and subalpine fir is expected to continue with little difference among alternatives. In the *multi-story* structural stage, Alternatives S1 and S3 would increase the extent slightly more than Alternative S2, but all would be more than double the historical extent. The shade-tolerant *single story* structure, however, has declined slightly from historical because of lack of disturbances and subsequent ingrowth and development of multiple canopy layers. Alternative S2 should by far result in the greatest increase of this single story structure (nearing historical extent), followed by Alternative S3, then Alternative S1.

Early Seral Forest

Early seral forest, with a current extent just above historical levels, is expected to decrease slightly throughout the project area under all alternatives. This would result in the extent being slightly below historical levels. The early seral forest is unique compared to other vegetation types because it is short-lived in the absence of very frequent disturbance. Historically, early seral forests came and went in patches on the landscape at time intervals determined by the predominant disturbance regime; as it was waning in one area, it was being created somewhere else on the landscape. In Alternative S1, areas of early seral forest are created by stand-replacing disturbance (wildfire, insects and disease) and traditional timber harvest. In Alternatives S2 and S3, areas of early seral forest would be created by smaller amounts of stand-replacing disturbance, establishing areas of regeneration for shade-intolerant species such as western white pine and western larch, and intentionally creating early seral habitat where it is needed on the landscape.

Mid Seral Forests

In mid seral forests of the project area, which have increased in extent substantially from historical, Alternative S3 would reduce the extent the most, followed by Alternative S2. Alternative S1 would reduce the extent of mid seral forests the least, and none of the alternatives would reach historical levels. Changes in the mid seral forest in Alternative S1 would be due to succession to late seral forest or to stand-replacing disturbance or traditional harvest that converts it back to early seral forest. Changes in Alternatives S2 and S3 would likewise be due to succession into late seral forest, as well as some stand-replacing disturbances or intentional activities that cause transitions to early seral forest.

Patterns of Composition and Structure

Another factor to consider in this comparison of alternatives is the pattern of species composition and structure on the landscape. Alternatives S2 and S3 emphasize placement of these vegetation types in appropriate patch sizes and locations where they are consistent with the native disturbance regime, landform, climate, and biological and physical characteris-

Map 4-1. Expected Extent of Old Forest, Current and by Alternative at 100 Years.

tics of the ecosystems. The result should be that under Alternatives S2 and S3 the vegetation types (species-structural stage combinations) would be more resilient to disturbance and more sustainable over time than with Alternative S1.

Disturbance

This section describes the dominant disturbances affecting succession of vegetation that are influenced by the alternatives.

Fire Regime

Currently about one percent of the Forest Service- and BLM-administered lands in the ICBEMP project area are affected by fire activity on an average yearly basis. This is a combination of wildfire, prescribed fire, and "wildland fire use for resource benefit" (formerly referred to as prescribed natural fire). Alternative S1 should maintain current levels of fire activity, while Alternatives S2 and S3 would sharply increase fire activity, with levels higher in Alternative S2 than Alternative S3 in the long term. The largest increases in fire activity are expected in the Southeast Oregon RAC, followed by the John Day-Snake RAC, the Butte RAC, the Upper Columbia-Salmon-Clearwater-R4 RAC, and the Upper Columbia-Salmon-Clearwater-R1 RAC. The Lower Snake River RAC and the Upper Snake River RAC are expected to show no increases and declines in fire activity respectively in the long term (Map 4-2). Other RAC/PACs would show lesser increases in fire activity.

Prescribed fire amounts are expected to differ greatly from Alternatives S2 and S3 to Alternative S1 on Forest Service- and BLM-administered lands in the long term (Map 4-3). Alternatives S2 and S3 would show substantial increases in many parts of the project area, while Alternative S1 would be expected to maintain current levels on average. Alternative S2 would treat more acres using prescribed fire than Alternative S3. Most likely, the greatest increases in prescribed fire and other fuels management activities under Alternatives S2 and S3 would be found in the John Day-Snake RAC, the Southeast Oregon RAC, the Upper Columbia-Salmon-Clearwater R1 RAC, the Upper Columbia-Salmon-Clearwater R4 RAC, the Eastern Washington-Cascades PAC, and the Upper Snake River RAC.

Long-term projections indicate that Alternatives S2 and S3 would have greater increases in "wildland fire use for resource benefit" than Alternative S1, although none of the alternatives would result in substantial increases (Map 4-4). The greatest increases would be expected in the John Day-Snake RAC, the Eastern Washington-Cascades PAC, the Upper Snake River RAC, and the Southeast Oregon RAC.

Because of activities such as prescribed fire, "wildland fire use for resource benefit," and fuel reduction, Alternatives S2 and S3 are expected to result in a smaller increase in the level of wildfire on Forest Service- and BLM-administered lands in the long term than Alternative S1 (Map 4-5). RAC/PACs where increases would be expected in the amount of wildfire are the John Day-Snake RAC, the Upper Columbia-Salmon-Clearwater R4 RAC, and the Lower Snake River RAC (all alternatives). Several RAC/PACs could experience lesser increases in wildfire activity, led by the Upper Snake River RAC (all alternatives), and including the Eastern Washington-Cascades PAC (Alternative S1 only), the John Day-Snake RAC (Alternative S1 only), the Lower Snake River RAC (all alternatives), and the Upper Columbia-Salmon-Clearwater R4 RAC (all alternatives). Wildfire activity is a relatively random process that depends on fuels, ignition, weather, and suppression ability, so these projections have somewhat large confidence bands.

In the high restoration priority subbasins identified in Alternatives S2 and S3, the story is more dramatic. Alternative S1 is expected to have twice the level of uncharacteristic wildfire in the long term in high restoration priority subbasins compared to Alternative S2 . The projected extent of uncharacteristic wildfire is expected to be 2.5 times greater for Alternative S1 compared to Alternative S3 in high restoration priority subbasins. These effects would be a result of the increased amount of prescribed fire and other restoration activities in Alternative S2, and to a slightly lesser extent, Alternative S3.

The extent and severity of wildfires depends on fuel levels and connectivity, topography, weather, vegetation composition and structure, and suppression efforts. Wildfires tend to be bigger currently than historically. However, through prescribed fire and repatterning of vegetation, Alternatives S2 and S3 would attempt to influence fire activities to respond more similarly in patch and pattern to historical ranges than would be expected to occur under Alternative S1. This, in turn should lead to better resiliency and sustainability of vegetation types on the landscape under Alternatives S2 and S3.

Insects and Disease

Insect and disease activity is an important natural process in the forests at all elevations in the basin.

Map 4-2. Annual Average Fire Activity and Diusturbance Classes: Change from Current (Year 100).

Map 4-3. Annual Average Prescribed Fire/Fuel Management Activity Classes: Change from Current.

Map 4-4. Annual Average "Wildland Fire Use for Resource Benefit" Activity Classes: Change from Current (Year 100).

Map 4-5. Annual Average Wildland Fire Disturbance Classes: Change from Current (Year 100).

However, much of the Forest Service- and BLM administered forestlands have come to experience uncharacteristic insect and disease activity. Uncharacteristic forest insect and disease activity is defined in the SAG *Effects Analysis* (Quigley 1999) as a change of more than 20 percent from the historical range of forest insect and disease conditions.

In the long term, there would be little difference among the alternatives in the extent of associated uncharacteristic insect and disease activity the project area is expected to experience (Map 4-6). Alternative S2 would be slightly better than Alternative S1, which would be slightly better than Alternative S3. The greatest increases are expected in central and north Idaho, western Montana, and the Cascades. Much of the uncharacteristic insect and disease activity is expected to be in wilderness areas. Uncharacteristic insect and disease activity may decline slightly in the Deschutes RAC and the Butte PAC. The greatest reductions would be in the accessible low elevation dry forests.

In high restoration priority subbasins, Alternatives S2 and S3 are expected to show only slight improvement in uncharacteristic insect and disease activity over Alternative S1. Alternatives S2 and S3 would probably hold the uncharacteristic insect and disease activity levels to slightly more than current levels compared to a modest increase under Alternative S1. Differences among the alternatives would result from a higher concentration of restoration activities in Alternatives S2 and S3, which would regulate stand densities and reduce moisture stress.

Human Disturbance

Timber harvest is a human-caused disturbance in forestlands. Traditional timber harvest has led to declines in old forests, shade-intolerant species, large trees, and snags and downed wood, all important elements for wildlife species. Alternative S1 would continue some of the same methods of timber harvest into the future. Alternatives S2 and S3 would increase the amount of thinning and timber harvest, but it would be a stewardship harvest. Stewardship harvest would focus on the ecological condition of the forest (outcomes), while traditional harvest has often focused on supplying timber (outputs). Stewardship harvest would promote desired outcomes for species composition and structure, and disturbances more characteristic of the site (such as shade-intolerant trees, large trees, snags, and downed wood). See the socio-economic section of this chapter for a more in-depth comparison of harvest and thinning levels by alternative. Traditional timber harvest and stewardship harvest are defined in the Key Terms at the beginning of this chapter, and in the Glossary.

The term 'downed wood' as used in this analysis is synonymous with the term 'coarse woody debris' as used in Chapters 2 and 3. *Large snags* and *large downed wood* are defined in this analysis as dead trees larger than 21 inches in diameter at breast height. Overall, all three alternatives should increase the number of large snags on Forest Service- and BLM-administered lands, with Alternatives S2 and S3 resulting in higher numbers than Alternative S1. In the dry forest PVG, Alternatives S2 and S3 should result in snag numbers slightly above current levels. Alternative S1 is expected to fall short of current numbers. These increases are attributable to aging forests (all alternatives), mortality from insects and disease, expected restoration efforts (Alternatives S2 and S3), and large snag requirements (Alternatives S2 and S3, and to a lesser extent, Alternative S1). All alternatives are expected to increase the large snag levels to slightly above historical levels in the cold forest PVG, and well above historical levels in the moist forest PVG. Some of the greatest increases are expected in the riparian woodland PVG because of the riparian buffers in all alternatives.

Overall, current levels of large downed wood are high. Generally, large downed wood levels on Forest Service- and BLM-administered lands are expected to drop below current levels in Alternatives S2 and S3 because of increases in prescribed fire. Under Alternative S1 the large downed wood levels should continue to increase. In the moist forest PVG, Alternative S1 would maintain the high levels of large downed wood, while Alternatives S2 and S3 would reduce those levels. In the dry forest PVG, all alternatives are expected to increase levels above current and historical, with Alternatives S2 and S3 higher than Alternative S1. There are few expected differences among alternatives in the cold forest PVG.

Map 4-6. Annual Average Uncharacteristic Insect/Disease Tree Mortality Vulnerability Classes: Change from Current (Year 100).

Potential Vegetation Groups

Effects of the Alternatives on Potential Vegetation Groups

Introduction

Just looking at species composition and structure, as discussed in the previous section, over simplifies the effects of the alternatives on the landscape. This section provides more detail on how effective the alternatives would be at restoring the diverse mixture of vegetation types across the project area. Understanding the effects of the alternatives on these diverse habitats is important to an understanding of effects on terestrial species, biodiversity, and landscape health.

Following Alpine PVG, the effects section for each *forest* potential vegetation group (PVG) (cold forest, moist forest, dry forest) starts out with a comparison ("Summary Effects") of how well the alternatives are expected to restore the PVG, especially addressing the issues presented in the background discussion for that PVG. The effects of the alternatives on the forested terrestrial communities of the PVG are presented next. Effects for each terrestrial community are described by:

1. A background description of the terrestrial community including current status;
2. The effects of the alternatives on the terrestrial community extent in the long term;
3. The effects of the alternatives on the extent of vegetation types that have declined substantially in geographical extent from historical to current periods, and on vegetation types that have not declined substantially, within the terrestrial community in the long term, if applicable;
4. The effects of the alternatives within T watersheds and high restoration priority subbasins in the long term; and
5. Where the terrestrial communities of the future will come from and/or transition to in the long term.

The effects discussion for each forested PVG ends with a table that displays how effective each alternative is expected to be at trending toward ecologically desired levels of individual terrestrial communities within the PVG.

The effects section for each *rangeland* PVG (woodland, cool shrub, dry grass, dry shrub) also starts out with a background discussion and Summary Effects comparison of how well the alternatives are expected to restore the PVG. However, effects on terrestrial communities in rangeland PVGs are presented in a different format from effects on terrestrial communities in forested PVGs, in part because many of the rangeland terrestrial communities would be expected to incur similar effects in more than one PVG. Additionally, compared to effects in forested PVGs and terrestrial communities (which are complicated by shade tolerance/ intolerance and single/multi-story considerations), the effects within rangeland PVGs are relatively straightforward. Therefore, effects on rangeland terrestrial communities are organized by terrestrial community, following the individual PVG discussions.

Alpine PVG

The alpine PVG makes up a very small part of the project area, and the extent did not change from historical to current periods. It is composed of a single cover type, the alpine tundra, which is divided into two structural stages: the closed low shrub and the open low shrub. The extents of these structural stages are somewhat evenly divided.

The alpine PVG is not expected to change much over the next 100 years because in the high elevation cold climate, vegetation changes from natural succession or disturbance come very slowly and none of the alternatives have priorities or management activities directed at the alpine PVG.

Cold Forest PVG

Background

From historical to current periods, the cold forest has seen the fewest changes of any of the forest PVGs. However, some of the major changes include a shift in dominance from shade-intolerant to shade-tolerant species, loss of whitebark pine due to blister rust, and an increase in the early seral vegetation types. The predominant fire regime has changed from mixed severity and infrequent, to stand-replacing and very infrequent.

Summary Effects for Cold Forest

Under Alternatives S2 and S3, a lower emphasis has been placed on restoration activities in the cold forest

PVG compared to other forest PVGs, because the shifts in vegetation and disturbance regimes have not been as great, much of the cold forest lacks accessibility, and the vegetation would be slower to show successional changes or to respond to restoration activities in the cooler, high elevation environments in the future than other forest PVGs.

Alternatives S2 and S3 (with little difference between them) would be expected to be more effective at slowing undesirable trends than Alternative S1. Beneficial effects under all alternatives, however, would be constrained by the lower concentration of restoration activities in the cold forest PVG compared to other forested PVGs, the relative slow growth of vegetation, and the fact that the cold forest PVG contains much of the wilderness areas and A1 subwatersheds (in Alternatives S2 and S3) where restoration is limited.

Basin-wide on Forest Service- and BLM-administered lands, all alternatives are expected to increase the extent of whitebark pine, with Alternatives S2 and S3 higher than Alternative S1. Most of that increase would come in the early seral structural stage, at the expense of old forests which would decline in the long term under all alternatives because of white pine blister rust.

The whitebark pine / subalpine larch cover type is relatively small in size compared to other cover types in the project area. However, it is very important both ecologically and because of its drastic decline. Overall, all alternatives would increase the extent of the whitebark pine / subalpine larch cover type on Forest Service- andBLM-administered lands in the long term.

Alternatives S2 and S3 are expected to show improvement in T watersheds and high restoration priority subbasins by bringing the whitebark pine / subalpine larch and whitebark pine vegetation types that have declined substantially in geographical extent from historical to current periods back to historical levels. Under Alternative S1 the extent of these vegetation types would continue to decline in these same areas.

When all cold forest cover types are considered, all of the alternatives are expected to reduce the extent of early seral forests to near historical levels, with Alternatives S2 and S3 coming closer than Alternative S1. Alternatives S2 and S3 should also come the closest to the ecologically desirable mix on the landscape of vegetation types that have and have not declined substantially in geographical extent from historical to current periods.

Based on HRV departure data, the landscape disturbance regimes would continue to move away from historical regimes in the long term on Forest Service- and BLM-administered lands basin-wide. This would result from continued succession and less frequent disturbance regimes than historical, leading to changes in vegetation and less landscape diversity in patch and pattern. Alternatives S2 and S3 should slow HRV departure more than Alternative S1. Alternatives S2 and S3 should slow HRV departure even more in the high restoration priority subbasins because of the increased emphasis on restoration and a higher concentration of restoration activities in those areas.

Effects on Cold Forest Terrestrial Communities

Early Seral Montane (Cold Forest PVG)

Background: This terrestrial community consists of stand-initiation and shrub / herb / tree regeneration. Lodgepole pine in the stand-initiation structural stage is the only vegetation type that has declined substantially in geographic extent from historical to current periods. The most extensive vegetation types that have not declined substantially are interior Douglas-fir and shrub / herb / tree regeneration. This terrestrial community is currently at greater than historical levels.

Future Extent: In the long term, all alternatives are expected to maintain near current levels of the early seral montane forest. The lack of difference among the alternatives is due to the relatively low priority for restoration activities in the cold forest.

Specified Areas: However, in T watersheds and high restoration priority subbasins, Alternatives S2 and S3 are expected to increase the extent of the vegetation type that has declined substantially in geographic extent from historical to current periods (lodgepole pine stand-initiation) and reduce the extent of the vegetation types that have not declined substantially (interior Douglas-fir and shrub / herb / tree regeneration) more than Alternative S1.

Future transitions: Stand-replacing disturbance would be the agent that shifts late seral and mid seral montane forests into the early seral montane terrestrial community. As these early seral montane forest grow, they would shift to the mid seral montane terrestrial community.

Early Seral Subalpine (Cold Forest PVG)

Background: This terrestrial community group is made up of the stand-initiation structural stage in just a few cover types. The vegetation types that have declined substantially in geographic extent from historical to current periods are in the whitebark pine and the whitebark pine / alpine larch cover types. Cover types that have not declined substantially are the Engelmann spruce / subalpine fir and mountain hemlock. Engelmann spruce / subalpine fir and whitebark pine are the major cover types in this terrestrial community. The extent of this terrestrial community is above historical levels.

Future Extent: All of the alternatives should reduce the extent of this terrestrial community, toward historical in the long term on Forest Service- and BLM-administered lands. Alternatives S2 and S3 are expected to decrease the extent the most compared to Alternative S1.

Alternatives S2 and S3 are expected to increase the extent of vegetation types that have declined substantially in geographic extent from historical to current periods (whitebark pine stand-initiation stage) more than Alternative S1, especially in T watersheds and high restoration priority subbasins. Alternatives S2 and S3 should also increase the extent of vegetation types that have declined substantially in geographic extent from historical to current periods and reduce the extent of the vegetation types that have not declined substantially (Engelmann spruce / subalpine fir stand-initiation stage) to closer to historical levels in these areas of interest.

Future Transitions: Most of this terrestrial community would be created through stand-replacing wildfire in all alternatives because of the increasing fire levels (Alternative S1 and to a lesser extent, Alternatives S2 and S3) and the relatively low priority for restoration in the high elevation forests (Alternatives S2 and S3 and to a lesser extent, Alternative S1). Also, much of this terrestrial community is within wilderness area boundaries, which limits the use of active management.

Stand-replacing disturbance would be the agent that shifts late seral and mid seral subalpine forests into the early seral subalpine terrestrial community. As these early seral subalpine forests grow, they would shift to the mid seral subalpine terrestrial community.

Mid Seral Montane (Cold Forest PVG)

Background: The mid seral montane forest is composed of young to middle-aged structural stages and three cover types in various combinations. The shade-intolerant species is lodgepole pine. The shade-tolerant species are interior Douglas-fir and red fir. There is one vegetation type that has declined substantially in geographic extent from historical to current periods: interior Douglas-fir stem exclusion closed canopy. This terrestrial community has declined in extent.

Future Extent: In the long term on Forest Service- and BLM-administered lands, all alternatives would increase the extent of the mid seral montane terrestrial community to near historical amounts.

Overall, Alternative S2 is expected to increase the most the extent of the vegetation type that has declined substantially in geographic extent from historical to current periods (interior Douglas-fir stem exclusion closed canopy) and increase the least the extent of the vegetation types that have not declined substantially. This would lead to closer to historical levels of vegetation types that have declined substantially and those that have not declined substantially. Alternative S1 is the furthest from historical ranges, and Alternative S3 is slightly less than Alternative S2.

Specified Areas: In T watersheds and high restoration priority subbasins, Alternatives S2 and S3 should do a better job of increasing the vegetation types that have declined substantially in geographic extent from historical to current periods and decreasing the vegetation types that have not declined substantially compared to Alternative S1. This is because of the higher priority for and higher concentration of restoration activities in these areas of concern.

Future Transitions: The expansion of the mid seral montane forest in the cold forest PVG would come through growth and succession from the early seral montane terrestrial community. The loss of this terrestrial communtity in some places would most likely be due to growth and succession to late seral montane multi- and single story forests, or conversion through stand-replacing disturbance such as wildfire, insects, and disease (all alternatives) to early seral montane forests.

Mid Seral Subalpine (Cold Forest PVG)

Background: The mid seral subalpine terrestrial community contains several young to middle-aged structural stages of the whitebark pine, whitebark pine / alpine larch, mountain hemlock, and Engelmann spruce cover types. Most of the whitebark pine and whitebark pine / alpine larch structural stages have declined substantially in geographic extent from historical to current periods. All but one of the Engelmann spruce structural stages have not declined substantially, and mountain hemlock is a minor type in the project area. The extent of this terrestrial community has not changed much.

Future Extent: All alternatives are projected to see a decline in the extent of the mid seral subalpine forest on Forest Service- and BLM-administered lands in the long term. The level would go below historical levels in Alternatives S2 and S3 because the high elevation cold forests are a relatively low priority for restoration activities and active management. Also, much of this terrestrial community is in designated wilderness area, where active management is limited.

Specified Areas: In T watersheds outside wilderness areas, and in high restoration priority subbasins, Alternatives S2 and S3 are expected to increase vegetation types that have declined substantially in geographic extent from historical to current periods while decreasing vegetation types that have not declined substantially more than Alternative S1. Because of increased emphasis on and a slightly higher concentration of restoration activities in high restoration priority subbasins, Alternatives S2 and S3 would come the closest to historical proportions.

Future transitions: The mid seral subalpine forests would grow and mature into late seral subalpine multi- and single story forests through the process of succession (all alternatives). Mid seral subalpine forests would develop from early seral subalpine forests through normal growth and succession, and from late seral subalpine forests through disturbances such traditional timber harvest (Alternative S1), and insects and disease (all alternatives), that would cause mortality in the older trees.

Late Seral Montane Multi-story (Cold Forest PVG)

Background: The late seral montane multi-story terrestrial community includes the late seral multi-story structural stage of four different cover types. None of the vegetation types in this terrestrial community have declined substantially in geographic extent from historical to current periods. The most prominent vegetation types are interior Douglas-fir, lodgepole pine, and grand fir / white fir. The trend from historical to current in this terrestrial community is a slight increase.

Future Extent: In the long term on Forest Service- and BLM-administered lands, all alternatives would maintain near current levels of late seral montane multi-story forest.

Specified Areas: In the T watersheds and high restoration priority subbasins, Alternatives S2 and S3 would maintain late seral montane multi-story vegetation types near current levels. However, Alternative S1 is expected to increase vegetation types beyond historical ranges. Alternative S2 would come the closest to reaching historical proportions. Alternative S3 would result in proportions slightly worse than Alternative S2 but better than Alternative S1.

Future transitions: The late seral montane multi-story terrestrial community would come from mid seral montane forests through growth and succession (all alternatives) and, in the absence of disturbance, from development of multiple canopy layers in late seral montane single story forests. Transitions out of this terrestrial community would go to early seral montane montane forests through disturbances such as traditional harvest, wildfire, insects (all alternatives), and disease (all alternatives).

Late Seral Montane Single Story (Cold Forest PVG)

Background: This is a relatively small terrestrial community compared to other terrestrial communities within the cold forest PVG. Lodgepole pine, late seral single story stage, is the only vegetation type within this terrestrial community that has declined substantially in geographic extent from historical to current periods. Of the vegetation types that have not declined substantially, interior Douglas-fir, and western redcedar / western hemlock (also late seral single story stage), are the predominant ones. Therefore, these are the three vegetation types driving the differences between the alternatives in this terrestrial community. The late seral montane single story forest has declined since historical times.

Future Extent: All of the alternatives are expected to increase the extent of this terrestrial community on Forest Service- and BLM-administered lands in the long term but all would still be at less than historical levels.

Alternative S2 would come closest to historical levels in extent of the vegetation type that has declined substantially in geographic extent from historical to current periods, followed by Alternative S3, with Alternative S1 last. Alternative S1 is expected to reduce vegetation types that have not declined substantially far below historical levels, followed by Alternative S3, and Alternative S2. The result is that basin-wide, Alternative S2 would be more effective at matching the levels of the vegetation types in this terrestrial community to historical amounts, with Alternative S3 next and Alternative S1 last.

Specified Areas: In T watersheds and high restoration priority subbasins, Alternative S2 would be most effective in increasing the vegetation type that has declined substantially in geographic extent from historical to current periods and reducing the vegetation types that have not declined substantially, followed by Alternative S3 and Alternative S1. Late seral single story lodgepole pine would be increased, especially in Alternatives S2 and S3, while the late seral single story interior Douglas-fir is expected to decline in extent, resulting in beneficial trends.

Future transitions: Transitions into this terrestrial community would come from the mid seral montane forest through growth and succession (all alternatives), and from late seral montane single story forests through restoration activities such as thinning and prescribed fire (Alternatives S2 and S3). Transitions out of this terrestrial community would be: to early seral forests through stand-replacing disturbances such as wildfire (all alternatives) and traditional harvest (Alternative S1); to mid seral montane forests through disturbances such as traditional harvest (Alternative S1) or insects and disease (all alternatives); or to late seral montane multi-story forests through growth and succession (all alternatives).

Late Seral Subalpine Multi-story (Cold Forest PVG)

Background: The late seral subalpine multi-story terrestrial community is composed of four species in the late seral multi-story structural stage. All of the vegetation types in this terrestrial community have declined substantially in geographic extent from historical to current periods, including: whitebark pine, whitebark pine / alpine larch, Engelmann spruce / subalpine fir, and mountain hemlock (a minor type).

Future Extent: All of the alternatives would increase this terrestrial community above current levels. Alternatives S2 and S3 are expected to increase the extent of this terrestrial community to within historical levels, while Alternative S1 would not.

Specified Areas: The results should be similar in T watersheds and high restoration priority subbasins, where Alternatives S2 and S3 achieve historical ranges. However, these gains are not expected to come in the whitebark pine cover type. Most gains would instead come in whitebark pine / alpine larch and especially the Engelmann spruce / subalpine fir late seral multi-story forests.

Future transitions: Transitions into this terrestrial community would come from the mid seral subalpine terrestrial community through growth and succession (all alternatives) and from late seral subalpine single story forests through successional development of multiple canopy layers in the absence of disturbance (all alternatives). Transitions out of this terrestrial community would be to early seral subalpine forests through stand-replacing disturbance such as wildfire, insects and disease (all alternatives); or to mid seral montane forest through lesser disturbance such as traditional timber harvest (Alternative S1) or white pine blister rust (all alternatives).

Late Seral Subalpine Single Story (Cold Forest PVG)

Background: The late seral subalpine single story terrestrial community is almost exclusively made up of whitebark pine in the late seral single story structure. This is vegetation type has not declined substantially in geographic extent from historical to current periods. This terrestrial community has expanded since historical times.

Future Extent: In the long-term, basin-wide on Forest Service- and BLM-administered lands, all alternatives are expected to reduce the extent of this vegetation type to well below historical levels. This decline can be attributed to white pine blister rust (all alternatives) and the lack of priority for restoration (Alternatives S2, S3, and to a lesser extent Alternative S1) in the late seral subalpine single story terrestrial community, much of which can be found in designated wilderness areas where active restoration is limited.

Specified Areas: In T watersheds the effects would likely be similar to basin-wide projections because it would require very active management to prevent the decline. In high restoration priority subbasins, Alternatives S2 and S3 would increase the amount of the old single story whitebark pine cover type even more because of the additional emphasis and funding intended for the high restoration priority subbasins. This would be encouraging, but there is uncertainty in the effective development of blister rust resistant planting stock.

Future transitions: Transitions into this terrestrial community would come from the mid seral subalpine terrestrial community through growth and succession (all alternatives), and from the late seral multi-story forests through restoration activities such as thinning (Alternatives S2 and S3) and prescribed fire (Alternatives S2 and S3). Transitions away from this terrestrial community would go to early seral montane forest through stand-replacing disturbance (all alternatives), or to mid seral montane forest through lesser disturbance such as traditional timber harvest (Alternative S1) or white pine blister rust (all alternatives).

Table 4-12 summarizes effects of the alternatives on the cold forest PVG.

Table 4-12. Effects of the Alternatives on the Cold Forest Potential Vegetation Group (PVG) in the Project Area,[1] Current to Long Term.

Terrestrial Community Group	Trend Toward (T) or Away (A) From Historical Amounts (Short Term/Long Term) Alternative S1	Alternative S2	Alternative S3	Alternative that Comes Nearest to Trending Terrestrial Communities Toward Historical
Early seral montane	T/T	T/T	T/T	S2
Early seral subalpine	T/T	T/T	T/T	S1=S2=S3
Mid seral montane	T/A	T/T	T/T	S2=S3
Mid seral subalpine	A/A	A/A	A/A	S2=S3
Late seral montane multi-story	A/A	A/A	A/A	S2
Late seral subalpine multi-story	T/A	T/T	T/T	S2=S3
Late seral montane single story	A/A	A/A	A/A	S2
Late seral subalpine single story	A/A	A/A	A/A	S2=S3

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Interpreted from ICBEMP GIS data.

Moist Forest PVG

Background

Because of fire suppression, timber harvest, roads, and white pine blister rust, the moist forest PVG has experienced great change since settlement of the project area by Euroamericans. Vast amounts of old forest have converted to mid seral stages. Early forest stages have declined. Only five percent of the western white pine cover type remains. Shade-intolerant species such as western white pine, western larch, and ponderosa pine have often been replaced by shade-tolerant species including interior Douglas-fir and grand fir / white fir. These changes in tree species and the stress from increased stand densities have led to uncharacteristic effects from insects and disease. The predominant fire regime has changed from mixed severity frequent and infrequent fires, to lethal stand-replacing infrequent and very infrequent fire.

Summary Effects for Moist Forest

A higher emphasis has been placed in Alternatives S2 and S3 on restoration activities in the moist forest PVG compared to the cold forest PVGs, because of large shifts in vegetation and disturbance regimes, scarcity of some terrestrial habitats, accessibility, and the rapid pace at which succession takes place in moist forest. This emphasis should lead to a higher concentration of restoration activities compared to the cold forest PVG but a slightly lower concentration of activities than in the dry forest PVG.

Alternatives S2 and S3 would be expected to be more effective in slowing the undesired trends in the moist forest PVG than Alternative S1. Alternative S2 should do slightly better than Alternative S3 because restoration activities would be concentrated in fewer high restoration priority subbasins, but even in Alternative S2 restoration activities would not be extensive or intensive enough to reverse the rapid successional changes that occur in the moist forests.

Alternatives S2 and S3 would increase the extent of old forests in the moist forest PVG in the long term to slightly above historical levels. Old forest in the moist forest PVG in Alternative S1 would not achieve historical levels. All alternatives would hold early seral forests near current levels, with Alternative S1 closer to historical than Alternatives S2 and S3.

Alternatives S2 and S3 are expected to increase the extent of the white pine species to slightly below the historical range, much above the extent expected for Alternative S1 over the long term. Other shade-intolerant species such as western larch and ponderosa pine also would increase under all alternatives but would be closer to historical levels under Alternatives S2 and S3. Uncharacteristic effects from insects and disease should continue near current levels under all alternatives with little difference between the alternatives.

The landscape disturbance regimes would continue to become less like historical regimes in the long term on Forest Service- and BLM-administered lands basin-wide. Alternatives S2 and S3 would not allow this departure from HRV to increase as much as Alternative S1. There would be even greater differences between alternatives in the high restoration priority subbasins; Alternatives S2 and S3, by focusing restoration activities to these areas of high risk and opportunity, would concentrate efforts to address landscape disturbance regimes; Alternative S1 does not have this basin-wide strategy.

Effects on Moist Forest Terrestrial Communities

Early Seral Lower Montane (Moist Forest PVG)

Background: The early seral lower montane forest covers a relatively small portion of the moist forest PVG. It is made up of only two species/ structural stage combinations, and both have declined substantially in geographic extent from historical to current periods: interior ponderosa pine and Pacific ponderosa pine, both in the stand-initiation stage of early seral forest. Pacific ponderosa pine is a minor type, leaving interior ponderosa pine stand-initiation as the vegetation type that drives this terrestrial community. The early seral lower montane forest has decreased in extent in the moist forest PVG.

Future Extent: Basin-wide, all alternatives would increase the interior ponderosa pine stand-initiation vegetation type to above historical levels on Forest Service- and BLM- administered lands. Alternative S1 is expected to increase the extent the most, followed by Alternative S3, with Alternative S2 closest to historical levels.

Since interior ponderosa pine stand-initiation is the driver in this terrestrial community, increasing its extent would increase presence of the main vegetation type that has declined substantially in geographic extent from historical to current periods in this terrestrial community.

Specified areas: In T watersheds, all alternatives are expected to increase extent of the interior ponderosa pine stand-initiation stage to near historical levels. In the high restoration priority subbasins of Alternatives S2 and S3, the extent of intererior ponderosa pine stand-initiation stage would be similar to that found project area-wide for all alternatives.

Future transitions: The transitions into this community would be mainly from mid and late seral stages of lower montane and montane forests through stand-replacing wildfire (all alternatives) and other severe disturbances (all alternatives), clearcuts (Alternative S1), and conversion from vegetation types inappropriate for the site through restoration (Alternatives S2 and S3). Transitions could go to mid seral lower montane forests such as young multi-story (managed or unmanaged) through growth and succession (all alternatives), or to shrub/herb/tree regeneration through stand replacing disturbance (all alternatives).

Early Seral Montane (Moist Forest PVG)

Background: Historically, the early seral montane terrestrial community accounted for one-fourth of the moist forest PVG. It is almost entirely made up of the stand-initiation structural stage with a variety of species. There are two main species that have declined substantially in geographic extent from historical to current periods: western larch and western white pine. The early seral montane terrestrial community also contains significant amounts of interior Douglas-fir and grand fir/white fir in the moist forest, which have not declined substantially in geographic extent from historical to current periods. The extent of the early seral montane forest has decreased since the historical period.

Future Extent: All of the alternatives are expected to maintain current extent of this terrestrial community with little difference between alternatives.

Alternatives S2 and S3 would increase the extent of vegetation types that have declined substantially in geographic extent from historical to current periods (western larch and western white pine) more than Alternative S1. Interior Douglas-fir and grand fir/ white fir, which have not declined substantially, would remain near current extent or slightly below for all alternatives.

Specified areas: In T watersheds, all alternatives should slightly increase the extent of vegetation types that have declined substantially in geographic extent from historical to current periods, with Alternative S2 more than Alternative S3 and Alternative S1. In high restoration priority subbasins, Alternative S1 is expected to increase the extent of vegetation types that have declined substantially in geographic extent from historical to current periods more than Alternatives S2 and S3. The main reason for these differences would be more stand-replacing wildfire under Alternative S1, which would create more early seral forest than under Alternatives S2 and S3.

Future transitions: The vegetation types that have not declined substantially would be created in this terrestrial community through stand-replacing wildfire (Alternative S1 more than Alternatives S2 and S3), clearcutting (Alternative S1), and other stand-replacing disturbances (all alternatives). The vegetation types that have declined substantially in geographic extent from historical to current periods would be increased through intentional creation of openings to establish western larch and western white pine (Alternatives S2, S3, and to a lesser extent, S1). Transitions out of the early seral montane forest would likely be to mid seral montane forest through growth and succession (all alternatives).

Early Seral Subalpine (Moist Forest PVG)

Background: A small amount of early seral subalpine terrestrial community overlaps with the moist forest PVG. The species are Engelmann spruce / subalpine fir and mountain hemlock, of which mountain hemlock is a very small amount. Therefore, Engelmann spruce in the stand-initiation stage, which has not declined substantially in geographic extent from historical to current periods, is the only substantial vegetation type. The early seral subalpine terrestrial community has slightly decreased in extent.

FutureExtent: All alternatives are projected to reduce the extent of this terrestrial community in the moist forest PVG on Forest Service and BLM administered lands in the long term, with little difference among alternatives, primarily because of low priority for restoration and slow growth and succession in these cool environments (all alternatives).

Future transitions: Forests transitioning into this terrestrial community would come from mid and late seral subalpine forests through stand-replacing disturbances such as wildfire, insects, and disease (all alternatives). The early seral subalpine terrestrial community would mature into mid seral subalpine forests through succession and growth (all alternatives).

Mid Seral Lower Montane (Moist Forest PVG)

Background: The vegetation types in the mid seral lower montane terrestrial community that have declined substantially in geographic extent from historical to current periods are Pacific ponderosa pine (stem exclusion closed canopy stage), a minor type, and interior ponderosa pine (stem exclusion closed canopy stage), which is the dominant type. The important vegetation types that have not declined substantially are all interior ponderosa pine: (1) understory reinitiation, (2) stem exclusion open canopy, (3) young multi-story unmanaged, and (4) young multi-story managed. Although the young multi-story managed vegetation type is important today, it did not exist historically. The mid seral lower montane forest has increased slightly in extent.

Future Extent: All alternatives would increase the extent of this terrestrial community above current levels on Forest Service- and BLM- administered lands in the long term.

It is projected that all alternatives would increase the extent of the vegetation type that has declined substantially in extent from historical to current periods (interior ponderosa pine stem exclusion closed canopy) but would fall short of historical levels. All alternatives are expected to maintain the extent of vegetation types that have not declined substantially near current levels with little difference among alternatives.

Specified areas: In T watersheds, Alternative S2 would return closest to historical levels the extent of vegetation types that have declined substantially in geographic extent from historical to current periods. The extent under Alternative S3 would be slightly less, followed by Alternative S1. In high restoration priority subbasins, Alternatives S2 and S3 would increase the extent of these vegetation types the nearest to historical and higher than Alternative S1.

Future transitions: Stand-replacing disturbances such as wildfire (all alternatives) could transition this terrestrial community back to an early seral lower montane terrestrial community. Other disturbances such as insects and disease (all alternatives), or traditional timber harvest (Alternative S1) could transition this terrestrial community to a mid seral montane forest by converting the ponderosa pine to a shade-tolerant cover type. Growth and succession (all alternatives) would transition these forests into late seral lower montane multi- or single story terrestrial communities (all alternatives).

New mid seral lower montane forest would come from the early seral lower montane forest through growth and succession (all alternatives). They may also transition from late seral forests through disturbances such as insects and disease (all alternatives), or timber harvest (Alternative S1) that removes the larger trees.

Mid Seral Montane (Moist Forest PVG)

Background: At present, the mid seral montane terrestrial community accounts for nearly 60 percent of the moist forest PVG. The vegetation types are composed of various combinations of several species and young to middle-age structural stages. There are four vegetation types of consequence that have declined substantially in geographic extent from historical to current periods: western larch (young multi-storied, and unmanaged), western white pine (stem exclusion closed canopy), western white pine (understory reinitiation), and interior Douglas-fir (stem exclusion closed canopy). The important vegetation types that have not declined substantially are combinations of six species (western larch, western white pine, interior Douglas-fir, grand fir / white fir, western redcedar / western hemlock, and lodgepole pine) and four structural stages (stem exclusion closed canopy, young multi-story unmanaged, young multi-story managed, and understory reinitiation). The mid seral montane terrestrial community has increased in extent.

Future Extent: The mid seral montane terrestrial community is expected to decrease in extent to near historical levels under all alternatives on Forest Service- and BLM- administered lands in the long term.

None of the alternatives would achieve the historical extent of vegetation types that have declined substantially in geographic extent from historical to current periods. Alternative S3 would increase the vegetation types that have not declined substantially from historical to current periods slightly more than Alternative S2, which would be higher than Alternative S1.

Specified areas: In T watersheds and high restoration priority subbasins together, Alternative S3, slightly more than Alternative S2, is expected to increase the extent of vegetation types that have declined substantially in geographic extent from historical to current periods and reduce the extent of vegetation types that have not declined substantially. Both Alternatives S2 and S3 would do a better job than Alternative S1 of adjusting the vegetation types that have and have not declined substantially. In high restoration priority subbasins alone, Alternative S2 would be better at increasing vegetation types that have declined substantially and decreasing vegetation types that have not declined substantially, followed by Alternative S3.

Future transitions: Much of the mid seral montane terrestrial community should transition to the late seral montane multi-story terrestrial community through growth and succession. With restoration activities such as thinning and prescribed fire (especially Alternatives S2 and S3), some would transition to the late seral montane single story terrestrial community. Also, because of stand-replacing disturbance such as wildfire (all alternatives) and clearcuts (Alternative S1), the mid seral montane would be converted to early seral montane forest. Intentionally creating openings to regenerate western larch and western white pine (Alternatives S2 and S3) should also convert the mid seral montane to early seral montane forest.

Mid Seral Subalpine (Moist Forest PVG)

Background: A small amount of mid seral subalpine terrestrial community is found in the moist forest PVG. The main species are Engelmann spruce / subalpine fir and mountain hemlock, of which mountain hemlock is a very small amount. Therefore, Engelmann spruce / subalpine fir in the (1) stem exclusion closed canopy, (2) young multi-story unmanaged, (3)young multi-story managed, and (4) understory reinitiation structural stages are the only substantial vegetation types. None of these vegetation types have declined substantially in geographic extent from historical to current periods. The mid seral subalpine forest has increased substantially in extent.

Future Extent: Alternatives S2 and S3 are expected to reduce the extent of the mid seral subalpine terrestrial community but not to historical on Forest Service- and BLM- administered lands in the long term. Alternative S1 would maintain the extent near current levels.

Specified areas: In T watersheds and high restoration priority subbasins, Alternatives S2 and S3 would reduce the extent of vegetation types that have not declined substantially in geographic extent from historical to current periods more than Alternative S1.

Future transitions: The mid seral subalpine forests would grow and mature into late seral subalpine multi- and single story forests through the process of succession (all alternatives). The mid seral subalpine forests would develop from early seral subalpine forests through normal growth and succession (all alternatives) and from late seral subalpine forests through disturbances such as traditional timber harvest (Alternative S1), and insects and disease (all alternatives) that would cause mortality in the older trees.

Late Seral Lower Montane Multi-story (Moist Forest PVG)

Background: The late seral lower montane multi-story terrestrial community is a very small part of the moist forest PVG. Within the terrestrial community, interior ponderosa pine and Pacific ponderosa pine are the only cover types and late seral multi-story forest is the only structural stage. Interior ponderosa pine late seral multi-story structural stage is by far the most important, although both vegetation types have declined substantially in geographic extent from historical to current periods. The late seral lower montane multi-story terrestrial community has decreased substantially in extent.

Future Extent: The late seral lower montane multi-story terrestrial community is expected to expand in extent under all alternatives. Alternative S1 would increase the extent beyond historical levels, while Alternatives S2 and S3 would be within the historical range. Alternative S1 would lead to higher amounts of this terrestrial community than Alternatives S2 and S3 because under Alternative S1 much of what should be in the late seral lower montane single story forest would develop multiple layers due to lack of disturbance.

Specified areas: In T watersheds and high restoration priority subbasins, the trends should be similar. Alternative S1 would increase the extent beyond historical levels. Alternative S2 would make the extent of this terrestrial community closest to historical levels. Alternative S3 would result in slightly above historical levels.

Future transitions: The vegetation types that would transition into this terrestrial community would be the late seral lower montane multi-story and mid seral lower montane forests. They would transition through restoration activities that develop single-story characteristics (Alternatives S2 and S3). Mid seral lower montane forest would mature into this terrestrial community through growth and succession (all alternatives). Late-seral lower montane multi-story forest would change to early seral montane forest through stand-replacing disturbance such as wildfire, insects, and disease (all alternatives). Transitions to the mid seral lower montane forests would be caused by less severe disturbances such as traditional timber harvest (Alternative S1) or insects and disease (all alternatives), which cause mortality in the large trees.

Late Seral Montane Multi-story (Moist Forest PVG)

Background: The late seral montane multi-story terrestrial community is composed of several species in the late seral multi-story structural stage. Western larch and western white pine are the two most important vegetation types that have declined substantially in geographic extent from historical to current periods. The important vegetation types that have not declined substantially include interior Douglas-fir, grand fir / white fir, and lodgepole pine. The late seral montane multi-story terrestrial community has decreased substantially in extent since historical times.

Future Extent: All alternatives are expected to increase the extent of late seral montane multi-story forest. The extent in Alternatives S2 and S3 would be near historical levels, while the extent in Alternative S1 would be slightly below historical.

Alternative S2 would increase the most the extent of vegetation types that have declined substantially in geographic extent from historical to current periods, followed closely by Alternative S3. Alternative S1 would produce the least amount of vegetation types that have declined substantially in geographic extent from historical to current periods. None of the alternatives would likely achieve historical extents of vegetation types that have declined substantially basin-wide on Forest Service- and BLM-administered lands in the long-term.

Specified areas: In T watersheds, Alternative S2 would best achieve the historical extent of vegetation types that have declined substantially from historical to current periods, with Alternative S3 close behind. Alternative S1 would result in slightly below historical levels. In high restoration priority subbasins, none of the alternatives are expected to reach the historical range of those vegetation types that have declined substantially in geographic extent from historical to current periods. However, Alternative S2 would likely get closest, with Alternative S3 slightly less and Alternative S1 far behind.

Future transitions: Late seral montane multi-story forests would come from mid seral montane forests and late seral montane single story forests in the absence of disturbance through growth and succession (all alternatives). They would transition to early seral montane forests when stand-replacing disturbances occur, such as wildfire (all alternatives), clearcut harvests (Alternative S1), or regeneration harvest (Alternatives S2 and S3). The structural stage pathway would go to mid seral montane when disturbances such as traditional harvest (Alternative S1) or insects and disease (all alternatives) cause mortality in the large trees.

Late Seral Subalpine Multi-story (Moist Forest PVG)

Background: The late seral subalpine multi-story terrestrial community is made up almost entirely of the Engelmann spruce / subalpine fir late seral multi-story vegetation type, a vegetation type which has decreased subastantially in extent from historical to current periods.

Future Extent: All alternatives are expected to increase the extent of the Engelmann spruce / subalpine fir late seral subalpine cover type and thus increase the extent of the terrestrial community far above historical levels on Forest Service- and BLM-administered lands in the long-term. The extent under Alternatives S2 and S3 would be slightly above historical levels for this terrestrial community. The extent under Alternatives S1 would be even higher.

Specified areas: In T watersheds, Alternatives S2 and S3 would maintain the extent of this terrestrial community within historical ranges. Alternative S1 would result in levels above historical. In high restoration priority subbasins, Alternatives S2 and S3 would likely cause the late seral subalpine multi-story forest to increase in extent somewhat above historical levels (but closer to historical than Alternative S1) because of the increased emphasis on restoration and the increased concentration of activities. The extent would go beyond the historical ranges, however, because subalpine types are not a high priority for restoration.

Future transitions: Transitions into the late seral subalpine multi-story forest would come from the mid seral subalpine forest through growth and succession (all alternatives), and from the late seral subalpine single story forest when lack of disturbance allows these forests to develop multiple canopy layers (all alternatives). Transitions out of this terrestrial community would likely be due to stand-replacing wildfire or insects and disease (all alternatives). Timber harvest (Alternative S1) is not common in this vegetation type but could also be a stand-replacing disturbance.

Late Seral Lower Montane Single Story (Moist Forest PVG)

Background: The overwhelming vegetation type in the late seral lower montane single story forest is interior ponderosa pine late seral single story forest. The Pacific ponderosa pine late seral single story forest is also a part of this terrestrial community, but a minor type. Interior ponderosa pine late seral single story forest has declined substantially in geographic extent from historical to current periods, while Pacific ponderosa pine has not declined substantially from historical to current periods. The extent of this terrestrial community has decreased substantially.

Future Extent: All alternatives are expected to increase the extent of the interior ponderosa pine late seral single story forest but not achieve historical levels on Forest Service- and BLM- administered lands in the long-term. Alternatives S2 and S3 would result in higher levels than Alternative S1.

Specified areas: In T watersheds and high restoration priority subbasins, Alternative S2 would increase the extent more than Alternative S3, followed by Alternative S1.

Future transitions: Transitions would come from mid seral lower montane forests and late seral lower montane multi-story forests through restoration activities such as thinning and low intensity burning (Alternatives S2 and S3 and to a lesser extent, Alternative S1). This terrestrial community would transition to early seral lower montane forests through stand-replacing disturbance such as wildfire (all alternatives) or traditional timber harvest (Alternative S1). Other transitions would be to the mid seral lower montane forest where less severe disturbances, such as traditional timber harvest (Alternative S1) or insects and disease (Alternatives S2 and S3) kill the large trees. Also, this terrestrial community would transition to late seral lower montane multi-story through succession and development of additional canopy layers. The late seral lower montane single story forest must be maintained by frequent light disturbances to prevent it from converting to a multi-story terrestrial community.

Late Seral Montane Single Story (Moist Forest PVG)

Background: The late seral montane single story accounts for a very tiny piece of the moist forest PVG. Of the vegetation types that make up the late seral montane single story terrestrial community, western larch and lodgepole pine in the late seral single story stage are the only vegetation types that have declined substantially in geographic extent from historical to current periods. There are five vegetation types that have not declined substantially, but only one existed historically: interior Douglas-fir late seral single story. The others are western white pine, grand fir / white fir, western redcedar / western hemlock, and Sierra Nevada mixed conifer (a very minor cover type). The late seral montane single story forest has increased slightly.

Future Extent: Alternatives S2 and S3 are expected to increase the extent of the late seral montane single story forest to above historical levels on Forest Service- and BLM-administered lands in the long term. Alternative S1 should reduce the extent slightly below current levels.

All alternatives are expected to increase the extent of the vegetation types that have declined substantially in geographic extent from historical to current periods, but short of historical extent. Alternative S2 would result in the greatest extent followed by Alternatives S3, than Alternative S1. Alternatives S2 and S3 are expected to decrease the extent of the vegetation types that not declined substantially to near historical levels. Alternative S1 would reduce the extent of vegetation types that have not declined substantially to below historical levels.

Specified areas: In T watersheds and high restoration priority subbasins, Alternative S2 would bring the extent of vegetation types that have declined substantially in geographic extent from historical to current periods the nearest to historical, with Alternative S3 following closely and Alternative S1 having the least increase in extent.

Future transitions: Some of this terrestrial community would likely go to late seral montane single story forest through restoration activities such as thinning or light burning (Alternatives S2 and S3). Some would likely go to early seral montane forest through stand-replacing wildfire (all alternatives), traditional timber harvest (Alternative S1), or regeneration harvests to create openings for shade-intolerant western larch (Alternatives S2 and S3). Less severe disturbances, such as traditional timber harvest (Alternative S1) and insects or disease (all alternatives), would transition some of this terrestrial community into mid seral montane terrestrial communities. This terrestial community would develop from the maturing mid seral montane forest through growth and succession (all alternatives). It could also come from late seral montane muti-story forest through restoration activities such as thinning and / or light fire (Alternatives S2 and S3).

Late Seral Subalpine Single Story (Moist Forest PVG)

Background: Historically and currently, the late seral subalpine single story forest, which is made up of the Engelmann spruce / subalpine fir and mountain hemlock cover types in the late seral single story structural stage, is insignificant in extent in the project area.

Future Extent: The late seral subalpine single story forest is not expected to change under any alternative in the future.

Table 4-13 summarizes effects of the alternatives on the moist forest PVG.

Dry Forest PVG

Background

The dry forest PVG has seen the most change in stand structure, composition, and fire regime of any forest PVG. One of the foremost changes in the dry forest is the decline in the amount of ponderosa pine, which has been replaced by interior Douglas-fir and grand

Table 4-13. Effects of the Alternatives on the Moist Forest Potential Vegetation Group (PVG) in the Project Area,[1] Current to Long Term.

Terrestrial Community Group	Trend Toward (T) or Away (A) From Historical Amounts or Maintain Current (C) Amounts(Short Term/Long Term) Alternative S1	Alternative S2	Alternative S3	Alternative that Comes Nearest to Trending Terrestrial Communities Toward Historical
Early seral lower montane	T/A	T/A	T/A	S 2
Early seral montane	C/C	C/C	C/C	S2=S3
Early seral subalpine	T/A	T/A	T/A	S1=S2=S3
Mid seral lower montane	A/A	A/A	A/A	S2=S3
Mid seral montane	T/T	T/T	T/T	S3
Mid seral subalpine	T/T	T/T	T/T	S2=S3
Late seral lower montane multi-story	T/A	T/T	T/T	S2
Late seral montane multi-story	A/A	T/T	T/T	S2
Late seral subalpine multi-story	T/A	T/A	T/A	S2=S3
Late seral lower montane single story	T/T	T/T	T/T	S2=S3
Late seral montane single story	A/A	T/A	T/A	S2=S3
Late seral subalpine single story	NA	NA	NA	NA

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Interpreted from ICBEMP GIS data.

fir / white fir. To a lesser extent, western larch has seen declines as well. Dry forests are often denser today, which leads to increased moisture stress, resulting in greater insect and disease mortality. A notable insect problem in the dry forest is bark beetles.

Higher tree densities, increased fuel levels, and greater continuity of fuels has led to changes in fire regime from historical times in the dry forest PVG. The predominant fire regime has gone from very frequent underburns to a fairly even mix of underburns, lethal stand-replacing, and a mix of lethal and non-lethal fire, burning on an infrequent and very infrequent basis.

Old forests have declined substantially in the dry forest PVG, especially those with single story structure. In general, forests showing the most change are those that have been roaded and harvested. Large trees, snags, and coarse woody debris are all below historical levels in these areas.

Summary Effects for Dry Forest

Under Alternatives S2 and S3, a higher emphasis has been placed on restoration activities in the dry forest PVG compared to other forest PVGs because of large shifts in vegetation and disturbance regimes, scarcity of some terrestrial habitats, accessibility, and fire danger in the urban–rural–wildland interface. This should lead to a higher concentration of restoration activities in the dry forest PVG compared to other forested PVGs.

In general, the old forest is expected to increase over the long term on Forest Service- and BLM-administered lands under all alternatives for the dry forest PVG. Alternatives S2 and S3 would be best at turning around the decline in old forest. These alternatives would increase the extent to within historical ranges, while Alternative S1 would be somewhat less. Much of this increase in old forest would be in the multi-story structural stage, which would be above historical levels for all alternatives, especially Alternative S1. Alternatives S2 and S3 would result in closer to desired levels of old forest multi-story structure.

Alternatives S2 and S3 would better increase the amount of old forest in the single story-structural stage but would not reach historical levels. Alternative S1 would increase old forest single story structure but to a lesser degree than the other two alternatives. The reason for more of this scarce vegetation type in Alternatives S2 and S3 is the increased amount of thinning and prescribed fire under these alternatives compared to Alternative S1. Single story structure requires frequent low intensity disturbances to create and maintain them. Succession, in the absence of disturbance, pushes the dry forest types toward multi-story structure. Alternative S2 would result in a more desirable mix of single story and multi-story on the landscape, followed closely by Alternative S3. Alternative S1 would be last.

The interior ponderosa pine cover type would increase above current levels for all alternatives, to slightly over historical levels. However, Alternatives S2 and S3 would do a better job than Alternative S1 of increasing the structural stages that have declined substantially in geographic extent from historical to current periods, and would put a more desirable mix of the interior ponderosa pine structural stages on the landscape.

Uncharacteristic insect and disease effects would increase slightly in the long term under Alternative S2 and S3, and more under Alternative S1 on Forest Service- and BLM-administered lands in the dry forest PVG. This unwanted trend can be taken as an indication that stand densities and moisture stress would be higher in Alternative S1 than Alternatives S2 and S3 because there would be more thinning, stewardship harvest, and prescribed fire in Alternatives S2 and S3.

Alternatives S2 and S3 are expected to increase the numbers of large snags in the dry forest to above historical levels, considered a positive trend. Alternative S2 would be higher than Alternative S3. These increases are attributable to aging forests, expected restoration efforts, and large snag requirements in the management direction. Alternative S1 is expected to increase the numbers of large snags in the long term because of aging forests, but would fall short of historical levels. Alternatives S2 and S3 would increase the levels of large downed wood to slightly above historical levels in the dry forest. Again, this would be a desirable trend. Alternative S1 would increase large downed wood levels above current but would not achieve historical levels.

Under Alternative S1 the amount of uncharacteristic wildfire is expected to increase in the long term on Forest Service- and BLM-administered lands. Alternatives S2 and S3, on the other hand, would likely see a desirable decrease in the amount of uncharacteristic wildfire from current levels, with Alternative S3 lower than Alternative S2. Much of this decrease would be expected to come in the dry forest PVG because of the emphasis on restoration there. The result would be an increase in thinning and prescribed fire, which leads to reductions in uncharacteristic wildfire effects.

Using HRV departure as an indicator of changes in future disturbance regimes, all alternatives would experience continued deviation of disturbance regimes on Forest Service- and BLM-administered lands in the long term. There would be little difference among alternatives, basin-wide, but Alternatives S2 and S3 should show improvement over Alternative S1 in T watersheds outside of wilderness areas and high restoration priority subbasins.

Effects on Dry Forest Terrestrial Communities

Early Seral Lower Montane (Dry Forest PVG)

Background: Historically, the early seral lower montane terrestrial community accounted for only about five percent of the dry forest PVG; currently it is much less. The vegetation types within the terrestrial community are interior ponderosa pine and Pacific ponderosa pine, both in the stand-initiation stage; both have declined substantially from historical to current periods. However, the Pacific ponderosa pine stand-initiation stage is of minor extent in the project area. In other words, the early seral lower montane terrestrial community is essentially all interior ponderosa pine in the stand-initiation stage. It has declined since historical times.

Future Extent: All alternatives are expected to increase the extent of interior ponderosa pine in the stand-initiation stage to above historical levels on Forest Service- and BLM-administered lands in the long term. Alternatives S2 and S3 are expected to be closer to the historical range than Alternative S1. Much of the expansion of this vegetation type would be the result of large stand-replacing wildfires.

Specified Areas: In T watersheds, all alternatives are expected to increase this vegetation type to near historical levels, with no differences among alternatives. In high restoration priority subbasins, Alternatives S2 and S3 are expected to do a better job of keeping the expansion of the early seral lower montane forest to within historical ranges or slightly above. Alternative S1 would allow this type to move further above historical ranges than is desirable.

Future transitions: Transitions into this terrestrial community would come from mid seral and late seral lower montane forest through stand-replacing disturbances such as wildfire (all alternatives), insects (all alternatives), and traditional timber harvest (Alternative S1). Transitions would come from intentional conversion of some montane cover types such as interior Douglas-fir or grand fir / white fir into interior ponderosa pine (Alternatives S2 and S3). Growth and succession would move this terrestrial community into various mid seral lower montane vegetation types (all alternatives).

Early Seral Montane (Dry Forest PVG)

Background: The early seral montane terrestrial community is almost entirely made up of the stand-initiation structural stage in several cover types. The two main cover types that have declined substantially in geographic extent from historical to current periods are: western larch and lodgepole pine. Early seral montane forest also contains significant amounts of interior Douglas-fir, grand fir / white fir, and shrub / herb / tree regeneration cover types, which have not declined substantially in geographic extent from historical to current periods. This terrestrial community has increased in extent since historical times.

Future Extent: All alternatives would reduce the extent of early seral montane forests on Forest Service- and BLM-administered lands in the long term. There would be little difference among alternatives basin-wide.

Specified Areas: In T watersheds and high restoration priority subbasins, all alternatives would increase the extent but would fall short of historical levels. Alternative S2 would come closest to historical levels, followed by Alternative S3, with Alternative S1 last.

Future transitions: Transitions into this terrestrial community would come from mid seral and late seral montane forest through stand-replacing disturbances such as wildfire, insects, and disease (all alternatives); and traditional timber harvest (Alternative S1). Transitions would also come from intentional conversion of some montane cover types such as interior Douglas-fir or grand fir / white fir (Alternatives S2 and S3) in mid seral and late seral stages to western larch or lodgepole pine. Growth and succession would change this terrestrial community into various mid seral montane vegetation types (all alternatives).

Mid Seral Lower Montane (Dry Forest PVG)

Background: The vegetation types in the mid seral lower montane terrestrial community that have declined substantially in geographic extent from historical to current periods are Pacific ponderosa pine stem exclusion closed canopy stage (a minor type) and interior ponderosa pine stem exclusion closed canopy stage (the dominant type). The vegetation types of note that have not declined substantially are interior ponderosa pine in the following structural stages: understory reinitiation, stem exclusion open canopy, young multi-story unmanaged, and young multi-story managed. The young multi-story managed stage, presently a fairly extensive stage, did not exist historically. The extent of the terrestrial community as a whole has increased slightly.

Future Extent: Alternatives S2 and S3 would do a good job of maintaining current levels of this terrestrial community on Forest Service- and BLM-administered lands in the long term. Alternative S1 would allow the mid seral montane forest to increase above current levels, not an ecologically desirable trend. Alternative S2 followed by Alternative S3 would get the vegetation types that have declined substantially into the historical range sooner than Alternative S1.

In the long term, Alternatives S2 and S3 are expected to maintain the amounts of vegetation types that have declined substantially to within the historical ranges, while Alternative S1 would allow them to move above desired levels.

Specified Areas: In T watersheds and high restoration priority subbasins, the results should be similar to the basin-wide results: Alternatives S2 and S3 would be better than Alternative S1.

Future transitions: Stand-replacing wildfire or other severe disturbances (all alternatives) could change this terrestrial community back to an early seral lower montane terrestrial community. Other disturbance such as insects (all alternatives), or traditional timber harvest (Alternative S1) could transition this terrestrial community to a mid seral montane forest by converting the ponderosa pine to an interior Douglas-fir or grand fir / white fir cover type. Growth and succession (all alternatives) would move these forests into late seral lower montane multi- or single story terrestrial communities. Restoration activities (Alternatives S2 and S3) could speed up this process and prevent stagnation of mid seral forests.

New mid seral lower montane forest would come from growth and succession (all alternatives) from the early seral lower montane forest. They may also come from late seral forests through disturbances such as insects (all alternatives) or timber harvest (Alternative S1) that remove the larger trees.

Mid Seral Montane (Dry Forest PVG)

Background: At present, the mid seral montane terrestrial community accounts for roughly one-fourth of the dry forest PVG. There are two vegetation types of consequence that have declined substantially in geographic extent from historical to current periods: western larch young multi-story unmanaged, and interior Douglas-fir stem exclusion closed canopy.

The important vegetation types that have not declined substantially are combinations of the following cover types: western larch, interior Douglas-fir, grand fir / white fir; and lodgepole pine; and structural stages: the stem exclusion closed canopy, young multi-story unmanaged, young multi-story managed, and understory reinitiation. This terrestrial community is currently substantially above its historical extent.

Future Extent: All alternatives are expected to successfully reduce the amount of the mid seral montane forest on Forest Service- and BLM-administered lands in the long term to within historical ranges.

Alternatives S2 and S3 would increase the vegetation types that have declined substantially in geographic extent from historical to current periods and would reduce the vegetation types that have not declined substantially more effectively than Alternative S1.

Specified Areas: In T watersheds and high restoration priority subbasins, Alternatives S2 and S3 are expected to reach the historical range of mid seral montane sooner than Alternative S1. In those same places, Alternatives S2 and S3 would increase the extent of the vegetation types that have declined substantially and reduce vegetation types that have not declined substantially better than Alternative S1.

Future transitions: Loss in extent of the mid seral montane forest would be due to transitions to late seral montane multi- and single story forests through growth and succession (all alternatives). Other changes into early seral montane forest would be from stand-replacing disturbance such as wildfire (all alternatives), traditional timber harvest (Alternative S1), or silvicultural activities to intentionally create openings for western larch regeneration (Alternatives S2 and S3). Transitions into mid seral montane forest would be from early seral montane forest because of growth and succession (all alternatives) or from late seral montane multi-story forests through disturbances such as traditional timber harvest (Alternative S1) or insects and disease (all alternatives), which remove the large trees.

Late Seral Lower Montane Multi-story (Dry Forest PVG)

Background: The late seral lower montane multi-story terrestrial community contains interior ponderosa pine and Pacific ponderosa pine in the late seral multi-story forest structural stage. Interior ponderosa pine late seral multi-story structural stage is by far the most important vegetation type because it accounts for 99 percent of the terrestrial community, although both have declined substantially in geographic extent from historical to current periods. This terrestrial community has not changed in extent much since historical times.

Future Extent: Alternatives S2 and S3 would maintain near current levels of this terrestrial community, within the historical range on Forest Service- and BLM-administered lands in the long term. Alternative S1 would allow the interior ponderosa pine in the late seral multi-story structural stage to move above the historical extent. Alternatives S2 and S3 would also move the mix of vegetation types that have and have not declined substantially close to historical. Alternative S1 would be somewhat behind the other alternatives.

Specified Areas: In T watersheds and high restoration priority subbasins, Alternatives S2 and S3 would increase the extent of the interior ponderosa pine late seral multi-story structural stage to near historical levels. Alternative S1 would go beyond desired levels.

Future transitions: This terrestrial community would expand as growth and succession pushes mid seral lower montane into this type (all alternatives). Stand-replacing disturbance would change some of these forests to early seral montane forest (all alternatives); less severe disturbances, such as traditional timber harvest (Alternative S1) or insects (all alternatives), which cause mortality in the larger trees, would cause transitions to the mid seral lower montane forests.

Late Seral Montane Multi-story (Dry Forest PVG)

Background: The late seral montane multi-story terrestrial community is composed of four cover types in the late seral multi-story structural stage. Western larch is the only species that has declined substantially in geographic extent from historical to current periods. The important vegetation types that have not declined substantially include interior Douglas-fir, grand fir / white fir, and lodgepole pine. The late seral montane multi-story terrestrial community has increased substantially in the dry forest PVG since historical times, just the opposite of what this terrestrial community has done in the moist forest PVG.

Future Extent: Basin-wide on Forest Service- and BLM-administered lands, all alternatives are expected to reduce the extent of the late seral montane multi-story terrestrial community, but none would likely reach the historical range in the long term. Alternative S2 would come the closest to historical levels. Alternative S3 would be next best, followed by Alternative S1.

Alternatives S2 and S3 would be the most effective alternatives at increasing vegetation types that have declined substantially in geographic extent from historical to current periods and at decreasing vegetation types that have not declined substantially.

Specified Areas: In T watersheds, Alternatives S2 and S3 are expected to increase to historical levels the vegetation types that have declined substantially, sooner than Alternative S1. In high restoration priority subbasins, Alternatives S2 and S3 are expected to increase these vegetation types more than Alternative S1 but short of historical levels.

Future transitions: Late seral montane multi-story forests would come from mid seral montane forests and late seral montane single story forests in the absence of disturbance through the forces of succession. They would transition to early seral montane forests when overstory trees are removed by stand-replacing disturbances such as wildfire (all alternatives), clearcutting (Alternative S1), or regeneration harvest (Alternatives S2 and S3). The transition would go to mid seral montane if disturbances such as traditional harvest (Alternative S1) or insects and disease (all alternatives) remove the large trees.

Late Seral Lower Montane Single Story (Dry Forest PVG)

Background: The most extensive vegetation type in this terrestrial community is the interior ponderosa pine late seral single story forest, which has declined substantially in geographic extent from historical to current periods. The Pacific ponderosa pine late seral single story forest, which has not declined substantially, is also a part of this terrestrial community, but a minor type. The interior ponderosa pine late seral lower montane forest has declined by 80 percent.

Future Extent: Although none of the alternatives would reach historical levels, they all are expected to increase the late seral lower montane single story forest. Alternative S2 would produce the highest amounts of this terrestrial community, Alternative S3 would be next, and Alternative S1 would be a distant third.

Specified Areas: In T watersheds and high restoration priority subbasins, the results would be similar with the same relative rank among the alternatives: Alternative S2 best, Alternative S3 next, and Alternative S1 last.

Future transitions: Transitions into the late seral lower montane single story forest would come from mid seral lower montane forests through growth and succession (all alternatives) and late seral lower montane multi-story forests through restoration activities such as thinning and low intensity burning (Alternatives S2 and S3 and to a lesser extent, Alternative S1). Transitions out of this terrestrial community would go to early seral lower montane forests through stand-replacing disturbance such as wildfire (all alternatives) or traditional timber harvest (Alternative S1). Other transitions would be to the mid seral lower montane forest, where disturbances such as traditional timber harvest (Alternative S1) or insects (all alternatives) would cause mortality in the large trees. Also, this terrestrial community would transition to late seral lower montane multi-story through succession and development of additional canopy layers (all alternatives). The late seral lower montane single story forest must be maintained by frequent light disturbances to prevent it from converting to a multi-story terrestrial community.

Late Seral Montane Single Story (Dry Forest PVG)

Background: The late seral montane single story accounts for a small piece of the dry forest PVG. Western larch and lodgepole pine in the late seral single story stage are the only vegetation types that have declined substantially in geographic extent from historical to current periods. There are two vegetation types that have not declined substantially, but only one existed historically: interior Douglas-fir late seral single story. The other is grand fir / white fir. This terrestrial community has increased slightly since historical times.

Future Extent: Alternatives S2 and S3 are expected to reduce the extent of the late seral montane single story forest to historical levels. Alternative S1 should reduce the amount well below historical levels.

Specified Areas: In T watersheds, Alternative S2 would reach historical levels sooner than Alternative S3, followed by Alternative S1. In high restoration priority subbasins, Alternative S2 would bring levels of vegetation types that have declined substantially in geographic extent from historical to current periods the nearest to historical levels, with Alternative S3 close behind, and Alternative S1 last.

Future transitions: Some of this terrestrial community would likely go to early seral montane forest through stand-replacing disturbance such as wildfire (all alternatives), traditional timber harvest (Alternative S1), or regeneration harvests to create openings for western larch or lodgepole pine (Alternatives S2 and S3). Less severe disturbances such as traditional timber harvest (Alternative S1), insects, or disease (all alternatives), would transition some of this terrestrial community into mid seral montane terrestrial communities. The late seral montane single story forest would come from the mid seral montane forest through growth and succession (all alternatives). It would also come from late seral montane multi-story forest through restoration activities such as thinning and light fire (Alternatives S2 and S3).

Table 4-14 summarizes effects of the alternatives on the dry forest PVG.

Table 4-14. Effects of the Alternatives on the Dry Forest Potential Vegetation Group (PVG) in the Project Area,[1] Current to Long Term.

Terrestrial Community Group	Trend Toward (T) or Away (A) From Historical Amounts (Short Term/Long Term) Alternative S1	Alternative S2	Alternative S3	Alternative that Comes Nearest to Trending Terrestrial Communities Toward Historical
Early seral lower montane	T/A	T/A	T/A	S2=S3
Early seral montane	T/T	T/T	T/T	S2
Mid seral montane	A/A	T/T	T/T	S2=S3
Mid seral lower montane	T/T	T/T	T/T	S2=S3
Late seral lower montane multi-story	A/A	T/T	T/T	S2=S3
Late seral montane multi-story	T/T	T/T	T/T	S2
Late seral lower montane single story	T/T	T/T	T/T	S2
Late seral montane single story	T/T	T/T	T/T	S2

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Interpreted from ICBEMP GIS data.

Woodland PVG

Background

From historical to current periods the dominant change within the woodland PVG was the encroachment of woodlands and shrublands into what was formerly herblands. This conversion of herblands to woodlands and shrublands, although not covering much area within the woodland PVG, contributed to the widespread decline in the project area of the wheatgrass bunchgrass and fescue-bunchgrass, two herbland vegetation types that have declined greatly from historical to current in the project area at current. Currently the woodland PVG is dominated by woodlands and shrublands, and noxious weeds and exotic undesirable plants are not common.

Summary Effects for Woodland PVG

In the long term, herblands would increase in extent at the expense of woodlands and shrublands under all alternatives. Herblands would increase more, and woodlands and shrublands would decline more, in Alternatives S2 and S3 than in Alternative S1. The effects of Alternatives S2 and S3 would be similar for the woodland PVG. Although noxious weeds and exotic undesirable plants would increase in extent under all alternatives, they would expand less in Alternatives S2 and S3 than in Alternative S1. While none of the alternatives would result, over the long term, in the extent of herblands, woodlands, shrublands, and noxious weeds and exotic undesirable plants estimated to have been present at historical within the woodland PVG, Alternatives S2 and S3 would come the closest to achieving historical levels for the vegetation types combined.

Cool Shrub PVG

Background

From historical to current the dominant change within the cool shrub PVG was the encroachment of woodlands into what was formerly herblands and / or shrublands. This conversion of herblands and shrublands to woodlands within the cool shrub PVG contributed to the widespread decline in the project area of the wheatgrass bunchgrass, fescue-bunchgrass, mountain big sagebrush, and big sagebrush, vegetation types that have declined substantially in geographic extent from historical to current periods in the project area. Western juniper, a native tree of the Pacific Northwest, has expanded greatly and is primarily responsible for the woodland expansion.

Summary Effects for Cool Shrub PVG

In the long term, the extent of woodlands would decrease, shrublands and herblands would increase, and noxious weeds and exotic undesirable plants would decrease, under all alternatives. Woodlands would decrease more, shrublands and herblands would increase more, in Alternatives S2 and S3 than in Alternative S1, with only slight differences between Alternatives S2 and S3. Although noxious weeds and exotic undesirable plants would increase in extent under all alternatives, they would expand less in Alternatives S2 and S3 than in Alternative S1. While none of the alternatives would result over the long term in the extent of woodlands, shrublands, herblands, and noxious weeds and exotic undesirable plants estimated to have been present historically within the cool shrub PVG, Alternatives S2 and S3 come the closest to achieving historical amounts for the vegetation types combined.

Dry Grass PVG

Background

The dominant change within the dry grass PVG was the conversion of herblands to noxious weeds and exotic undesirable plants. This conversion of herblands to noxious weeds and exotic undesirable plants within the dry grass PVG contributed to the widespread decline in the project area of wheatgrass bunchgrass and fescue-bunchgrass, which have declined substantially in geographic extent from historical to current periods.

Summary Effects for Dry Grass PVG

Over the long term, herblands would continue to decrease in extent while noxious weeds and exotic undesirable plants would increase in extent, under all alternatives. Although noxious weeds and exotic undesirable plants would increase in extent under all alternatives, they would expand less in Alternatives S2 and S3 than in Alternative S1. Therefore, herblands would decline less in Alternatives S2 and S3 than in Alternative S1.

Dry Shrub PVG

Background

From historical to current periods the dominant changes within the dry shrub PVG were the conversion of herblands and shrublands to noxious weeds and exotic undesirable plants, and the conversion of herblands to shrublands. These conversions within the dry shrub PVG contributed to the widespread decline in the project area of the wheatgrass bunchgrass, fescue-bunchgrass, big sagebrush, and antelope bitterbrush-bluebunch wheatgrass, vegetation types that have declined substantially in geographic extent from historical to current periods. Cheatgrass, an exotic undesirable plant, has expanded greatly and is primarily responsible for the decline in herblands and shrublands.

Summary Effects for Dry Shrub PVG

Over the long term, the extent of shrublands would decrease, herblands would increase, and noxious weeds and exotic undesirable plants would increase, under all alternatives. In Alternatives S2 and S3, shrublands would decrease less, herblands would increase less, and noxious weeds and exotic undesirable plants would increase less, than in Alternative S1, with only slight differences between Alternatives S2 and S3. Shrubland decrease would be attributable to wildfire, which will create upland herbland that is characterized by native bunchgrasses with a substantial component of exotic undesirable plants such as cheatgrass, medusahead, and mustards, which will vary in abundance. Some lesser amounts of upland herbland will be seedings of shrubs, grasses, and forbs as a result of fire rehabilitation efforts in what once was upland shrubland previous to the wildfire. Shorter intervals between wildfires caused by increased flammability from the exotic undesirable plants will retard shrub establishment and retard conversion of upland herblands to upland shrublands. Fire pre-suppression (for example, greenstripping) would be more effective in Alternatives S2 and S3 than in Alternative S1, and this would reduce the amount of shrubland that experiences wildfire. Noxious weeds and exotic undesirable plants would increase in extent, particularly in areas that have not been seeded in the past and probably would not be seeded in the future. Noxious weeds and exotic undesirable plants would expand less and dominate less acreage in Alternatives S2 and S3 than in Alternative S1.

Rangeland PVG Terrestrial Communities

Vegetation Changes Within Upland Woodlands

As described in the previous section on PVGs, the upland woodland terrestrial community within the woodland PVG and the cool shrub PVG would trend toward historical amounts and would decrease in extent under all alternatives from current to long term, with Alternatives S2 and S3 trending slightly more toward historical (decreasing in extent) than Alternative S1. This is notable because from historical to current periods, upland woodlands in these two PVGs increased in extent and were trending away from historical.

The main driver in the desired decline in upland woodlands would be a decline in extent of juniper–sagebrush, particularly in the cool shrub PVG. All alternatives (Alternatives S2 and S3 more so than Alternative S1) would achieve some control of western juniper, a native tree of the Pacific Northwest, which expanded greatly between historical and current periods and was primarily responsible for the woodland expansion.

The greater reduction of woodlands in the cool shrub PVG achieved by Alternatives S2 and S3 would be most apparent in the high restoration priority subbasins. Alternative S2 would achieve greater reduction of woodlands within the high restoration priority subbasins than Alternative S3 would do (Table 4-15), because of the greater concentration of restoration activity. Outside of the high restoration priority subbasins, all alternatives would reduce the woodland terrestrial community in the woodland and cool shrub PVGs to a similar degree.

Table 4-15 shows trends in extent from current to long term for upland woodlands within the woodland and cool shrub PVGs. Trends are reported for the high restoration priority subbasins and in the project area, for each alternative on BLM- and Forest Service-administered lands, as related to historical amounts.

Vegetation Changes Within Upland Shrublands

As described in the previous section on PVGs, upland shrublands within the woodland PVG and the cool shrub PVG would trend toward historical amounts between current and long-term. Upland shrublands would decrease in extent in the woodland PVG, and would increase in extent in the cool shrub PVG, under all alternatives in the long term, with Alternatives S2 and S3 trending slightly more toward historical in this regard than Alternative S1. This is notable because from historical to current, upland shrublands in these two PVGs were trending away from historical, increasing in extent in the Woodland PVG and decreasing in extent in the Cool Shrub PVG.

Conversely, within the dry shrub PVG, upland shrublands would trend away from historical amounts over the long term. Upland shrublands

Table 4-15. Effects of the Alternatives on Upland Woodlands within Woodland and Cool Shrub Potential Vegetation Groups (PVGs) in the Project Area,[1] Current to Long Term.

	Trend Toward (T), or Away (A) from Historical Amounts			Alternative That Comes Nearest to Trending Upland Woodlands Toward Historical
	Alternative S1	Alternative S2	Alternative S3	
Project Area	T	T	T	S2=S3
High Restoration Priority Subbasins in Alternative S2	T	T	T	S2
High Restoration Priority Subbasins in Alternative S3	T	T	T	S2

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Interpreted from ICBEMP GIS data; Hemstrom et al. 1999.

would decrease in extent under all alternatives, with Alternatives S2 and S3 showing less decrease than Alternative S1. This decline in upland shrublands under all alternatives continues the declining trend estimated for historical to current periods.

The main driver in the decline in upland shrublands in the woodland PVG under all alternatives is a decline in extent of closed stands of mountain big sagebrush. Conversion of mountain big sagebrush to upland herblands is attributable to fire. The extent of this vegetation change in total acreage is minor.

The drivers in the increase in upland shrublands in the cool shrub PVG under all alternatives are an increase in extent of mountain big sagebrush, and to a lesser degree, an increase in big sagebrush, both of which have declined substantially in geographic extent from historical to current periods. These trends, to a large degree, would be attributable to the reduction of upland woodlands and more specifically, western juniper, achieved by the alternatives. The greater increase in upland shrublands in the cool shrub PVG that would be achieved by Alternatives S2 and S3 would be most apparent in the high restoration priority subbasins. Within the high restoration priority subbasins, Alternative S2 would achieve slightly greater increase in upland shrublands than Alternative S3 would do (Table 4-16). There would be a greater concentration of restoration activity under Alternative S2, which translates into more acres treated per subbasin than Alternative S3. Outside of the high restoration priority subbasins, all alternatives would increase upland shrublands in the cool shrub PVG, more similarly than in the high restoration priority subbasins.

The driver in the decrease in upland shrublands in the dry shrub PVG would be a decrease in extent of big sagebrush, which has declined substantially in geographic extent from historical to current periods, and a concurrent increase in extent of upland herblands, composed primarily of wheatgrass bunchgrass, which has declined substantially in geographic extent from historical to current periods. Because of fine, herbaceous, flammable fuels such as cheatgrass (an exotic undesirable plant that is ubiquitous but varies in abundance within the dry shrub PVG), upland shrublands would continue to be susceptible to wildfire. Most upland shrublands that burn would convert to upland herblands that are composed of native bunchgrasses, with presence of exotic undesirable plants such as cheatgrass, medusahead, and mustards. These upland herblands would be susceptible to recurring wildfires because of the addition of flammable fine fuels attributable to the exotic plants. Recurring wildfires would retard shrub establishment and increase the proportion of exotic undesirable plants within the upland herblands. A relatively lesser amount of upland shrublands that burn would convert to upland herblands through rehabilitation by seedings that are composed of mixtures of exotic desirable grasses and forbs, and native grasses, shrubs, and forbs.

The lesser decline in upland shrublands in the dry shrub PVG that would be achieved by Alternatives S2 and S3 would be most apparent in the high restoration priority subbasins, where the decline in upland shrublands would be arrested and there would be an increase in extent over the long term. Within the high restoration priority subbasins, Alternative S2 would increase upland shrublands slightly more than

Table 4-16. Effects of the Alternatives on Upland Shrublands within Woodland, Cool Shrub, and Dry Shrub Potential Vegetation Groups (PVGs) in the Project Area,[1] Current to Long Term.

	Trend Toward (T), or Away (A) from Historical Amounts			Alternative That Comes Nearest to Trending Upland Shrublands Toward Historical
	Alternative S1	Alternative S2	Alternative S3	
		Upland Shrublands within Woodland and Cool Shrub PVGs		
Project Area	T	T	T	S2=S3
High Restoration Priority Subbasins in Alternative S2	T	T	T	S2
High Restoration Priority Subbasins in Alternative S3	T	T	T	S2
		Upland Shrublands within Dry Shrub PVG		
Project Area	A	A	A	S2=S3
High Restoration Priority Subbasins in Alternative S2	T	T	T	S2
High Restoration Priority Subbasins in Alternative S3	T	T	T	S2

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Interpreted from ICBEMP GIS data; Hemstrom et al. 1999.

Alternative S3 would do (Table 4-16). There would be a greater concentration of restoration activity, including: (1) wildfire suppression activities, such as greenstripping; (2) seedings (which will in most cases contain some shrubs in the mixture); and (3) changes in livestock grazing management—which collectively translate into more acres treated per subbasin and a greater increase in upland shrublands under Alternative S2 for the high restoration priority subbasins than under Alternative S3. Outside of the high restoration priority subbasins, the decline in upland shrublands would continue, similarly among the alternatives.

Table 4-16 shows trends in extent from current to long term for upland shrublands within the woodland, cool shrub, and dry shrub PVGs. Trends are reported for the high restoration priority subbasins and in the project area, for each alternative on BLM- and Forest Service-administered lands, as related to historical amounts.

Vegetation Changes Within Upland Herblands

As described in the previous section on PVGs, upland herblands within the woodland PVG and the cool shrub PVG would trend toward historical amounts and would increase in extent over the long term. The increase is apparent under all alternatives, with Alternatives S2 and S3 showing slightly more improvement in this regard than Alternative S1 within both woodland and cool shrub PVGs. This is notable because from historical to current periods, upland herblands in these two PVGs were trending away from historical, decreasing in extent.

Conversely, within the dry grass and dry shrub PVGs, upland herblands would trend away from historical amounts over the long term. Upland herblands would decrease in extent within the dry grass PVG under all alternatives, with Alternatives S2 and S3 showing less decrease than Alternative S1. Upland herblands would increase in extent within the dry shrub PVG under all alternatives, with Alternatives S2 and S3 showing less increase than S1.

The main driver in the desired increase in upland herblands in the woodland PVG under all alternatives is an increase in wheatgrass bunchgrass, which has declined substantially in geographic extent from historical to current periods. Although notable and attributable to fire converting woodlands to herblands, the extent of this change in acreage is relatively minor.

The main driver in the desired increase in upland herblands in the cool shrub PVG under all alternatives is an increase in the wheatgrass bunchgrass and fescue-bunchgrass cover types, which have declined substantially in geographic extent from historical to current periods. These trends, to a large degree, would be attributable to the reduction of upland woodlands and more specifically, western juniper, that would be achieved by the alternatives. The greater increase in upland herblands in the cool shrub PVG under Alternatives S2 and S3 would be most apparent in high restoration priority subbasins. Within the high restoration priority subbasins, Alternative S2 would achieve a greater increase in upland herblands than Alternative S3 would do (Table 4-17). There would be a greater concentration of restoration activity, which translates into more acres treated per subbasin, under Alternative S2 for the high restoration priority subbasins compared to Alternative S3. Outside the high restoration priority subbasins, there would be less distinction among the alternatives, as all alternatives would increase upland herblands similarly.

The main driver in the decrease in upland herblands in the dry grass PVG under all alternatives would be an increase in noxious weeds and exotic undesirable plants. Some notable noxious weeds and/or exotic undesirable plants characteristic of the dry grass PVG that would increase in extent are yellow starthistle, spotted knapweed, dalmatian toadflax, and cheatgrass. The lesser decline in upland herblands in the dry grass PVG achieved by Alternatives S2 and S3 would be most apparent in the high restoration priority subbasins. Within the high restoration priority subbasins, Alternative S2 would arrest the decline to a slightly greater extent than would Alternative S3 (Table 4-17). There is a greater concentration of restoration activity, which translates into more acres treated per subbasin, under Alternative S2 for the high restoration priority subbasins compared to Alternative S3. Outside the high restoration priority subbasins, there would be less distinction among the alternatives, as upland herblands would decline similarly under all alternatives.

The main driver in the increase in upland herblands in the dry shrub PVG under all alternatives would be an increase in wheatgrass bunchgrass, which has declined substantially in geographic extent from historical to current periods. The lesser increase in upland herblands in the dry shrub PVG that would be achieved by Alternatives S2 and S3 is most apparent in the high restoration priority subbasins. Within the high restoration priority subbasins, Alternative S2 would achieve slightly less increase than Alternative S3 and would trend upland herblands nearest to historical (Table 4-17).

The reasons explaining the lesser increase of herblands in Alternative S2 originate in the greater concentration of restoration activity in Alternative S2, which includes: (1) wildfire pre-suppression activities, such as greenstripping (which would help reduce the amount of shrubland that converts to herbland); (2) seedings (which will in most cases

Table 4-17. Effects on Upland Herblands within Woodland, Cool Shrub, Dry Grass, and Dry Shrub Potential Vegetation Groups (PVGs) in the Project Area,[1] Current to Long Term.

	Trend Toward (T), or Away (A) from Historical Amounts			Alternative That Comes Nearest to Trending Upland Herblands Toward Historical
	Alternative S1	Alternative S2	Alternative S3	
Upland Herblands within Woodland and Cool Shrub PVGs				
Project Area	T	T	T	S2=S3
High Restoration Priority Subbasins in Alternative S2	T	T	T	S2
High Restoration Priority Subbasins in Alternative S3	T	T	T	S2
Upland Herblands within Dry Grassand Dry Shrub PVGs				
Project Area	A	A	A	S2=S3
High Restoration Priority Subbasins in Alternative S2	A	A	A	S2
High Restoration Priority Subbasins in Alternative S3	A	A	A	S2

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Interpreted from ICBEMP GIS data; Hemstrom et al. 1999.

contain some shrubs in the mixture and would be expected to develop into shrublands); and (3) changes in livestock grazing management that would reduce grazing pressure on the native herbaceous species and slow down the rate of expansion and increasing density of exotic annual species such as cheatgrass, thereby reducing the spread and increase in flammable fine fuels and retarding wildfire's conversion of shrublands to herblands. Collectively, these would translate into more acres treated per subbasin and a greater increase in upland shrublands and a concomitant lesser increase in upland herblands, under Alternative S2 for the high restoration priority subbasins compared to Alternative S3. Outside of the high restoration priority subbasins, the increase in upland herblands would continue, similarly among the alternatives.

Although an increase in upland herblands within the dry shrub PVG seems beneficial because it reflects an increase in the wheatgrass bunchgrass cover type (which has declined substantially in geographic extent from historical to current periods), the increase in upland herblands exceeds the land area that was in upland herblands historically. The increase in upland herblands and wheatgrass bunchgrass is due to both native bunchgrasses and seedings of exotic desirable grasses such as crested wheatgrass. In addition, exotic undesirable plants such as cheatgrass, medusahead, and mustards would be present in varying amounts within the upland herblands and also within upland shrublands, increasing flammable fine fuels and increasing wildfire incidence. While the increase in the native component of upland herblands is desirable (especially for such terrestrial vertebrates as sage grouse and Columbian sharp-tailed grouse in Terrestrial Families 11 and 12), the increase in exotic seedings and exotic undesirable plants is comparatively less desirable. As mentioned previously, Alternative S2 would achieve the most effective prevention of these undesirable characteristics of upland herblands within the dry shrub PVG.

Table 4-17 shows trends in extent from current to long term for upland herblands within the woodland, cool shrub, dry grass, and dry shrub PVGs. Trends are reported for the high restoration priority subbasins and the project area, for each alternative on BLM- and Forest Service-administered lands, as related to historical amounts.

Terrestrial Species Component

This section presents the effects of the alternatives on terrestrial species and their habitats, including plants, terrestrial invertebrates, broad-scale terrestrial vertebrates, terrestrial riparian and wetland species, and special status terrestrial species (threatened, endangered, proposed, or sensitive). The EIS Team used information provided by the Science Advisory Group (SAG) to develop this chapter. The EIS Team also developed additional analyses (for example, to identify habitats that have declined substantially from historical, to determine the likelihood of persistence, and to estimate effects of the alternatives on invertebrates). A summary of key effects and conclusions for all subject areas is presented first. Each subject area then presents methods for estimating effects, and effects of the alternatives. This section concludes with a discussion of hunting, viewing, and collecting considerations.

Summary of Key Effects and Conclusions

In general, Alternative S2 would result in better conditions for terrestrial vertebrates on BLM- and Forest Service-administered lands than Alternative S3, followed by Alternative S1. Differences among alternatives would be smaller when looking at all lands because of the higher proportion of human effects on private ownerships. Relative to the differences among alternatives, most of the species in the following groups would see improved conditions compared to current conditions: old-forest species, riparian species, and species that use habitats that have declined substantially in geographic extent from historical to current periods. Conditions for rangeland species are expected to be stable or declining because of a lack of restoration technology and available resources for active restoration. Within high restoration priority subbasins, the differences among alternatives would be greater. In the long term, passive management would have adverse effects on some terrestrial species. Because the land area within the project area is finite, management actions to benefit one species could harm another.

Plants

- Plant species in all major plant groups would remain stable in their likelihood of persistence under Alternatives S2 and S3 relative to current conditions. In contrast, plant species in all major plant groups would have a reduced likelihood of persistence under Alternative S1 relative to current conditions.
- All alternatives would promote development and maintenance of biological crusts. Alternatives S2 and S3 would provide more restoration focus on biological crusts than Alternative S1.

Terrestrial Invertebrates

- Alternatives S2 and S3 should provide more general benefits to invertebrates than would Alternative S1.

Broad-scale Terrestrial Vertebrates

- Generally, for broad-scale terrestrial vertebrates, there are not substantial differences among the alternatives.
- Number of areas with a high or low environmenal index for terrestrial vertebrate species dependent on old-forest conditions would generally increase from current levels under all alternatives, sometimes approaching historical levels.
- Number of areas with a high or low environmental index for terrestrial vertebrate rangeland species typically would be reduced under all alternatives. Areas with high habitat capacity would be further reduced from current levels.
- Environmental index scores among species would be about 10 to 15 percent higher on Forest Service- or BLM-administered lands compared to all lands under all alternatives.

Terrestrial Riparian and Wetland Species

- For riparian- or wetland-dependent terrestrial vertebrates, Alternative S2 would provide general improved results compared to Alternatives S3, which would have slightly improved results compared to Alternative S1.

Special Status Terrestrial Species

- Management of ecosystems is more effective at maintaining a diverse array of species compared to management for single species. For example, most vertebrate Terrestrial Families have at least one species with reduced habitat capability, so an action to benefit one species could adversely affect another species.

- Broad-scale threatened and endangered species (woodland caribou, gray wolf, and grizzly bear) would trend toward recovery within recovery areas, but basin-wide conditions would remain greatly reduced from historical for gray wolf and grizzly bear.
- Generally, passive management would have adverse effects on species in a variety of environments. A high degree of departure of vegetation from historical range of variability (HRV) was judged to be adverse for many species. The number of acres with a high level of HRV departure would increase considerably more in wilderness and wilderness-like areas than elsewhere.

Plants

Methodology: How Effects on Plants were Estimated

The assessment of effects of Supplemental Draft EIS on plants of concern was based on qualitative judgments from the Science Advisory Group. Judgments were made relative to the current known distribution and condition of plants of widespread or range-wide concern within the project area from current conditions to 100 years, based on the effectiveness of the management direction in the Supplemental Draft EIS. This effects analysis was not based on habitat persistence. There are 333 plant species in the basin which are of highest concern. For analysis purposes these 333 plants were grouped into nine major plant groups. Judgments of effects on the nine major plant groups were made by placing effects into two categories: decreasing likelihood of persistence relative to current period, and stable likelihood of persistence relative to current period.

The effects of the management alternatives on biological crusts were compiled using a combination of several sources. These sources included Johnson and Kingery (1999), which provided a qualitative evaluation of the effects of the management alternatives on biological crusts, and trends for livestock grazing effects and exotic undesirable plants interpreted from SAG data.

Effects of the Alternatives on Plants

Generally non-vascular plants and vascular plants of concern are affected the most by local conditions. Even broadly distributed non-vascular and vascular species are often limited to specific habitats. Therefore, the effects of broad-scale direction on these species are general in nature as opposed to species-specific. Further analysis of effects of proposed management on these species or their habitats should be conducted on a finer-scale such as during step-down processes (land use planning amendment and revision, Subbasin Review, EAWS, and / or site-specific NEPA analyses).

General

All three alternatives would benefit vascular and non-vascular plants through protection of special habitat features (such as downed wood). The restoration of habitats that have declined substantially in geographic extent from the historical to current period, and the repatterning of vegetation across the landscape in Alternatives S2 and S3 would improve habitat diversity for and stability of plant communities to a greater extent than Alternative S1. Alternatives S2 and S3 would also reduce the adverse effects of invasive exotic plant species through Integrated Weed Management and restoration of native species to a greater extent than would Alternative S1 (see section on Noxious weeds). Furthermore, Alternatives S2 and S3 would have general, beneficial effects on widely distributed plants of concern and rare plant communities through step-down processes, and through prioritization and preparation of conservation strategies for widely distributed plants.

Unnaturally dense forest stands are often unsuitable habitat for many plant species, such as some lichen species. Alternatives S2 and S3 should improve habitat for such species through the use of thinning and prescribed fire to move stands closer to the historical range of variability.

Biological Crusts

As noted in Chapter 2, biological crusts are most prevalent on arid rangelands, primarily in the dry shrub potential vegetation group (PVG), where above-ground plant production is inherently low. Biological crusts influence many processes, including soil stability, nutrient cycling, infiltration and soil moisture, and interactions with vascular plants. Activities that disturb the soil surface, including fire, livestock grazing, off-road vehicle use, recreational hiking, and others, can reduce the maximum potential development of biological crusts.

Although more research would help clarify the roles that biological crusts play, perhaps the most agreed upon contribution of biological crusts to rangeland health is its role in stability of rangeland soils. Biological crusts stabilize fine soil particles at the soil surface. This role alone, according to Johnson and Kingery (1999), provides sufficient justification for evaluating the effects of the alternatives on biological crusts.

The potential for biological crusts to develop and increase in geographic extent is and would continue to be meager on sites that have already crossed a threshold or will cross a threshold in the next 100 years. In particular, the potential is and would be meager on sites that are already dominated by fine fuels (such as the exotic annual grasses cheatgrass and medusahead) or will become so in the next 100 years. On these sites the potential is meager regardless of management direction, meaning that even if livestock grazing management would be improved, for example, conditions would not revert back to their pre-threshold state, exotic annual grasses would still dominate, and therefore conditions would not likely become more favorable for biological crust development. Restoration that achieves wholesale conversion of the exotic annual grasses to perennial species, such that the exotic annual grasses are still present but no longer dominate, would be necessary to foster biological crust development. Conversely, on sites that have yet to cross a threshold, changes in management show greater potential to foster development of biological crusts and increase their geographic extent.

On rangeland sites that have not and will not cross a threshold in 100 years, conditions required for development of biological crusts would trend toward historical under all alternatives, with Alternatives S2 and S3 coming the nearest to historical conditions for biological crust development. All alternatives emphasize Healthy Rangelands direction to some degree (Alternative S1 on BLM-administered lands, and Alternatives S2 and S3 on both Forest Service- and BLM-administered lands). Therefore, all alternatives would stimulate changes in livestock grazing management that promote developing and maintaining biological crusts. Alternatives S2 and S3 would provide additional restoration focus on biological crusts over Alternative S1, attributable directly or indirectly to:

1. A project-area wide Integrated Weed Management (IWM) strategy. This would reduce the expansion rate of exotic undesirable plants more than under Alternative S1, which lacks a project-area wide IWM.
2. A focus on managing land uses (such as livestock grazing) and reducing the geographic extent of exotic undesirable plants to provide favorable conditions for biological crust development where development potential is high (for example, in the salt desert shrub cover type, Wyoming big sagebrush portion of the big sagebrush cover type, and the low sage cover type).
3. A focus on instituting changes to livestock grazing management in areas that are "functioning at risk" and therefore at risk of crossing a threshold.
4. A short-term conservation emphasis and a long-term restoration emphasis for terrestrial source habitats within T watersheds that have declined substantially in geographic extent from historical to current periods.
5. High restoration priority subbasins, where additional priority would be given to implement restoration direction. This would result in livestock grazing management changes, exotic undesirable plant control, and reestablishment of native plant vegetative types.

Under all alternatives, conditions required for development of biological crusts would trend *toward* historical conditions in both the project area and the high restoration priority subbasins. Conversely, under all alternatives, the geographic extent of biological crusts would trend *away* from historical extent for the project area as a whole, but would trend *toward* historical extent in the high restoration priority subbasins in Alternatives S2 and S3. Expansion of exotic undesirable plants would continue under all alternatives, with Alternatives S2 and S3 slowing the expansion to a greater degree than Alternative S1. More acres with potential for biological crust presence will cross a threshold and be dominated by exotic undesirable plants in Alternative S1 compared with Alternatives S2 and S3. Comparing Alternatives S2 and S3 within the high restoration priority subbasins, both would slow the expansion of exotic undesirable plants, with Alternative S2 achieving slightly more decline in geographic extent of exotic undesirable plants than Alternative S3.

Table 4-18 summarizes the effects of the alternatives on biological crust development and extent in the dry shrub PVG, where biological crusts are most prevalent. Trends are reported for the entire project area and for the high restoration priority subbasins, for each alternative, on lands administered by the BLM and the Forest Service, as related to historical geographic extent.

Conclusions

Alternatives S2 and S3 would provide for more improvement of ecosystem processes and functions than Alternative S1. This, along with direction to develop conservation strategies and address risks through step-down, would provide more benefits to vascular and non-vascular plants and rare plant communities than would Alternative S1. Alternatives S2 and S3 should provide for stable populations of these species and communities over the next 100 years, while populations may decrease under Alternative S1. The likelihood of persistence for these species should be stable with Alternatives S2 and S3, but would be reduced with Alternative S1.

Cumulative Effects (All Lands)

The effects of activities predicted to occur on lands not administered by the Forest Service or BLM would affect plant species similarly with implementation of any of the alternatives. Generally habitat conditions would be less favorable on all lands than on Forest Service- and BLM-administered lands primarily because of the increased effect of human activities on many private lands. Although specific effects on vascular and non-vascular plants from activities on all lands can not be predicted, it is possible that the cumulative effect on these species over the next 100 years would be a slight decrease in geographic extent from the current extent.

Table 4-18. Biological Crust Development and Extent within the Dry Shrub Potential Vegetation Group (PVG) in the Project Area,[1] at 100 Years.

	Trend toward (T), or Away (A) from Historical			Alternative That Comes Nearest to Returning Biological Crust *Development* or *Extent* to Historical
	Alternative S1	Alternative S2	Alternative S3	
		Biological Crust Development within Dry Shrub PVG		
Project Area	T	T	T	S2=S3
High Restoration Priority Subbasins in Alternative S2	T	T	T	S2=S3
High Restoration Priority Subbasins in Alternative S3	T	T	T	S2=S3
		Biological Crust Extent within Dry Shrub PVG		
Project Area	A	A	A	S2=S3
High Restoration Priority Subbasins in Alternative S2	A	T	T	S2
High Restoration Priority Subbasins in Alternative S3	A	T	T	S2

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Interpreted from Johnson and Kingery (1999); ICBEMP GIS data; Hemstrom et al. 1999.

Definitions

Environmental Index - A measure of the capability of a watershed or subwatershed to support a species.

Extirpation - Loss of populations from all or part of a species' range within a specified area.

Habitat Capacity - A weight-averaged environmental index in which the weights are the areas of each Hydrologic Unit Code (HUC). The weight average is presented in this EIS as a percentage of historical weight-average.

Habitats that have declined substantially in geographic extent from the historical to the current period- Those cover type–structural stage combinations that have declined by more than 20 percent in more than half of the Ecological Reporting Units (ERUs) where the historical extent is 50 percent of the ERU area or greater and where the overall net change in extent from historical to current is negative (see the cover type-structural stage discussion in Chapter 2).

Likelihood of Persistence- A relative measure of risk developed by the EIS Team, related to changes in habitat conditions, to the continued distribution of species in a Terrestrial Family on Forest Service- and BLM- administered lands. Three relative rating levels were used: good, fair, or poor. A rating is established for a Family based on the predicted effects on modeled species in that Family. Given the selection criteria for the species modeled as described in the Terrestrial Effects Analysis of SDEIS Alternatives (Raphael et al. 1999), it is assumed that risk to species not modeled would be similar to or less than the modeled species, unless specific factors such as low population size are involved. The ratings are determined based on predicted conditions resulting from the alternatives analyzed. An assumption is that improving habitat conditions should result in reduced risk to species persistence. The habitat variables reviewed to arrive at a rating were: the amount and trend of source habitat, the level and trend of the habitat capacity as a percent of historical, the trend in extent of habitat, and the environmental outcome. Generally, the trends described for the various ratings in the following paragraphs were consistent. However, there were a few exceptions where one of the variables did not conform. These exceptions are discussed where there is a difference from the overall rating for each grouping of Families (discussion related to each exception is included in the planning record).

A rating of "good" would be associated with predicted habitat conditions that would generally be improving over the next 100 years and indicates that there should be minimal risk to persistence of the species based on the predictions. Generally, the predicted amount of source habitat, predicted habitat capacity as a percent of historical and predicted extent of habitat are increasing, and the environmental outcome will be an "A" or "B".

A rating of "fair" would be associated with predicted habitat conditions that would be stable over the next 100 years and indicates that there would be some risk to persistence of the species based on the predictions. Generally, the predicted amount of source habitat, predicted habitat capacity as a percent of historical and predicted extent of habitat are stable (within +or- 10 percent of current), and the environmental outcome will be a "C".

A rating of "poor" would be associated with habitat conditions that would be declining or stable at a relatively low level over the next 100 years, or associated with other limiting factors (such as small population size); a poor rating indicates that there would be substantial risk to persistence of the species based on the predictions. Generally, the predicted amount of source habitat, predicted habitat capacity as a percent of historical and predicted extent of habitat are decreasing, and the environmental outcome will be a "D"or "E".

Habitat conditions for a Family or species with a poor rating indicate a need for priority for restoration of habitat (or factors that are reducing the value of habitat) and careful monitoring to assure habitat conditions do not become worse than predicted. For example, various management options were tested to determine the potential for improving the outcomes. The most promising was increasing the level of restoration actions in subbasins with potential to improve habitat conditions. The possible effects of doing so were tested for sage grouse. By focusing on 20 subbasins within the range of sage grouse and assuming approximately 20 million dollars, it was possible to raise the basin-wide outcome for sage grouse, although the outcome class did not change.

Outcomes- A characterization of the likely distribution and relative abundance of each species across its range in the project area. Two types of outcomes are reported:

Environmental outcome- A characterization of outcome based on habitat capacity, range extent, and connectivity. This outcome is reported for all lands in the project area and for Forest Service- and BLM-administered lands. It can be interpreted for Forest Service- and BLM-administered lands in much the same way as the federal habitat outcomes were reported in the Draft EISs.

Population outcome- A characterization of outcome based on habitat capacity, range extent, and connectivity and which accounts for other influences that could have pervasive effects on a species population (such as other organisms and small population size). Population outcome levels are reported for all lands, and are similar to the cumulative effects outcomes in the Draft EISs.

Source Habitats- Those characteristics of vegetation that support long-term species persistence or characteristics of vegetation that contribute to stable or positive population growth for a species in a specified area and time.

Successional Momentum- The increasing departure (change) of landscape vegetation, structure, composition, patch, pattern, and disturbance regimes away from the historical range at an increasing rate.

Terrestrial Family- An aggregate of groups of broad-scale terrestrial vertebrate species of focus for the ICBEMP, organized into "families" based on habitat requirements (Wisdom et al. in press). Twelve Terrestrial Families are discussed in this EIS.

Terrestrial Invertebrates

Methodology: How Effects on Terrestrial Invertebrates were Estimated

As discussed in Chapter 2 of this EIS, habitat requirements for invertebrates are generally at a scale so fine that it is difficult to precisely establish their current condition and status or to determine the effects of the broad-scale direction in the alternatives. However, it is possible for the EIS Team to discuss general issues and compare the general effects of the alternatives on these issues. Further analysis of effects of proposed management on these species or their habitats should be conducted on a local basis during site-specific NEPA analysis.

Effects of the Alternatives on Terrestrial Invertebrates

All three alternatives would have a positive effect on invertebrates by protecting special habitat features such as talus and caves and maintaining soil structure, although the consistency in approach would be enhanced in Alternatives S2 and S3. In addition, Alternatives S2 and S3 would have a positive effect on invertebrates by improving diversity and sustainability of habitats through restoration of those habitats that have declined substantially in geographic extent from historical to current periods. Furthermore, Alternatives S2 and S3 would reduce the negative effects of pesticides and restore frequent, low intensity fire where it would be appropriate to repattern vegetation to a greater extent than Alternative S1.

Implementation of Alternatives S2 and S3 would increase understory vegetation, restore temperature regimes, and improve decomposition rates through thinning and increased use of prescribed fires. These actions would reduce densely stocked stands, which would increase the amount of sunlight reaching the forest floor compared with implementation of Alternative S1.

All three alternatives would improve soil stability, soil productivity, and plant cover by reducing soil compaction and displacement during management activities. In addition, Alternatives S2 and S3 would further benefit invertebrates by improving habitat effectiveness through restoration of vegetation patches, patterns, structure, and species composition by repatterning vegetation to be more consistent with the landform, climate, biological and physical characteristics of the area.

Conclusions

Specific effects on invertebrates can not be predicted from broad-scale data. However, all three alternatives would provide general positive benefits for invertebrates. Alternatives S2 and S3 would provide for more improvement of ecosystem processes and functions than does Alternative S1. Therefore, Alternatives S2 and S3 should provide more general benefits to invertebrates than does Alternative S1.

Cumulative Effects (All Lands)

The effects of activities predicted to occur on lands not administered by the Forest Service or BLM would affect invertebrate species similarly with implementation of any of the alternatives. Generally habitat conditions would be less favorable on all lands than on Forest Service- and BLM-administered lands primarily because of the increased effect of human activities on many private lands. Although specific effects on invertebrates from activities on all lands can not be predicted, it is possible that the cumulative effect on these species over the next 100 years would be a slight decrease in geographic extent from current.

Broad-scale Terrestrial Vertebrates

Methodology: How Effects on Terrestrial Vertebrates were Estimated

Landscape Model

Landscape projection models used by the SAG predicted trends in vegetation composition and structure resulting from management activities and succession. Projected future conditions reflect estimates of vegetation cover 100 years into the future under prescriptions and land allocations of each alternative. The predicted amounts of vegetation were input into the terrestrial models.

Terrestrial Models

Wisdom et al. (in press) identified 91 broad-scale species of focus (see Chapter 2, Terrestrial Species section). For more detailed analyses, a subset of 28 species (31 species-seasonal combinations) was selected from the 91 species as a representative cross-section of the variation in environmental requirements. This selection was made by examining environmental requirements of all 91 species. The concept of focal species (Lambeck 1997), the findings of Wisdom et al. (in press), and the structure of the models were applied to make this selection. The intent was to select a set of species to represent the full array of species responses to conditions projected under the management alternatives.

Note: Specific model predictions are not presented here for the brown-headed cowbird, because issues relating to this species on Forest Service- and BLM-administered lands are localized in nature and are best addressed at a finer scale through the step-down process. There was no difference between alternatives in effects on this species at the broad scale. The model predictions are contained in the planning record.

Two complementary types of Bayesian Belief Network models (see sidebar) were developed by the SAG: an Environmental Index model and a Population Outcome model. A basic assumption of model development and interpretation is that conditions existing historically provided adequate habitat condition for species. The models are working hypotheses that have not yet been validated through monitoring and research (Raphael et al. 1999).

Environmental Index Model

This Environmental Index Model was used by SAG to characterize the quantity and quality of habitat and other environmental factors affecting populations of each species. Input data for this model were primarily derived from outputs of the landscape model. The index incorporates source habitat and additional aspects of habitat quality and other influences that affect species. For large species with extensive home ranges (grizzly bear, gray wolf, lynx, and wolverine),

Bayesian Belief Network (BBN) Models

A Bayesian Belief Network (BBN) is a model in graphical form representing a multivariate probability distribution of random variables (Haas 1991). The graphical form of a BBN resembles a flowchart in which variables (referred to as nodes) are linked with arrows, representing causal influences among the variables. A BBN is directed so influences among variables flow in one direction only; because there are no arrows leading back to input variables, they are acyclic. BBNs provide a quantitative framework that allows information from both empirical data and expert opinion to be combined in an evaluation process.

Outcomes for each node are described by predicted levels or states, which are expressed as probabilties. For example, the state levels "Yes" (probability of occurrence = 0.65) and "No" (probability of non-occurrence = 0.35) could define a node representing a large flood event.

For further information on the BBN models, see Quigley 1999.

watersheds were used as the basic unit of analysis. For other species, subwatersheds were used as the basic unit of analysis.

The results of the environmental index model were summarized in two ways to reflect land ownership patterns. First, the results were computed across all ownerships throughout the project area. Second, each watershed / subwatershed with a land area of 50 percent or more administered by either the Forest Service or Bureau of Land Management (50 percent HUCs) was identified and results computed and summarized for them. Because such a large percentage of subwatersheds contain a mix of Forest Service- and BLM-administered lands with other ownerships, and because the base level model projections were estimated by subwatershed or watershed, it was not possible to partition out all Forest Service- and BLM-administered lands separately from other ownerships for model inputs. The area within these 50 percent watersheds / subwatersheds represents 53 percent of the total land base, and 88 percent of the total Forest Service- and BLM-administered lands in the project area. Approximately 11 million acres of "other" lands are included in the terrestrial model predictions of effects of alternative implementation on Forest Service- and BLM- administered lands.

The results of the environmental index model are reported as "habitat capacity," which is a weight-averaged environmental index in which the weights are the areas of each Hydrologic Unit Code (HUC). The weight average is presented in this EIS as a percentage of the historical weight-average.

Population Outcome Model

This model was used by SAG to summarize the spatial distribution of watershed / subwatershed-level results generated from the environmental index model to evaluate outcomes for species across the entire basin for any point in time for any alternative. This model has three primary inputs: (1) an index of overall habitat capacity, (2) a measure of the extent of a species' range, and (3) a measure of habitat connectivity. The overall status of a species was characterized by assigning likelihoods to each of five possible outcomes, labeled A to E.

Again, SAG performed two sets of model calculations, one based on all lands within the project area, and one restricted to watersheds or subwatersheds containing at least 50 percent Forest Service- and BLM- administered lands.

The population outcome model has two findings. The first is a characterization of outcome, based on the three nodes described above (habitat capacity, range extent, and connectivity). This set of outcomes is referred to as *environmental outcomes* (not to be confused with *environmental index*). These outcomes can be interpreted in much the same way as the federal habitat outcomes reported in the Draft EISs. The second set is referred to as *population outcomes* and accounts for other influences that could affect a species population throughout its range. These influences included presence of other influential organisms (for example, presence of predators of woodland caribou), and small population size (a factor to adjust for demographic effects of small populations). The population outcome levels are similar to the cumulative effects outcomes in the Draft EISs.

The outcome classes, A to E, are broad classes based on expected values which were predicted on a numeric scale of one to five. As discussed in the following section it is not possible to estimate the overall uncertainty related to the expected values. However, a standard deviation of the probability distribution was calculated for the Bayesian model outputs. For a normal (gaussian) distribution, 68.2 percent of the probability is within one standard deviation of the mean. The standard deviation is only one measure of the uncertainty associated with model outputs, and it is likely that other sources of uncertainty, such as inaccuracy of model inputs, would increase the size of the standard deviation about the mean expected values of the environmental and population outcomes. Consequently, any conclusions made about a difference in outcomes based on a variation of one standard deviation or less must be interpreted with caution and with the above considerations in mind.

Rationale for Qualitative Interpretation of Modeling of Management Alternatives

The value and limitations of models has been discussed, in general terms, in the introduction to this chapter. These caveats are applicable to the models used for the terrestrial species analysis.

- Some of the specific direction from Alternatives S2 and S3 may not be fully reflected in the SAG's landscape models or management prescriptions. In Alternatives S2 and S3 in areas where high concentrations of restoration activities would occur with a focused restoration design (for example, where EAWS takes place or in T watersheds), landscape projections would likely be better than were predicted for the following: levels of snags and downed wood, reduction in HRV departure, restoration of habitats that have declined substantially in geographic extent from the historical to current period, reduction in livestock grazing effects, and reduction in noxious weeds and exotic plants (SAG, personal communication, November 1999).

- Cover type and structural stage estimates of vegetation were derived from the landscape model. There is no statistical estimate of the error associated with these predictions. However, high error rates are associated with estimates of cover type and structural stage at the scale of individual subwatersheds (see Hann, Jones, Karl, et al. 1997 and Wisdom et al. [in press] for details), but these errors decline with increasing size of area analyzed, with lowest error rates associated with basin-wide estimates.
- Projected effects of the alternatives on specific environmental attributes (such as snag or log density trend or grazing effects departure) are also subject to estimation errors. Because of uncertainties involved in future projections, these errors are difficult to estimate. In addition, such errors can be propagated with the inclusion of a large number of environmental parameters in a given model. The potential limitations that estimation errors may place on inferences for management have not been quantified.
- Most effects of forest and range management were estimated by using landscape proxies to index the environmental attributes of interest. For example, the degree of HRV departure was used as a proxy for snag species when the tree species is important to a wildlife species. These landscape proxies presumably are correlated with the attribute, but the strength of this correlation is untested. More-

Species Viability and Persistence

Regulations implementing the National Forest Management Act (NFMA) require that:

> *Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area.*

Key points of this requirement are that: (1) the obligation is to provide habitat, but the adequacy of that habitat must be judged on the basis of its capability to support populations; (2) the requirement is to provide for habitat that can support a population that is well-distributed across the planning area, not just a population that can persist within the planning area; (3) the term well-distributed is defined in terms of the ability of individuals of the species to interact with each other. Biological and legal interpretation of the concept of well-distributed has further clarified that it must be judged relative to the life history and historical distribution of the species. Many species were not historically distributed in a continuous fashion across the landscape, and it should not be expected that they would be continuously distributed across the future landscape. Legal interpretation has also clarified that it is not a requirement to absolutely "insure" species viability, but that the level of certainty should reflect both biological reality and needs for multiple uses (see 1994 Dwyer decision, Northwest Forest Plan). Thus, viability and risk must be expressed as variables, and the trade-offs between them made explicit.

The regulation also makes it clear that viability is a requirement of the federal landscape (that is, the planning area). This requirement creates stiff analytical challenges, as species populations operate across entire landscapes with no reference to land ownership. The terrestrial species effects analysis presented in this Supplemental Draft EIS provides the information that the decision makers will use to judge whether federal habitat management meets NMFA requirements. These include analyses of environmental outcomes (a large-scale index of the capability of the environment to support population abundance and distribution); population outcomes (supplementing environmental outcomes by reflecting other influences on species populations such as the effect of small population size); and the availability of habitat for species grouped by similar habitat associations. The necessary analysis that contributes to determining likelihood of viability is presented here; however, the final determination of viability will be made in the Record of Decision.

over, it is possible that many local changes in landscape conditions that may occur under each alternative would not be reflected to their full extent in the landscape proxies.

- The models are meant to portray relative quality of environmental conditions affecting populations over time and among alternatives, not the actual density or population size of a species at any particular location. In this context, it is important to note that the environmental index model estimated relative densities, not absolute densities. The population outcome scale is a relative measure of the amount and distribution of suitable environments. Population outcomes are not a direct measure of population viability.
- The use of subwatersheds or watersheds with 50 percent or more Forest Service- or BLM-administered lands to represent effects on actual Forest Service- or BLM-administered lands increases the level of uncertainty related to effects of the alternatives on Forest Service- and BLM-administered lands. Any Forest Service- or BLM-administered lands in watersheds with less than 50 percent Forest Service- and BLM-administered lands was excluded from the analysis; conversely, any non-Forest Service- or BLM-administered lands in watersheds with 50 percent or more Forest Service- and BLM-administered land was included in the analysis. It was not possible to quantify the degree of uncertainty related to this effect.

Effects of the Alternatives on Terrestrial Vertebrates

This section presents the effects of implementing the alternatives on the broad-scale, terrestrial species of concern (see the Terrestrial Species section in Chapter 2). The evaluation of the effects are directed toward issues identified for the 12 Terrestrial Family groupings in Wisdom et al. (in press). The predictions of the various models developed by the SAG were used to support the discussions and provide an indication of the relative degree of difference among the alternatives.

General Effects on Terrestrial Families Grouped by Similar Habitat Requirements

This section describes the effects on terrestrial species, grouped by Terrestrial Families, which are further grouped by similar habitat conditions. The effects described in the following are related to implementation of the alternatives on Forest Service- and BLM-administered lands. Effects related to all lands in the basin are disclosed in the cumulative effects section.

The analysis indicates that the species modeled should continue to exist in the project area for the next 100 years, with the greatest level of uncertainty and risk associated with those species whose population outcome is “E”. Aggressive actions will be necessary to avoid extirpations.

Forested Habitat

Alternative S2 and to a slightly lesser extent Alternative S3 would generally improve overall habitat conditions for species in Terrestrial Families 1, 2, 3, and 4 (see Chapter 2 and Table 4-22, later in this section, for species), which primarily use forested habitat, through restoration and maintenance of habitats that have declined substantially in geographic extent from historical to current periods and the repatterning of vegetation to where it would be sustainable to a greater extent than Alternative S1 (see Terrestrial [Upland] Vegetation effects section, earlier in this chapter, for additional discussion).

Rangeland Habitat

Alternatives S2 and S3 would slow succession momentum and declines in habitat conditions for species in Terrestrial Families 11 and 12, which primarily use rangeland habitat, through: restoration and maintenance of habitats that have declined substantially in geographic extent from historical to current periods; repatterning vegetation to where it would be sustainable; expansion of the area covered by the Healthy Rangeland Strategy; and Integrated Weed Management, to a greater degree than Alternative S1 (see Terrestrial [Upland] Vegetation effects section, earlier in this chapter, for additional discussion).

Forest and Rangeland Habitats

For species in Terrestrial Families 5, 6, 7, 8, 9, and 10 that use a mix of forested and rangeland habitats, Alternatives S2 and S3 would generally improve overall habitat conditions, through restoration and maintenance of habitats that have declined substantially in geographic extent from the historical to the current period and through repatterning of vegetation to where it would be sustainable to a greater extent than Alternative S1. These alternatives would expand the area covered by the Healthy Rangeland Strategy from BLM-administered lands to all Forest Service- and BLM-administered lands in the project area. This direction in combination with an integrated weed

Outcomes

Environmental Outcomes

The environmental outcomes should be thought of as a large-scale index of the capability of the environment to support population abundance and distribution, but not as an actual prediction of population occurrence, size, density, or other demographic characteristics.

Outcome A. Suitable environments are broadly distributed and of high abundance across the historical range of the species. The combination of distribution and abundance of environmental conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the species.

Outcome B. Suitable environments are either broadly distributed or of high abundance across the historical range of the species, but there are gaps where suitable environments are absent or only present in low abundance. However, the disjunct areas of suitable environments are typically large enough and close enough to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation (groups of populations) across its historical range.

Outcome C. Suitable environments are distributed frequently as patches and/or exist at low abundance. Gaps where suitable environments are either absent or present in low abundance are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in overall species range from historical may have resulted from this isolation.

Outcome D. Suitable environments are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these environments may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition, reduction in overall species range from historical may have resulted from this isolation.

Outcome E. Suitable environments are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches, and little likelihood of recolonization of such patches. There has likely been a reduction in overall species range from historical, except for some rare, local endemics that may have persisted in this condition since the historical time period.

Population Outcomes

The following definitions of population outcome classes reflect the availability of both federal and non-federal habitat and environmental conditions within the project area, and all other influences on the species population that are not accounted for in the modeling of environmental outcomes.

Outcome A. The combination of environmental and population conditions provides opportunity for the species to be broadly distributed and of high abundance across its historical range. There is potential for continuous or nearly continuous intraspecific interactions at high population size.

Outcome B. The combination of environmental and population conditions provide opportunity for the species to be broadly distributed and/or of high abundance across its historical range, but there are gaps where populations are potentially absent or only present in low density as a result of environmental or population conditions. However, the disjunct areas of higher potential population density are typically large enough and close enough to other subpopulations to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation across its historical range.

Outcome C. The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by patchiness and/or areas of low abundance. Gaps where the likelihood of population occurrence is low or zero are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in overall species range from the historical range may have resulted from this isolation.

Outcome D. The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by areas with high potential for population isolation and/or very low potential abundance. While some of these subpopulations may be self-sustaining, gaps where the likelihood of population occurrence is low or zero are large enough that there is limited opportunity for interactions among them. For species for which this is not the historical condition, reduction in overall species range from historical has likely resulted from this isolation.

Outcome E. The combination of environmental and population conditions restricts the potential distribution of the species, which is characterized by high levels of isolation and very low potential abundance. Gaps where the likelihood of population occurrence is low or zero are large enough there is little or no possibility of interactions, strong potential for extirpations, and little likelihood of recolonization. There has likely been a reduction in overall species range from historical, except for some rare, local endemics that may have persisted in this condition since the historical time period.

management strategy also would contribute to improvement of habitat conditions for these families, compared to Alternative S1.

Habitats that have Declined Substantially

EIS Team analysis indicates that habitats that have declined substantially in geographic extent from the historical to the current period would generally be maintained or increased in all terrestrial communities, except upland shrubland, in all alternatives (see Table 4-19). Generally Alternatives S2 and S3 are predicted to increase the geographic extent of these habitats more than Alternative S1. Further, species composition and habitat connectivity would be improved with Alternatives S2 and S3 because of their emphasis on repatterning.

The emphasis on maintaining source habitats in T watersheds and on restoration in the high restoration priority subbasins would have a positive effect on habitats that have declined substantially in geographic extent from the historical to the current period. Alternatives S2 and S3 generally would restore more acres in these areas than Alternative S1.

Snags

Generally, the number of snags would increase on Forest Service- and BLM-administered lands at the end of 100 years (see Table 4-20). All alternatives generally would maintain or restore large snags and downed wood to above historical levels, although Alternatives S1 and S3 would provide less flexibility to modify snag and downed wood amounts to reflect local conditions. The primary exception to maintaining snags levels would be that snags of shade-intolerant species in the dry forest potential vegetation group and to a lesser extent in the moist forest potential vegetation group are predicted to decrease. A predicted lack of snags from old, shade-intolerant tree species restricted the environmental index for many species modeled. The landscape models did not distinguish which tree species would generate snags in the future. Management direction in Alternatives S2 and S3 that favors production of large snags from shade-intolerant tree species might improve habitat for some species in Terrestrial Families 1, 2, and 8 more than the models predicted (see Table 4-25, later in this section). Alternative S1 would maintain large snags within the areas covered by the Eastside

Table 4-19. Extents of Habitats that Have Declined Substantially within Six Categories of Terrestrial Communities, Current and by Alternative at 100 years.

Terrestrial Community Category	Current	Alternative S1	Alternative S2	Alternative S3
		Percent of Historical Levels		
Subalpine Forest[1]	21	122	123	123
Montane Forest[2]	36	62	64	64
Lower Montane Forest[3]	29	77	79	78
Upland Woodland[4]	55	229	231	230
Upland Shrubland[5]	63	41	42	42
Upland Herbland[6]	33	82	80	80

[1] Mountain hemlock: young multi-story; old multi-story. Whitebark pine/alpine larch: stand initiation; young multi-story; old multi-story; stem exclusion, open. Whitebark pine: stand initiation; young multi-story; old multi-story; stem exclusion, closed. Engelmann spruce/ subalpine fir: young multi-story; old multi-story.
[2] Interior Douglas-fir: stem exclusion, closed. Western larch: stand initiation; young multi-story; old multi-story; old single story. Western white pine: stand initiation; stem exclusion, closed; understory reinitiation; old multi-story. Lodgepole pine: stand initiation; young multi-story; old single story. Western redcedar/ Western hemlock: young multi-story. Cottonwood/willow: understory reinitiation; old multi-story. Sierra Nevada mixed conifer: stand initiation; young multi-story; stem exclusion, closed; understory reinitiation; old multi-story.
[3] Interior ponderosa pine: stand initiation; stem exclusion, closed; old multi-story; old single story. Pacific ponderosa pine: stem exclusion, closed; old multi-story.
[4] Mixed conifer woodlands: woodlands.
[5] Alpine tundra: closed, low, medium shrub. Shrub wetlands: open, low, medium shrub; closed tall shrub. Antelope bitterbrush/ bluebunch wheatgrass: closed, low, medium shrub. Mountain mahogany: open, low, medium shrub. Mountain big sagebrush: open, low, medium shrub. Chokecherry/seviceberry/rose: closed, low, medium shrub. Big sagebrush: open low, medium shrub; closed, low, medium shrub.
[6] Wheatgrass/bunchgrass: closed herbland; open herbland. Fescue bunchgrass: closed herbland; open herbland. Big sagebrush: closed herbland.

Source: ICBEMP GIS Data (converted to 1 km^2 raster data).

Table 4-20. Current and Predicted Number[1] of Large Snags and Pieces of Downed Wood Per Acre in the Project Area,[2] by Potential Vegetation Group (PVG) and Alternative, at 100 years.

Potential Vegetation Group	Current	Alternative S1	Alternative S2	Alternative S3
		Number of Large Snags Per Acre		
Cold Forest	4.23	4.57	4.65	4.60
Dry Forest	1.56	1.22	1.79	1.65
Moist Forest	3.89	4.59	4.47	4.59
Riparian Woodland	1.82	4.13	4.67	4.49
Woodland	0.40	0.40	0.26	0.35
		Downed Wood Pieces Per Acre		
Cold Forest	9.14	9.57	9.58	9.57
Dry Forest	2.41	2.49	2.86	2.80
Moist Forest	8.00	8.11	5.56	6.58
Riparian Woodland	1.45	1.84	2.52	2.43
Woodland	0.40	0.40	0.26	0.35

[1] See Table 2-23b in Chapter 2 for historical numbers.
[2] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Hemstrom et al. 1999.

Screens, but outside these areas fewer large snags could be maintained. Therefore, Alternatives S2 and S3 would have substantially better effects than Alternative S1 regarding snag levels.

Unroaded Areas

There would be fewer areas with high and very high road densities under all alternatives (see Table 4-21). The reductions would be from very high to high road density class and from high to moderate road density class and would be greater with Alternatives S2 and S3 than with Alternative S1. There also would be substantially more areas with decreasing trends in road density with Alternatives S2 and S3 compared to current and Alternative S1 (see Table 4-22). There would continue to be adverse effects from human activities associated with roads; however, these decreases in road density should reduce the effects on species.

Effects on Terrestrial Families Grouped by Similar Trends in Effects

This section describes the effects on Terrestrial Families that are similar in trend. The effects on species in each of the 12 Terrestrial Families were reviewed and it was determined that the 12 Terrestrial Families could be separated into three groups by similar trends in effects: Terrestrial Families 1, 2, 3, 4, 6, 8,and 9; Terrestrial Families 5, 7, and 10; and Terrestrial Families 11 and 12. In the following sections, both the geographic extent of source habitats and habitat capacity are discussed.

Improving or Stable Trends

Habitat conditions for Terrestrial Families 1, 2, 3, 4, 6, 8, and 9 are generally predicted to be improving or stable. Species in these families depend on forested habitat or a mix of forest, woodland and rangeland habitat. Landscape modeling results indicate that total source habitats would generally increase in geographic extent over the next 100 years on BLM- and Forest Service-administered lands and in some cases may equal or exceed historical acres for species in these Families (see Table 4-23). Total source habitat would, in most cases, equal or exceed 65 percent of historical levels. Management direction in Alternatives S2 and S3 is similar in intent to that represented by the Eastside Screens for Oregon and Washington in Alternative S1, relative to maintaining old forests, and it extends this intent throughout the project area. The outcome-based direction in Alternatives S2 and S3 does not contain specific direction relative to northern goshawk, as is included in the Eastside Screens. Alternatives S2 and S3 direction goes beyond the Eastside Screens by directing restoration and repatterning of old forest types to areas where they would be sustainable, which

Table 4-21. Area of Road Density Classes and Percent of Road Density Classes in the Project Area,[1] Current and by Alternative, at 100 years.

	Current		Alternative S1		Alternative S2		Alternative S3	
Class[2]	Million Acres	Percent	Million Acres	Percent	Million Acres	Percent	Million Acres	Percent
None	20.0	31	20.0	31	20.0	31	20.0	31
Very Low	4.2	7	4.2	7	4.2	7	4.2	7
Low	6.6	10	6.5	10	6.6	10	6.6	10
Moderate	15.8	25	18.5	29	20.3	32	20.0	31
High	14.4	23	12.0	19	10.7	17	11.0	17
Extremely High	2.6	4	2.3	4	1.7	3	1.8	3

[1] Project Area = Forest Service- or BLM-administered lands in the project area.
[2] None = 0.0 to <0.02 miles of road, Very Low = 0.02 to <0.1 miles of road per square mile, Low = 0.1 to <0.7 miles of road per square mile, Moderate = 0.7 to <1.7 miles of road per square mile, High = 1.7 to <4.7 miles of road per square mile, Extremely High = >4.7 miles of road per square mile.

Source: Hemstrom et al. 1999.

generally would lead (with a few exceptions) to modest increases in total source habitats compared to Alternative S1.

Also, Alternative S1 is projected to provide slightly more source habitat (one to three percent) for the western bluebird, Lazuli bunting and blue grouse than Alternatives S2 or S3. It appears that this increase is due to a higher amount of early seral forest in Alternative S1. Alternative S1 takes a passive approach at managing mid seral forest and protecting late seral forest, while Alternatives S2 and S3 place emphasis on reducing risk of crown fires in mid seral forests, protecting late seral forests, restorating early seral conditions that were created through past logging, and restoring mid seral forests that were created through fire exclusion. This difference in focus results in a slightly higher level of early seral forest under Alternative S1. However, the early seral forest of Alternatives S2 and S3 would be more similar in composition and structure to habitats that existed historically and would be more likely to be sustained than would the early seral forest conditions in Alternative S1. Thus, the habitat in Alternatives S2 and S3 would likely be of higher quality than that of Alternative S1. Since there is no difference in the environmental outcomes among the alternatives for these species except the western bluebird (Table 4-26), the differences in amount of source habitat among alternatives represent local (among watersheds) effects compared to basin-wide effects on Forest Service- and BLM-administered lands. In the case of the western bluebird, the environmental outcome with Alternatives S2 and S3 would be better than with Alternative S1 because of other direction which offsets the lower amount of source habitat.

Alternative S1 is projected to provide slightly more source habitat (one to five percent) for ash-throated flycatcher and western bluebird than Alternatives S2

Table 4-22. Trends in Road Density in the Project Area,[1] Acres and Percent, by Alternative, at 100 years.

	Alternative S1		Alternative S2		Alternative S3	
Class	Million Acres	Percent	Million Acres	Percent	Million Acres	Percent
Increasing	0.1	0	0.1	0	0.1	0
Stable	57.8	91	43.9	69	45.0	71
Decreasing	5.7	9	19.5	31	18.5	29

[1] Project Area = Forest Service- or BLM-administered lands in the project area.

Source: Hemstrom et al. 1999

Table 4-23. Current and Predicted Amounts of Source Habitats, by Terrestrial Species and Alternative, at 100 years.

Species	Current	Alternative S1	Alternative S2	Alternative S3
	Percent of Historical Levels			
Family 1				
pygmy nuthatch	38	62	69	69
Lewis' woodpecker (migrant)	23	55	69	67
Family 2				
American marten	67	100	105	105
flammulated owl	47	84	90	89
northern goshawk (summer)	68	93	100	99
hoary bat	69	88	92	92
black-backed woodpecker	71	93	102	101
woodland caribou	73	291	277	285
Family 3				
blue grouse (summer)	85	128	125	125
lynx	121	111	112	113
wolverine	110	115	116	116
Family 4				
lazuli bunting	84	78	75	76
Family 5				
gray wolf	100	102	102	102
grizzly bear	100	106	105	105
Rocky Mountain bighorn sheep (summer)	76	69	68	68
Rocky Mountain bighorn sheep (winter)	64	65	63	63
Family 6				
rufous hummingbird	86	115	117	117
northern goshawk (winter)	72	97	103	102
Family 7				
long-eared myotis	95	91	91	91
Family 8				
western bluebird	68	79	78	78
Family 9				
ash-throated flycatcher	181	93	88	91
Family 10				
pronghorn	90	91	87	87
short-eared owl	93	91	90	90
striped whipsnake	95	95	90	90
Washington ground squirrel	20	22	21	21
Family 11				
Brewer's sparrow	93	68	70	69
sage grouse (summer)	92	70	72	72
sage grouse (winter)	91	70	72	72
Family 12				
Columbian sharp-tailed grouse (summer)	82	78	73	73
grasshopper sparrow	72	36	39	39

Source: Raphael et al. 1999.

or S3. One primary difference in habitats for these species in all alternatives is change in woodland cover types. Management direction intended to provide benefits for multiple species in Alternatives S2 and S3 is aimed at halting the encroachment of woodlands, especially juniper woodlands, on sites where woodlands did not occur historically. The increased vulnerability of these cover types to wildfire, induced through fine fuel buildup as livestock grazing decreases, is evident in all alternatives by the increases projected in wildfire occurrence within these types. These woodland cover types remain, or even increase, with Alternative S1, because it is passive on the issue of woodland encroachment. However, the amount of this source habitat type is projected to remain abundant with all alternatives. The woodland source habitat that is conserved or restored with Alternatives S2 or S3 is likely to be of higher quality than with

Alternative S1. Since there is no difference in the environmental outcomes among the alternatives for these species except the western bluebird (Table 4-26), the differences in amount of source habitat among alternatives represent local (among watersheds) effects compared to basin-wide effects on Forest Service and BLM-administered lands. In the case of the western bluebird, the environmental outcome with Alternatives S2 and S3 would be better than with Alternative S1 because of other direction which offsets the lower amount of source habitat.

The number of areas with a high or low environmental index for species in these seven Families generally would increase on Forest Service- and BLM-administered lands to a similar degree with all alternatives, because many areas that currently are without habitat would gain habitat. For example, with pygmy nuthatch the percentage of total subwatersheds with either a high or low environmental index would increase from 53 percent currently to 93 percent in 100 years with Alternative S2. This indicates either an expansion of habitat into subwatersheds currently without habitat, or an improvement in habitat quality in those subwater-sheds. There would generally be increases in the percentage of subwatersheds with predicted high or low environmental index (see Table 4-24) indicating an expansion of habitat. The repatterning of vegetation in Alternatives S2 and S3 should improve connectivity, and the increases in geographic extent of source habitat would be more sustainable than under Alternative S1.

The habitat capacity on Forest Service- and BLM-administered lands compared to current generally would show substantial increases for the species in these seven Families (see Table 4-25). There would be a slight decrease for lynx. A predicted lack of snags from old, shade-intolerant tree species restricted the habitat capacity for many species modeled. Management direction in Alternatives S2 and S3 that favors production of large snags from shade-intolerant tree species might improve habitat conditions for species in Terrestrial Families 1, 2, and 8 more than the models predict. The EIS Team concluded that the benefits of Alternatives S2 and S3, which contain direction for wide-ranging carnivores to minimize and mitigate adverse effects of management and develop broad-scale linkages which are not reflected in modeled results, should be somewhat higher than in Alternative S1 for lynx and wolverine. Low population size and human disturbance would limit the potential for wolverine to respond to improvements in habitat. Low population size would also limit lynx, and competition with other predators may further limit this species. Low population size and predation by cougars would limit woodland caribou recovery to lower levels than the amount of source habitat indicates.

In summary, habitat conditions on BLM- and Forest Service-administered lands for the species in Terrestrial Families 1, 2, 3, 4, 6, 8, and 9 generally would improve over the next 100 years under all three alternatives. Model predictions of the environmental outcomes on BLM- and Forest Service-administered lands for species in these Families would not vary among alternatives by greater than one standard deviation, except for the black-backed woodpecker with Alternatives S2 and S3 better than Alternative S1, at the basin-wide scale (see Table 4-26). Alternatives S2 and S3 contain, along with other direction, specific direction to: restore habitats that have declined substantially in geographic extent from the historical to the current period, maintain and recruit snags, repattern vegetation consistent with the landscape, and reduce road effects. Therefore, at the watershed level, implementation of the direction in Alternative S2, followed closely by Alternative S3, should create improved habitat conditions for species in these Families compared to Alternative S1. The predicted trends in environmental outcomes for species in these Families would be increasing for 14 of 16 species modeled with Alternatives S2 and S3, and 13 of 16 species with Alternative S1. Most of these increases would relate to environmental outcomes greater than one standard deviation different than current (see Table 4-26). Environmental outcomes for the other species would be stable. The outcome levels would be either “A”, “B”, or “C”.

There would be a “good” likelihood of persistence of species within these seven families under all three alternatives, except for woodland caribou, lynx, and wolverine, because of the improving environmental outcomes, increasing extent of source habitats, improved distribution of habitats over the next 100 years, and improving habitat capacity. There would be a “poor” likelihood of persistence of woodland caribou over the next 100 years because of the small population size of the caribou and predation by cougars. Forest Service or BLM could do little through management of habitat to improve this likelihood, other than continuing to cooperate with the U.S. Fish and Wildlife Service and state wildlife management agencies to facilitate recovery of woodland caribou (see Threatened and Endangered Species section). There would be a “fair” likelihood of persistence for lynx because of their small population size and potential competition with other predators, and for wolverine because of small population size and unaccounted-for human disturbance near denning sites. Adverse effects of human-related activities on these two species should be reduced

Table 4-24. Percent of Watersheds or Subwatersheds[1] with 50 Percent or More Forest Service- or BLM-administered Lands with a High Environmental Index or with Either a High or Low Environmental Index (Total), by Species Current and by Alternative at 100 years.

Species	Class[2]	Current	Alternative S1	Alternative S2	Alternative S3
			Percent of Total Range		
Family 1					
pygmy nuthatch	High	5	8	13	12
	Total	53	93	93	93
Lewis' woodpecker	High	5	5	10	9
	Total	35	90	91	91
Family 2					
American marten	High	23	50	51	51
	Total	70	99	99	99
flammulated owl	High	7	13	18	18
	Total	59	98	98	98
northern goshawk (summer)	High	15	32	39	38
	Total	62	98	98	98
hoary bat	High	16	29	36	35
	Total	83	99	99	99
black-backed woodpecker	High	22	41	49	48
	Total	62	99	99	99
woodland caribou	High	34	97	95	95
	Total	51	98	98	97
Family 3					
blue grouse (summer)	High	35	68	65	65
	Total	89	100	100	100
lynx	High	69	69	69	69
	Total	100	100	100	100
wolverine	High	34	41	41	41
	Total	100	100	100	100
Family 4					
Lazuli bunting	High	38	60	57	58
	Total	68	96	96	96
Family 5					
gray wolf	High	3	2	3	3
	Total	99	99	99	99
grizzly bear	High	15	13	13	13
	Total	75	68	68	68
Rocky Mountain bighorn sheep (summer)	High	12	8	8	8
	Total	34	35	35	35
Rocky Mountain bighorn sheep (winter)	High	10	7	8	7
	Total	33	35	35	35
Family 6					
northern goshawk (winter)	High	27	56	60	60
	Total	67	97	97	97
rufous hummingbird	High	39	69	69	69
	Total	90	98	99	98
Family 7					
long-eared myotis	High	19	18	18	18
	Total	100	100	100	100
Family 8					
western bluebird	High	4	3	6	5
	Total	76	99	99	99
Family 9					
ash-throated flycatcher	High	78	78	75	75
	Total	81	86	82	83

Table 4-24. Percent of Watersheds or Subwatersheds[1] with 50 Percent or More Forest Service- or BLM-administered Lands with a High Environmental Index or with Either a High or Low Environmental Index (Total), by Species Current and by Alternative at 100 years. (continued)

Species	Class[2]	Current	Alternative S1	Alternative S2	Alternative S3
			Percent of Total Range		
Family 10					
striped whipsnake	High	47	37	18	18
	Total	98	97	96	96
short-eared owl	High	5	0	3	3
	Total	84	78	79	79
pronghorn	High	28	28	24	24
	Total	94	94	93	93
Washington ground squirrel	High	0	0	0	0
	Total	90	90	90	90
Family 11					
Brewer's sparrow	High	40	14	17	17
	Total	91	95	95	95
sage grouse (summer)	High	46	14	17	17
	Total	87	88	89	89
sage grouse (winter)	High	46	22	27	27
	Total	88	88	90	89
Family 12					
Columbian sharp-tailed grouse (summer)	High	6	1	2	2
	Total	75	72	71	71
grasshopper sparrow	High	2	0	0	0
	Total	69	55	59	58

[1] Grizzly bear, gray wolf, lynx, and wolverine percentages were calculated by watershed. Other species were calculated by subwatershed.
[2] High = watersheds or subwatersheds with a High environmental index; Total = watersheds or subwatersheds with either a High or a Low environmental index.

Source: Modified from Raphael et al. 1999.

with Alternatives S2 and S3 compared to Alternative S1, because of direction to minimize or mitigate adverse effects of management actions on wide-ranging carnivores and to facilitate development of broad-scale habitat linkages.

The likelihood of persistence for species in all seven Terrestrial Families is predicted to be similar with all three alternatives. However, as previously stated, it is felt that Alternative S2 followed closely by Alternative S3 include specific direction that would improve habitat conditions to a greater extent than Alternative S1.

Stable or Slightly Decreasing Trends: Mixed Habitats

Habitat conditions for species in Terrestrial Families 5, 7, and 10 are predicted to be stable or decrease slightly. Species in these Families all depend on a mix of forest, woodland, and rangeland source habitat. The landscape modeling results indicate that over the next 100 years, total source habitats on BLM- and Forest Service-administered lands generally would be stable or decrease slightly for species in these Families (see Table 4-23). Total source habitat would, in most cases, equal or exceed 85 percent of historical levels, except for bighorn sheep and Washington ground squirrel. All alternatives generally would lead to similar amounts of total source habitats.

Alternative S1 is projected to provide slightly more source habitat (one to two percent) for bighorn sheep than Alternatives S2 or S3. It appears that this increase is due to a higher amount of early seral forest in Alternative S1. As mentioned previously, Alternative S1 takes a passive approach at managing mid seral forest and protecting late seral forest, while Alternatives S2 and S3 place emphasis on reducing risk of crown fires in mid seral forests, protecting late

Table 4-25. Current and Predicted Habitat Capacity, by Species and Alternative, for Watersheds or Subwatersheds[1] with 50 Percent or More Forest Service- or BLM-administered Lands and on All Lands within the Project Area.

Species	FS/BLM Lands				Cumulative-All Lands			
	Current	Alt. S1	Alt. S2	Alt. S3	Current	Alt. S1	Alt. S2	Alt. S3
	Percent of Historical							
Family 1								
pygmy nuthatch	30	45	50	49	20	36	39	38
Lewis' woodpecker (migrant)	19	37	45	43	14	29	34	33
Family 2								
American marten	56	89	90	90	48	77	79	79
flammulated owl	34	49	53	52	26	41	44	43
northern goshawk (summer)	51	85	92	91	44	66	70	70
hoary bat	54	71	76	75	52	56	59	59
black-backed woodpecker	47	73	85	83	40	63	73	71
woodland caribou	53	107	108	107	50	106	106	106
Family 3								
blue grouse (summer)	77	102	101	100	78	101	100	100
lynx	90	86	87	86	86	82	83	83
wolverine	59	65	66	65	54	57	57	58
Family 4								
Lazuli bunting	62	92	94	93	55	90	93	92
Family 5								
gray wolf	32	31	31	31	25	24	24	24
grizzly bear	36	32	32	32	25	22	22	22
Rocky Mountain bighorn sheep (summer)	57	59	60	60	49	52	53	53
Rocky Mountain bighorn sheep (winter)	53	59	60	60	47	52	52	52
Family 6								
rufous hummingbird	74	98	99	99	68	95	96	96
northern goshawk (winter)	71	107	110	110	72	108	109	109
Family 7								
long-eared myotis	63	58	60	59	55	51	52	52
Family 8								
western bluebird	49	58	62	61	38	44	46	45
Family 9								
ash-throated flycatcher	106	110	106	107	122	119	117	117
Family 10								
pronghorn	58	57	55	55	53	52	51	51
short-eared owl	41	35	36	36	27	26	26	26
striped whipsnake	84	75	63	63	76	68	60	60
Washington ground squirrel	27	24	27	25	14	15	14	14
Family 11								
Brewer's sparrow	60	36	40	39	45	29	30	30
sage grouse (summer)	47	26	30	29	34	20	22	22
sage grouse (winter)	46	36	41	40	34	27	30	29
Family 12								
Columbian sharp-tailed grouse (summer)	33	26	26	26	19	17	17	17
grasshopper sparrow	33	14	15	15	18	10	11	10

Abbreviations used in this table:
FS = Forest Service
BLM = Bureau of Land Management
Alt. = Alternative

[1] Grizzly bear, gray wolf, lynx, and wolverine percentages were calculated by watershed. Other species were calculated by subwatershed.

Source: Raphael et al. 1999.

Table 4-26. Current and Predicted Environmental Outcomes on Watersheds or Subwatersheds[1] with 50 Percent or More Forest Service- and BLM- administered Lands, and Current and Predicted Population Outcomes on All Lands, by Species and Alternative.

Species	FS/BLM Lands				Cumulative-All Lands			
	Current	Alt. S1	Alt. S2	Alt. S3	Current	Alt. S1	Alt. S2	Alt. S3
Family 1								
pygmy nuthatch	D	C[2]	C[2]	C[2]	D	C[2]	C[2]	C[2]
Lewis' woodpecker (migrant)	E	C[3]	C[3]	C[3]	E	C[3]	C[3]	C[3]
Family 2								
American marten	D	B[3]	B[3]	B[3]	D	C[2]	C[2]	C[2]
flammulated owl	D	C[2]	C[2]	C[2]	D	C[2]	C[2]	C[2]
northern goshawk (summer)	C	A[3]	A[3]	A[3]	C	B[2]	B[2]	B[2]
hoary bat	C	B	B	B	C	C	C	C
black-backed woodpecker	C	B[2]	A[3, 4]	A[3, 4]	C	B[2]	B[2]	B[2]
woodland caribou	D	B[3]	B[3]	B[3]	E	D[3]	D[3]	D[3]
Family 3								
blue grouse (summer)	B	A[2]	A[2]	A[2]	B	A[2]	A[2]	A[2]
lynx	A	A	A	A	C	C	C	C
wolverine	C	B	B	B	D	D	D	D
Family 4								
Lazuli bunting	C	A[3]	A[3]	A[3]	D	A[3]	A[3]	A[3]
Family 5								
gray wolf	C	C	C	C	D	D	D	D
grizzly bear	C	D[2]	D[2]	D[2]	E	E	E	E
Rocky Mountain bighorn sheep (summer)	C	C	C	C	E	E	E	E
Rocky Mountain bighorn sheep (winter)	D	C[2]	C[2]	C[2]	E	E	E	E
Family 6								
rufous hummingbird	B	A[2]	A[2]	A[2]	B	A[2]	A[2]	A[2]
northern goshawk (winter)	B	A[2]	A[2]	A[2]	B	A[2]	A[2]	A[2]
Family 7								
long-eared myotis	B	C	B	C	C	C	C	C
Family 8								
western bluebird	C	C	B	B	C	C	C	C
Family 9								
ash-throated flycatcher	B	B	B	B	B	B	B	B
Family 10								
pronghorn	C	C	C	C	C	C	C	C
short-eared owl	C	C	C	C	D	D	D	D
striped whipsnake	A	B[2]	B[2]	B[2]	B	B	B	B
Washington ground squirrel	C	C	C	C	E	E	E	E
Family 11								
Brewer's sparrow	B	C[2]	C	C[2]	C	C	C	C
sage grouse (summer)	C	D	D	D	D	D	D	D
sage grouse (winter)	C	D	C	C	D	D	D	D
Family 12								
Columbian sharp-tailed grouse (summer)	D	D	D	D	E	E	E	E
grasshopper sparrow	D	E	E	E	E	E	E	E

Abbreviations used in this table:
FS = Forest Service
BLM = Bureau of Land Management
Alt. = Alternative

[1] Grizzly bear, gray wolf, lynx, and wolverine percentages were calculated by watershed. Other species were calculated by subwatershed.
[2] Expected values are greater than one standard deviation different from current.
[3] Expected values are greater than two standard deviations from current.
[4] Expected values are greater than one standard deviation from Alternative S1.

Source: Modified from Raphael et al. 1999.

seral forests, restoring early seral conditions that were created through past logging, and restoring mid seral forests that were created through fire exclusion. This difference in focus results in a slightly higher level of early seral forest under Alternative S1. However, the early seral forest of Alternatives S2 and S3 would be more similar in composition and structure to habitats that existed historically and would be more likely to be sustained than would the early seral forest conditions in Alternative S1. Thus, the habitat in Alternatives S2 and S3 would likely be of higher quality than that of Alternative S1. Since there is no difference in the environmental outcomes among the alternatives for this species (Table 4-26), the differences in amount of source habitat among alternatives represent local (among watersheds) effects compared to basin-wide effects on Forest Service- and BLM-administered lands.

Also, Alternative S1 is projected to provide slightly more source habitat (five percent) for striped whipsnake than Alternatives S2 or S3. One of the primary differences in habitats for this species for all alternatives is change in woodland cover types. Management direction intended to provide benefits for multiple species in Alternatives S2 and S3 is aimed at halting the encroachment of woodlands, especially juniper woodlands, on sites where woodlands did not occur historically. The increased vulnerability of these cover types to wildfire, induced through fine fuel buildup as livestock grazing decreases, is evident in all alternatives by the increases projected in wildfire occurrence within these types. These woodland cover types remain, or even increase, with Alternative S1, because it is passive on the issue of woodland encroachment. However, the amount of this source habitat type is projected to remain abundant with all alternatives. The woodland source habitat that is conserved or restored with Alternatives S2 or S3 is likely to be of higher quality than with Alternative S1. Since there is no difference in the environmental outcomes among the alternatives for this species (Table 4-26), the differences in amount of source habitat among alternatives represent local (among watersheds) effects compared to basin-wide effects on Forest Service- and BLM-administered lands.

Furthermore, Alternative S1 is projected to provide slightly more source habitat (one to five percent) for short-eared owl, striped whipsnake, Washington ground squirrel, and pronghorn than Alternatives S2 or S3. Implementation of Alternatives S2 and S3 would emphasize transitioning to native herbland or open or closed canopy shrublands and away from non-native bunchgrasses through wildfire suppression in high-risk areas, passive restoration, and changes in grazing systems, which would likely lead to reduction of livestock grazing in the first decade. The ecological interactions that occur in these systems are complex and are more complicated than described here. The direction in Alternatives S2 and S3 is designed to more actively prevent the spread of non-native vegetation and to produce more sustainable habitats. Where rangeland source habitats reflect a higher outcome under Alternative S1, it generally would be a result of the interaction of livestock grazing, wildfire, flammable exotics (annual grasses such as cheatgrass), and woody fuels. The projected declines in livestock grazing are expected to provide beneficial environmental effects. However, the higher level of decreases in livestock grazing expected in some areas with Alternatives S2 and S3 would result in increased fine fuels (both native and non-native annual grasses) in the short term. The non-native grasses are more flammable and would triple the length of the wildfire season compared to native perennial grasses. These increases in fuels and flammability are expected to result in more wildfire, that in turn are expected to change cover types, structural stages, and susceptibility to exotic invasions in specific areas and thus reduce source habitat for these species. Advances in restoration technology and available resources for aggressive active restoration of the dry rangelands would have to be applied at higher levels than what was modeled to sustain the native habitats produced for these species with Alternatives S2 and S3. Since there is no difference in the environmental outcomes among the alternatives for these species (Table 4-26), the differences in amount of source habitat among alternatives represent local (among watersheds) effects compared to basin-wide effects on Forest Service- and BLM-administered lands.

The number of areas with a high or low environmental index of source habitats for species in these three Families generally would be stable or would slightly decrease on Forest Service- and BLM-administered lands to a similar degree with all alternatives. Generally there would be stable levels or slight reductions in the percentage of subwatersheds with predicted high or low environmental index (see Table 4-24) indicating the geographic extent of habitat would be maintained. The percentage of subwatersheds with a high environmental index generally would be reduced from current to a similar degree in all alternatives. The repatterning of vegetation in Alternatives S2 and S3 should improve connectivity and make the increases in number of areas with a high or low environmental index more sustainable.

The habitat capacity on BLM- and Forest Service-administered lands would be stable or would decrease for the species in these three Families (see Table 4-25), compared to current levels, except for bighorn sheep, which would increase slightly. The

EIS Team concluded that there may be better improvement in livestock management with Alternatives S2 and S3 compared to Alternative S1, which could improve the habitat capacity under these alternatives compared to Alternative S1 for Family 10. The EIS Team also concluded that values might also be higher with Alternatives S2 and S3 for gray wolf and grizzly bear, because direction for wide-ranging carnivores to minimize and mitigate adverse effects of management and develop broad-scale linkages is not reflected in modeled results. Moderate and high grazing effects continue to would con-tribute to lower habitat capacity values for Family 10.

In summary, habitat conditions on BLM- and Forest Service-administered lands for the species in Terrestrial Families 5, 7, and 10 would remain stable or would slightly decrease over the next 100 years under all three alternatives. Model predictions of the environmental outcomes for species in these Families do not vary among alternatives by greater than one standard deviation at the basin-wide scale (see Table 4-26). Alternatives S2 and Alternative S3 include specific direction to restore habitats that have declined substantially in geographic extent from the historical to the current period, maintain and recruit snags, repattern vegetation consistent with the landscape, use the Healthy Rangelands strategies throughout the project area, reduce exotic plant invasion through Integrated Weed Management, and reduce roads. Therefore, both would slow succession momentum and the declines in habitat condition to a greater extent than Alternative S1. The predicted trends in environmental outcomes on Forest Service- and BLM-administered lands for species in these Families would be stable for six of nine species with Alternative S2, and for five of nine species with Alternative S1 and S3 (see Table 4-26). The environmental outcome levels would be either “B”, or “C”, except for grizzly bear which would have a predicted outcome of “D”. The environmental outcome for striped whipsnake and grizzly bear decrease with all alternatives and the outcome for long-eared myotis decreases with Alternatives S1 and S3. Rocky Mountain bighorn sheep (winter) increase one outcome class with all alternatives. The outcome class changes for grizzly bear, bighorn sheep (winter), and striped whipsnake are greater than one standard deviation different than current.

It is unlikely that the outcomes for gray wolf or grizzly bear would get much better. Social pressures would most likely restrict the distribution of these species to areas with sparse human populations. This limited distribution would limit the potential outcomes for these species. Recovery plans and post-recovery monitoring would be important in maintaining these outcomes (see the Threatened and Endangered Species section).

There would be a “fair” likelihood of persistence of species within these three Families under all three alternatives, except for the Washington ground squirrel, because of the following stable or slightly decreasing factors: (1) environmental outcomes, (2) amounts of source habitats, (3) distribution of habitats over the next 100 years, and (3) habitat capacity. Although the environmental outcome for Washington ground squirrel is predicted to be a “B”, because of its small population size there would be a “poor” likelihood of persistence of this species over the next 100 years for all three alternatives. There would be little that the Forest Service or BLM can do to improve this likelihood at the broad-scale, because of the limited amounts of source habitat on Forest Service- or BLM-administered lands.

Stable or Decreasing Trends: Rangeland Habitats

Habitat conditions for species in Terrestrial Families 11 and 12 are predicted to be stable or decreasing. Species in these Terrestrial Families all depend on rangeland habitat. The landscape modeling results indicate that, for species in these Families, total source habitats on Forest Service- and BLM-administered lands would generally decrease over the next 100 years (see Table 4-23). Total source habitat would, in most cases, equal or exceed 65 percent of the historical level, except for grasshopper sparrow, which is predicted to be less than 40 percent of historical. For all alternatives, there would be a similar trend for the amounts of total source habitats, except source habitat for Columbia sharp-tailed grouse would increase slightly from current with Alternative S1.

Alternative S1 is projected to provide slightly more source habitat (five percent) for Columbian sharp-tailed grouse than Alternatives S2 or S3. As mentioned previously, implementation of Alternatives S2 and S3 would emphasize transitioning to native herbland or open or closed canopy shrublands and away from non-native bunchgrasses through wildfire suppression in high-risk areas, passive restoration, and changes in grazing systems, which will likely lead to reduction of livestock grazing in the first decade. The higher level of decreases in livestock grazing expected in some areas with Alternatives S2 and S3 would result in increased fine fuels (both native and non-native annual grasses) in the short term. These increases in fuels and flammability are expected to result in more wildfire that in turn, are expected to change cover types, structural stages, and susceptibility to exotic invasions in specific areas. Advances in restoration technology and available resources for aggressive active restoration of the dry rangelands would have to be applied at higher levels than what was modeled to sustain the native habitats produced for this species with Alternatives S2 and S3. Since there is no difference in the environmental outcomes among the alternatives for this species (Table 4-26), the differences in amount of source habitat among alternatives represent local (among watersheds) effects compared to basin-wide effects on Forest Service- and BLM-administered lands.

The number of areas with a high or low environmental index for species in these two Families would generally be stable or reduced (see Table 4-24,) indicating maintenance or a reduction in the extent of habitat. The percentage of subwatersheds with a high environmental index would generally be reduced similarly from current for all alternatives. The reduction is substantial for some species. The repatterning of vegetation in Alternatives S2 and S3 should improve connectivity and make remaining source habitat more sustainable.

The habitat capacity on BLM- and Forest Service-administered lands compared to current would decrease for the species in these two Families (see Table 4-25). The habitat capacity would generally be slightly higher with Alternatives S2 and S3 than with Alternative S1, even though alternative S1 is predicted to provide greater amounts of source habitats for one species. This is because Alternatives S2 and S3 with active restoration would do a better job at slowing successional momentum and reductions in habitat quality than would Alternative S1. As discussed previously, the EIS Team concluded that there may be more improvement in livestock management with Alternatives S2 and S3, which could improve the habitat capacity for species in these two Families with these alternatives compared to Alternative S1. Moderate and high grazing effects would continue to contribute to lower habitat capacity for Families 11 and 12.

In summary, habitat conditions for the species in Terrestrial Families 11 and 12 would be stable or would decrease over the next 100 years under all three alternatives. Model predictions of the environmental outcomes for species in these Families do not vary between alternatives by greater than one standard deviation at the basin-wide scale (see Table 4-26). It is felt that Alternative S2 followed closely by Alternative S3, would slow both succession momentum and the declines in habitat conditions to a greater extent than Alternative S1. These two alternatives include specific direction to restore habitats that have declined substantially in geographic extent from the historical to the current period, repattern vegetation consistent with the landscape, use the Healthy Rangelands strategies throughout the project area, reduce exotic plant invasion through Integrated Weed Management, and reduce roads. The predicted trends in environmental outcomes on Forest Service- and BLM-administered lands for species modeled in these Families would decrease for three of five species with Alternatives S2 and S3, and would decrease for four of five species with Alternative S1 (see Table 4-26). The outcome levels would be either “C”, “D”, or “E”. Of these, only the change for Brewer’s sparrow with Alternatives S1 and S3 would be greater than one standard deviation different from current and Alternative S2.

There would be a “fair” to “poor” likelihood of persistence of species within these two Families under all three alternatives, because of the following stable or decreasing factors: (1) environmental outcomes, (2) amounts of source habitats, (3) distribution of habitats over the next 100 years, and (4) habitat capacity. In some cases the “poor” likelihoods result from the inability of alternatives to reverse the momentum of vegetative succession, and habitat conditions would continue to worsen for these species. As mentioned previously, implementation of the alternatives would slow successional momentum to varying degrees. Alternative S2, followed closely by Alternative S3, includes specific direction that would slow declines in habitat conditions to a greater extent than Alternative S1.

The likelihood of persistence ratings for the species in these families are as follows. The predicted decreases in habitat are of concern, but because of the predicted environmental outcome of “C” the Brewer’s sparrow was given a “fair” rating for all alternatives, and there would be less risk to persistence with Alternative S2. Predicted low habitat capacities and low environmental outcomes caused sage grouse (summer) and grasshopper sparrow to be given a “poor” likelihood of persistence for all alternatives. The likelihood also would be “poor” for Columbian sharp-tailed grouse because of a low habitat capacity as a percent of historical capacity, and small, disjunct populations.

Cumulative Effects (All Lands)

The effects of activities predicted to occur on lands not administered by the BLM and Forest Service would affect species in the Terrestrial Families similarly with implementation of any of the alternatives. The habitat capacity for all lands would increase for about 55 percent of the species modeled, and decrease for about 45 percent (see Table 4-25). The habitat capacity would generally be less on all lands than on BLM- and Forest Service-administered lands primarily because of the greater effect of human activities on private lands.

For all alternatives, the predicted population outcome classes would improve from current for 11 species-seasonal combinations and would remain stable for 19 species-seasonal combinations. The number of species-seasonal combinations with predicted outcomes of "A", "B", "C", "D", or "E", would be 4, 4, 10, 6, and 6, respectively (see Table 4-26). The continued predicted outcome of "E" for six species-seasonal combinations: grizzly bear, Rocky Mountain bighorn sheep (summer and winter), Washington ground squirrel, Columbian sharp-tailed grouse, and grasshopper sparrow indicate a strong potential for extirpations. Aggressive actions, such as outlined in recovery plans and associated documents for grizzly bear and the reintroductions which have occurred for bighorn sheep, will be necessary to avoid such extirpations.

Terrestrial Riparian and Wetland Species

Methodology: How Effects on Terrestrial Riparian and Wetland Species were Estimated

The nature of the broad-scale data used for analysis of the alternatives precluded detailed analysis of riparian and wetland conditions. No comprehensive wetlands inventory is available for the basin. Consistent basin-wide data were not available for amount of riparian habitat within subwatersheds or for condition of that habitat. Because of these limitations the effects of the alternatives on Forest Service- and BLM-administered lands were qualitatively described based on expected effects of implementing the alternatives on riparian and wetland resources.

In addition, results from the aquatic habitat capacity model are presented to provide an indication of the degree of the difference among alternatives on Forest Service- and BLM-administered lands. This model was used by SAG to describe effects on aquatic species (see Aquatic–Riparian–Hydrologic Component section, later in this chapter). However, it is believed that predictions from this model can show trends in habitat of riparian-dependent terrestrial species whose habitat factors, such as water quality and riparian vegetative cover, are also important to aquatic species.

Cumulative effects on all lands use qualitative discussions and model predictions. Models to predict effects on terrestrial riparian and wetland species across the project area were based solely on upland landscape proxies, and no attempt was made to model actual amounts of riparian or wetland habitat (Raphael et al. 1999).

Effects of the Alternatives on Terrestrial Riparian and Wetland Species

As discussed in Chapter 2, riparian and wetland habitats are fine-scale and, for the most part, cannot be identified with the broad-scale vegetation data used by this project. Therefore, only the following general broad-scale issues have been identified for riparian and wetland habitats:

- Riparian or wetland areas have been degraded from activities such as grazing, recreation, timber harvest and roads.
- The introduction of exotic plant and animal species has adversely affected riparian and wetland habitats and species.
- Dams and their operation have altered flow regimes and negatively affected riparian habitat; many riparian shrub habitats have declined because of overgrazing and fire exclusion.
- Levels of snags and downed wood have been adversely affected by timber harvest and fuelwood gathering.

For more details on effects of the alternatives on riparian habitats, also see the Aquatic–Riparian–Hydrologic Component section, later in this chapter, and Raphael et al. (1999).

General Effects

As discussed in Chapter 2 and in the methods section, it is not possible to analyze specific effects of the alternatives on terrestrial riparian or wetland species. It is possible to estimate the general effects that implementation of the alternatives would have on these species. These general effects are presented in the following paragraphs.

Slowing the Decline of Rangeland Terrestrial Habitats: Options Considered

Within the overall framework of the Supplemental Draft EIS alternatives, various options to further slow the decline of rangeland terrestrial habitats have been explored or analyzed to varying levels. Generally, these options deal with increasing specificity of broad-scale direction as opposed to allowing flexibility for adapting solutions to meet local conditions through the step-down process. The following descriptions are intended to provide a brief overview of the direction and approach currently existing in the Supplemental Draft EIS contrasted with an overview of the options that have been considered and might be further explored up through the Record of Decision.

1. Apply broad-scale restoration priority to more subbasins dominated by rangeland habitats.

A set of rangeland subbasins has been included in the 40 high restoration priority subbasins of Alternative S2 and the 51 high restoration subbasins of Alternative S3. A preliminary evaluation explored effects from the option of adding 8 to 20 more rangeland habitat subbasins to the high restoration priority list of subbasins. This analysis was limited to a few key species of concern and their associated habitats. The effects suggested that it is possible to improve conditions when restoration is an emphasis on rangeland settings. This analysis did not find that basin-wide population outcomes shifted significantly as a result of the additional investment in restoration. The full level and extent of restoration required to generate a basin-wide shift in population outcomes by a whole category was not fully defined. However, the degree of change in restoration investments and/or management actions would be substantial, and the tradeoffs essential to undertake such a shift were not explored in depth. It would likely mean a shift in restoration resources away from the forested and aquatic environments. The consequences on these other environments may be substantial.

Improving rangeland conditions is generally an expensive and long-term process. Applying priority to all the rangeland-dominated subbasins would likely detract from the beneficial effects of treatments applied in other settings within the project area. Whether a different specific set of rangeland subbasins might be emphasized to improve conditions and still be within acceptable cost boundaries was not explored beyond what has been described above. Alternatives S2 and S3 include direction intended to improve habitat conditions in rangeland areas for species of concern. Thus it is possible to put more specific emphasis on where and how this might be accomplished and still be within the overall framework of the Supplemental Draft EIS alternatives. The implication would be to provide more prioritization up-front as opposed to allowing the step-down process to drive the priorities and potential actions.

2. At the broad scale, specify very large reductions in livestock stocking rates as a low cost means of improving condition of rangeland habitats.

Current direction in the Supplemental Draft EIS states that land uses such as livestock grazing should provide for maintenance and the opportunity for restoration of terrestrial source habitat. This is believed to be the direction appropriate at the broad scale. Because of the highly variable rangeland conditions, the extent of restoration and change in livestock grazing rates would be determined through locally driven management analyses and plans. The amount of change in stocking rates would vary locally depending on what was necessary to achieve this and other broad-scale objectives in the Supplemental Draft EIS for rangeland habitats.

Specifying major reductions in livestock grazing across large areas would change the effects projected under Alternative S2 and/or Alternative S3. To project the specific effects of this option would be a substantial modeling effort. The extent to which this might contribute to substantial improvements in rangeland habitat trends is unknown, but it would likely be variable depending on conditions within specific habitat types and landscapes. While this option is "low cost" to the federal agencies, it may have social and economic consequences affecting livestock operators and rural agriculturally based communities. The tradeoffs would need to be fully disclosed.

3. At the broad scale, specifically identify changes in livestock management which would be implemented to improve condition of rangeland habitats.

Option 2 above addressed substantial reductions in livestock grazing. Option 3 is focused on the components of grazing management strategies such as riding, herding, salting, season of use, class of livestock, and grazing systems. Again, current direction in the Supplemental Draft EIS states that these components should be addressed and modified as necessary at the local level to maintain and restore terrestrial source habitat consistent with broad-scale objectives. Because of the high variability in rangeland conditions and grazing allotments, the precise strategies were not specified at the broad-scale.

The specific effects of this option have not been evaluated. Whether a set of specific changes in livestock management would show improved conditions in rangeland habitats requires more analyses. Providing more definition to where and how changes might be undertaken specifically to improve rangeland habitat conditions may prove beneficial for some species habitats. The question remains, however, as to whether it is appropriate or even feasible with broad-scale information to provide this level of fine-scale direction with enough certainty at the broad scale to actually benefit the rangeland species of concern.

Options (continued)

4. **At the broad scale, specify reduction of road density classes to low, very low, or none across large rangeland areas.**

   Current direction in Alternatives S2 and S3 is to complete a roads analysis that results in providing human access while minimizing risk to resources (such as terrestrial species). This direction provides through the step-down process the ability to address terrestrial species needs and the potential to reduce adverse effects of roads.

   A preliminary evaluation was undertaken on the option of specifying reductions in road density class at the broad scale. Where density classes were reduced to 0.7 miles of road per square mile or less (the low road density class), the effect on most species modeled did not result in a shift of a whole population outcome category. A benefit associated with road reductions could be a slower rate of spread of exotic vegetation. However, predicting the effects of such a change in road densities in the rangeland setting would involve more analyses.

   The general landforms and vegetation on rangelands make it difficult to restrict vehicle travel on many landscapes. Removing roads in these situations might not be as effective as removing roads in the forested environment. Thus, predicting outcomes from road reductions is more complicated in the rangeland setting. The issue is really about the management of human access to these settings, not just the presence of roads.

5. **At the broad scale, designate a network of habitats for conservation of terrestrial species.**

   The intent of Alternatives S2 and S3 is to maintain and restore rangeland habitats. This is accomplished by the identification of high restoration priority subbasins, identification of T watersheds, and direction to increase source habitats that have declined substantially in geographic extent from the historical to the current period throughout the basin, so that, through time, a well-distributed network of habitats exists. No concerted effort has been undertaken at the broad scale to define a specific network of habitats for terrestrial species of concern. The wide-ranging species under consideration here might result in a designated network of habitats for terrestrial species that would include most of the BLM- and Forest Service- administered lands in the project area. A network with such a broad definition would not likely contribute to conservation management for the species of concern.

   The option of developing a restricted network focused on specific habitats for species of rangeland concern would require additional analysis. The potential benefit that such a designation might have on outcomes for species and their habitats is not known. Although it is unknown how much such a designation might improve habitat conditions through the emphasis such a network would provide, it is unlikely that the designation itself would reverse major trends for these species.

6. **At the broad scale, add specificity to management practices to be used in high restoration priority subbasins.**

   The current direction requires accelerated step-down analysis, both Subbasin Review and Ecosystem Analysis at the Watershed Scale (EAWS), in the high restoration priority subbasins to assist in the planning and designing of management activities to meet the broad-scale Supplemental Draft EIS objectives and address local resource conditions and issues.

   This option is a combination of options 1, 2, and 3 defined above. It may be possible to define more broadly a limited set of specific actions that would focus on specific rangeland species habitats. The highly variable conditions across the subbasins, however, would create a need for different mixes of practices and emphases. The degree to which this is both desirable and possible is not known at this time.

7. **At the broad scale, adopt a specific timeline for completion of rangeland grazing allotment analysis.**

   The BLM has adopted a rapid rangeland assessment process to be completed during a 10-year period. The Forest Service has not committed to such a process but has stated the intent to undertake rangeland assessments as part of their overall rangeland management efforts. The Supplemental Draft EIS does not presently include a specific timeline for completion of allotment analyses. The degree to which this might contribute to improved habitats in the rangeland as is not known.

8. **Identify areas that are functioning but at risk and could be prioritized for changes in livestock management or restoration/maintenance.**

   Current direction in Alternatives S2 and S3 states that areas that are functioning at risk because of livestock grazing management and that would be responsive to treatment, are high priority to initiate changes to livestock management.

   Some lands are still functioning much as they would in a native, undisturbed state yet are at risk of transitioning to a non-functional state. This is an inventory issue, as insufficient information is available now to geographically identify and designate these rangeland areas that would respond to restoration. Currently, this inventory is addressed within the step-down processes that link broad-scale direction to specific project decisions. It is possible to undertake an effort with field biologists and range conservationists to define these areas with more detail. The outcome could help define where priority for restoration investment might be undertaken. The issues related to this are similar to those shown under Options 1 and 6 above. This inventory could strengthen implementation of the existing direction. No new direction would have to be added to the Supplemental Draft EIS to implement the inventory.

Options (continued)

9. **Increase funding to improve fire management and/or to assure rehabilitation following wildfire events.**

   The issues surrounding this option are subsets of issues generally addressed in Option 1 above. These are potential ways to manifest a restoration emphasis.

10. **At the broad scale, specifically identify actions to reduce human uses that would be implemented to improve condition of range habitats.**

    In addition to the objectives and standards that address management activities and human uses, current direction in Alternatives S2 and S3 is to reduce the negative effects of human disturbance through assessment of risks and opportunities during step-down processes.

    The issues surrounding this option are generally addressed in Option 4 above. The potential improved rangeland habitat conditions from road reductions include the beneficial aspects of limited or reduced human access and uses. This option includes more than simply removing roads, however; it also addresses the issues associated with off-road vehicle uses, hunting, fishing, recreation, and other uses. Given the variability of terrain, current conditions of the landscape, and uses across the project area, the step-down process has been determined to this point to be the appropriate strategy for addressing these issues.

Options Summary

All the options described above for improving habitats for rangeland species of concern were explored and discussed to varying degrees by the ESC. As noted, some changes in management direction were made. However, these options were not pursued further at this time for several reasons, including:

- The concern that alternatives must be developed that could be implemented within a realistic budget framework;
- The attempt to prioritize limited restoration funding to areas where current available science information indicated an opportunity to be successful;
- The emphasis on aquatic species and forest restoration issues and the unknown tradeoffs of shifting limited funding or priority away from these resources to rangelands; and
- The intent to provide broad-scale direction that clearly sets sideboards of what needs to be accomplished, yet leaves the decisions on how best to apply it to local decision makers through local analyses and public involvement.

Implementation of any of the alternatives should improve terrestrial riparian and wetland habitats. However, the riparian direction in Alternative S1 focuses on aquatic values, while Alternatives S2 and S3 addressed aquatic and riparian-dependent terrestrial species. For example, Alternative S1 contains direction to develop Riparian Management Objectives for aquatic species in riparian conservation areas (RCAs), and to manage subwatersheds with high aquatic species populations to maintain those populations. Although targeted for aquatic species these should have positive effects on habitat for terrestrial riparian species, through restoration of shrubs and other vegetation. In contrast, Alternatives S2 and S3 contain specific direction to: meet objectives for terrestrial riparian and wetland species in RCAs and to focus additional restoration activities in subbasins with good opportunities to improve terrestrial riparian and wetland habitats as well as direction similar to Alternative S1 to manage subwatersheds with high aquatic species populations to maintain those populations. Therefore, Alternatives S2 and S3 should have more positive effects on habitat for terrestrial riparian or wetlands species than Alternative S1. Results of the aquatic habitat capability model indicate that maintenance and restoration of riparian areas under Alternative S2 would be considerably better than with Alternative S1 or Alternative S3. Specific Watershed Condition Indicators for terrestrial riparian or wetland species and communities may not be completed for approximately two years following the ICBEMP Record of Decision. During this interim period, the lack of standard, measurable indicators of habitat condition will increase the risk that objectives to restore and/or maintain terrestrial riparian and wetland habitats may not be consistently achieved.

Management direction for riparian-dependent terrestrial species is more explicit, consistent, and comprehensive in Alternative S2, and, to a lesser extent Alternative S3, than in Alternative S1. More uncertainty is associated with Alternative S1 because of inconsistent goals, objectives, and standards, especially on rangelands.

Habitats for wetland-dependent species could initially have less improvement than habitats for riparian-dependent species because interim RCA criteria related to wetlands is not as encompassing as it is for riparian areas. However, the interim RCA criteria would be revised during implementation of either Alternative S2 or Alternative S3 and this difference would likely be reduced.

Alternative S1 would reduce the spread of exotic plants through incorporation of noxious weed management into project and activity planning (see Factors of Influence section, later in this chapter). This should aid in maintenance and some restoration of riparian and wetland habitats, although to a lesser extent than Alternatives S2 or S3 which apply Integrated Weed Management and emphasize seeding with native species to reduce the spread of exotic plants. All alternatives would also limit the spread of exotic fish species, which should beneficially affect many amphibians.

All alternatives address water flow regimes to some degree, with greater clarity and consistency provided by the direction in Alternatives S2 and S3. This should benefit terrestrial species, especially those dependent on flood plain habitats.

As discussed previously, riparian and wetland habitats are generally too limited in extent to be identified using the broad-scale data. Where patch size of habitats are large enough to identify riparian or wetland habitats, Alternatives S2 or S3 should restore habitats that have declined substantially in geographic extent from the historical to the current period (shrub wetlands / open low-medium shrub, shrub wetlands / closed tall shrub, aspen / understory reinitiation, cottonwood-willow / understory reinitiation, cottonwood-willow / old multi-story forest) to a greater extent than Alternative S1. For most riparian and wetland habitats, however, Alternative S2 and to a somewhat lesser extent Alternative S3, focus on restoring networks of well-distributed, high quality habitats without specifying specific habitat restoration needs. It is anticipated that implementation of Alternatives S2 and S3 would result in restoration of shrub habitats to a greater extent than Alternative S1, although prediction of the exact amount of improvement is not possible.

Alternative S1 would provide levels of downed wood, but at levels below historical. Implementation of Alternative S1 should maintain or improve snag numbers in riparian areas, although to a lesser extent than with Alternatives S2 and S3. Alternatives S2 and S3 provide for the number, size, and species of snags and downed wood which can be sustained on a site on all Forest Service- and BLM-administered land within the project area. However, with Alternative S3 there would be less opportunity to adjust snag and downed wood numbers to fit local conditions, which could result in snag numbers, size, or species or downed wood outside the historical range. This could adversely affect riparian species locally.

Conclusions

Considering all the effects in combination, it appears likely that all alternatives would lead to improvement in terrestrial riparian condition over the next 100 years. The improvement in terrestrial riparian habitat in 100 years would be higher with Alternative S2 than with Alternatives S1 or S3. Alternative S2 would provide more opportunities for maintenance and restoration of riparian and wetland habitat because the extent of RCAs is greater than with Alternative S3. Compared to Alternative S1, Alternative S2 also provides more opportunities for maintenance and restoration of riparian and wetland habitat RCAs.

The differences in improvements between Alternatives S1 and S3 are less clear; Alternative S1 focuses on aquatic condition while direction in Alternative S3 includes more emphasis on riparian condition.

Generally, improving riparian and wetland conditions should improve the likelihood of persistence of riparian or wetland species. However, since specific effects can not be predicted at the basin scale because of data limitations, it is not possible to classify a relative level of likelihood of persistence.

Cumulative Effects

It is expected that on lands not administered by the Forest Service or BLM, riparian and wetland habitat condition would either be maintained or reduced. Reductions would adversely affect dependent species because of reduced connectivity.

Model predictions for terrestrial riparian and wetland species indicate at the basin level there would only be a slight reduction in riparian and wetland condition on all lands from current conditions. Most of the reduction in predicted riparian condition would be due primarily to increasing levels of HRV departure that is largely in wilderness and wilderness-like areas. These results indicate that basin-wide there would be little change in overall riparian or wetland condition over the next 100 years.

Special Status Terrestrial Species

Methodology: How Effects on Special Status Terrestrial Species were Estimated

This section presents the effects of the alternatives on species listed as threatened or endangered or proposed for listing under the Endangered Species Act (ESA), candidate species for listing under the ESA, and agency sensitive species. The effects which will be present were determined through methods already described in the plant, invertebrate, terrestrial vertebrate, and riparian and wetland species sections.

Effects of the Alternatives on Threatened, Endangered, or Proposed Species

Plants

As discussed previously, it is not possible to discuss specific effects of implementation of broad-scale direction on individual plant species. The effects on threatened or endangered plant species would be the same as previously described for plants of concern. Alternatives S2 and S3 provide for more improvement of ecosystem processes and functions, direct development of conservation strategies, and consistency with recovery plans. Thus, these alternatives should have a beneficial effect on listed, proposed, or candidate plant species. By these strategies, Alternatives S2 and S3 should reduce the potential for future listings. Alternative S1 does not propose changing current direction in various land use plans, which have had Endangered Species Act consultation competed and under which site-specific consultation is required on finer-scale project proposals. It is felt that this situation is best described as "not likely to adversely affect" listed or proposed species. However, it is doubtful that future listings would be prevented.

Riparian- and Wetland-dependent Species

Bald eagles and whooping cranes, which are listed, and the Columbia spotted frog and Oregon spotted frog, which are candidates for listing, are associated with riparian or wetland habitats. Bald eagles and the two species of spotted frog should be beneficially affected by implementation of any of the alternatives through general improvement of riparian habitats. The emphasis in Alternatives S2 and S3 on protecting large, old trees should benefit bald eagles, which occasionally nest in large trees in upland areas adjacent to rivers or lakes. Alternative S2 should have more beneficial effects than either Alternative S3 or Alternative S1 (see the Terrestrial Riparian and Wetland section for more information). There should be no effect on whooping cranes as records indicate they do not occur within the project area in western Montana, eastern Oregon, or eastern Washington where they are listed as endangered (see Chapter 2). Through improvement in riparian and wetland habitats there could be beneficial effects on the experimental population in Idaho; however, due the small numbers of whooping cranes and their limited distribution on Forest Service- and BLM-administered lands these benefits would be negligible.

Woodland Caribou

The woodland caribou, listed as endangered, was included in Terrestrial Family 2. Species in this Family depend on late seral, multi- and single storied montane forests as source habitat. Some also use late seral stages of subalpine or lower montane forests. Alternatives S2 and S3 would maintain and increase late seral, multi- and single storied montane and lower montane forests. The effects of the alternatives on woodland caribou were modeled by the SAG. There would be a substantial increase in the amount and distribution of source habitat for woodland caribou with all the alternatives, as well as substantial increases in the habitat capacity for this species. Woodland caribou should be beneficially affected by implementation of any of the alternatives (the environmental outcome would improve from a "D" to a "B" with all three alternatives). The primary limiting factor for woodland caribou would be small population size and predation by cougars. Predation factors could be influenced through cooperation with state wildlife management agencies in population and habitat management plans for white-tailed deer and cougar. The Forest Service and BLM will need to continue to cooperate with the U.S. Fish and Wildlife Service and state wildlife management agencies to facilitate woodland caribou recovery, recognizing, from a habitat management perspective, that other factors such as predation will affect recovery.

All alternatives would increase the amount of source habitat for woodland caribou to levels well above historical levels. However, there would be more source habitat produced for woodland caribou with Alternative S1 than with Alternatives S2 or S3. The intent of management direction in Alternatives S2 and S3 is to provide a mosaic of habitats that are similar to historical conditions. Alternative S1 would be less effective in transitioning multi-story old forest in the moist forest PVGs to single story stands. Implementation of Alternatives S2 and S3 would include more active management to transition these habitats to single story stands, which represent transitions toward a more historical and sustainable composition and structure of old-forest conditions. Moving from contiguous multi-story stands of shade tolerant species to a mosaic that more closely matches historical conditions, which includes single story stands of shade intolerant species (such as whitebark pine, ponderosa pine, or white pine) would require passing through a growth stage that is not included in the source habitat for the woodland caribou. The intent of management direction in Alternatives S2 and S3 is to benefit multiple species, and would shift some stands through this process, resulting in slightly less habitat for this species than with Alternative S1.

Gray Wolf

The gray wolf, listed as endangered in part of the project area and as a non-essential experimental population in part of the project area, was included in Terrestrial Family 5. Species in this Family use a broad range of forest, woodlands, and rangelands as source habitat. Gray wolf are primarily limited by non-habitat factors such as: conflicts on private lands, the presence of domestic livestock, and human-caused mortality, all of which are often linked to road access. The effects of alternative implementation on gray wolf were modeled.

It is unlikely that the outcomes for gray wolf will be much higher. Social pressures will most likely restrict the distribution of this species to areas with sparse human populations. This limited distribution will affect the potential outcomes for the species. Compliance with recovery plans and post-recovery monitoring will be important. The environmental outcome reflects conditions across the historical range of gray wolf on Forest Service- and BLM- administered lands. Recovery plans, other related documents, and individual land use plans provide finer-scale guidance to protect these species. The purpose of this finer-scale direction is to recover gray wolf populations. Within recovery areas wolves appear to be increasing and nearing recovery goals. Alternatives S2 and S3 and to a lesser extent Alternative S1 should have beneficial effects on gray wolf and contribute to recovery.

In all alternatives there would be a slight increase in the amount of source habitat. The distribution of source habitat would be similar to current with all the alternatives. The habitat capacity for gray wolf would slightly decrease with all alternatives.

Conflicts on private land could contribute to the decrease in habitat capacity. The environmental outcome would be “C” for all alternatives, which is the same as current. The alternatives would reduce adverse effects from roads and human disturbance, with reductions greater under Alternatives S2 and S3 than under Alternative S1. Alternatives S2 and S3 also contain direction to minimize or mitigate adverse effects of management actions on wide-ranging carnivores and to develop broad-scale habitat linkages. This direction, which the EIS Team concluded should have positive effects on the gray wolf, was not reflected in the model inputs.

Grizzly Bear

The grizzly bear, listed as threatened, was also included in Terrestrial Family 5. Grizzly bear are primarily limited by non-habitat factors such as: conflicts on private lands, the presence of domestic sheep, and human-caused mortality, all of which are often linked to road access. The effects of alternative implementation on grizzly bear were modeled by SAG.

It is unlikely that the outcomes for the grizzly bear will be much higher. Social pressure will most likely restrict the distribution of this species to areas with sparse human populations. This limited distribution will affect the potential outcomes for this species. Compliance with recovery plans and post-recovery monitoring will be important. The environmental outcome reflects conditions across the historical range of the grizzly bear on Forest Service- and BLM-administered lands. Recovery plans, other related documents, and individual land use plans provide finer-scale guidance to protect these species. The purpose of this finer-scale direction is to recover grizzly bear populations. Within the Northern Continental Divide and Yellowstone Recovery Areas, grizzly bears appear to be increasing and nearing recovery goals. (Note: The Yellowstone Recovery Area is outside the project area.) Alternatives S2 and S3, and to a lesser extent Alternative S1 should have beneficial effects on grizzly bears and contribute to recovery.

In all alternatives there would be a slight increase in the amount of source habitat. The distribution of source habitat would slightly decrease with all the alternatives. Whitebark pine nuts are a very important source of protein for grizzly bears. The extent of seed-producing whitebark pine trees is expected to decrease under all alternatives because of white pine blister rust (see Factors Influencing Health of Ecosystems section, later in this chapter). The predicted decrease is, to some degree, related to the limited ability to do restoration activities in A1 subwatersheds under Alternatives S2 and S3 and wilderness and wilderness-like areas under all alternatives. Many areas of whitebark pine are located in these areas.

There would be slightly more (one percent) source habitat produced for grizzly bear with Alternative S1 than with Alternatives S2 or S3. The intent of managment direction in Alternatives S2 and S3 is to provide a mosaic of habitats that are similar to historical conditions. Alternative S1 would be less effective in transitioning multi-story old forest in the moist forest PVGs to single story stands. Implementation of Alternatives S2 and S3 would include more active management to transition these habitats to single story stands, which represent transitions toward a more historical and sustainable composition and structure of old-forest conditions. Moving from contiguous multi-story stands of shade tolerant species to a mosaic that more closely matches historical conditions, which includes single story stands of shade intolerant species (such as whitebark pine, ponderosa pine, or white pine) would require passing through a growth stage that is not included in the source habitat for this species. The intent of management direction in Alternatives S2 and S3 is to benefit multiple species, and would shift some stands through this process, resulting in slightly less habitat for this species than with Alternative S1.

Habitat capacity for grizzly bears would slightly decrease with all alternatives. The primary factor affecting grizzly bears is from conflicts on private land. The environmental outcome would be “D” with all the alternatives, which is a decrease from the current level of “C”. The alternatives would reduce adverse effects from roads and human disturbance on Forest Service- and BLM-administered lands, with reductions greater under Alternatives S2 and S3 than under Alternative S1. Alternatives S2 and S3 also contain direction to minimize or mitigate adverse effects of management actions on wide-ranging carnivores and to develop broad-scale habitat linkages. This direction, which the EIS Team concluded should have positive effects on the grizzly bear, was not reflected in the modeling inputs.

Northern Idaho Ground Squirrel

The northern subspecies of northern Idaho ground squirrel is proposed to be listed as threatened. Northern Idaho ground squirrel was included in Terrestrial Family 12, but it was not one of the species individually modeled for Supplemental Draft EIS effects. Species in Family 12 depend on rangeland habitat. Source habitat for this species is projected to improve under all alternatives. However, populations of this species are small, disjunct, and isolated, which poses the most significant challenge to future management. In addition, a variety of fine-scale habitat issues pose challenges to management, including the displacement of native habitat by exotic vegetation, fire suppression that has facilitated the encroachment of trees and shrubs on meadow habitat, and conversion of private lands to non-habitat.

The northern Idaho ground squirrel is best addressed at a finer scale because of its limited distribution. In addition, most habitat for the species is found on private land. However, implementation of all alternatives should have general beneficial effects on this species’ habitat on Forest Service- and BLM-administered lands.

Lynx

Lynx, proposed to be listed as threatened, are included in Terrestrial Family 3. The effects of alternative implementation on lynx were modeled. There would be a slight decrease with all alternatives in the amount of source habitat, although the amount would remain above historical levels. The distribution of source habitat on Forest Service- and BLM-administered lands would be similar to current with all the alternatives. The habitat capacity of Forest Service- and BLM-administered lands would slightly decrease with all alternatives. The environmental outcome on Forest Service- and BLM-administered lands would be "A" with all the alternatives, which is the same as current. Alternatives S2 and S3 contain direction to minimize or mitigate adverse effects of management actions on wide-ranging carnivores and to develop broad-scale habitat linkages. This direction, which the EIS Team concluded should have positive effects on lynx, was not reflected in the modeling inputs. On the other hand, coarse-scale habitat and environmental factors used in the model may not reflect finer-scale environmental requirements that potentially account for a large amount of variation in key lynx population characteristics. For example, within-stand characteristcs of habitat, such as understory stem density of trees, may strongly affect prey availability and hunting efficiency of lynx; such within-stand characteristics of lynx habitat either were not measured or were measured coarsely in the model. If such within-stand characteristics actually do explain a large amount of the variation in population characteristics of lynx, then the model predictions may be optimistic.

Lynx may be primarily limited by non-habitat factors such as: low population size and competition with other predators. Current knowledge about lynx population size, density, and distribution suggest that lynx are quite rare within the southern portion of the species' range in the lower 48 United States. Competition with coyotes, cougars, and other predators may have a strong effect on lynx. These factors may account for most variation in lynx population characteristics. If this is the case, habitat and other environmental factors beyond those associated with competition may have relatively weak influence on lynx population characteristics. The potential negative effects of competition with other predators and low population size were included in the population outcome model; however, the modeled relations may not reflect the true strength of these hypothesized negative effects. Consequently, the predicted population outcome of "C" for current conditions and for all alternatives on all lands may be optimistic. However, a population outcome of "C" is within the range of population outcomes suggested by current knowledge of the spatial structure of lynx populations in the U.S.

Broad-scale conditions for lynx should remain stable with Alternative S1. Overall, the best habitat conditions would be with Alternatives S2 and S3, both of which should be better than with Alternative S1. Alternatives S2 and S3 should have positive effects due to repatterning vegetation to be more sustainable, minimizing or mitigating adverse effects of management actions on wide-ranging carnivores, facilitating development of broad-scale habitat linkages, and reducing roads. It is possible that the emphasis on restoration with Alternatives S2 and S3 could adversely affect prey availability and hunting efficiency of lynx. However, most restoration efforts are directed at dry and moist forest PVGs, as opposed to the cold forest PVGs more commonly used by lynx. Also, an objective of restoration is to repattern vegetation to fit the landscape. Areas with high stem densities are within the HRV for cold forest and some higher elevation, moist forest PVGs. Therefore, the need to treat these areas to lower stem density from a repatterning standpoint may be minimal, which will reduce the potential for adverse effects. Finally, both Alternatives S2 and S3 contain direction to minimize or mitigate adverse effects from proposed activities on wide-ranging carnivores such as lynx. Therefore, overall, Alternatives S2 and S3 should have a beneficial effect on lynx at the broad scale. A determination of effects relative to specific project proposals will have to be made on a site-specific basis.

Washington Ground Squirrel

The Washington ground squirrel, a candidate species, was included in Terrestrial Family 10. Species in Terrestrial Family 10 use a variety of shrublands, herblands, and woodlands. Small and disjunct populations would continue to limit Washington ground squirrels. The effects of alternative implementation on this species were modeled. The amount of source habitat on Forest Service- and BLM-administered lands would slightly increase with all alternatives. However, the repatterning of vegetation in Alternatives S2 and S3 should improve connectivity and make the increases in source habitat more sustainable. Habitat capacity for this species is predicted to be stable (Alternative S2) or decreasing (Alternatives S1 and S3). The environmental outcome would remain at the current level of "C" under all alternatives. Less than two percent of the source habitat available for the Washington ground squirrel occurs on Forest Service- and BLM-administered lands; therefore, this species is best addressed at a finer scale. The population outcome of "E" on all lands is driven by loss of habitat due to conversion for agricultural purposes and human disturbance. These factors are expected to continue to limit Washington ground squirrel populations.

Effects of the Alternatives on Sensitive Species

More than 700 plant species have been identified by the Forest Service and BLM as sensitive. It is not possible to discuss specific effects of implementation of broad-scale direction on individual plant species. Broad-scale models cannot incorporate fine-scale effects.

Most of 333 plants of concern were also identified as agency sensitive species. The effects on these sensitive plant species would be the same as previously described for plants of concern; that is, these sensitive plants could decrease with implementation of Alternative S1, which could adversely affect them. However, agency policy is to evaluate effects of specific projects or activities on sensitive species, so the effect of Alternative S1 is best described as “not likely to adversely affect” these sensitive plant species. Alternatives S2 and S3 should have a beneficial effect on the sensitive plant species resulting in continuation of stable populations.

The other 370 plants which have been identified as sensitive by the agencies, but which were not identified as plants of broad-scale concern, are more appropriately analyzed through the step-down process, including site-specific NEPA analysis. The broad-scale direction in any of the alternatives should have a general beneficial effect or no effect on these species.

One hundred terrestrial vertebrate species, including the recently delisted peregrine falcon, are considered sensitive by the agencies. Forty-four of the terrestrial vertebrates identified as sensitive by the Forest Service or BLM were identified as broad-scale species of focus in Wisdom et al. (in press) and were included in one of the 12 Familes or 40 Groups (see Table 4-27). The effects on these species would generally be the same as those described in the Terrestrial Vertebrate section for the various Families.

There are 21 species included in Families 1, 2, 3, and 6. The effects for these species would be generally increasing amount of source habitat, increasing habitat capacity, and environmental outcomes of “A”, “B’, and “C”. All alternatives should have beneficial effects on these 21 species. Effects would be best with Alternative S2, slightly less with Alternative S3, and least with Alternative S1.

There are 14 species in Families 5, 7, and 10. One other species, the black rosy finch, can be represented by species in Family 5. The effects on these species would be generally stable or slightly decreasing amount of source habitat, stable or slightly decreasing habitat capacity, and environmental outcomes of “B” and “C”. Alternative S2 and Alternative S3 both would slow declines in habitat to a greater extent than Alternative S1.

There are eight species in Families 11 and 12. The effects for these species are generally stable or decreasing amount of source habitat, decreasing habitat capacity, and environmental outcomes of “C”, “D”, and “E”. Alternatives S2 and S3 should have beneficial effects on these species as they slow the habitat declines caused by succession. Alternative S2 followed closely by Alternative S3 would slow declines in habitat to a greater extent than Alternative S1.

Twenty-eight of the terrestrial vertebrates identified as sensitive by the Forest Service or BLM were identified as fine-scale in Wisdom et al. (in press). Many of these species are associated with riparian or wetland habitats. Implementation of any of the alternatives should have general positive effects on riparian- or wetland-dependent species through general improvement of riparian habitats. Alternative S2 should have more beneficial effects than either Alternative S3 or Alternative S1 (see terrestrial riparian and wetland section for more information). For all these species, the effects of management activities are more appropriately analyzed through the step-down process, including site-specific NEPA analysis.

Another 28 of the terrestrial vertebrates identified as sensitive by the Forest Service or BLM were found (Lehmkuhl et al. 1997) to be secure at the basin scale or more appropriately analyzed at a finer scale. The effects of management activities are more appropriately analyzed through the step-down process, including site-specific NEPA analysis.

Table 4-27. Classification of Threatened, Endangered, Proposed, Candidate, or Sensitive Terrestrial Vertebrates into 'Families' of Species of Broad-scale Focus, Species of Fine-scale Focus, or Not of Concern, Basin Wide.

Species	Status	Family or Scale[1]
woodland caribou	Endangered	Family 2
gray wolf	Endangered	Family 5
grizzly bear	Threatened	Family 5
bald eagle	Threatened	fine scale
whooping crane	Endangered	no
canada lynx	Proposed Threatened	Family 3
northern Idaho ground squirrel	Proposed Threatened	Family 12
Washington ground squirrel	Candidate	Family 10
Columbia spotted frog	Candidate	fine scale
Oregon spotted frog	Candidate	fine scale
western gray squirrel	Sensitive	Family 1
Lewis' woodpecker	Sensitive	Family 1
white-headed woodpecker	Sensitive	Family 1
pygmy nuthatch	Sensitive	Family 1
Vaux's swift	Sensitive	Family 2
olive-sided flycatcher	Sensitive	Family 2
three-toed woodpecker	Sensitive	Family 2
black-backed woodpecker	Sensitive	Family 2
pileated woodpecker	Sensitive	Family 2
fisher	Sensitive	Family 2
flammulated owl	Sensitive	Family 2
great gray owl	Sensitive	Family 2
boreal owl	Sensitive	Family 2
northern goshawk	Sensitive	Family 2 and 6
Williamson's sapsucker	Sensitive	Family 2
Hammond's flycatcher	Sensitive	Family 2
mountain quail	Sensitive	Family 3
wolverine	Sensitive	Family 3
California wolverine	Sensitive	see wolverine
Preble's shrew	Sensitive	Family 3
California bighorn sheep	Sensitive	Family 5
black rosy finch	Sensitive	Group 39 (Family 5)
rufous hummingbird	Sensitive	Family 6
spotted bat	Sensitive	Family 7
Townsend's (Pacific, western) big-eared bat	Sensitive	Family 7
western small-footed myotis	Sensitive	Family 7
long-eared myotis	Sensitive	Family 7
fringed myotis	Sensitive	Family 7
long-legged myotis	Sensitive	Family 7
Yuma myotis	Sensitive	Family 7
Mojave black-collared lizard	Sensitive	Family 10
western ground snake	Sensitive	Family 10
longnose snake	Sensitive	Family 10
burrowing owl	Sensitive	Family 10
ferruginous hawk	Sensitive	Family 10
kit fox	Sensitive	Family 11
pygmy rabbit	Sensitive	Family 11
Brewer's sparrow	Sensitive	Family 11
sage sparrow	Sensitive	Family 11
sage grouse	Sensitive	Family 11
loggerhead shrike	Sensitive	Family 11
Columbian sharp-tailed grouse	Sensitive	Family 12
grasshopper sparrow	Sensitive	Family 12
northern leopard frog	Sensitive	fine scale
tailed frog	Sensitive	fine scale
western toad	Sensitive	fine scale

Table 4-27. Classification of Threatened, Endangered, Proposed, Candidate, or Sensitive Terrestrial Vertebrates into 'Families' of Species of Broad-scale Focus, Species of Fine-scale Focus, or Not of Concern, Basin Wide.

Species	Status	Family or Scale[1]
Coeur d'Alene salamander	Sensitive	fine scale
Larch Mountain salamander	Sensitive	fine scale
painted turtle	Sensitive	fine scale
western pond turtle	Sensitive	fine scale
northern bog lemming	Sensitive	fine scale
common loon	Sensitive	fine scale
red-necked grebe	Sensitive	fine scale
trumpeter swan	Sensitive	fine scale
black tern	Sensitive	fine scale
harlequin duck	Sensitive	fine scale
yellow rail	Sensitive	fine scale
greater sandhill crane	Sensitive	fine scale
long-billed curlew	Sensitive	fine scale
upland sandpiper	Sensitive	fine scale
snowy plover	Sensitive	fine scale
red-naped woodpecker	Sensitive	fine scale
tricolored blackbird	Sensitive	fine scale
yellow-billed cuckoo	Sensitive	fine scale
American white pelican	Sensitive	fine scale
willow flycatcher	Sensitive	fine scale
yellow warbler	Sensitive	fine scale
Virginia's warbler	Sensitive	fine scale
Wilson's warbler	Sensitive	fine scale
bobolink	Sensitive	fine scale
veery	Sensitive	fine scale
northern red-legged frog	Sensitive	no
Cope's giant salamander	Sensitive	no
ringneck snake	Sensitive	no
dark kangaroo mouse	Sensitive	no
rock squirrel	Sensitive	no
prairie falcon	Sensitive	no
Swainson's hawk	Sensitive	no
northern harrier	Sensitive	no
hairy woodpecker	Sensitive	no
yellow-headed black bird	Sensitive	no
black-billed cuckoo	Sensitive	no
black swift	Sensitive	no
dusky flycatcher	Sensitive	no
northern pygmy owl	Sensitive	no
Cordilleran flycatcher	Sensitive	no
gray flycatcher	Sensitive	no
black-throated warbler	Sensitive	no
Townsend's warbler	Sensitive	no
MacGillivray's warbler	Sensitive	no
purple martin	Sensitive	no
solitary vireo	Sensitive	no
Scott's oriole	Sensitive	no
Swainson's thrush	Sensitive	no
Calliope hummingbird	Sensitive	no
green-tailed towhee	Sensitive	no
peregrine falcon	Sensitive	no
Acrtic peregrine falcon	Sensitive	see peregrine
wood frog	Sensitive	fine

[1] Family 1, 2, 3, etc = Terrestrial Families of species of broad-scale focus (Wisdom et al. in press); no = species not of concern basin-wide (Lehmkuhl et al. 1997); fine scale or fine = species more appropriately addressed at finer-scale (Wisdom et al. in press; Lehmkuhl et al. 1997).

Hunting, Viewing, and Collecting Considerations

Effects of the Alternatives on Hunting, Viewing, and Collecting Opportunities

This section presents the effects of the alternatives on hunting, viewing, and collecting of selected terrestrial species. Discussion of additional harvestability considerations specific to tribes is found in the Federal Responsibility and Tribal Rights and Interests section, later in this chapter.

Elk, Mule Deer, and White-tailed Deer

The capability of habitat to support elk, mule deer,and white-tailed deer was predicted by the SAG through models for all lands within a species range (Lehmkuhl and Kie 1999). Habitat capability is a measure of forage and cover habitat adjusted for qualitative effects of factors affecting habitat and factors affecting use of habitat.

The elk and mule deer model predictions indicate that under any of the alternatives, over the next 100 years, effects would be similar and most areas within the basin would have a stable to a modest increase in habitat capability. All areas of the basin would fall in the moderate category of habitat capability, except the northern portion of the Upper Columbia-Salmon Clearwater RAC, which would be in the high category. The northern portion of the Upper Columbia-Salmon Clearwater RAC would change one category by moving from moderate to high under all alternatives. The Butte, southern portion of the Upper Columbia-Salmon Clearwater, and the Eastern Washington RACs would improve from low to moderate habitat capability for elk and mule deer. In addition, for elk, the John Day-Snake River RAC and Yakima PAC would also improve from low to moderate habitat capability.

Based on this data, habitat capability would be available to continue to support elk and mule deer population levels similar to or slightly higher than current, although population numbers can be influenced by numerous factors other than habitat capability. Where habitat capability increases hunting opportunities could increase. However, it would be less likely that the potential increases in elk and mule deer numbers would keep pace with anticipated future demand as human populations increase in the basin. Therefore, because of non-habitat factors, hunting opportunities for elk and mule deer would likely be reduced from current over the next 100 years.

The white-tailed deer model predictions indicate that over the next 100 years under any of the alternatives, effects would be similar and many areas within the project area would have a stable to a modest increase in habitat capability. The John Day- Snake and Eastern Washington RACs would fall in the low category of habitat capability, while the Southeastern Oregon RAC and the northern portion of the Upper Columbia-Salmon-Clearwater RAC would be in the high category. All other areas would fall in the moderate category of habitat capability. The northern portion of the Upper Columbia-Salmon-Clearwater RAC would shift from moderate to high. The Butte and southern portion of the Upper Columbia-Salmon-Clearwater RACs would improve from low to moderate habitat capability.

Based on this data, habitat capability would to continue to support white-tailed deer population levels generally similar to or slightly higher than current, although population numbers can be influenced by numerous factors other than habitat capability. Where habitat capability increases, hunting opportunities could increase. However, as with elk and mule deer, it would be less likely that the potential increases in white-tailed deer numbers would keep pace with anticipated future demand by hunters. Therefore, because of non-habitat factors, over the 100-year prediction period, hunting opportunities for white-tailed deer would likely be reduced from current levels.

Other Species

The predicted habitat capacity for *bighorn sheep* (Terrestrial Family 5) would increase slightly from current levels with all alternatives. Based on this prediction, habitat would be available to continue to support bighorn sheep population levels at similar or slightly higher than current populations. This could make slightly more animals available for harvest. Harvest of bighorn sheep is highly regulated as demand currently exceed supply. Hunting opportunities for bighorn sheep would likely be maintained at current levels, although population numbers can be influenced by numerous factors other than habitat capability. Implementation of

Alternatives S2 and S3 would have the most improvement, followed closely by Alternative S1. Mountain goats are also in Terrestrial Family 5 and would probably be affected similarly.

The predicted habitat capacity for *pronghorn antelope* (Terrestrial Family 10) would decrease slightly from current levels with all alternatives. Based on this prediction, habitat would be available to continue supporting pronghorn populations that are similar to or slightly reduced from current levels. Harvest of pronghorn is highly regulated as demand currently exceeds supply. Hunting opportunities for pronghorn could be reduced slightly from current opportunities, although population numbers can be influenced by numerous factors other than habitat capability. Implementation of all alternatives would have similar effects.

The predicted habitat capacity for *American marten* (Terrestrial Family 2) would increase substantially from current levels with all alternatives. Based on this prediction, habitat would be available to support higher marten populations than current population levels. Currently there is little increasing demand for marten or furbearers in general, and it would not be anticipated that demand would increase to the same degree as with some other species. Therefore, trapping opportunities for marten would be increased from current levels, and it would be unlikely that demand would exceed supply. Implementation of Alternative S2 would have the most improvement, followed closely by Alternative S3. There would be least improvement with Alternative S1. The fisher is also in Terrestrial Family 2 and would probably be affected similarly.

The predicted habitat capacity for *blue grouse* (Terrestrial Families 2 and 3) would increase substantially from current levels with all alternatives. Based on this prediction, habitat would be available to support higher blue grouse population levels than currently. It is not anticipated that demand would increase to the same degree as with some other species. Therefore, hunting opportunities for blue grouse should be increased from current levels, and it would be unlikely that demand would exceed supply. Implementation of all alternatives would have similar effects on blue grouse.

The predicted habitat capacity for *sage grouse* (Terrestrial Family 11) and *Columbian sharp-tailed grouse* (Terrestrial Family 12) would decrease from current levels with all alternatives. Based on this prediction, habitat would be less available to support population levels of both species. It is not anticipated that demand would increase to the same degree as with some other species. However, hunting opportunities for these grouse species would be decreased from current levels, and it would be likely that demand would exceed supply. Implementation of Alternative S2 followed closely by Alternative S3 would slow declines in habitat to a greater extent than with Alternative S1.

The *western gray squirrel* is included in Terrestrial Family 1. The amount of source habitat would be reduced for this species under all alternatives. This could decrease hunting opportunities, although population numbers can be influenced by numerous factors other than habitat capacity. Implementation of Alternatives S2 and S3 would slow declines to a greater extent than with Alternative S1.

Habitat conditions would improve under all alternatives for harvested species which are dependent on riparian or wetland habitats (such as *ducks* and *geese*). This should have a positive effect on hunting opportunities for these species, although population numbers can be influenced by numerous factors other than habitat capability. Implementation of Alternative S2 would have the most improvement. There would be less improvement with Alternative S3, followed closely by Alternative S1.

Some harvested terrestrial species (such as *moose, black bear, mountain lion, chukar, California quail,* and *turkey*) were not included as species of focus, because there of their current abundance, the lack of risk factors, or current restricted harvest. It is anticipated that hunting opportunities would continue at current levels.

The effects of harvesting *plants* are generally localized, and the degree of these effects can not be evaluated at the broad scale. However, Alternatives S2 and S3 should have positive effects on species adversely affected by harvesting by providing management direction that focuses on development of conservation strategies for species of broad-scale concern, and on maintenance and / or restoration of harvestability of all species, to a higher degree than Alternative S1. This should benefit species which may be adversely affected by harvesting, especially those harvested for commercial purposes.

Aquatic–Riparian–Hydrologic Component

This section presents the effects of the alternatives on aquatic and riparian habitats, water quality, and aquatic species. A summary of key effects and conclusions for all subject areas is presented first. Each subject area then begins with methods of estimating effects, followed by the analysis of effects.

Summary of Key Effects and Conclusions

The largest increase in aquatic habitat capacity would come from Alternative S2, followed by Alternative S1 and then Alternative S3. Alternative S2 would maintain or improve riparian ecological processes, while Alternative S1 would likely maintain them and Alternative S3 would contain more uncertainty. Water quality effects can be thought of as indicators of the upland physical and biological processes. For example, high water quality generally suggests that these processes are on an improving trend, characteristic of historical succession and disturbance regimes.

Aquatic habitat on BLM- and Forest Service-administered lands is vital to native fish populations, but other factors are also important, such as effects from harvest, dams that restrict fish migrations, non-native aquatic species, and human activities and habitat conditions on private lands.

Aquatic and Riparian Habitats

- All three alternatives are projected to improve aquatic habitat conditions on BLM- and Forest Service-administered lands compared to projections of current conditions over the long term. The largest increase in aquatic habitat capacity would occur under Alternative S2 and the smallest increase under Alternative S3.
- Alternative S2 would maintain and improve riparian ecological processes through time, based on the interim RCA delineation criteria. Some uncertainty is associated with the other two alternatives, where one-half site potential tree height is used as an interim RCA delineation criterion.

Water Quality

- In the long term (100 years) all three alternatives are predicted to improve water quality conditions on BLM- and Forest Service-administered lands compared to current conditions.
- Alternative S2 is predicted to have the most positive influence on water quality, while Alternative S3 is predicted to result in the least improvement.

Aquatic Species

- All alternatives are expected to result in improved population status and habitat capacity for the six key salmonids over the long term. Predicted changes in population status reflect less improvement than does habitat capacity because of other biological constraints on a population's response (for example, exotic species and migratory corridor survival) and uncertainty in the analysis. Overall, Alternative S2 is expected to result in the most improvement for these six species. Alternative S3 is expected to result in the least improvement when compared to the other two alternatives.
- Other factors beyond Forest Service or BLM management authority may limit the response of aquatic species to habitat conservation and restoration on federal lands. These factors include condition of non-federal habitat and non-native fish species. It is assumed that habitat conditions on non-federal lands would remain stable or would slightly improve over the long term.
- Although stream-type chinook and steelhead habitat capacity would substantially improve under all alternatives, population status outcomes reflect minor or no improvement. Population status outcomes reflect the assumptions regarding biological constraints which influence survival throughout their life cycle. The greatest uncertainty is associated with migration corridor survival, especially for populations above several

dams in the Snake River and Upper Columbia River. Management of habitat on Forest Service- and BLM-administered lands is expected to play a major but not exclusive role in the future status of the species. Rehabilitation of depressed populations above several dams cannot be accomplished via federal habitat improvement alone but will require improvements in migration corridor survival and efforts to address causes of mortality in other life stages. However, securing and restoring federal freshwater habitat may be critical to the short-term persistence of many anadromous populations. Trends in improving strong status and habitat associated with Alternative S2 were slightly greater than those in Alternatives S1 and S3; thus, Alternative S2 is expected to result in more favorable conditions supporting the persistence of anadromous fish.

Aquatic and Riparian Habitats

Methodology: How Effects on Aquatic and Riparian Habitats were Estimated

The Draft EIS evaluation methods consisted of arraying available alternative information (such as management direction, projected levels of activity, some model results, and knowledge of fish or habitat distribution and status) and asking one or more experts to formulate opinions on the likely future outcomes. A different evaulation method is used in this Supplemental Draft EIS to display future outcomes from the alternatives (Rieman et al. 1999), because:

- For the Draft EISs, it was difficult to account for multiple interacting effects. Assumptions were stated but it was hard to determine how they influenced outcomes or uncertainty in outcomes.
- With the Draft EIS methodology, it was difficult to replicate or update the analysis when management drivers or key assumptions were modified.
- Results were not easily quantified and were not spatially explicit for the Draft EISs. This made it difficult to evaluate relative differences among alternative outcomes.

To address these issues the aquatic Science Advisory Group (SAG) used a model called Bayesian Belief Networks (BBN) as a formal framework for the analysis of the Supplemental Draft EIS alternatives (see sidebar in Terrestrial Species section of this chapter and Rieman et al. [1999] for description of the model). Bayesian Belief Networks provide a quantitative framework that allows the use of quantitative and qualitative information to be combined in an evaluation process. These models also allow incorporation of uncertainty into this process. Using Bayesian Belief Networks, the aquatic SAG linked key processes in aquatic systems and conditions to landscape characteristics that are predicted to change as a result of management activities.

Bayesian Belief Networks were developed to estimate trends in aquatic habitat capacity and future status of key salmonids. Model outputs were estimated probabilities of particular states occurring within a subwatershed at 10- and 100-year time periods for each alternative and current condition. In this context, probabilities measure the relative strength of a particular outcome. Current condition represents a projection of approximately 1996–1998 aquatic and riparian conditions and management direction.

Changes in aquatic habitat capacity were examined using counts of the most likely state (high, moderate, low; see Glossary) and probabilities for high and low habitat capacity. The most likely state was estimated as that with the greatest probability. For example, if the probability of high aquatic habitat capacity was greater than both moderate or low, then the most likely state was classified as high.

Differences among the alternatives and evaluation time periods were examined by comparing: (1) the number of subwatersheds where the most likely state was high or low; and (2) the mean probability of high and low habitat capacity of subwatersheds for federal lands and all lands. (Federal lands are defined for this purpose as subwatersheds where federal ownership is 50 percent or higher.) NOTE: Summary counts of the most likely state should not be considered a prediction of the actual number of subwatersheds with high or low aquatic habitat capacity, but rather as a summary of trend or differences between the alternatives.

Effects of the Alternatives on Aquatic and Riparian Habitats

Aquatic Habitat Capacity

Projected changes in aquatic habitat capacity at 10 years were small. Consistent declines in habitat capacity were evident at 10 years only in Alternative S3. These results may suggest that greater risks exist in the short term with Alternative S3.

The remaining effects discussion is focused on changes at 100 years. Based on the number of subwatersheds with a change in aquatic habitat capacity state, all three alternatives are projected to improve aquatic habitat conditions on BLM- or Forest Service-administered lands compared to current conditions (Figure 4-12). However, the magnitude of change varies among alternatives. Compared to current conditions, Alternative S2 would result in 51 percent improvement in aquatic habitat capacity (from low to moderate or high), followed by Alternative S1 at 43 percent and Alternative S3 at 30 percent. Alternative S2 would result in the largest number of subwatersheds moving out of a low aquatic habitat capacity state. Compared to Alternative S1, Alternative S2 would result in 18 percent greater improvement in aquatic habitat capacity, while Alternative S3 would result in 30 percent less improvement to aquatic habitat capacity.

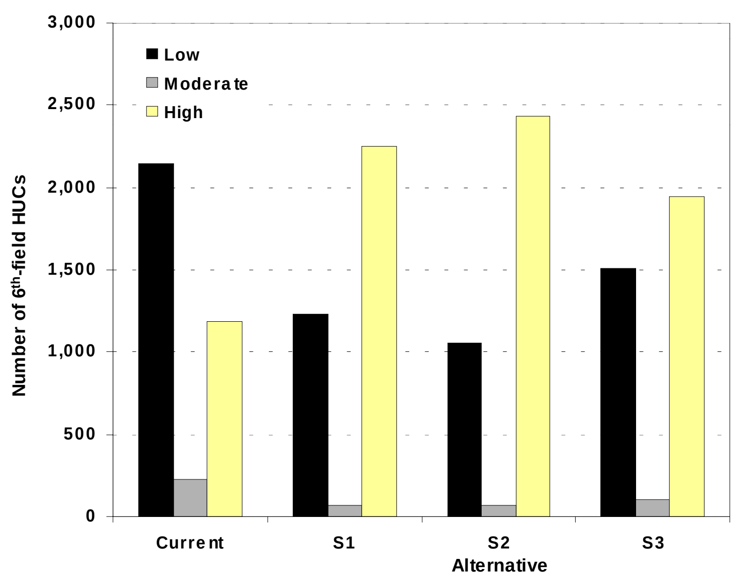


Figure 4-12. Change in Aquatic Habitat Capacity State for BLM- and Forest Service-administered Lands – Long Term.

Mean probability for high aquatic habitat capacity displayed similar relative trends as the counts of subwatersheds. Compared to projections of current conditions, Alternative S2 is expected to increase the mean probability by 19 percent, followed by Alternative S1 at 16 percent and Alternative S3 at 15 percent. Map 4-7 displays the projected spatial changes in high habitat capacity probability for the three alternatives compared to current conditions.

In summary, the largest increase in aquatic habitat capacity would occur under Alternative S2 and the smallest increase under Alternative S3. Alternative S2 would result in the largest number of subwatersheds moving out of low aquatic habitat capacity and a higher mean probability for high aquatic habitat capacity. Alternative S1 would show more subwatersheds moving out of low, and a larger mean probability of high than Alternative S3.

The level of aquatic habitat maintenance and restoration provided by a particular alternative had the greatest influence on the projected aquatic habitat capacity outcomes among model input variables. Other model input variables that had major influences on projected outcomes among alternatives were changes in road density and future livestock grazing.

Riparian Habitats

All alternatives have goals, objectives, and standards pertaining to the maintenance and restoration of riparian areas and wetlands. Riparian management direction associated with Alternatives S2 and S3 is more focused on achieving desired outcomes and is less specific on management activity requirements than Alternative S1. Initial compliance and consistent implementation of management direction may be higher with Alternative S1; however, greater flexibility to tailor management needs to ecological conditions (with potentially better acceptance of and commitment to outcomes) may be associated with Alternatives S2 and S3. Alternative S2 would maintain riparian ecological processes through time based on the interim RCA delineation criteria. Some uncertainty is associated with the other two alternatives, where

Map 4-7. High Aquatic Habitat Capacity Probablility: Change from Current (Year 100).

one-half site potential tree height is used as an interim RCA delineation criteria (see Chapter 3; RCA Delineation section for applicable areas). RCAs of one site potential tree height provide little margin for uncertainty and may not provide for full riparian ecological function (Sedell et al. 1997; National Research Council 1996). The one-half site potential tree height criterion would apply to a larger area in Alternative S3 and thus would result in the highest uncertainty associated with maintainance of riparian processes.

The extent of the area given riparian consideration and emphasis varies by alternative (Figure 4-13). Using broad-scale information, Alternative S2 would result in the most area within RCAs, followed by Alternatives S1 and S3. At finer scales, the area within RCAs will vary depending on local conditions such as landform, climate, and geology as illustrated by the examples shown in Table 4-28. However, the relative ranking, in terms of area within RCAs, would remain the same as displayed at the broad scale.

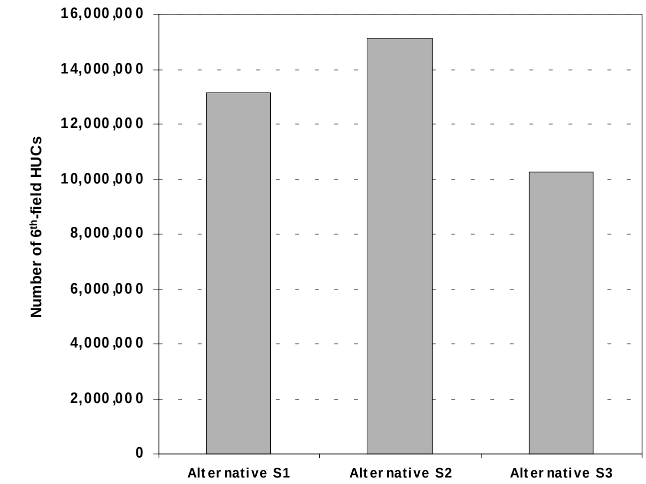


Figure 4-13. Estimated Acres of BLM- and Forest Service-administered Lands Within Riparian Conservation Areas (RCAs).

Ecological functions provided by riparian vegetation are achieved at different distances depending on the function and width of riparian vegetation (Lee et al. 1997; FEMAT 1993). Use of fixed distances from the streambank in delineation of RCAs, without opportunity for adjustments, would not account for variable ecological conditions. Each alternative allows for adjustment to interim RCAs to account for ecological variability. Adjustments to interim RCAs in Alternative S1 can be made after conducting either EAWS or site-specific analysis with the result documented in the appropriate NEPA document. In Alternatives S2 and S3, adjustment to interim RCAs can be made after conducting EAWS or programmatic planning processes followed by site-specific analysis, with the result documented in the appropriate NEPA document. Alternative S1 thus provides flexibility for adjustment; however, PACFISH / INFISH implementation monitoring indicates adjustment to interim RCAs using site-level analysis is difficult because it is less acceptable to some publics and other agencies because of the lack of larger context information on riparian condition and function (Gordon Haugen, USDA Forest Service, personal communication).

Although less flexible, Alternatives S2 and S3 set the expectation that RCAs will be adjusted at the site level following completion of a larger scale analyses. The rate and acceptance of RCA adjustment maybe higher with Alternative S2 because of its greater emphasis on EAWS compared to Alternatives S1 and S3.

Alternatives S2 and S3 would have designated areas to reduce sediment delivery to the RCA; such designated areas would be absent in Alternative S1. In Alternative S2 this consideration applies to all RCAs while in Alternative S3 it applies only to intermittent stream RCAs (Figure 4-14). The width of area is based upon hillslope steepness. New management activities within this sediment-delivery area are to be

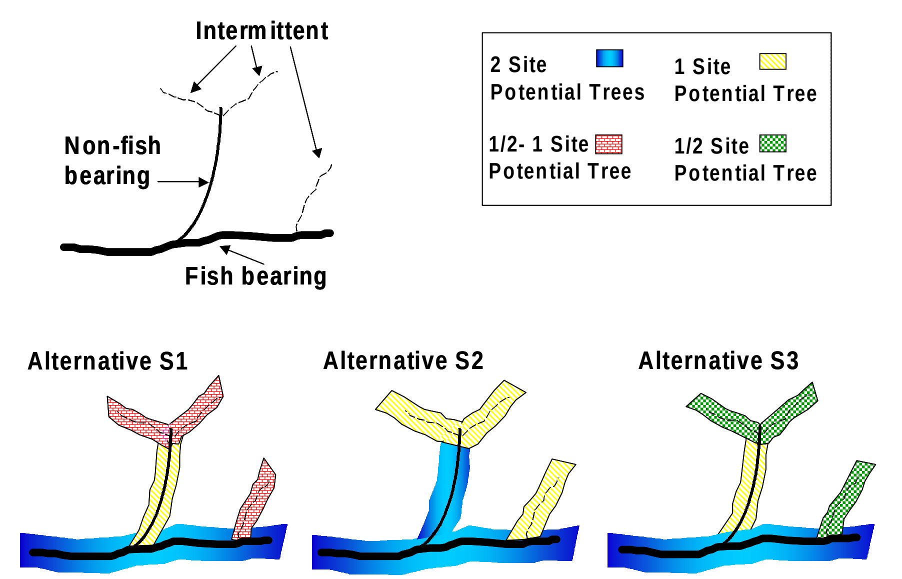


Figure 4-14. Schematic Delineation of Riparian Conservation Areas.

Table 4-28. Examples of Percent Subwatershed Area Within Streamside RCAs,[1] for Each Alternative.

Subwatershed/ Potential Vegetation Type	Information Source	Subwatershed Area (Acres)	Alternative	Percent of Subwatershed within Streamside RCAs
170602050903	Boise NF	26,150	S1	10
Cold Forest			S2	11
			S3	9
170501221301	Boise NF	23,926	S1	12
Dry Forest			S2	13
			S3	10
170501200401	Boise NF	10,884	S1	12
Dry Forest			S2	16
			S3	11
170603071010	Clearwater NF[2]	23,200	S1	30
Moist Forest			S2	51
			S3	30
170603062520	Clearwater NF[2]	27,100	S1	26
Moist Forest			S2	43
			S3	26
170603035720	Clearwater NF[2]	7,600	S1	20
Moist Forest			S2	33
			S3	20
170603030320	Clearwater NF[2]	5,300	S1	40
Moist Forest			S2	63
			S3	40
1706010411F	Boise Cascade	16,776	S1	20
Dry Forest			S2	24
			S3	15

Abbreviations used in this table:
RCA = Riparian Conservation Area
NF = National Forest

[1] Site-potential tree height was used as the RCA delineation criteria. Values for site-potential tree height are based on information in Appendix G (UCRB) or 3-4 (Eastside) of the Draft EISs.

[2] Alternatives S1 and S3 results for the Clearwater NF information are the same because no intermittent streams occur within these four subwatersheds. If intermittent streams existed, Alternative 2 would still have the greatest area within RCAs followed by Alternative S1 and Alternative S3.

Major Changes from the Draft EISs

Methodology
The Draft EIS alternatives were evaluated by the Science Integration Team (SIT) by arraying available alternative information (such as management direction, projected levels of activity, some model results, and knowledge of fish or habitat distribution and status) and asking one or more experts to formulate opinions on likely future outcomes. The Supplemental Draft EIS alternatives were evaluated by the Science Advisory Group (SAG) using a model called Bayesian Belief Networks (BBN), which allowed for both quantitative and qualitative information to be combined to arrive at the effects analysis. (See Terrestrial Species section for a description of the BBN.)

Native Fish Species
The Draft EISs included analysis of effects on ocean-type chinook salmon; this species was not included in the evaluation of the Supplemental Draft EIS because virtually all spawning and rearing habitat for ocean-type chinook salmon occurs on non-federal land.

The Draft EISs included evaluation of effects on 18 sensitive fish species, including the Wood River bridgelip sucker; the Supplemental Draft EIS effects analysis for aquatics does not explicitly include the Wood River bridgelip sucker, but it does include results for Wood River sculpin habitat, which coincides with habitat for the sucker.

conducted in manner that limits sediment movement into the RCA. This would prevent or reduce riparian and in-stream effects due to management-induced sediment delivery. Additionally, all three alternatives require that unstable or potentially unstable lands be managed to not increase the natural frequency and distribution of landslides. This requirement would prevent or minimize management-related landslides, reducing negative impacts on riparian and aquatic habitats.

Water Quality

Methodology: How Effects on Water Quality were Estimated

The models used for the aquatic analysis [Bayesian Belief Network (BBN)] were not constructed to directly evaluate the effects of alternatives on water quality. However, the aquatic habitat capacity module within the BBN includes components that can serve as proxies for some, but not all, water quality parameters. For example, the sediment 'node' within the aquatic habitat capacity model was used to estimate trends in sediment production and delivery. The sediment node characterizes the likelihood that accelerated sediment will be delivered to a stream; it can provide an indication of effects and trends on water quality. Factors that influenced sediment delivery in the model included changes in road density/road disturbance and estimated soil disturbance from proposed timber harvest and prescribed fire activities.

The model ranked subwatersheds into low, moderate, or high sediment delivery classes for current conditions and the alternatives. The "low" sediment delivery class was assigned to subwatersheds where accelerated sediment yields are less than 20 percent over natural. This value is based on studies that indicate a 20 percent *sustained* increase in depositional sediment yield is needed to detect a significant change in stream channels resulting from disturbance by logging, fire, or roads (J. King, personal communication, letter on file). Because of differing rock types, landforms, and valley bottom-channel type combinations, there are large natural variations in sediment yields. For some stream systems, increases in sediment delivery may need to be higher than 20 percent to detect significant changes in stream channels. Subwatersheds classified as "moderate" were estimated to have sediment delivery ranging from 20 to 100 percent over natural. This delineation is based on the level of increase that will generally result in stream bed morphology changes such as pool filling and excessive sediment deposition in spawning substrate. “High” was assigned to subwatersheds having greater than 100 percent over natural sediment delivery.

Differences among the alternatives and current conditions were determined by comparing the sediment delivery ratings for subwatersheds for the short term (10 years) and the long term (100 years). The sediment delivery and water quality evaluation applies only to federal lands within the project area, which are defined as subwatersheds where ownership by the federal land management agencies is 50 percent or greater.

Rationale for Qualitative Interpretation of Modeling of Management Alternatives

Qualitative interpretation of potential effects on water quality included evaluation of the alternatives on riparian and aquatic habitats, watershed protection and restoration via the A1 / A2 networks, high restoration priority subbasins, and step-down analysis. Favorable outcomes for these management elements return desirable sediment delivery and riparian conditions that provide benefits to water quality.

Direction requiring the Forest Service and BLM to apply the 303(d) protocol was issued while SAG was in the process of completing their effects analysis. Therefore, the protocol was modeled under Alternatives S2 and S3 and not modeled for Alternative S1. This direction requires Forest Service and BLM units within the project area to implement the 303(d) protocol, regardless of which alternative is selected. Any analyses for proposed management activities within a subbasin containing a 303(d) listed water body will incorporate the protocol.

Effects of the Alternatives on Water Quality

Direct effects on water quality are best predicted using modeled results for sediment production and delivery. Indirect effects can be evaluated by interpreting expected outcomes for water quality indicators such as riparian condition and aquatic habitat capacity. Additional considerations in the proposed management direction that can affect water quality conditions and trends include the high restoration priority subbasins and the 303(d) protocol.

Sediment Delivery Effects on Water Quality

There were no discernible differences in effects on sediment delivery, and therefore on water quality, among the alternatives in the short term (10 years) (Rieman et al. 1999).

For the long term (100 years), the *Effects Analysis* indicates implementing Alternative S2 would result in more positive outcomes with respect to water quality than the other alternatives. The relative benefits associated with Alternative S2 include a projected two-fold increase in likelihood for low sediment delivery class compared to Alternatives S1 and S3, and slightly lower probabilities for high and moderate sediment classes than the other two alternatives. The *Effects Analysis* suggests Alternative S3 would have slightly higher likelihood for the high and moderate sediment delivery classes, and lower probability for the low sediment delivery class compared to Alternative S1. To summarize, Alternative S2 is predicted to have a more positive influence on water quality, while Alternative S3 is predicted to result in the least improvement.

Trends in effects on water quality were determined by evaluating the changes in probabilities for low, moderate, or high sediment delivery class caused by each of the three alternatives compared to the current condition of each subwatershed. In the long term (100 years) all three alternatives are predicted to improve water quality conditions on BLM- and Forest Service-administered lands compared to current conditions (see Figure 4-15).

To summarize the long-term trends of the effects on water quality, the probability of improving water quality through reductions in the moderate or high sediment delivery class is highest for Alternative S2, with Alternative S1 having a slightly higher probability than Alternative S3.

Related Water Quality Indicators

Water quality effects are basically response indicators, suggesting that the physical and biological processes within the project area are moving in an improving trend, characteristic of their geomorphic setting and natural disturbance and recovery regimes. The trends in sediment production and delivery, used as an indicator for determining effects on water quality, are similar to those for riparian conditions and aquatic habitat.

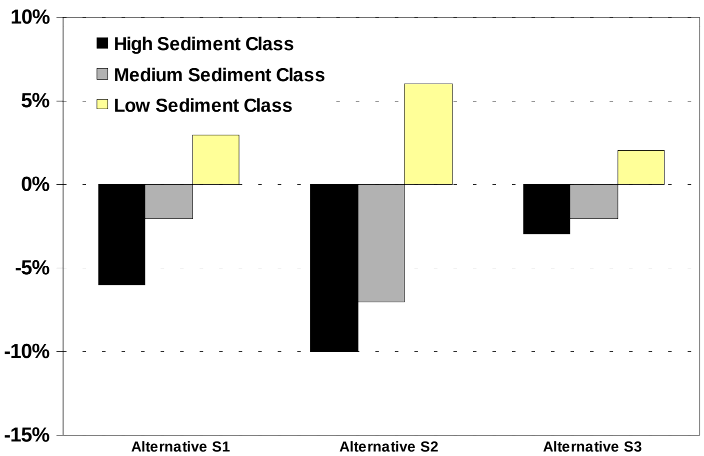


Figure 4-15. Change in Sediment Production and Delivery Class From Current Condition (at 10 years).

Having fully functioning or improving riparian conditions indicates positive effects on water quality. Intact riparian condition includes stable soils, abundant native vegetation, and channel geometry that reflects neither atypical widening nor incision. Functioning riparian condition provides several processes that maintain water quality, including: sediment storage during overbank flow, energy dissipation, nutrient uptake and storage, and channel shading. Water quality parameters that would be beneficially affected by intact riparian habitat include suspended sediment, bedload sediment, water temperature, dissolved and readily available nutrients, and dissolved oxygen. In relating the effects of the alternatives predicted for riparian habitats on sediment delivery, Alternative S2, followed by Alternative S1, would provide higher benefits to water quality. Higher risk of maintaining or protecting riparian function is predicted for Alternative S3 (see Effects on Aquatic and Riparian Habitats, earlier in this section).

In addition to riparian conditions, the likelihood for high aquatic habitat capacity provides another qualitative relationship to water quality and beneficial use support. High aquatic habitat capacity includes sufficient structure from coarse wood and large boulders to provide a mix of channel habitats, sediment particle size distributions on the channel bottom that indicate sufficient transport of fine particles, and appropriate amounts of stable, overhanging streambanks that are characterized by adequate natural vegetation. Desirable outcomes of high aquatic habitat are highest for Alternative S2, followed by Alternatives S1 and S3, respectively. These ratings imply water quality conditions under Alternative S2 would more likely support beneficial uses than Alternatives S1 or S3.

Effects of High Restoration Priority Subbasins on Water Quality

High restoration priorities are identified at the subbasin scale. Similar to the sediment delivery classifications for subwatersheds, road density / road disturbance, ground disturbance, and management direction were the primary factors influencing sediment delivery at the subbasin scale. Subbasins containing subwatersheds with a current rating for high sediment delivery are those having the most road disturbance. The largest decreases in high sediment delivery would occur under Alternatives S2 and S3 in subbasins that are identified as priorities for restoration. Within the high restoration priority subbasins, the management direction focuses on minimizing or mitigating negative impacts by implementing activities in a manner that will produce effects that resemble natural disturbance regimes (that is, “high” sediment delivery is influenced most by the management direction node in the Bayesian Belief Network model).

Likewise, a low rating for sediment delivery is most influenced by high maintenance / restoration themes in the management direction of Alternative S2. The management direction elements likely to influence processes related to sediment and hydrologic regimes and riparian function (such as riparian buffers, A1 / A2 watershed designations, and Subbasin Review and EAWS criteria) were considered to increase the effectiveness of restoration activities in Alternative S2 more than Alternative S3. For Alternatives S2 and S3, high maintenance / restoration management direction infers successful mitigation in the implementation of restoration activities. New and ongoing activities proposed in Alternatives S2 and S3 would not likely impair watershed processes and would not retard the recovery of watershed processes or riparian function.

Effects of 303(d) Protocol

It was previously mentioned that the 303(d) protocol was not modeled for Alternative S1. Had the protocol been modeled for that alternative, slightly greater decreases in sediment delivery might be expected than those initially estimated for Alternative S1.

An additional consideration is the intent for the protocol to be applied along with or prior to the completion of Ecosystem Analysis at the Watershed Scale (EAWS). The rate and effectiveness of active restoration combined with the overlap of areas requiring EAWS could shorten the time for bringing 303(d) waters into compliance. In Alternative S3 the frequency of EAWS is predicted to be higher than in Alternative S1. Therefore, it is likely that Alternative S3 would result in greater decreases in sediment delivery and subsequent improvements in water quality than Alternative S1, more so if increased analyses and activities are proposed in subbasins with 303(d) waters. This would be especially true if activities are planned primarily in the integrated restoration priority subbasins.

Including the protocol under all alternatives would still result in Alternative S2 having the greatest decreases in sediment delivery, with more positive benefits to water quality. Qualitatively, considering only the application of the 303(d) protocol, Alternative S3 may be slightly better than Alternative S1 in addresssing water quality concerns.

Native Fish and Other Aquatic Species

Methodology: How Effects on Aquatic Species were Estimated

Similar to aquatic habitat capacity, the relative change in future population status for six key salmonids was examined using the classifications of the most likely population status (strong, depressed, or absent) summarized as the count or probability of strong or present (strong and depressed). The analysis was limited to subwatersheds containing spawning and rearing habitat for the species. (The aquatic science advisory group did not include ocean-type chinook salmon in this analysis because virtually the entire spawning and rearing habitat for this species occurs on non-federal land.) A subwatershed was classified as strong when the probability for strong was greater than the probability for depressed and their sum exceeded absent.

The differences among alternatives were examined by comparing: (1) the number of subwatersheds where the most likely state was strong or present; and (2) the mean probabilities for each future state for subwatersheds on BLM- and Forest Service-administered lands and all lands. The 10-year summaries are not included in this evaluation because they differed little from current conditions. NOTE: as with habitat capacity, summary counts of the most likely state should not be considered a prediction of the actual number of strong or depressed populations, but as a summary useful for considering the relative trend or differences among the alternatives.

Habitat capacity and population states or probability outcomes are compared against the current condition and Alternative S1. Comparisons to current conditions are termed relative change, which is expressed as a percent change from current conditions. Comparisons to Alternative S1 are termed relative benefit, which is the percentage increase or decrease of the relative change of Alternatives S2 and S3 compared to the relative change of the no-action alternative.

The aquatic science advisory group did not attempt to model alternative effects on sensitive aquatic species status because the specific environmental requirements of these species are largely unknown. However, they did summarize changes in habitat capacity across the distribution of these species. Summary information is presented and is useful for considering which species may experience relatively large or minor changes relative to current conditions.

For further information on analysis methods see Rieman et al. (1999).

Effects of the Alternatives on Fish and Other Aquatic Species

Aquatic Mollusks

Six federally listed threatened or endangered aquatic mollusks are found within the project area. Three of these species occur on BLM-administered lands in Idaho: Banbury Springs lanx (*Lanx* sp.), Bliss Rapids snail (*Taylorconcha serpenticola*), and Utah valvata (*Valvata utahensis*). Effects on aquatic mollusks were not analyzed because of the landscape-scale nature of the data compared to the limited and localized distributions of these species. Future analysis of effects of proposed management on habitat or populations should be conducted on a site-specific basis.

'Viability' and 'Persistence'

The regulations implementing the National Forest Management Act (NFMA) require that:

> *Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area.*

Key points of this requirement are that: (1) the obligation is to provide habitat, but the adequacy of that habitat must be judged on the basis of its capability to support populations; (2) the requirement is to provide for habitat that can support a population that is well-distributed across the planning area, not just a population that can persist within the planning area; (3) the term well-distributed is defined in terms of the ability of individuals of the species to interact with each other. Biological and legal interpretation of the concept of well-distributed has further clarified that it must be judged relative to the life history and historical distribution of the species. Many species were not historically distributed in a continuous fashion across the landscape, and it should not be expected that they would be continuously distributed across the future landscape. Legal interpretation has also clarified that it is not a requirement to absolutely "insure" species viability, but that the level of certainty should reflect both biological reality and needs for multiple-uses (see 1994 Dwyer decision, Northwest Forest Plan). Thus, viability and risk must be expressed as variables, and the trade-offs between them made explicit.

The regulation also makes it clear that viability is a requirement of the federal landscape (that is, the "planning area"). This requirement creates stiff analytical challenges, as species populations operate across entire landscapes with no reference to land ownership. The aquatic species effects analysis presented in the Supplemental Draft EIS provides the information that the decision makers will use to judge whether federal habitat management meets the NMFA requirements. These include analyses of aquatic habitat capacity (a count of subwatersheds in and probability of high habitat capacity in potential spawning and rearing habitat) and population status outcomes (a count of subwatersheds with and probability of strong species status and species presence in potential spawning and rearing habitat). Declining trends in these indicators are likely to be associated with increasing threats to the persistence of existing populations and less potential for rebuilding populations in depressed portions of species' ranges; increasing trends in the indicators should suggest decreasing threats to persistence and more potential for rebuilding populations. All the necessary analysis is presented here that contributes to concluding likelihood of viability, although the final determination of viability will be made in the Record of Decision.

Introduced Fish Species

Effects analyses were not conducted for introduced fish species. The distribution and status of some introduced fish species tend to be influenced by repeated stocking and therefore are not good indicators of changes in habitat condition.

Native Fish Species

Effects analyses and outcomes were directed exclusively at six key salmonids: bull trout, westslope cutthroat trout, Yellowstone cutthroat trout, redband trout, steelhead, and stream-type chinook salmon. Ocean-type chinook salmon were not included in the evaluation because virtually all spawning and rearing habitat for this species occurs on non-federal land. The key salmonids were selected for analysis because of their importance as broad indicators of aquatic integrity and the large amount of existing information for these species.

Overall effects of the alternatives on the six key salmonids were assessed with respect to changes in aquatic habitat capacity and influences of biological constraints (such as threats from exotic aquatic species, current productivity of the population) on population response.

The analysis was limited to the estimated spawning and rearing habitat for the species for the following reasons: (1) spawning and rearing habitats are the critical areas found predominately on federal land and most likely to be sensitive to land management; (2) spawning and rearing habitats are more likely to be in headwater systems sensitive to land management activities; and (3) knowledge and ability to predict effects on other habitats is poor.

The following effects discussion for the six key salmonids is derived from the species-specific narratives, outcomes, and other information provided in the aquatics chapter (Rieman et al. 1999) of the *SAG Effects Analysis* (Quigley 1999). Population response was not considered over the short term (10 years) because predicted changes were very small. For most species, 10 years is an insufficient time frame to expect substantive differences in effects among alternatives. Reported outcomes reflect estimates about how population status would change over the long term (50 to 100 years) if the alternatives were implemented and the intent of the alternatives followed in coming decades.

The SAG evaluation for narrow endemic and sensitive species focused on 17 of the 39 identified species in the aquatics chapter (Lee et al. 1997) of the *Assessment of Ecosystem Components* (Quigley and Arbelbide 1997). The basis for species selection is described in the aquatics chapter (Sedell et al. 1997) of the *Evaluation of Alternatives* for the Draft EISs (Quigley, Lee, and Arbelbide 1997). The Draft EIS evaluation included 18 sensitive species, including the Wood River bridgelip sucker. The Supplemental Draft EIS *Effects Analysis* for aquatics (Rieman et al. 1999) does not explicitly include the Wood River bridgelip sucker, but it does include results for Wood River sculpin habitat, which coincides with habitat for the sucker.

Habitat capacity outcomes were directed mainly at habitat needs for the six widely distributed salmonids. However, a brief summary of trends in habitat capacity associated with distribution of the sensitive species was provided by SAG. The SAG did not attempt to model the specific effects of changes in habitat capacity on the sensitive species because the specific environmental requirements of these species are largely unknown. While the trends presented are useful for considering the implications of the alternatives on these species, the SAG did not interpret these trends because the implied changes or interactions with other species that respond to changes in habitat may be positive for some species and negative for others. However, the summary is useful for determining which species may experience relatively large or minor changes as compared to current conditions.

Bull Trout

A positive long-term trend in bull trout population strong status is projected for all alternatives compared to current conditions (Table 4-29). The number of subwatersheds estimated as strong would increase approximately 14 percent under Alternatives S1 and S2, and 12 percent under Alternative S3. Mean probability of strong status also shows a similar trend. In comparsion to Alternative S1, Alternative S2 would have the same outcome for the number of subwatersheds projected as strong and the mean probability of strong status. The relative benefit of Alternative S3 would be slightly less when compared to Alternative S1.

Projected bull trout presence also shows positive trends for all alternatives over the long term compared to current conditions (Table 4-29). Subwatersheds classified as present for bull trout would increase three percent under Alternatives S1 and S2, and two percent for Alternative S3. Mean probabilities display a similar trend. In comparison to Alternative S1, Alternative S2 would have the same population outcomes. Relatively, Alternative S3 would result in less benefit to bull trout presence when compared to Alternative S1.

Similar to changes in population status, high aquatic habitat capacity within estimated bull trout spawning and rearing habitat is projected to increase in the long term compared to current conditions under all alternatives (Table 4-29). However, the changes are more substantial. Subwatersheds in high aquatic habitat capacity are projected to increase 60 percent, 57 percent, and 32 percent for Alternatives S1, S2, and S3, respectively. Mean probability for aquatic habitat capacity in high status also would increase over current conditions for all alternatives, with Alternatives S1 and S2 having similar outcomes. The benefit of Alternative S2 to bull trout habitat would be similar to Alternative S1, while Alternative S3 would be substantially less than Alternative S1.

In summary, all alternatives are expected to show positive changes in future population status and aquatic habitat capacity relative to current conditions on Forest Service- and BLM-administered lands. Outcomes for Alternative S1 and S2 would be similar, because of the compensating effect of the extensive coverage of priority watersheds in Alternative S1 compared to the hierarchical analyses, restoration priorities, and the A1/A2 network in Alternative S2. Alternative S3 would have consistently lower out-

Table 4-29. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capability for the Six Fish Species Used to Evaluate Effects of the Alternative over the Long Term.

Species	Current[1]	S1	Alternative S2	S3
Bull Trout				
Strong				
Count[2]	310	352	352	347
Relative Change[3] (%)		13.5	13.5	11.9
Relative Benefit[4] (%)			0.0	**-11.9**[5]
Mean Probability[6]	0.183	0.198	0.198	0.195
Relative Change (%)		8.2	8.2	6.7
Relative Benefit (%)			0.0	**-18.2**
Presence				
Count	1069	1099	1100	1089
Relative Change (%)		2.8	2.9	1.9
Relative Benefit (%)			3.3	**-33.3**
Mean Probability	0.451	0.468	0.467	0.463
Relative Change (%)		3.8	3.7	2.8
Relative Benefit (%)			**-2.4**	**-26.0**
High Habitat Capacity				
Count	1040	1663	1629	1371
Relative Change (%)		59.9	56.6	31.8
Relative Benefit (%)			**-5.5**	**-46.9**
Mean Probability	0.380	0.439	0.440	0.425
Relative Change (%)		15.4	15.9	11.9
Relative Benefit (%)			3.2	**-22.8**
Westslope Cutthroat Trout				
Strong				
Count	459	503	500	490
Relative Change (%)		9.6	8.9	6.8
Relative Benefit (%)			**-6.8**	**-29.5**
Mean Probability	0.289	0.308	0.309	0.304
Relative Change (%)		6.6	6.9	5.1
Relative Benefit (%)			4.8	**-22.0**
Presence				
Count	1289	1293	1292	1291
Relative Change (%)		0.3	0.2	0.2
Relative Benefit (%)			**-25.0**	**-50.0**
Mean Probability	0.627	0.645	0.645	0.639
Relative Change (%)		3.0	3.0	2.0
Relative Benefit (%)			0.0	**-32.0**
High Habitat Capacity				
Count	853	1378	1366	1091
Relative Change (%)		61.5	60.1	27.9
Relative Benefit (%)			**-2.3**	**-54.7**
Mean Probability	0.383	0.440	0.441	0.424
Relative Change (%)		15.0	15.3	10.9
Relative Benefit (%)			2.0	**-27.4**
Yellowstone Cutthroat Trout				
Strong				
Count	11	14	15	15
Relative Change (%)		27.3	36.4	36.4
Relative Benefit (%)			33.3	33.3
Mean Probability	0.215	0.224	0.235	0.231
Relative Change (%)		4.2	9.7	7.7
Relative Benefit (%)			132.2	85.0

Table 4-29. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capability for the Six Fish Species Used to Evaluate Effects of the Alternative over the Long Term. (continued)

Species	Current[1]	Alternative S1	Alternative S2	Alternative S3
Presence				
Count	50	50	50	50
Relative Change (%)		0.0	0.0	0.0
Relative Benefit (%)			0.0	0.0
Mean Probability	0.561	0.566	0.570	0.568
Relative Change (%)		0.9	1.8	1.3
Relative Benefit (%)			91.5	44.3
High Habitat Capacity				
Count	19	36	41	35
Relative Change (%)		89.5	115.8	84.2
Relative Benefit (%)			29.4	**-5.9**
Mean Probability	0.293	0.327	0.358	0.343
Relative Change (%)		11.5	22.1	17.2
Relative Benefit (%)			92.2	49.5
Redband Trout				
Strong				
Count	497	649	674	627
Relative Change (%)		30.6	35.6	26.2
Relative Benefit (%)			16.4	**-14.5**
Mean Probability	0.266	0.283	0.287	0.282
Relative Change (%)		6.1	7.6	6.0
Relative Benefit (%)			25	**-0.7**
Presence				
Count	1335	1346	1347	1340
Relative Change (%)		0.8	0.9	0.4
Relative Benefit (%)			9.1	**-54.5**
Mean Probability	0.580	0.588	0.590	0.587
Relative Change (%)		1.4	1.7	1.3
Relative Benefit (%)			24.9	**-4.1**
High Habitat Capacity				
Count	654	1224	1340	1113
Relative Change (%)		87.2	104.9	70.2
Relative Benefit (%)			20.4	**-19.5**
Mean Probability	0.333	0.389	0.402	0.387
Relative Change (%)		16.8	20.8	16.3
Relative Benefit (%)			23.8	**-3.2**
Steelhead				
Strong				
Count	6	14	14	14
Relative Change (%)		133.3	133.3	133.3
Relative Benefit (%)			1.0	1.0
Mean Probability	0.104	0.111	0.112	0.111
Relative Change (%)		6.4	7.9	6.5
Relative Benefit (%)			23.1	1.4
Presence				
Count	101	101	101	101
Relative Change (%)		1.0	1.0	1.0
Relative Benefit (%)			0	0
Mean Probability	0.325	0.331	0.332	0.331
Relative Change (%)		2.0	2.4	2.0
Relative Benefit (%)			20	0
High Habitat Capacity				
Count	500	735	723	669
Relative Change (%)		47	44.6	33.8
Relative Benefit (%)			**-5.1**	**-28.1**

Table 4-29. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capability for the Six Fish Species Used to Evaluate Effects of the Alternative over the Long Term. (continued)

Species	Current[1]	S1	Alternative S2	S3
Mean Probability	0.396	0.458	0.465	0.453
Relative Change (%)		15.5	17.3	14.4
Relative Benefit (%)			11.6	**-7.1**
Stream Type Chinook Salmon				
Strong				
Count	2	4	5	5
Relative Change (%)		100.0	150.0	150.0
Relative Benefit (%)			50.0	50.0
Mean Probability	0.053	0.057	0.058	0.057
Relative Change (%)		7.3	8.8	7.4
Relative Benefit (%)			21.8	2.3
Presence				
Count	50	50	50	50
Relative Change (%)		0	0	0
Relative Benefit (%)			0	0
Mean Probability	0.202	0.207	0.208	0.207
Relative Change (%)		2.7	3.1	2.6
Relative Benefit (%)			13.9	**-4.7**
High Habitat Capacity				
Count	494	703	691	641
Relative Change (%)		42.3	39.9	29.8
Relative Benefit (%)			**-5.7**	**-29.7**
Mean Probability	0.406	0.467	0.473	0.462
Relative Change (%)		14.8	16.4	13.7
Relative Benefit (%)			10.8	**-7.5**

[1] Current conditions represent projection of conditions equivalent to those present in 1994.
[2] Counts represent the number of subwatersheds projected to be in a particular state within potential spawning and rearing habitat for the species.
[3] Relative change was calculated as the percent increase over base.
[4] Relative benefit is the percentage increase (+) or decrease (-) of the relative change of Alternatives S2 and S3 compared to the relative change of the no action alternative.
[5] Bold values represent a decline from either base or S1 conditions.
[6] Mean probability is the mean for all subwatersheds.

Source: Rieman et al. 1999.

comes because of the increased uncertainty associated with implementation of EAWS and lower amount of protection provided by RCAs. Nevertheless, bull trout are projected to persist under all alternatives over the long term.

All alternatives would secure and strengthen the core distribution of the species and would prevent further declines in populations through prevention of further degradation and improvement in spawning and rearing habitat over the long term. Positive trends are associated with the depressed portions of the distribution, but they are not strong enough to suggest substantial rebuilding in currently depressed areas. Some loss in populations may continue to occur, however, even without further habitat loss, because of biological constaints and/or natural disturbance events. Bull trout population response to increases in habitat capacity would be constrained by factors affecting the biological potential of populations, including such factors as threats from exotic species, the highly depressed state of the current distribution of bull trout, and low support from populations for refounding adjacent bull trout populations.

Westslope Cutthroat Trout

Estimates for all alternatives indicate a positive trend compared to current conditions for strong westslope cutthroat trout status over the long term (Table 4-29). Subwatersheds classified as strong would increase approximately ten percent under Alternative S1, nine percent under Alternative S2, and seven percent under Alternative S3. Mean probability of strong status also displays a similar trend. In comparing change in subwatersheds classified as strong, Alternative S2 would have slightly less benefit than Alternative S1. However, Alternative S2 would have a slightly higher probability of strong status than Alternative S1. Alternative S3 would have substantially less benefit than Alternative S1.

Projected westslope cutthroat presence is expected to slightly increase under all alternatives over the long term compared to current conditions (Table 4-29). Counts for present are projected to increase less than one percent in all alternatives. Mean probabilities for presence show larger increases over current conditions than do counts, with Alternative S1 and S2 having the same outcome and a larger increase than Alternative S3. Alternative S2 would have population presence outcomes similar to Alternative S1. Relatively, Alternative S3 would result in less improvement than Alternative S1.

High aquatic habitat capacity within estimated westslope cutthroat trout spawning and rearing habitat is projected to increase in the long term as compared to current conditions under all alternatives (Table 4-29). Changes in habitat capacity are more substantial than population outcomes. Subwatersheds in high aquatic habitat capacity are projected to increase 62 percent for Alternative S1, 60 percent for Alternative S2, and 28 percent for Alternative S3. Mean probabilities for aquatic habitat capacity in high status also would increase for all alternatives. Compared to current conditions, Alternatives S1 and S2 would would have the highest increase in mean probability, followed by Alternative S3. The relative benefit of Alternative S2 to habitat condition would be similar to Alternative S1. Alternative S3 would result in substantially less benefit to westslope cut-throat trout habitat when compared to Alternative S1.

In summary, all alternatives would produce positive trends in population status and habitat condition for westslope cutthroad trout when compared to current conditions over the long term on Forest Service- and BLM-administered lands. Therefore, it is expected westslope cutthroat trout would persist over the long term under all alternatives. Alternatives S1 and S2 would have similar population and habitat outcomes. Outcomes for Alternative S3 would be consistently less than the other two alternatives. Reasons for these outcomes are similar to those presented for bull trout.

All alternatives are likely to conserve and strengthen the core of the westslope cutthroat trout distribution. Alternative S2 would result in stronger trends in improvement in the fringe distribution than other alternatives. Positive trends are associated with the depressed portions of the distribution, but they are not strong enough to suggest substantial rebuilding in currently depressed areas. Habitat outcomes would be substantially higher than population status outcomes for all alternatives. Westslope cutthroat trout population responses would be constrained by other factors affecting the biological potential of populations, including such factors as threats from exotic species, the highly depressed state of the current distribution, and low support from populations for refounding adjacent westslope cutthroat populations.

Yellowstone Cutthroat Trout

A positive long-term trend in Yellowstone cutthroat trout population strong status is projected for all alternatives compared to current conditions(Table 4-29). Subwatersheds classified as strong would increase approximately 27 percent under Alternative S1 and 36 percent for Alternatives S2 and S3. The mean probability for strong status is projected to increase the most under Alternative S2, followed by Alternative S3 and Alternative S1. Both Alternatives S2 and S3 would result in more benefit to strong Yellowstone cutthroat status than Alternative S1, with Alternative S2 having the most benefit.

Although subwatershed counts for projected Yellowstone cutthroat trout presence would not change for any alternative when compared to current conditions (Table 4-29), mean probability of presence would increase slightly for all alternatives over current conditions (1–2 percent) in the long term. Alternative S2 would result in the most improvement, followed by Alternative S3 and Alternative S1.

High aquatic habitat capacity within estimated spawning and rearing habitat is expected to increase under all alternatives in the long term when compared to current conditions (Table 4-29). Subwatersheds in high aquatic habitat capacity are projected to increase 90 percent under Alternative S1, 116 percent under Alternative S2, and 84 percent under Alternative S3. Mean probability for high aquatic habitat capacity showed the greatest increase under Alternative S2 followed by Alternative S3 and Alternative S1. Alternative S2 would result in more benefit to Yellowstone cutthroat trout habitat than Alternative S1. Alternative S3 would result in less benefit than Alternative S1 when comparing subwatersheds classified as high aquatic habitat capacity, but more benefit when comparing mean probabilities.

In summary, all alternatives would produce positive trends in population status and habitat condition when compared to current conditions over the long term on Forest Service- and BLM-administered lands. Outcomes for Alternative S2 would consistently display more improvement in population status and habitat than the other alternatives. Outcomes for Alternative S1 would be consistently less than the other two alternatives. Reasons for these outcomes are the conservation / restoration emphasis provided by the A1 / A2 subwatersheds and high restoration priorities in Alternatives S2 and S3, compared to little to no conservation / restoration emphasis in Alternative S1 except for RCA management direction. Given that all alternatives would improve over current conditions, it is expected that Yellowstone cutthroat trout would persist under all alternatives over the long term.

All alternatives are likely to conserve and strengthen the core of the Yellowstone cutthroat trout distribution within the project area. Most of the species range is not included in the project area. Parts of the excluded distribution are remote and within parks or reserves providing habitat protection that is lacking in the lower elevations of the distribution. There are no fringe populations within the project area. Habitat outcomes would be substantially higher than population status outcomes for all alternatives. Status of many populations is uncertain because of the potential for hybridization with non-native trout.

Redband Trout

Estimates for all alternatives indicate a positive trend compared to current conditions for strong redband trout status over the long term (Table 4-29). Subwatersheds classified as strong would increase approximately 31 percent under Alternative S1, 36 percent for Alternative S2, and 26 percent for Alternative S3. The mean probability for strong status is also projected to increase under all alternatives, with Alternative S2 showing the highest increase and Alternatives S1 and S3 having similar outcomes. Alternative S2 would result in more benefit to strong redband trout status than Alternative S1. Alternative S3 would result in similar or slightly less benefit than Alternative S1.

Projected redband presence is expected to slightly increase under all alternatives over the long term compared to current conditions (Table 4-29). Counts for present were projected to increase less than one percent in all alternatives. Mean probabilities for presence showed larger increases over current conditions than do counts, with Alternative S2 having the most improvement over current conditions. Alternative S2 would result in more benefit than Alternative S1. Alternative S3 would result in similar or slightly less benefit than Alternative S1.

Similar to changes in population status, high aquatic habitat capacity within estimated redband trout spawning and rearing habitat is projected to increase in the long term compared to current conditions under all alternatives (Table 4-29). However, the changes would be more substantial. Subwatersheds in high aquatic habitat capacity are projected to increase 87 percent under Alternative S1, 105 percent under Alternative S2, and 70 percent under Alternative S3. Mean probability for aquatic habitat capacity in high status also would increase over current conditions for all alternatives, with Alternative S2 having the highest increase followed by Alternative S1 and Alternative S3. Alternative S2 would result in more benefit to redband trout habitat than Alternative S1. Alternative S3 would result in slightly less benefit than Alternative S1.

In summary, all alternatives would produce positive trends in population status and habitat condition when compared to current conditions over the long term on Forest Service- and BLM-administered lands. Therefore, it is expected that redband trout would persist under all alternatives. Outcomes for Alternative S2 consistently display more improvement in population status and habitat than the other alternatives. Outcomes for Alternative S1 would be slightly greater than Alternative S3. Alternative S2 would result in the strongest improvement because of a greater emphasis on conservation and restoration provided by the A1 / A2 subwatersheds, RCA management direction, and restoration priorities compared to Alternative S1. Alternative S3 generally would result in the least improvement because of the uncertainty associated with implementation of EAWS and lower amount of protection provided by RCAs.

All alternatives are likely to conserve and strengthen the core of the redband trout distribution within the analysis area. Positive trends are also expected in depressed portions of the species distribution. These trends suggest that some rebuilding may be expected in the southern portions of the species distribution. Alternative S2 would produce the strongest trend

"Strong" Populations

For this discussion, 'strong' populations or 'stronghold' subwatersheds for key salmonids have the following characteristics:

1. All major life-history forms that historically occurred within the subwatershed are present;
2. Numbers are stable or increasing and the local population is likely to be at half or more of its historical size or density;
3. The population or metapopulation within the subwatershed, or within a larger region of which the subwatershed is a part, probably contains at least 5,000 individuals or 500 adults.

compared to the other alternatives. Each alternative is expected to strengthen and improve the fringe distribution, expecially Alternative S2.

Steelhead

Over the long term, model results indicate a slight positive trend from current conditions for strong status under all alternatives (Table 4-29). Since the number of strong subwatersheds is so low, the percentage changes in counts among the alternatives and current conditions are not meaningful. Counts for strong would show an increase of eight subwatersheds for all alternatives. Mean probability of strong status would increase eight percent under Alternative S2 and approximately six percent under Alternatives S1 and S3. Relatively, Alternative S2 would result in more benefit to strong status than Alternative S1. Alternatives S3 and S1 are expected to result in similar benefits to strong steelhead status.

The projected counts of steelhead presence would not vary among the alternatives and current conditions (Table 4-29). Changes in mean probability of presence would increase approximately two percent under all alternatives.

Much different than population status outcomes, high habitat capacity is projected to substantially increase for steelhead under all alternatives compared to current conditions over the long term (Table 4-29). Subwatersheds in high aquatic habitat capacity are projected to increase 47 percent under Alternative S1, 45 percent under Alternative S2, and 34 percent under Alternative S3. Mean probability of high habitat capacity also would increase over current conditions for all alternatives, with Alternative S2 having the highest increase followed by Alternative S1 and Alternative S3. Although Alternative S2 would have fewer subwatersheds classified as high capacity, mean probabilities indicate a stronger trend and thus more benefit than Alternative S1. Outcomes for Alternative S3 would be less than Alternative S1 and are expected to result in less benefit to steelhead habitat.

Although steelhead habitat capacity would improve substantially under all alternatives, population status outcomes reflect minor or no improvement because of the many physical and biological constraints and uncertainty associated with the steelhead life cycle. The greatest uncertainty is associated with migration corridor survival, especially for populations above several dams in the Snake River and upper Columbia River. Management of habitat on Forest Service- and BLM- administered lands is expected to play a major but not exclusive role in the future status of the species. Rehabilitation of depressed populations above several dams cannot be accomplished via federal habitat improvement alone but will require improvements in migration corridor survival (Marmorek et al. 1998) and efforts to address causes of mortality in other life stages (Lee et al. 1997). However, securing and restoring federal freshwater habitat may be critical to the short-term persistence of many steelhead populations (Lee et al. 1997). Trends in improving strong status and habitat associated with Alternative S2 are larger than those in Alternatives S1 and S3 and thus are expected to result in more favorable conditions supporting the persistence of steelhead.

Stream-Type Chinook Salmon

Projected trends for stream-type chinook salmon over the long term indicate positive trends from current conditions for strong status under all alternatives (Table 4-29). Because the number of strong subwatersheds is so low, a percent change comparison among the alternatives and current conditions is not meaningful. Counts for strong show an increase of two subwatersheds for Alternative S1, and three subwatersheds for Alternatives S2 and S3. Mean probability of strong status would increase nine percent under Alternative S2 and approximately seven percent under Alternatives S1 and S3. Relatively, Alternative S2 would result in more benefit to strong status than Alternative S1. Alternatives S3 and S1 are expected to result in similar benefits to strong stream-type chinook status.

The projected counts of stream-type chinook presence do not vary among the alternatives and current conditions (Table 4-29). Changes in mean probability of presence would increase approximately two to three percent under all alternatives, with Alternative S2 projected to result in the most improvement.

Similar to steelhead effects, high habitat capacity is projected to substantially increase under all alternatives compared to current conditions over the long term (Table 4-29). Subwatersheds in high aquatic habitat capacity are projected to increase 42 percent, 40 percent, and 30 percent for Alternatives S1, S2, and S3, respectively. Mean probability high habitat capacity also increases over current conditions for all alternatives, with Alternative S2 having the highest increase followed by Alternative S1 and Alternative S3. Although Alternative S2 would have fewer subwatersheds classified as high capacity, mean probabilities indicate a stronger trend and thus more benefit than Alternative S1. Outcomes for Alternative S3 would be less than Alternative S1 and are expected to result in less benefit to stream-type chinook.

Similar to steelhead, habitat capacity for stream-type chinook would improve substantially under all alternatives, yet population status outcomes reflect minor or no improvement. Like steelhead, population status outcomes reflect the many biological constraints which influence survival throughout the stream-type chinook life cycle. A major uncertainty is associated with migration corridor survival, especially for populations above several dams in the Snake River and upper Columbia River. These populations are more likely to be absent in the future than those populations in downstream areas (such as the middle Columbia). Similar to steelhead, management of habitat on Forest Service- and BLM-administered lands is expected to play a major but not exclusive role in the future status of stream-type chinook. Rehabilitation of depressed populations above several dams cannot be accomplished via federal habitat improvement alone but will require improvements in migration corridor survival (Marmorek et al. 1998) and efforts to address causes of mortality in other life stages (Lee et al. 1997). However, securing and restoring federal freshwater habitat may be critical to the short-term persistence of many stream-type chinook populations (Lee et al. 1997). Trends in improving strong status and habitat associated with Alternative S2 would be larger than those in Alternatives S1 and S3, and thus are expected to result in more favorable conditions supporting the persistence of stream-type chinook.

Narrow Endemic and Sensitive Native Fish

As mentioned previously, the SAG did not attempt to model the effects of changes in habitat capacity on these sensitive species because the specific environmental requirements of these species are largely unknown. The trends presented are useful for considering the implications of the alternatives on these species. The SAG did not interpret these trends because the implied changes or interactions with other species that respond to changes in habitat may be positive for some species and negative for others. However, the summary is useful for determining which species may experience relatively large or minor changes as compared to current conditions.

Long-term trends in habitat capacity would be positive under all alternatives in areas associated with the 17 species (Table 4-30). The greatest increases in habitat capacity occurred in Alternative S2 (11 species) followed by Alternative S1 (6 species). Alternative S3 never resulted in the most improvement for a species among the alternatives.

Only widely distributed threatened and endangered aquatic species were selected by SAG for in-depth effects analysis.

Threatened and Endangered Aquatic Species

Only widely distributed threatened and endangered aquatic species were selected by SAG for in-depth effects analysis. Those federally listed species occurring on more than one national forest or BLM district and affected by land management activities and having sufficient information on life history and habitat requirements were selected for analysis. These species include bull trout, steelhead (Upper Columbia, Middle Columbia, and Snake River), and chinook salmon (Upper Columbia spring, Snake River spring/summer). Similar information as the preceding sections is presented below for each of these species, but the information is summarized here by specific geographic areas that correspond to the range of listed species or stocks. This summarized informa-

Table 4-30. Relative Ranking of Mean Probabilities for High Habitat Capacity in Areas Associated with the Distribution of 17 Sensitive Native Fishes over the Long Term.

		Alternative	
Species	**S1**	**S2**	**S3**
Goose Lake Sucker	3	1	2
Klamath Largescale Sucker	2	1	3
Lahontan Cutthroat Trout	1	2	3
Leatherside Chub	3	1	2
Lost River Sucker[1]	1	2	2
Malheur Sculpin	3	1	2
Margined Sculpin	2	1	3
Oregon Lakes Tui Chub	3	1	2
Pacific Lamprey	2	1	3
Pit-Klamath Brook Lamprey	2	1	3
Pygmy Whitefish	1	2	3
Shorthead Sculpin	2	1	3
Shortnose Sucker	1	2	3
Slender Sculpin	1	2	3
Torrent Sculpin	2	1	3
Warner Sucker	1	2	3
Wood River Sculpin	2	1	3

A ranking of “1” indicates the alternative with the highest probability for high habitat capacity.

[1] Alternative S2 and S3 would have the same outcome.

Source: Rieman et al. 1999.

tion is based on the evaluation performed by SAG. The remaining 10 listed species would be best addressed by individual administrative units through existing programmatic and site-specific planning and analyses processes.

Under the Endangered Species Act, federal activities that may have an effect on threatened, endangered, or proposed species are subject to consultation with the U.S. Fish and Wildlife Service or National Marine Fisheries Service. Requirements for consultation would remain in effect under any selected alternative.

Bull Trout

Predicted bull trout population status and habitat capacity in the different geographic areas were similar to those summarized previously for bull trout project area-wide. The trends were generally positive for all alternatives when compared to current conditions (Table 4-31). The largest increases in population outcomes were associated with geographic areas that currently support populations in relatively good condition, such as the Snake River and Upper Columbia River geographic areas. SAG concluded that trends in the Middle Columbia geographic area are not meaningful because most of the potential spawning and rearing habitat is excluded from the project area. Overall, Alternatives S1 and S2 generally would have similar outcomes, while Alternative S3 projections tend to show less improvement than Alternatives S1 and S2. Reasons for the outcomes are similar to those described previously for bull trout.

Steelhead

In all geographic areas, with the exception of the Middle Columbia, there were no changes in the summary counts for strong or present classes and no or slight improvement in probabilities for both classes under all alternatives when compared to current conditions (Table 4-31). Summary counts for strong status indicate an increase of 11 subwatersheds for the Middle Columbia for all alternatives. Probabilities for the strong and present class in the Middle Columbia were projected to slightly increase under all alternatives. The projected population status improvement in the Middle Columbia area is a reflection of predicted improvements in habitat capacity and the lower number of dams (3) steelhead pass en route to spawning and rearing habitat in this area as compared to the other two areas (5 or more dams). The future status of steelhead in the Middle Columbia is more secure and less uncertain than the populations in the two areas upstream.

Habitat capacity estimates indicated a larger improvement than population status projections for all areas under all alternatives as compared to current conditions (Table 4-31). Reasons for this trend are similar to those described previously for steelhead basin-wide. Alternative S2 is predicted to result in greater improvement than Alternative S1 in areas with large amounts of potential spawning and rearing habitat. Alternative S3 would result in less improvement than Alternative S1 except for the Middle Columbia ESU. Reasons for the outcomes are similar to those described previously for steelhead.

Stream-Type Chinook

Model estimates indicate that under all alternatives there would be no change in strong or present summary counts and no or slight improvement in probabilities for both classes as compared to current in all areas except the Middle Columbia (Table 4-31). As compared to current conditions, summary counts for strong status increased by three subwatersheds in Alternative S1 and four subwatersheds in Alternatives S2 and S3 in the Middle Columbia. Summary counts for present did not change from current under all alternatives in the Middle Columbia. Probabilities for the strong and present class in the Middle Columbia were projected to slightly increase under all alternatives. The projected population status improvement in the Middle Columbia area is a reflection of predicted improvements in habitat capacity and the lower number of dams (3) stream-type chinook pass en route to spawning and rearing habitat in this area as compared to the other two areas (5 or more dams). The future status of stream-type chinook in the Middle Columbia is more secure and less uncertain than the populations in the two areas upstream.

Habitat capacity estimates indicated a larger improvement than population status projections for all areas under all alternatives as compared to current conditions (Table 4-31). Reasons for this trend are similar to those described previously for stream-type chinook basin-wide. Alternative S2 is predicted to result in greater improvement than Alternative S1 in areas with large amounts of potential spawning and rearing habitat. Alternative S3 would result in less improvement than Alternative S1 except for the Middle Columbia ESU. Reasons for the outcomes are similar to those described previously for stream-type chinook.

Cumulative Effects on Aquatic Species

Non-federal Habitat

Management of federal habitat for the six species analyzed in depth is expected to play a major although not exclusive role in their future status. Approximately 22 percent of the expected present distribution of bull trout, 28 percent of westslope cutthroat trout, 78 percent of Yellowstone cutthroat trout, 47 percent of redband trout, 43 percent of steelhead, and 27 percent of stream-type chinook salmon occur on *non*-federal lands within the project area.

No alternative specifically addresses the role of non-federal lands with the respect to aquatic ecosystems. Most states within the project area have developed or are in the process of developing conservation plans (such as the Oregon Plan, the Washington Statewide Strategy To Recover Salmon, the Montana Bull Trout and Westslope and Yellowstone Cutthroat Trout Conservation Plans, and the Idaho Bull Trout Plan) and revising land use regulations to address at-risk aquatic species. In addition, many tribal governments within the project area have developed aquatic conservation and restoration strategies (such as *Wy-Kan-Ush-Mi Wa-Kish-Wit* [Columbia River Intertribal Fish Commission 1995]). Because of these efforts, the SAG assumed that aquatic habitat on non-federal lands would remain stable or slightly improve over the long term. However, the rate and extent of improvement are expected to be much lower than that projected for the alternatives for federal lands. Generally, habitat quality tends to be lower on non-federal lands compared to federal lands within the project area (Lee et al. 1997). Some of these conditions (such as high stream temperatures, dewatering, migration barriers) found on non-federal lands may limit the potential effectiveness of habitat conserva-

Table 4-31. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capacity for Specific Geographic Areas Within the Distribution of Federally Listed Bull Trout, Steelhead, and Chinook Salmon. Results Represent Effects over the Long Term.

Species	Current[1]	Alternative S1	S2	S3
Bull Trout				
Snake River Geographic Area				
Strong				
Count[2]	222	250	252	247
Relative Change (%)[3]		12.6	13.5	11.3
Relative Benefit (%)[4]			7.1	**-10.7**[5]
Mean Probability[6]	0.216	0.233	0.234	0.231
Relative Change (%)		8.1	8.5	7.3
Relative Benefit (%)			4.9	**-9.6**
Presence				
Count	662	684	683	678
Relative Change (%)		3.3	3.2	2.4
Relative Benefit (%)			**-4.5**	**-27.3**
Mean Probability	0.509	0.527	0.528	0.525
Relative Change (%)		3.7	3.8	3.1
Relative Benefit (%)			2.4	**-15.0**
High Habitat Capacity				
Count	657	943	898	839
Relative Change (%)		43.5	36.7	27.7
Relative Benefit (%)			**-15.6**	**-63.8**
Mean Probability	0.403	0.465	0.467	0.456
Relative Change (%)		15.4	15.9	13.2
Relative Benefit (%)			3.2	**-14.3**
Lower Columbia River Geographic Area				
Strong				
Count	2	2	2	2
Relative Change (%)		0.0	0.0	0.0
Relative Benefit (%)			0.0	0.0
Mean Probability	0.096	0.104	0.105	0.103
Relative Change (%)		8.2	9.3	7.4
Relative Benefit (%)			13.3	**-9.9**
Presence				
Count	53	55	56	55
Relative Change (%)		3.8	5.7	3.8
Relative Benefit (%)			1.5	0.0
Mean Probability	0.311	0.322	0.324	0.321
Relative Change (%)		3.5	4.1	3.4
Relative Benefit (%)			16.2	**-5.3**
High Habitat Capacity				
Count	24	45	48	45
Relative Change (%)		87.5	100.0	87.5
Relative Benefit (%)			14.3	0.0
Mean Probability	0.349	0.408	0.428	0.414
Relative Change (%)		16.9	22.6	18.6
Middle Columbia River Geographic Area				
Strong				
Count	1	1	1	1
Relative Change (%)		0.0	0.0	0.0
Relative Benefit (%)			0.0	0.0
Mean Probability	0.078	0.083	0.083	0.082
Relative Change (%)		6.4	6.4	5.1
Relative Benefit (%)			0.0	**-20.4**

Table 4-31. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capacity for Specific Geographic Areas Within the Distribution of Federally Listed Bull Trout, Steelhead, and Chinook Salmon. Results Represent Effects over the Long Term. (continued)

Species	Current[1]	S1	Alternative S2	S3
Presence				
Count	8	8	8	8
Relative Change (%)		0.0	0.0	0.0
Relative Benefit (%)			0.0	0.0
Mean Probability	0.247	0.254	0.253	0.252
Relative Change (%)		2.8	2.4	2.0
Relative Benefit (%)			**-14.3**	**-28.6**
High Habitat Capacity				
Count	0	10	7	4
Relative Change (%)		NA	NA	NA
Relative Benefit (%)			**-30.0**	**-60.0**
Mean Probability	0.278	0.361	0.341	0.325
Relative Change (%)		29.8	22.6	16.9
Relative Benefit (%)			**-24.2**	**-43.3**
Upper Columbia River Geographic Area				
Strong				
Count	77	89	87	87
Relative Change (%)		15.6	13.0	13.0
Relative Benefit (%)			**-16.7**	**-16.7**
Mean Probability	0.153	0.164	0.163	0.160
Relative Change (%)		7.3	6.5	4.5
Relative Benefit (%)			**-10.7**	**-38.4**
Presence				
Count	467	486	486	479
Relative Change (%)		4.1	4.1	2.6
Relative Benefit (%)			0	**-36.8**
Mean Probability	0.432	0.446	0.444	0.440
Relative Change (%)		3.3	2.8	1.7
Relative Benefit (%)			**-15.0**	**-48.0**
High Habitat Capacity				
Count	291	518	494	355
Relative Change (%)		78.0	69.8	22.0
Relative Benefit (%)			**-10.6**	**-71.8**
Mean Probability	0.372	0.428	0.423	0.401
Relative Change (%)		15.1	13.7	7.8
Relative Benefit (%)			**-9.3**	**-48.3**
Steelhead				
Snake River				
Strong				
Count	0	0	0	0
Relative Change (%)		NA	NA	NA
Relative Benefit (%)			NA	NA
Mean Probability	0.075	0.079	0.079	0.079
Relative Change (%)		5.3	5.3	5.3
Relative Benefit (%)			0	0
Presence				
Count	101	101	101	101
Relative Change (%)		1.0	1.0	1.0
Relative Benefit (%)			0	0
Mean Probability	0.325	0.331	0.332	0.331
Relative Change (%)		2.0	2.4	2.0
Relative Benefit (%)			20	0

Table 4-31. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capacity for Specific Geographic Areas Within the Distribution of Federally Listed Bull Trout, Steelhead, and Chinook Salmon. Results Represent Effects over the Long Term. (continued)

Species	Current[1]	Alternative S1	Alternative S2	Alternative S3
High Habitat Capacity				
Count	460	627	597	561
Relative Change (%)		36.3	29.8	22.0
Relative Benefit (%)			**-17.9**	**-39.4**
Mean Probability	0.413	0.474	0.477	0.467
Relative Change (%)		14.8	15.5	13.1
Relative Benefit (%)			4.7	**-11.5**
Middle Columbia River				
Strong				
Count	8	19	19	19
Relative Change (%)		137.5	137.5	137.5
Relative Benefit (%)			0.0	0.0
Mean Probability	0.261	0.272	0.275	0.273
Relative Change (%)		4.3	5.5	4.7
Relative Benefit (%)			27.1	8.4
Presence				
Count	397	397	397	397
Relative Change (%)		0	0	0
Relative Benefit (%)			0	0
Mean Probability	0.648	0.655	0.657	0.655
Relative Change (%)		1.1	1.4	1.1
Relative Benefit (%)			26.6	0
High Habitat Capacity				
Count	26	79	98	85
Relative Change (%)		203.8	276.9	226.9
Relative Benefit (%)			35.8	11.3
Mean Probability	0.308	0.371	0.403	0.384
Relative Change (%)		20.4	30.8	24.6
Relative Benefit (%)			51.0	20.6
Upper Columbia River				
Strong				
Count	0	0	0	0
Relative Change (%)		NA	NA	NA
Relative Benefit (%)			NA	NA
Mean Probability	0.085	0.089	0.089	0.089
Relative Change (%)		4.7	4.7	4.7
Relative Benefit (%)			0	0
Presence				
Count	6	6	6	6
Relative Change (%)		0	0	0
Relative Benefit (%)			0	0
Mean Probability	0.291	0.295	0.295	0.294
Relative Change (%)		1.3	1.3	1.0
Relative Benefit (%)			0	**-23.1**
High Habitat Capacity				
Count	1	8	6	4
Relative Change (%)		700.0	500.0	300.0
Relative Benefit (%)			**-28.6**	**-57.2**
Mean Probability	0.316	0.393	0.373	0.360
Relative Change (%)		24.3	18.0	13.9
Relative Benefit (%)			**-26.0**	**-42.8**

Table 4-31. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capacity for Specific Geographic Areas Within the Distribution of Federally Listed Bull Trout, Steelhead, and Chinook Salmon. Results Represent Effects over the Long Term. (continued)

Species	Current[1]	S1	Alternative S2	S3
Stream Type Chinook Salmon				
Snake River				
Strong				
Count	0	0	0	0
Relative Change (%)		NA	NA	NA
Relative Benefit (%)			NA	NA
Mean Probability	0.085	0.089	0.089	0.089
Relative Change (%)		4.7	4.7	4.7
Relative Benefit (%)			0	0
Presence				
Count	6	6	6	6
Relative Change (%)		0	0	0
Relative Benefit (%)			0	0
Mean Probability	0.291	0.295	0.295	0.294
Relative Change (%)		1.3	1.3	1.0
Relative Benefit (%)			0	**-23.1**
High Habitat Capacity				
Count	463	625	603	563
Relative Change (%)		35.0	30.0	21.6
Relative Benefit (%)			**-14.3**	**-38.3**
Mean Probability	0.417	0.477	0.481	0.470
Relative Change (%)		14.4	15.3	12.7
Relative Benefit (%)			6.3	**-11.8**
Middle Columbia River				
Strong				
Count	3	6	7	7
Relative Change (%)		100.0	133.3	133.3
Relative Benefit (%)			33.3	33.3
Mean Probability	0.156	0.165	0.168	0.166
Relative Change (%)		5.8	7.7	6.4
Relative Benefit (%)			32.8	10.3
Presence				
Count	134	134	134	134
Relative Change (%)		0	0	0
Relative Benefit (%)			0	0
Mean Probability	0.486	0.492	0.493	0.492
Relative Change (%)		1.2	1.5	1.2
Relative Benefit (%)			25	0
High Habitat Capacity				
Count	19	56	67	58
Relative Change (%)		194.7	252.6	205.3
Relative Benefit (%)			29.7	5.4
Mean Probability	0.317	0.381	0.412	0.394
Relative Change (%)		20.2	30.0	24.3
Relative Benefit (%)			48.5	20.3
Upper Columbia River (spring chinook)				
Strong				
Count	0	0	0	0
Relative Change (%)		NA	NA	NA
Relative Benefit (%)			NA	NA
Mean Probability	0.035	0.036	0.036	0.036
Relative Change (%)		2.9	2.9	2.9
Relative Benefit (%)			0	0

Table 4-31. Counts and Mean Probabilities for Strong Status, Presence, and High Habitat Capacity for Specific Geographic Areas Within the Distribution of Federally Listed Bull Trout, Steelhead, and Chinook Salmon. Results Represent Effects over the Long Term. (continued)

Species	Current[1]	S1	Alternative S2	S3
Presence				
Count	0	0	0	0
Relative Change (%)		NA	NA	NA
Relative Benefit (%)		NA	NA	NA
Mean Probability	0.160	0.163	0.163	0.162
Relative Change (%)		1.9	1.9	1.8
Relative Benefit (%)			0	**-5.3**
High Habitat Capacity				
Count	3	6	5	5
Relative Change (%)		100.0	66.7	66.7
Relative Benefit (%)			**-33.3**	**-33.3**
Mean Probability	0.401	0.459	0.448	0.440
Relative Change (%)		14.5	11.7	9.7
Relative Benefit (%)			**-19.3**	**-33.1**

[1] Current conditions represent projection of conditions equivalent to those present in 1994.
[2] Counts represent the number of subwatersheds projected to be in a particular state within potential spawning and rearing habitat for the species.
[3] Relative change was calculated as the percent increase over base.
[4] Relative benefit is the percentage increase (+) or decrease (-) of the relative change of Alternatives S2 and S3 compared to the relative change of the no action alternative.
[5] Bolded values represent a decline from either base or S1 conditions.
[6] Mean probability is the mean for all subwatersheds.

Source: Rieman et al. 1999.

tion and restoration projected for the alternatives on federal lands.

Non-native Fish Species

The influence of exotic species is another factor over which the BLM and the Forest Service have little management authority but which could potentially limit the effectiveness of habitat improvements under the alternatives. Numerous exotic aquatic species exist within the project area. Generally these species hybridize or compete with native species, reducing genetic purity and displacing them from available habitat. States and tribes have management authority over these populations. The widespread distribution of some exotic species within native fish habitat, and the high value fishery some of these populations support, are problematic. States and tribes have targeted eradication of some local populations of exotic fish species under their conservation plans. A key component to increase the effectiveness of habitat restoration and limit the spread of undesirable exotic aquatic species on BLM- and Forest Service-administered land is collaboration, which is an emphasis of the action alternatives. Early interaction and sharing of information among the responsible agencies would ensure that habitat restoration treatments on federal land: (1) are properly planned, and (2) maintain or reduce the effect of undesirable exotic species. Similarly, all alternatives as well as existing MOUs emphasize that BLM and Forest Service field units provide information regarding state or tribal decisions on fish stocking.

Factors Affecting Anadromous Fish

The most complex and contentious cumulative effects issue relates to restoration of anadromous fish stocks within the project area. The complexity of the anadromous fish life cycle exposes them to many factors influencing their abundance. Human activities have altered anadromous fish environments leading to widespread declines. These activities are commonly referred to as the 'All Hs'—hydropower, hatcheries, harvest, and habitat. Debate has centered on these four categories relative to their contribution to the overall decline in anadromous fish stocks. Regarding the relative influences of habitat and hydropower on the Snake and Columbia rivers, declines in fish stocks are least attributable to freshwater habitat in the less disturbed areas in central Idaho and the northern Cascades; in these areas, hydropower has the greatest influences on anadromous fish because of the numerous dams below spawning and rearing habitat, which affects migrant survival (Lee and Rieman 1996). Conversely, habitat influences are greater and hydropower effects are less in the middle Columbia area, where there are fewer dams.

Habitat quality is vital to the persistence of anadromous fish stocks. All alternatives would substantially increase the likelihood of high quality habitat, with Alternative S2 having the highest probability. However, steelhead and stream-type chinook population outcomes would only slightly improve, mainly because of uncertainty associated with survival of anadromous fish through the migratory corridor. Influences of hatcheries and harvest on future population status were not modeled by SAG.

The SAG analyzed anadromous fish population outcomes relative to habitat improvements achieved by the alternatives, both with and without an added scenario of improved migrant survival equivalent to a reduction in mortality caused by the lower four Snake River dams. In this scenario, the relative ranking of alternatives did not change (Alternative S2 greater than Alternative S1 greater than Alternative S3) but the magnitude of change in strong populations and, particularly, population presence increased on federal lands (Table 4-32). This indicates a 7- to 10-fold increase in population presence, possibly leading to some rebuilding of anadromous fish stocks on federal lands under all three alternatives if migrant survival were addressed as part of a comprehensive recovery effort. If these conditions are not improved, it is probable that many remaining stocks of anadromous

Table 4-32. Comparison of Counts[1] and Mean Probabilities[2] for Strong Status and Presence for Steelhead and Stream-type Chinook on Federal Lands over the Long Term under Conditions Projected for the Alternatives With and Without Improved Migratory Corridor Survival in the Lower Snake River.

	Projections *Without* Improved Migratory Survival in the Lower Snake River Alternative			Projections *With* Improved Migratory Survival in the Lower Snake River Alternative		
Species	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**
Steelhead						
Strong						
Count	14	14	14	33	33	33
Mean Probability	0.111	0.112	0.111	0.283	0.285	0.281
Presence						
Count	101	101	101	758	759	758
Mean Probability	0.331	0.332	0.331	0.652	0.653	0.651
Stream-Type Chinook Salmon						
Strong						
Count	4	5	5	4	5	5
Mean Probability	0.057	0.058	0.057	0.165	0.167	0.165
Presence						
Count	50	50	50	524	524	522
Mean Probability	0.207	0.208	0.207	0.496	0.497	0.495

[1] Counts represent the number of subwatersheds projected to be in a particular state within potential spawning and rearing habitat for the species.
[2] Mean probability is the mean for all subwatersheds.

Source: Rieman et al. 1999.

fish will continue to decline over the long term even with improved federal habitat conditions. In Alternatives S2 and S3, aquatic abitat restoration priorities targeted for anadromous fish upstream of several dams may be reconsidered by decision makers in the future if other mortality sources are not decreased, in order to maximize the effectiveness of habitat restoration investments.

Since publication of the Draft EISs, additional efforts have been made to evaluate mortality contributions related to the 'All Hs,' particularly for Snake River anadromous fish. Most of these studies have focused on the lower Snake River hydrosystem. The Plan for Analyzing and Testing Hypotheses (PATH; Marmorek et al. 1998) evaluated several management options related to hydrosystem operation to enhance recovery of anadromous fish stocks within the Snake River basin. In addition, they conducted sensitivity analyses on the effects of changes in habitat and harvest in relation to the hydrosystem alternatives. Results indicate that hydrosystem options containing scenerios of natural drawdown of the four lower Snake River dams would produce higher biological benefits to anadromous fish than other options. PATH's habitat sensitivity analysis indicated that habitat improvements would result in minor benefits to Snake River spring/summer chinook when comparing hydrosystem options of current condition, current condition plus maximum transport, and natural drawdown of the lower four Snake River dams. Harvest analysis results were dependent on the amount of reduced harvest, harvest schedule, and run size.

Using PATH results and additional information, the National Marine Fisheries Service (NMFS) produced a draft appendix ("A Fish Appendix" [USDC/NMFS 1999]) to the Army Corps of Engineers' Lower Snake River Juvenile Salmonid Migration Feasibility Study. This draft appendix evaluates management alternatives for the four lower Snake River dams in the context of providing for threatened and endangered anadromous fish. NMFS concluded in the draft report that breaching the lower four Snake River dams is more likely than any other hydrosystem management alternative to meet survival and recovery critieria for listed anadromous fish and is the most risk-averse strategy. However, they stated that there are sets of assumptions under which breaching yields little or no improvement over transportation, especially if delayed mortality of transported fish is low.

A draft EIS is being prepared by the Corps of Engineers evaluating several lower Snake River hydrosystem management options. The draft EIS is expected to be complete in December 1999.

Three additional efforts are being developed to address anadromous fish recovery in the Northwest:

- The *Multispecies Framework* directed by the Northwest Power Planning Council is an effort to provide context for decisions concerning multiple species recovery in the Columbia River Basin. The Framework identifies seven broad alternatives for future river management addressing a range of environmental and economic issues. A draft Framework report is expected in late 1999.
- A *paper on the 'All Hs'* (hydropower, hatcheries, harvest, and habitat; see Chapter 2) is being developed by nine federal agencies responsible for anadromous fish management. This is a conceptual document that explores alternative actions to recovery of ESA-listed species, organized around the four factors which affect the life cycle of anadromous fish. It consolidates information from the Framework report. The intent is to develop a conceptual recovery plan that could guide future federal actions. The paper examines several basic options for future management in each of the 'All Hs'. Using these options, a set of integrated alternatives is developed, mixing and matching the various options. These integrated alternatives are intended to illustrate the type of integrated strategies that will be required for successful recovery. They are not presented, however, as the exclusive set of packages that are possible. The goal is to stimulate discussion of what the region can do to recover salmon, steelhead, and other aquatic species. A draft document is expected to be completed in late 1999 or early 2000.
- The *Cumulative Risk Initiative (CRI)* is being developed by NMFS. The CRI is an analytical framework that integrates all risk factors associated with the 'All Hs' across anadromous fish populations and multiple species. A main goal of CRI is to provide decision support for recovery options. The intial round of CRI results should be completed near the end of 1999 or the beginning of 2000. Some preliminary analyses have been conducted for Snake River anadromous fish (NMFS, November 17, 1999, Draft; CRI Assess-

ment of Management Actions Aimed at Snake River Salmonids). From the perspective of extinction risks alone for Snake River fall chinook and steelhead, it appears that harvest reductions would be adequate to sufficiently increase annual population growth rates. It also appears that modest survival improvements due to dam breaching could accomplish the same goals. In addition, dam breaching would also increase the availability of habitat (and thus carrying capacity) for fall chinook, whereas harvest reductions have no such possibility. The situation for Snake River spring/summer chinook is more complicated. Preliminary results indicate that dam breaching alone would not recover Snake River spring/summer chinook salmon unless very optimistic scenarios were assumed about survival below Bonneville Dam. For aggressive habitat management and other management actions alone to be sufficient for recovery, magnitudes of habitat improvements that are not known to be achievable would have to be assumed, as well as reductions in predation effects for which little data exist. When viewed separately, neither breaching nor habitat/harvest action would have effects on population that are likely to recover Snake River spring/summer chinook salmon. Only in combination would these actions produce an increase in population growth that is close to what is needed for recovery.

As concluded by most of the above efforts, there is no simple answer but only tradeoffs between potential risks and benefits for anadromous fish recovery within the interior Columbia Basin. Learning more and gathering additional information on uncertainities prior to decisions on a comprehensive plan would entail delays, potentially increasing risk of short-term extinction of some anadromous fish populations. All alternatives, especially Alternative S2, would provide protection and restoration of key habitats supporting anadromous fish on federal lands and would contribute to increasing the short-term persistence of anadromous fish. However, rebuilding and long-term persistence will depend on reducing mortality from other factors.

Social–Economic–Tribal Component

This section presents the effects of the alternatives on social-economic considerations and on federal trust responsibility and tribal rights and interests. A summary of key effects and conclusions for both subject areas is presented first. Each subject area then begins with methods of estimating effects, followed by the effects of the alternatives.

Summary of Key Effects and Conclusions

The effects analysis on biophysical resources differs from the socio-economic effects analysis in that most of the biophysical analysis focuses on the long term (100 years) while the socio-economic analysis is more concerned with the short term (10 years). It is clear that the first priority of Alternatives S2 and S3 is restoration of ecosystems and watersheds. However, along with ecological benefits, restoration activities also make an important human contribution through generating employment and economic activities. Overall, Alternative S2 would be best for tribal rights and interests, with Alternative S3 next and Alternative S1 last.

In the first decade, within the project area, livestock grazing on BLM- and Forest Service-administered lands and the number of related jobs would decline most under Alternative S2, followed by Alternative S3. Conversely, first-decade increases in timber volume, forest and rangeland recreation activities, and related jobs are expected to be felt slightly higher under Alternative S2 than Alternative S3. Alternative S1 is expected to hold livestock grazing, timber volumes, restoration, and jobs related to federal land outputs, at near current levels. No broad-scale changes are predicted for levels of recreation and related jobs. In general, economic and social effects at the broad scale would be small. However, this may not be true for geographically isolated communities whose economies are specialized in sectors that depend on outputs from federal lands. In these places, adverse economic and social effects would likely be more pronounced if the levels of outputs and activities from BLM- and Forest Service-administered lands decline.

Social–Economic Considerations

- Timber harvest levels in the first decade are projected to increase at both the basin level and by all RAC / PACs as the consequence of implementation of either Alternative S2 or Alternative S3, compared to Alternative S1. Estimated increases would be just over 21 percent for Alternative S2 and just under 21 percent for Alternative S3. Harvest level increases would come primarily from commercial thinning and other harvest activity designed to promote ecosystem and forest stand restoration (stewardship harvest). While harvest levels would increase in Alternatives S2 and S3, the size and quality of logs produced would decrease because of the stand restoration objectives guiding the thinning and harvest activities. Thus, there is uncertainty about the actual commercial marketability of the volume of wood that is projected for harvest.
- Model projections indicate domestic livestock use of forage, as measured by Animal Unit Months (AUMs), could decline, both basin-wide and by all RAC / PACs (with one minor exception), in the first decade under either Alternative S2 or Alternative S3, compared to Alternative S1. The estimated decreases would be 10 percent for Alternative S2 and 11 percent for Alternative S3. Reductions in AUMs could result indirectly from objectives and standards to be implemented for watershed and rangeland protection and restoration, as well as directly from the continued historical trend of contraction of the livestock industry in the basin from other social, cultural and economic factors.
- Forest / woodland restoration activity (precommercial thinning and planting), measured in acres treated, would increase substantially in the first decade, by 40 percent for Alternative S2 and 36 percent for Alternative S3, compared to Alternative S1. There would be a modest increase in rangeland restoration and maintenance: nine percent for Alternative S2 and four percent for Alternative S3. With the focus on reducing forest and range susceptibility to uncharacteristic wildfire, and the threats to the urban / rural /

wildland interface, there would be large increases in acres treated by prescribed fire and fuels management in the first decade compared to Alternative S1: seven-fold for Alternative S2 and five-fold for Alternative S3.

- Given the broad scale and refined focus of this analysis, there are no projections for changes in recreation use among the alternatives. Therefore, there are no expected changes in recreation-related employment among alternatives.
- Impacts on total basin-wide employment would be negligible—an increase of less than three-tenths of one percent of jobs in the first decade. However, local impacts, both positive and negative, could be much more significant, particularly for rural and tribal communities that are isolated and economically specialized in economic sectors dependent on goods and services from Forest Service- and BLM-administered lands.
- Average annual direct employment associated with Forest Service- and BLM-administered lands would increase by about 3,900 jobs for Alternative S2 and by a little over 3,100 jobs for Alternative S3, compared to Alternative S1. About 35 to 40 percent of the increase would be associated with stewardship timber harvest, and 60 to 65 percent associated with prescribed fire/fuels management. An increase of about 100 jobs per year in forest and rangeland restoration jobs would be matched by a decrease in grazing-related jobs.
- Specific effects of the alternatives on specific local communities or other areas smaller than the RAC/PACs (county, subbasin, community) cannot be measured directly because of the broad-scale nature of this analysis. However, it is likely that isolated and economically specialized communities would be more affected by changes in output and activity levels than communities that are not isolated or economically specialized. And it is likely that, where projected changes within a RAC/PAC are larger, those communities in counties with higher socio-economic resiliency would likely tend to manage change more readily than similar communities in counties where socio-economic resiliency is low.
- Under the action alternatives, restoration activity in the first decade would be focused on high restoration priority subbasins (which include a component of community economic need). Within those subbasins, activities would be first concentrated as near as possible to those isolated and economically specialized communities that are in greatest need of economic stimulus. Alternative S2 would have more acres of restoration and prescribed fire/fuels management work scheduled per year than would Alternative S3. In addition, the work in Alternative S2 would initially be concentrated in 40 high restoration priority subbasins, compared to 51 high restoration priority subbasins in Alternative S3. Therefore, it is expected that the direct community effects in high restoration priority subbasins would be less under Alternative S3 than under Alternative S2 because fewer acres would be treated across a larger area.
- Each of the three alternatives has a certain degree of uncertainty and unpredictability associated with it. The non-traditional broad-scale outcome-based objectives and standards in Alternatives S2 and S3—designed to achieve restoration and maintenance of sustainable ecosystems—have not been operationally tested at this scale before. Therefore, there is uncertainty about the levels of goods and services (timber harvest and grazing) that are projected, as well as the effectiveness of the proposed restoration activities in achieving the desired results. On the other hand, Alternative S1, with its continuation of varying management direction across the basin, and no systematic requirements for hierarchical ecosystem analysis (Subbasin Review or EAWS), also faces uncertainty in implementation. There would continue to be project-by-project and area-by-area consultation and mitigation requirements for protection of species listed under the Endangered Species Act (ESA), without broader scale context. Thus, for Alternative S1, the individual mitigation requirements may be more varied, and more restrictive in total, than the management direction, A1/A2/T habitat designations, and restoration focus of Alternatives S2 and S3.

Federal Trust Responsibility and Tribal Rights and Interests

- Generally, Alternatives S2 and S3 would provide the best approach to appropriate government-to-government consultation because of more consistent and effective consultation direction.
- Both Alternatives S2 and S3 would provide more opportunities for tribal involvement in both planning and decision-making processes than Alternative S1. Alternative S2, with more extensive requirements for analysis at finer scales, would provide increased opportunities for tribal involvement in planning processes over Alternative S3. While Alternative 3's increased emphasis on restoration actions near reservations and tribal communities may provide for greater consultation opportunities in project decision-making, the

difference is negligible since Alternative S2 would have more restorative actions overall. Therefore, Alternative S2 would likely provide more opportunities for tribal consultation and involvement than Alternatives S1 or S3.

- Alternative S2 appears to be most responsive to honoring the federal trust responsibility and consideration of tribal rights and interests because it would provide more upfront direction (processes and prescriptions) and therefore better certainty to tribes of consistent and accountable implementation.
- Alternatives S2 and S3 both would respond better than Alternative S1 to protection and/or restoration of identified species of interest to tribes, with Alternative S2 being somewhat more responsive than Alternative S3.
- Alternatives S2 and S3, because of their broad-scale landscape, terrestrial, aquatic, economic, and restoration strategies, appear most responsive to the restoration of ecological processes as well as consideration of tribal resource concerns. Alternative S3 would provide a better response than Alternative 2 to some social and economic concerns by emphasizing more high restoration priority subbasins that are also high priority tribal subbasins. However, Alternative S2, with a higher rate and intensity of restoration and more analysis to target restoration at lower scales, is predicted to be more responsive than Alternative S1 and somewhat more responsive than Alternative S3 in addressing most social and biophysical concerns.

Social and Economic Considerations

Methodology: How Social and Economic Effects Were Estimated

The main sources of information for evaluation of the effects of the alternatives in this Supplemental Draft EIS include: Socioeconomic Evaluation of the EIS Alternatives (Crone and Haynes 1999), the Economic and Social Conditions of Communities (ICBEMP 1998), and Developing Measures of Socioeconomic Resiliency in the Interior Columbia Basin (Horne and Haynes 1999). This section of Chapter 4 blends the findings of the economics and social science staffs of the Science Advisory Group with additional analysis and interpretation provided by the EIS Team.

Science Advisory Group Economics Evaluation

The SAG's landscape and modeling scientists estimated 10-year and 100-year outputs that are expected to be produced from the Supplemental Draft EIS alternatives. Outputs included forage for livestock grazing produced, measured as Animal Unit Months (AUMs); timber volume harvested; acres of forest/woodland and rangelands restoration; and acres of prescribed fire and fuels management treatments. The SAG's economics staff (Crone and Haynes 1999) analyzed and presented economic activity and estimated outputs related to implementation of the Supplemental Draft EIS alternatives, and they calculated employment that would be associated with those output and activity levels.

For this Supplemental Draft EIS, because of the broad scale of the analysis, there were no economic benefits or costs of production calculated, other than for budgeting purposes, and no economic efficiency analysis was undertaken.

Science Advisory Group/Science Integration Team Social Science Evaluation

The Science Integration Team social science staff evaluation conducted for the Draft EISs (Burchfield, Allen, and McCool 1997) was based primarily on information collected through a panel process set up to support a Social Impact Analysis. Three panels were conducted. Two separate panels for the two EIS planning areas consisted of a variety of interest groups, consultants, college professors, county commissioners, sociologists, community development specialists, and state representatives. The third panel consisted of representatives from 14 tribes in the project area. Social impact analyses are usually conducted for more site-specific projects where the scope of activities and their effects can be understood.

The broad-scale plan of the Draft EISs could not provide the understanding that panelists felt they needed to evaluate social effects, except in the broadest terms. Also, attempts by the panels to estimate social effects were impeded by minimal information about how plans would be implemented

Major Changes from the Draft EISs

Changes from the Draft EISs were made in the outputs (such as AUMs and board feet), activities, and economics sections, along with more information on potential effects on isolated and economically specialized communities and tribal communities.

The social effects for this Supplemental Draft EIS relies on, and is very similar to that of the Draft EISs, with additional discussions by the SAG economics and social staff on potential county and community effects, tribal concerns, and environmental justice. Outputs were estimated for the entire project area, as modified since the Draft EISs, and by RAC/PAC, which replaced Bureau of Economic Analysis economic subregions, or trade areas.

and what the economic impacts might be, and by questions of financial and operational feasibility of the alternatives.

Because the Supplemental Draft EIS is also at a broad scale, there was no more specific information on implementation and effects available than for the Draft EISs. The report by Reyna (1998) did provide additional current condition information at the community level, identifying and classifying communities in the basin according to their economic specialization and whether they are isolated or not isolated. This information, along with Horne and Haynes' (1999) work on socio-economic resiliency at the county level, provided a way for the SAG to include more discussion about possible effects of changing output and activity levels on rural and tribal isolated and economically specialized communities, and on factors that influence socio-economic resiliency over the long run. Information and assessments related to attitudes, beliefs, values, quality of life, lifestyle, and sense of place are essentially the same as for the Draft EISs.

Additional EIS Team Effects Evaluation

Factors used by both the SAG and the EIS Team to estimate effects included existing conditions, objectives, standards, and modeled management prescriptions.

The EIS Team economics staff used the evaluation from the SAG, along with the ICBEMP (1998) and Horne and Haynes (1999) reports to assess, in general terms, potential effects of the alternatives on local communities. Of particular interest were rural and tribal communities that are isolated and economically specialized in economic sectors that rely on resources from, or management of, federal lands.

The broad scale of the modeling and analysis means that management prescriptions in the model are not tied to specific locations within the basin. It is not appropriate, given the coarseness of the data base to estimate effects directly by administrative unit, subbasin, or a smaller unit. As such, the discussion of effects is of necessity relatively broad, and not site- or area-specific.

The EIS Team used a variety of information that relates RAC/PAC areas to counties, subbasins, and communities. The effects discussions at those levels provide general trends and likely potential consequences based on community types or groups. However, specific estimates of changes in outputs or activity levels for a particular county, administrative unit, or community will have to come during mid-scale analyses done during the step-down process (such as Subbasin Review and revision of Forest Service and BLM land use plans).

Effects of the Alternatives on Annual Level of Goods and Services

Outputs and activities were analyzed for the next 10 years (the short term). For the economic and social analyses, the output and activity levels projected from the CRBSUM model in the tenth decade were not carried forward into the environmental consequences chapter. It was felt that for economic and social conditions, any attempt to assess effects 100 years into the future would be misleading because of the many changes that occur to economies and societies over a century.

The effects on specific communities or counties from changing supplies of timber and forage for livestock grazing, as well as potential employment through restoration work, could not be predicted for reasons that have been previously described. However, the SAG and the EIS Team used a variety of information that relate RAC/PACs to counties, subbasins, and communities to provide general trends and potential consequences at the local level for groups or types of communities.

Levels of Outputs and Management Activities Expected from the Alternatives

While goods and services provided from Forest Service- and BLM-administered lands potentially represent a large array of benefits, five major outputs and activities are quantified here, including two commercially marketable outputs and three types of ecological restoration activity:

- Livestock animal unit months (AUMs), representing the number of domestic livestock that graze on Forest Service- and BLM-administered rangelands;
- Wood volume produced from timber harvest and vegetation management actions measured in millions of board feet (mmbf);
- Acres of forest/woodland restoration activity, including planting (reforestation) and precommercial thinning;
- Acres of rangeland restoration activity; and
- Acres of prescribed fire and fuels management treatments to restore vegetation conditions that more closely reflect historical ranges, and to reduce risk of uncharacteristically severe wildfires.

Table 4-33 displays the average annual amount of outputs and activities for each alternative for the first decade. Next, tables with outputs and activities by RAC/PAC are shown with discussions of each output or activity. Discussions address how output and activity levels were determined, the uncertainty associated with their production, and other factors relevant to interpreting effects of these expected numbers. Later in this section, estimates of employment associated with the output and activity levels are displayed for the project area and by RAC/PAC.

The first priority of Alternatives S2 and S3 is restoration of ecosystems and watersheds. Production of market and non-market (priced and non-priced) goods and services for human use (timber, domestic livestock grazing, recreation, minerals, etc.) is also an important consideration, but only within the capabilities and limits of healthy ecosystems.

In addition to the timber and livestock grazing benefits quantified above, other benefits would be provided through restoration activities designed to move current ecosystem conditions to the desired condition. The expected ecological outcomes from restoration activities are not easily quantified, either biophysically or economically; however, if they were successfully quantified they would show that valuable direct and indirect benefits (such as healthier plant and wildlife populations, cleaner water, cleaner air, lower soil productivity loss) would be provided. Along with ecological benefits, restoration activities also make an important human contribution through generating employment and economic activity.

Table 4-33. Estimated Average Annual Output/Activity Levels, by Alternative.[1]

Output or Activity (units)	Alternative S1	Alternative S2	Alternative S3
Animal Unit Months (AUMs)	3,111,000	2,798,000	2,765,000
Timber Harvest Volume (mmbf)	810	990	980
Forest/Woodland Restoration (acres)	142,000	199,000	192,000
Rangeland Restoration (acres)	3,074,000	3,339,000	3,183,000
Prescribed Fire/Fuels Management (acres)	181,000	1,456,000	1,110,000

Abbreviations used in this table:
mmbf = million board feet

[1]AUMs and acres rounded to nearest thousand; mmbf rounded to nearest ten.

Source: Crone and Haynes 1999.

Livestock AUMs

Production Levels

Estimated domestic livestock use on Forest Service- and BLM-administered lands, measured in AUMs, is shown in Table 4-34 by RAC / PAC for each alternative.

Figures are estimated annual average use for the first decade after plan implementation. AUMs were calculated as part of the CRBSUM modeling process, discussed in the landscape section of this chapter. Prescriptions designed to reflect objectives, standards and management priorities were applied to areas as defined by each alternative, with resulting effects on the quality, or health, of rangelands estimated by the model. Investments in rangeland improvements and changes in rangeland management practices are expected to improve quantity of forage, as well as the quality of the rangelands, although only the latter was modeled.

While these modeling estimates do not state the total forage that could be produced in the basin, the AUMs shown in Table 4-33 are an estimate of the sustainable grazing that could be allowed as a consequence of management direction implemented for watershed and ecosystem protection and restoration. Management direction does not require certain levels of permitted livestock grazing. Rather, it describes desired rangeland conditions. Therefore, changes in AUMs are indirect consequences, rather than prescribed outcomes, of this direction. Estimated grazing is reported and discussed only for the first decade of plan implementation.

The projected decline in AUMs does not reflect any possible future changes in the structural nature of the livestock industry, such as shifts in the share of range feeding vs. stockyard feeding for cattle, shifts in the culture and economics or ranching, or the withdrawal and conversion of lands from ranching to other types of development (such as resorts, housing

Table 4-34. Projected Animal Unit Months (AUMs), by RAC/PAC and Alternative, Annual Average First Decade, Project Area and All Lands.[1]

			Change from S1			Change from S1	
RAC/PAC	**Alt. S1**	**Alt. S2**	**AUMs**	**%**	**Alt. S3**	**AUMs**	**%**
Project Area (FS-BLM Lands)							
Butte RAC	38,000	34,700	-3,300	-9	34,300	-3,700	-10
Klamath PAC	42,800	39,300	-3,500	-8	39,700	-3,100	-7
Deschutes PAC	113,600	95,300	-18,300	-16	91,300	-22,300	-20
John Day-Snake RAC	347,400	324,100	-23,300	-7	311,500	-35,900	-10
Southeastern Oregon RAC	765,500	697,800	-67,700	-9	681,100	-84,400	-11
Lower Snake River RAC	581,000	546,500	-34,500	-6	545,300	-35,700	-6
Upper Snake River RAC	741,100	609,800	-131,300	-18	616,200	-124,900	-17
Upper Columbia-Salmon Clearwater RAC R4	365,800	337,200	-28,600	-8	334,400	-31,400	-9
Eastern Washington	65,100	63,900	-1,200	-2	61,800	-3,300	-5
Yakima PAC	3,900	3,700	-200	-5	3,800	-100	-3
Eastern Washington Cascades	12,400	12,300	-100	-1	12,300	-100	-1
Upper Columbia-Salmon Clearwater RAC R1	34,000	33,700	-300	-1	33,700	-300	-1
Total - Project Area	3,110,600	2,798,300	-312,300	-10	2,765,300	-345,300	-11
All Lands							
Total - All Lands	45,752,000	45,439,600	-312,400	-1	45,406,700	-345,300	-1

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
FS = Forest Service
BLM = Bureau of Land Management
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] Sums of columns may not equal totals because of rounding.

Source: Crone and Haynes 1999.

developments, and the like). Some or all of these types of changes may occur, with effects on the livestock grazing industry in the basin. However, they are outside the control of the agencies and were not modeled.

Livestock grazing use projected for Forest Service- and BLM-administered lands under Alternatives S2 and S3, compared to continuation of current management in Alternative S1, would be expected to decrease 10 percent and 11 percent, respectively. The effect compared to total grazing use on all ownerships would be much smaller—less than one percent decrease for either alternative. The projected decline in grazing from implementation of Alternative S2 or Alternative S3 confirms the USDA / USDI 1994 projection of reductions in grazing use over the next two decades to protect rangelands from further degradation and to provide protection for habitats of listed species (see Chapter 2). That process started with the implementation of PACFISH, INFISH, and Healthy Rangelands direction, and it would continue with implementation of either of the action alternatives.

With Alternatives S2 and S3, all RAC / PACs would see a decline in AUMs on Forest Service- and BLM-administered lands. The changes in grazing levels from Alternative S1 are not consistent among the RAC / PACs in magnitude.

While the overall decrease in grazing levels for the ICBEMP project area is somewhat larger for Alternative S3 than for Alternative S2, only 7 of the 12 RAC / PACs would actually experience greater declines in Alternative S3. Three RAC / PACs would show smaller declines in Alternative S3 compared to Alternative S2; the other 2 RAC / PACs would see no difference in grazing levels. These variations between the two alternatives reflect the differences among RAC / PACs in geographic extent of A1 / A2 subwatersheds, T watersheds, and riparian conservation areas in conjunction with the difference in focus, amount, and location of restoration activities.

While the total effect on basin-wide grazing use from either Alternative S2 or Alternative S3 would be very small, there could still be impacts at the local level in some areas. Those ranching operations that are most dependent on grazing Forest Service- and BLM-administered range allotments would be likely to feel a more substantial effect from changes in AUMs from these lands. (See Community Effects discussion later in this section.)

Predictability and Sustainability of Livestock Production

Although projected grazing use was drawn in part from livestock-oriented management direction, this direction was assigned to improve ecosystem conditions, not to achieve a particular livestock production objective. Improving ecological conditions on rangelands depends on application of grazing systems, managing season of use, and investing in range improvements as well as on control of the number of livestock grazed. While Alternative S1 would continue current livestock and grazing management practices under PACFISH, INFISH, and other existing management direction from land use plans, Alternatives S2 and S3 would implement more comprehensive, landscape-scale livestock and grazing management practices. This may introduce additional uncertainty in forage and livestock production compared to continuation of current practices. As shown in Table 4-34, changes in amounts of grazing use (AUMs) could be expected from implementing Alternatives S2 and S3.

Both private livestock operators and the agencies would face some additional costs for management of rangeland and livestock grazing if either Alternative S2 or S3 were selected, above those cost increases that have already been incurred with the implementation of PACFISH, INFISH, and Healthy Rangelands management direction. At this broad-scale, it was not possible to estimate costs for implementing new, potentially more intensive management practices for livestock operators; however, costs were estimated for the rangeland restoration and maintenance work associated with each alternative. Those costs currently average $0.10 per acre. They are estimated to be $0.40 per acre for high restoration priority subbasins and $0.15 per acre for the other subbasins (Crone and Haynes 1999). Additional mid-scale analysis should provide information on the expected magnitude of additional costs of rangeland management, livestock grazing, and rangeland restoration, as well as their distribution between the livestock operators and agencies.

If short-term uncertainty for livestock operators is assumed to increase with the implementation of new management direction, then the most to least predictable alternative in the short term would be Alternatives S1, S2, and S3. There is little difference between Alternatives S2 and S3. The major source of additional uncertainty in Alternative S3 would be potentially more stringent consultation requirements and mitigation measures at the individual project and allotment levels, because Alternative S3 requires less Ecosystem Analysis at the Watershed Scale (EAWS) than Alternative S2.

Over time, predictability for Alternatives S2 and S3 should improve as new allotment management plans are completed, rangeland conditions improve, and operators adjust to new direction. Short-term effects on the ranching industry that could result from proposed changes include: financially marginal operators departing, financially stable operators becoming marginal, and larger or more efficient operators buying out smaller or less efficient ones.

Recreation

The prediction in the Draft EISs of future recreation use on Forest Service- and BLM-administered lands was based on the interaction of supply (the number of acres in each Recreation Opportunity Spectrum [ROS] class) and demand (human population growth and demographic change). Little change in distribution of acres among ROS classes was projected in the short term, and change thereafter was predicted to be modest. Population growth would be the dominant factor affecting the type and amount of recreation uses during the next 10 years. In the longer term, demographic changes (especially an aging population) would become increasingly important.

For the Supplemental Draft EIS, the CRBSUM model predicted almost no change in distribution of ROS acres across the landscape in the short term. Also, changes in road conditions, locations, and accessibility—critical to the assessment of recreation supply and use patterns—were not modeled at this broad scale. Finally, potential effects of objectives and standards to protect and restore aquatic and riparian habitats, such as those for riparian conservation areas, could not be modeled at the broad scale, because they rely on more site- and condition-specific information.

Therefore, changes in recreation use were not predicted. Changes in recreation supply and expected use will be estimated and effects evaluated at the mid scale during the step-down process (Subbasin Review, EAWS, and land use planning), where more specific information will be available.

Timber Volume

Timber Production Calculations

Estimated average annual timber production for the first decade from Forest Service- and BLM-administered lands, measured in millions of board feet (mmbf), is shown in Table 4-35 by RAC / PAC. Percentage changes in timber harvest levels from Alternative S1 to Alternatives S2 and S3 are also shown.

Timber production was calculated as part of the CRBSUM modeling process, discussed in the landscape section earlier in this document. Prescriptions reflecting objectives, standards and priorities were assigned in the CRBSUM model. Timber production levels were projected based on acres to be treated by timber harvesting (commercial thinning and final harvest) to achieve the objectives of the alternatives. Timber production is not prescribed by the management direction. It results from the restoration activities conducted to achieve the desired outcomes expressed in the management direction. Because of the broad-scale basis of the CRBSUM model and its underlying data, timber harvest levels were projected for the project area as a whole and for each RAC / PAC area.

Timber production estimates are based on simulations of natural disturbance and succession processes (including natural fire and vegetation growth) as well as human management of fuels and vegetation. This method is different from traditional timber scheduling models (see Table 4-36). Refined estimates of timber supply and sustainability need to be completed by individual national forests and BLM districts as they adjust their land use plans. Until then, these initial projections provide estimates of the relative differences among the alternatives at the broad scale.

As a result of the restoration and maintenance of sustainable ecosystems, most of the commercially saleable volume in the first decade is expected to come from the large amounts of forest and woodland restoration work proposed, particularly in Alternatives S2 and S3. These trees will generally be smaller and of poorer quality than what has typically been harvested commercially in the past.

Timber Production Levels

Timber production estimated for Forest Service- and BLM-administered lands under Alternatives S2 and S3 compared to Alternative S1, would change by almost the same amounts, rising by about 172 mmbf and 167 mmbf (approximately 21 percent), respectively. The effect compared to total timber production from all ownerships would be much smaller—an increase of about five percent for either alternative.

Table 4-35 shows estimated projected timber harvest levels for the project area and by RAC / PAC area.

With Alternative S2, all RAC / PACs except the Eastern Washington RAC would see an increase in timber harvest levels compared to Alternative S1. In Alternative S3, all RAC / PACs would see an increase in timber harvest levels from Forest Service- and BLM-administered lands, compared to Alternative S1.

Among the RAC / PACs, the changes in harvest levels from Alternative S1 are not consistent in magnitude.

Table 4-35. Projected Timber Harvest (mmbf), by RAC/PAC and Alternative, Annual Average First Decade,[1] Project Area and All Lands.

RAC/PAC	Alt. S1	Alt. S2	Change from S1 mmbf	Change from S1 %	Alt. S3	Change from S1 mmbf	Change from S1 %
Project Area (FS-BLM Lands)							
Butte RAC	161	174	13	8	172	11	7
Klamath PAC	41	51	10	24	51	10	24
Deschutes PAC	56	57	1	2	59	3	5
John Day-Snake RAC	122	190	68	56	178	56	47
Southeastern Oregon RAC	73	99	26	36	90	17	23
Lower Snake River RAC	42	59	17	40	64	22	52
Upper Snake River RAC	12	14	2	17	14	2	17
Upper Columbia-Salmon Clearwater RAC R4	116	145	29	25	140	24	21
Eastern Washington	49	48	-1	-2	52	3	6
Yakima PAC	0	1	1	nc	1	1	nc
Eastern Washington Cascades	3	4	1	33	5	2	67
Upper Columbia-Salmon Clearwater RAC R1	138	144	6	4	155	17	12
Total Project Area	814	986	172	21	981	167	21
All Lands							
Total All Lands	3,355	3,527	172	5	3,522	167	5

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
mmbf = million board feet
nc = not calculable
FS = Forest Service
BLM = Bureau of Land Management
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1]Sums of columns may not equal totals because of rounding.

Source: Crone and Haynes 1999.

While the overall increase for the ICBEMP project area would be similar for Alternatives S2 and S3, four of the RAC/PACs would experience larger increases in Alternative S2, compared to Alternative S3. Three RAC/PACs would not change between the two alternatives, while the others would show smaller increases in Alternative S2 compared to Alternative S3. These variations between the two alternatives reflect the differences among RAC/PACs in locations and sizes of A1/A2 subwatersheds, T watersheds, and RCAs in conjunction with the difference in focus, amount, and location of restoration activity using timber harvest as a management tool and the size of the timber resource base.

While the total effect on basin-wide production of timber from Forest Service- and BLM-administered lands from Alternative S2 or S3 would be relatively small (about a five percent increase), there would be larger or smaller impacts in some localized areas. Those timber harvest and milling operations that are most dependent on wood from Forest Service- and BLM-administered lands would likely feel a more substantial effect from changes in timber harvest from agency lands. (See community effects discussion later in this section.)

Predictability and Sustainability of Timber Harvest Volume Levels

The projected timber harvest volumes displayed in Table 4-35 are not based on more traditional timber harvest modeling methods. Rather, they are based on the broad-scale landscape disturbance and succession approach, which expands the meaning of sustainability to include all components and processes

Table 4-36. Comparison of Modeling Methods with Regard to Sustainability and Predictability of Timber Harvest Levels.

Projecting Timber Outputs in Conventional Modeling	Projecting Timber Outputs in ICBEMP Broad-scale Landscape Disturbance Modeling
Management intensity and timber harvest rates are based on a formal system designed to provide predictable timber volume outputs.	System is adapted to accommodate new management approaches designed to provide more predictable landscape disturbance outcomes.
Sustained yield of wood fiber is used as a formal measure of sustainability based on the premise that sustained timber yield, properly constrained and mitigated, would sustain the underlying forest processes.	Sustained yield of wood fiber is still important, but not as a formal measure of sustainability. Sustainability is more broadly defined to account for ecosystem functions, processes, and landscape disturbance.
Assumes static ecosystems.	Assumes dynamic ecosystems.
Pattern, timing, and type of disturbance are designed to support sustained yield of wood in perpetuity by managing the age, size, species, and development of forest growing stock.	Pattern, timing, and type of disturbance are designed to support desired disturbance patterns and ecosystem processes and conditions by managing cover types and structural stages across the landscape.

of ecosystems and to account for the role of disturbance regimes in shaping how ecosystems change over time. Some key differences between conventional timber modeling and the landscape approach used in this EIS are displayed in Table 4-36. Refined estimates of timber supply will be determined when the selected alternative is incorporated into local Forest Service and BLM land use plans.

Shifting management objectives and silvicultural prescriptions from a timber production emphasis to a restoration emphasis would change both the nature of the timber product removed from the forest and the cost of removing it. Log size, log quality, and volume per acre removed are critical to the profitability of harvest operations and lumber manufacturing. Average diameter of trees removed has been shown especially important to the financial feasibility of a timber sale (Crone and Haynes 1999).

Achieving the levels of timber harvest projected, as shown in Table 4-35, assumes that all the estimated available volume will be sold. However, an emphasis on the restoration work prescribed to produce desirable stand structures and other ecosystem characteristics would generally result in harvesting smaller diameter trees and producing less volume per acre. Restrictions on the removal of large trees will have similar results. As noted earlier, both log size and volume per acre removed are critical to the profitability of harvest operations and lumber manufacturing. These factors, along with the use of higher cost logging systems would have a higher risk of not being sold than would the prescriptions in Alternative S1. An unsold timber sale either delays the accomplishment of restoration objectives or shifts the restoration work from a timber sale to a service contract, which is generally a higher cost option.

These factors raise uncertainty about the timber harvest projections under Alternatives S2 and S3. However, the amount of timber that is offered for sale and how it is marketed is also a key determinant of how much timber is ultimately sold. Differences in marketing practices among national forests have shown major differences in timber sale success. Therefore, different marketing approaches can mitigate the uncertainty associated with timber harest projections. There is little uncertainty associated with the volume projected for Alternative S1; it is based on actual timber harvests and is the result of current marketing practices.

Forest and Rangeland Restoration Activity Levels

Maintenance and restoration of watersheds and terrestrial habitats constitute a major focus of Alternatives S2 and S3. Restoration work is expected to provide both biophysical and socio-economic benefits. Ecosystem structure, function, and process would be anchored and maintained where already in good shape, and will be strengthened and restored where degradation has occurred. At the same time, restoration project expenditures would provide additional employment in local areas (see Employment section).

On-the-ground restoration activities that were not modeled will be identified during the step-down process through national forest / BLM land use planning, Subbasin Review, EAWS, and site-specific NEPA analyses. These types of restoration activities include road treatments (decommissioning, closures, stormproofing, and upgrading), and in-stream and stream channel improvements.

Forest/Woodland Restoration Activity Levels

Forest and woodland restoration activities that were modeled include planting after timber harvest and precommercial thinning. Expected acres of restoration activity to be carried out each year over the first decade are displayed for the project area and by RAC / PAC in Table 4-37.

The total amount of forest / woodland restoration activity, including both harvest and precommercial thinning, would increase substantially compared to Alternative S1: about 40 percent for Alternative S2 and almost 35 percent for Alternative S3.

With Alternatives S2 and S3, all RAC / PACs would see an increase in acres of forest / woodland restoration activity compared to Alternative S1.

Table 4-37. Acres of Projected Forest/Woodland Restoration Activity[1] by RAC/PAC and Alternative, Average Annual First Decade, Project Area. [2]

RAC/PAC	Alternative S1	Alternative S2	% Change from S1	Alternative S3	% Change from S1
Butte RAC	26,300	33,700	28	33,400	27
Klamath PAC	11,300	14,400	27	14,300	26
Deschutes PAC	12,600	15,400	22	15,000	19
John Day-Snake RAC	21,400	38,500	80	35,300	65
Southeastern Oregon RAC	17,600	26,300	49	23,100	31
Lower Snake River RAC	6,100	10,200	67	10,200	67
Upper Snake River RAC	2,100	3,700	76	3,500	67
Upper Columbia-Salmon Clearwater RAC R4	19,000	24,200	27	23,700	25
Eastern Washington	7,300	8,600	18	9,200	26
Yakima PAC	100	100	0	100	0
Eastern Washington Cascades	600	1,100	83	1,200	100
Upper Columbia-Salmon Clearwater RAC R1	17,300	22,500	30	23,000	33
Total Project Area (FS-BLM Lands)	141,700	198,600	40	192,200	36

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] Includes post-harvest reforestation and precommercial thinning.
[2] Sum of columns may not be equal totals because of rounding.

Source: Crone and Haynes 1999

Among the RAC/PACs, the changes in harvest or restoration levels from Alternative S1 to Alternatives S2 and S3 are not consistent in magnitude. Most of the RAC/PACs would follow the basin-wide pattern of more restoration acres under Alternative S2 than Alternative S3. However, three of the RAC/PACs have fewer projected restoration acres in Alternative S2 than Alternative S3. The differences by RAC/PAC between the two action alternatives can be attributed to differences in locations and sizes of A1/A2 subwatershed areas and riparian conservation areas by alternative, in conjunction with the difference in focus, amount, and location of restoration activity. In addition, restoration is distributed across 11 more high restoration priority subbasins in Alternative S3 than in Alternative S2.

At the basin scale, changes in planting from Alternative S1 to Alternatives S2 and S3 follow the pattern of the total forest/woodland restoration activity levels, as well as the pattern of timber harvest volume: both alternatives would show increases from Alternative S1, but Alternative S2 would show a slightly greater increase than Alternative S3.

Table 4-38 shows the planting portion of the total forest/woodland restoration activity for the project area and by RAC/PAC. Acres to be planted are based on the harvest acres requiring reforestation, as modeled in CRBSUM.

At the basin scale, changes in precommercial thinning from Alternative S1 to Alternatives S2 and S3 would follow the pattern of the total forest/woodland restoration activity levels: both alternatives would show increases from Alternative S1. In this case, Alternative S2 would have a significantly larger percentage increase than Alternative S3, although the numeric difference of just under 4,000 acres basin-wide is not as large as the percentage difference might suggest.

In summary, Alternatives S2 and S3, respectively, would increase planting and precommercial thinning acres similarly. Planting would increase just under 28,000 acres for Alternative S2 and just over 25,000 acres for Alternative S3. Precommercial thinning acres would increase 29,000 acres in Alternative S2 and just over 25,000 acres for Alternative S3. (Note that the percentage changes in precommercial thinning acres, as shown in Table 4-39, are much larger than for planting acres because they begin with a substantially lower base.)

Rangeland Maintenance and Restoration Activity Levels

Rangeland maintenance and restoration activities are currently occurring (Alternative S1). However, under the two action alternatives, acres treated each year in the first decade would increase, by about nine percent in Alternative S2 and four percent in Alternative S3. Rangeland restoration activities may include prescribed burning, weed control, mechanical treatments, thinning, and seeding. Expected acres of restoration activity to be carried out each year over the first decade are displayed for the project area and by RAC/PAC in Table 4-40.

For the basin as a whole, rangeland restoration activity would increase from the no-action alternative for both Alternatives S2 and S3, with Alternative S2 resulting in about 156,000 acres (or about five percent) more restoration than Alternative S3.

In general, the changes by RAC/PAC between Alternatives S2 and S3 would follow the same pattern as the project area as a whole. There is a smaller increase, or larger decrease, for Alternative S3 than for Alternative S2. The exceptions, both relatively minor, would be the Klamath and the Upper Snake River RACs.

Prescribed Fire and Fuels Management

The current ecological condition of many forested areas in the project area and their increased susceptibility to uncharacteristic wildfire are significant issues being examined through this EIS. Both action alternatives propose fuels management, prescribed fire, and wildland fire management direction to begin to move the condition of these forests toward their historical conditions. This would provide benefits in terms of reducing the risk of uncharacteristic wildfire and would promote recovery of terrestrial habitat that has been degraded or lost over the past century or more.

Expected acres of prescribed fire and fuels management activity each year over the first decade are displayed for the project area and by RAC/PAC in Table 4-41.

As can be seen from Table 4-41, substantial increases are proposed in prescribed fire and fuels management activities for both action alternatives compared to no-action levels. For the basin as a whole, Alternative S2

Table 4-38. Acres of Projected Post-Harvest Planting Activity[1] by RAC/PAC and Alternative, Average Annual First Decade, Project Area.[2]

	Alternative S1	Alternative S2	% Change from S1	Alternative S3	% Change from S1
RAC/PAC					
Butte RAC	17,500	19,400	11	19,100	9
Klamath PAC	10,000	12,400	24	12,400	24
Deschutes PAC	10,800	12,600	17	12,600	17
John Day-Snake RAC	19,600	29,600	51	27,800	42
Southeastern Oregon RAC	15,300	21,300	39	19,100	25
Lower Snake River RAC	5,400	7,600	41	8,300	54
Upper Snake River RAC	1,300	1,400	8	1,400	8
Upper Columbia-Salmon Clearwater RAC R4	15,300	18,200	19	17,900	17
Eastern Washington	5,000	5,000	0	5,400	8
Yakima PAC	0	100	nc	100	nc
Eastern Washington Cascades	500	600	20	700	40
Upper Columbia-Salmon Clearwater RAC R1	11,300	11,700	4	12,500	11
Total Project Area (FS-BLM Lands)	112,000	139,900	25	137,200	23

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
nc = not calculable
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] Portion of total forest/woodland restoration activity.
[2] Sum of columns may not be equal totals because of rounding.

Source: Crone and Haynes 1999.

Table 4-39. Acres of Projected Pre-commercial Thinning Activity[1] by RAC/PAC and Alternative, Average Annual First Decade,[2] Project Area.

RAC/PAC	Alternative S1	Alternative S2	% Change from S1	Alternative S3	% Change from S1
Butte RAC	8,800	14,300	62	14,200	61
Klamath PAC	1,300	2,000	54	1,900	46
Deschutes PAC	1,700	2,700	59	2,400	41
John Day-Snake RAC	1,900	8,900	368	7,600	300
Southeastern Oregon RAC	2,300	5,000	117	4,000	74
Lower Snake River RAC	800	2,600	225	2,000	150
Upper Snake River RAC	800	2,200	175	2,100	163
Upper Columbia-Salmon Clearwater RAC R4	3,700	6,100	65	5,900	59
Eastern Washington	2,300	3,600	57	3,800	65
Yakima PAC	0	0	nc	0	0
Eastern Washington Cascades	100	500	400	500	400
Upper Columbia-Salmon Clearwater RAC R1	6,000	10,800	80	10,500	75
Total Project Area (FS-BLM Lands)	29,800	58,800	97	54,900	84

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] Portion of total forest/woodland restoration activity.
[2] Sums of columns may not equal because of rounding.

Source: Crone and Haynes 1999.

Table 4-40. Acres of Projected Rangeland Maintenance and Restoration Activity by RAC/PAC and Alternative, Average Annual First Decade,[1] Project Area.

RAC/PAC	Alternative S1	Alternative S2	% Change from S1	Alternative S3	% Change from S1
Butte RAC	85,300	115,100	35	97,600	14
Klamath PAC	84,400	66,200	-22	66,500	-21
Deschutes PAC	167,100	144,700	-13	135,900	-19
John Day-Snake RAC	305,000	377,400	24	349,600	15
Southeastern Oregon RAC	1,115,200	1,144,200	3	1,092,900	-2
Lower Snake River RAC	445,600	507,800	14	484,600	9
Upper Snake River RAC	516,900	539,900	4	550,400	6
Upper Columbia-Salmon Clearwater RAC R4	278,600	315,600	13	299,600	8
Eastern Washington	33,000	54,200	64	47,900	45
Yakima PAC	900	1,000	11	1,000	11
Eastern Washington Cascades	9,200	11,500	25	9,700	6
Upper Columbia-Salmon Clearwater RAC R1	32,700	61,500	88	47,500	45
Total Project Area (FS-BLM Lands)	3,074,100	3,339,200	9	3,183,300	4

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1]Sums of columns may not equal totals because of rounding.

Source: Crone and Haynes 1999.

would have about 350,000 acres of treatment per year more than Alternative S3.

Table 4-41 also shows the expected percentage changes in acres to be treated under either Alternative S2 or S3, compared to Alternative S1. As can be seen, the increases would be substantial on this basis.

Special Forest Products

The effects of the alternatives on various special forest products—such as mushrooms, berries, ferns, and boughs—were not estimated. As mentioned in Chapter 2, special forest products are a small but growing industry, estimated already to be producing several hundred million dollars annually in sales. The demand for these products has been growing rapidly, from both within and outside the project area.

Several national forests and BLM districts have some management controls on harvesting some types of special forest products. The same type of varying management direction would continue under Alternative S1. Alternatives S2 and S3 would apply landscape-scale ecosystem maintenance and restoration objectives to agency lands throughout the basin.

Because knowledge of special forest products depends on site-specific information, the effects of management activities on special forest products will be analyzed at a finer scale during the step-down process (including land use plan adjustments, Subbasin Review and EAWS, and project-level NEPA analysis).

Permitted Mineral and Energy Operations

Broad-scale effects on mineral and energy exploration and development were not estimated for this EIS and can only be inferred from management direction that could hinder potential operations.

Standards and guidelines to protect aquatic and riparian areas already in place on most Forest Service- and BLM-administered lands through PACFISH and INFISH, as well as additional aquatic and riparian protection under Alternatives S2 and S3, may increase the cost of mining and energy developments by limiting the location (or requiring relocation) of mining operations and facilities (such as mill buildings, settling ponds, sanitary and solid waste structures, and overburden piles). Alternatives S2 and S3 may require relocating access roads or changing mine design and operation to avoid impacts to riparian areas.

Table 4-41. Projected Acres of Prescribed Fire and Fuels Management, by RAC/PAC and Alternative, Annual Average First Decade,[1] Project Area.

RAC/PAC	Alt. S1	Alt. S2	Change from S1 Acres	Change from S1 %	Alt. S3	Change from S1 Acres	Change from S1 %
Butte RAC	24,400	211,800	187,400	768	200,900	176,500	723
Klamath PAC	13,100	43,300	30,200	231	37,200	24,100	184
Deschutes PAC	24,300	79,400	55,100	227	80,200	55,900	230
John Day-Snake RAC	46,400	484,800	438,400	945	366,500	320,100	690
Southeastern Oregon RAC	33,900	313,000	279,100	823	182,100	148,200	437
Lower Snake River RAC	2,600	26,100	23,500	904	10,700	8,100	312
Upper Snake River RAC	3,500	17,300	13,800	394	18,600	15,100	431
Upper Columbia-Salmon Clearwater RAC R4	17,700	98,700	81,000	458	84,800	67,100	379
Eastern Washington	2,600	33,500	30,900	1,188	26,500	23,900	919
Yakima PAC	0	100	100	nc	0	0	nc
Eastern Washington Cascades	800	14,300	13,500	1,688	10,800	10,000	1,250
Upper Columbia-Salmon Clearwater RAC R1	11,700	134,200	122,500	1,047	91,400	79,700	681
Total Project Area (FS-BLM Lands)	181,100	1,456,400	1,275,300	704	1,109,900	928,800	513

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1]Sums of columns may not equal totals because of rounding.

Source: Crone and Haynes 1999.

Effects of the Alternatives on Employment

Background

Direct employment generated from Forest Service- and BLM-administered lands falls mostly into job categories such as wood products manufacturing, livestock grazing, forestry services, mining, federal employment, and recreation related retail trade and services. Together, these employment categories are most likely to be affected as a result of changing federal land uses. In Chapter 2 it was noted that about 95,000 jobs are associated with livestock grazing, recreation, and timber harvest on lands administered by the Forest Service or BLM in the project area. It was estimated that recreation accounts for 81 percent of these jobs, timber harvest for 9 percent, livestock grazing for 1 percent, and various forestry services for the remaining 8 percent (Crone and Haynes 1999).

The reader may notice a difference between the total direct employment figure of approximately 8,100 in Table 4-42, and the total of about 18,000 direct jobs associated with outputs and activities (other than recreation) on Forest Service- and BLM-administered lands that would be calculated from the figures in the previous paragraph. The difference of almost 10,000 jobs can be attributed primarily to the different base years on which the figures were calculated (1995–1997 for Table 4-42, and 1993–1994 for the revised Crone and Haynes (1999) figures, and to the area over which the employment figures were calculated. The Crone and Haynes figures are based on the entire Columbia River Basin assessment area, while the figures in Table 4-42 are based on just the current Supplemental Draft EIS project area. Also, during 1995–1997, the basin timber harvest from agency lands fell by about one billion board feet, which would have supported nearly 8,000 jobs.

Differences in employment levels by alternative are identifiable for several, but not all of these employment categories. The categories where changes in employment by alternative are discernable include timber, grazing, forestry services including range restoration, and prescribed fire. The largest component, recreation, would have no identifiable difference in use levels across the alternatives for the next decade. Therefore, recreation-related employment would be held constant. Mining employment would also be held constant since no differences in mining activity could be estimated among the alternatives.

The following discussion identifies the alternative employment effects in total and for those components where differences in direct employment could be determined. The indirect and induced employment effects resulting from the changes in direct employment are not included in order to focus on the initial employment changes associated with BLM- and Forest Service-administered lands.

Potential Effects

Total Employment

Employment opportunities would be augmented in Alternatives S2 and S3, resulting in job increases of about 4,000 and 3,000 jobs respectively in direct employment generated from Forest Service- and BLM-administered lands. These differences are displayed by RAC/PAC in Table 4-42. The increases represent a four percent gain in Alternative S2 and a three percent gain in Alternative S3 with respect to the total 95,000 jobs associated with Forest Service- and BLM-administered lands in the project area. Each of the components are described in more detail following this general discussion. All components would increase except for grazing-related employment.

When compared to Alternative S3, Alternative S2 would result in higher employment opportunities except for relatively small declines in a few RAC/PACs (Table 4-42).

Grazing-related Employment

Grazing-related employment is expected to decline somewhat across the project area and within most RAC/PACs, with the implementation of either Alternative S2 or Alternative S3, compared to continuation of current management practices under Alternative S1. Ranching employment could be reduced by about 112 to 125 jobs (10–11 percent), respectively (Table 4-43). This decline in employment would be associated with the projected decrease in grazing use resulting from implementation of the alternatives. It does not include any other employment effects that might take place as a result of structural, cultural, or land use changes in the livestock industry arising from conditions outside the agencies' control.

Only minor differences can be seen between Alternatives S2 and S3. The largest declines would be found in those RAC/PACs where BLM and Forest Service grazing is a significant resource use, because domestic livestock grazing stocking levels could decrease as an indirect consequence of meeting rangeland restoration and other landscape objectives.

Range jobs were calculated by multiplying the number of animal unit months (AUMs) under each alternative by 0.00036 jobs per AUM. This response coefficient for rangeland grazing employment includes an adjustment of 20 percent to account for seasonal use patterns of federal allotments (see Haynes and Horne 1997 for details).

Recreation-related Employment

No effects on levels of recreation use from implementing either of the action alternatives were predicted because of the broad scale of analysis (see Outputs and Activities/Recreation, earlier in this section). Therefore, no effects on recreation-related employment could be projected. Employment effects may be identified from subsequent finer-scale analyses during the step-down process.

Timber-related Employment

Timber-related employment associated with timber harvest and manufacture generated from Forest Service- and BLM-administered lands has declined for the past several years in the project area. Alternatives S2 and S3 would reverse this trend by increasing employment opportunities by about 1,300 jobs or 21 percent. This information is presented by RAC/PAC and by alternative in Table 4-44.

The cause of increase in timber and timber-related employment is the focus on restoration activities in substantially forested areas. Alternatives S2 and S3 differ in which RAC/PAC areas show increased employment because of the different areas where restoration would be focused. These projections are subject to the cautions identified previously: the quality of the timber being harvested and the costs of harvest activities may result in timber sales that are not economically viable, which may result in less timber being harvested and manufactured than estimated.

Direct timber employment is estimated by multiplying the timber harvest for each alternative by 7.75 jobs per million board feet. This factor was determined by dividing current employment in the wood and forest products industry by current timber harvest in the project area. No offsetting increases or decreases are assumed for other ownerships. Also, no job changes

Table 4-42. Total Direct Employment Associated with Activities (Other Than Recreation) on Forest Service- and BLM-administered Lands, by RAC/PAC and Alternative, Average Annual Number of Jobs.

RAC/PAC	Alt. S1	Alt. S2	Alt. S3	S2 Change from S1	S3 Change from S1
Butte RAC	1,363	1,854	1,806	491	453
Klamath PAC	385	525	513	140	128
Deschutes PAC	548	666	681	118	133
John Day-Snake RAC	1,207	2,639	2,301	1,432	1,094
Southeastern Oregon RAC	950	1,700	1,355	750	405
Lower Snake River RAC	552	729	738	177	186
Upper Snake River RAC	372	374	378	2	6
Upper Columbia-Salmon Clearwater RAC R4	1,105	1,493	1,424	388	319
Eastern Washington	420	477	494	57	74
Yakima PAC	4	10	9	6	5
Eastern Washington Cascades	31	67	69	36	38
Upper Columbia-Salmon Clearwater RAC R1	1,143	1,443	1,440	300	297
Total	8,080	11,977	11,218	3,897	3,138

Abbreviations used in this table:
BLM - Bureau of Land Management
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

Source: Crone and Haynes 1999.

Table 4-43. Grazing Direct Employment Related to Forest Service- and BLM-Administered Lands, by RAC/PAC and Alternative, Average Annual Number of Jobs.

RAC/PAC	Alt. S1	Alt. S2	Alt. S3	S2 Change from S1	S3 Change from S1
Butte RAC	13	12	12	-1	-1
Klamath PAC	15	14	14	-1	-1
Deschutes PAC	41	34	33	-7	-8
John Day-Snake RAC	125	117	112	-8	-13
Southeastern Oregon RAC	276	251	245	-25	-31
Lower Snake River RAC	209	197	196	-12	-13
Upper Snake River RAC	267	220	222	-47	-45
Upper Columbia-Salmon Clearwater RAC R4	132	121	120	-11	-12
Eastern Washington	23	23	22	0	-1
Yakima PAC	1	1	1	0	0
Eastern Washington Cascades	4	4	4	0	0
Upper Columbia-Salmon Clearwater RAC R1	12	12	12	0	0
Total	1,118	1,006	993	-112	-125

Abbreviations used in this table:
BLM - Bureau of Land Management
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

Source: Crone and Haynes 1999.

Table 4- 44. Timber Direct Employment Related to Forest Service- and BLM-administered Lands, by RAC/PAC and Alternative, Average Annual Number of Jobs.

RAC/PAC	S1	S2	S3	S2 Change from S1	S3 Change from S1
Butte RAC	1,247	1,351	1,334	104	87
Klamath PAC	321	395	395	74	74
Deschutes PAC	433	442	457	9	24
John Day-Snake RAC	945	1,473	1,383	528	438
Southeastern Oregon RAC	569	765	694	196	125
Lower Snake River RAC	325	457	497	132	172
Upper Snake River RAC	92	110	109	18	17
Upper Columbia-Salmon Clearwater RAC R4	899	1,124	1,085	225	186
Eastern Washington	377	370	400	-7	23
Yakima PAC	3	8	8	5	5
Eastern Washington Cascades	23	32	40	9	17
Upper Columbia-Salmon Clearwater RAC R1	1,072	1,117	1,199	45	127
Total	6,308	7,644	7,601	1,336	1,293

Abbreviations used in this table:
BLM - Bureau of Land Management
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

Source: Crone and Haynes 1999.

are estimated for the pulp and paper industry. This is not to suggest that there would not be impacts on the pulp and paper industry, only to suggest that the industry will respond to supply-induced changes in ways different from the solid wood products sector.

Forestry Services and Range Restoration-related Employment

Forestry services and range restoration employment opportunities would increase in Alternatives S2 and S3 by about 100 jobs or 40 percent. This information is displayed by RAC/PAC and by alternative in Table 4-45.

Alternatives S2 and S3 would be similar even at the RAC/PAC level. The largest increases in job opportunities would occur in those RAC/PACs where forest stands in need of precommercial thinning are most numerous.

These job numbers should be interpreted with caution. While the job estimates are for full-time equivalent jobs, many of these jobs are seasonal. The implication is that changes would affect more people than the job numbers indicate because the income is being shared among more individuals.

The number of forestry workers required for precommercial thinning was based on a calculation of one job per $43,125 of expenditures. This ratio was then converted to one job per 500 acres treated based on per-acre thinning costs. Range restoration jobs are also based on one job per $43,125 of expenditures.

Prescribed Fire-related and Fuels Treatment Employment

The large increases in prescribed fire activity and associated employment reflect a significant focus of Alternatives S2 and S3 to restore areas to historical fire patterns. Alternative S2 would increase employment by about 2,600 jobs, a seven-fold increase, and Alternative S3 would increase employment by about 1,900 jobs, a five-fold increase. This information is displayed by RAC/PAC and by alternative in Table 4-46.

In total, Alternative S2 would provide 700 more jobs than Alternative S3. However, similar to forestry services and range restoration, these job estimates are for full-time equivalent jobs, while many of the jobs actually are seasonal. The implication is that changes would affect more people than just the job numbers indicate because the income is being shared among more individuals.

Table 4-45. Forestry Services and Range Restoration Direct Employment Related to Forest Service- and BLM-Administered Lands, by RAC/PAC and Alternative, Average Annual Number of Jobs.

RAC/PAC	Alt. S1	Alt. S2	Alt. S3	S2 Change from S1	S3 Change from S1
Butte RAC	53	68	67	15	14
Klamath PAC	23	29	29	6	6
Deschutes PAC	26	32	31	6	5
John Day-Snake RAC	44	80	73	36	29
Southeastern Oregon RAC	38	58	51	20	13
Lower Snake River RAC	13	23	23	10	10
Upper Snake River RAC	5	10	10	5	5
Upper Columbia-Salmon Clearwater RAC R4	39	50	49	11	10
Eastern Washington	15	18	19	3	4
Yakima PAC	0	0	0	0	0
Eastern Washington Cascades	1	2	3	1	2
Upper Columbia-Salmon Clearwater RAC R1	35	45	46	10	11
Total	292	415	401	123	109

Abbreviations used in this table:
BLM - Bureau of Land Management
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

Source: Crone and Haynes 1999.

Table 4-46. Prescribed Fire and Fuels Treatment Direct Employment Related to Forest Service- and BLM-Administered Lands by RAC/PAC and Alternative, Average Annual Number of Jobs.

RAC/PAC	Alt. S1	Alt. S2	Alt. S3	S2 Change from S1	S3 Change from S1
Butte RAC	49	424	402	375	353
Klamath PAC	26	87	74	61	48
Deschutes PAC	49	159	160	110	111
John Day-Snake RAC	93	970	733	877	640
Southeastern Oregon RAC	68	626	364	558	296
Lower Snake River RAC	5	52	21	47	16
Upper Snake River RAC	7	35	37	28	30
Upper Columbia-Salmon Clearwater RAC R4	35	197	170	162	135
Eastern Washington	5	67	53	62	48
Yakima PAC	0	0	0	0	0
Eastern Washington Cascades	2	29	22	27	20
Upper Columbia-Salmon Clearwater RAC R1	23	268	183	245	160
Total	362	2,914	2,219	2,552	1,857

Abbreviations used in this table:
BLM - Bureau of Land Management
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

Source: Crone and Haynes 1999.

The number of jobs required for the fuel treatment and prescribed fire is similar to forestry workers and was based on a calculation of one job per $43,125 of expenditures. This ratio is also converted to one job per 500 acres.

Effects on Communities

Background

Economic effects of the alternatives on communities would not be substantial when measured against the project area-wide regional economy. The regional economy is strong, growing, and mostly immune from changes proposed in either of the two action alternatives. Science findings noted "...for most people in the basin, expansion in other sectors means that the impact of FS/BLM decisions on their employment and income will be negligible..." (Haynes and Horne 1997).

This may not be true for local areas, especially small rural and tribal communities that are geographically isolated from population centers and are not experiencing the economic growth that characterizes the project area as a whole. This is also not true for economic sectors or individual firms that are economically specialized in industries that depend primarily on federal land outputs, such as wood products manufacturing or ranching. While the influence of these sectors on the regional economy is lessened by the rapid growth in other sectors, changes in federal land uses are still important to those communities and businesses economically (and culturally) tied to these industries.

As discussed in Chapter 2, the effects of implementing the alternatives were estimated at a broad-scale level for RAC/PAC areas. A focus on these larger subregions misses many of the economic concerns associated with Forest Service and BLM land management, which are more local than regional. Where concerns are local, they are as much social issues as they are economic ones.

In the Draft EISs, community resiliency was described as a function of population size, economic diversity, attractiveness, amenities, leadership, and the community residents' ability to work together and be proactive toward change. In Chapter 2 of this Supplemental Draft EIS, additional information by SAG was described, which built on previous studies of community resiliency, but which narrowed the focus to population density, economic diversity, and lifestyle diversity as the three most important, and measurable, factors by which socio-economic resiliency could be assessed. Socio-economic resiliency ratings were developed for all the counties within the project area (Horne and Haynes 1999).

In general, Forest Service and BLM land use decisions have little influence on factors important to socio-economic resiliency. The agencies also have no mandate to set goals for changing community resiliency; however, the Forest Service and BLM can have a role in helping communities achieve their economic goals, which may include economic diversification. Alternatives S2 and S3 include management direction for this purpose.

Socio-economic resiliency is a measure of how well counties or communities may respond to external forces and changes. As such, socio-economic resiliency itself will not change, at least in the short term, in response to changes in federal land management policies and practices. Rather, the measures are used to indicate the degree to which communities may be able to respond to and manage change brought on by external forces or actions, such as those being discussed in this Supplemental Draft EIS.

Potential Effects on Agriculture (Grazing) Specialized Communities

Background

There are 259 identified communities in the project area that have an economic specialization in agriculture (see Appendix 7, Tables 5 and 6). Eighty-six of these communities have been classified as isolated (including isolated trade-centers), and the remaining 175 are considered not isolated. Of the isolated communities, 6 are identified as associated with an American Indian reservation. The agriculture industry includes both crop and livestock production. Many of the communities have strong grazing components, with some linked to federal land grazing permits. It is important to identify this component of agriculture-specialized towns, since the dependency of the livestock industry on BLM and Forest Service forage averages seven percent of the total forage in the ICBEMP project area (Haynes and Horne 1997).

Livestock forage obtained from federal lands was estimated at the county level (Frewing-Runyon 1995). This information is used to identify the 249 (83 isolated) agriculture-specialized towns that are likely to have a significant association with federal land forage. Since the data were collected at the county level, some

Major Changes from the Draft EISs

In the Scientific Assessment (Haynes and Horne 1997), it was estimated that, as of 1990, approximately 220,000 jobs in the basin were associated with livestock grazing, recreation, and timber harvest on lands administered by the Forest Service or BLM. Of those, it was estimated that about 190,000 were associated with recreation. In response to comments on the original methodology, and with further review and analysis, the estimate of recreation-associated jobs was adjusted to about 77,000 as of 1994 (Crone and Haynes in press). The total estimate of jobs associated with livestock grazing, recreation, and timber harvest (accounting for some declines in grazing and timber jobs in the first part of the decade) was reduced to 95,000 (Crone and Haynes 1999).

of these communities may not actually have ties to federal land grazing.

Effects on Grazing Activities by Alternative and RAC/PAC

Federal forage availability and differences among the alternatives during the first decade are displayed in Table 4-34, earlier in this section. As has been discussed, an indirect consequence of actions taken to achieve the desired outcomes of Alternatives S2 and S3 could be a decrease in grazing on Forest Service- and BLM-administered lands of 10 percent for Alternative S2 and 11 percent for Alternative S3 compared to Alternative S1 across the project area. This is less than a one percent change in livestock forage consumption from all ownerships. Changes in AUMs by RAC/PAC were described earlier in the Outputs and Activities section for Livestock AUMs and are shown in Table 4-34.

Socio-Economic Effects on Agriculture (Grazing) Specialized Communities by Alternative

The following discussion highlights the general socio-economic effects that grazing-specialized communities may experience under each alternative. The effects of the alternatives discussed here apply only to those communities associated with federal land grazing and not to all of the communities in the agriculture specialization group.

Estimates of the livestock animal unit month (AUM) production were made for each of the RAC/PACs. These are displayed in Table 4-34, earlier in this section. These estimates were based on the potential effects of implementing each alternative. Table 4-47 shows a measure of the uncertainty under Alternatives S2 and S3 associated with changes in estimated production levels from Alternative S1.

In several of the RAC/PACs, the action alternatives are expected to result in reductions in AUMs as a consequence of management actions taken to protect or improve ecosystem components and achieve desired outcomes in rangeland health. Larger predicted decreases are assumed to correlate with greater uncertainty.

Table 4-48 identifies the magnitude of the effect of potential changes in AUMs from Alternative S1 by RAC/PAC on an average grazing-specialized community basis. (The "average" community basis does not imply that there is an "average" community, or that the effects will be distributed evenly among them. Rather, it is used to provide a comparative basis to display differences among the alternatives.) There are also communities not economically specialized in grazing that may incur reductions in grazing.

The ability of isolated communities to deal with change may be less than that found in larger non-isolated communities. The resulting impacts may differ in magnitude and duration for isolated rural and tribal communities where fewer economic options are available and fewer opportunities exist to interact with nearby towns and cities. Isolated and economically specialized rural and tribal communities located in counties that have higher socio-economic resiliency will likely tend to manage change better than similar communities located in counties where socio-economic resiliency is low. Isolated rural and tribal communities that are specialized in grazing but have few other local businesses and experience high unemployment rates are likely to have a proportionately more difficult time adjusting to adverse effects from potentially decreasing levels of grazing on federal lands.

Table 4-47. Uncertainty Associated with Projected First-Decade Changes in AUMs,[1] by Resource Advisory Council/Provincial Advisory Committee (RAC/PAC).

RAC/PAC	Uncertainty
Butte RAC	Medium
Klamath PAC	Medium
Deschutes PAC	High
John Day-Snake RAC	High
Southeastern Oregon RAC	High
Lower Snake River RAC	High
Upper Snake River RAC	High
Upper Columbia-Salmon Clearwater RAC R4	High
Eastern Washington	Medium
Yakima PAC	Low
Eastern Washington Cascades	Low
Upper Columbia-Salmon Clearwater RAC R1	Low

Abbreviations used in this table:
AUM = Animal Unit Month
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] See Table 4-34 earlier in this section for numbers of AUMs. Uncertainty in this table refers to uncertainty expected for Alternatives S2 and S3 based on the projected changes in estimated production levels from Alternative S1.

Table 4-48. First Decade Average Annual Change in AUMs per "Average" Grazing-Specialized Community, byResource Advisory Council/Provincial Advisory Committee (RAC/PAC).

	Number of Grazing-Specialized Communities		Potential Changes from Alt. S1 (Average AUMs/Community)	
RAC/PAC	Total	Isolated	Alternative S2	Alternative S3
Butte RAC	16	5	-200	-230
Klamath PAC	4	1	-880	-790
Deschutes PAC	8	3	-2,290	-2,790
John Day-Snake RAC	41	19	-570	-880
Southeastern Oregon RAC	7	4	-9,670	-12,060
Lower Snake River RAC	27	6	-1,280	-1,320
Upper Snake River RAC	52	3	-2,530	-2,400
Upper Columbia-Salmon Clearwater RAC R4	10	10	-2,860	-3,140
Eastern Washington	37	17	-40	-90
Yakima PAC	14	0	-10	-10
Eastern Washington Cascades	7	2	-10	-10
Upper Columbia-Salmon Clearwater RAC R1	26	13	-10	-10

Abbreviations used in this table:
AUM = Animal Unit Month
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

Source: Derived from Appendix 7, Tables 5 and 6, and Table 4-34 earlier in this section.

Potential Effects on Wood Products Manufacturing (Timber) Specialized Communities

Background

There are 132 identified communities in the project area that have an economic specialization in logging and wood products manufacturing (see Appendix 7). Sixty-four of these communities are classified as geographically isolated, including isolated trade-centers. Of these isolated communities, 6 are identified as associated with an American Indian reservation. The remaining 68 communities are classified as not isolated. Timber harvest and wood products manufacturing have been an important part of the basin's economy since the late 1800s. The timber industry was a primary reason why many towns were established, and why they continue to exist today. The supply of timber is important to wood products industries, and the sale of federal timber provides revenues for county roads and schools under the Payments to States, or 25 Percent Fund Act (Act of May 23, 1908, as amended).

In the past, the timber supply from all ownerships was an important factor in determining how the overall supply in a given area may be affected by changes in supply from one ownership. Increases in the distance that logs can be hauled economically have obscured this consideration. The increased haul distances have reduced differences in log supplies between areas and between ownerships, making predictions about the effect of changes in timber supply on local log users difficult. For the purposes of this analysis, timber supplies from other owners are held constant and local supply differences projected by the alternatives are assumed to affect local mills, even though logs can be, and are, hauled greater distances to day than in the past.

Socio-Economic Effects on Timber Specialized Communities by Alternative

The following discussion highlights the general socio-economic effects that timber-specialized communities may experience under each alternative. Table 4-49 identifies the uncertainty associated with the estimated change in timber supply levels (see Table 4-35, earlier in this section) for Alternatives S2 and S3, based on potential timber sale profitability. Currently, the uses and value of small diameter and salvage trees are limited, and projected increases in marketed volume of these products may result in nonviable timber sales. Therefore, a projected increase in timber supply is assumed to be directly related to increased uncertainty. This uncertainty may be reduced to the extent that marketing of timber sales is improved.

Table 4-50 identifies the potential magnitude of the effect of changes in timber supply (see Table 4-35, earlier in this section) on an average timber-specialized community basis by RAC/PAC. (The "average" community basis does not imply that there is an "average" community, or that the effects will be distributed evenly among these communities. Rather, it is used to provide a comparative basis to display differences between the alternatives.) There are also communities not economically specialized in timber that have wood products industries, and which may also experience increases in timber supplies.

The ability of isolated communities to deal with change may be less than that found in larger non-isolated communities. The resulting impacts may differ in magnitude and duration in isolated rural and tribal communities where fewer economic options are available and fewer opportunities to interact with nearby towns and cities exist. Isolated and economically-specialized communities located in counties that have higher socio-economic resiliency will likely tend to manage change better than similar communities located in counties where socio-economic resiliency is low. In the case of those timber-specialized communities (including isolated rural and tribal communities) which experience no change to moderate increases in timber supply in the first decade, economic and social challenges will be less than if they faced decreases, regardless of socio-economic resiliency.

Potential Effects of Restoration and Prescribed Fire/Fuels Management on Communities

Background

It is estimated that current levels of restoration activity support approximately 290 jobs. As discussed earlier in the Employment section, about 110 to 120 additional jobs (compared to current levels) might be expected from undertaking the forest/woodland and rangeland restoration work envisioned in Alternatives S3 and S2, respectively (Table 4-45, earlier in this section).

Table 4-49. Uncertainty[1] in Timber Sale Viability Associated with Projected First-Decade Changes in Timber Supply, by Resource Advisory Council/Provincial Advisory Committee (RAC/PAC).

RAC/PAC	Uncertainty
Butte RAC	Medium
Klamath PAC	Medium
Deschutes PAC	Low
John Day-Snake RAC	High
Southeastern Oregon RAC	Medium
Lower Snake River RAC	Medium
Upper Snake River RAC	Low
Upper Columbia-Salmon Clearwater RAC R4	Medium
Eastern Washington	Low
Yakima PAC	Low
Eastern Washington Cascades	Low
Upper Columbia-Salmon Clearwater RAC R1	Medium

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] Uncertainty in this table refers to uncertainty expected for Alternatives S2 and S3 based on the projected changes in estimated production levels from Alternative S1.

Table 4-50. First Decade Average Annual Change in Timber Harvest (mmbf) per "Average" Timber-Specialized Community, byResource Advisory Council/Provincial Advisory Committee (RAC/PAC).

	Number of Timber-Specialized Communities		Potential Changes from Alt. S1 (Average mmbf per Community)	
RAC/PAC	Total	Isolated	Alternative S2	Alternative S3
Butte RAC	17	8	1	1
Klamath PAC	2	1	5	5
Deschutes PAC	5	1	0	1
John Day-Snake RAC	22	14	3	3
Southeastern Oregon RAC	5	5	5	3
Lower Snake River RAC	9	1	2	2
Upper Snake River RAC	14	1	0	0
Upper Columbia-Salmon Clearwater RAC R4	5	5	6	5
Eastern Washington	14	12	0	0
Yakima PAC	8	0	0	0
Eastern Washington Cascades	3	2	0	1
Upper Columbia-Salmon Clearwater RAC R1	28	14	0	1

Abbreviations used in this table:
mmbf = million board feet
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

Source: Derived from Appendix 7, Tables 5 and 6, and Table 4-35, earlier in this section.

Employment associated with prescribed fire and fuels management in the first decade is estimated to be substantially higher than for other restoration work. Alternative S3 would support about 1,860 additional jobs, and Alternative S2 would support about 2,550 additional jobs, in addition to the 360 jobs currently supported by these activities.

Socio-economic objectives and standards for both Alternatives S2 and S3 require that restoration activity be focused near those rural and tribal communities that are isolated and economically specialized, and which have the greatest need for economic stimulus. This direction relates to locally determined priorities for restoration as well as those set at the broad scale through identification of high restoration priority subbasins. The management direction requires that the Forest Service and BLM, working with state, county, community, tribal and other federal entities, seek a variety of ways to promote participation of the local workforce and local or tribal businesses in the various restoration and fuels management activities. Therefore, those isolated and economically specialized rural and tribal communities that lie within or adjacent to areas that are a restoration priority, including A2 subwatersheds and/or high restoration priority subbasins, could expect to see higher numbers of jobs and associated economic activity within the first few years of plan implementation than similar communities in areas not prioritized for restoration. (A list of high restoration priority subbasins for Alternatives S2 and S3 can be found in Appendix 15. Information on community location by RAC/PAC and by subbasin within a RAC/PAC can be found in Appendix 7.) Somewhat higher levels of job creation and economic activity related to restoration and fuels management work could be expected under Alternative S3 than Alternative S2.

If either Alternative S2 or S3 were selected, there would be a lag time of months, or even a year or two, before these effects would be realized. This lag time would result in part from the need to complete any required Subbasin Review, EAWS, and NEPA analysis for individual projects or groups of projects.

Effects on Fire Suppression Costs

Fire suppression and fire rehabilitation costs would likely show a limited decrease in the short term because of the amount of time and management actions needed to substantially change landscape disturbance patterns. It could take several decades for management-induced changes in fire regimes to be evident apart from normal season-to-season variation in fire weather conditions. Over the long term, noticeable decreases in the acreage of severe wildfire and associated fire suppression and rehabilitation costs should occur as restoration efforts lead to a progressive shift toward less severe fire regimes. Post-wildfire watershed rehabilitation costs are correlated with wildfire suppression costs, as both reflect the size and severity of wildfires.

Ultimately, there is uncertainty in predicting specific long-term changes in severe wildfire acreage and the suppression and rehabilitation cost that could result. Such a prediction would depend on the complex interaction of natural disturbance processes, the intensity and location of restoration actions conducted by the Forest Service and BLM, and the management of private and other public lands in the project area.

Effects on Communities from Delayed Rate of Implementation

Adverse effects on communities, particularly isolated and economically specialized rural and tribal communities, could result if implementation of the selected alternative (other than Alternative S1) were slower than planned. Slow or delayed implementation would postpone the benefits derived from activities.

A slow rate of implementation of timber harvest activities especially could be cause for concern. Slow or delayed initiation of activities, in addition to changes in the timber program experienced since 1990 (see Figure 2-20, in Chapter 2), could pose potential adverse cumulative effects on the wood products industry and counties whose budgets depend on revenues derived from federal timber sales.

Firms and workers in the wood products industry that have persevered through recent declines could be permanently affected by slow initiation of activities for Alternative S2 or S3, both of which show a first decade increase in timber volume available for harvest.

Temporary mill closures and layoffs can become permanent, resulting in a departure of labor and capital from some rural communities. This may be an inevitable cost of a long-term change in management strategy; however, such losses would represent an unintended consequence of the alternatives if they resulted from a short-term delay in implementing a strategy that would otherwise avoid this outcome. Mill closures and job losses can occur even with rapid implementation if new management direction shifts harvest out of a mill's supply area (assuming alternative timber sources are not available). And some mill closures and job losses will continue through technological and structural changes in the industry that are unrelated to federal land management policies.

Public Participation and Collaboration

Both Alternatives S2 and S3 include several objectives and standards meant to improve the participation of tribes, state and county government, federal agencies, RAC/PACs, and public interest groups in the planning, implementation, and monitoring of Forest Service and BLM land management strategies and activities. Some of these objectives and standards direct the agencies to assist and support local communities, particularly rural and tribal communities that are isolated and economically specialized, to achieve their economic goals. Some refer to improving efficiency in the delivery of goods and services from Forest Service- and BLM-administered lands, in the context of promoting and supporting commercial and economic activity.

Most of these objectives could probably be achieved through current management direction (Alternative S1). However, incorporating additional direction in Alternatives S2 and S3 is expected to improve the agencies' effectiveness at public participation and responsiveness to public needs. The objectives by themselves would not change people's values, but they should increase understanding among the competing interests and improve public involvement in and acceptance of management strategies, so that plans can be implemented with more consistency and predictability.

Effects of the Alternatives on Environmental Justice

Executive Order 12898 (59 Fed. Reg. 7629, 1994) directs federal agencies to identify and address, as appropriate, any disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

Implementation of the selected alternative may potentially incur some of these effects. Should these effects occur, they would most likely be related to potential declines in grazing-related jobs and to changes in road access to areas where special forest products are gathered, particular recreation sites, or special places. These effects could occur if a particular minority or low-income population were involved in one of the types of activities mentioned, and if that population were adversely affected to a greater degree than the corresponding majority (Euroamerican) population.

At the broad scale of this analysis, it is not possible to identify specific effects on local populations, from two standpoints. First, the analysis does not identify site-specific output and activity levels. Effects are not projected for areas smaller than a RAC/PAC area. Therefore, at this scale, it is not possible to identify where changes in grazing jobs may occur at the local level, or where road access changes may take place. Second, a "population" will generally be defined at a local or subregional level (although there may be some exceptions to this). Again, because effects are not projected down to the local level in this analysis, it is not possible to identify specific populations that might be adversely and disproportionately affected.

It is more appropriate to evaluate environmental justice effects during the step-down process. At that finer scale, road access and changes in the road system will be evaluated on a local subregional scale, and more specific effects of applying new rangeland management standards will be assessed at that scale, for example. At the same time, areas of special forest products, recreation use, and special places will be identified, and use by local minority and low-income populations evaluated. Management direction found in Chapter 3 requires identification of potential issues related to environmental justice concerns through Subbasin Review and Ecosystem Analysis at the Watershed Scale (EAWS). Full environmental justice evaluations will be done during subsequent plan adjustment or project-level NEPA analysis.

Major Changes from the Draft EISs

In the Draft EISs, community resiliency was described as a function of population size, economic diversity, attractiveness, amenities, leadership, and the community residents' ability to work together and be proactive toward change. In this Supplemental Draft EIS, additional information by SAG was described, which narrowed the focus to population density, economic diversity, and lifestyle diversity. Socio-economic resiliency ratings were developed for all the counties within the project area.

Cumulative Effects

A basic component of the Interior Columbia Basin Ecosystem Management Project identified in Chapter 1 is to support the economic and / or social needs of people, cultures, and communities through the availability of sustainable and predictable levels of products and services from Forest Service- and BLM-administered lands. This includes the need to contribute to the vitality and resiliency of human communities, consistent with maintaining healthy and diverse ecosystems. The expected outputs and services, and their effects on employment and communities, have been discussed in the preceding sections. This section brings together key components of previous discussions to identify cumulative effects.

Socio-economic Resiliency

Chapter 2 introduced an operational definition for socio-economic resiliency developed at the county level for the interior Columbia Basin (Horne and Haynes 1999). The definition provides a socio-economic resiliency index calculated using a composite of three measures: economic resiliency (defined as diversity of employment), population density (defined as people per square mile), and lifestyle diversity (computed using the PRIZM database [Claritas Corporation 1994]). The index resulted in a low, medium, or high rating for each county in the basin. There is no good or bad connotation to the rating; it is simply one way to identify the potential capability of human communities and economies to adapt to change. A community with low employment diversity, low cultural diversity, and low population density will generally be less resilient in adapting to change compared to communities with opposite characteristics. A community or economy that is less resilient will be at more risk when confronting change.

This analysis takes the county socio-economic resiliency indices, displayed in Appendix 7, and aggregates them by RAC / PAC in Table 4-51 for comparison with the alternative effects identified by RAC / PAC in previous discussions.

The RAC / PAC resiliency scores were derived by summing the county indices and dividing by the number of counties in each RAC / PAC. Counties that are split by RAC / PAC boundaries are counted in each RAC / PAC where they are found. The results are then interpreted by identifying RAC / PACs with resiliency scores below two as being less resilient than RAC / PACs with scores that are two and greater. The alternative effects on employment, population density, or lifestyle diversity are then compared to RAC / PAC socio-economic resiliency scores to indicate their relative adaptability.

At the basin or RAC / PAC scale, the alternatives would not have a measurable effect on population

Table 4-51. Cumulative Effects of the Alternatives on Socio-economic Resilience Ratings, by Resource Advisory Council/Provincial Advisory Committee (RAC/PAC) and Alternative.

RAC/PAC	Resiliency Score[1]	Change in Employment S2	Change in Employment S3	Change in AUMs S2	Change in AUMs S3	Change in Timber (mmbf) S2	Change in Timber (mmbf) S3	Change in Prescribed Fire - Fuels Mgmt (Acres) S2	Change in Prescribed Fire - Fuels Mgmt (Acres) S3
Butte RAC	1.8	490	460	-3,300	-3,700	13	11	187,400	176,500
Klamath PAC	3.0	140	120	-3,500	-3,100	10	10	30,200	24,100
Deschutes PAC	2.2	120	130	-18,300	-22,300	1	3	55,100	55,900
John Day-Snake RAC	1.8	1430	1090	-23,300	-35,900	68	57	438,400	320,100
Southeastern Oregon RAC	1.0	750	410	-67,700	-84,400	26	17	279,100	148,200
Lower Snake River RAC	1.7	180	190	-34,500	-35,700	17	22	23,500	8,100
Upper Snake River RAC	1.7	0	10	-131,300	-124,900	2	2	13,800	15,100
Upper Columbia-Salmon Clearwater RAC R4	1.0	380	310	-28,600	-31,400	29	24	81,000	67,100
Eastern Washington	1.9	60	70	-1,200	-3,300	-1	3	30,900	23,900
Yakima PAC	2.5	10	10	-100	0	1	1	100	0
Eastern Washington Cascades	2.0	40	40	-100	-100	1	2	13,500	10,000
Upper Columbia-Salmon Clearwater RAC R1	1.6	300	300	-300	-300	6	17	122,500	79,700

1 = Low, 2 = Medium, 3 = High

[1] Estimated from county level data identified in Horne and Haynes 1999.

density, so this resiliency component is considered unaffected. A change in lifestyle diversity is likely to be affected by the changes in outputs, services, and uses of BLM- and Forest Service-administered lands. The outputs, services, and uses most affected by the alternatives are: changes in livestock grazing, changes in timber harvest and wood products manufacturing, and changes in additional opportunities to maintain lifestyles associated with working in the woods and on rangelands. Prescribed fire and fuels management acres are used in this analysis as an index of all restoration activity since they are by far the largest component.

Change in employment is also an important factor affecting socio-economic resiliency. Although a change in jobs associated with one industry may have minimal effect on employment diversity, it is assumed that decreases in employment will have negative effects on employment diversity and that increases in jobs will have a positive effect.

The implementation of PACFISH, INFISH, Eastside screens, and Healthy Rangelands has resulted in significant declines in extractive resource uses, especially in the amount of timber harvest. BLM and Forest Service goals to restore, maintain, and improve ecosystem health have also altered the size class and species mix of harvested trees. Implementation of Healthy Rangelands direction on BLM lands has increased the emphasis on aquatic and riparian values, altering management of rangelands and livestock utilization. These changes, represented by Alternative S1, have resulted in impacts on the employment and lifestyle diversity components of socio-economic resiliency.

Alternatives S2 and S3 are designed to manage the risk to human social and economic systems as well as the biophysical components of the ecosystem. Rangeland ecosystem management objectives in these two alternatives would result in AUM declines across all of the RAC/PACs. At the same time, however, ecosystem restoration would result in more timber supply and associated timber-related jobs, and more restoration related employment in those RAC/PACs where the potential for forest ecosystem restoration exists. For example, the greatest declines in AUMs would be found in the Upper Snake River RAC, but there are few opportunities to mitigate lifestyle and employment losses associated with grazing declines with additional restoration associated with forested ecosystems. In the Southeastern Oregon RAC, where AUM declines are the second greatest, there are opportunities to mitigate negative socio-economic effects with increased opportunities in restoration.

Both Alternatives S2 and S3 would result in positive cumulative effects on employment and lifestyle diversity in every RAC/PAC compared to Alternative S1. Furthermore, over 90 percent of the increases in timber and restoration activities occur in RAC/PACs with resiliency scores that are less than two. However, individuals and communities who are highly associated with Forest Service and BLM livestock grazing may be negatively affected. Overall, the emphasis of Alternative S2 to minimize short-term risk to the biophysical ecosystem through more restoration activity during the first decade also addresses short-term socio-economic resiliency concerns more than Alternative S3.

Risk Management

The underlying theme of both Alternatives S2 and S3 is management of risk. This includes risk to physical and biological components of ecosystems as well as risk to human communities. Both alternatives seek to manage and minimize the risk to these systems over the long term through protection of important aquatic, riparian, and terrestrial habitats; an aggressive program of ecosystem restoration; and an emphasis on conducting employment- and income-producing management activities near those communities most in need of economic support and stimulus.

The primary difference in focus between the two action alternatives is the degree to which greater levels of short-term risk are accepted while still managing for the same level of long-term risk management and reduction. Alternative S3 accepts a somewhat higher level of short-term risk to biophysical components of ecosystems through less emphasis on conducting Subbasin Review and Ecosystem Analysis at the Watershed Scale prior to implementation of management activities in the first decade.

Management of risk to communities in the basin from changes in federal land management policies, particularly those rural and tribal communities that are isolated and economically specialized, is emphasized in the social-economic-tribal components of both base-level and restoration management direction for Alternatives S2 and S3. In particular, the objectives, standards, and guidelines in the base-level management direction section, Support Economic and Social Needs of Communities and Cultures, emphasize design and use of sales and services contracts that will promote participation of local community and tribal businesses and work force in management of nearby Forest Service- and BLM-administered lands. The objectives, standards, and guidelines in both the base-level and restoration management direction sections also emphasize giving highest priority to conducting management activities, such as restoration work, in areas near communities and reservations with the greatest economic need.

The identification of high restoration priority subbasins provided a way to integrate restoration needs and opportunities for a variety of ecosystem components and functions, including aquatic and terrestrial species and habitats, habitat mix, disturbance/succession processes, and human social and economic needs. Identification of these subbasins is a major step toward managing risk to forest and rangeland ecosystems, as well as to human communities, while getting the greatest return for the funds expended.

The emphasis of Alternatives S2 and S3 on risk management and reduction is reflected in the effects of the alternatives, as described earlier in this chapter. At least during the first decade, the two action alternatives would generate mostly neutral to positive results for human social and economic needs that may be affected by agency actions. However, the agencies are limited in the amount of overall risk to biophysical components of ecosystems and to human communities that can be mitigated. Many forces are outside the agencies' control. External forces that may affect social and economic conditions include population changes, industry restructuring, changes in economic supply and demand, lifestyle preferences, and climatic changes. In addition, there are legal and regulatory bounds within which the agencies must operate that may limit the amount and type of economic and social support that can be provided directly from the federal level. To the degree those may be limiting, the objectives, standards, and guidelines of the alternatives direct that the agencies support and cooperate with other economic development efforts led by other federal, state, and local entities.

Quality of Life

Quality of life refers to the satisfaction people feel for the place they live (or may visit) and for the place they occupy as part of that experience. As discussed in Chapter 2, a variety of factors affecting quality of life are important to residents and visitors of the interior Columbia basin. Among these are air quality, water quality, open spaces (both with and without roads), and scenery, along with employment opportunities and availability of amenities. In general, there is a concern for balance between environmental and economic facets affecting quality of life.

The interpretation of quality of life factors differs for each individual depending on his or her personal values, occupation, economic status, and other factors. Many factors— such as community infrastructure, medical, education and commercial services, and crime rates—are not directly influenced by Forest Service and BLM management decisions. However, some may be affected by agency decisions, including water and air quality, open spaces, roadless/unroaded lands, scenery, and, to some degree, employment opportunities.

There is no one comprehensive way to measure how the alternatives may affect the quality of life of project area residents. Many other variables that make up one's sense of quality of life are not under the control of the BLM or Forest Service. These factors may be affected by local, regional, national, or global forces. They may change within the basin from year to year or from decade to decade, at regional or local levels, regardless of federal land management decisions. One's perception of whether quality of life is good or bad, better or worse, also is a very personal issue. Two people living under very similar circumstances may have widely varying perceptions about their quality of life. Furthermore, changes in the surrounding economic, social, or natural environment please one person may well displease another.

As with most change, some people would receive a disproportionate share of the benefits while others would bear a disproportionate share of the costs. Accordingly, some may feel their quality of life would improve while others may feel a decline. Rather than measuring how quality of life may be changing, this analysis identifies how the Forest Service and BLM may affect several components used in describing the quality of life.

With their focus on restoration of ecosystem function and healthy habitats, Alternatives S2 and S3 both are expected to have more positive effects on air quality and water quality than Alternative S1. Restoration of aquatic systems and riparian areas should provide improvements in water quality, at least in areas within or just downstream from agency lands. Reduction of forest fuels buildups and restoration of more fire-resistant vegetation structures should lead to long-term improvements in air quality as incidence of large and intense wildfires declines.

Although there will be a much larger amount of prescribed fire in the first decade under Alternatives S2 and S3, compared with Alternative S1, the smoke generated will be spread over the entire burning season (spring through fall), and is not projected to cause health risks or create long-term or large-scale visibility problems. In contrast, smoke generated by large wildfires is typically much more dense, more of a potential health risk, and can cause large-scale visibility problems over wide areas for days, or even several weeks at a time. The increase over the first decade or two in smoke levels from prescribed fire, spread out over the entire burning season, is a near-term tradeoff for a longer-term reduction in the risk of large-scale uncharacteristic wildlife and the associated major air quality impacts.

None of the alternatives is expected to adversely affect open spaces in the basin. Alternatives S2 and S3 over the longer term will contribute more to open spaces that are undisturbed by motorized vehicle traffic, as well as preservation of currently unroaded lands, because fewer roads would be built and some roads would be closed and decommissioned in order to reduce road network densities.

In the short term there would be little difference in effects on scenery among the alternatives. Over the longer term, Alternatives S2 and S3 would be expected to have more positive effects on scenery and scenic quality than Alternative S1, because occurrence of uncharacteristic wildlife would be reduced, riparian areas would be restored, and some vegetation types such as ponderosa pine would be returned to a more characteristic open park-like state.

As displayed earlier in the discussion of effects of the alternatives on employment, at the basin and RAC/PAC levels, adoption of either Alternative S2 or Alternative S3 would result in an overall increase in the employment opportunities in the first decade. Positive effects on employment would occur in the lumber and wood products sector from the commercial utilization of wood volume harvested as part of ecosystem restoration activities, as well as from the actual work undertaken for forest and rangeland restoration and for prescribed fire/fuels reduction. These positive effects would offset projected declines in grazing-related employment at the basin and RAC/PAC levels.

Employment effects basin-wide and at the RAC/PAC scale may mask more locally significant changes that would occur at the county or community level. Changes that affect employment opportunities, either positively or negatively, disproportionately more at the local level than at the basin level may contribute to a more discernable change in quality of life at the local scale than is evident over the broader region.

While there may be local quality of life effects that are more pronounced, or that run counter to, the effects at the basin or RAC/PAC scale, it is not possible to identify those potential finer-scale variations from this broad-scale analysis. However, such variations should become more apparent from the mid-scale and fine-scale analyses to be conducted as part of the step-down process.

In summary, as described above, agency decisions may affect some variables that define an individual's or group's quality of life. However, it is not possible predict actual changes in quality of life at various scales within the basin over the next decade or two based on adoption of any of the alternatives.

Sense of Place

"Sense of place" refers to how individuals or groups define and relate to specific geographic locations. These may be specific natural features; areas such as a particular plain, watershed or park; or a community. A key component of residents sense of place in the basin is living near public lands.

At the broad scale of this Supplemental Draft EIS, it is not possible to identify effects of proposed agency land management decisions on particular places. However, this is an important consideration for potential effects on one of the quality of life factors, for tribes, and for possible environmental justice effects. Therefore, potential effects on sense of place will be further analyzed and considered through mid-scale and fine-scale analyses during the step-down process.

Socio-economic Tradeoffs

Ecosystem management and restoration is a long-term process. For some ecosystem components, such as recovery of riparian areas, aquatic habitat, and anadromous fish populations, it may take 20 to 50 years to bring about substantial change over broad landscapes. While management direction and projected effects are based on the best available science, there is still a fairly wide band of uncertainty around just what the actual state of an ecosystem will be 50 to 100 years from now.

Management actions taken to prevent further degradation of ecosystems, or to restore ecosystems already in a degraded state, often require a substantial shift in land management policies and practices. In the case of the interior Columbia River basin, this shift began with the implementation of the Eastside screens, PACFISH, INFISH, and Healthy Rangeland strategies.

A shift in land management policies and associated activities to accomplish long-range ecosystem objectives may result in relatively immediate changes to human economic and social patterns. Projections of these shorter term social and economic changes will generally have a higher degree of certainty than projections of ecosystem changes 50 years or more into the future. It is therefore important to identify any short-term social and economic changes, or tradeoffs, that will take place in order to achieve longer-term ecosystem objectives.

As discussed earlier in this chapter, the expected short-term socio-economic effects from implementing either Alternative S2 or Alternative S3, when compared to Alternative S1, are minor but positive in the first decade at the basin scale. The exception is a relatively small projected decrease in grazing AUMs and associated employment. At the RAC / PAC level, short-term effects are expected to be proportionally more positive for several RAC / PACs, and minor but still positive for others. Thus, the implementation of either action alternative to achieve positive long-term ecosystem results is also expected to result in positive near-term socio-economic gains as well, rather than (negative) tradeoffs.

As has been emphasized throughout this section, more individual county and community differences can be expected, compared to the basin- and RAC / PAC-level results. Those differences will become more apparent at finer scales of analysis during the step-down process than can be determined at this broad scale. Where more localized tradeoffs are identified, the objectives, standards, and guidelines of the ICBEMP EIS and implementing Record of Decision are designed to mitigate those effects to the greatest degree possible, and to provide additional assistance and support to communities with economic need.

Federal Trust Responsibility and Tribal Rights and Interests

Methodology: How Effects on Tribal Rights and Interests Were Estimated

Background

Identification of criteria for assessing potential effects of proposed ICBEMP management strategies evolved over a several year period, beginning with staff-to-staff and government-to- government meetings and other information sources. In assessing the Draft EIS alternatives, a socio-cultural evaluation of the alternatives was conducted in part by a panel of representatives of affected American Indian tribes. The methods adopted by the panel to assess effects on American Indian tribes were primarily qualitative, based on selected key indicator variables emphasizing topical areas on which tribal issues appeared to focus. Early project efforts are described in Chapter 4 of the Draft EISs and in Burchfield, Allen, and McCool (1997).

Several key developments occurred since the tribal panels convened. In December 1997, Secretary of the Interior Bruce Babbitt met with representatives of the tribes potentially affected by the ICBEMP management decisions. As a result, a Tribal/ESC (ICBEMP Executive Steering Committee) Working Group was initiated to work on incorporating tribal rights and interests into the integrated project land management strategies. In addition, three Regional Tribal Summits were held, and project executives and staff have continued an ongoing dialogue with tribal governments and staff, further refining what are essentially evaluation criteria.

Commonly at issue was how management direction has progressed or changed since the Draft EIS. New studies of tribal communities in the region also appeared, including Economic Contributions of Indian Tribes to the Economy of Washington State (Tiller and Chase 1998). New formal guidance addressing government-to-government relations has appeared as well, including the 1996 Executive Order 13007 addressing protection of sacred sites, the 1997 Secretarial Order 3206 addressing tribal rights and the Endangered Species Act, and Executive Order 13084 of May 14, 1998, addressing consultation and coordination with Indian tribal governments regarding development of federal policies.

Broad-scale Evaluation Methods for Consideration of Tribal Rights and Interests, Habitat Trends, and Harvestability

American Indian tribes and tribal communities depend on Forest Service- and BLM-administered lands for economic, cultural, subsistence, religious, and treaty purposes. The culture as well as the rights and interests of American Indian people are rooted in these lands, and tribal teachings are based on understanding the relationship between themselves, as a people, and the land and its resources. While at the broad scale these values cannot be quantified or measured in a scientific sense, the following evaluation methods are possible:

a. The ability of alternatives to protect and/or restore habitat for species associated with the rights and interests of tribes can be evaluated and the habitat trend predicted;
b. Alternatives can be evaluated on their relative influence on aiding ecological processes such as natural disturbance regimes and proper functioning condition, upon which tribal rights and interests depend;

c. Alternatives' responsiveness to tribal social / economic needs and considerations can be considered; and

d. The responsiveness of alternatives to providing for consistent and substantive tribal consultation and involvement can be estimated. This is important because protection and / or restoration of habitat important to the rights and interests of tribes is predicated upon substantive consultation with tribal governments.

Accordingly, management direction was evaluated several ways for each alternative:

1. The Science Advisory Group (SAG) assessed potential effects of Supplemental Draft EIS alternatives on tribal rights and interests using three primary criteria categories: Politico-legal Relations, Ethno-habitat Management, and Socio-Economics. These categories represent an artifical collapsing of the eight basin-wide tribal issues that management direction is intended to address (see sidebar on basin-wide tribal issues).
2. Implementation of management direction was modeled by the SAG where possible. For example, selected species (plant, animal, fish / aquatic) generally important to the rights and interests of American Indian tribes were associated with vegetative cover types and structural stages, as well as with source habitat for the 12 Terrestrial Families and with the habitats for key salmonids, where appropriate. Habitat and species trends were then predicted based upon these findings.
3. Trends (historical, current, projected future) in habitat status or population outcomes were used to measure the habitat's capability to provide harvestable populations of resources associated with tribal rights and / or interests.
4. Where effects couldn't be modeled (such as much of the process direction for consultation, monitoring, and step-down analysis), evaluation was qualitative and based on whether or not the alternative contained direction which appeared to be responsive to basin-wide tribal concerns.
5. Selection of subbasins for active restoration actions was considered critical for assessing the relative effects of the alternatives on tribal interests. Subbasins in the region were identified as high priority based, in part, on tribal interests (offering the highest need or most opportunity for the restoration of resources important to tribes in addition to enhancing employment and economic development opportunities).

Rationale for Qualitative Interpretations of Modeling of Management Alternatives

While the Science Advisory Group (SAG) measured effects using various predictive models, many times these methodologies were unable to incorporate and measure the effects of implementing direction on tribal rights and interests, which may differ significantly from non-tribal implications.

For example, social-economic considerations for tribes include tribal subsistence, cultural, or treaty uses. Where SAG models or analysis processes were unable to fully display the effects of management direction, socio-economic findings were qualitatively adjusted. Typical social / economic indicators, such as the ones used to characterize specialized communities in the interior Columbia Basin, do not readily lend themselves to characterization of reservation communities. For example, "industry specialization" presupposes that there is industry present which can be categorized and compared relative to other communities across the project area. It also presupposes that the value of federal lands and resources is primarily associated with the commodity products they provide relative to these industries. This generally is not the case for American Indian tribes and tribal communities, although some elements may have application for tribal communities. Where applicable, these were emphasized in the social-economic analysis; where they were not applicable, alternatives were evaluated on how well management direction responded to tribal basin-wide issue of employment and economics, as well as the protection and / or restoration resources on lands administered by the Forest Service and BLM, which are critical to reservation communities and the American Indian people who live there.

Two factors were important for an assessment of ethno-habitat management effects: (1) health and abundance of ethno-habitats (as indicated by relative protection and / or restoration direction, and habitat trends for harvestability), and (2) American Indian access to ethno-habitats for harvest. Consequently, to provide a relative ranking of effects on resources associated with contemporary Indian interests, a qualitative assessment was made as to how alternatives: (a) would provide for consideration of the exercise of tribal reserved rights as provided by

Basin-wide Tribal Issues

Language in quotations is from Tribal/ESC Working Group material provided by tribal representatives. Other language is summarized or paraphrased by ICBEMP. NOTE: Since the issues influence and are interdependent in their relationship to one another, there is much overlap between these major areas. Furthermore, the eight issues, while raised and defined by tribal representatives in a working group and discussed in numerous other forums between tribal and agency leadership, should be understood to be an artificial collapsing of project-area-wide tribal issues and concerns. Any particular tribe, as an individual sovereign, may have offered a significantly different mix of issues as their own.

1. Treaty/Federal Trust Responsibility: "The federal government and the tribes must develop a common understanding of the federal government's trust responsibility. This includes land management designed to protect resources reserved by treaties or executive orders. It is likely that we (tribes) would have to identify those resources."
2. Harvestability as Soon as Possible (ASAP): Harvestability refers to the availability of sufficient habitat for adequate numbers of aquatic, animal, and plant species for harvest by tribes as a part of their culture and for the meaningful exercise of reserved rights. ASAP is in reference to those species (particularly salmon) currently at risk and the tribal desire for federal management of habitat to aid species progression from viability to recovery and harvestability in the shortest possible time frame by managing or avoiding further risk to these at-risk species and their habitat.
3. Basin-wide Habitat Standards: "The tribes and the federal government must agree on a set of binding basin-wide objectives for anadromous fish, freshwater fish, wildlife, and plant species that will ensure restoration of these resources."
4. Interagency and Intergovernmental Coordination/Collaboration: "The federal government's land management decision-making will affect Columbia Basin fish and wildlife restoration efforts. Federal land management must be thoroughly coordinated... and these decisions must be consistent with federal trust responsibilities and Indian treaty rights."
5. Monitoring and Accountability: "The federal government must commit to monitoring and accountability protocols."
6. Government-to-government Collaboration/Consultation: "The Tribes and the Federal government need to develop a streamlined, meaningful, and feasible consultation process that results in a resolution of the issues."
7. Implementation Funding: "There is very little likelihood that Congress will fully fund ICBEMP (nor will) the regulatory agencies (EPA, NMFS, and the USFWS) receive the funds needed to implement their obligations under the existing ICBEMP fish habitat and water quality management approach. (Save) the expense of analysis... by implementing simple riparian prescriptions." If not fully funded, don't selectively scale back portions of the decision, such as monitoring, but all aspects of the decision.
8. Tribal Economics and Unemployment: Tribes depend on Forest Service- and BLM-administered lands for economic, as well as cultural, subsistence, religious, and treaty purposes. ICBEMP should strive to provide employment or contracting opportunities in which tribes can participate and aid in tribal community well-being as well as the recovery of the land and resources.

treaty or executive order; (b) would provide for consideration of tribal access to healthy ethnohabitats in traditional use areas as provided by federal statute; and, (3) would protect and/or restore resources and species important to tribes as well as landscape processes.

Variation among the three Supplemental Draft EIS alternatives regarding monitoring and accountability was determined to be insignificant for evaluation purposes; however, this was qualitatively adjusted for the following reasons: While Alternatives S2 and S3 would be equally responsive, Alternative S1 would rate lower since no basin-wide monitoring strategy is required under this alternative, and there is no multi-scaled analysis process to aid monitoring and adaptive management efforts, which are defined as inclusive of tribal participation.

Effects of the Alternatives on Federal Trust Responsibility and Tribal Rights and Interests

Assessment of effects on federal trust responsibility and tribal rights and interests is difficult at the broad-scale level. Because of various factors including distinctness of communities, their spatial discreteness, and the sensitivity of resource and economic information, assessments should more appropriately be performed at finer scale levels in coordination with the tribes. However, some trends can be identified and are summarized here. Discussions are arranged by the categories used by the Science Advisory Group (SAG) in their assessment of potential effects of the Supplemental Draft EIS alternatives on tribal rights and interests (Hanes 1999):

- Politico-legal Relations,
- Ethno-habitat Management, and
- Socio-Economics.

These categories represent an artifical collapsing of the eight basin-wide tribal issues that management direction is intended to address (see sidebar on basin-wide tribal issues).

Politico-legal Relations

Politico-legal relations stresses the unique relationship between the federal government and tribal governments that is distinct from social communities found in the region. Included in this category are Treaty and Federal Trust Responsibility, Intergovernmental Coordination and Collaboration, and Federal Monitoring and Accountability criteria.

Key factors influencing the qualitative rankings of alternatives for politico-legal relations was the relative degree that alternatives would provide for consistency in interagency, region-wide consultation policies and guidelines, and the relative opportunities for tribal government access to and involvement in agency planning and decision-making.

Overall, Alternative S2 for long-term benefits, and Alternative S3 for short-term benefits, would likely bring about enhanced agency–tribe relations through more effective approaches in communication and an emphasis on a balance of agency policy, program, and project level participation of tribes.

Table 4-52 shows a relative ranking of 1, 2, or 3 to indicate a range from most to least, respectively, of how responsive management direction is to four primary issue areas of tribal-BLM / Forest Service relations, based on qualitative information and the description of the alternative.

Treaty/Federal Trust Responsibility

All three Supplemental Draft EIS alternatives reflect the management intent to be responsive, as land management agencies, to the federal trust responsibility and the rights and interests of affected federally-recognized tribes. However, Alternative S2 appears to be most responsive to honoring the federal trust responsibility and consideration of tribal rights and interests (Table 4-52), because it best responds to several critical tribal issues:

- While Alternative S1 may retain greater riparian and aquatic prescriptive language, in some cases, than Alternatives S2 and S3, it does not have the basin-wide integrated restoration strategy which would provide not only for aquatic needs but also terrestrial, landscape, and social considerations. Alternative S1 also lacks a basin-wide monitoring strategy.
- While both Alternatives S2 and S3 have basin-wide direction for the protection and restoration of habitat, Alternative S2 would provide more upfront direction (processes and prescriptions) than Alternative S3, and therefore higher certainty to tribes of consistent and accountable implementation.
- Alternative S2 also would provide the highest levels of habitat protection for habitats of species most at risk than either Alternative S3 or Alternative S1. Alternative S1 has no management direction aimed at protection and / or restoration of key habitats and species in A1, A2, or T areas. Alternative S3 has the same protection and restoration for T areas as Alternative S2, but less area in A1 and A2 subwatersheds.
- Because of the increased requirements for multi-scaled analysis, there would be greater predictability in Alternative S2 than in Alternative S3 or Alternative S1, that risk will be managed conservatively and restoration will be focused where it most needs to occur.

Table 4-52. Relative Effects of the Alternatives on Politico-legal Relations.

Issue Area	Alternative S1	Alternative S2	Alternative S3
Treaty/trust responsibility[1]	3	1	2
Federal intergovernmental coordination[2]	3	1	1
Tribal consultation[3]	3	1	2
Federal monitoring and accountability[4]	3	1	2
Politico-legal relations overall	3	1	2

1 = Management direction most responsive to tribal basin-wide issues on this subject; 3 = least responsive.

[1] To provide a *relative ranking for treaty/trust responsibility*, consideration was given to the relative degree that alternatives are responsive to the eight basin-wide tribal issues. Since no federal land management interpretation exists which definitively denotes respective treaty/trust responsibilities, federal managers have strived to honor treaty and trust responsibilities by being as responsive as possible to tribal issues and concerns regardless of whether it was done as a legal trust obligation or a matter of policy. Relative ranking is also based upon how well alternatives would provide for protection and restoration of treaty resources and other resources important to the rights and interests of tribes.

[2] To provide a *relative ranking of federal intergovernmental coordination*, a qualitative assessment was made as to how alternatives would provide for interagency and intergovernmental coordination on basin-wide issues involving federal land management. Also examined was how well alternatives provided opportunities for involvement of regulatory agencies in BLM and Forest Service planning and decision making processes.

[3] To provide a *relative ranking of tribal consultation,* a qualitative assessment was made as to how well alternatives would provide opportunities for tribal consultation, as well as define and provide direction for substantive tribal consultation in multi-scaled analysis and decision making processes.

[4] To provide a *relative ranking of federal monitoring and accountability,* a qualitative assessment was made as to the amount and type of management direction provided by alternatives. Alternatives were rated based upon the amount of prescriptive and process direction, as well as the amount of designated T, A1, and A2 areas.

- Alternatives S2 and S3 would be most responsive to the restoration of resources and species significant to potentially affected tribes. Of the 16 high restoration priority subbasins emphasizing restoration for tribal interests, 11 are included in Alternative S2; all 16 are included in Alternative S3, and none are identified in Alternative S1. While Alternative S3 may appear to be more responsive to restoration because it includes more subbasins with a tribal emphasis, has less emphasis on analysis, and has more on projects, actually Alternative S2 appears to be the better performer. This is mainly because Alternative S2 would have more restoration activities spread over fewer subbasins, so the rate and intensity of restoration would be greater for habitats in those subbasins than it would be for Alternative S3, which must cover more ground with less restoration activities.

Intergovernmental Coordination and Collaboration

Generally, Alternatives S2 and S3 would provide the best approach to appropriate government-to-government consultation (Table 4-52).

This is expected given that Alternative S1 would not address the inconsistencies in tribal consultation between agency administrative units or emphasize a more effective consultation process as found in Alternatives S2 and S3. Under existing BLM and Forest Service regional guidance and land use plans (Alternative S1), management actions addressing the government-to-government relationship with tribes have little and varying direction to address the complex federal legal responsibilities toward tribes. When dialogue does occur between agencies and tribes, it typically occurs within the context of agency business and the NEPA process rather than being a government-to-government-driven dialogue process. Agency expectations for tribal responses to their inquiries within specified regulatory time frames, which legally apply only to federal agencies, maintain stress on agency-tribe relations.

Alternatives S2 and S3 would provide direction for more opportunities for tribal involvement in both planning and decision-making processes than would Alternative S1, based on an approach to identify, understand, and work toward resolving conflicts through a relationship characterized by ongoing dialogue between agencies and tribes. As time passes and relations are developed based on effective consultation, and as ethno-habitat trends, access, and ecosystem conditions are addressed, it is expected that agency–tribal relations will improve. Alternatives S2 and S3 also would enhance the development of tribal self-governance programs and would more effectively support tribal self-determination than would Alternative S1. (However, Alternatives S2 and S3 could also be seen as somewhat limiting opportunities for consultation and access to agency policy-making by providing up-front structure to management decisions through identification of high priority restoration subbasins, as well as A1, A2, and T areas.)

Some differences do exist between Alternatives S2 and S3. For instance, with more restoration subbasins potentially located near tribal lands in Alternatives S3 than Alternative S2, opportunities for collaboration at the project level may be heightened in Alternative S3 at least for short-term beneficial results; however, there is more certainty and accountability under Alternative S2 because of increased multi-scaled analysis requirements aiding the focus of restoration and protection.

Alternative S2, with more extensive requirements for analysis at finer scales, would provide increased opportunities for tribal involvement in planning processes over Alternative S3. Alternatives S2 and S3 also would provide for a more tiered contribution from tribes in agency planning and decision-making processes than would Alternative S1. In other words, requirements for tribal consultation in each analysis process (broad, mid, fine, project) as well as in project decisions provides opportunities for tribes to "nest" responses to their concerns at different scales so that they all contribute to an overall solution rather than focusing at any one scale. Since Alternative S2 has more extensive multi-scaled analysis requirements, it would somewhat outperform Alternative S3 for the long term, and would greatly outperform Alternative S1.

Federal Monitoring and Accountability

Alternatives S2 and S3 would be comparable relative to monitoring and accountability, Alternative S1 would rate lower since no basin-wide monitoring strategy is required under this alternative, and there is no multi-scaled analysis process to aid monitoring and adaptive management efforts, which are defined as inclusive of tribal participation.

Regarding monitoring processes, Alternatives S2 and S3 would offer basin-wide monitoring strategies and multi-scaled analysis while Alternative S1 would not. No broad-scale monitoring strategies, particularly interagency in nature, are currently in place to be carried forward by Alternative S1. Consequently, with greater multi-scaled analysis requirements, Alternative S2 potentially offers the most comprehensive monitoring strategy.

Regarding accountability in basin-wide objectives, the project sought to develop an integrated ecosystem strategy, including "binding" basin-wide objectives and standards which ensure appropriate protection and / or restoration of resources. While the resultant strategy is multi-species and emphasizes aquatic, terrestrial, landscape, and social elements, many of the principles and objectives for management of resources and associated species in the ICBEMP preferred alternative are considered consistent with the Columbia River tribes' salmon restoration plan, Wy-Kan-Ush-Mi Wa-Kish-Wit (Columbia River Intertribal Fish Commission 1995).

Accountability factors also potentially vary by alternative. Although legal responsibilities and requirements are consistent across all alternatives, the emphasis on process in Alternative S2 offers a greater role for step-down processes, monitoring, and tribal collaboration. Collaboration would likely become more consistent across the region under Alternative S2 than Alternative S1 or Alternative S3. Additionally, because of multi-scaled analysis involvement, tribes can "nest" responses to any particular issue at the appropriate scale and better contribute to an overall solution; this is better responded to by Alternative S2 than Alternative S3, and it is not addressed in Alternative S1.

Ethno-habitats are those portions of the natural habitat range of plant and animal species that play a role in sustaining important socio-cultural traditions of tribal communities.

Ethno-habitat Management

Ethno-habitat management criteria invoke a broad range of terrestrial and aquatic resource interests, including water quality and quantity. Ethno-habitat issues involve protection and restoration of resources, harvestability, and access factors.

Ethno-habitats are considered here as those portions of the natural habitat range of plant and animal species (including fish and other aquatic species) that play a role in sustaining important socio-cultural traditions of tribal communities (see Chapter 2).

Given the reliance of tribes on these lands and resources, evaluation of the alternatives considered the protection and / or restoration of terrestrial and aquatic resources, species, and landscape processes, as well as the water that sustains ethno-habitat health.

Two factors were important for this assessment: (1) health and abundance of ethno-habitats (as indicated by relative protection and / or restoration direction, and habitat trends for harvestability), and (2) American Indian access to ethno-habitats for harvest. Consequently, to provide a relative ranking of effects on resources associated with contemporary Indian interests, a qualitative assessment was made as to how alternatives: (a) would provide for consideration of the exercise of tribal reserved rights as provided by treaty or executive order; (b) would provide for consideration of tribal access to healthy ethno-habitats in traditional use areas as provided by federal statute; and, (3) would protect and / or restore resources and species important to tribes as well as landscape processes.

Overall, for long term region-wide results, Alternative S2 would offer the best opportunity of the three alternatives for addressing protection and restoration of ethno-habitats, access, and harvestability considerations as they relate to tribes. Alternative S3 may present more opportunities to address resources and habitats important to tribes in those high priority restoration subbasins near reservations, than would Alternative S2. However, the benefit may be more applicable to the particular tribe(s) associated with the reservation rather than to the ethno-habitats basin-wide. Again, this is because Alternative S3 would have a lower rate and intensity of restorative actions than Alternative S2.

Table 4-53 shows a relative ranking of 1, 2, or 3 to indicate a range from most to least, respectively, of how responsive management direction is to four primary issue areas of ethno-habitat management, based on qualitative information and the description of the alternative.

Important Species and Habitats

American Indian tribal cultural uses in the project area typically have their basis in individual cultural traditions and seasonal subsistence patterns (see Chapter 2), involving acquisition or use of potentially hundreds of species and use of many ethno-habitat types over the course of a year. Traditional uses considered here include Indian peoples' sacred values and uses of the landscape and cultural places. Because of the critical importance of tribal fisheries and their extensive decline in recent years, aquatic species and habitats are particularly important for the ethno-habitat evaluation. Analyses show that all alternatives would improve aquatic habitat condition and population status for the six key salmonids compared to projected current conditions over the long term. Alternative S2 would result in the most improvement followed by Alternative S1 and Alternative S3. Alternative S2 would maintain riparian ecological processes through time based on the RCA delineation criteria. Some uncertainty is associated with the other two alternatives, where one-half site potential tree height is used as an interim RCA delineation criteria. For more detailed discussion on aquatic habitat and riparian effects refer to the Aquatic Effects section of this chapter.

Table 4-53. Relative Effects of the Alternatives on Ethno-habitat Management.

Issue Area	Alternative S1	Alternative S2	Alternative S3
Protection/restoration of important species/habitats/ water	3	1	2
Restoration of landscape processes	3	1	2
Harvestability	3	1	2
Access	3	1	2
Ethno-habitat management, overall	3	1	2

1 = Management direction most responsive to this subjects and basin-wide tribal issues; 3 = least responsive.

The elements in Table 4-53 were rated relative to each alternative using a 1, 2, or 3 to show a range of most to least able, respectively, to respond to tribal issues of harvestability, provide for basin-wide protection and/or restoration of ethno-habitats and resources important to tribal rights and interests, and provide access to these resources and places. Greater emphasis on direction addressing negative road effects was not assumed to equate to negative impacts to tribal access, since management direction requires tribal consultation and involvement in access management decisions. Predicted road closures, however, were assumed to provide greater protection to sacred and cultural resource sites important to tribes. Alternatives with more T, A1, and A2 areas were less responsive to access, but rated higher for resource protection and restoration.

Regarding anadromous fishes, habitat capacity is expected to substantially increase under all alternatives. Overall habitat capacity results indicate that Alternative S2 would result in a stronger trend than Alternative S1. Outcomes for Alternative S3 are consistently lower than the other alternatives. Although habitat capacity would improve under all alternatives, population status outcomes reflect minor or no improvement. This reflects the uncertainty associated with migration corridor survival, especially for populations above several dams in the Snake River and Upper Columbia River. For more detailed discussion on anadromous fish effects refer to the Aquatic Effects section of this chapter.

The SAG did not attempt to model the effects of changes in habitat on narrow endemic and sensitive fishes because the specific environmental requirements of these species are largely unknown. However, SAG did provide trends which are useful for determining which species may experience relatively large or minor changes compared to current conditions. Trends in habitat capacity would be positive under all alternatives. The largest changes in habitat capacity would occur in Alternative S2, followed by Alternative S1. Alternative S3 would not result in the most improvement for any species in this analysis. For more detailed discussion on narrow endemic and sensitive fishes refer to the Aquatic Effects section of this chapter.

Regarding the plant habitat analysis (Croft and Owen 1999), problems of scale are associated with the findings. If one were to look at the basin-wide outcomes associated with some species of interest to tribes, it would appear that all alternatives would result in a continued decline despite habitat gains on federal lands and the increased restoration emphasis of two of the alternatives. This conclusion, however, must be qualified by the fact that many of these plants and their associated habitats tend toward micro-environments rather than broad bands of vegetative communities. Analyses at finer scales may display other results. Probably the most critical finding is that "restoration actions that improve landscape outcomes also improve plant habitats important to tribes;" this then leads to Alternative S2 being most responsive. Further, the analysis also asserts that tribal consultation direction, coupled with step-down analysis requirements regarding resources and lands important to tribes, would further contribute to the protection and / or restoration of plants and plant habitats associated with the rights and interests of tribes. Given the greater requirements for multi-scaled analysis and protection / restoration direction, as well as consultation requirements of Alternative S2, it again appears that Alternative S2 would be more responsive than Alternative S3 or Alternative S1.

The concerns and issues involving water are broad and related to a host of tribal rights, social-economic needs, cultural uses, and property interests. Tribal governments are especially concerned about water quality and quantity, hydrologic functions, aquatic ecosystems' integrity, and soil integrity. Alternative S2 is predicted to have a more positive influence on improving water quality, followed by Alternatives S3 and S1. The restoration emphasis intended to reduce uncharacteristic adverse effects from disturbances indicates that Alternative S2 would maintain or slightly restore hydrologic processes, more so than Alternative S3. The highest benefits to water quality, hydrologic function, and soil productivity are expected to be gained with higher levels of landscape restoration that would occur in the high restoration priority subbasins under Alternative S2. Alternative S3 would provide similar benefits, but in smaller amounts across the project area. Alternative S1 is predicted to maintain hydrologic function at current levels. The maintenance approach in Alternative S1 would not promote restoration of broad-scale landscape processes that influence water quality, hydrologic function, or soil productivity. No decreases in long-term soil productivity would result from implementing any of the alternatives.

Restoration of Landscape Processes

Changes in landscape disturbance processes over the project area are tied closely to changes in vegetation patches, patterns, structure, and composition. Fire was, and continues to be, one of the predominant disturbance process in the project area. In general, Alternative S2 would increase the fire activity (prescribed fire, "wildland fire use for resource benefit", and wildfire combined) in the project area slightly more than Alternative S3, which is sharply higher than Alternative S1. These differences between Alternatives S2 and S3 and Alternative S1 are even more dramatic in the integrated high restoration priority subbasins. Conversely, there is little difference among the alternatives relative to fire activity in A1 subwatersheds and in wilderness.

Effects from uncharacteristic wildfire are expected to increase slightly under Alternative S1 and decrease in Alternatives S2 and S3, with Alternative S2 being slightly better on Forest Service- and BLM-administered lands in the long term. Again, because of the higher emphasis on restoration and greater restoration activity, the differences between Alternatives S2 and S3 and Alternative S1 are more pronounced in the high restoration priority subbasins.

Historical range of variability (HRV) refers to the estimated range in which disturbance regimes, vegetation characteristics, and other ecological processes and functions fluxed over time. Departure from HRV is another way to gauge the restoration of landscape processes. Basin-wide, on Forest Service- and BLM-administered lands, HRV departure would continue to decline under all alternatives. The highest decline would be under Alternative S1; Alternative S2 would have the least HRV departure, with Alternative S3 in between.

Because disturbance regimes and overall ecosystem health are best addressed in high restoration priority subbasins, the selection of subbasins for active restoration actions is a critical element in achieving landscape health as well as in assessing the relative effects of the alternatives on tribal interests. An analysis was performed by the EIS Team to identify high restoration priority areas based, in part, on tribal interests. Subbasins were identified as very high priority based on offering the greatest need or greatest opportunity for the restoration of resources important to tribes in addition to enhancing employment and social-economic considerations. In Alternative S2, 11 of the 40 high restoration priority subbasins, or 28 percent, were selected on the basis of tribal interest. In Alternative S3, 16 of the 51 high restoration priority subbasins, or 31 percent, were selected on the basis of tribal interest. From this comparison, Alternative S3 could possibly provide higher benefit to tribal communities since more reservations (and therefore tribes) would have at least one basin-wide high restoration priority subbasin near their reservation. However, the benefit may be more applicable to socio-economic considerations than to protection and restoration of the habitats basin-wide. Again, this is because Alternative S3 would have a lower rate and intensity of restorative actions than Alternative S2 overall.

Harvestability

While determination of Supplemental Draft EIS alternative implications for harvestability on a broad scale are not particularly amenable to analysis, Table 4-54 shows predicted species or habitat trends for selected species associated with the rights and interests of tribes. These are discussed in more detail following the table.

Table 4-54. Relative Effects of the Alternatives on Harvestability of Terrestrial Vertebrate Species Important to Tribes.

Selected Tribal Species of Interest	Trend from Current Alternative S1	Trend from Current Alternative S2	Trend from Current Alternative S3
Big game—mule deer, elk, and white-tailed deer	Stable S1=S2=S3	Stable S1=S2=S3	Stable S1=S2=S3
Family 2—blue grouse, northern goshawk, great gray owl, boreal owl, flammulated owl	Improving S2>S3>S1	Improving S2>S3>S1	Improving S2>S3>S1
Family 5—gray wolf, grizzly bear, bighorn sheep, mountain goat, and long-eared owl	Stable S2=S3>S1	Stable S2=S3>S1	Stable S2=S3>S1
Family 10—pronghorn, burrowing owl, short-eared owl, and ferruginous hawk	Stable S2=S3=S1	Stable S2=S3=S1	Stable S2=S3=S1
Family 11—sage grouse and pygmy rabbit	Decline[1] S2=S3>S1	Decline[1] S2=S3>S1	Decline[1] S2=S3>S1
Family 12—sharp-tailed grouse	Decline[1] S2=S3>S1	Decline[1] S2=S3>S1	Decline[1] S2=S3>S1
Riparian-wetland—bald eagle, canada goose, ducks, coots, herons, swans, western screech owl	Improving S2>S3>S1	Improving S2>S3>S1	Improving S2>S3>S1

Species whose outcomes appear secure on Forest Service- and BLM-administered lands: moose, golden eagle, marmot, snowshoe hare, black bear, jackrabbits, Nuttall's cottontail rabbits, spruce grouse, ruffed grouse, merlin, black-tailed deer, Swainson's hawk.

[1] These species would decrease under all alternatives, but Alternatives S2 and S3 would lessen the decline. See Terrestrial Species section of this chapter for additional discussions.

Source: Hemstrom et al. 1999; Rieman et al. 1999.

Terrestrial Wildlife

Twenty-eight terrestrial vertebrates of conservation concern (including pronghorn antelope, bighorn sheep, grizzly bear, grey wolf, sage grouse, and sharp-tailed grouse) that depend on upland environments were assessed for possible response to the Supplemental Draft EIS alternatives (Raphael et al. 1999). The analysis suggests that population densities of terrestrial wildlife would increase on agency lands more than on non-federal lands. This pattern is more apparent in Alternative S2. Analysis of the alternative effects on road densities conclude that Alternatives S2 and S3 would reduce road densities to a somewhat higher degree than Alternative S1.

Specific conclusions include the following. Relative population density for bighorn sheep, pronghorn, American marten, blue grouse, sage grouse, and Columbian sharp-tailed grouse was predicted through models. This adjusted, inherent habitat capability was predicted for Forest Service- and BLM-administered lands within a species range. For bighorn sheep, population density would be slightly up from current levels with all alternatives. Pronghorn are slightly down under all alternatives, American marten and blue grouse would be substantially up under all alternatives, and sage grouse and sharp-tailed grouse would decrease under all alternatives, although Alternatives S2 and S3 may lessen the decline (see Chapter 4 - Terrestrial Vertebrate Species Section).

A second analysis (Lehmkuhl and Kie 1999) on terrestrial species focused on the culturally important "big game" species of elk, mule deer, and white-tailed deer habitat capabilities. Conclusions from this analysis suggest that habitat capability to support elk, mule deer, and white-tailed deer generally would be maintained or modestly increased under all alternatives in the long term (100 years).

A contributing factor that would enhance habitat improvement and greater responsiveness of both Alternatives S2 and S3 is the conservation focus on certain terrestrial source habitats in T watersheds, which would directly benefit culturally important species and substantially supplement the more intensive efforts in high restoration priority subbasins. Improved connectivity among such habitats is a prescribed long-term goal.

Plants

An analysis of the potential effects of the three Supplemental Draft EIS alternatives on the availability of native plants of tribal interest for harvesting indicates that species found "in a broad range of cover types and structural stages" project a future increase in number of plants from historical levels (Croft and Helliwell 1999). The study also concludes that cultural "plants in nonforested habitats are more at risk for decreases in habitat" than forested and riparian / wet meadow habitats.

Assessing cultural plant trends at the broad scale is tenuous because broad-scale vegetation data routinely underestimate existing riparian habitat and poorly represent the highly important scabland (composed of mounds of windblown soil surrounded by rock fragments) ethno-habitats. Consequently, cultural plant trends are best evaluated during project planning at finer scales. However Croft (1999), citing M. Hemstrom, states:

> "Restoration actions that improve landscape outcomes under both alternatives S2 and S3, will most likely improve habitat for tribal plants, as none are considered rare. Alt. S2 would most likely be more beneficial to (these) plants since it has more step down analysis requirements, though S3 does have more acres targeted for active restoration that are strategically located near reservations. Crucial to improvement is that the plants of concern to tribes in the area are considered and restoration activities are planned to benefit / protect these species and their habitat"

Croft further states, "Those species that occur in a wide range of habitat types will be better able to withstand disturbance, thus respond to improved habitat across a wider range of their distribution than those that have a narrow habitat preference. These factors may need to be considered when designing restoration activities as part of the step down implementation process."

Salmonids and Aquatic Habitat

Given the lack of existing quantification of actual harvestable population levels desired by tribes and the many factors besides habitat condition which influence fish populations, it is difficult to discern whether such levels would be attained by the proposed ICBEMP strategies. However, trends in habitat capacity can be used to indicate whether conditions that support harvestablility are improving. All alternatives would produce positive trends in aquatic habitat capacity for the six key salmonids, with trends in Alternative S2 being strongest. Alternative S1 would provide some overall habitat improvement due to application of restrictive measures throughout the region. However, Alternative S2 would show added improvement in selected areas where active restoration programs are implemented. Alternative S3 would show the lowest improvement because of uncertainty associated with RCA delineation and less required hierarchical analysis preceding restoration actions. Regarding tribal interest effects, these results indicate conditions supporting harvestability would improve most under Alternative S2. These conditions would be most likely in A2 subwatersheds, high restoration priority subbasins, and areas currently with high habitat capacity (such as wilderness areas and A1 subwatersheds).

Population outcomes for the six key salmonids indicate that all alternatives would result in improved status. Overall, Alternative S2 would result in the most improvement followed by Alternative S1 and S3. Improvements in populations outcomes were not as substantial as changes in habitat capacity because many other biological constraints influence population status and distribution (Lee et al. 1997, Rieman et al. 1999). This influence is most notable for anadromous fish. Anadromous fish population outcomes, particularly those above several dams in the Snake River and Upper Columbia River, showed minor to no improvements because of the high uncertainty associated with migrant survival. For more detail on anadromous fish and cumulative effects see the Aquatic Effects section of this chapter.

Access

Access is a critical factor to American Indian peoples with regard to harvests of resources for cultural uses and practices. The presence of healthy and sustainable populations of culturally significant species in ethno-habitats is not sufficient if access to familiar ethno-habitat areas is precluded by physical barriers, socio-cultural restrictions, or change in land ownership.

Alternatives S2 and S3 may pose some limitations of access within A1, A2, or T areas, which may restrict the full range of Indian cultural uses. However, federal / tribal consultation processes should provide for adequate consideration of reserved rights to habitats and resources and allow for the continued use of treaty and cultural uses, assuming that federal / tribal collaboration and consultation typically has an end goal of consensus agreement. Conversely, road closures can also protect treaty and cultural uses and resources by limiting access to certain areas and places by others. Furthermore, pedestrian access may remain viable in some road closure situations, which would allow at least some access for tribal purposes.

Socio-economics

The socio-economics evaluation of alternatives includes the “bread-and-butter” issues of economic development and employment opportunities, as well as consideration of habitat and resource conditions

The socio-economics evaluation includes the “bread-and-butter” issues of economic development and employment opportunities, as well as habitat and resource conditions which contribute to social well-being, including cultural and historical preservation.

which contribute to social well-being issues, including cultural and historical preservation.

An assessment of Supplemental Draft EIS socio-economic affects on all communities, tribal and non-tribal, was performed by Crone and Haynes (1999). Regarding commodity outputs and their influence on community economies, the study indicates relatively few effects of the Supplemental Draft EIS alternatives on the region’s populations. However, these may not be completely applicable to tribal communities because socio-economic issues and indicators used to characterize specialized communities do not necessarily apply to tribes and tribal communities.

Table 4-55 shows a relative ranking of 1, 2, or 3 to indicate a range from most to least, respectively, of how responsive management direction is to four primary areas of tribal social-economic issues, based on qualitative information and the description of the alternative.

Overview

Since typical socio-economic indicators do not readily lend themselves to characterization of reservation communities or the evaluation of effects on those communities and tribal rights and interests, the alternatives were evaluated on how well management direction responded to tribal basin-wide issues of employment and economics, and also on factors that contribute to social and economic conditions of tribal communities: subsistence and treaty uses and the associated protection and restoration of important species and habitats related to these uses.

Economics and Employment

Since the economy of most tribal communities is typically severely depressed and employment opportunities are limited compared to other communities in the basin, management direction in Alternatives S2 and S3 would be most responsive to tribal economic and employment issues because these alternatives emphasize the economic participation of tribal communities along with economically vulnerable

Table 4-55. Relative Effects of the Alternatives on Tribal Socio-economic Issues.

Issue Area	Alternative S1	Alternative S2	Alternative S3
Economics/employment emphasis	3	2	1
Subsistence and Treaty Use Considerations	3	2	1
Protection/restoration of important species/habitats	3	1	2
Cultural preservation	3	1	2
Socio-economic, overall	3	1	2

1 = Management direction most responsive to this subjects and basin-wide tribal issues; 3 = least responsive.

communities. Alternative S1 doesn't include this management direction emphasis and it does not include identification of high restoration priority subbasins.

Under Alternatives S2 and S3, basin-wide high restoration priority subbasins were selected in part based upon proximity to reservations and an opportunity to restore lands and resources of particular interest to American Indian tribes, as well as to provide employment and contracting opportunities to reservation communities. Alternative S3 includes all 16 tribal high restoration priority subbasins, compared to 11 in Alternative S2 and none in Alternative S1. This means that under Alternative S3, each of the 16 reservations within the basin would have at least one high restoration priority subbasin in their traditional homelands and in close proximity to their reservation. (It should be noted that high restoration priority subbasins are often grouped. While only one subbasin in a group may have been selected for high restoration priority, base level socio-economic direction that emphasizes tribal considerations would still apply to all subbasins in the project area.) This provides for greater opportunities for tribal businesses and people to participate in and benefit from restoration activities near their respective reservation. Benefits are not only for employment and community economics, but for subsistence, cultural, and treaty uses, as well as heightened influence on and involvement in restoration work in these high restoration priority subbasins.

Additionally, management direction in Alternatives S2 and S3 emphasizes the identification and use of authorities which provide for more targeted use of tribal businesses and enterprises, so that federal land managers are aware of the many authorities available to them to use Indian-owned businesses. There is also management direction on appropriately working with Tribal Employment Rights Ordinance (TERO) offices so federal managers better understand how tribes are organized and which departments can best assist them in working with tribal businesses and contractors. While these authorities and TERO offices exist under Alternative S1, there is no consistent management emphasis on their identification and use.

Training on federal Indian law and policy, as well as on tribal sovereignty and the rights and interests of American Indian tribes, is also emphasized under Alternatives S2 and S3, so that land managers understand the legal status of tribes and tribal governments well enough to explain it to non-Indian community leaders and others when needed. Again, this management emphasis is not well articulated under Alternative S1.

Subsistence and Treaty Use Considerations

Alternatives S2 and S3 would be most responsive to subsistence and treaty use considerations because they contain tribal consultation direction, which would provide for a more consistent and substantive involvement of tribes in all aspects of federal planning and decision-making processes than Alternative S1. This increased involvement would provide for greater consideration of tribal rights and interests, as would the use of multi-scaled assessment provided by Alternatives S2 and S3, with more requirements under Alternative S2. Alternative S1 does not consistently include this direction.

Protection and Restoration of Important Species and Habitats

Since the protection and restoration of resources also contributes greatly to subsistence, cultural, religious, and treaty uses, the evaluation criteria on for protection and restoration of important species and habitats are the same as those discussed under "Ethno-habitat Management" earlier in this section. Those criteria also contribute greatly to tribal social / economic implications and effects of the alternatives in this regard would be the same: Alternative S2 the most responsive, followed by Alternative S3, followed by Alternative S1.

Cultural Preservation

The primary measure of effects on cultural preservation is the degree of information exchange and consultation promoted between the agencies and tribes. The importance of shared cultural experiences, values, and information between generations, and the significance of these activities for tribal cultural survival, are at the heart of cultural landscape preservation and tribal access to culturally significant places and resources. Allowance for American Indian elders' access to important places has implications for cultural survival and social well-being of tribes and for tribal sovereignty.

All alternatives would recognize the importance of places, including sacred sites, traditional use areas, and archaeological sites, to American Indians, through implementation of existing laws. However, as discussed earlier under Politico-legal Relations, processes for determining local management direction under Alternatives S2 and S3 are designed to more thoroughly proceed through the consultation process with tribes than is offered by Alternative 1. Recognition of place attachments across unit and agency boundaries would therefore more likely be achieved under Alternatives S2 and S3.

The effect of Alternatives S2 and S3 is expected to help bring about better sensitivity toward and incorporation of tribal rights and interests with regard to cultural preservation, through more effective and consistent consultation and collaboration and through focusing on ecologial restoration. Because Alternative S2 focuses on the special manage- ment of more acreage through step-down ecological restoration programs, it is ranked most responsive to tribal cultural interests. Alternative S1's strong reliance on existing land use plans and restrictive measures would provide a more limiting forum to coordinate protection of culturally important resources and locations, and access to them.

In summary, for socio-economic considerations, it appears that both Alternatives S2 and S3 would accommodate economic needs of the region's tribal communities beyond current levels (Alternative S1). Relative to tribes, under Alternatives S2 and S3, high restoration priority subbasins are purposefully located in proximity to tribal lands not only to maximize effects of habitat improvement, but also to increase employment potential. Jobs created by on-the-ground restoration programs would be much more accessible to tribal members. In addition, subsistence and treaty uses would gain from increased protection and / or restoration of federally administered lands. While Alternative S3 does focus on more acreage in proximity to tribal lands for restoration activity, and economic benefits would likely be greater for each of the tribal communities in the basin, the resultant gains in restoration and their contribution to overall ecosystem health and productivity would be higher under Alternative S2. Given the fact that tribal communities depend on federal lands for a myriad of uses and as an integral part of their culture, Alternative S2 would provide greater opportunity for improvement of the lands and resources than Alternatives S3, and greater than Alternative S1, which does not include this management direction emphasis.

Conclusions

Each of the three primary criteria—politico-legal relations, ethno-habitat management, and socio-economics— indicate that Alternative S2 would be the most responsive of the three Supplemental Draft EIS alternatives to tribal interests over the long term. The consistency is based on the pervasive theme of enhanced consultation and collaboration offered by Alternative S2, along with the benefits of increased multi-scaled analysis, economic emphasis of tribal communities, and the identification of basin-wide high restoration priority subbasins.

In summary, the effects of the three Supplemental Draft EIS alternatives on federal trust responsibility and tribal rights and interests are as follows:

Alternative S1 would offer no region-wide consistency in consultation, ecological restoration, economic benefits, and monitoring. The alternative also lacks the step-down processes that would address accountability and consistency. Historical trends of decline in habitats and resources of importance to tribes would be less effectively addressed. Protection of treaty-related resources and culturally important species would continue to be inconsistent across the project area, jeopardizing continued access and availability of ethno-habitat patches. The decline in species availability has in the past imposed substantial socio-economic impacts on Indian societies, disrupting all aspects of tribal community economies. Socio-cultural effects would continue to be pervasive under Alternative S1, reinforcing high unemployment rates and the inherent social problems associated with depressed economies. Continued decline in resource access and availability has negative implications to the relationship between tribal people and the land and resources, which could disrupt subsistence and cultural uses. There could also be implications for economic gains in tourism, product manufacturing, and other facets of reservation revitalization currently experienced by some of the tribes.

Alternative S2 includes 11 subbasins in the basin-wide restoration strategy that are identified based on tribal factors. The economic strategies emphasize tribal involvement in restoration through use of tribally owned businesses and contractors. Step-down processes included in the alternative emphasize tribal involvement in restoration priority areas as well as other phases of planning and decision-making. Overall, more opportunities and consistency for tribal consultation would be offered, and basin-wide issues would be addressed on a basin-wide basis. Habitat would be improved in some regions, and declining trends would be slowed in most others. Alternative S2 would offer more long-term protection for current values, with less short-term risk. Ability to pursue traditional resource and land uses would be best served by Alternative S2 compared to the other alternatives. The long, complex process of habitat restoration would also better provide for the tribal exercise of treaty rights on public lands.

Alternative S3 includes restoration emphasis on 16 subbasins based on tribal factors. This increase over the 11 subbasins so identified in Alternative S2 would provide more economic benefits to all the tribes, since each would have at least one restoration subbasin in close proximity to their reservation. In addition, consultation would still be significant in Alternative S3, with continued Subbasin Review, some use of watershed analyses (EAWS), and NEPA consultations on project-specific work. However, the lesser analysis called for in Alternative S3 would decrease the level of certainty in the desired outcomes and provide less opportunity for tribes to "tier" responses at the appropriate scale to issues they raise. The goals of harvestability may be approached more quickly on a localized basis, but the short-term risks regarding harvestability would be higher than under Alternative S2.

Alternatives S2 and S3 both would respond better than Alternative S1 to protection and / or restoration of identified species of interest to tribes (Table 4-54), with Alternative S2 being somewhat more responsive than Alternative S3. Both Alternatives S2 and S3 contain management direction specific to: (a) a meaningful agency–tribal consultation process; (b) consideration of tribal rights and interests; (c) identification of basin-wide and tribal high restoration priority subbasins; (d) protection and / or restoration of important salmonid habitats and source habitats for terrestrial vertebrates of focus; (e) multi-scaled analysis; and (f) consideration of tribal restoration, project, and analysis priorities. However, Alternative S2 includes greater protection of key habitats, higher analysis requirements, and more restoration. Further, when reviewing the projections of landscape findings and overall aquatic and terrestrial projections of habitat trend for identified tribal species of interest, Alternative S2 appears to be more responsive than either Alternative S1 or Alternative S3.

Alternative S2 thus appears to be most responsive to honoring the federal trust responsibility and consideration of tribal rights and interests, because it provides more upfront direction (processes and prescriptions) and therefore greater certainty to tribes of consistent and accountable implementation. Alternative S2 would provide the highest levels of habitat protection for habitats of species most at risk than either Alternative S3 or Alternative S1. It also would be most responsive to the protection and / or restoration of resources and species significant to potentially affected tribes. Both Alternatives S2 and S3 have basin-wide strategies for aquatics, terrestrial, landscape, restoration, monitoring, and social / economics; Alternative S1 does not. Both Alternatives S2 and S3 include definitions and provisions for emphasis on tribal communities along with economically vulnerable and isolated communities in their social / economic direction. However, there is greater predictability in Alternative S2 than in Alternative S3 or Alternative S1 that risk will be managed conservatively and restoration will be focused where it most needs to occur.

Factors Influencing Ecosystem Health

Effects of the alternatives on ecosystem conditions discussed throughout this chapter relate to a variety of interconnected factors such as fire suppression, timber harvest, human demographics, insects and disease, livestock grazing, and noxious weeds. Many of these factors influence more than one resource or vegetation type–that is, they create unpredictable conditions that can affect of number of ecosystem resources regardless of whether the location is forestland, rangeland, or an aquatic or riparian area. They also affect each other, and their effects often cannot be separated.

This section discusses effects of the alternatives on fire regimes, timber harvest, the urban–rural–wildland interface, white pine blister rust, livestock grazing, and noxious weeds and other exotic undesirable plants, in a more integrated way than found elsewhere in this chapter. Additional effects on these and other factors more specific to individual resources or vegetation types can be found in the physical, terrestrial (upland) vegetation, terrestrial species, aquatic–riparian–hydrologic, and social–economic–tribal sections of this chapter. This Factors section concludes with a discussion of composite landscape effects, focusing on ecological integrity and landscape health (trends, and benefits / costs).

Summary of Key Effects and Conclusions

- Uncharacteristic wildfire effects on vegetation and soils would steadily decline and move toward historical conditions under all alternatives within rangeland PVGs (woodland, cool shrub, dry grass, and dry shrub) on BLM- and Forest Service-administered lands in the long term. The most substantative improvement (that is, over the largest portion of the project area) is projected under Alternatives S2 and S3, and least improvement in Alternative S1.
- Overall, Alternative S2 would be slightly better than Alternative S3, which is better than Alternative S1 at restoring fire regimes to a frequency and severity that would be more in line with the vegetation patches and patterns on the landscape. This would reduce the size, severity, and other unwanted effects of uncharacteristic wildfires. However, projections indicate that increased but moderate emphasis on restoration at a broad scale would not be enough to reverse the trends in fire regimes basin-wide. In the high restoration priority subbasins, fire regimes are expected to be closer to historical than elsewhere in the project area in the long term.
- In general, Alternative S1 is expected to produce somewhat larger logs, yet lesser volume of sawtimber than Alternatives S2 and S3. Alternatives S2 and S3 are expected to have more acres of timber harvest, thinning, and fuel reduction, all of which will produce wood products.
- The effects of timber harvest in combination with prescribed fire and wildfire on vegetation includes large expected differences in the old forest single-story structure. Alternative S2 would result in more of this scarce vegetative type than Alternative S3, which would result in substantially more than Alternative S1. Alternative S3 would reduce the extent of the mid seral forest toward historical levels more than Alternative S2, followed by Alternative S1. All alternatives are expected to slightly reduce levels of early seral forest to below historical levels.
- Project-wide, Alternatives S2 and S3 are expected to reduce the effects of uncharacteristic wildfire from current levels slightly more than Alternative S1 in the urban–rural–wildland interface. The improvements are due to increased concentrations of restoration activities in these interface areas.
- The only proxies for the effects of the alternatives on white pine blister rust in the long term are the changes in the western white pine and whitebark pine cover types. Both cover types are expected to expand under all alternatives, but western white pine would not achieve historical levels on Forest Service- and BLM-administered lands in the long term; Alternatives S2 and S3 would produce western white pine levels well above Alternative S1. Whitebark pine would expand almost to historical, with Alternatives S2 and S3

increasing levels slightly more than Alternative S1. However, much of this increase would come in the stand-initiation stage. In the important whitebark pine late seral single story vegetative type, there would be great reduction in all alternatives because of the effects of white pine blister rust.

- Livestock grazing effects over the long term would trend toward historical vegetative and soil conditions under all alternatives, within high restoration priority subbasins in both Alternative S2 and S3. Alternative S2 would achieve vegetative and soil conditions nearest to historical within high restoration priority subbasins because of the greater concentration of restoration activity per subbasin.
- While expansion of noxious weeds and other exotic undesirable plants would continue under all alternatives, Alternatives S2 and S3 would slow the expansion to a greater degree than Alternative S1. Over the long term, extent would decline within the aquatic A1 and A2 subwatersheds, within the terrestrial T watersheds, and within the high restoration priority subbasins, in Alternatives S2 and S3.

Fire and Fire Suppression

There is little similarity between historical and current succession / disturbance regimes within forested and rangeland ecosystems of the interior Columbia Basin. In the past 100 years, fires have generally become less frequent and more severe than historical times, affecting the vegetation patches, patterns, structure, and species composition. All of these features of vegetation along with other landscape characteristics have, in turn, a major influence on the predominant wildland fire regimes. Other factors also affect fire regimes: build-up of fuels, greater continuity in fuels, climate (including drought cycles), and increased suppression efforts, for example. Fire regimes are a cycle on the landscape, with fire influencing all of these factors, which in turn determine the frequency, severity, and patchiness of the fires.

All Supplemental Draft EIS alternatives are somewhat similar with respect to wildfire, in that they seek to reduce the severe effects and large extent of wildfire. However, they differ in their strategies. Alternative S1 emphasizes wildfire suppression mixed with fuel reduction, prescribed fire, and a small amount of "wildland fire use for resource benefit" (formerly called prescribed natural fire). The result would be some short-term successes and more future struggles with disturbance regimes. Alternatives S2 and S3 put more emphasis on prescribed fire, fuel reductions, small amounts of "wildland fire use for resource benefit", and increasing the fire-resistant vegetative types, in an attempt to make fire regimes more similar to historical and reduce the effects of uncharacteristic wildfire. Rather than trying to reduce the extent of all wildfire in general, the intent of Alternatives S2 and S3 is to make wildfire less destructive, by creating sustainable vegetation patterns and associated fire regimes that society and ecosystems can accommodate.

Prescribed Fire

Prescribed fire amounts are expected to differ greatly from Alternatives S2 and S3 to Alternative S1 on Forest Service- and BLM-administered lands in the long term. In forested landscapes, Alternatives S2 and S3 would show substantial increases in prescribed fire in many parts of the project area, while Alternative S1 would maintain current levels on average. Alternative S2 would treat 10 times more acres with fuel reduction activities and prescribed fire than Alternative S1; Alternative S3 would treat 8 times more acres with fuel reduction activities and prescribed fire than Alternative S1. On rangelands, Alternatives S2 and S3 would result in more modest increases in acres treated by prescribed fire in many parts of the project area, while Alternative S1 would probably cause slight reductions in prescribed fire from current levels on average, especially because of the need to keep fire out of areas with high concentrations of exotic annual grasses. Alternative S2 would treat 4 times more acres with fuel reduction activities and prescribed fire than Alternative S1. Alternative S3 would treat 3 times more acres with fuel reduction activities and prescribed fire than Alternative S1.

Overall, the largest increases in prescribed fire and other fuels management activities under Alternatives S2 and S3 would be found in the John Day-Snake RAC, the Southeastern Oregon RAC, the Upper Columbia-SalmonClearwater - R1 RAC, the Upper Columbia-Salmon Clearwater - R4 RAC, the Eastern Washington-Cascades PAC, and the Upper Snake River RAC.

"Wildland Fire Use for Resource Benefit"

In the short term, Alternatives S2 and S3 would have higher amounts of "wildland fire use for resource benefit" (formerly referred to as prescribed natural fire) than Alternative S1 on Forest Service- and BLM-administered lands. Alternatives S2 and S3 should be similar and slightly above current levels overall. "Wildland fire use for resource benefit" should slowly increase in the long term as it starts to take the place of prescribed fire. The largest increases are expected in the John Day-Snake RAC, the Eastern Washington-Cascades PAC, the Upper Snake River RAC, and the Southeastern Oregon RAC.

Wildfire

Alternative S1 generally attempts to reduce the amount of wildfire in order to reduce the severe effects of wildfire; suppression is the main focus. Alternatives S2 and S3 approach the problem by trying to balance wildfire levels with prescribed fire. While fire suppression is still important, it is only one component of the disturbance management strategy in the action alternatives.

Alternatives S2 and S3 are expected to lower the level of wildfire on Forest Service- and BLM-administered lands in the long term compared to Alternative S1 because of activities such as prescribed fire, "wildland fire use for resource benefit", and fuel reduction. Although the relative rank of alternatives would generally be the same, expected increases in the amount of wildfire are in the John Day-Snake RAC, the Upper Columbia-Salmon Clearwater - R4 RAC, and the Lower Snake River RAC. Several RAC/PACs could experience lesser increases in wildfire activity, led by the Upper Snake River RAC (all alternatives), and including the Eastern Washington-Cascades PAC (Alternative S1 only), the John Day-Snake RAC (Alternative S1 only), the Lower Snake River RAC (all alternatives), and the Upper Columbia-Salmon Clearwater - R4 RAC (all alternatives).

Looking specifically at high restoration priority subbasins, the differences among alternatives would be larger. In the areas that were identified under Alternative S2 as high restoration priority subbasins, Alternative S1 is expected to have twice the level of wildfire in the long term on Forest Service- and BLM-administered lands compared to Alternative S2. This is because Alternative S2 focuses restoration to these areas and increases the amount of prescribed fire and other restoration activities. In the areas that were identified under Alternative S3 as high restoration priority subbasins, the projected extent of wildfire is 2.5 times greater for Alternative S1 compared to what would occur in those same subbasins in Alternative S3 on Forest Service- and BLM-administered lands.

Total Fire Activity

Currently about one percent of the Forest Service- and BLM-administered lands in the ICBEMP project area are affected by fire activity on an average yearly basis. Fire activity is a combination of wildfire, prescribed fire, and "wildland fire use for resource benefit" (formerly referred to as prescribed natural fire). Alternative S1 should maintain current levels of fire activity, while Alternatives S2 and S3 would sharply increase fire activity, with Alternative S2 higher than Alternative S3 in the long term on Forest Service- and BLM-administered lands. The largest increases in fire activity are expected in the Southeast Oregon RAC, followed by the John Day-Snake RAC, the Butte RAC, the Upper Columbia-Salmon Clearwater - R4 RAC, and the Upper Columbia-Salmon Clearwater - R1 RAC. The Lower Snake River RAC is expected to show no increases, and the Upper Snake River RAC is expected to show declines in fire activity in the long term. Other RAC/PACs show lesser increases in fire activity.

Uncharacteristic Wildfire Effects

One of the ways to gauge the success of the alternatives at restoring disturbance regimes is to compare the effects of uncharacteristic wildfire. Fire will continue to be an important ecosystem process. However, when the fire regimes are in balance with the vegetation, landform, and climate, ecosystems are more resilient after disturbance and more sustainable in the long term. If effects of uncharacteristic wildfire are minimized, then ecosystems should be healthier.

Uncharacteristic wildfire effects are expected to increase slightly under Alternative S1 and decrease in Alternatives S2 and S3, with Alternative S3 slightly better than Alternative S2 on Forest Service- and BLM-administered lands in the long term (see Figures 4-16 and 4-17). In high restoration priority subbasins, the differences between Alternatives S2 and S3 and Alternative S1 would be substantially

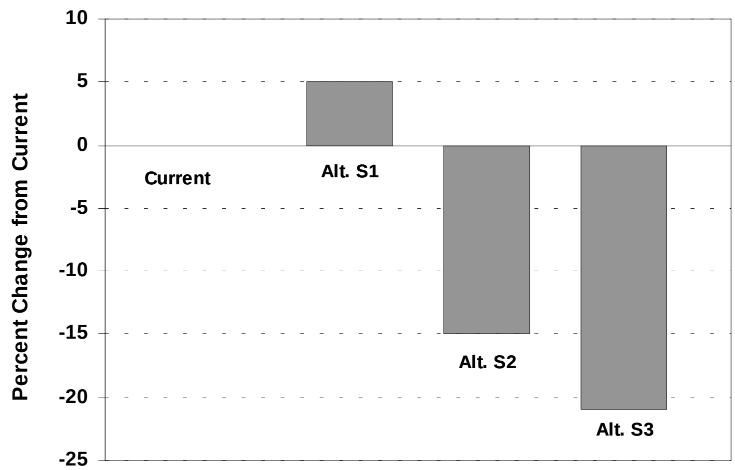


Figure 4-16. Change in Area Expected to Experience Uncharacteristic Wildfire, Long Term. Project Area = Forest Service- and BLM-administered Lands.

it would be likely to cause erosion events, reduction in riparian habitat condition, and increased stream temperatures. The native (historical) system, used as the benchmark for comparison, had no uncharacteristic wildfire effects as here defined.

greater. These differences can be attributed to higher emphasis on restoration in Alternatives S2 and S3 and higher concentrations of restoration activities in the high restoration priority subbasins. Alternative S1 projections indicate further departures in fire regimes in the long term, resulting in more extensive and severe effects, compared to historical. (See Map 4-8.)

In A2 subwatersheds and T watersheds, effects would be similar to those in the high restoration priority subbasins: Alternatives S2 and S3 would reduce the amount of uncharacteristic wildfire compared to Alternative S1 for these same land areas. However, in wilderness areas, Alternatives S3 and S2 are expected to have similar uncharacteristic wildfire effects compared to Alternative S1. Furthermore, in areas designated as A1 subwatersheds in Alternatives S2 and S3, uncharacteristic wildfire effects would be greater under Alternatives S2 and S3 than Alternative S1. Maintenance and restoration of fire regimes are a high priority in T watersheds and somewhat less in A2 subwatersheds. Active restoration activities would be limited in A1 subwatersheds (Alternatives S2 and S3), and wilderness areas (all alternatives) because the emphasis there is on conservation.

Uncharacteristic wildfire effects on rangeland PVGs (woodland, cool shrub, dry grass, dry shrub) would generate increased chances that vegetative and litter cover would be reduced, root-binding capability in soil would be reduced, and the soil surface heated across large enough areas that collectively

Departure from Historical Range of Variability for Fire

Historical range of variability (HRV) refers to the normal range within which disturbance regimes, vegetation characteristics, and other ecological processes and functions fluxed over time. Departure from HRV is another way to measure how much disturbance regimes have changed or will be restored in the future. The higher the departure from HRV, the less desirable the effects.

Basin-wide, on Forest Service- and BLM-administered lands, average conditions would continue to move away from HRV in all alternatives, because it will take an extensive and concentrated restoration effort to stop and reverse trends across Forest Service- and BLM-administered lands. In most subbasins and many subwatersheds, extensive and concentrated restoration cannot occur because of protection of aquatic habitats (A1 subwatersheds), lack of access in roadless areas, and reliance on lightning ignitions for prescribed fire restoration in wilderness areas. However, trends could be reversed

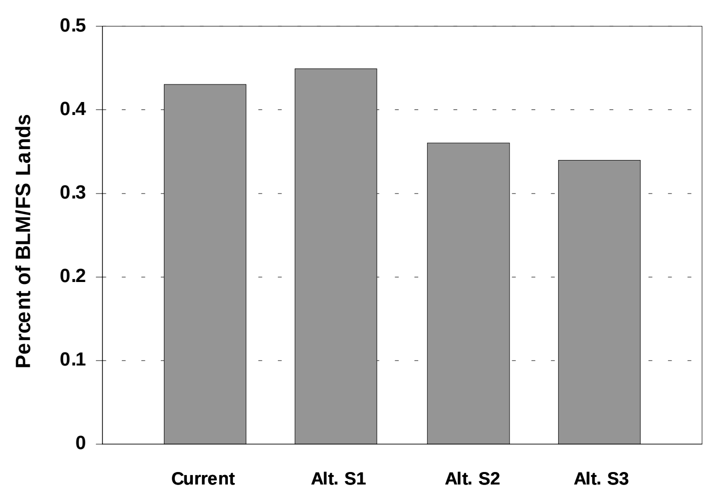


Figure 4-17. Percent of Area Expected to Experience Uncharacteristic Wildfire, Project Area, Long Term. Project Area = Forest Service- and BLM-administered Lands.

Map 4-8. Annual Average Uncharacteristic Wildfire Classes: Change from Current (Year 100).

in subwatersheds that have reasonable access for restoration activities and where these activities are not constrained at a subwatershed scale by protection standards or reliance on lightning ignitions for prescribed fire. The average trend away from HRV would be most pronounced under Alternative S1, and least under Alternative S2, followed by Alternative S3; however, the differences between Alternatives S2 and S3 would be small (see Figure 4-18, Map 4-9). Substantial local reversals in subwatershed trends would be expected in Alternatives S2 and S3 in areas where most of the subwatershed is restored, while few subwatersheds would improve in trend in Alternative S1.

When looking specifically at high restoration priority subbasins, Alternatives S2 and S3 would not move away from HRV as much as they would when looking basin-wide. Therefore, when looking at high restoration priority subbasins, there would be a bigger difference between Alternatives S2 and S3 and Alternative S1 than when looking basin-wide. This is because of higher concentrations of restoration activities in high restoration priority subbasins in alternatives S2 and S3.

In A2 subwatersheds and T watersheds, the same relative rank among alternatives would be expected: Alternative S2 would be greater than or equal to Alternative S3 which would be greater than Alternative S1 for these same areas. HRV departure in A2 subwatersheds would be less than it would be basin-wide; it would be maintained near current levels in T watersheds under Alternatives S2 and S3 because of higher priorities of restoration and maintenance of disturbance regimes. HRV departure is expected to increase in A1 subwatersheds (Alternatives S2 and S3) and wilderness areas (all alternatives) because of limited amounts of restoration activities.

On rangelands on BLM- and Forest Service-administered lands in the long term, uncharacteristic wildfire effects would trend toward historical range of variability under all alternatives and in all areas, including project area-wide, except for high restoration priority subbasins in Alternatives S2 and S3, where no trend would be evident. Alternatives S2 and S3 would be similar in achieving conditions that are nearest to historical in A1 and T areas, and Alternative S2 would achieve those conditions in A2 and high restoration priority subbasins. Alternatives S2 and S3 also would be similar in achieving conditions nearest to historical for all other Forest Service- and BLM-administered lands, and the project area as a whole.

Summary: Fire

Overall, Alternative S2 would be slightly better than Alternative S3, which is better than Alternative S1 at restoring fire regimes to a frequency and severity that would be more in line with the vegetation patches and patterns on the landscape. This would reduce the size, severity, and other unwanted effects of uncharacteristic wildfires. Prescribed fire on the landscape, at the rates projected in Alternatives S2 and S3, would mean breaks in fuel continuity, lower suppression costs, and better success in suppression efforts compared to Alternative S1. It would mean greater sustainability of cover types and structural stages that have evolved with fire and are adapted to historical fire regimes. With greater sustainability of ecosystems, comes more predictability of the products and uses of the ecosystem.

However, projections indicate that increased but moderate emphasis on restoration at a broad scale would not be enough to reverse the trends in fire regimes basin-wide, because reversing trends would take extensive and intensive investments in restoration as is intended for the high restoration priority subbasins under Alternatives S2 and S3. The analysis indicates that restoration activities, when highly concentrated in high restoration priority subbasins, make a difference. In the high restoration priority subbasins, fire regimes are expected to be closer to historical than elsewhere in the project area in the long term.

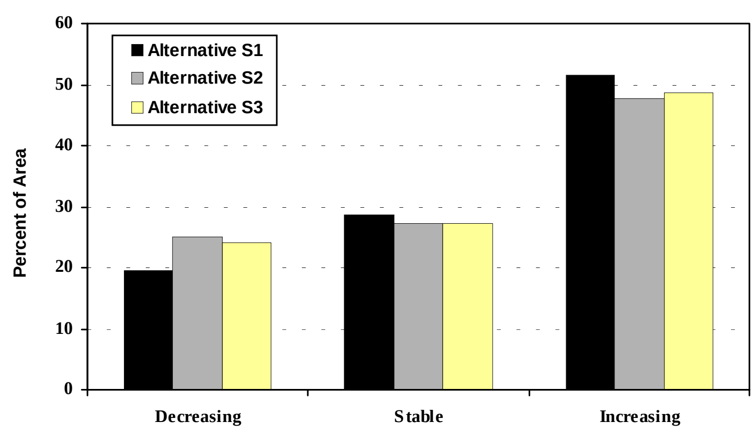


Figure 4-18. Historical Range of Variability Departure Trends, by Alternative, Project Area. Project Area = Forest Service- and BLM-administered Lands.

Map 4-9. Historical Range of Variability Departure Classes: Change from Historical.

Timber Harvest

Over the years, timber harvest has had positive impacts on growth in northwest U.S. economies, communities, businesses, and families. Timber harvest has provided livelihoods and careers, and it has been a way of life for many. The benefits of the many wood products to society are also important.

Timber harvest has also had impacts on the forests and their ecosystems of the project area. Timber harvest and other forest management practices, along with fire suppression, have changed disturbance regimes, natural succession pathways, and vegetation patterns. Roads built to access timber have led to secondary effects, some harmful and some beneficial.

Timber harvest methods are a reflection of the desires of society and will continue to be important socially and ecologically in the future. There would be a difference in the kind of timber harvest among the alternatives. Alternatives S2 and S3 would use stewardship harvest as a restoration tool, focusing on the ecological function of the remaining forest. The largest trees are more likely to remain, as are the more fire-resistant and shade-intolerant trees. Stewardship harvest often uses "thinning from below" methods to give growing space to the overstory trees, reduce fuel levels, and / or remove fuel ladders. Sometimes this includes large openings that allow shade-intolerant species to regenerate. Stewardship harvest can be an effective tool in restoring vegetation patterns and disturbance regimes. Alternative S1 would incorporate a high proportion of traditional timber harvest and a smaller proportion of stewardship harvest, much like the predominate practices of the past 30 to 40 years. An important focus of traditional harvest (Alternative S1) has been harvesting the best timber, often the largest and most fire-resistant trees, and mitigating the effects on other resources such as wildlife and streams.

There are also differences in the outputs of timber harvest among the alternatives in the short term. In general, Alternative S1 is expected to produce somewhat larger logs, yet lesser volumes of sawtimber than Alternatives S2 and S3. Alternatives S2 and S3 are expected to have more acres of timber harvest, thinning, and fuel reduction, all of which will produce wood products.

The effects of timber harvest in combination with prescribed fire and wildfire on vegetation includes large expected differences in the old forest single story structure. Alternative S2 would result in more of this scarce vegetation type than Alternative S3, which would result in substantially more than Alternative S1. Alternative S3 would reduce the extent of the mid seral forest toward historical levels more than Alternative S2, followed by Alternative S1. All alternatives are expected to slightly reduce levels of early seral forest to below historical levels.

Urban–Rural–Wildland Interface

In low to mid elevation forests and rangelands, urban areas and rural developments continue to encroach on wildlands even as the fire risk in these areas has continued to increase. As wildfires become more severe, the associated hazards to life and property have increased, as have wildfire suppression costs. Several activities can reduce the fire risk in the urban–rural–wildland interface, including: timber harvest, thinning, prescribed fire, fuel reduction activities, greenstrips, brush reduction, adequate access for suppression, and responsive, effective suppression efforts. While prescribed fire is not without risks of its own, in general it is safer to burn under the closely calculated conditions of prescribed fire than to chance a wildfire when fuels are extremely dry and weather conditions are unfavorable.

Improvements (reductions) in uncharacteristic wildfire effects can be interpreted as a reduction in the wildfire danger. Basin-wide, Alternatives S2 and S3 are expected to reduce the effects of uncharacteristic wildfire from current levels slightly more than Alternative S1 in the urban–rural–wildland interface. The improvements are due to increased concentrations of restoration activities in these interface areas.

Another measure of future trends in the urban–rural–wildland interface is departure from historical range of variability. If vegetation structure, species composition, and disturbance regimes are more like historical ranges, then disturbances should have effects that are more similar to historical and less severe, resulting in less fire danger overall. In addition to vegetation similarity and disturbance regimes, HRV departure is also based on landscape patch and pattern. There is not much chance of improving HRV departure in the urban–rural–wildland interface because of limited ability to improve vegetation patch and pattern. However, analysis of HRV departure can provide a context for comparison between alternatives.

Basin-wide, Alternative S2 would reduce the extent of HRV departure in the urban–rural–wildland interface compared to Alternative S1. Alternative S3 is expected to be intermediate. HRV departure under Alternatives S2 and S3 is expected to be below current levels, while Alternative S1 would be slightly above. The main reason for the expected reductions in fire risk (based on HRV departure) is the increased emphasis on and higher concentration of restoration activities in the urban–rural–wildland interface under Alternatives S2 and S3.

Within high restoration priority subbasins where there are also urban–rural–wildland interface areas, Alternatives S2 and S3 are expected to greatly reduce the HRV departure well below current levels. Alternative S1 would allow HRV departure to get slightly higher than current levels. These effects would be caused by a combination of increased emphasis on and higher concentration of restoration activities in the high restoration priority subbasins and in the urban–rural–wildland interface under Alternatives S2 and S3.

White Pine Blister Rust

White pine blister rust is the primary introduced disease that has changed successional pathways, species, and structures of the cold and moist forest potential vegetation groups. It has already devastated the moist forest through the reduction of the western white pine by 95 percent. Blister rust-resistant varieties of western white pine have been developed and the road to recovery is now underway. The effects of white pine blister rust in the cold forest have been slower to start and gain momentum because of slower growth and development processes in the cooler environment, and less human access in the cold forest PVG to spread the disease. However, from modeled projections of vegetation in the project area, it appears that whitebark pine in the cold forest is on the same track as western white pine in the moist forest.

The only proxies for the effects of the alternatives on white pine blister rust in the long term are the changes in the extent of western white pine and whitebark pine. The extent of western white pine is expected to expand under all alternatives but not achieve historical levels on Forest Service- and BLM-administered lands in the long term. Alternatives S2 and S3 would increase the extent well above Alternative S1.

All alternatives are expected to increase the extent of the whitebark pine on Forest Service- and BLM-administered lands in the long term almost to historical levels. Alternatives S2 and S3 would increase extent slightly more than Alternative S1. However, much of this increase would come in the stand-initiation stage, showing an effort to restore the species. But in the important whitebark pine late seral single story vegetation type, there would be great reduction in all alternatives due to the effects of white pine blister rust. In the cold forest PVG where vegetation growth and development, succession, and restoration are slow, the problem of white pine blister rust will take a long time to overcome.

Livestock Grazing

Livestock grazing effects are defined as land areas where changes of more than 20 percent from the historical (native) vegetation composition and structure, soil cover, and soil surface characteristics are evident. These changes can reduce native species habitat quality, vegetation and litter cover, root binding capability, and riparian condition; and they can increase the probability of soil erosion and compaction, noxious weeds and exotic undesirable plant presence and abundance, stream bank erosion and failure, and stream temperature. The historical system, used as the benchmark for comparison, had no domestic livestock grazing effects because it predated the beginning of domestic livestock grazing in the project area.

Livestock grazing effects in this section reflect effects analyzed at the subwatershed level. Entire subwatersheds were classified as being either high, moderate, low, or none for livestock grazing effects. The proportion of the subwatershed showing these livestock grazing effects increases as the classification system runs from none to high. The high and moderate classes encompass broad ranges. For example, the high class means that somewhere between 55 and 100 percent of a subwatershed's area shows livestock grazing effects (as defined above), whereas the moderate class means that somewhere between 5 and 55 percent of a subwatershed's area shows livestock grazing effects. Thus, very few subwatersheds with BLM- and Forest Service-administered lands that have been or are currently being grazed by livestock show no livestock grazing effects. The majority of subwatersheds that are rangeland-dominated by the dry shrub PVG and that have been or are currently being grazed are in the high class (Map 4-10).

The broad range of the high and moderate classes creates a situation where moving a subwatershed from a high to a moderate or from a moderate to a low class (meaning a trend in livestock grazing effects toward historical vegetation and soil conditions—improvement in rangeland condition), requires changes in livestock grazing management across a substantial area of the subwatershed. Changes that are not large enough to cause a change in class (for example, changes that occur in localized areas within subwatersheds) nevertheless in reality can cause substantial improvement within a subwatershed. Localized improvements in rangeland condition (for example within a riparian area along a portion of a stream reach, or on upland areas within a portion of a pasture within an allotment) will likely not be detected across the entire subwatershed. Thus localized improvements in rangeland condition attributable to changes in livestock grazing management will be the first observable signs of improvements attributable to livestock grazing management direction under any of the alternatives. However, because it takes a substantial amount of improvement to show a change at the subwatershed level, in most cases it will take a long time before subwatershed-level improvement is detected.

In summary, localized improvements would be masked. Localized improvements in rangeland condition attributable to changes in livestock grazing management would occur in addition to the improvements discussed below at the subwatershed level.x

Livestock grazing effects would trend toward historical vegetative and soil conditions over more extensive portions of the project area (9 of 12 RAC / PACs) in Alternative S2 than in Alternatives S3 (8 of 12 RAC / PACs) and S1 (7 of 12 RAC / PACs) (see Table 4-56). Confidence in the long-term trends is relatively high for the RAC / PACs with livestock grazing effects over extensive acreage currently (Deschutes PAC, John Day-Snake RAC, Klamath PAC, Lower Snake River RAC, Southeastern Oregon RAC, Upper Columbia-Salmon-Clearwater RAC-R4, and Upper Snake River RAC). In these RAC / PACs, Alternative S2 would consistently achieve vegetative and soil conditions over the long term that are nearest to historical, whereas Alternative S3 would often be similar but not consistently as positive.

Livestock grazing effects, over the long term and throughout the project area, would trend toward historical vegetative and soil conditions, under all alternatives, and in particular within high restoration priority subbasins in both Alternatives S2 and S3. Alternative S2 would achieve vegetative and soil conditions nearest to historical within high restoration priority subbasins because of the greater concentration of restoration activity per subbasin.

Changes in livestock grazing management are more likely to cause localized improvements and to trend livestock grazing effects toward historical vegetation and soil conditions on sites that have not crossed a threshold (within the state-and-transition model of vegetation succession [see Chapter 2]) to a more degraded state, than on sites that have crossed a threshold (Archer and Smeins 1991; Johnson and Kingery 1999). Examples of degraded steady states are: (1) western juniper-dominated sites that used to but no longer support a well-distributed and diverse a shrub and herb understory, show soil loss in the A horizon and would experience less frequent and more intense fire compared to historical; and (2) exotic annual grass-dominated sites that lack perennial shrubs, forbs, and grasses; lack biological crusts; and would experience more frequent fire compared to historical. On these degraded sites that have crossed a successional threshold, restoration activities (in the form of prescribed burning, tree thinning, herbicide treatments, rehabilitation seedings, and other intensive practices) are necessary to reverse the degraded condition and reverse the successional momentum. Changes in livestock grazing management alone would not be likely to do the job. Even if intensive restoration activities are applied onsites that have crossed a threshold, historical vegetation and soil conditions would be predicted to reestablish slowly or not at all, attributable to ecological, technical, and financial restraints (Tausch 1998; Johnson and Kingery 1999). Intensive restoration activities can prevent further degradation by establishing some perennial plant species, reducing the dominance of exotic undesirable plants, lessening fire risk, and promoting conditions favorable for biological crust development.

On sites that have not crossed a threshold, some can be determined to be functioning and others can be determined to be functioning “at risk,” based on physical (such as soil) and biological (such as biological crusts or plant cover) indicators of rangeland health (USDI / BLM 1999). Those that are functioning “at risk” are at risk of crossing a successional threshold to a degraded state. In both kinds of sites, localized improvements discussed previously would be likely if changes are made to livestock grazing management. If livestock grazing is determined to be a factor that had caused the site to be functioning at risk, then changes made to livestock grazing manage-

Map 4-10. Livestock Grazing Effects Classes, Current.

Table 4-56. Trends in Livestock Grazing Effects,[1] Project Area, Current to Long Term.[2]

	Trend Toward (T), or Away (A) from Historical Conditions			Alternative that Would Achieve Conditions Nearest to Historical
	Alt. S1	Alt. S2	Alt. S3	
Butte RAC[3]	A	A	A	S2=S3
Deschutes PAC[4]	A	T	T	S2=S3
Eastern Washington Cascades PAC[3]	No trend	A	A	S1
Eastern Washington RAC[3]	T	T	T	S1=S2=S3
John Day-Snake RAC[4]	No trend	T	T	S2
Klamath PAC[4]	T	T	T	S2=S3
Lower Snake River RAC[4]	T	T	T	S2
Southeastern Oregon RAC[4]	T	T	T	S2=S3
Upper Columbia-Salmon-Clearwater RAC R1[3]	No trend	T	No trend	S2
Upper Columbia-Salmon-Clearwater RAC R4[4]	T	T	T	S2=S3
Upper Snake River RAC[4]	T	T	T	S2=S3
Yakima PAC[3]	T	No trend	No trend	S1=S2=S3
High Restoration Priority Subbasins in Alt. S2	T	T	T	S2
High Restoration Priority Subbasins in Alt. S3	T	T	T	S2=S3
Project-Area	T	T	T	S2

Abbreviations used in this table:
RAC = Resource Advisory Council
PAC = Provincial Advisory Committee
Alt. = Alternative
R1 = Forest Service Northern Region
R4 = Forest Service Intermountain Region

[1] Livestock grazing effects are land areas within subwatersheds where changes of more than 20% from the native (historical) vegetative composition and structure, soil cover, and soil surface characteristics are evident. These changes attributable to livestock grazing can (sometime during the current to long-term period) or might have already (sometime during the historic to current period) reduce(d) native species habitat quality, vegetative and litter cover, root binding capability, riparian condition, and increase(d) the probability of soil erosion and compaction, exotic undesirable plant presence and abundance, stream bank erosion and failure, and stream temperature. The native (historical) system, used as the benchmark for comparison, had no domestic livestock grazing effects because it predates the beginning of domestic livestock grazing in the project area.

[2] The current to long-term period for livestock grazing effects refers to the average of these effects over the 100 year time period and does not refer to the effects observable at exactly year 100.

[3] Relatively low confidence in current to long-term trends, attributable to relatively low amounts of acreage of livestock grazing effects at current.

[4] Relatively high confidence in current to long-term trends, attributable to relatively high amounts of acreage of livestock grazing effects at current.

Project Area = BLM- and Forest Service-administered lands

ment would help prevent these sites from crossing a threshold. This depends on being able to prevent exotic undesirable plants (such as noxious weeds) from invading or increasing, which would negate the benefits accrued to the changes in livestock grazing management.

For BLM- and Forest Service-administered lands in the project area, livestock grazing effects would trend toward historical vegetative and soil conditions under all alternatives, with Alternative S2 achieving vegetative and soil conditions that are nearest to the historical. For non-BLM- and Forest Service-administered lands, livestock grazing effects would decline in the long term similarly under all alternatives, but the trend would not be as strong as that predicted for BLM- and Forest Service-administered lands.

Livestock grazing effects that trend toward the historical can reflect many different changes in vegetative and soil conditions. Some notable examples include vegetative type changes, such as woodlands to shrublands, as mentioned in the Upland Vegetation section in this chapter; trends in biological crust development and extent (see Terrestrial Species section); trends in noxious weeds and exotic undesirable plants; trends in wildfire frequency and severity; and trends in aquatic and riparian habitats.

Noxious Weeds and Other Exotic Undesirable Plants

As discussed in other sections in this chapter, noxious weeds and other exotic undesirable plants would continue to expand in acreage over time in the project area as a whole, under all alternatives. Expansion would happen primarily in the dry forest, woodland, cool shrub, dry grass, and dry shrub PVGs.

While expansion of noxious weeds and other exotic undesirable plants would continue under all alternatives, Alternatives S2 and S3 would slow the expansion to a greater degree than Alternative S1. Alternatives S2 and S3 would implement project-area-wide Integrated Weed Management (IWM) strategy(ies) throughout the Forest Service- and BLM-administered land within the project area, whereas Alternative S1 lacks a comprehensive focus on IWM. In Alternatives S2 and S3, IWM is prioritized highest for implementation to aquatic A1 and A2 subwatersheds, and terrestrial source habitats that have declined substantially in geographic extent from historical to current periods within terrestrial T watersheds. These areas contain aquatic habitats that support important fish populations (A1 and A2 subwatersheds), and terrestrial source habitats that are the most sustainable through time. Weed control that is prioritized in these areas would solidify those areas as "anchor points" necessary for a long-term creation of a network of secure and productive habitats within the project area. Wherever IWM occurs, implementation priorities are built based on those vegetative cover types that are rated High, Moderate, and Low for Susceptibility to Invasion by noxious weeds (see Chapter 2). Prioritizing implementation based on vegetative type susceptibility will focus weed prevention and control on vegetative types most at risk to weed invasion and spread, many of which also happen to be in short supply currently (for example the wheatgrass bunchgrass and fescue-bunchgrass cover types).

Although expansion of noxious weeds and other exotic undesirable plants would continue for the project area as a whole, over the long term extent would decline within the aquatic A1 and A2 subwatersheds, within the terrestrial T watersheds, and within the high restoration priority subbasins, in Alternatives S2 and S3. Both Alternatives S2 and S3 within the high restoration priority subbasins, would arrest the expansion of exotic undesirable plants, with Alternative S2 achieving slightly more decline in extent (acreage) of exotic undesirable plants than Alternative S3. Restoration activity that would result in long-term declines in exotic undesirable plants include the following: (1) integrated weed control actions, such as herbicides and biological control (insects, fungi); (2) wildfire pre-suppression activities, such as greenstripping, which effectively acts as a weed prevention technique; (3) rehabilitation seedings, which will retard weed dominance and spread; and (4) changes in livestock grazing management that reduce soil surface disturbance and increase persistence of native vegetation.

There would be a greater concentration of these restoration activities in the high restoration priority subbasins in Alternative S2 compared to Alternative S3. In general, the high restoration priority subbasins were selected based on having a moderate to high opportunity at the subbasin scale for restoration activities to actually be successful in achieving restoration.

Outside the area where IWM is prioritized (that is, outside aquatic A1 and A2 subwatersheds, outside terrestrial T watersheds, and outside high restoration priority subbasins), noxious weeds and exotic undesirable plants would continue to expand in the long term. In these areas, Integrated Weed Management direction would achieve a slowdown in the rate of expansion under Alternatives S2 and S3, but the intensity of effort would not be enough to completely stop or reverse the trend in weed expansion. The expansion of noxious weeds and other exotic undesirable plants in rangelands, particularly the dry shrub PVG, has not slowed because of: (1) the extent of the infestations (for example, cheatgrass is found in every county in the project area); (2) the numerous ways that noxious weeds and other exotic undesirable plants are spread; (3) the adaptability that noxious weeds and other exotic undesirable plants show; and (4) the ability of some species (such as yellow starthistle, spotted knapweed, dalmatian toadflax) to invade areas even without any disturbance to the soil surface. These conditions would hinder effective weed prevention and control.

Composite Landscape Effects

As described in Chapters 1 and 2, changed conditions over the past century and new information and understandings indicate that the ecosystems of the interior Columbia River Basin are declining in health.

The purpose of the proposed action of this Supplemental Draft EIS is to take a coordinated broad-scale approach and select a management strategy that best achieves a combination of the following: (1) restore and maintain long-term ecosystem health and ecological integrity; and (2) support economic and/or social needs of people, cultures, and communities through availability of sustainable and predictable levels of products and services from lands administered by the Forest Service or the BLM. This chapter has looked at the effects of the alternatives on the individual components of ecosystem health such as repatterning of vegetation, uncharacteristic disturbances, aquatic habitat quality, and socio-economic resiliency of tribes and communities. This section will attempt to address the question of how the alternatives affect the health of the ecosystem as a whole. The primary integrated outcomes are reflected in the trends in ecological integrity, and landscape health trends and benefit/cost.

Ecological Integrity

Ecological integrity is an attempt to show the integrated condition of the biophysical environment within the project area (Quigley, Hann, Haynes, et al. 1999). Aquatic contributions to ecological integrity (that is, habitat conditions) were shown to be generally either stable or improving. For the most part, changes in activity levels and changes in the kinds of activities of the recent past, coupled with the direction to conserve or restore aquatic systems, should result in either stable or improving conditions from an aquatic perspective, with Alternative S2 better than Alternative S1 followed by Alternative S3.

Terrestrial contributions to overall ecological integrity trends were developed from proxy variables (historical range of variability departure, uncharacteristic grazing, topography, landscape vegetation patterns, snags and downed wood, fire disturbances, predicted road densities, the presence of domestic livestock, and human population densities), rather than from estimates of source habitat amounts or species outcomes. These contributions to ecological integrity should be mostly stable in subbasins dominated by rangeland systems and should show improving trends in forested environments. Differences among alternatives should be evident, especially in areas with higher concentrations of restoration activities such as high restoration priority subbasins in Alternatives S2 and S3. Alternatives S2 and S3 should show better trends from a terrestrial perspective than Alternative S1 (Quigley, Hann, Haynes, et al. 1999).

Contributions of landscape variables to overall integrity trends were mixed. Subbasins showing the strongest declines in ecological integrity, from a landscape perspective, should be areas where restoration activities are not effective in reversing succession, disturbance regimes, and exotic plant invasion. This may be due to lack of priority; limits on restoration activities in A1 subwatersheds, wilderness areas, roadless areas, or other restrictive areas; or to lack of restoration technology, such as in the driest parts of the rangelands. For most ecosystems in the project area, passive restoration approaches will not shift altered successional pathways of vegetation back to those that are more characteristic of historical conditions. Active restoration and maintenance techniques would be necessary to reverse the momentum of uncharacteristic succession and disturbance and reduce the uncharacteristic disturbance effects. The subbasins showing improved conditions largely coincide with the high restoration priority subbasins. In these areas, prioritizing restoration would pay off by reversing the momentum of uncharacteristic succession and disturbance and create conditions more similar to historical conditions in Alternatives S2 and S3 than in Alternative S1 (see Map 4-11) (Quigley, Hann, Haynes, et al. 1999).

Wildfire, insects and disease, exotic plant invasions, and drought will continue to play a large role in shaping the ecosystems of the project area. The effects analysis shows that even in 100 years, evidence of improvements would be slow for all alternatives. However, a hands-off approach to restoration should result in continued downward trends in ecological integrity. From an integrated standpoint, Alternatives S2 and S3 should be more effective than Alternative S1 in slowing the downward trends and improving ecological integrity (see Figure 4-19).

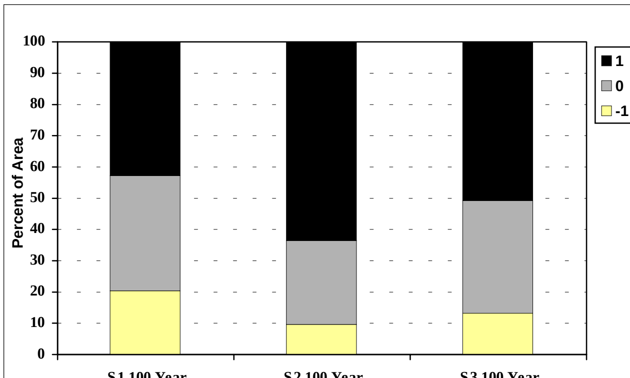


Figure 4-19. Long-term Ecological Integrity Trends, by Alternative, Project Area. Project Area = Forest Service- and BLM-administered Lands.

Map 4-II. Ecological Integrity Trends (Year 100).

The alternatives are quite different in their approach to the management of risk. Alternative S1 attempts to manage risk to important terrestrial and aquatic habitats through more restrictive measures such as Eastside Screens to manage old forests and PACFISH / INFISH standards and guidelines for fish, than do Alternatives S2 and S3 where actions are planned to achieve outcomes. Alternative S1 is based on a short-term risk management strategy of holding on to some of the scarce habitats, while Alternatives S2 and S3 have a more comprehensive short-term strategy (maintain all scarce habitats) but also attempt to bring in a long-term risk management strategy as well (provide a full range of habitats at appropriate scales).

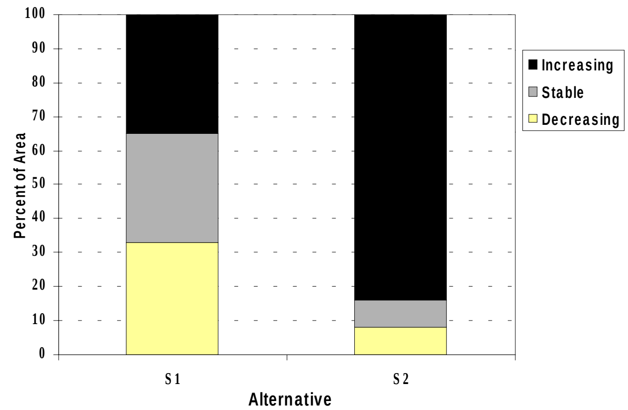


Figure 4-20. Long-term Landscape Health Trends, by Alternative, All Ownerships, Basin-wide.

Landscape Health Trends and Cost Per Unit Area

Landscape health is defined by Hann, Jones, Karl, et al. (1997) as "the best fit of the dynamic interaction of human land use, biodiversity, and ecosystem health that is in balance with the limitations of the biophysical system and inherent disturbance processes...." In their analysis, all of the subwatersheds in the project area currently fall in to the moderate, low, and very low landscape health categories. None are high or very high.

In the long term, projections indicate that Alternative S2 would result in substantially more of the project area with stable and increasing landscape health trends than in Alternative S1. Alternative S3 would fall between Alternatives S2 and S1 (see Figure 4-20). The improvements under Alternative S1 would occur in small scattered patches, while Alternatives S2 and S3 also would show improvements in more concentrated areas that would receive restoration focus (see Map 4-12). In Alternatives S2 and S3, high restoration priority subbasins would show substantial improvements in landscape health over Alternative S1. Alternatives S2 and S3 are expected to move a great majority of the high restoration priority subbasins into the stable or increasing landscape health trends categories (see Figures 4-21 and 4-22).

The average cost-per-unit-area ratio projections show that Alternative S1 would have the highest cost per unit area, with Alternative S2 the lowest cost and Alternative S3 intermediate. Costs would drop lower for Alternatives S2 and S3 in the high restoration priority subbasins.

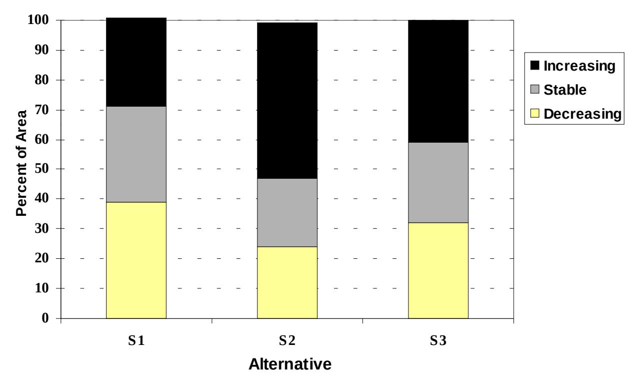


Figure 4-21. Landscape Health in High Restoration Priority Subbasins Alternative S2, Project Area. Project Area = Forest Service- and BLM-administered Lands.

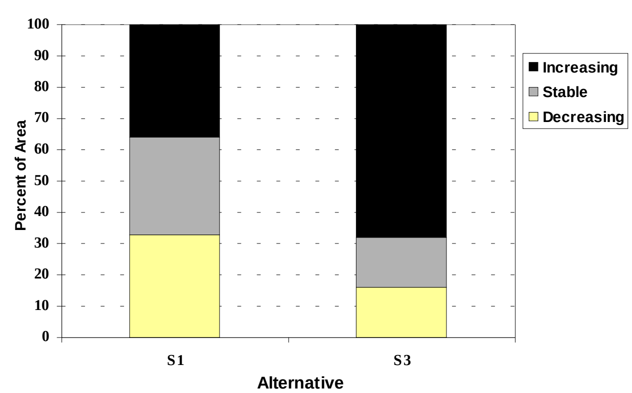


Figure 4-22. Landscape Health in High Restoration Priority Subbasins, Alternative S3, Project Area. Project Area = Forest Service- and BLM-administered Lands.

Map 4-12. Landscape Health Trends (Year 100).

Analysis of Implementation Costs and Outputs

Background

This section takes a different look at the three alternatives by approaching them as the budget analysts for the land management agencies might do: describing management activities, potential activity costs, and associated potential outputs at comparable and incremental implementation funding levels. This analysis is distinct from the budget sensitivity analysis, discussed early in this chapter. Tables 4-57, 4-58, 4-59 and 4-60, later in this section, display projected estimates of selected activity costs and associated outputs that would result from the management strategies of the three alternatives.

Implementation of the ICBEMP decision will be financed, as are most land management actions, through federal appropriations from the Congress. As the federal agencies begin to implement the decision, they will request changes in emphasis and funding through the normal appropriations process. They may also work to accomplish work through strategies such as partnerships and volunteers.

Three principles underlie the alternatives:

1. The cost of the alternatives must be realistic with respect to current funding levels for the land management agencies (see sidebar). This was accomplished by providing for a hierarchy of management direction that protects and maintains conditions and then prioritizes restoration to areas where the science findings indicate good opportunities for management actions to be effective.
2. The pace of implementing the alternatives will vary with amount of funding; however, the emphasis and strategies of each alternative would remain the same regardless of the funding level.
3. The selection of the preferred alternative is based on its emphasis and strategies, not on funding levels.

With these principles in mind, the selection of the preferred alternative was based on the management strategies it represents. The Record of Decision will address management direction, not funding levels or funding allocations.

Once a decision is made, the strategy and associated actions called for in the selected alternative will be converted into the budget structure for both the BLM and Forest Service, and the appropriations process will be followed. Administrative units of the BLM and Forest Service will be requesting changes in emphasis and additional capability for all their programs to facilitate implementation of the ICBEMP direction. The management direction of the alternatives is adjustable to variable future funding levels.

Implementation Costs and Outputs Summary

Methodology: How the Implementation Costs and Outputs Summary was Estimated

A team of budget analysts developed the information in Tables 4-57 through 4-60, using standard budget analysis techniques.

The team made assumptions about the amount of overall funding available to undertake the strategies called for in the alternatives. Four levels of funding are assumed in this analysis of implementation costs and outputs. One is the estimated current level of funding, used in the analysis of Alternative S1. This allows for comparison using a "baseline" condition. In addition, three increased increments of funding were selected by the budget analysts as reasonable increases when compared to the overall budgets for the Forest Service and BLM in the project area. The four levels are:

1. No new funding ($135.0 million total; see Table 4-57);
2. $148.5 million ($13.5 million increase; see Table 4-58);
3. $168.75 million ($33.75 million increase; see Table 4-59);
4. $202 million ($67.0 million increase; see Table 4-60).

Level #4 is comparable to the budget assumption associated with the analysis of Alternative S2, conducted by the SAG (Quigley 1999).

The team identified representative management activities (selected outputs) for display. Through deliberations with policy specialists, the set of variables was determined that represents specific types of restoration activities and their associated outputs. These categories of management activities do not directly correlate to the outcomes identified in other portions of Chapter 4 because they represent a budget analyst's approach to development of future funding proposals and were not generated from the variables modeled by the SAG.

The team identified average total costs for the selected categories of activities across the entire project area, and they used these average costs to estimate activity costs and associated levels of outputs. Costs were estimated using historical budget information on file at the Forest Service and BLM offices at the national, regional, state and national forest/BLM district levels. These estimates will be refined in future budget formulation processes.

The team of budget analysts calibrated the associated levels of outputs to the four selected levels of funding, working from the information available for Alternative S1 (assumed to be funded at the level identified in Table 4-57, no new funding) and Alternative S2 (assumed to be funding at the level in Table 4-60 increased funding). Thus, the alternatives are contrasted at comparable funding levels using the selected management activity variables.

Interpretation of Analysis

To avoid misinterpretation of this analysis the following information is offered:

1. The "employment estimated" figure estimates employment that would result from only 4 of the 12 categories of activities: thinning and harvest, young stand density management, animal unit months (AUMs), and prescribed fire fuel treatments. This category did not estimate jobs that may result from other activities such as those associated with fish habitat improvements or wildlife habitat improvements.
2. The acreage figures for the management activity of prescribed fire/fuel treatments include burning and mechanical fuel reduction. The total treatment area does not always correlate with acres actually burned. For example, an area of 10,000 acres can be treated by prescribed fire restoration activities, but because the management prescription calls for a desired fire intensity that is light or moderate, 500 acres may have been treated mechanically before burning and then only 5,000 acres may actually burn. The resulting mosaic pattern of burned and unburned landscape is generally what is desired.

Changes from the Draft EISs: Implementation Costs

The development of the Supplemental Draft EIS Implementation Costs and Outputs Summary tables reflects a different approach to funding than presented in the Draft EISs. The action alternatives in the Supplemental Draft EIS were designed to " accommodate a range of funding levels so that Congress and the Administration can consider on an annual basis, the costs and benefits of action and inaction and set an appropriate pace for restoration and management" (Babbitt and Glickman 1998). This approach is different from the Draft EISs, where the alternatives were not analyzed at several funding levels. Also, the Draft EISs' analyses were not constrained by funding thresholds; rather, modeled outcomes tended to drive budget needs.

3. The management activities reflect broad categories of funding for both the Forest Service and BLM, and do not directly correlate to the existing budget line items for these agencies.
4. The levels of output for management activities assume 10-year (short-term) averages.
5. None of the management activities have spatial identity; that is, they cannot be spatially located at this point in the analysis and cannot be correlated with specific projects, administrative units, RAC / PAC areas, states, or counties. They are summarized at the project-area-scale only.
6. Implementation of these management activities is guided by the direction of the alternatives and thus by the step-down analysis procedures called for in the alternatives.
7. Consultation and collaboration requirements have a cost and are difficult to estimate. The costs shown here are the costs of collaboration and consultation with states, tribes, and regulatory agencies, in addition to public participation processes, that are additional to the collaboration and consultation processes already in place for the land management agencies.
8. The output of AUMs is an indirect, not direct, result of management direction. Management direction in Alternatives S2 and S3 is not designed to prescribe the levels of AUMs permitted by the Forest Service and BLM in the project area. Rather, it is designed to addressed desired outcomes for landscape health (rangelands, riparian areas, and so on); these desired outcomes mean that there will likely be adjustments in intensity, location, timing, and pattern of domestic livestock grazing. These adjustments could affect total AUMs, but the changes that may result are difficult to predict.
9. Management direction in Alternatives S2 and S3 is not designed to prescribe production levels of volume of timber (board feet) from Forest Service- and BLM-administered lands. Rather, the volume is an output that results from the activities that occur as a result of management direction.

Estimates of the Alternatives' Implementation Costs and Outputs

Tables 4-57, 4-58, 4-59, and 4-60 show the rough, projected implementation cost and output estimates for a select group of management activities at comparable and increasing budget levels. Each table represents a different budget level. A brief summary of the major conclusions from the implementation cost analysis tables is provided at the end of this section.

Alternatives at Different Budget Levels

Tables 4-57 through 4-60 each compare the three alternatives at a consistent level of assumed budget for restoration actions. Each table should be reviewed as a whole. Since the alternatives, especially the action alternatives, are intended to meet integrated ecosystem management objectives and not singular functional objectives, the alternatives should be broadly compared with each other in terms of the multiple activities they achieve and not compared by the singular functional categories of management activities.

No New Funding

With no increases in funding beyond the estimated current level (Table 4-57), outputs associated with the selected categories of management activities would vary among the three alternatives relative to the amount of scarce funds allocated to the management activities to address aquatic and terrestrial wildlife resource issues. Acres of wildlife habitat improvement would double, for example, in Alternatives S2 and S3 compared to Alternative S1. Prescribed fire

Table 57. ICBEMP Implementation Costs and Outputs Summary for Alternatives S1, S2, and S3 Selected Management Activities Assuming No New Funding (Total, BLM- and Forest Service-administered Lands).

Management Activity[1]	Alternative S1[2] ($000s)	Alternative S2 ($000s)	Alternative S3 ($000s)	Alternative S1 Outputs	Alternative S2 Outputs	Alternative S3 Outputs
Thinning and harvest	$54,540	$54,827	$53,423	814 MMBF	818 MMBF	797 MMBF
Young stand density management	$17,077	$18,802	$18,883	211 Macres	232 Macres	233 Macres
Prescribed fire/fuel treatment	$19,370	$23,333	$23,498	483 Macres	730 Macres	734 Macres
Watershed/riparian restoration	$6,853	$9,777	$9,447	22 Macres	33 Macres	31 Macres
Road treatments	$3,520	$3,815	$3,688	620 miles	671 miles	650 miles
Weeds management	$4,945	$5,210	$5,116	165 Macres	174 Macres	170 Macres
Domestic livestock grazing	$3,111	$4,578	$4,224	3,129 MAUMs	2,814 MAUMs	2,781 MAUMs
Rangeland improvements	$1,239	$1,276	$1,190	25 Macres	25 Macres	24 Macres
Fish habitat improvements	$4,598	$4,829	$4,640	511 miles	537 miles	515 miles
Wildlife habitat improvements	$1,747	$3,553	3,391	40 Macres	81 Macres	77 Macres
Total, Management Activities	$117,000	$130,000	$127,500			
Total, Analysis/Collaboration[3]	$18,000	$5,000	$7,500			
Total, No New Funds[4]	$135,000	$135,000	$135,000			
Employment Estimates[5]				8,426 jobs	8,484 jobs	8,313 jobs

Abbreviations used in this table:
ICBEMP - Interior Columbia Basin Ecosystem Management Project
BLM - Bureau of Land Management
MMBF - Million board feet
Macres - Thousand acres
MAUMs - Thousand AUMs (Animal Unit Months)

[1] Management activities are a representative sample of outputs that are reasonably expected from management strategies in the alternatives. These categories of activities approximate those that have been used by the land management agencies in development of programs of work.
[2] This level of funding is what the Science Advisory Group assumed in modeling this alternative.
[3] Collaboration and consultation includes the efforts made to work with states, tribes and regulatory agencies, in addition to the public participation processes that are already in place and in use by the agencies.
[4] This total approximates those funds available to the land management agencies for accomplishment of the restoration actions described in this table.
[5] Employment estimates rounded to the nearest 100 jobs. Employment is estimated for 4 of the 12 management activities: thinning and harvest, young stand density management, prescribed fire, and AUMs.

Table 58. ICBEMP Implementation Costs and Outputs Summary for Alternatives S1, S2, and S3 Selected Management Activities Assuming + $13.5 Million over Current Funding (Total, BLM- and Forest Service-administered Lands).

Management Activity[1]	Alternative S1 ($000s)	Alternative S2 ($000s)	Alternative S3 ($000s)	Alternative S1 Outputs	Alternative S2 Outputs	Alternative S3 Outputs
Thinning and harvest	$61,757	$57,581	$56,711	922 MMBF	859 MMBF	846 MMBF
Young stand density management	$18,782	$19,666	$19,830	231 Macres	242 Macres	244 Macres
Prescribed fire/fuel treatment	$21,303	$29,190	$29,531	665 Macres	912 Macres	923 Macres
Watershed/riparian restoration	$7,562	$9,746	$9,490	24 Macres	31 Macres	31 Macres
Road treatments	$3,896	$4,249	$4,151	618 miles	748 miles	731 miles
Weeds management	$5,438	$6,035	$5,960	181 Macres	201 Macres	198 Macres
Domestic livestock grazing	$3,422	$4,495	$4,338	3,129 MAUMs	2,814 MAUMs	2,781 MAUMs
Rangeland improvements	$1,362	$1,695	$1,627	27 Macres	34 Macres	32 Macres
Fish habitat improvements	$5,056	$5,536	$5,389	561 miles	615 miles	599 miles
Wildlife habitat improvements	$1,922	$3,695	3,570	44 Macres	84 Macres	81 Macres
Total, Management Activities	$130,500	$141,888	$140,597			
Total, Analysis/Collaboration[2]	$18,000	$6,612	$7,903			
Total Funds	$148,500	$148,500	$148,500			
Employment Estimates[3]				9,360 jobs	8,989 jobs	8,882 jobs

Abbreviations used in this table:
ICBEMP - Interior Columbia Basin Ecosystem Management Project
BLM - Bureau of Land Management
MMBF - Million board feet
Macres - Thousand acres
MAUMs - Thousand AUMs (Animal Unit Months)

[1] Management activities are a representative sample of outputs that are reasonably expected from management strategies in the alternatives. These categories of activities approximate those that have been used by the land management agencies in development of programs of work.
[2] Collaboration and consultation includes the efforts made to work with states, tribes, and regulatory agencies, in addition to the public participation processes that are already in place and in use by the agencies.
[3] Employment estimates rounded to the nearest 100 jobs. Employment is estimated for 4 of the 12 management activities: thinning and harvest, young stand density management, prescribed fire, and AUMs.

Table 4-59. ICBEMP Implementation Costs and Outputs Summary for Alternatives S1, S2, and S3 Select Management Activities Assuming + $33.75 Million over Current Funding (Total, BLM- and Forest Service-administered Lands).

Management Activity[1]	Alternative S1 ($000s)	Alternative S2 ($000s)	Alternative S3[2] ($000s)	Alternative S1 Outputs	Alternative S2 Outputs	Alternative S3 Outputs
Thinning and harvest	$71,387	$60,403	$60,370	1,065 MMBF	901 MMBF	901 MMBF
Young stand density management	$21,699	$21,347	$21,640	268 Macres	263 Macres	267 Macres
Prescribed tire/tuel treatment	$24,612	$38,251	$38,863	769 Macres	1,195 Macres	1,214 Macres
Watershed/riparian restoration	$8,708	$9,924	$9,768	28 Macres	32 Macres	32 Macres
Road treatments	$4,472	$4,969	$4,909	787 miles	874 miles	863 miles
Weeds management	$6,283	$7,354	$7,309	209 Macres	245 Macres	244 Macres
Domestic livestock grazing	$3,952	$4,479	$4,599	3,129 MAUMs	2,814 MAUMs	2,781 MAUMs
Rangeland improvements	$1,574	$2,334	$2,293	32 Macres	47 Macres	46 Macres
Fish habitat improvements	$5,842	$6,676	$6,586	649 miles	741 miles	959 miles
Wildlife habitat improvements	$2,221	$3,984	$3,906	50 Macres	90 Macres	87 Macres
Total, Management Activities	$150,750	$159,721	$160,243			
Total, Analysis/Collaboration[3]	$18,000	$9,029	$8,507			
Total Funds	$168,750	$168,750	$168,750			
Employment Estimates[4]				10,639 jobs	9,607 jobs	9,614 jobs

Abbreviations used in this table:
ICBEMP - Interior Columbia Basin Ecosystem Management Project
BLM - Bureau of Land Management
MMBF - Million board feet
Macres - Thousand acres
MAUMs - Thousand AUMs (Animal Unit Months)

[1] Management activities are a representative sample of outputs that are reasonably expected from management strategies in the alternatives. These categories of activities approximate those that have been used by the land management agencies in development of programs of work.
[2] The level of funding the Science Advisory Group assumed in modeling Alternative S3 was approximately $47.0 million, $13.25 million more than this budget scenario.
[3] Collaboration and consultation includes the efforts made to work with states, tribes, and regulatory agencies, in addition to the public participation processes that are already in place and in use by the agencies.
[4] Employment estimates rounded to the nearest 100 jobs. Employment is estimated for 4 of the 12 management activities: thinning and harvest, young stand density management, prescribed fire, and AUMs.

Table 4-60. ICBEMP Implementation Costs and Outputs Summary for Alternatives S1, S2 and S3 Selected Management Activities Assuming + $67 Million over Current Funding (Total, BLM- and Forest Service-administered Lands).

Management Activity[1]	Alternative S1 ($000s)	Alternative S2[2] ($000s)	Alternative S3 ($000s)	Alternative S1 Outputs	Alternative S2 Outputs	Alternative S3 Outputs
Thinning and harvest	$88,495	$66,059	$67,416	1,380 MMBF	986 MMBF	1,006 MMBF
Young stand density management	$26,112	$24,001	$24,502	322 Macres	296 Macres	302 Macres
Prescribed fire/fuel treatment	$29,619	$52,500	$53,570	925 Macres	1,465 Macres	1,503 Macres
Watershed/riparian restoration	$10,479	$10,207	$10,210	34 Macres	33 Macres	33 Macres
Road treatments	$5,381	$6,102	$6,104	947 miles	1,074 miles	1,074 miles
Weeds management	$7,561	$9,429	$9,433	252 Macres	314 Macres	314 Macres
Domestic livestock grazing	$4,756	$4,455	$5,012	3,129 MAUMs	2,814 MAUMs	2,781 MAUMs
Rangeland improvements	$1,895	$3,339	$3,340	37 Macres	67 Macres	67 Macres
Fish habitat improvements	$7,031	$8,470	$8,474	781 miles	941 miles	941 miles
Wildlife habitat improvements	$2,671	$4,438	$4,439	60 Macres	100 Macres	100 Macres
Total, Management Activities	$184,000	$189,000	$192,500			
Total, Analysis/Collaboration[3]	$18,000	$13,000	$9,500			
Total Funds	$202,000	$202,000	$202,000			
Employment Estimates[4]				13,335 jobs	10,731 jobs	10,913 jobs

Abbreviations used in this table:
ICBEMP - Interior Columbia Basin Ecosystem Management Project
BLM - Bureau of Land Management
MMBF - Million board feet
Macres - Thousand acres
MAUMs - Thousand AUMs (Animal Unit Months)

[1] Management activities are a representative sample of outputs that are reasonably expected from management strategies in the alternatives. These categories of activities approximate those that have been used by the land management agencies in development of programs of work.
[2] Approximates the outputs and funding level as modeled by Science Advisory Group for this alternative only.
[3] Collaboration and consultation includes the efforts made to work with states, tribes and regulatory agencies, in addition to the public participation processes that are already in place and in use by the agencies.
[4] Employment estimates rounded to the nearest 100 jobs. Employment is estimated for 4 of the 12 management activities: thinning and harvest, young stand density management, prescribed fire, and AUMs.

and fuel treatment acres also would increase for Alternatives S2 and S3, reflecting the themes of activities that focus on restoration of landscape disturbance patterns. Thinning and restoration timber harvest also would increase slightly for Alternatives S2 and S3, although harvest would be focused on smaller trees with less volume per unit. Acres treated for noxious weeds would increase slightly. In summary, the focus of the action alternatives on maintenance and restoration of aquatic and terrestrial habitats and sustainable landscape dynamics require more restoration management actions and consequent outputs in those categories of actions under Alternatives S2 and S3 compared to Alternative S1, even at no increased funding.

These cost and output estimates do not adequately acknowledge the prioritization strategies of the action alternatives. Even at current funding levels, Alternatives S2 and S3 are designed such that restoration funds would be targeted toward areas identified as restoration priorities, thereby maximizing the efficient and effective expenditure of fiscal resources. Restoration priorities were determined, in part, based on the risk to resource values and the opportunity for management actions to "make a difference." The budget analysts who developed these tables did not calibrate the per-unit costs to account for the enhanced effectiveness and efficiencies of the design embedded in the action alternatives. Since the same per-unit costs are used for all three alternatives, the outputs are probably underestimated for Alternatives S2 and S3 at current funding levels.

$13.5 Million Over Current Funding

The outputs associated with the selected categories of management activities would increase proportionately with increased funding to $13.5 million over current funding (Table 4-58), because in this rough analysis the per-unit costs would stay relatively the same between alternatives. As a result, the cost and output estimates do not adequately acknowledge the prioritization strategies of the action alternatives. The new funding available in Alternative S1 would be distributed throughout the project area using existing mechanisms for determining priority (existing land use plans, regional and state priorities, and so on). New funding for the action alternatives would be focused on and allocated to high restoration priority areas (high risk and high opportunity).

Alternative S1, with increased funding, follows a pattern of funding allocation more typical of the existing 62 individual forest and land use plans. Thinning and harvest volumes would increase at a higher rate than Alternatives S2 and S3 because of these more traditional management themes and because of the lack of a comprehensive and focused strategy to guide restoration activities. These projected levels of activity account for the increase in employment simply because employment is calculated based on only four of the categories of management activities. Other employment opportunities are associated with fish and wildlife habitat improvements, for example, but this analysis was not able to calculate them.

As discussed above, management direction in the action alternatives is not designed to address the level of permitted AUMs; rather, it is designed to addressed desired outcomes for landscape health. To achieve the desired outcomes means likely adjustments in intensity, location, timing, and pattern of domestic livestock grazing. These adjustments could affect AUMs, but that relationship is difficult to predict. Nonetheless, the increased funds invested in the category of rangeland improvements and grazing (associated with livestock grazing) would increase the amount of activity in the categories, while the associated outputs (AUMs or rangeland improvement acres), would stay the same as presented with "no additional funding" in the Table 4-57. With increased funding, there would be direct increases in prescribed fire treatments in Alternative S1, but not to the extent of the increases for the action alternatives, where the focus of the alternatives is on using prescribed fire and fuel treatments to restore vegetation disturbance patterns and processes.

$33.75 Million Over Current Funding

Continuing the trend, the outputs associated with the selected categories of management activities would increase in proportion to the allocations of increased funding to $33.75 million over current funding (Table 4-59), because in this rough analysis the per-unit costs would stay relatively the same between alternatives. As described above, the cost and output estimates do not adequately acknowledge the prioritization strategies of the action alternatives. The new funding available in Alternative S1 would be distributed throughout the project area using existing allocation mechanisms for determining priority (existing land management plans, regional and state priorities, and so on). New funding for the action alternatives would be focused on and allocated to high restoration priority areas (high risk and high opportunity).

Management activities intended to produce integrated landscape improvements and treatments for wildlife, fisheries, roads, watersheds, and riparian habitats would continue to increase steadily with additional funding. Levels of activities associated with thinning and harvest also would increase, as a result of restoration activities occurring in forested landscapes. Given the less integrated, less restorative theme of Alternative S1, there would be a greater increase in thinning and harvest than in the action alternatives and, as already demonstrated, the projected increased volumes directly correlate with anticipated employment opportunities. Finally, the same caveat relative to livestock grazing is relevant—the intent of the management direction is to focus on grazing systems intended to achieve desired outcomes. Management direction does not prescribe levels of AUMs.

$67.0 Million Over Current Funding

The pattern of increases in implementation costs and associated outputs would continue at $67.0 million over current funding (Table 4-60) and is consistent with the descriptions provided above. Harvest volumes from thinning and harvest are anticipated to continue to increase under existing land use plans in Alternative S1 if additional funding were available. The caveat is that other factors, not well integrated in Alternative S1, are expected to make these projections difficult to achieve. Alternatives S2 and S3 would generate noticeable increases in outputs for restoration activities and improvements such as road treatments, fish improvements, wildlife improvements, and treatment of noxious weeds. Alternative S3 would provide for slightly more activities and jobs than Alternative S2 since it was designed to more rapidly move to restoration actions with less attention paid to up-front analyses.

Implementation Cost Summary

The integrated strategies of the action alternatives would distribute the available budgets to restoration activities with more of an emphasis on addressing a broad suite of ecosystem management issues. At any given budget, the action alternatives would ensure that the strategies can be achieved through the hierarchy of direction and the prioritization of restoration investment to places where risk and opportunity are high. Increased funding to Alternative S1 would generate additional outputs, consistent with existing land use plan directions and allocations.