Chapter 4 Environmental Consequences

Chapter 4 analyzes the environmental consequences of the alternatives for the six resource management plans of the planning area that are being revised.

In this chapter:

Summary of Major Changes from Chapter 4 of the Draft EIS/Draft RMP

Forest Structure and Spatial Pattern

- The section (formerly called Ecology) was re-titled to better reflect the content of the analysis.

Carbon Storage

- A section describing carbon storage on BLM-administered lands was added.

Socioeconomics

- The display of employment impacts was expanded to show changes by county, sector, and alternative

Timber

- The volume from Eastern Management Lands was split out to differentiate this type of volume.
- A discussion on how changes in log prices or harvesting costs would affect stumpage prices was added.
- A section was added about the timing of receipts expected under the plan.

Botany

- Species placement in habitat groups was re-evaluated.
- Species occurrences and the distribution of Bureau special status plant and fungi species was re-analyzed, based on: new species list; number of occurrences; occupied habitat; and changes to land use allocations for the No-Action Alternative and Alternatives 1, 2, and 3.
- The effects to species, occurrences, and occupied habitat from management activities for the No Action and Alternatives 1, 2, and 3 were re-analyzed.
- New data sets were used and remodeling was done for projected occurrences and occupied habitat on unsurveyed BLM-administered lands at regional and district scales.
- A discussion was added about the effects to subgroups of species at risk from the loss of forest biological legacies, older forest habitat, and interior habitat that resulted in a slight increase in risk for all alternatives from the No Action Alternative.

Invasive Plants

- A relative risk comparison among the alternatives for introduction of invasive plant species over both the long and short term was added.
- The mitigation measure section was relocated in the FEIS to the Summary and describes specific measures for preventing introduction of new infestations that may be incorporated in the planning and design of implementation-level actions.

Wildlife (Northern Spotted Owl)

- The evaluation of suitable habitat was refined to evaluate the actual locations, sizes, and spatial arrangement of stable nesting territories and blocks of nesting habitat.
- The scale for evaluating dispersal between and within habitat blocks was modified according to current science.

- The analysis of "areas of concern" was refined to better identify potential barriers to owl movement and survival.
- Evaluations were added to address the impact of wildfire to owl habitat and conservation risks associated with the declining spotted owl population.

Wildlife (other than Northern Spotted Owl)

- The range of the marbled murrelet has been modified to reflect a needed correction in the Medford District, and an analysis of structurally complex forest greater than 200 years of age has been included to differentiate this habitat component from overall nesting habitat.
- The narrative describing fisher natal habitat has been revised to include an analysis of those structurally complex stands greater than 200 years of age, separate from the overall discussion of natal habitat.
- An expanded discussion of legacy components (i.e. snags, coarse woody debris, and green tree retention) has been added to the land bird section.
- The special status species analysis has been extensively revised to facilitate effect analysis based on five broad categories of habitat types: (1) westside forest habitats; (2) habitat on the Eastside Management Lands (i.e., east side of the Klamath Falls Resource Area); (3) non-forested habitats; (4) riparian habitats; and (5) forest floor habitats.
- The cover analysis in the deer and elk narrative has been revised to discuss hiding cover, not thermal cover.

Fish

- The wood delivery model was expanded to use highly detailed stand information rather than general structural classes.
- The wood delivery modeling and analysis was also expanded, from five representative watersheds to all fifth-field watersheds in the planning area.
- Expansion of the wood delivery model and analysis was done to include large and small wood contribution; contribution of fish-bearing and non-fish bearing streams; contribution from BLM-administered lands to non-BLM administered lands; contribution by source (riparian, debris flow, channel migration); and the contribution by land use allocation.
- The fish productivity index was replaced with a more comprehensive, qualitative discussion of the effects of the alternatives on fish productivity.
- A more quantitative analysis of nutrient input to stream channels was added.
- Estimates and assumptions regarding future levels of instream restoration, fish passage improvements, road improvement and road decommissioning were included.

Water

- An error was corrected for the peak flow planning criteria in the rain-dominated hydroregion. The number of susceptible subwatersheds increased from 1, to a range of 5-12 under the alternatives.
- Mortality of Port-Orford-cedar within riparian areas and its effect on stream temperature change has been previously analyzed under the FSEIS Management of Port-Orford-Cedar in Southern Oregon 2004, which is incorporated by reference.
- Landsliding susceptibility analysis was added for all land use allocations by calculating a relative landslide density that indicates the expected amount of landslides which could deliver sediment to streams.

Fire and Fuels

- A discussion of changes in Fire Regime Condition Class under each alternative was addedsw

Air

- Analysis of PM 2.5 emissions for each alternative was added.
- Analysis of current emissions was added to provide comparison for projected future emissions under each alternative.
- Annual emissions from prescribed burning on all ownerships were addressed.

Soils

- A section on biomass removal/whole tree logging was added.
- A section on western juniper control was added.
- The outcome of the analysis for soils was clarified to show that the long-term conservation and the productive capacity of the forest and rangeland soils across the planning area would be maintained.

Cultural Resources

- The numbers and percentages of cultural sites damaged were recalculated, based on the revised number of disturbed acres under each alternative.

Introduction

Chapter 4 describes the environmental consequences of the alternatives on the affected environment (described in *Chapter 3*) within the planning area (defined in *Chapter 2*). The five alternatives analyzed in detail (the PRMP, No Action Alternative, and Alternatives 1, 2, and 3) provide varying management direction with respect to the resources within the planning area, and would have varying effects on resources and programs. Also described in this chapter are the analytical assumptions, key assumptions, analytical methodology and modeling, and data that were used in the analyses of this final environmental impact statement. Finally, this chapter suggests mitigation measures that may be needed to reduce impacts to certain resources.

This final environmental impact statement describes the consequences of generalized management-level direction of a resource management plan. The final environmental impact statement is not intended to analyze fully the site-specific effects that may occur from all of site-specific implementation-level actions that may be conducted in the future under such a plan. Site-specific effects would be considered during the planning of implementation-level actions.

Analytical Assumptions

The analytical assumptions that were used in the analysis of the PRMP and alternatives are based on the science of, and the relationships within, the natural systems that exist within the planning area. The specific assumptions that were used for the analysis in this final environmental impact statement are contained within the specific sections of *Chapter 4*, appendices, and the 2006 *Proposed Planning Criteria and State Director Guidance* document and its subsequent updates (incorporated by reference). The details about the methodology, including assumptions, that was used to model vegetation, water, large wood source areas, timber valuation, and socioeconomics are included as appendices.

Following are the key assumptions common to the PRMP and all four alternatives. The assumptions that are specific to a resource or program are contained within the individual sections of *Chapter 4* for those resources or programs.

Key Assumptions and Information Common to All Alternatives

Terminology

The following terms are used in this final environmental impact statement:

- **Commercial forest lands** - Those lands that are capable of producing 20 cubic feet per acre per year of wood of commercial species. These lands are identified in the timber productivity capability classification (see *Appendix R - Vegetation Modeling*). These lands are biologically capable of producing a sustained yield of timber.
- **Forested lands** - Those lands that are capable of 10% tree stocking. This excludes roads and such nonforest areas as water, meadows, and rock outcrops that are identified in the GIS data.
- **Long term** - For the management directions of these resource management plan revisions, long term is considered to be 100 years.
- **Short term** - For the management directions of these resource management plan revisions, short term is considered to be 10 years.

Projection of Forest Conditions

For the PRMP and all four alternatives, the lands that would be available for harvesting in support of the allowable sale quantity and sustained yield management (harvest land base) were mapped. Other lands (nonharvest land base) were also mapped and segregated into those lands where active management could occur and those lands where timber harvesting is prohibited. This mapping allowed the spatial application of the analytical assumptions of the alternatives, including timber harvesting, to model forest conditions over time. These modeled projections of forest conditions were expressed as classifications of habitat for the northern spotted owl, and as structural stages of forests, which were used by the interdisciplinary team in their analyses. See *Appendix B - Forest Structure and Spatial Pattern* and *Appendix R- Vegetation Modeling*.

As part of this revision effort, the BLM has modeled timber harvesting and the development of wildlife habitat on BLM-administered lands. See *Appendix R - Vegetation Modeling*. This modeling allowed projections to be made of the changes to the vegetation over time in the harvest land base. See the *Forest Structure and Spatial Pattern* section of this chapter.

Information from the Northwest Forest's Plan 10-Year Monitoring Report

Information from the Northwest Forest Plan's 10-year monitoring report was considered in the analyses in this final environmental impact statement. Some of the general key findings in this monitoring report were that:

- Watershed conditions improved.
- Late-successional and old-growth forest increased more than was anticipated.
- Less timber harvesting occurred on federal lands than was anticipated.

Specific information used from the report is referenced in the individual sections found in Chapters 3 and 4.

BLM Budget and Implementation

For analytical purposes, it is assumed that all alternatives would be adequately funded to implement the alternatives as designed.

It is expected that an organizational transition to the new allowable sale quantity levels would occur over a period of up to five years. Due to the speculative nature of the transition period, analysis of effects assumed full implementation from the date of the decision.

Administrative Actions

It is assumed that most of these types of routine transactions and activities (see *Chapter 2* for details) would occur under all four alternatives at approximately the same level as during the past 10 years. Some variation from past levels for certain activities such as surveys and road maintenance would occur as the level of timber harvest varies by alternative. The effects of these actions have been generally incorporated into the analysis for each resource or program.

Reasonably Foreseeable Mineral Development

Minerals that can be reasonably foreseeable for development include:

- fluid minerals (from natural gas wells, oil wells, geothermal wells and plants, and coal bed natural gas wells)

- salable minerals (from rock quarries and decorative stone collection)
- locatable minerals (from dredging and mines)

With the exception of natural gas and coal bed natural gas, it is assumed that these types of activities would occur at a rate consistent with the past 10 years and would not vary by alternative. Exploration and development of the Mist gas field in the Salem District and coal bed natural gas in the Coos Bay District is expected to increase in the next 10 years. Development scenarios would not vary by alternative. A detailed description of the reasonably foreseeable development scenario can be found in *Appendix Q - Energy and Minerals*. The effects of these actions have been generally incorporated into the analysis for each resource or program. Site-specific effects would be considered during the planning of implementation-level actions.

Threatened and Endangered Species

The environmental impact statement analyzes the effects of the alternatives on all species that are listed under the Endangered Species Act as threatened or endangered or have been identified as candidate species at the time of the preparation of this final environmental impact statement. This includes species that have recently been listed, including the Oregon Coast coho salmon, which was listed as threatened in 2008. The environmental impact statement also includes analysis of species on which the U.S. Fish and Wildlife Service has recently made decisions on proposals for listing or delisting. For example, the environmental impact statement analyzes the effects of the alternatives on:

- fisher, for which the U.S. Fish and Wildlife Service found in 2004 that listing was "warranted but precluded"
- sage grouse, for which the U.S. Fish and Wildlife Service found in 2005 that listing was not warranted, but has initiated a status review in 2008 to re-examine its 2005 decision; and
- bald eagle, which the U.S. Fish and Wildlife Service removed from the endangered species list in 2007

Several recovery planning efforts and redesignations of critical habitat were underway at the time of the preparation of this final environmental impact statement. Information from these efforts was used in formulating the PRMP and alternatives, management objectives and directions, and effects analyses to the extent practical, because the design of the alternatives and the analyses anticipated that these efforts and redesignations would be completed prior to the publication of the final environmental impact statement.

Analytical Methodologies and Models

The analytical methodologies that were used in assessing the effects of the alternatives are described in detail in the specific sections of *Chapter 4*, appendices, and the 2006 *Proposed Planning Criteria and State Director Guidance* document and its subsequent updates (incorporated by reference). The public was requested to provide comments on the methodologies described in the 2006 *Proposed Planning Criteria and State Director Guidance*. Those comments were used to refine the methodologies used in the analysis. As a result, certain of the methodologies and assumptions of the Planning Criteria were subsequently updated. In addition, the details about the methodology, including assumptions, that was used to model vegetation, water, large wood source areas, timber valuation, and socioeconomics are included as appendices. The analyses are both qualitative and quantitative in nature. The methodologies consist of procedures or models from experimental forests, scientific papers, previous environmental impact statements, and procedures developed by BLM resource specialists.

Analytical models based on scientific principles have been used to assess and compare some of the environmental consequences of the alternatives. These models simplify the complexity of biological, physical, or economic systems. Although the analytical models are limited by current knowledge, they represent a synthesis of the knowledge of BLM resource specialists who are familiar with the subjects of concern. As detailed in *Chapter 5*, the interdisciplinary team members have the necessary scientific expertise, through education and experience, to provide high quality information and accurate analysis to the environmental impact statement.

Forest Vegetation and Habitat Modeling

The alternatives outline a range of approaches for managing the BLM-administered forest lands by varying the size and placement of land use allocations and varying the intensity with which the BLM-administered forest lands are managed. These different management approaches would result in a range of outcomes—forest characteristics, habitat types, and sustainable harvest levels. A model was used to simulate the development of the forest over time under each alternative. The model simulated the application of management practices and forest development assumptions to characterize what the forests would be like in 10, 20, 30,40, 50, and 100 years into the future. The outputs from this modeling form a quantitative basis for the analysis in this final environmental impact statement that compares the alternatives.

The OPTIONS model by D.R. Systems was used to model forest vegetation conditions, to model endangered species habitat, and to determine a sustainable harvest level. It is a scenario-based model and not an optimization model. A scenario-based model simulates the intensity of management and the analytical assumptions of the alternatives that produce a solution that satisfies both the resource objectives of the alternative and a sustainable harvest level. An optimization model seeks to find combinations of the types, timing, and intensity of harvests that increase the value of a forest in terms of its economic value from timber harvesting, as well as its ecological and social value from its composition.

The OPTIONS model is also a spatially explicit model. This allowed for the development of map-based scenarios for the estimation of the environmental consequences of the alternatives within the short term (10 years) and long term (100 years).

The OPTIONS model was applied to the approximately 2.6 million acres of BLM-administered lands within the planning area. The surrounding private, state, and other federal lands comprise approximately 22 million acres. Modeling the non-BLM-administered lands to the same level of detail as the BLM-administered lands is not possible, because there is inadequate information available on which to base such modeling. Data on existing forest stand conditions of sufficient precision and accuracy to support detailed modeling does not exist or is not readily available for other ownerships. In addition, the prediction of specific harvesting practices on state lands and private lands would be complex and largely speculative. Context vegetation modeling for the non-BLM-administered lands was done by applying broad assumptions regarding the future management of non-BLM-administered lands to the Interagency Vegetation Mapping Project satellite image vegetation classification, as discussed in *Chapter 4 - Forest Structure and Spatial Pattern*.

The OPTIONS model came with no data and was used only as a modeling tool. The BLM was responsible for the data, assumptions, and rules that were used in formulating the model for analyzing the alternatives. A complete description of the OPTIONS modeling effort can be found in *Appendix R - Vegetation Modeling*.

The ORGANON growth and yield model was used to determine the volume outputs for the silviculture regimes of each alternative and was a key input into the OPTIONS model. A complete description of the growth and yield modeling effort can be found in *Appendix R - Vegetation Modeling*.

The OPTIONS model provided an assessment of the changes to the structural stages of forests and the changes to the habitat of the northern spotted owl over time for each alternative. A detailed description of these vegetation classes may be found in *Appendix B - Forest Structure and Spatial Pattern*. The OPTIONS model also provided changes to key baseline vegetation conditions and northern spotted owl habitats. These outputs were used by resource specialists to estimate the environmental consequences of the alternatives. Outputs were also used as data inputs for other models (such as the modeling of hydrology and fire).

The harvest treatments that were simulated in the model for the first 10 years were used to develop a first decadal scenario. This first decadal scenario was used to estimate short-term change to the forests and to display the types of treatments that would be applied. It also served as a basis to estimate road construction and harvesting methods. In addition, the first decadal scenario served as a quality control check of the sampled harvest units that were identified by the model. These harvest units were examined for the practicality of implementation. The first decadal scenario was not intended to be a plan for subsequent implementation on the ground. The environmental consequences from subsequent implementation of forest treatments through actual projects will be analyzed and disclosed in project-level environmental analysis. Project-level analysis will examine project-level impacts and determine if they are within those already anticipated and described in this environmental impact statement. Additional information about the first decadal scenario can be found in *Appendix E - Timber*.

Sustained Yield Units

Sustained yield units serve as the base geographical unit for which the allowable sale quantity is determined. The BLM recently revised sustained yield units to match the five western Oregon BLM District boundaries and the western portion of the Klamath Resource Area in the Lakeview District. The old sustained yield units had been established based on supplying marketing centers that are no longer relevant. Funding and implementing the resource management plans is done on a district basis, which provides a more logical basis for the sustained yield units. The revised sustained yield unit boundaries would result in slightly higher (2%) allowable sale quantity level than would have occurred under the previous units. The larger sustained yield units would result in a slightly higher sustainable harvest level, because there would be more flexibility in placement and timing of harvest with a larger forest inventory. The amount of acres in the harvest land base under each alternative would not be affected by the sustained yield unit boundary change.

Geographic Information System Data

To support the western Oregon resource management planning effort in the mid-1980s, the BLM created an automated geospatial database, which is a geographic information system (GIS) database. Ongoing collaborative efforts in the collection, standardization, and acquisition of data have resulted in a substantial increase in the amount and accuracy of the geospatial data that is available for land use planning.

The quality, quantity, and management of the data that is contained within the GIS database have provided managers and resource professionals with the ability to analyze complex land management issues and scenarios. The western Oregon component of the GIS database includes many data layers such as forest vegetation, management units, roads, hydrology, elevation, ownership, and a wide range of wildlife habitat information (including the location of threatened and endangered species on BLM-administered lands).

Existing data was evaluated for accuracy, reliability, and limitations and also was updated. Of particular note is an update to the estimated amount of BLM-administered lands that are contained in the riparian reserve land use allocation under the No Action Alternative. Over the past 10 years, the extent of the hydrology network has been more fully mapped and the information regarding the presence of fish has increased. This improved GIS data about hydrology and the presence of fish on BLM-administered lands within the planning area made it possible to model the extent of the riparian reserves to a precision that was not feasible 10 years ago. For the 1995 resource management plans, it was estimated that 22% (522,000 acres) of the BLM-administered lands within the planning area was contained in the riparian reserve land use allocation (the portion interspersed with the matrix and adaptive management areas after all other allocations were deducted). Based on the updated data, that number is now estimated at 15% (364,000 acres) for the No Action Alternative, which increases the acreage of the harvest land base, and, consequently, would increase the allowable sale quantity.

Other updates that resulted from the improved accuracy of the GIS information included a mapping correction. A mapping error during the 1995 Medford District resource management plan revision resulted in the inaccurate reporting of the district's acres that were open to off-highway vehicle use. The 1995 resource management plan showed 391,400 acres were open to off-highway vehicle use when, in fact, only 139,878 acres were open to off-highway vehicle use.

Besides the improved GIS data, another important source of data that was used in the analysis of the alternatives included the recently completed decadal assessment of the Northwest Forest Plan. This decadal assessment generated more current, accurate, and detailed data on the existing condition of the environment across the area of the Northwest Forest Plan than was available in 1995.

The data used in this analysis is also at a far finer resolution than was previously available. In 1995, the Northwest Forest Plan analysis used a geographical information database that was limited to a resolution of units of 40 acres in size. The current database has a resolution of units of 10 square meters in size, which is more than 16,000 times finer in resolution. This finer data allows more detailed analysis than was previously possible. As a result, this analysis can more precisely map resource conditions and accurately include fine-scale features, such as streams and roads, in the analyses that could not previously be considered. The data used in the analyses of the alternatives was summarized at various scales, including the planning area, physiographic provinces, the BLM districts, and fifth-field watersheds. There are 260 fifth-field watersheds, averaging 87,000 acres in size, that are located all or partially within the planning area.

Reference Analysis

Two reference analyses are included in this final environmental impact statement. Reference analyses provide additional information that is useful to understand more fully the effects of one or more of the alternatives.

The reference analyses are focused and limited to specific analytical questions. The reference analyses are not selectable during decision making, because they would not meet the purpose and need for action.

The two reference analyses for this final environmental impact statement include:

1. ***Allow no harvesting.*** This reference analysis provides information about the vegetation condition that would occur naturally and the capacity of the BLM-administered lands to provide fish and wildlife habitat if management of those lands ceased.

2. ***Manage most commercial forest lands for timber production.*** This reference analysis provides information about the vegetation condition and timber production levels that would occur if most of the BLM-administered lands (except the National Landscape Conservation System lands, the administratively withdrawn lands, and lands within 25 feet of streams) were managed for intensive timber harvesting in a manner similar to private industrial lands.

Scope of the Analysis

The Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) direct that "NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail" (40 CFR 1500.1[b]). Issues are "truly significant to the action in question" if they are necessary to make a reasoned choice between alternatives (i.e., the issue relates to how the alternatives respond to the purpose and need). Issues are also "truly significant to the action in question" if they relate to significant direct, indirect, or cumulative impacts resulting from the alternatives. This analysis addresses the environmental consequences that are associated with the issues that are related to the purpose and need (see *Chapter 1*) or relate to significant impacts. For example, the analysis of fisheries focuses on the effects on listed fish species to address the issue of “How should the BLM manage federal lands in a manner that is consistent with the Endangered Species Act in order to contribute to the conservation of species.” Other fish species occur within the planning area, and some have different habitat requirements and life histories than the listed fish species. However, this analysis does not attempt to analyze the effects of the alternatives on all fish species. Similarly, the analysis of plants and wildlife focuses on the effects on species listed under the Endangered Species Act, and effects are analyzed for BLM sensitive species to the extent necessary to evaluate changes in populations or habitat that would affect the conservation of these species. These sections do not attempt to analyze the effects of the alternatives on all plant and animal species.

Direct and Indirect Effects

The Council on Environmental Quality’s regulations for implementing the National Environmental Policy Act require that both the direct and indirect effects on the quality of the human environment of a proposed action or alternative be disclosed. Direct effects and indirect effects are described below:

- **Direct effects.** Those effects “which are caused by the action and occur at the same time and place.”
- **Indirect effects.** Those effects “which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable.”

There is no requirement that direct and indirect effects be discussed individually. It can also be difficult to distinguish between direct and indirect effects, particularly at the scale of the planning area. Additionally, it does not make any difference to the resource affected whether the effects are directly or indirectly caused. Therefore, the terms direct and indirect are not used to differentiate the effects analyzed in this final environmental impact statement.

Cumulative Effects

Cumulative effects result from the incremental impact of an action when added to past actions, other present actions, and reasonably foreseeable actions (40 CFR 1508.7). Due to the nature of the analysis in this large-scale and long-term resource management plan/environmental impact statement, all environmental effects described in this environmental impact statement would have incremental impacts that would have a cumulative effect together with past actions, other present actions, and reasonably foreseeable actions. Therefore, there is not a discreet and separate section labeled as cumulative effects. The discussion of effects on each resource incorporates the effects of past actions, and describes other present actions and reasonably foreseeable actions to provide context in which the incremental effects are examined, thus revealing the cumulative effects of the alternatives.

As the Council on Environmental Quality points out, in guidance issued on June 24, 2005, the “environmental analysis required under NEPA is forward-looking,” and review of past actions is required only “to the extent that this review informs agency decision making regarding the proposed action.” Use of information on the effects of past actions may be valuable in two ways according to the Council on Environmental Quality guidance. One is for consideration of the proposed action’s cumulative effects, and secondly as a basis for identifying the proposed action’s direct and indirect effects.

The Council on Environmental Quality stated in this guidance that “[g]enerally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.” This is because a description of the current state of the environment inherently includes the effects of past actions. The Council on Environmental Quality guidance specifies that the “[Council on Environmental Quality] regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions.”

The existing baseline information used in this analysis is a result of the aggregation of all past actions. The information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for a cumulative effects analysis than attempting to establish such a starting point by adding up the described effects of individual past actions to some environmental baseline condition in the past, which unlike current conditions can no longer be verified by direct examination.

The second area in which the Council on Environmental Quality guidance states that information on past actions may be useful is in "illuminating or predicting the direct and indirect effects of a proposed action." Extrapolation of data from largely anecdotal information of past actions is not generally accepted as a reliable predictor of effects. The basis for predicting the direct and indirect effects of this proposed action and its alternatives is published empirical research, the general accumulated experience of the resource professionals in the agency with similar actions, and models based on current scientific knowledge regarding relationships of the proposed management directions and effects that are generally accepted by the scientific community in the various specialized fields. Information on past actions has been integral to the development of many of the analytical methods in the EIS; for example, timber sale costs are analyzed based on data on past timber sale costs, as detailed in *Appendix E - Timber*. However, cataloguing individual past timber sales and their individual costs would not provide a better basis for analyzing the timber sale costs of the alternatives.

Scoping for this project did not identify any need to list individual past actions nor to analyze, compare, or describe environmental effects of individual past actions in order to complete an analysis that would be useful for illuminating or predicting the effects of the proposed action.

The effects of other present actions have been incorporated into the description of the existing condition. For the purpose of this analysis, projects scheduled to be sold under the 1995 resource management plans that were proposed prior to December, 2008, are assumed for the purpose of this analysis to be completed as proposed. For example, the habitat on acreage included in a timber sale project proposed prior to that date would be displayed and analyzed as harvested, whether or not that harvest has yet been completed. This assumption may overestimate the actual acreage harvested from sold sales, because some sales have not yet been awarded or have been enjoined. This analytical assumption does not constitute a decision in principle about the disposition of these sales. On other ownerships, the effects of other present actions are integrated into the broader analysis of current condition and assumptions about continued management consistent with existing plans or current trends. Other specific actions that are proposed, but have not yet been decided at the time of the preparation of this EIS, are described below.

For BLM-administered lands, reasonably foreseeable future actions are those actions that would occur as described under the various alternatives. For U.S Forest Service and state of Oregon lands, reasonably foreseeable actions are those that would occur under their current land use plans from a broad-scale perspective. For private lands, reasonably foreseeable actions are those actions that would occur with the continuation of present management, also from a broad-scale perspective. It would be speculative for the analysis to presume knowledge of site-specific actions that would occur in the future on lands managed by others over the time period analyzed in the final environmental impact statement. These assumptions about future management on other ownerships are based on existing plans or current trends and are broad and general in nature. However, the broad assumptions are sufficient to provide context for evaluating the incremental effect of the alternatives.

There are other broad-scale analyses currently underway that are other present or reasonably foreseeable actions for purposes of analyzing cumulative effects. They include:

- **Westwide Energy Corridor Project.** This project, which is currently underway, is a national programmatic environmental impact statement mandated under the Energy Policy Act of 2005 to designate corridors for oil, gas, and hydrogen pipelines, as well as electricity transmission and distribution facilities on federal lands in 11 western states. The *Westwide Energy Corridor Draft*

Programmatic Environmental Impact Statement was led by the Department of Energy (the BLM is a co-lead) and released in October 2007. The final environmental impact statement is scheduled for release in late 2008. After the environmental impact statement is completed, the BLM will issue a Record of Decision amending the relevant land use plans, as necessary, to implement corridor designations on the lands it administers. The U.S. Forest Service and Department of Defense are also cooperating agencies in the project. A decision is anticipated after the release of the Records of Decision for the Western Oregon Plan Revisions.

- **Proposed Jordan Cove Energy (Liquid Natural Gas Terminal) Project and Proposed Pacific Connector Gas Pipeline Project.** These two projects consist of an onshore liquid natural gas import and storage terminal located on the bay side of the North Spit of Coos Bay, Oregon, and an approximately 223-mile-long, 36-inch-diameter natural gas pipeline from the terminal southeastward across Coos, Douglas, Jackson, and Klamath counties to an interconnection with existing pipelines near Malin, Oregon. The Federal Energy Regulatory Commission will prepare an environmental impact statement to address the environmental consequences of the project. The Bureau of Land Management, U. S. Forest Service, and other governmental entities are formal cooperators in the environmental documentation. The current schedule calls for completion of the draft environmental impact statement by late 2008 and the final environmental impact statement by early 2009.
- **Proposed Bradwood Landing (Liquid Natural Gas Terminal) and Palomar Pipeline Projects.** These two projects would consist of an onshore liquid natural gas import and storage terminal located on the south shore of the Columbia River at river mile 38 and an approximately 220-mile-long, 36-inch-diameter natural gas pipeline extending from the terminal southeastward across Clatsop, Columbia, Washington, Yamhill, Marion, Clackamas and Wasco counties to an interconnection with an existing pipeline near Madras, Oregon. The Federal Energy Regulatory Commission has prepared a draft environmental impact statement to address the environmental consequences of the liquid natural gas terminal. The current schedule calls for completion of the final environmental impact statement by late 2008. The Federal Energy Regulatory Commission will prepare an environmental impact statement for the proposed pipeline once the pipeline project proponent files a complete application. The current schedule calls for completion of the draft environmental impact statement for the proposed pipeline by early 2009 and the final environmental impact statement by late 2009.
- **Proposed Ruby Pipeline.** This project would consist of the construction of a buried natural gas pipeline between locations known as the Opal Hub in Lincoln County, Wyoming and the Malin Hub near Malin, Oregon, and crossing through the states of Utah, Idaho and Nevada. The proposed pipeline would consist of 680 miles of 42-inch high pressure pipeline. The proposed location would pass through the eastern portion of the Klamath Falls Resource Area in the BLM's Lakeview District. The Federal Energy Regulatory Commission issued a Notice of Intent to prepare an Environmental Impact Statement in March 2008.
- **EIS for Invasive Plant and Landscape Health Management Using Herbicides on BLM-administered lands in Oregon.** An EIS team has initiated work on an Oregon-wide programmatic environmental impact statement for the use of 18 herbicide-active ingredients. The herbicides are those that were analyzed in the *Final Programmatic EIS for Vegetation Treatments Using Herbicides in 17 Western States (2007).* The Oregon-wide environmental impact statement will support all BLM districts in Oregon for use in their existing integrated weed management program and will further identify the details of how and when herbicides would be used as part of an integrated vegetation management program. Scoping is currently planned to be completed during summer 2008.

Spatial and Temporal Scales of Analysis

Some resources are spread more broadly across the planning area than others. Therefore, the analysis of the alternatives at multiple spatial scales is necessary to examine those resources for which their geographic area differs from the planning area. For example, the analysis of certain animals or birds may require consideration of a geographic area that is broader than individual districts. In contrast, the geographic area appropriate for analysis of a rare plant that has a highly localized geographic range may be quite limited. Information presented at multiple spatial scales helps the BLM to understand issues, analyze cumulative impacts, and tailor decisions to specific needs and circumstances.

It is also necessary to consider various temporal scales. The Council on Environmental Quality's regulations require consideration of the relationships between the short-term uses of the human environment and the maintenance and enhancement of long-term productivity. Some natural processes and the implementation of management directions or their effects may occur over a relatively short time, whereas other natural processes and implementation of management directions or their effects occur over longer periods of time. Therefore, vegetation changes were analyzed at 10, 20, 30, 40, 50, and 100 years. Effects are reported for different sets of time points for different analyses. Where possible, interim benchmarks and rates of progress or trends have been identified for those management objectives that may not be achieved for decades, a century, or longer.

In general, for these analyses, the short term is considered 10 years and the long term is considered 100 years. In the analysis of certain resources, the definition of short term and long term varies from this general definition. In those instances, the time period for short and long term is specified in the text.

Potential Changes in Conditions Not Incorporated into the Analysis

There are potential future events or changes in conditions that would alter the analysis of effects, for which there is insufficient information at this time to incorporate into the detailed quantitative analysis of future resource conditions. These future changes include climate change, Sudden Oak Death, and natural disturbance. For each of these, it is not speculative that some change in conditions will occur in the future, but it is not possible to reasonably foresee the specific nature or magnitude of the changes.

Climate Change

The global climate is becoming warmer, and there is strong evidence that this warming is resulting, at least in part, from human-caused production of greenhouse gases, including carbon dioxide (IPCC 2007). Climate interacts with vegetation and ecosystems; climate affects plant growth and ecosystem productivity; and ecosystem dynamics affect climate through the storage and release of greenhouse gases, including carbon dioxide.

In the past decades, the regional climate has become warmer and wetter with reduced snowpack (Scientific Consensus Statement 2004). Current climate conditions have changed from the climate conditions when the current old-growth stands were developing (Franklin et al. 2006). It is unknown whether these changes in climate have altered fundamental processes about tree regeneration and stand development in a way that changes the likely development of currently young stands.

The analysis does not incorporate changes in future climate conditions in the vegetation modeling, because the specific nature of regional climate change over the next decades remains speculative. Although an increase in average annual regional temperatures is likely, changes to the amount and timing of precipitation are too uncertain to predict (U.S. Global Change Research Program 2001, Climate Impacts Group 2004, and Scientific Consensus Statement 2004). Changes in the impact analysis as a result of climate change would be highly sensitive to changes in the amount and timing of precipitation. Furthermore, it would be very difficult to apply the results of climate change models to a finer scale than the entire Pacific Northwest, which limits the ability to apply the results of climate change models to the analysis of specific management strategies or actions.

Climate change could result in changes in vegetation types and species distributions, but the predicted effects vary with different climate change scenarios (Bachelet and Neilsen 2000). Increasing temperatures would likely result in expansion of forest vegetation into currently alpine areas (Field et al. 2007, Millar et al. 2006, Climate Impacts Group 2004, and Mote et al. 2003). Millar et al. (2006) predicted that several climate change scenarios would result in an increase in "warm temperate/sub-tropical mixed forest" in the Coast Range and Klamath Provinces. These shifts could result in an increase in madrone, tanoak, and other oak species in the drier sites, and maple and alder in the wetter sites, with a possible increase in southerly conifers such as redwood and some pines (Millar et al. 2006). In contrast, Busing et al. (2007) modeled future forest conditions in a western Cascades watershed within the planning area under two different climate change scenarios: (1) minor warming with drier summers, and (2) major warming with wetter conditions. For both scenarios, the modeling found that climate change would not result in rapid shifts in tree species dominance or total basal area, but that some tree species may shift their ranges to higher elevations. It is not known whether forests in southwestern Oregon, most of which receive less annual precipitation and longer summer drought, would respond similarly to the modeled watershed.

Either higher than previous temperatures or higher than previous atmospheric carbon dioxide levels could increase tree growth rates. However, the overall effects on regional forest growth are uncertain, especially because of the uncertainty of precipitation changes (Millar et al. 2006 and Smith 2004). At the broader scale, the IPCC report (2007) concluded:

> "overall forest growth in North America will likely increase modestly (10-20%) as a result of extended growing seasons and elevated CO_2 over the next century, but with important spatial and temporal variations." (Field et al. 2007).

Higher temperatures could lead to increased drought stress on plants and could potentially result in some shift from forest to non-forest vegetation on currently dry sites (Climate Impacts Group 2004, Scientific Consensus Statement 2004, Mote et al. 2003). However, such shifts are difficult to predict and remain speculative. As noted by Millar et al. (2006):

> "Hotter temperatures would enhance evaporative demand, tending to drought-stress the vegetation. However, that is somewhat countered, or even reversed, if it is also accompanied by increases in precipitation, as well as the increased water use efficiency of the vegetation from elevated CO_2 concentrations."

Higher summer temperatures would likely extend the season of high fire risk and could result in increased frequency and intensity of wildfires (Field et al. 2007, Climate Impacts Group 2004, Scientific Consensus Statement 2004, Mote et al. 2003). However, the potential effects of increased fire risk on forests depend heavily on predictions about broad-scale patterns of ocean/atmosphere interactions, changes in precipitation, and fire suppression activities (Westerling et al. 2006, Millar et al. 2006, Mote et al. 2003).

Higher temperatures could result in changes to hydrologic processes, including reduced snowpacks, earlier snowmelt, shifting of the rain-on-snow zones, higher spring streamflows, and lower summer streamflows (Field et al. 2007). The overall effects on hydrologic processes are uncertain because of the uncertainty of precipitation changes. Increased winter precipitation could potentially mitigate or overwhelm the effects of increased temperatures on snowpack and the changes in the timing of streamflows. However, decreased summer precipitation, coupled with reduced snowpacks and earlier snowmelt, would reduce summer streamflow. Hydrologic processes are heavily influenced by broad-scale patterns of ocean/atmosphere interactions (such as El Nino/Southern Oscillation) (Mote et al. 2003). Changes to these broad-scale patterns remain speculative (Field et al. 2007, Climate Impacts Group 2004).

Higher summer temperatures, especially if coupled with reduced summer streamflow, could contribute to degraded freshwater habitat conditions for salmon (Lawson et al. 2004, Climate Impacts Group 2004). Even if summer precipitation does not decrease, changes in seasonal patterns of precipitation and runoff could alter hydrologic characteristics of aquatic systems, such as the frequency and timing of floods, affecting species composition and ecosystem productivity (Field et al. 2007, Mote et al. 2003).

Changes in vegetation in response to increased temperature, altered precipitation, and altered fire regimes would alter wildlife habitat. However, because the changes in vegetation are uncertain, consequent changes in wildlife habitat are uncertain. The Sustainable Ecosystems Institute (SEI) report noted that an increase in fire frequency "may affect the capability of the west-side reserve network to recover Spotted Owls" (SEI 2008: 53). The Final Recovery Plan for the northern spotted owl suggested that "the spotted owl and its habitat probably will be affected by climate change through several pathways, including but not limited to changes in fire regime; patterns of rain and snowfall; wildlife diseases; and abundance and distribution of native and nonnative species of fish, wildlife, and plants." However, the Final Recovery Plan concluded that "at this time, we do not have adequate information to accommodate or specifically predict these possible future changes" (USDA USFWS 2008, 34:143).

Sudden Oak Death

The analysis does not incorporate future changes in forest structure and composition and wildlife habitat as a result of Sudden Oak Death, a recently recognized disease that is killing tanoak, oaks, and other plant species in California and southwestern Oregon. The disease is caused by the introduced pathogen, *Phytophthora ramorum*. The disease causes trunk cankers, which often directly lead to the death or weakening of a tree to the point that fungi or insects kill it (Rizzo et al. 2002). Tree mortality rates vary widely, even in susceptible species. A wide range of other species with visible branch cankers or foliar lesions is infected by the pathogen, but with uncertain effects on the plant. One of the most common oak species within the planning area, Oregon white oak (*Quercus garryana*), appears to be unaffected by the pathogen (Rizzo 2003). The long-term effect of sudden oak death on infected forest ecosystems is unknown.

The disease has been confirmed in Oregon at several locations near Brookings, in Curry County (Palmieri and Frankel 2006, Kanaskie et al. 2006). The state of Oregon and U.S. Forest Service are implementing eradication measures (Kanaskie 2007, Palmieri and Frankel 2006). Future spread of the disease into Oregon is uncertain. Models identify different levels of risk of sudden oak death spread across the planning area (Kelly et al. 2005). Widespread infections and mortality of tanoak and oak species could alter not only forest composition and structure, but also important forest processes such as nutrient cycling and wildlife habitat. For example, tanoak and oaks are important in many southwestern Oregon stands in providing cover and food for a wide variety of wildlife species. Widespread infections could affect suitable northern spotted owl habitat in southwestern Oregon through the removal of sub-dominant canopy tree and shrub species, thereby altering habitat structure and prey base numbers. The SEI report evaluated the effect of Sudden Oak Death on northern spotted owls and concluded that there is no reason at this time "to elevate [Sudden Oak Death] above the level of a potential threat, subject to continued monitoring" (SEI 2008:13). The final Recovery Plan for the northern spotted owl concluded that it was not necessary to do anything specific to address Sudden Oak Death, as it was not considered a significant threat (USDI USFWS 2008: 144). Because future spread of the disease and subsequent tree mortality in the planning area is speculative, there is no basis on which this analysis can assume future changes to forest composition, structure, and process as a result of Sudden Oak Death.

Natural Disturbance

This analysis does not include detailed estimates of future natural disturbances, such as wildfires, windstorms, disease, or insect infestations. These disturbances will occur in the future under all alternatives, but predicting their location, timing, severity, and extent would be speculative. Such disturbances would have the potential to alter the future abundance and spatial pattern of structural stages and habitat. There are no available theoretical approaches for estimating the location, timing, or severity of future natural disturbances at the scale of the planning area over the time frame of this analysis. A general discussion of various approaches to estimating the extent of future natural disturbances and the effects of natural disturbances is provided below.

The Extent of Natural Disturbance

Wildfire is the most predictable of these natural disturbances, yet predicting specific effects related to wildfires it is still impossible at the scale of the planning area. The effects are highly dependent on a wildfire's location, timing, severity, and extent, all of which depend on variables that cannot be reasonably foreseen. Those variables include weather, ignition sources, fuel conditions in the fire location, and the effectiveness of control efforts.

The FSEIS of the Northwest Forest Plan responded to this uncertainty about future wildfires with a theoretical approach, which assumed that 2.5% of late-successional forests would be lost to wildfires each decade (USDA USFS and USDI BLM 1994b, p. 3&4:42). That theoretical approach was based on an assumption that forests in the Northwest Forest Plan area experienced a natural disturbance rotation of 250 years, which was extended to a 400-year disturbance rotation as a result of "partial fire suppression" (USDA USFS and USDI BLM 1994b, p. 3&4:42). That analysis assumed an even rate of loss to wildfire over time and among provinces. The FSEIS of the Northwest Forest Plan also assumed that the rate of loss from natural disturbance of late-successional forests would not vary among the alternatives. Therefore, that theoretical approach to analyzing future disturbance would provide little information to help sharply define the issues or provide a clear basis for choice among the alternatives.

The Late-Successional/Old-Growth Monitoring Report found that the actual loss of late-successional forests over the past 10 years was lower than anticipated by the FSEIS for the Northwest Forest Plan: 1.8% for the entire Northwest Forest Plan area[1] (Spies 2006: 84, 89; and Moeur et al. 2005). The Late- Successional/ Old-Growth Monitoring Report also found that there was high variation among the provinces in the loss of late-successional forest to wildfires in the past 10 years: the Coast Range Province had no loss, and the Klamath Province had a much higher loss rate (9.5% for the decade) (Spies 2006: 84; Moeur et al. 2005), but most of this was on U.S. Forest Service lands, rather than BLM-administered lands, as explained below. The predictive power of that empirical data from the Late-Successional/Old-Growth Monitoring Report is uncertain, in part because of the overwhelming influence of individual wildfires in that data. More than three-quarters of the acreage lost to wildfires in the entire Northwest Forest Plan area were the result of a single fire (Moeur et al. 2005: 95). The Late-Successional/Old-Growth Monitoring Report described a <1% decadal loss of late-successional forest from wildfire in the Eastern Cascades Province. However, if the monitoring period had been extended for one additional year, the decadal loss rate would have increased to 14.6% because of a single large fire (Spies 2006: 84; Moeur et al. 2005: 96). Attempts to provide detailed predictions of wildfire acreage are confounded by the high spatial and temporal variability, even at the scale of provinces and decades.

The actual total wildfire acreage on BLM-administered lands over the past decade has been less than the acreage of late-successional forest that had been anticipated to be lost by the FSEIS of the Northwest Forest Plan. From 1995 to 2004, wildfire occurred on 29,800 acres of BLM-administered lands in the planning area (1.2% of BLM-administered lands). This acreage includes wildfires of all severities in all vegetation conditions, rather than just stand-replacing fires in late-successional forest. If this wildfire acreage were assumed to be entirely stand-replacing fire and also to have occurred in vegetation conditions proportional to their abundance (which is unlikely, given that stand establishment and young forests have higher fire hazard and fire severity than mature and structurally complex forest as addressed in the *Fire and Fuels*

[1]Note that the Late Successional/Old Growth Monitoring Report reported values for late-successional forest loss to wildfire by a variety of classifications of late-successional forest. The numbers reported here are from the summarization of the results of the Late-Successional/ Old-Growth Monitoring Report in the monitoring synthesis report (Spies 2006).

section of *Chapter 4*), the decadal loss of mature & structurally complex forest on BLM-administered lands would still have been less than half the amount anticipated to be lost by the FSEIS of the Northwest Forest Plan. The lower than expected rate of loss from wildfire may be a result of the BLM-administered lands having greater interspersion with private lands and greater access for fire suppression than Forest Service lands.

The information available for predicting future disturbances has not substantially changed since the FSEIS for the Northwest Forest Plan, and there are no better methods for incorporated disturbance predictions into detailed analysis of forest management strategies at the scale of this planning area. If the empirical data from the past 10 years is predictive of future conditions, the theoretical approach of assuming a 2.5% decadal loss of late-successional forest would be an overestimate of the acreage lost. Nevertheless, even if loss of this magnitude were to occur under the alternatives considered here, it would not alter the relative comparison of the effects of alternatives or the fundamental conclusions about the effects of the alternatives. However, incorporating such a loss into the quantitative analysis of structural stage abundance would alter the quantitative outcomes and obscure the effects of the alternatives. A 2.5% decadal loss of late-successional forest (if equated to mature & structurally complex forest in this analysis) would result in a reduction over time in the abundance of mature & structurally complex forest that would be comparable to the difference in the abundance of mature & structurally complex forest that can be attributed to the effects of the alternatives.

Most other studies in the planning area that have modeled future forest conditions under different management regimes have not incorporated large-scale disturbance (see, e.g., Cissel et al. 1999; Kennedy 2005:103; Spies et al. 2007; and Torgersen et al. 2004:13; and). Busing et al. (2007) simultaneously modeled different management regimes and different disturbance scenarios. However, that simulation addressed only a single watershed and used extremely general descriptions of starkly contrasting management scenarios, which would not adequately provide for a reasoned choice among the alternatives in this plan.

In summary, it is not possible to accurately predict the total acreage of wildfires or other disturbances at the scale of the planning area (Spies 2006:84). To predict total acreage of wildfires for BLM-administered lands, which are highly dispersed among other ownerships, would be far more speculative. To attempt to predict wildfire acreage for BLM-administered lands at finer scales, or to predict wildfire severity, timing, or extent, would be so speculative as to be arbitrary. However, if wildfires and other disturbances occur at approximately the rate anticipated in the FSEIS in the Northwest Forest Plan or at the lower rate actually experienced over the past decade, the relative effects of the alternatives would not be substantially altered from the effects described in this analysis.

Effects of Natural Disturbances

Natural disturbances kill trees, creating snags and coarse woody debris. Some disturbances, such as wildfires, consume some portion of the trees that are killed, but other disturbances leave the killed trees intact. Disturbances drive the development of forest structure, composition, and process (Franklin et al. 2002). Disturbances have strong controls on the pattern of the landscape, nutrient cycling, hydrology, and habitat (Hutto 2006; Lindenmayer and Noss 2006; Reeves et al. 2006; Beschta et al. 2004; Ice et al. 2004; Karr et al. 2004; Lindenmayer et al. 2004; Robichaud et al. 2000; Perry 1998; Forman 1995). The analysis in the Biscuit Fire Recovery Project environmental impact statement described the effects of wildfire within the planning area, as detailed below, and that analysis is incorporated by reference. For example:

- **Vegetation.** Disturbances such as wildfire and windstorms alter vegetation conditions and influence forest composition, structure, and spatial pattern (Franklin et al. 2002 and Forman 1995). The environmental impact statement for the Biscuit Fire Recovery Project concluded that the wildfires had removed late-successional forest habitats and created early-successional habitats (USDA USFS/USDI BLM 2004d: III-153 - III-173).

- **Soil conditions and processes.** The effects of fire on soils are variable depending on the intensity of the fire and the type of fuels consumed. If forest litter and the decomposed organic material on and in the soil are not totally consumed, then fire effects on soil are usually minimal. In areas of moderate to high burn severity, all the duff and litter on forested sites, including logs on the forest floor, may be consumed. This can heat the soil enough to make fine-textured soils, such as clays and silts, increase in coarseness. Fire has the potential to make soils hydrophobic, or resistant to the natural movement of water into and through the soil profile. This may impact summer water availability to sprouting and recently planted vegetation. At the same time, loss of all the vegetation and surface cover has the potential to decrease the movement of water into soil, increase the potential for overland flow of water, and increase the risk of erosion and mass wasting (USDA USFS/USDI BLM 2004d: III-81 and Robichaud et al. 2000). Fire recycles nutrients otherwise stored in organic matter on the forest floor and unavailable for plant use. After a fire, many nutrients are made available for use by vegetation. Usually following wildfire, there is a short-term increase in soil fertility lasting several years. However, if the organic matter of the mineral soil is lost or reduced, which can occur in hot long-duration fires, then the ability of the soil to hold nutrients leached from the ash is reduced. As a result, nutrients can be lost from the nutrient cycling system. The environmental impact statement for the Biscuit Fire Recovery Project concluded that wildfire altered the conditions and processes of the soil, but did not conclude that the wildfire had increased the risk of landslides (USDA USFS/USDI BLM 2004d: III-81 - III-85).
- **Stream flow, sedimentation, and water temperature.** Wildfires generally increase peak flows: water-repellent soils and cover loss causes flood peaks to arrive faster, rise to higher levels, and entrain significantly greater amounts of bedload and suspended sediments than unburned watersheds (Robichaud et al. 2000). Where fires remove streamside canopy, the increased solar radiation reaching the stream can increase water temperatures. The environmental impact statement for the Biscuit Fire Recovery Project concluded that the wildfires had increased stream flow, sedimentation, and water temperature (USDA USFS/USDI BLM 2004d: III-206 - III-211).
- **Insect infestations.** Disturbances such as wildfire and windstorms can lead to increased populations of insects, including bark beetles and wood borers that attack weakened, dying, or dead trees. Insects, in general, and associated disease organisms are integral parts of the forest ecosystem. They help decompose and recycle nutrients, build soils, and can help maintain genetic diversity within tree species. Wood borers start the decomposition process on downed wood by breaking down the dead wood, especially the downed material. The environmental impact statement for the Biscuit Fire Recovery Project concluded that the extensive insect infestations following the fire were possible, but not predictable (USDA USFS/USDI BLM 2004d: III-143 - III-144).

Incomplete or Unavailable Information

If information that is relevant to reasonably foreseeable significant adverse impacts and essential to a reasoned choice among alternatives is incomplete or unavailable, the Council on Environmental Quality's regulations (40 CFR 1502.22[a]) require that an environmental impact statement:

- include a statement that the information is incomplete or unavailable.
- describe the relevance of this information to analyzing the impacts.
- summarize existing credible scientific evidence which is relevant to evaluating the impacts.
- evaluate such impacts based on theoretical approaches or research methods.

There is incomplete or unavailable information about salvage after natural disturbance that is relevant to reasonably foreseeable significant adverse impacts and essential to a reasoned choice among alternatives.

Salvage after Natural Disturbance

The alternatives contain management directions related to salvaging of trees killed following disturbances, and those management directions vary among the alternatives. Information on the effects of salvage is incomplete or unavailable. The analysis of the effects of such salvage after natural disturbances (the location, timing, severity, and extent of which cannot be predicted, as discussed above) prior to their occurrence would require making so many speculative assumptions regarding specific circumstances that the conclusions of the analysis could not be used to make reasonably informed decisions regarding management directions. In addition to the summarization of existing scientific evidence and the evaluation of impacts provided below, the analysis of specific salvage actions would be addressed at the time of proposed implementation, when specific circumstances could be analyzed.

Salvaging after natural disturbances provides opportunities for timber harvesting. When such harvesting would occur in the non-harvest land base is not included in computing the allowable sale quantity (see *Chapter 4 - Timber*), because this harvesting would not be repeated over time. The economic return from harvesting in the non-harvest land base that would not otherwise occur in the absence of a natural disturbance cannot be analyzed because of the speculative nature of the timing and magnitude of the disturbance and the value of the timber that might be killed. When harvesting after natural disturbance occurs in the harvest land base, the harvests would be included as part of the allowable sale quantity. Therefore, any increase in the timber volume that would be offered for sale in a given year because of salvaging after a natural disturbance would result in lower programmed harvest in subsequent years, so that the total volume harvested in a decade would not exceed the decadal level of cut. Consequently, such salvage harvesting in the harvest land base area would create no economic benefit beyond that assumed from programmed harvesting in these areas.

Salvaging after natural disturbances can potentially reduce the risk of a future high-severity fire by reducing the quantity of large fuels (USDA USFS/USDI BLM 2004d: III-37 - III-38 and III-58; McIver and Starr 2000). In contrast, Donato et al. (2006) and Beschta et al. (2004) concluded that salvage logging increases fire risk by increasing surface fine fuels, and suggested that leaving snags standing could result in a lower fire hazard. More recent studies have found that salvage logging increases fine fuels in the short term, but reduces the quantity of large fuels a decade or more after salvage logging (Monsanto and Agee 2008, McIver and Ottmar 2007). The large fuels in a fire release a large amount of energy over a sustained time period. This heat pulse contributes to long-term soil damage and root mortality (Monsanto and Agee 2008 and Robichaud et al. 2000: 5). All disturbances that kill trees increase the quantity of both fine and large fuels on the ground. Salvage logging reduces the quantity of large fuels, but can increase the quantity of fine fuels. Although the potential for reducing future fire severity by reducing large fuels is consistent with existing research on fire effects (Monsanto and Agee 2008; Brown et al. 2003), there is little research that directly evaluates the effectiveness of salvage logging in achieving this objective. As noted by Reeves et al. (2006):

> *"reburn probability and reburn fire behavior are understood mostly in theory; there is little empirical evidence that would be useful for evaluating risks."*

Salvaging after natural disturbances can potentially reduce insect and disease outbreaks (Ice et al. 2004, Sessions et al. 2004, McIver and Starr 2000). For example, windthrow can contribute to increases in Douglas fir bark beetle populations (Furniss and Carolin 1977). However, the effect of salvage logging on future insect and disease outbreaks, like the effect on reburns, is understood mostly in theory and without empirical evidence (USDA USFS/USDI BLM 2004d: III-143 - III-144).

Ground disturbances that are caused by salvage logging can mechanically break up hydrophobic soils (McIver and Starr 2000). However, some studies suggest that hydrophobic soils are temporary and would be naturally altered before salvage logging would typically occur (Reeves et al. 2006, Beschta et al. 2004, USDA USFS/USDI BLM 2004d: III-82).

Salvaging can reduce safety hazards. Natural disturbances create snags and logs that can pose safety hazards to people and infrastructure (roads, trails, and recreation facilities). Salvaging can also reduce safety hazards during wildfire suppression, because large fuels contribute to the difficulty of suppression operations, and snags and logs pose direct safety hazards to firefighters (USDA USFS/USDI BLM 2004d: III-38 - III-41, III-51 - III-53, and III-55 - III-56).

Salvage logging can disrupt natural tree regeneration (Donato et al. 2006, McIver and Starr 2000), but can improve access to disturbed sites to allow replanting and future silvicultural treatments (Sessions et al. 2004). Several studies have asserted that salvage logging necessarily causes forest degradation as a result of soil compaction, erosion, sedimentation to streams, and the spread of invasive species (Lindenmayer and Noss 2006, Reeves et al. 2006, Beschta et al. 2004, Karr et al. 2004). These adverse effects are only potential results of salvage logging, not certain results. As with other timber harvesting, proper logging design and implementation can avoid adverse effects on soil and water (Ice et al. 2004, Sessions et al. 2004, Duncan 2002, McIver and Starr 2000).

Salvaging does not directly contribute to the ecological recovery of disturbed forests and, in some respects, impairs or delays ecological recovery. Salvaging reduces snag and coarse woody debris levels, which reduces ecological functions and alters future stand development (Lindenmayer and Noss 2006, Noss et al. 2006, Reeves et al. 2006, Franklin et al. 2002). Salvage logging simplifies and homogenizes the post-disturbance early-successional forest, and several studies have asserted that early-successional forests with abundant structural legacies from the previous stand (as would occur typically in naturally-created early-successional forests) are becoming increasingly rare and are important sites for many biological and ecological processes (Hutto 2006, Lindemayer and Noss 2006, Spies 2006, Ohmann et al. 2005, Lindemayer et al. 2004, Franklin et al. 2002).

Irreversible or Irretrievable Commitment of Resources

The irreversible or irretrievable commitment of resources refers to those that cannot be reversed or that are lost for a long period of time. Examples include the extraction of minerals or the commitment of land to permanent roads. Although not specifically labeled, irreversible or irretrievable commitments of resources are described in the environmental consequences for each resource.

Adverse Effects That Cannot be Avoided

Under the National Environmental Policy Act (NEPA), an agency does not have to avoid adverse effects. However, an agency must identify adverse effects and disclose them. An agency must also identify the means to mitigate those adverse effects that can be mitigated—not all adverse effects can be mitigated. Adverse effects that cannot be avoided are those that would remain even after mitigation measures have been applied.

Mitigation

The Council of Environmental Quality regulations regarding the National Environmental Policy Act state that mitigation includes avoiding, minimizing, rectifying, reducing, eliminating or compensating for adverse environmental impacts. Many relevant, reasonable mitigation measures that could avoid or reduce the adverse environmental impacts of the proposed action while still meeting the purpose and need were incorporated into the alternatives either specifically or programmatically. Many other reasonable mitigation measures that would be identified and considered in implementation project design and analysis have been described to the extent possible at this scale (see the Best Management Practices in *Appendix I-Wate*r). Where unmitigated adverse impacts remain at the programmatic scale, some relevant and reasonable measures have been identified (e.g., green tree retention for rain-on-snow watersheds susceptible to peak flow increases). In addition, there will be an opportunity in the Record of Decision to incorporate aspects of the various alternatives as mitigation in the Approved Resource Management Plan to avoid or reduce adverse environmental impacts.

Measures to avoid, rectify, or reduce environmental impacts were incorporated into the alternatives where practicable and consistent with meeting the purpose and need of the plan revision. The analysis of the PRMP in the Final EIS indicates that levels of impacts to the various resources would be very low. This is primarily a result of the incorporation of mitigation into the design of land use allocations and management direction of the PRMP to avoid, rectify, or reduce adverse environmental impacts. For example, the BLM Special Status Species Policy was incorporated into the PRMP as a result of adverse impacts identified in the Draft EIS. As a result, the environmental effects of the PRMP would be very low and, therefore, few additional specific mitigation measures were identified in the effects analysis for the PRMP

The following are a few examples of specific mitigation that has been incorporated as management direction into the PRMP to avoid, rectify, or reduce adverse environmental impacts:

- Livestock exclosures, or seasonal restrictions from streams or special status plant sites, to conserve species.
- Road improvement, storm-proofing, maintenance, or decommissioning to reduce chronic sediment inputs along stream channels and waterbodies.
- Application of uneven-age management to reduce fire hazard and increase fire resiliency of forest stands in southern Oregon.
- Seasonal restriction of motor vehicle use, or closure of roads, in deer and elk winter range to maintain healthy populations.
- Restriction of activities during nesting season of the northern spotted owl and marbled murrelet, where they have been found to be currently nesting, to increase nesting success.

Programmatic mitigation measures are those that may be appropriate at the time of project implementation of the Approved RMP. Programmatic mitigation measures were incorporated into the alternatives including the PRMP. These measures would be required through management direction and would be applied as determined necessary through analysis of site-specific circumstances at the project level. The following are a few examples of programmatic mitigation that have been incorporated into the PRMP as management direction and may be applied as determined necessary though project-level, site-specific analysis to avoid or reduce adverse environmental impacts:

- Altering the type, timing, extent, and intensity of actions to maintain populations of special status plant and animal species.
- Implementing Best Management Practices to maintain water quality.
- Implementing prescribed burns in accordance with the Oregon Smoke Management Plan to reduce emissions, to avoid smoke intrusions into designated areas, and to avoid degrading the visibility in Class I areas.
- Including stipulations in permits issued for collection of special forest products to limit adverse impacts on plant communities, individual plants, soil, and water.
- Altering the design of projects within Visual Resource Management Classes I, II, and III to preserve, retain, or partially retain the existing character of the landscape.

Management directions in the alternatives are mostly broad in nature and are not intended to provide an exhaustive list of project-level practices that could be implemented to accomplish management objectives. Specific project-level mitigation measures that are consistent with an alternative's management objectives or management direction may be implemented as determined necessary. The following are a few examples of project-level mitigation that are not specifically listed in the individual alternatives, but which are consistent with the management objectives and management direction of all alternatives including the PRMP and may be applied at the time of project implementation:

- Washing of vehicles to reduce the risk of introduction or spread of invasive plants.
- Using weed-free straw and mulch to reduce the risk of introduction or spread of invasive plants.
- Restricting ground-based harvesting equipment to slopes less than 35 percent to avoid detrimental soil disturbance.
- Restricting ground-based harvesting equipment to designated skid trails to reduce the extent of detrimental soil disturbance.
- Increasing initial plantation spacing to reduce the need to thin and thereby reduce the amount of slash that would contribute to fire hazard or require fuels treatment.

Estimated Management Activity for the First 10 Years

See *Table 4-1 (Estimated first decade levels of timber management activity by alternative)* for the assumed levels of timber management activities that were used in the analysis of the environmental consequences. See *Table 4-2* (*Estimated first decade levels of timber management activity by district under the PRMP*) for the assumed levels of activity by individual district.

See *Table 4-3* (*Estimated first decade levels of non-timber management activity by alternative*) for the assumed levels of certain non-timber related activities that were used in the analysis of the environmental consequences.

These assumed levels of activities are broad approximations used to compare the environmental consequences of the PRMP and the alternatives. The achievement of objectives and anticipated environmental consequences are not highly sensitive to short-term and relatively minor departures from the broad levels of assumed activities used as analytical assumptions.

Table 4-1. Estimated First Decade Levels Of Timber Management Activity By Alternative

Timber Management Activity	Unit	Alternative				
		No Action	Alt. 1	Alt. 2	Alt. 3	PRMP
Regeneration harvesting	acres	60,500	90,600	143,400	3,900	76,600
Partial harvesting	acres	0	0	0	124,600	0
Harvest land base thinning	acres	36,800	45,400	43,300	160,300	146,400
Nonharvest land base thinning	acres	63,200	68,000	33,400	0[a]	73,900
Eastside Management Lands thinning	acres	3,200	3,200	3,200	3,200	800
Allowable sale quantity (ASQ) volume	mmbf	2,680	4,560	7,270	4,710	5,020
Nonharvest land base (NHLB) volume	mmbf	870	810	400	20	860
Eastside Management Lands volume	mmbf	20	20	20	20	5
Total harvest volume	**mmbf**	**3,570**	**5,390**	**7,690**	**4,750**	**5,885**
Permanent road construction	miles	360	520	610	550	700
Temporary road construction	miles	460	310	400	510	570
Right-of-way area for permanent road construction	acres	1,800	2,800	3,300	3,200	3,870
Ground-based yarding	acres	31,100	38,700	36,500	58,500	56,700
Cable yarding	acres	100,400	139,100	157,000	187,900	202,500
Aerial yarding	acres	29,000	26,200	26,600	42,400	38,500
Site preparation:						
Prescribed burning	acres	48,200	71,700	109,300	60,800	70,900
Other	acres	14,900	28,500	46,200	20,400	15,400
Release/precommercial thinning	acres	54,600	54,600	54,600	54,600	57,700
Stand conversion	acres	2,100	2,100	2,100	2,100	2,200
Planting/unimproved genetics	acres	18,600	29,300	38,600	20,300	30,100
Planting/improved genetics	acres	50,800	73,500	115,700	62,400	74,200
Fertilization	acres	104,700	129,700	127,200	204,400	108,600
Stand maintenance/protection	acres	112,500	161,400	259,900	134,400	153,200
Pruning	acres	37,600	37,600	37,600	37,600	35,600

[a]In Alternative 3, nonharvest land base is less than 50, so rounding to nearest 100 is 0.

Table 4-2. Estimated First Decade Levels Of Timber Management Activity By District Under The PRMP

Timber Management Activity	Unit	District					
		Salem	Eugene	Roseburg	Coos Bay	Medford	Klamath Falls
Regeneration harvesting ASQ	acres	13,100	15,000	13,500	8,900	26,100	0[a]
Thinning ASQ	acres	28,800	33,100	16,100	23,500	37,100	7,800
Allowable sale quantity *volume* (ASQ) (*annual level*)	mmbf	117	139	69	75	97	5
Nonharvest land base thinning	acres	21,400	16,300	12,400	18,800	4,900	0
Nonharvest land base *volume* (*annual level*)	mmbf	28	20	13	22	3	0
Eastside Management Lands *volume* (*annual level*)	mmbf	n/a	n/a	n/a	n/a	n/a	0.5
Total harvest volume	**mmbf**	**145**	**159**	**82**	**97**	**100**	**5.5**
Permanent road construction	miles	140	120	90	60	280	10
Temporary road construction	miles	110	130	110	130	90	0
Right-of-way area for permanent road construction	acres	780	670	470	340	1,520	60
Ground-based yarding	acres	18,200	4,500	8,600	3,600	13,500	7,600
Cable yarding	acres	35,700	54,200	27,300	40,600	44,600	300
Aerial yarding	acres	9,400	5,700	6,100	7,000	10,200	0
Site preparation:							
Prescribed burning	acres	13,300	13,460	11,900	6,210	25,960	50
Other	acres	10,500	150	140	1,630	3,030	0
Release/precommercial thinning	acres	7,700	8,500	6,000	4,000	30,000	1,500
Stand Conversion	acres	50	100	150	1,800	100	0
Planting/unimproved genetics	acres	3,860	8,960	4,160	1,590	11,360	130
Planting/improved genetics	acres	11,170	15,700	14,300	8,290	24,760	10
Fertilization	acres	44,240	7,000	29,810	25,000	2,500	0
Stand maintenance/protection	acres	20,560	25,890	28,900	25,450	52,270	160
Pruning	acres	6,800	4,000	6,300	5,100	13,000	350

[a] Acres are rounded to nearest 100; amounts less than 50 reflect 0 acres.

Table 4-3. Estimated First Decade Levels Of Non-Timber Management Activity by Alternative

Activity	Unit	Alternative				
		No Action	Alt 1	Alt. 2	Alt. 3	PRMP
Lands Available for Grazing	acres	560,000	418,500	418,500	418,500	418,500
Range Improvements						
Reservoirs	number	9	35	35	35	35
Fences	miles	24	53	53	53	53
Energy/Mineral Development						
Quarries	acres	700	700	700	700	700
Mining Notices	acres	450	450	450	450	450
Gas Wells	acres	780	780	780	780	780
Off-Highway Vehicle Areas						
Open	acres	330,000	77	77	77	0
Closed	acres	84,600	98,800	98,800	98,800	98,800
Limited to Existing Roads/Trails	acres	950,000	0	0	0	0
Limited to Designated Roads/Trails	acres	1,300,000	2,400,000	2,400,000	2,400,000	2,400,000
Instream Restoration	miles	126	126	126	126	126
Remove Barriers to Fish Passage	number	144	144	144	144	144
Road Decommissioning	miles	200	200	200	200	200
Invasive Weed Treatments						
Chemical	acres	19,100	19,100	19,100	19,100	19,100
Other (manual, mechanical, hot foam, goats, & fire)	acres	24,400	24,400	24,400	24,400	24,400
Vegetative Treatments[a]						
Broadcast Burn/Underburn	acres	111,600	111,600	111,600	111,600	111,600
Hand Cut, Pile, and Burn	acres	75,800	75,800	75,800	75,800	75,800
Machine Cut, Pile, and Burn	acres	17,100	17,100	17,100	17,100	17,100
Machine Cut and Yard (Biomass)	acres	83,600	83,600	83,600	83,600	83,600
Habitat Restoration[b]	acres	1,500	1,500	1,500	1,500	1,500
Mastication (slash buster, moving)	acres	20,100	20,100	20,100	20,100	20,100

[a]Treatments serve various purposes such as hazardous fuels treatments, wildlife improvements, and range enhancements. A single activity can serve one or more purposes.

[b]Includes activities such as oak habitat enhancement, meadow enhancement, and aspen enhancement. Activities could include any combination of cutting, burning, or mechanical removal.

Forest Structure and Spatial Pattern

Key Points

- The abundance of the forest structural stages across all ownerships:
  - would not return to their average historic conditions in 100 years, even if there were no timber harvesting on the BLM-administered lands, and
  - would only shift 1% in 100 years under all alternatives.
- The abundance of the forest structural stages on the BLM-administered lands would be consistent with the average historic conditions only under the No Action Alternative. Under all alternatives, the abundance of the young forests would decrease, and the abundance of the mature & structurally complex forests would increase from the current condition.
- Retention of structural legacies in regeneration harvests, which would occur under the No Action Alternative and Alternative 3 and in some areas under the PRMP, would result in structurally complex forests redeveloping on harvested lands almost twice as fast after harvesting as under Alternatives 1 and 2.
- The alternatives would vary widely in the amount of existing old forest that would be harvested in 100 years — from 14% under the No Action Alternative, to 63% under Alternative 3. Under the PRMP, 27% of existing old forest would be harvested in 100 years.
- Across all ownerships, the patch size of mature and structurally complex forests would increase under all alternatives. The No Action Alternative would result in the largest increase, and Alternative 3 would result in the smallest increase in most provinces.
- On the BLM-administered lands, the size and connectivity of the patches of the mature & structurally complex forests:
  - would increase from the current condition in most provinces under the No Action Alternative and the PRMP,
  - would decrease in most provinces under Alternatives 1 and 2.
  - would decrease in all provinces under Alternative 3.

This analysis describes the abundance and spatial patterns at various points in time of the forest structural stages that would exist under each of the alternatives:

- for the BLM-administered lands within the entire planning area, by land use allocation and by physiographic province
- across all ownerships for the entire planning area, by physiographic province

This analysis compares these abundances and spatial patterns to the average historic conditions. As explained in *Chapter 3* (in *Forest Structure and Spatial Pattern)*, this analysis uses the average historic conditions as a benchmark to provide context in comparing the effects of the alternatives. The average historic conditions do not represent a goal or target for management.

Although of interest in itself, this analysis is intended to serve as an important basis for other subsequent analyses in this EIS by providing a description of the forest at broad landscape scales that would occur at various time periods under the alternatives.

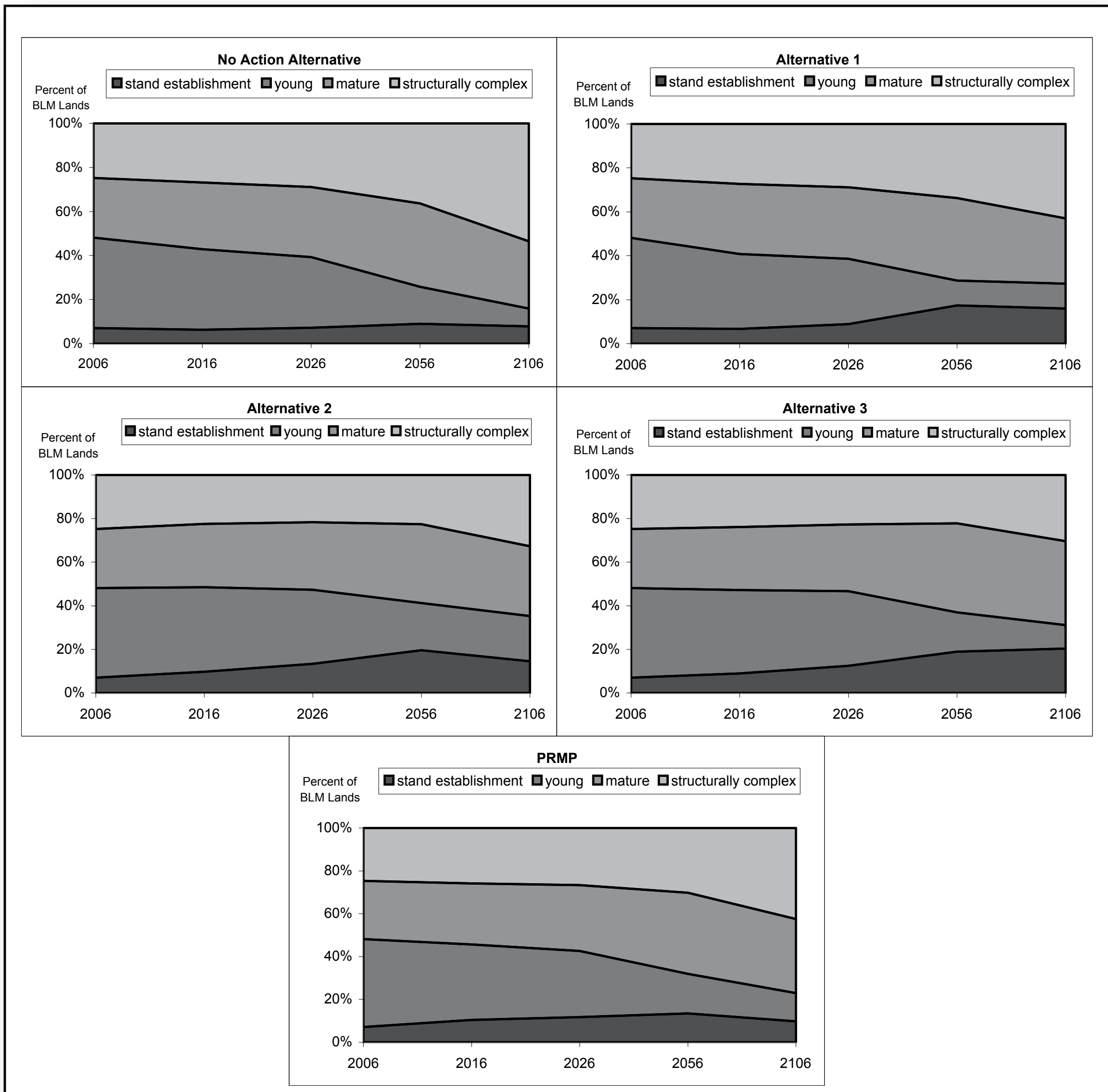
Forest Structure and Spatial Pattern on the BLM-Administered Lands across the Planning Area

On the BLM-administered lands in 100 years, the abundance of:

- stand establishment forests would remain approximately constant under the No Action Alternative, and increase under the PRMP and Alternatives 1, 2, and 3;
- young forests would decrease under the PRMP and all alternatives;
- mature forests would increase under the PRMP and all alternatives; and
- structurally complex forests would increase under the PRMP and all alternatives.

See *Figure 4-1 (Structural stage abundances on the BLM-administered lands by alternative)*.[2]

Figure 4-1. Structural Stage Abundances on The BLM-Administered Lands By Alternative



[2]The 2006 forest structural stage abundances differ slightly among the alternatives due to differences in how inventory information is assembled for modeling under each alternative and the changes in identification of nonforest. See the Forest Structure and Spatial Pattern section in Chapter 3 for further explanation.

Under the No Action Alternative, the abundance of the forest structural stages on the BLM-administered lands would become roughly consistent with the estimates of the average historic conditions (Nonaka and Spies 2005) within 100 years. Under the PRMP and Alternatives 1, 2, and 3, the abundance of the forest structural stages on the BLM-administered lands would move toward the average historic conditions, but would not reach the average historic conditions within 100 years. See *Figure 4-2 (Comparison of the BLM-administered forested lands by 2106 with the average historic conditions and current conditions by alternative)* and *Table 4-4 (Structural stage abundances by percentage of the BLM-administered forested lands by alternative)*.

The No Action Alternative would result in the BLM-administered lands being dominated by mature and structurally complex forests. The amount of the structurally complex forests would more than double in 100 years. The increase in structurally complex forests would be accompanied by a comparable decrease in the amount of young forests. The overall result of these changes would be to shift the BLM-administered lands from a condition in which the young forests are the most common, to a condition in which the structurally complex forests are the most common. This shift would occur largely as a result of four factors:

- **The large acreage in the nonharvest land base would develop into mature and structurally complex forests.** The nonharvest land base would develop similarly under all alternatives, but the nonharvest land base (73% of the forested acres) would be larger under the No Action Alternative than the PRMP or any other alternative. See *Figure 4-9 (Structural stage abundances on the forested lands in the nonharvest land base by alternative)* later in this section.
- **The regeneration harvest rate would be too low to increase the amount of stand establishment forests, eventually resulting in a decrease in the young forests.** Regeneration harvesting in the harvest land base would create an average of 6,100 acres of stand establishment forest per year in the first decade, but 8,400 acres of stand establishment forest would develop into young forests across all allocations. Meanwhile, an average of 15,600 acres of young forest would develop into mature forest per year the first decade, which would result in a substantial decrease in the total abundance of young forest. This net loss in young forest acreage would continue in the following decades. The net loss would slow between 2056 and 2106, but would not reach equilibrium in 2106. Young forest abundance would decrease over time under all alternatives, because fewer acres of stand establishment would develop into young forest than the acres of young forest that would develop into mature forest. However, the greatest decline in young forest abundance would occur

Figure 4-2. Comparison Of The BLM-Administered Forested Lands By 2106 With The Average Historic Conditions And Current Conditions By Alternative

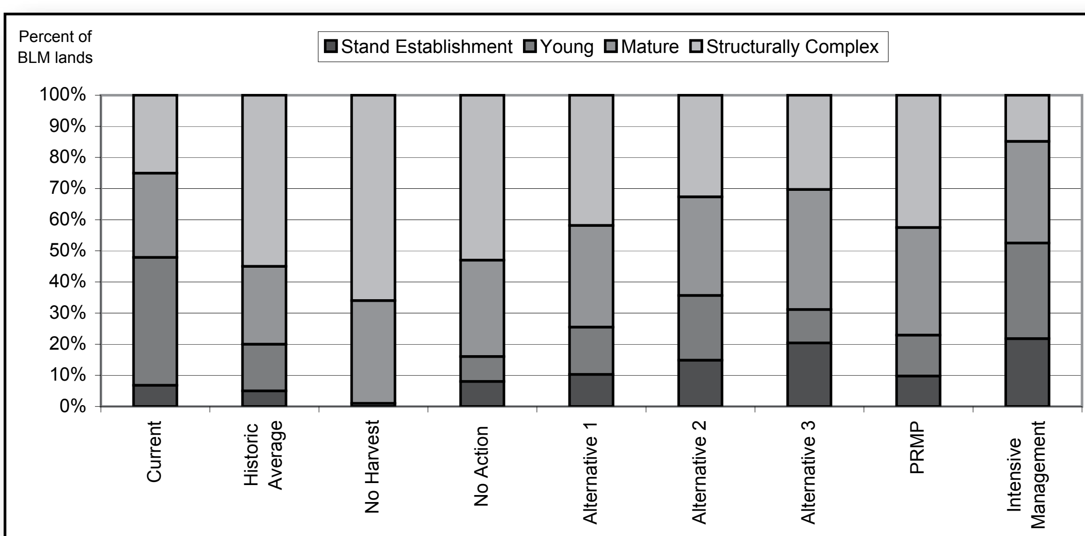


Table 4-4. Structural Stage Abundances By Percentages Of The BLM-Administered Forested Lands By Alternative

Year	Stand Establishment	Young	Mature	Structurally Complex
	(%)			
No Action Alternative				
2006	7	41	27	25
2016	6	36	30	27
2026	7	32	32	29
2056	9	17	38	36
2106	8	8	31	53
Historic Averages	5	15	25	55
Alternative 1				
2006	7	41	27	25
2016	7	39	29	25
2026	10	34	31	26
2056	14	19	37	30
2106	10	15	33	42
Historic Averages	5	15	25	55
Alternative 2				
2006	7	41	27	25
2016	10	39	29	22
2026	13	34	31	22
2056	20	22	36	23
2106	15	21	32	33
Historic Averages	5	15	25	55
Alternative 3				
2006	7	41	27	25
2016	9	38	29	24
2026	13	34	31	23
2056	19	18	41	22
2106	20	11	39	30
Historic Averages	5	15	25	55
PRMP				
2006	7	41	27	25
2016	10	35	29	26
2026	12	31	31	27
2056	13	18	38	30
2106	10	13	35	43
Historic Averages	5	15	25	55

under the No Action Alternative compared to the other alternatives, because it would have the lower regeneration harvesting rate (and subsequently the lower abundance of stand establishment forest) of all alternatives.

- **Green tree retention in regeneration harvests would speed redevelopment of the structurally complex stands after harvesting.** Green tree retention in regeneration harvest units results in harvest stands with structural legacies. The green tree retention requirements in the harvest land base would result in harvested stands developing into structurally complex forest almost twice as quickly as stands without structural legacies. Stand establishment forests with structural legacies, such as those that would be produced under the No Action Alternative and Alternative 3, would develop into structurally complex forests in approximately 80 years for the most common stand conditions on productive sites. Stand establishment forests without structural legacies, such as those that would be produced under Alternatives 1 and 2 and the PRMP, would develop into structurally complex forests in approximately 150 years for common stand conditions on productive sites. See *Figure 4-3 (The influence of legacy retention on future stand development)*. This finding is consistent with other studies that concluded that green tree retention would speed the redevelopment of the structurally complex forests (Spies 2006: 94, Zenner 2000 and 2005).
- **The standards and guidelines of the Matrix land use allocation under the No Action Alternative would constrain harvesting of the structurally complex forests.** The following Matrix standards and guidelines would contribute to retention of structurally complex forest within the harvest land base under the No Action Alternative:
    - retention of late-successional forests in landscape areas where little late-successional forest persists (15% rule)
    - maintenance of 25% to 30% of each connectivity/diversity block in late-successional forest
    - management of connectivity/diversity blocks on a 150-year area control rotation (see Eugene RMP in USDI BLM 1994b: 35)
    - a 120-year minimum regeneration harvest age in the Southern General Forest Management Area (see Medford RMP in USDI BLM 1994e:72-74)

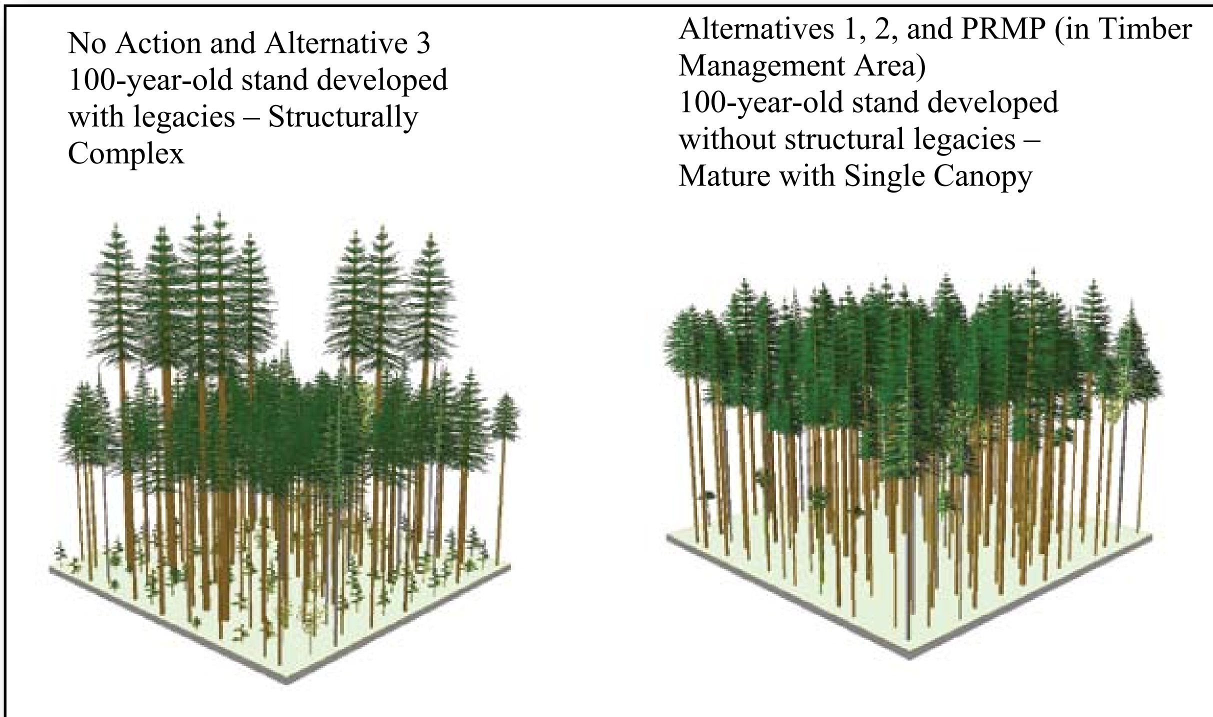
The 120-year minimum regeneration harvest age in the Southern General Forest Management Area would contribute to retention of the structurally complex forest because some forests (7,700 acres in 2006) in the Medford District were identified in the inventory as less than 120 years old, but were classified as structurally complex forest. The green tree retention requirements in regeneration harvesting in the Southern General Forest Management Area would result in harvested stands developing back into structurally complex forests in less than 120 years on some sites.

Under the No Action Alternative, the size and connectivity of mature & structurally complex forest[3] patches would increase more than under any other alternative, when compared to the current condition, which would move the spatial patterns in the direction of historic conditions in the Coast Range, West Cascades, and Klamath Provinces. See *Figure 4-11 (Change in the mean patch size from the current condition to 2106 by forest structural stage on the BLM-administered lands)* later in this section. (As explained in the *Forest Structure and Spatial Pattern* section of *Chapter 3*, patch size is measured by the mean average of the distribution of patch sizes, and connectivity is measured by the connectance index.) The No Action Alternative is the only alternative under which the size and connectivity of the mature & structurally complex forest patches in the West Cascades would increase.

Under Alternative 1, the overall change in the abundance of the forest structural stages would be similar to the No Action Alternative, in part because the large acreage in the late-successional management areas would be coincident with the mapped late-successional reserves of the No Action Alternative. However, the shift in the forest structural stage abundances would not be as pronounced as under the No Action

[3]As explained in Chapter 3 (Forest Structure and Spatial Pattern section), this analysis refers to the combined class as mature & structurally complex forest where mature forest cannot be distinguished from structurally complex forest.

Figure 4-3. The Influence Of Legacy Retention On Future Stand Development



Alternative, because the total of the riparian management areas would be smaller than the riparian reserves of the No Action Alternative; the redevelopment of the structurally complex forests would be slower than under No Action because of the absence of green tree retention; and the regeneration harvest rate would be higher in the harvest land base.

The size and connectivity of the mature & structurally complex forest patches in the Coast Range Province would increase under Alternative 1 compared to the current condition, but less so than under the No Action Alternative. See *Figure 4-11 (Change in the mean patch size from the current condition by 2106 by forest structural stage on the BLM-administered lands)*. In all other provinces, the size and connectivity of the mature & structurally complex forest patches would decrease under Alternative 1 compared to the current condition. Under Alternative 1, the BLM-administered lands would become dichotomous (i.e., divided into two parts), with the nonharvest land base being dominated by mature and structurally complex forests, and the harvest land base being dominated by stand establishment without structural legacies forest and young forest without structural legacies forests.

The edges between the harvest land base and nonharvest land base would be abrupt; the adjacent forests would contrast highly in their structure. Dichotomous landscape patterns with abrupt edges would be inconsistent with modeled historic conditions for western Oregon (Nonaka and Spies 2005, Wimberly et al. 2000), and some research has suggested that such a dichotomous landscape would pose a risk to species and ecological processes (Spies 2006, Cissel et al. 1999, Forman 1995). Little empirical research is available to evaluate the effects of a dichotomous landscape pattern on most species and ecological processes. However, at broad spatial scales, the ability of the BLM to re-create historic spatial patterns is limited by its checkerboard ownership pattern that likely would continue a dichotomous landscape pattern under all alternatives.

Under Alternative 2, the overall change in the abundance of the forest structural stages would also be similar to that projected to occur under the No Action Alternative. However, the shift in structural stage abundances from current conditions would be less than under Alternative 1, because the late-successional management areas and the riparian management area would be smaller than under Alternative 1. Similar to Alternative 1, the regeneration harvest rate under Alternative 2 would be higher in the harvest land base than under the No Action Alternative, and the redevelopment of the structurally complex forests would be slower than under No Action because of the absence of green tree retention in regeneration harvest units under Alternative 2.

Alternative 2 would decrease the size of the mature & structurally complex forest patches compared to the current condition in all provinces, though less so than Alternative 3. See Figure 4-11 (Change in the mean patch size from the current condition by 2106 by forest structural stage on the BLM-administered lands). The connectivity of the mature & structurally complex forest patches would decrease under Alternative 2 in all provinces, except the Coast Range Province where a smaller increase in connectivity would occur under Alternative 2 than under the PRMP, Alternative 1, and the No Action Alternative. Decreasing the size and connectivity would move the spatial pattern of the mature & structurally complex forests further away from the historic conditions. The shift in the spatial patterns and the increase in the dichotomous nature of the landscape on the BLM-administered lands under Alternative 2 would be similar to that which would occur under Alternative 1.

A larger increase in the abundance of stand establishment forests and a smaller increase in the abundance of the structurally complex forest would occur under Alternative 3 than with all other alternatives. The development of the structural stages would be different under Alternative 3 from the other alternatives, because of the relatively small acreage that would be allocated to the nonharvest land base. As a result, there would not be a large acreage that would develop into mature & structurally complex forests, as in the other alternatives. Nevertheless, there would be slightly less mature & structurally complex forest by 2106 under Alternative 3 than under Alternative 1 and more than under Alternative 2. Mature & structurally complex forest would redevelop more quickly after harvesting under Alternative 3 than under the other alternatives, because of the more extensive use of partial harvest and the green tree retention requirements in both partial and regeneration harvest units.

The size and connectivity of the mature & structurally complex forest patches in all provinces would decrease under Alternative 3 more than any other alternative, which would move the spatial pattern of the mature & structurally complex forest away from historic conditions. See *Figure 4-11 (Change in the mean patch size from the current condition by 2106 by forest structural stage on the BLM-administered lands).*

The harvest intervals under Alternative 3 are designed to mimic the historic average fire return interval, which might suggest that Alternative 3 would be effective at restoring average historic conditions. However, the conclusion here that the application of the harvesting based on the average fire return interval would not restore average historic conditions in 100 years is consistent with other analyses (Nonaka and Spies 2005, Wallin et al. 1994). The current structural stage abundances and spatial patterns are the result of extensive forest management, human-caused fires, and fire suppression policies in the twentieth century and are strongly inconsistent with the average historic conditions. The application of extensive active forest management—even management mimicking natural disturbances—to the current condition would initially move forests away from the average historic conditions and would likely take several centuries to return the BLM-administered lands to the average historic conditions.

Under the PRMP, the overall change in the abundance of the forest structural stages would be similar to Alternatives 1 and 2. Under the PRMP, the allocation of lands to late-successional management areas would be approximately comparable to Alternative 2, and the allocation of lands to riparian management area would be approximately comparable to Alternative 1. Similar to Alternatives 1 and 2, the regeneration harvest rate under the PRMP would be higher in the harvest land base than under the No Action Alternative, and the absence of green tree retention in regeneration harvest units would slow the redevelopment of the structurally complex forests under the PRMP compared to the No Action Alternative.

The size of the mature & structurally complex forest patches would increase under the PRMP compared to the current condition in all provinces except the West Cascades Province. See *Figure 4-11 (Change in the mean patch size from the current condition by 2106 by forest structural stage on the BLM-administered lands)*. Under the PRMP, the connectivity of the mature & structurally complex forest patches in all provinces would increase. The PRMP is the only alternative under which the size and connectivity of the mature & structurally complex forest patches would increase compared to the current condition in the Eastern Cascades Province. Increasing the size and connectivity would move the spatial pattern of the mature & structurally complex forests towards historic conditions, though less so than the No Action Alternative in the Coast Range, West Cascades, and Klamath Provinces.

The stand establishment forests on the BLM-administered lands would be transformed under the No Action Alternative and Alternative 3 to a structural condition more like naturally created, early-successional forests than the current condition, or the condition that would occur under Alternatives 1 and 2. *See Figure 4-4 (Stand establishment forests with and without structural legacies by alternative) and Figure 4-5 (Young forests with and without structural legacies by alternative)*. Under the No Action Alternative and Alternative 3, the stand establishment forests would completely shift to dominance by stand establishment with structural legacies. This shift would occur because the current stand establishment without structural legacy forests would develop into young forests and would be replaced by new stand establishment with structural legacy forests resulting from green tree retention in regeneration harvest units under the No Action Alternative and Alternative 3.

Stand establishment forests would be created under Alternatives 1 and 2 and the PRMP that would lack the structural complexity of naturally created, early-successional forests. Stand establishment with structural legacy forests would almost completely disappear because of the absence of green tree retention in regeneration harvest units. A very small acreage of stand establishment with structural legacy would be created under Alternative 2 in regeneration harvest units within riparian management areas. These areas would be along intermittent non-fish-bearing streams that are not prone to debris flows and in the management area adjacent to the Coquille Forest, where green tree retention is required. Under the PRMP, in the Uneven-aged Management Area, the abundance of stand establishment forest would be reduced over time. See *Figure 4-8 (Structural stage abundance in the harvest land base by land use allocation in the PRMP)* later in this section.

In 100 years, the abundance of stand establishment forest on the BLM-administered lands would be slightly above the average historic conditions under the No Action Alternative, and well above the average historic conditions under Alternatives 1, 2, and 3, and the PRMP.

The abundance of young forests would drastically decline under all alternatives. The remaining young forests would slowly shift to an eventual dominance by young with structural legacy forests under the No Action Alternative and Alternative 3. This shift would occur because the young forests without structural legacies would develop into mature forests over time and then be replaced by young forests with structural legacies due to the continuous new supply of stand establishment forests with structural legacies under these two alternatives.

The proportion of young without structural legacy forests would increase under Alternatives 1 and 2 and the PRMP, because almost all new young forests would develop from stand establishment without structural legacy forests. In the Uneven-aged Management Area under the PRMP, very little stand establishment without structural legacy forests would be created, and harvesting in mature and structurally complex forest would create young with structural legacy forests. In the Timber Management Area under the PRMP, only stand establishment without structural legacy forests would be created.

In 100 years, the abundance of young forests on the BLM-administered lands would be slightly below the average historic conditions under the No Action Alternative, Alternative 3, and the PRMP; equal to the average historic conditions under Alternative 1; and slightly above the average historic conditions under Alternative 2.

Figure 4-4 (Stand establishment forests with and without structural legacies [e.g., retained green trees] by alternative) displays stand conditions that would develop following regeneration harvest in the No Action Alternative (General Forest Management Area) or Alternative 3 (western hemlock retention levels). Partial harvesting under Alternative 3 would also create stand establishment with structural legacy forests, but with more overstory trees than shown here.

Figure 4-5 (Young forests with and without structural legacies [e.g., retained green trees] by alternative) displays stand conditions that would develop following regeneration harvest in the No Action Alternative (General Forest Management Area) or Alternative 3 (western hemlock retention levels). Partial harvesting under Alternative 3 would also create young with structural legacy forests, but with more overstory trees than shown here.

The overall abundance of mature forests would be more consistent among the alternatives than other structural stages. See *Figure 4-6 (Mature forest with multi-layered canopies or single canopies by alternative)*. All alternatives would result in an overall increase in the abundance of mature forests over the next 50 years (as young forests develop into mature forests), and then a decrease after 50 years. However, the alternatives would differ in the proportion of mature forests with multi-layered canopies to mature forests with single canopies. Under all alternatives, mature forests with single canopies would predominate in 50 years, as the large acreage of young without structural legacy forest develops. The abundance of mature forest with multi-layered canopies in 100 years would be influenced primarily by the effect of green tree retention in regeneration harvest units or uneven-aged management. These types of management would speed redevelopment of mature forest with multi-layered canopies after timber harvest, and, to a lesser extent, by the size of the harvest land base.

Compared to the other alternatives, the No Action Alternative (which would have the smallest harvest land base of all alternatives) and Alternative 3 (which would have the largest harvest land base of all alternatives), would have the highest proportion of mature forest in mature forest with multi-layered canopies (74% and 73%, respectively) in 100 years. This would occur because both of these alternatives include green tree retention in regeneration harvest units. Under the PRMP, there would be slightly more mature forest with multi-layered canopies than mature forest with single canopies (58%) in 100 years; mature forest with multi-layered canopies would predominate in the non-harvest land base and the Uneven-Age Management Area, and mature forest with single canopy would predominate in the Timber Management Area due to the lack of green tree retention in regeneration harvest units. Under Alternative 1, there would be very slightly more mature forest with multi-layered canopies than mature forest with single canopies (53%) in 100 years.

Although the harvest land base under Alternative 1 would be roughly similar to that under the PRMP, Alternative 1 would lack the Uneven-Age Timber Management Area. Under Alternative 2, there would be less mature forest with multi-layered canopies than mature forest with single canopies (38%), because the harvest land base would be larger than that under the PRMP or Alternative 1 and would lack green tree retention in regeneration harvest units. The influence of timber harvest and green tree retention on mature forests is further demonstrated by the two reference analyses. The reference analysis of intensive management on most commercial timber lands, which would have no green tree retention, would have the most extreme outcome: 80% of all mature forests would be mature with single canopies in 100 years. Under the no harvesting reference analysis, the abundance of mature forest with multi-layered canopies would be approximately equal to the abundance of mature forest with single canopies in 100 years, as a result of the current abundance of young, high-density, even-aged managed stands (see Forest Structure and Spatial Pattern in Chapter 3).

In 100 years, the amount of mature forests on the BLM-administered lands would be above the average historic conditions under all alternatives.

Figure 4-4. Stand Establishment Forests With And Without Structural Legacies (e.g., Retained Green Trees) By Alternative

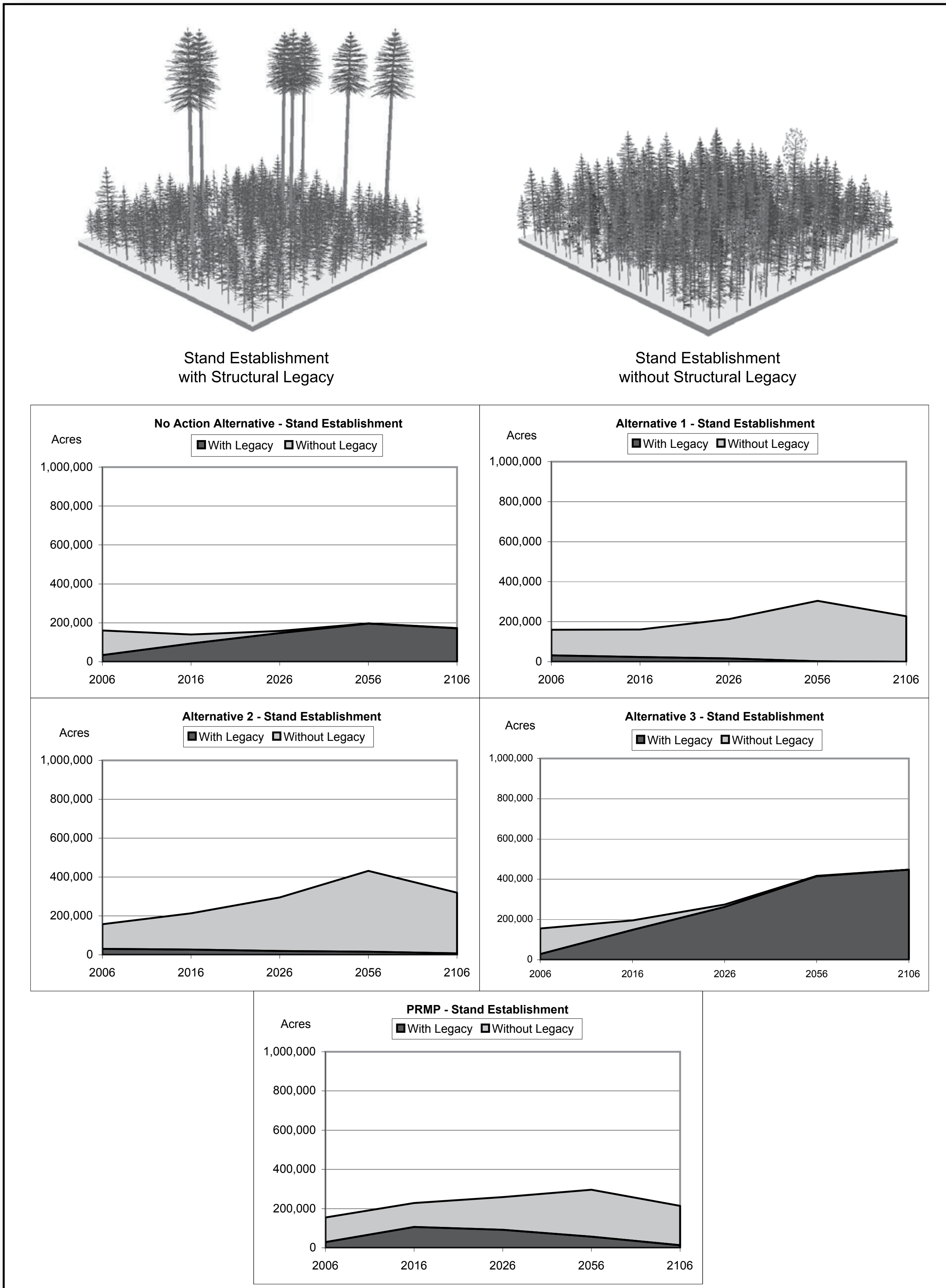


Figure 4-5. Young Forests With And Without Structural Legacies (e.g., Retained Green Trees) By Alternative

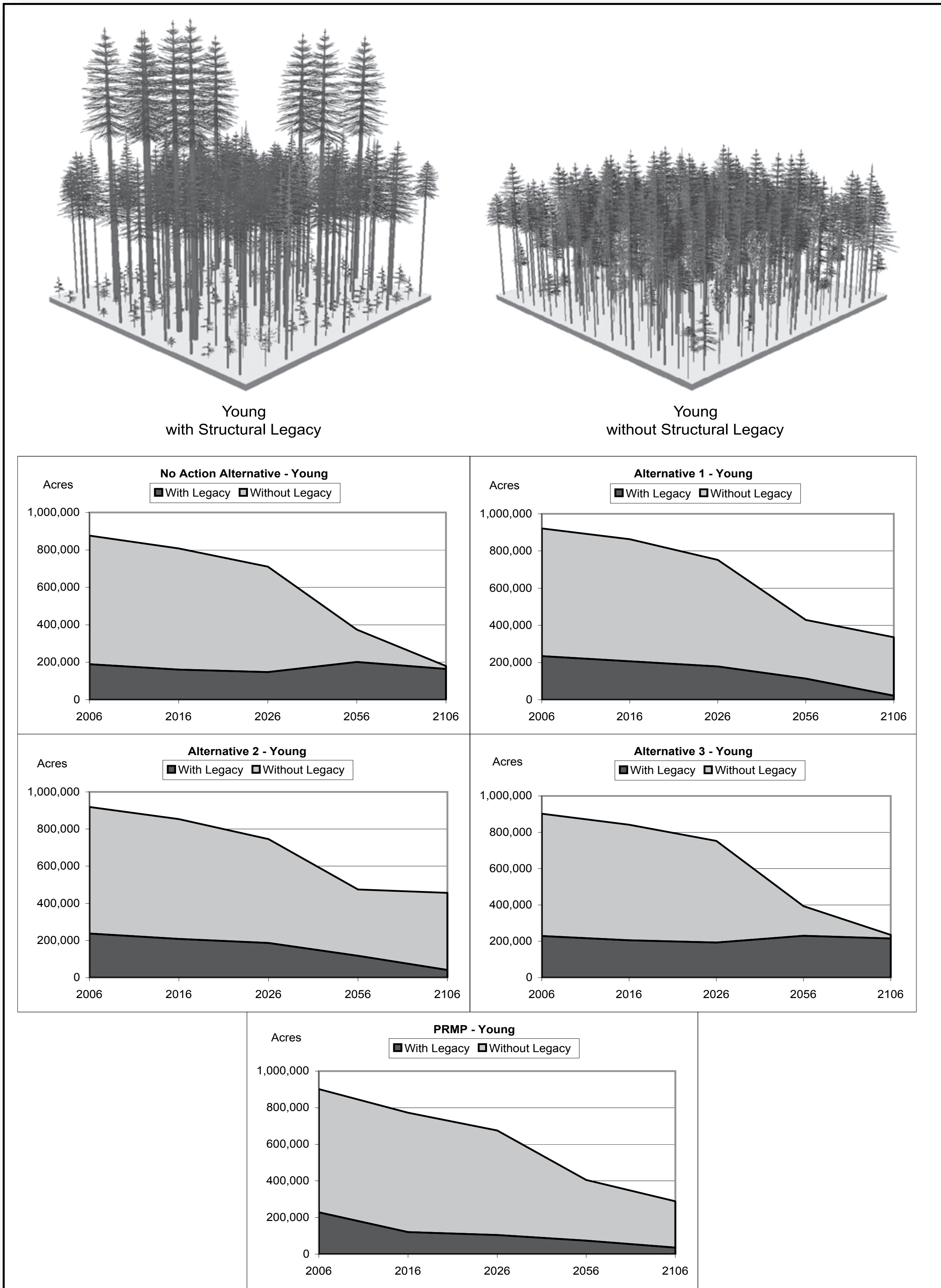
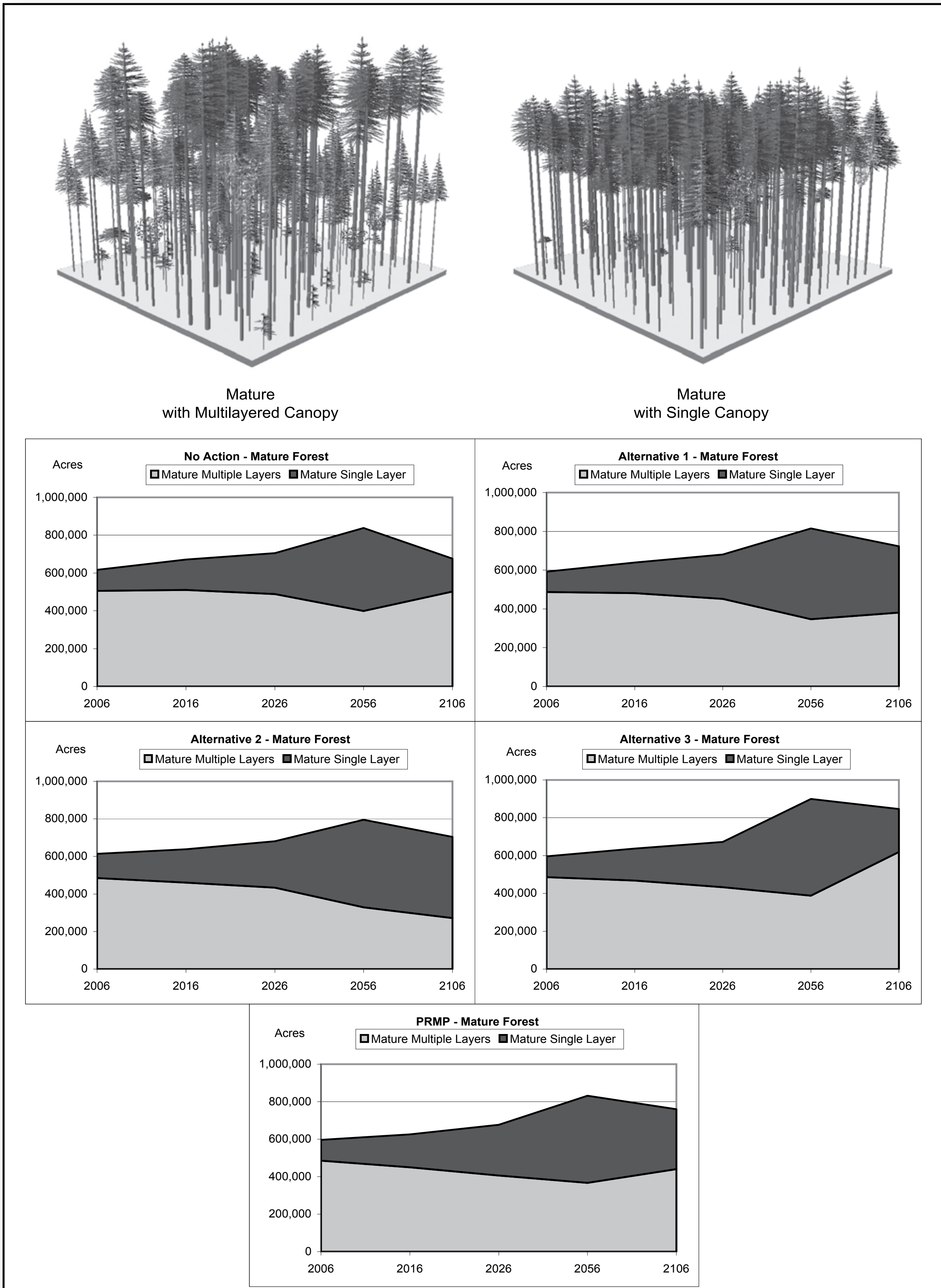


Figure 4-6. Mature Forest With Multi-Layered Canopies Or Single Canopies By Alternative



Under all alternatives, the abundance of the structurally complex forests would result from retention of existing structurally complex forests, coupled with future development of additional structurally complex forests. However, the alternatives would vary in both the amount of the existing structurally complex forest that would be retained and the amount of additional structurally complex forest that would develop. Under all alternatives, the additional structurally complex forest that would develop would initially be at the lower end of forest structural conditions meeting the definition of structurally complex forests; this is generally consistent with the implementation pattern of the No Action Alternative for the past decade (Moeur et al. 2005:100).

The No Action Alternative would result in a larger increase in the abundance of the structurally complex forests than any other alternative. Less existing old forest would be harvested under the No Action Alternative than any other alternative, because the No Action Alternative would have the smallest amount of existing old forest in the harvest land base. See *Table 4-5 (Outcome of existing old forest by 2106 by alternative)* later in this section. The harvest of existing old forest under the No Action Alternative would be offset by development of far more additional structurally complex forest, for a net increase of 624,800 acres. The overall function of the structurally complex forests would improve under the No Action Alternative, because:

- The majority of existing old forest (86%) would remain unharvested and would continue to develop into older structurally complex forest.
- An even greater percentage (90%) of the oldest of these forests (existing very old forest, which are stands that are 400 years or older in the current inventory) would remain unharvested and continue to develop.
- Approximately 15 times more acres would develop into new structurally complex forest by 2106 than the acreage of existing old forest that would be harvested by that year.
- The size and connectivity of the mature & structurally complex forest patches would increase from the current condition in all provinces, except the Eastern Cascades. See text under *Forest Structure and Spatial Pattern on the BLM-administered Lands at the Province Scale* later in this section.

The abundance of the structurally complex forests would increase more under Alternative 1 than under Alternatives 2 or 3 or the PRMP, but less than under the No Action Alternative. Under Alternative 1, the structurally complex forests that would remain after 100 years would be almost entirely restricted to the nonharvest land base. More existing old forest would be harvested than under the No Action Alternative, but less than under Alternatives 2 or 3 or the PRMP. See *Table 4-5 (Outcome of existing old forest by 2106 by alternative)*. The harvest of 88,800 acres of existing old forest under Alternative 1 would be offset by development of additional structurally complex forest for a net increase of 370,000 acres by 2106.

The overall function of the structurally complex forests would improve under Alternative 1 (though less so than under the No Action Alternative) because:

- The majority of existing old forest (75%) would remain unharvested and would continue to develop into older structurally complex forests.
- An even greater percentage (90%) of the oldest of these forests (existing very old forest, which are the stands that are 400 years or older in the current inventory) would remain unharvested and continue to develop.
- Approximately six times more acres would develop into new structurally complex forest by 2106 than the acreage of existing old forest that would be harvested by that year,
- The size and connectivity of the mature & structurally complex forest patches would increase from the current condition in the Coast Range Province. Size and connectivity would decrease in other provinces, but less than under Alternatives 2 and 3 and the PRMP. See text under *Forest Structure and Spatial Pattern on the BLM-administered Lands at the Province Scale* later in this section.

Under Alternative 2, the abundance of the structurally complex forests would slightly decrease in the first 50 years and eventually increase in abundance in 100 years. As under Alternative 1, the structurally complex forests remaining after 100 years would be almost entirely restricted to the nonharvest land base. More existing old forest would be harvested under Alternative 2 than under the No Action Alternative, Alternative 1, or the PRMP, but less than under Alternative 3. See *Table 4-5 (Outcome of existing old forest by 2106 by alternative)*. Of the existing old forest, 57% would be allocated to the nonharvest land base (compared to 83% under the No Action Alternative, 74% under Alternative 1, and 52% under Alternative 3). The harvest of 152,400 acres of existing old forest under Alternative 2 would be offset by development of additional structurally complex forest; the abundance of the structurally complex forest would remain almost constant for the first 50 years with an eventual net increase of 210,100 acres by 2106. The overall function of the structurally complex forests would increase in some aspects under Alternative 2 (though less than under the No Action Alternative, Alternative 1, or the PRMP), and decrease in other aspects because:

- The majority of existing old forest (57%) would remain unharvested and would continue to develop into older structurally complex forests.
- A greater percentage (76%) of the oldest of these forests (existing very old forest, which are the stands that are 400 years or older in the current inventory) would remain unharvested and continue to develop.
- Slightly more acres would develop into new structurally complex forest by 2106 than the acreage of the existing old forest that would be harvested by that year.
- The size of the mature & structurally complex forest patches would decrease from the current condition in all provinces, and the connectivity of the mature & structurally complex forests would decrease in all provinces, except the Coast Range Province. See text under *Forest Structure and Spatial Pattern on the BLM-administered Lands at the Province Scale* later in this section.

A lower acreage of structurally complex forests would occur under Alternative 3 than any other alternative. Under Alternative 3, the amount of the structurally complex forests would decrease slightly over the first 50 years, and then eventually increase slightly from current levels. The harvest of the structurally complex forests (including partial harvest) would be roughly balanced by development of additional structurally complex forest, which would result in a fluctuating total abundance over time. Alternative 3 would harvest more of the existing old forest than any other alternative. See *Table 4-5 (Outcome of existing old forest by 2106 by alternative)*. A larger amount of the existing old forest would be allocated to the harvest land base under Alternative 3 than any other alternative. The harvest of 220,000 acres of existing old forest under Alternative 3 would be offset by development of additional structurally complex forest, but less than under other alternatives with a net increase of 122,000 acres by 2106. The overall function of the structurally complex forests would decrease from the current condition under Alternative 3, because:

- The majority of existing old forest (63%) would be harvested within 100 years.
- The majority (68%) of the oldest of these forests (existing very old forest, which are stands that are 400 years or older in the current inventory) would be harvested within 100 years.
- The total abundance of the structurally complex forest would decline slightly for the first 50 years.
- The size and connectivity of the mature & structurally complex forest patches would decrease from the current condition in all provinces. See text under *Forest Structure and Spatial Pattern on the BLM-administered Lands at the Province Scale* later in this section.

The abundance of the structurally complex forests would increase over time under the PRMP. The abundance of existing old forest would remain at current levels in 2016, higher than under any other alternative. More existing old forest would be harvested in 100 years under the PRMP than under the No Action Alternative or Alternative 1, but less than under Alternatives 2 or 3. See *Table 4-5 (Outcome of existing old forest by 2106 by alternative)*. Thirty-five percent of the existing old forest would be allocated to the harvest land base under the PRMP (compared to 17% under the No Action Alternative, 26% under Alternative 1, 43% under Alternative 2, and 48% under Alternative 3). Under the PRMP, a lower percentage of the existing old forest that would be allocated to the harvest land base (79%) would be harvested after 100 years than under any other alternative. The eventual harvest of 96,200 acres of existing old forest under the PRMP would be offset by development of additional structurally complex forest, for a net increase of 397,900 acres by 2106. The overall function of the structurally complex forests would improve under the PRMP (though less than under the No Action Alternative) because:

- The majority of existing old forest (73%) would remain unharvested and would continue to develop into older structurally complex forests.
- A greater percentage (86%) of the oldest of these forests (existing very old forest, which are the stands that are 400 years or older in the current inventory) would remain unharvested and continue to develop.
- More acres would develop into new structurally complex forest by 2106 than the acreage of the existing old forest that would be harvested by that year.
- The size of the mature & structurally complex forest patches would increase from the current condition in all provinces, except the West Cascades Province, and the connectivity of the mature & structurally complex forests would increase in all provinces. See text under *Forest Structure and Spatial Pattern on the BLM-administered Lands at the Province Scale* later in this section.

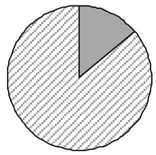
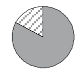
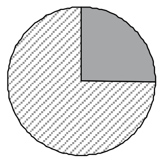
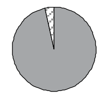
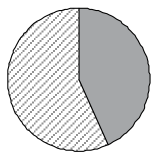
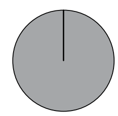
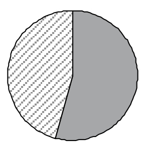
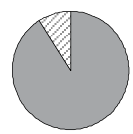
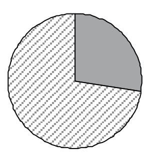
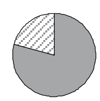
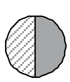
In 100 years, the amount of the structurally complex forest on the BLM-administered lands would be approximately equal to the average historic condition under the No Action Alternative, and below the average historic condition under Alternatives 1, 2, and 3, and the PRMP.

There is insufficient information to quantify the abundance of hardwood stands. See the *Forest Structure and Spatial Pattern* section in *Chapter 3*. Furthermore, there is insufficient information about hardwood stand development, especially red alder stands, to model future stand development and transition to mixed or conifer-dominated stands. Some researchers have hypothesized that riparian red alder stands might develop into shrub-dominated areas (especially salmonberry) where conifer tree regeneration is absent (Deal 2006, Harrington 2006, Hibbs and Bower 2001). Empirical evidence for this successional pathway is generally lacking. Although this successional development is possible for small patches, studies in the Coast Range did not find evidence of this successional development at the landscape scale (Kerns and Ohmann 2004). Red alder stands in the Coast Range would likely continue to decline in abundance because of restrictions or exclusion of timber harvest in riparian areas under all alternatives. Existing red alder stands would eventually develop into mixed or conifer-dominated stands (western hemlock, western red-cedar, and Douglas fir), except near large streams where growing conditions favor red alder (Spies et al. 2007, Kennedy and Spies 2005). Successional development into conifer stands would be accelerated where hardwood conversion actions would be implemented, but the rate of this successional development is unknown. Riparian and upland hardwood stands would persist under all alternatives where:

- natural disturbances maintain hardwoods
- activities to maintain or restore natural plant communities on nonforest and noncommercial forest lands are implemented to maintain hardwoods
- site conditions preclude succession to a conifer forest

As a result, hardwood forest abundance would decline under all alternatives. In addition, none of the alternatives would create additional hardwood stands because of the limited disturbance of the nonharvest land base and the intensive silvicultural practices to reestablish conifers following disturbances in the harvest land base.

Table 4-5. Outcome Of Existing Old Forest By 2106 By Alternative

	All Land Use Allocations Acres Harvested (% of Existing Old Forest harvested)	**Harvest Land Base Only** (% of Existing Old Forest harvested)
No Action	 48,700 acres (14%)	 (83%)
Alternative 1	 88,800 acres (25%)	 (96%)
Alternative 2	 152,400 acres (43%)	 (100%)
Alternative 3	 220,000 acres (63%)	 (91%)
PRMP	 96,200 acres (27%)	 (79%)
unharvested  harvested		

Note: The harvest land base graphs are sized approximately to reflect total acreage.

Forest Structure and Spatial Pattern on the BLM- Administered Lands by Land Use Allocation

Harvest Land Base

In the harvest land base under all alternatives, the abundance of stand establishment forests and mature forests would increase, and the abundance of young forests and structurally complex forests would decrease. The abundance of structurally complex forests would be reduced in the harvest land base to 14% in 100 years (compared to the current condition of 19%) under the No Action Alternative and Alternative 3. The abundance of structurally complex forests would be reduced in the harvest land base in 100 years more under the PRMP than under the No Action Alternative and Alternative 3 (10% of the harvest land base in 2106, compared to the current condition of 20%).[4] The structurally complex forests in the harvest land base would be nearly eliminated under Alternatives 1 and 2 (2% and 1% in 2106, respectively, compared to the current condition of 19%).

The combined abundance of the mature & structurally complex forests in the harvest land base would stay approximately constant under the No Action Alternative and the PRMP, decrease under Alternatives 1 and 2, and increase under Alternative 3. The analysis of terrestrial habitats in the Northwest Forest Plan FSEIS, on which the current (1995) RMPs of the No Action Alternative relied, analyzed the abundance and connectivity of late-successional and old-growth forests (which approximates mature & structurally complex forests in this analysis) based on the abundance and future development of forests in the nonharvest land base (USDA USFS/USDI BLM 1994b: 3&4:39-43, 3&4:238-241). That previous analysis did not account for the retention or development of late-successional and old-growth forests in the harvest land base. Nevertheless, the analysis if this EIS reveals that the mature & structurally complex forest together would continue to constitute approximately half of the acres (289,000 acres) within the harvest land base over the next 100 years under the No Action Alternative. See *Figure 4-7 (Structural stage abundances on the forested lands in the harvest land base by alternative).*

A larger increase in the stand establishment forests and a larger decrease in the structurally complex forests in the harvest land base would occur under Alternatives 1 and 2 than under the No Action Alternative because of:

- **higher regeneration harvest rate in the harvest land base than under the No Action Alternative.** Alternatives 1 and 2 do not have any of the standards and guidelines of the No Action Alternative that would constrain the harvesting of the structurally complex forests in the harvest land base.
- **absence of green tree retention, which would slow development of the structurally complex forests after harvesting.** Alternatives 1 and 2 do not have management direction that would require green tree retention in regeneration harvest units. Without green tree retention in regeneration harvest units, stands would take approximately twice as long (e.g., 150 years instead of 80 years on the most common stand conditions on productive sites) to develop into structurally complex forest after regeneration harvesting.

These two factors would interact to decrease the abundance of the structurally complex forest in the harvest land base. The higher regeneration harvest rate combined with the slower development into structurally complex forests would increase the likelihood that a stand would be harvested before it would have time to develop into structurally complex forest. As a result, structurally complex forest would be almost eliminated from the harvest land base by 2106, even though the total acreage of the structurally complex forests across all land use allocations would increase under Alternatives 1 and 2.

The harvest land base under Alternative 3 would have the most stand establishment forest, the least young forest, and the most mature forest of any alternative. The abundance of structurally complex forest would be

[4]The area allocated to the harvest land base would differ among the alternatives. Therefore, the percentage of the harvest land base currently in structurally complex forest differs slightly among the alternatives.

maintained in the harvest land base under Alternative 3 similar to the No Action Alternative, even though under Alternative 3 the most existing old forest would be harvested of any alternative.

Under the PRMP, stand establishment forest would increase, and structurally complex forest would decrease in the harvest land base as a whole. The different allocations within the harvest land base would result in different patterns. In the Timber Management Area, under the PRMP an increase in the stand establishment forests and decrease in the structurally complex forests would occur, similar to under Alternatives 1 and 2. In the Uneven-Aged Management Area under the PRMP, a decrease in stand establishment forest and an increase in mature forest and structurally complex forest would occur. See Figure 4-8 *(Structural stage abundances in the harvest land base by land use allocation in the PRMP)*.

Figure 4-7. Structural Stage Abundances On The Forested Lands In The Harvest Land Base By Alternative

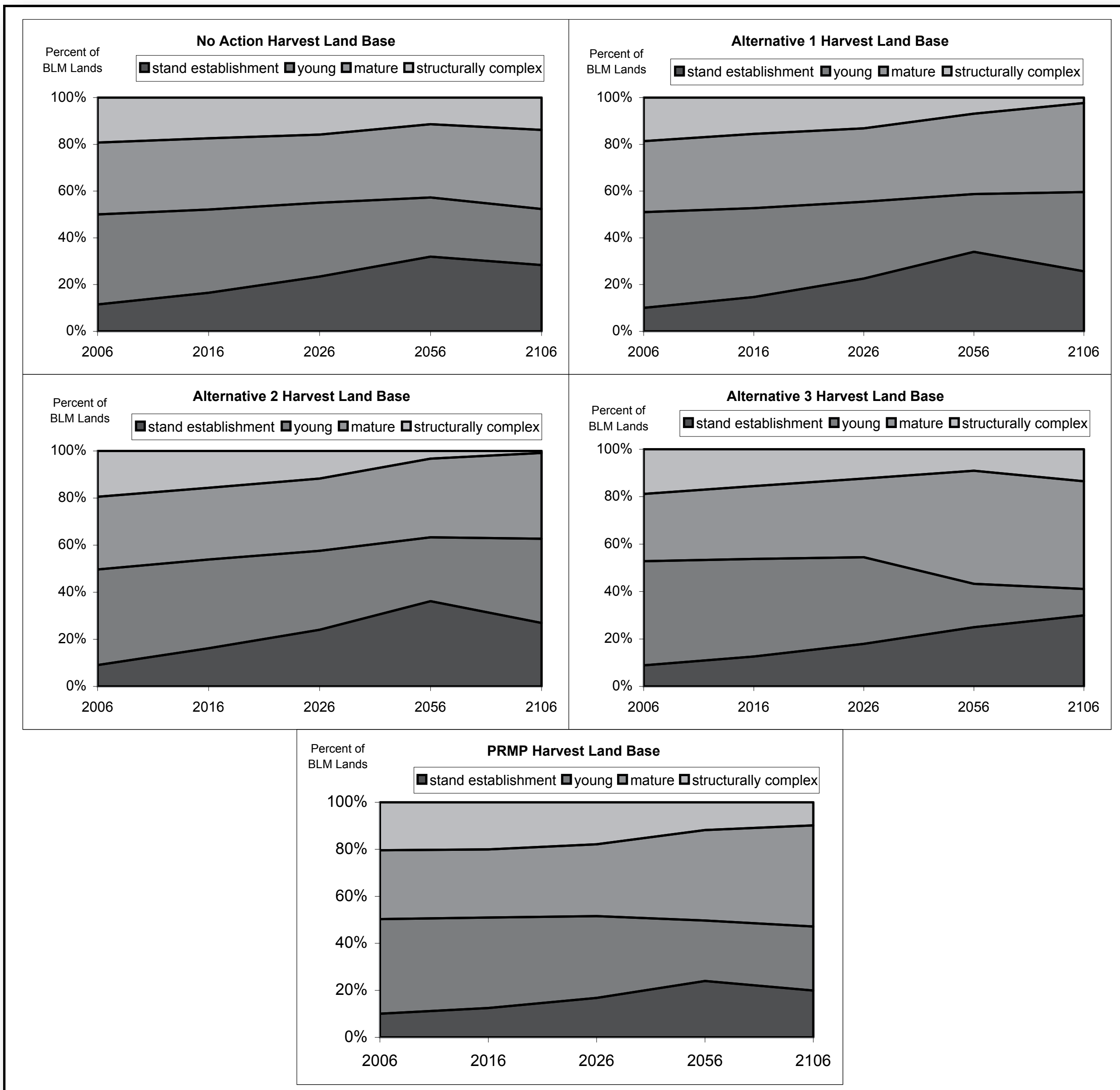
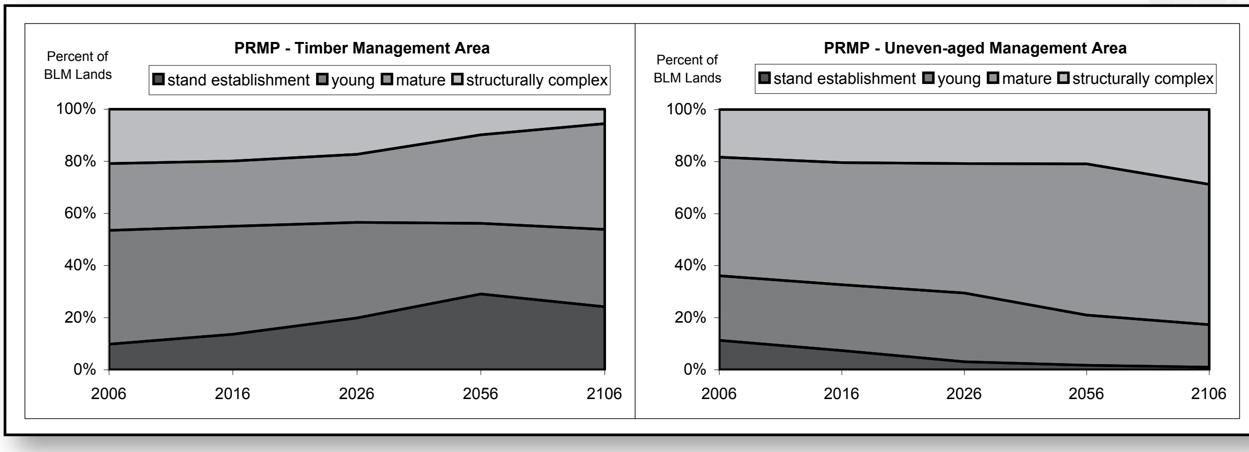


Figure 4-8. Structural Stage Abundances In The Harvest Land Base By Land Use Allocation In the PRMP



This analysis does not include estimates of future natural disturbances, but most natural disturbances in the harvest land base would have little effect on the abundance of the structural stages described here. Except in the most severe and extensive disturbances, salvage of naturally disturbed stands would result in the same eventual effect on the overall structural stage abundances in the harvest land base as scheduled timber harvesting under all alternatives.

Nonharvest Land Base

The structural stage development within the nonharvest land base would be similar under all alternatives, although the total acreage in the nonharvest land base would vary. The forest-capable portion of the nonharvest land base would become almost completely dominated by mature and structurally complex forest in 100 years. See *Figure 4-9 (Structural stage abundances on the forested lands in the nonharvest land base by alternative)*.

This analysis does not include estimates of future natural disturbances, but natural disturbances would increase the amount of stand establishment and young forests from the abundances described here. The Northwest Forest Plan FSEIS assumed that 2.5% of the late-successional forests in the late-successional reserves would be lost to wildfire each decade (NWFP FSEIS, 3&4:42). The actual rate of disturbance over the past decade has been lower on the BLM-administered lands. See text earlier in this chapter in the *Introduction* section, *Incomplete or Unavailable Information – Salvage After Natural Disturbance*.

Forest Structure and Spatial Pattern on the BLM- Administered Lands at the Province Scale

The effects of the alternatives on the structural stage abundances and spatial patterns in the Coast Range, West Cascades, and Klamath Provinces generally reflect the structural stage abundances and spatial patterns described for the planning area as a whole. The effects of the alternatives in the Eastern Cascades Province differ from the other provinces in many measures of the structural stage abundance and spatial pattern, in part because of the differing ecological conditions and management history. However, these different patterns have little effect on the overall pattern for the planning area, because the Eastern Cascades Province makes up only 2% of the BLM-administered forest lands modeled within the planning area.

See *Figure 4-10*, *Figure 4-11*, and *Figure 4-12* on the next several pages.

Figure 4-9. Structural Stage Abundances On The Forested Lands In The Nonharvest Land Base By Alternative

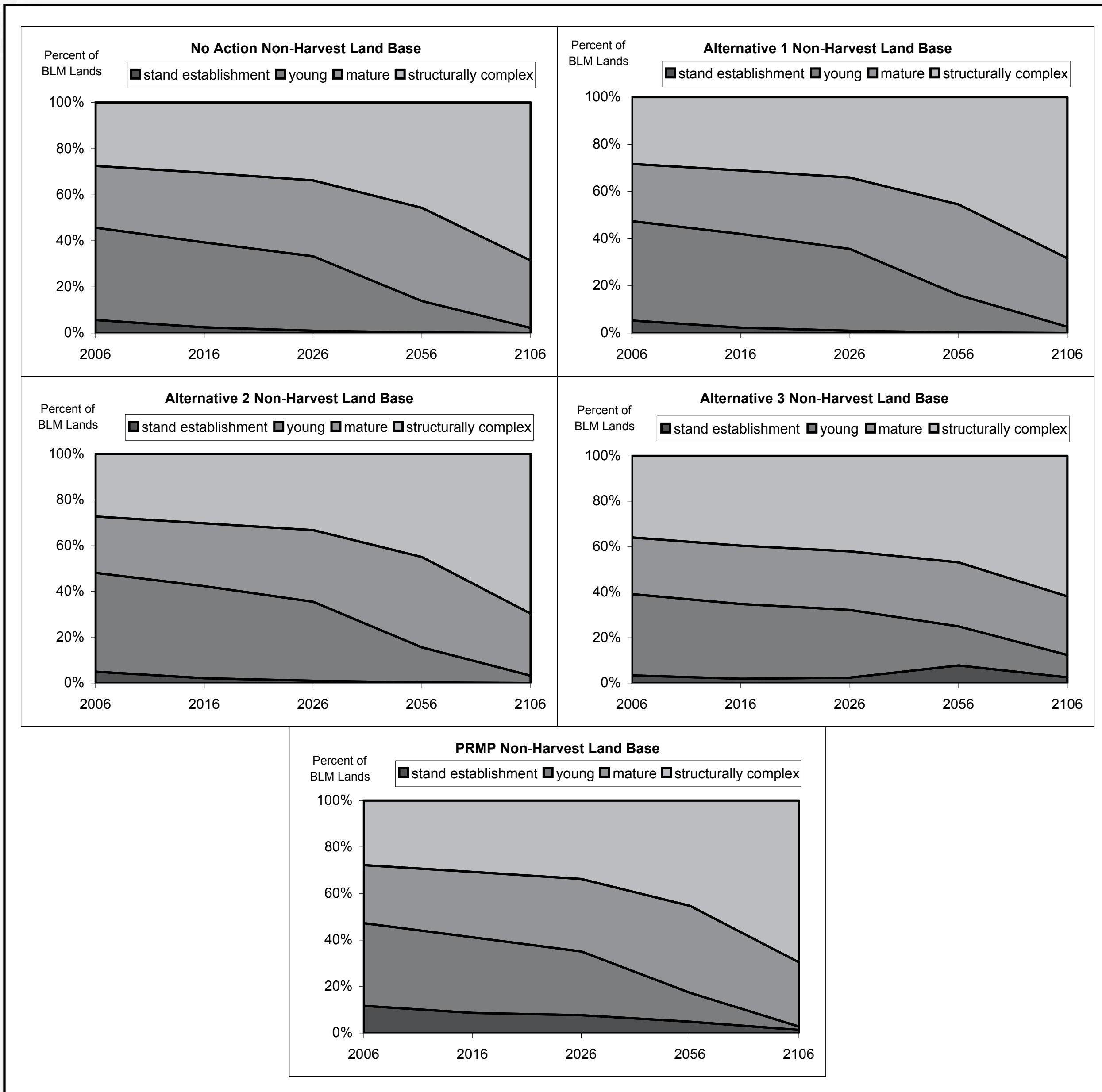


Figure 4-10. Comparison Of The Structural Stage Abundances On The BLM-Administered Forested Lands By 2106 With The Current Conditions And The Average Historic Conditions By Alternative By Province

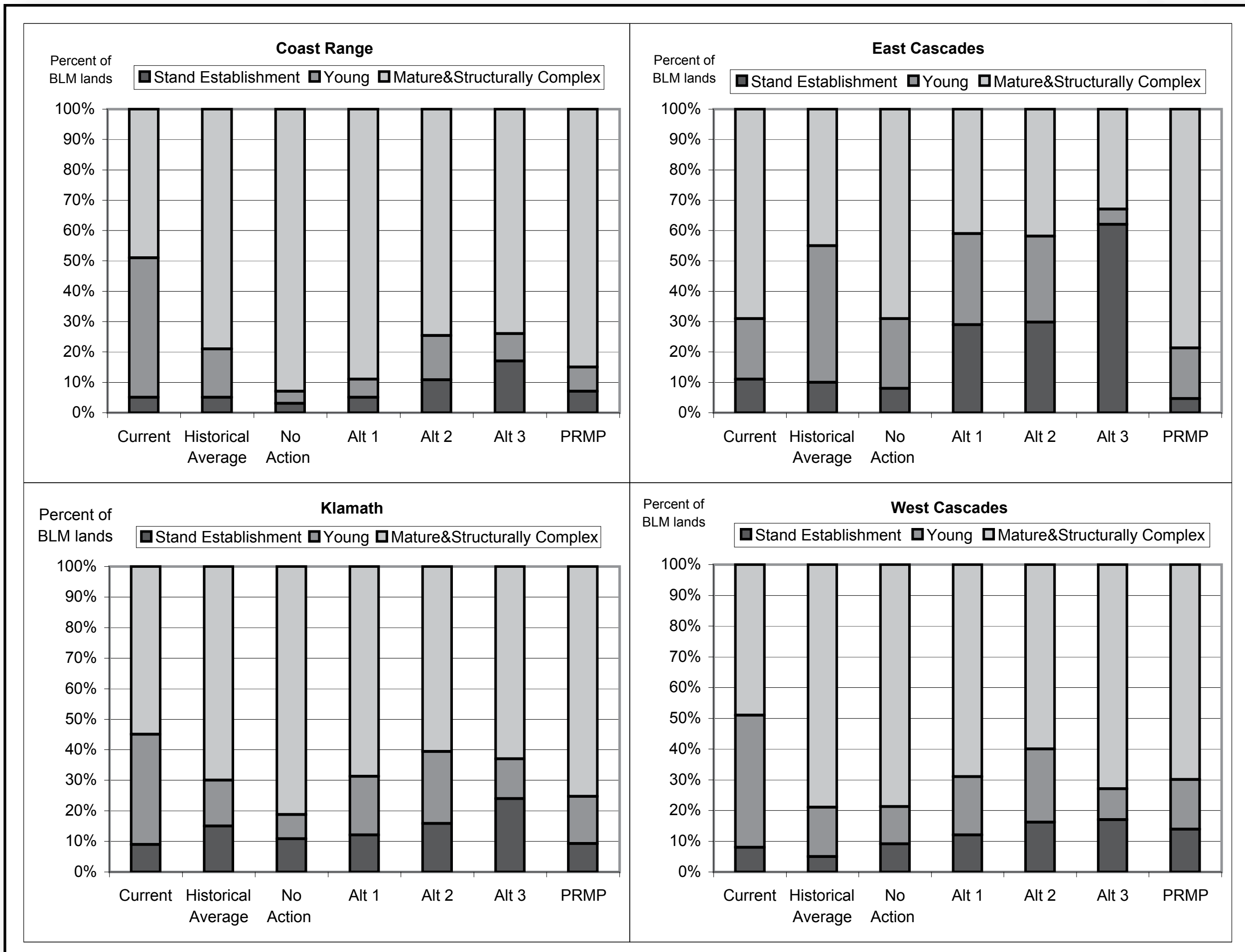


Figure 4-11. Change In The Mean Patch Size From The Current Condition By 2106 By Forest Structural Stage On The BLM-Administered Lands

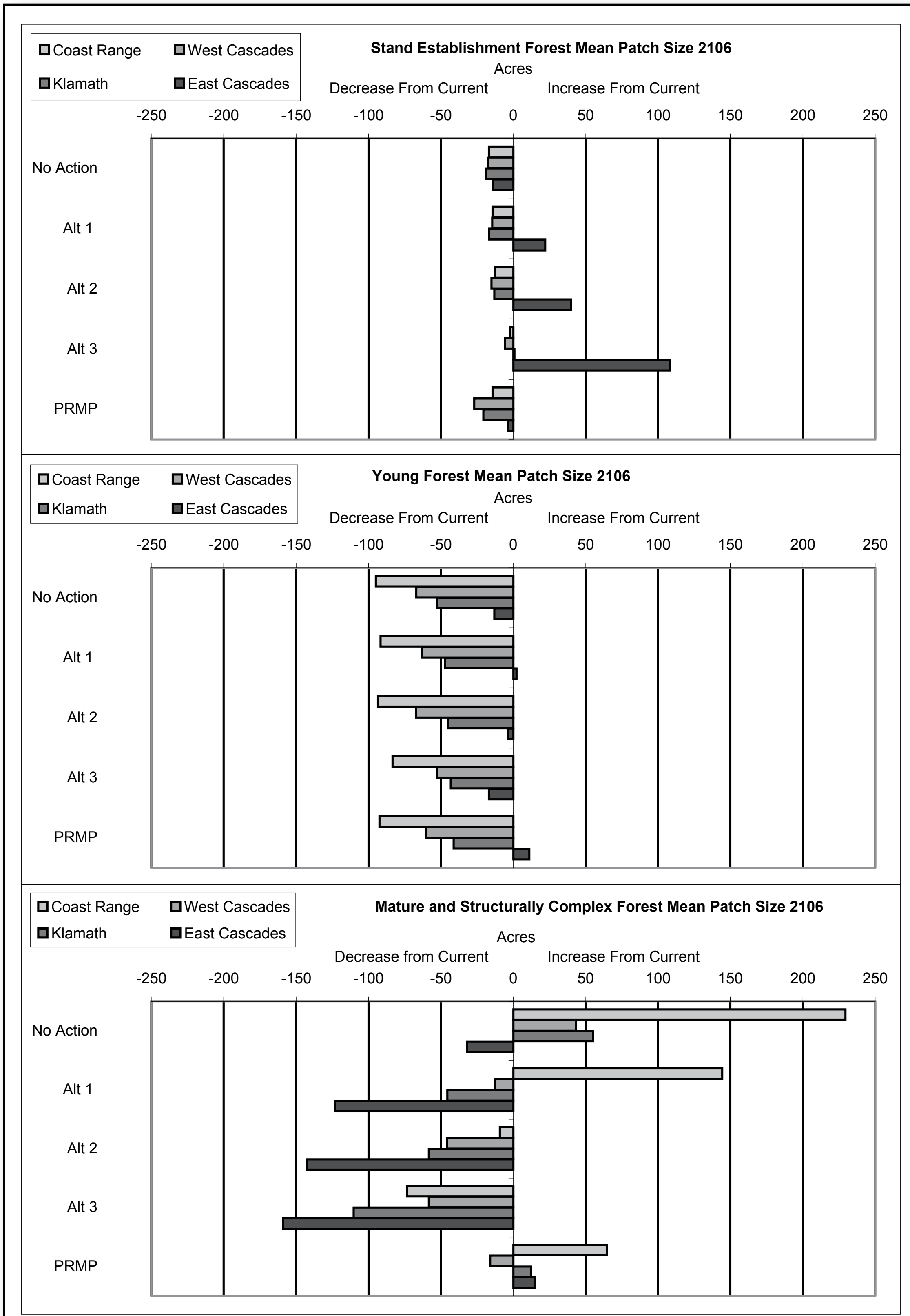
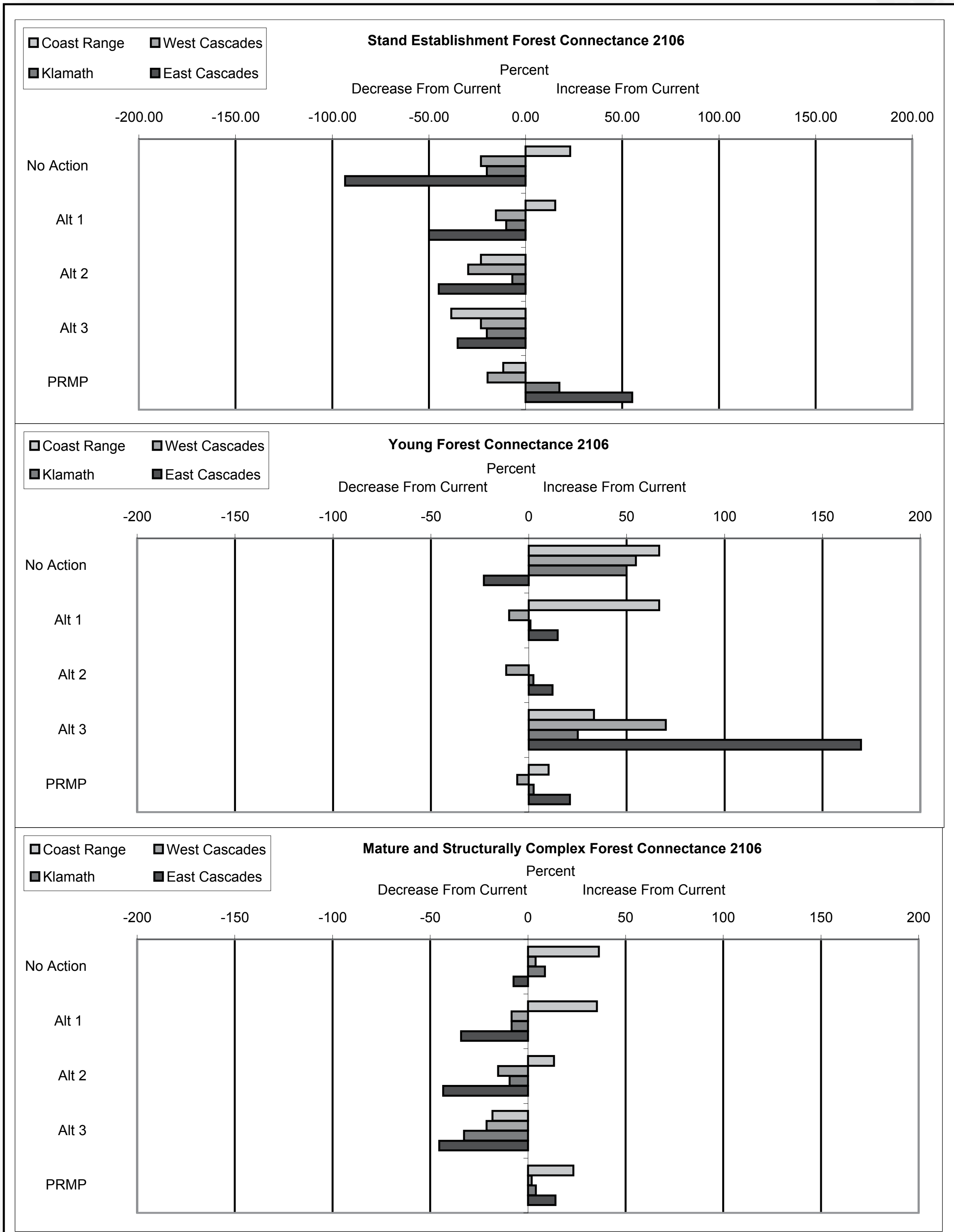


Figure 4-12. Change In The Connectivity From The Current Condition By 2106 By Forest Structure Stage On The BLM-Administered Lands.



Coast Range Province

Under all alternatives, the young forests would decrease and the mature forests would increase in abundance in the Coast Range Province. See *Figure 4-13 (Structural stage abundances on the BLM-administered forested lands in the Coast Range province by alternative)*. Under the No Action Alternative and Alternative 1, the abundance of stand establishment forests would remain approximately constant and the abundance of structurally complex forests would steadily increase to become the most abundant structural stage because of the predominance of the nonharvest land base in the Coast Range. Under the No Action Alternative and Alternative 1, very little of the existing old forest (less than 10% in 100 years) would be harvested in the Coast Range Province. Under Alternative 2, a larger harvest land base would be allocated in the Coast Range Province than under the No Action Alternative or Alternative 1, and consequently the abundance of stand establishment forests would increase and the abundance of the structurally complex forests would remain approximately constant for the first 50 years under Alternative 2. An even larger harvest land base would be allocated in the Coast Range Province under Alternative 3 than under Alternative 2, and consequently the abundance of the stand establishment forests would increase more than under any other alternative, and the abundance of the structurally complex forests would slightly decrease. The majority of the existing old forest (69% in 100 years) would be harvested in the Coast Range Province under Alternative 3. A larger harvest land base in the Coast Range Province would be allocated under the PRMP than under the No Action Alternative or Alternative 1, but smaller than under Alternatives 2 or 3. The abundance of the stand establishment forests would increase under the PRMP, but less so than under Alternatives 2 or 3. The abundance of the structurally complex forests would increase under the PRMP, but less so than under No Action or Alternative 1. Approximately 11% of the existing old forest in the Coast Range would be harvested under the PRMP in 100 years.

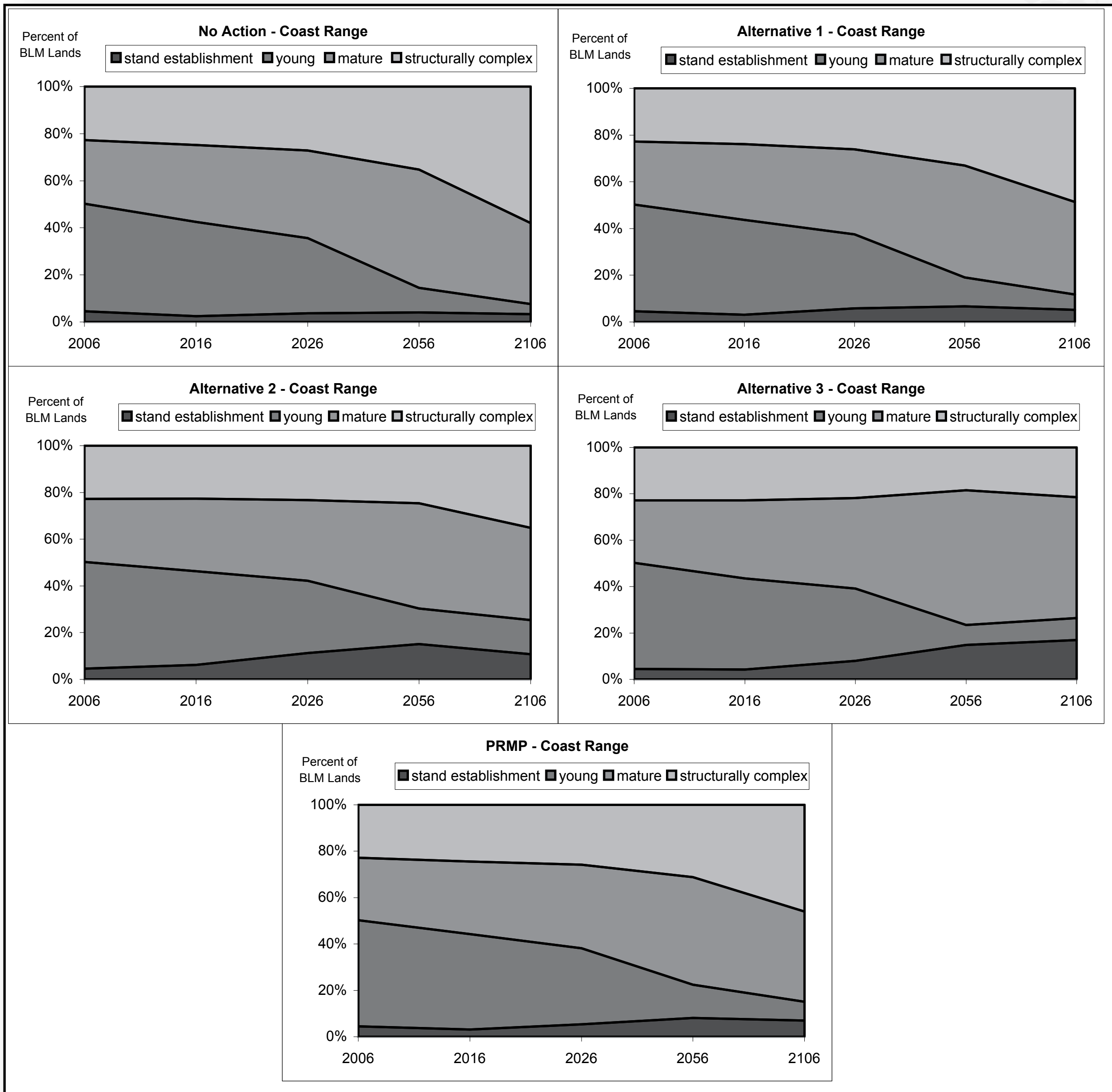
In 100 years, the No Action Alternative, Alternative 1, and the PRMP would result in less young forest and more mature & structurally complex forest than the average historic condition.[5] See *Figure 4-10 (Comparison of the structural stage abundances on the BLM-administered forested lands by 2106 with the current conditions and the average historic conditions by alternative by province)*. Alternative 2 would result in a structural stage abundance that is approximately similar to the average historic condition in the Coast Range Province in 100 years with slightly more stand establishment forest and slightly less mature & structurally complex forest. Alternative 3 would result in more stand establishment forest, less young forest, and slightly less mature & structurally complex forest than the average historic condition in the Coast Range Province in 100 years.

All alternatives would result in smaller patches of stand establishment forest and young forest in the Coast Range Province as shown in *Figure 4-11*. The No Action Alternative would result in the most decrease in the size of stand establishment patches, and Alternative 3 would result in the least decrease, which is consistent with the changes in the overall structural stage abundances. All alternatives would result in mean patch size of stand establishment and young forests that would be far below the average historic condition. Although a direct comparison of these results is problematic (see the *Forest Structure and Spatial Pattern* section in *Chapter 3*), Nonaka and Spies (2005) reported historic mean patch sizes of stand establishment forest and young forest ranging from 183 to 264 acres, which is 10 to 20 times larger than the alternatives.

The size and connectivity of the mature & structurally complex forest patches on the BLM-administered lands would increase over the next 100 years in the Coast Range Province under the No Action Alternative, Alternative 1, and the PRMP. See *Figure 4-11* and *Figure 4-12*. Over the next 100 years, patches of mature & structurally complex forest that are larger and have more interior habitat than the current condition would be created under the No Action Alternative, Alternative 1, and the PRMP (see *Appendix B - Forest Structure and Spatial Pattern*). The size of the mature & structurally complex forest patches would slightly decrease, and the connectivity would increase from the current condition in the Coast Range Province under Alternative 2. Both the size and connectivity of the mature & structurally complex forest patches

[5] Note that for this analysis, the mature and structurally complex forests are combined (and referred to as mature & structurally complex forest) because of the limitations in the description of the average historic conditions

Figure 4-13. Structural Stage Abundances On The BLM-Administered Forested Lands In The Coast Range Province By Alternative



would decrease under Alternative 3. The spatial pattern of the mature & structurally complex forest would move further away from the historic conditions under Alternative 3, which is consistent with the research concluding that the restoration of historic wildfire would move the Coast Range Province further away from the historic range of variability over the next 100 years (Nonaka and Spies 2005).

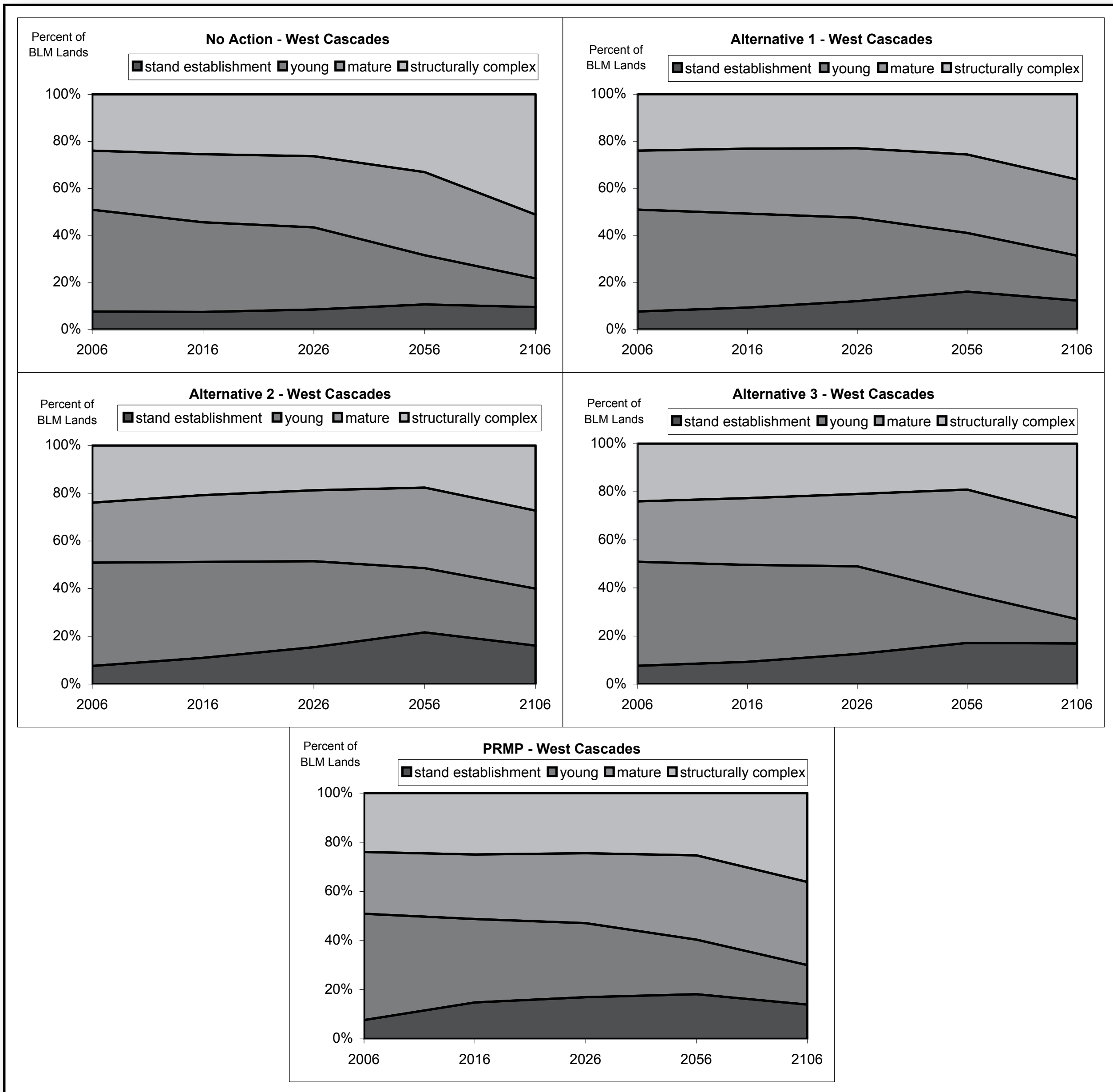
The increase in the mean patch size for the mature & structurally complex forests under the No Action Alternative, Alternative 1, and the PRMP would be comparable to the estimates of the average historic mature forest patch size (Nonaka and Spies 2005). In their modeling of the average historic spatial patterns in the Coast Range Province, Nonaka and Spies reported the mean patch size of the mature forests as 272 acres, compared to a current mean patch size of 84 acres across all ownerships. From this analysis, the mean patch size of the mature & structurally complex forest on the BLM-administered lands in the Coast Range

Province is currently 110.8 acres and would increase to 340.2 acres under the No Action Alternative; 255.1 acres under Alternative 1; and 176.4 acres under the PRMP.

West Cascades Province

The structural stage abundance in the West Cascades Province would show overall changes similar to the Coast Range Province. See *Figure 4-14 (Structural stage abundances on the BLM-administered forested lands in the West Cascades Province by alternative)*. The difference among the alternatives would be less pronounced than in the Coast Range Province, because the No Action Alternative and Alternative 1 would allocate a larger portion of the BLM-administered lands in the West Cascades to the harvest land base than in the Coast Range Province.

Figure 4-14. Structural Stage Abundances On BLM-Administered Forested Lands In The West Cascades Province By Alternative



In 100 years, the No Action Alternative would result in a structural stage abundance that is approximately similar to the average historic condition in the West Cascades with slightly more stand establishment forest and slightly less young forest. See *Figure 4-10 (Comparison of the structural stage abundances on the BLM-administered forested lands by 2106 with the current conditions and the average historic conditions by alternative by province)*. Alternatives 1, 2, and 3, and the PRMP would result in more stand establishment forest and less mature & structurally complex forest than the average historic condition in the West Cascades in 100 years.

Most of the changes in the spatial patterns in the West Cascades Province under the alternatives would be similar to the changes in the Coast Range Province, although the changes from the current condition and the differences among the alternatives would be less pronounced for all measures of spatial pattern. (See *Figures 4-11* and *4-12)*. The No Action Alternative is the only alternative under which both the size and connectivity of the mature & structurally complex forest patches would increase from the current condition in the West Cascades Province. The size and connectivity of mature & structurally complex forest patches would decrease slightly under Alternative 1. A larger decrease would occur under Alternative 2. The largest decrease in size and connectivity would occur under Alternative 3. The size of mature & structurally complex forest patches would slightly decrease, and the connectivity of mature & structurally complex forest patches would increase under the PRMP. There are no detailed studies of the historic spatial pattern in the West Cascades Province comparable to those in the Coast Range Province. However, studies of fire frequency and extent have suggested that the historic spatial pattern would have been larger and more connected mature & structurally complex forest patches than the current condition (Weisberg and Swanson 2003, Cissel et al. 1999). Therefore, the spatial pattern of the mature & structurally complex forest would move further away from the historic conditions in the West Cascades Province under Alternatives 1, 2, 3, and the PRMP.

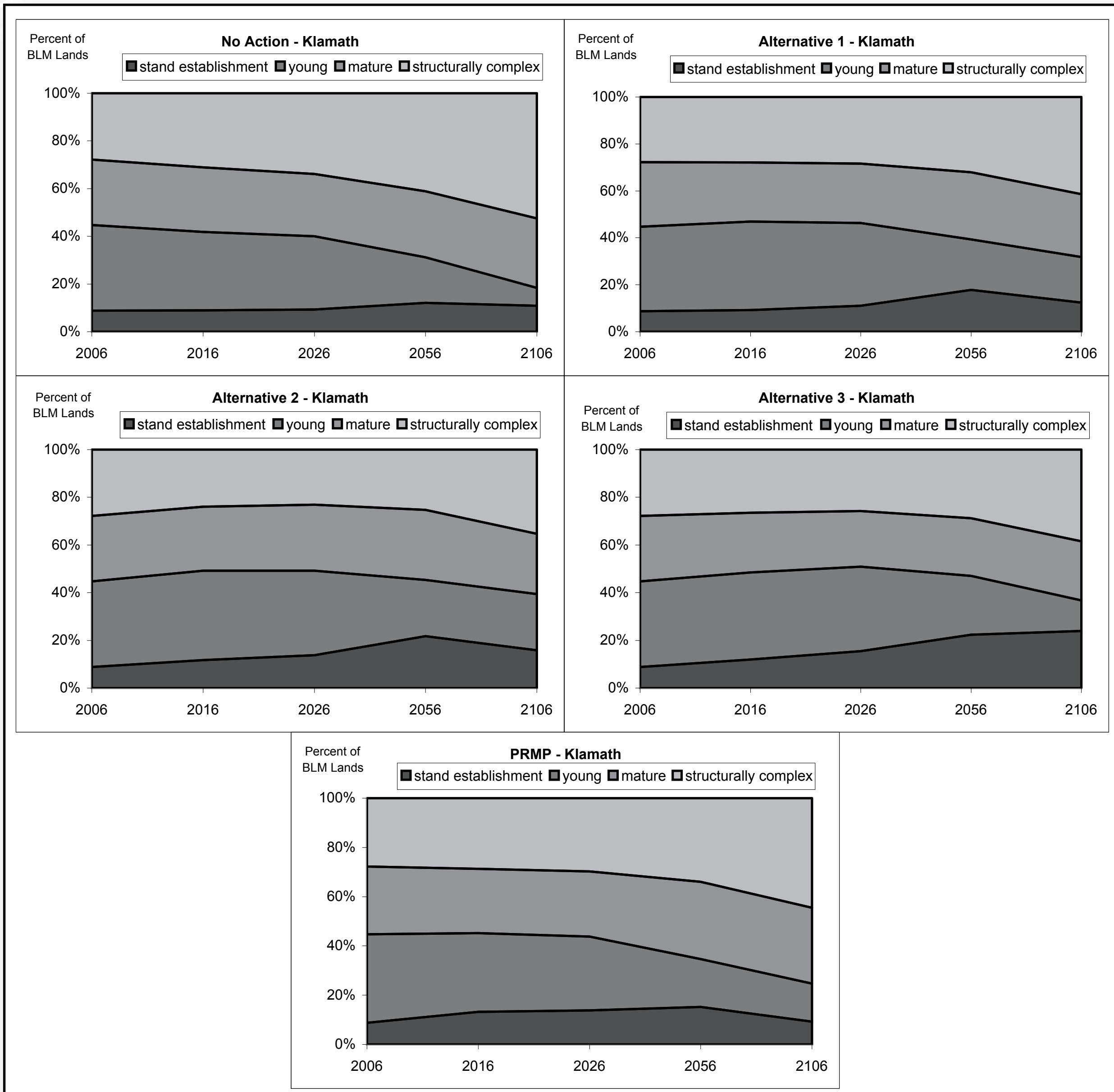
Klamath Province

The structural stage abundance in the Klamath Province would show the overall changes similar to the Coast Range and West Cascades Provinces, although the mature forest would remain approximately constant in abundance under the No Action Alternative and decrease slightly under Alternative 3. *See Figure 4-15 (Structural stage abundances on the BLM-administered forested lands in the Klamath Province by alternative).* The difference among the alternatives in the Klamath Province would be less pronounced than in the Coast Range Province, because the No Action Alternative and Alternative 1 would allocate a larger portion of the Klamath Province to the harvest land base than in the Coast Range Province.

In 100 years, the No Action Alternative and the PRMP would result in less stand establishment forest and more mature & structurally complex forest than the average historic condition in the Klamath Province. See *Figure 4-10 (Comparison of the structural stage abundances on the BLM-administered forested lands by 2106 with the current conditions and the average historic conditions by alternative by province)*. Alternative 1 would result in less stand establishment forest, more young forest, and the same amount of mature & structurally complex forest as the average historic condition in the Klamath Province in 100 years. Alternative 2 would result in more young forest and less mature & structurally complex forest than the average historic condition in the Klamath Province in 100 years. Alternative 3 would result in more stand establishment forest and less mature & structurally complex forest than the average historic condition in the Klamath Province in 100 years.

This analysis does not include the estimates of future natural disturbances, but natural disturbances would be more likely to alter the structural stage abundances in the nonharvest land base in the Klamath Province than in the Coast Range or West Cascades Provinces. The predominant high fire frequency regime and the effects of past fire suppression increase the likelihood that wildfires would increase the amount of stand establishment and young forests in the nonharvest land base from the abundances described here. However, as discussed under this chapter's Introduction, it is not possible to accurately predict the acreage, location, timing, severity, and extent of such disturbances.

Figure 4-15. Structural Stage Abundances On The BLM-Administered Forested Lands In The Klamath Province By Alternative

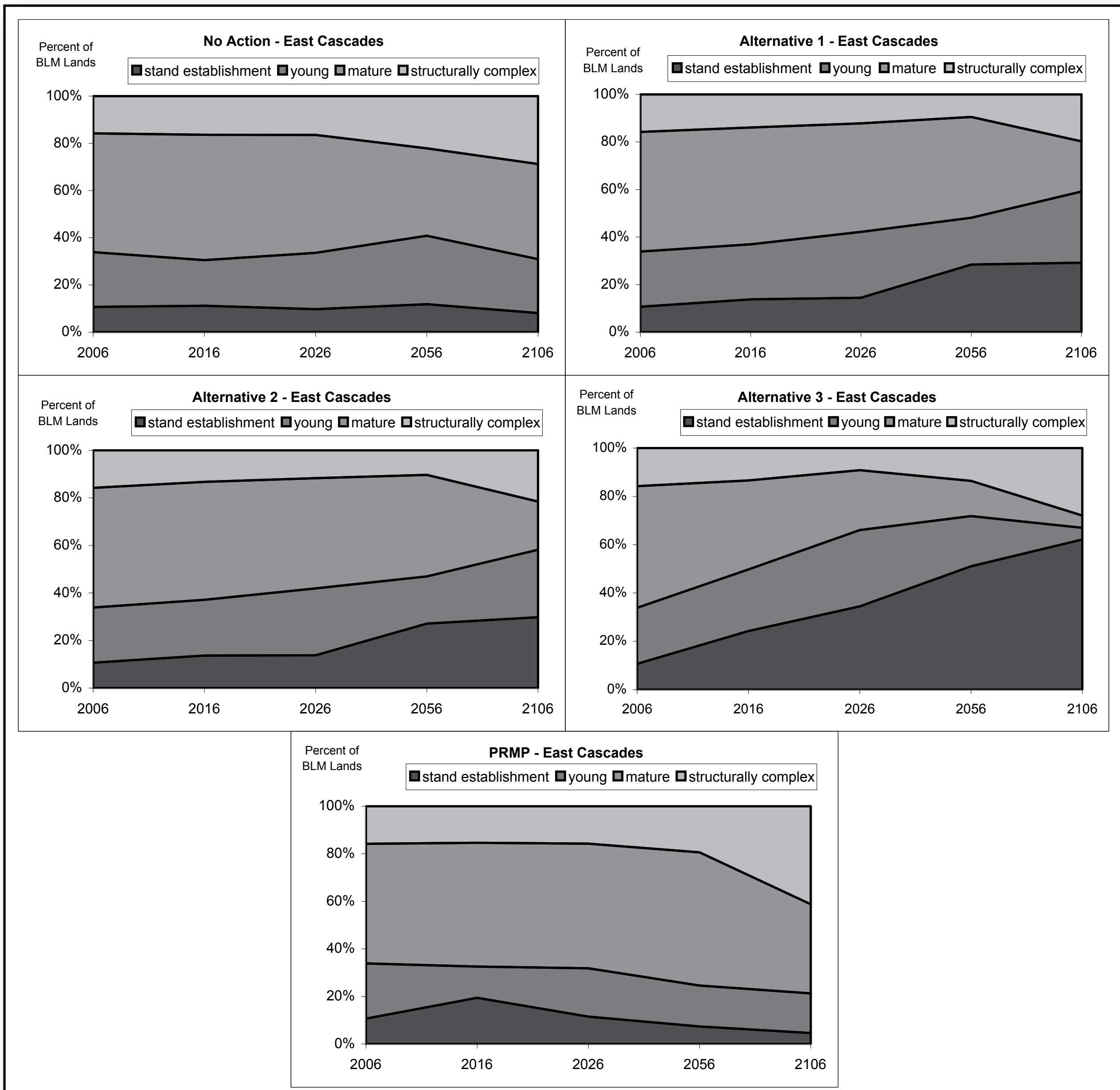


The size and connectivity of stand establishment forest patches would decrease under the No Action Alternative, Alternatives 1 and 2, and the PRMP. See *Figure 4-11 (Change in the mean patch size from the current condition by 2106 by forest structural stage on the BLM-administered lands)*. Although there would be little change in the patch size under Alternative 3, the connectivity of stand establishment forest patches would decrease. Under the PRMP, the patch size would decrease but the connectivity of stand establishment forest patches would increase. The size of young forest patches would decrease under all alternatives. As in the West Cascades Province, the size and connectivity of the mature & structurally complex forest patches would decrease compared to the current condition under Alternatives 1, 2, and 3. Alternative 1 would result in the least decrease, and Alternative 3 would result in the most decrease. See *Figures 4-10* and 4-*11*. The size and connectivity of mature & structurally complex forest patches would increase under the PRMP. There are no detailed studies of the historic spatial pattern in the Klamath Province to compare these results. The historic spatial pattern was likely more variable than in the Coast Range or West Cascades Provinces, because of the complex interaction of highly variable geology and climate with the highly variable disturbance regimes (Frost and Sweeney 2000, Taylor and Skinner 2003).

Eastern Cascades Province

The structural stage abundances in the Eastern Cascades Province would differ from the other provinces and would differ strongly among the alternatives. See *Figure 4-16 (Structural stage abundances on the BLM-administered forested lands in the Eastern Cascades Province by alternative)*.

Figure 4-16. Structural Stage Abundances On The BLM-Administered Forested Lands In The Eastern Cascades Province By Alternative



Under the No Action Alternative, the structural stage abundances in the Eastern Cascades Province would fluctuate, but remain approximately constant. The patterns in the Eastern Cascades Province would differ from the other provinces under the No Action Alternative because of the absence of the late-successional reserves and the small acreage of the riparian reserves in the Eastern Cascades Province. Overall, 69% of the BLM-administered forested acres in the Eastern Cascades Province would be in the harvest land base compared to the planning area average of 26%. Similar acreage amounts would be allocated to the harvest land base under Alternatives 1 and 2, and consequently similar structural stage abundance would result under these alternatives: the abundance of stand establishment forests would increase, and the abundance of mature forests would decrease over the next 100 years.

The structural stage abundance under Alternative 3 in the Eastern Cascades would be a different pattern than the other alternatives, and different than Alternative 3 in the other provinces. The abundance of stand establishment forests would increase to become the most abundant structural stage, and the abundance of young forests and mature forests would decrease. The partial harvests in the Eastern Cascades Province under Alternative 3 would repeatedly reset stands to the stand establishment with structural legacies forest structural stage, which would limit or preclude development into mature forest. The PRMP would reduce the abundance of stand establishment forests and increase the abundance of mature & structurally complex forest from current conditions. Uneven-aged management under the PRMP would maintain higher stand densities than the partial harvest in Alternative 3 and, therefore, would not repeatedly reset stands to stand establishment forest as a result of timber harvest.

In 100 years, none of the alternatives would result in structural stage abundances that are similar to the average historic condition in the Eastern Cascades. See *Figure 4-10 (Comparison of the structural stage abundances on the BLM- administered forested lands by 2106 with the current conditions and the average historic conditions by alternative by province)*. The No Action Alternative and the PRMP would result in less stand establishment and young forest, and more mature & structurally complex forest, than the average historic condition in the Eastern Cascades Province in 100 years. Alternatives 1 and 2 would result in more stand establishment forest, and less young forest, than the average historic condition. Alternative 3 would result in a structural stage abundance that would be most different from the average historic condition of all alternatives; there would be more stand establishment forest, less young forest, and less mature & structurally complex forest than the average historic condition.

Classification of the forest structural stages in the Eastern Cascades Province and characterization of the average historic condition are more challenging than in any other province. The partial harvest under Alternative 3, which would mimic the effect on stand density that would occur following moderate- or low-severity fire, would result in classification of the harvested stand as stand establishment forest. As noted in the *Forest Structure and Spatial Pattern* section of *Chapter 3,* most descriptions of the average historic abundance do not classify all stands that experience moderate- or low-severity fire as stand establishment forest. Therefore, the classification of stands following partial harvest under Alternative 3 does not equate precisely to stand classification in most description of the average historic abundance.

As in the Klamath Province, natural disturbances would be more likely to alter the structural stage abundances in the nonharvest land base in the Eastern Cascades Province than in the Coast Range or West Cascades. The predominant high fire frequency regime and the effects of past fire suppression increase the likelihood that wildfires would increase the amount of the stand establishment and young forests in the nonharvest land base from the abundances described here. However, as discussed in the *Introduction* to this chapter, it is not possible to accurately predict the acreage, location, timing, severity, and extent of such disturbances.

The size of the stand establishment forest patches in the Eastern Cascades Province would decrease under the No Action Alternative and the PRMP. Under Alternatives 1, 2, and 3, the size of the stand establishment forest patches would increase. These changes are consistent with the changes in the overall structural stage abundance. See *Figure 4-11 (Change in the mean patch size from the current condition by 2106 by forest structural stage on the BLM-administered lands).*

All alternatives would result in only slight changes in the size of young forest patches compared to the current condition. The size of young forest patches would slightly decrease under the No Action Alternative and Alternatives 2 and 3, and would slightly increase under Alternative 1 and the PRMP.

The size and connectivity of the mature & structurally complex forest patches would decrease in the Eastern Cascades Province under the No Action Alternative, and Alternatives 1, 2 and 3. See *Figures 4-11* and 4-*12.* The No Action Alternative would result in the least decrease, and Alternative 3 would result in the most decrease of all the alternatives. Only under the PRMP would there be an increase in the size and connectivity of the mature & structurally complex forest patches in the Eastern Cascades Province. There are no studies of historic spatial pattern to compare to these results. However, the historic spatial pattern in the Eastern Cascades likely differed from other provinces within the planning area because of the prevalence of a low-severity/high-frequency fire regime that would have produced a fine-grained mosaic of the forest structural stages (Frost and Sweeney 2000).

Reference Analyses

No Harvesting Reference Analysis

Without any timber harvesting on the BLM-administered lands, the stand establishment forests would completely disappear and the young forests would almost completely disappear from the BLM-administered lands by 2106. See *Figure 4-2 (Comparison of the BLM-administered forested lands by 2106 with the average historic conditions and current conditions by alternative)* early in this section. The mature and structurally complex forests would increase to occupy almost all the BLM-administered lands. This would result in less stand establishment and young forests, and more mature and structurally complex forests on the BLM-administered lands than the average historic condition. Because the mature & structurally complex forests would occupy almost all the BLM- administered lands, the size and connectivity would increase in all provinces far more than any alternative. See *Appendix B - Forest Structure and Spatial Pattern*.

This analysis does not include the estimates of future natural disturbances, but natural disturbances would increase the amount of the stand establishment and young forests from the abundances described here. The Northwest Forest Plan FSEIS assumed that 2.5% of the late-successional forests in the late-successional reserves would be lost to wildfires each decade (USDA USFS and USDI BLM 1994b, 3&4:42). The actual rate of disturbance over the past decade has been lower on the BLM-administered lands (see text earlier in this chapter under *Introduction - Incomplete or Unavailable Information – Salvage After Natural Disturbance*).

Across all ownerships, no timber harvesting on the BLM-administered lands, combined with the effect of the management on other lands, would result in a decrease in the stand establishment forests and young forests from the current condition and an increase in the mature & structurally complex forests, as in all alternatives. These changes would move the landscape in the direction of the historic average conditions. However, the structural stage abundances across all ownerships would not reach the average historic conditions in 100 years. The stand establishment forests would remain above the average historic condition, and the mature & structurally complex forests would remain below the average historic condition as they would in all four alternatives and the PRMP. See *Figure 4-17 (Comparison of all ownerships by 2106 with average historic conditions and current conditions by alternative)* later in this section.

Intensive Management on Most Commercial Timber Lands Reference Analysis

This reference analysis would result in more stand establishment forests, more young forests, and less structurally complex forests than any alternative. The structurally complex forests would be restricted almost entirely to the nonharvest land base, which would comprise 18% of the BLM-administered lands (compared to 40% under Alternative 3, which is the lowest of the alternatives). Although the mature forests would continue to comprise 33% of the BLM-administered lands, the majority (80%) would be mature with single canopy forests (far higher than any other alternative). See *Figure 4-6 (Mature forest with multi-layered canopies or single canopies by alternative)* earlier in this section. This reference analysis would result in more stand establishment forests, more young forests, more mature forests, and less structurally complex forests than the average historic condition.

Forest Structure and Spatial Pattern across All Ownerships

The structural stages for all lands other than the BLM-administered lands were classified using Interagency Vegetation Mapping Project (IVMP) data (see text under *Forest Structure and Spatial Pattern* in *Chapter 3*). The IVMP data, however, only describes the current conditions. The BLM-administered lands are classified for both the current and future conditions based on modeling outputs rather than IVMP data. The modeling outputs provide the only available data on the future conditions under the different alternatives. It is not possible to conduct comparable modeling of future conditions on lands other than the BLM-administered lands. Therefore, the analysis relies on broad assumptions about the future conditions on other lands.

The analysis assumes that all forest-capable lands in the U.S. Forest Service late-successional reserves, administratively withdrawn, and congressionally reserved lands would develop through the structural stages by the following progression:

- In 2016, all stand establishment forests would become young forests.
- In 2056, all young forests that were young forests in 2006 would become mature & structurally complex forests.
- In 2106, all young forests that were stand establishment forests in 2006 would become mature & structurally complex forests.

The analysis assumes that all other lands would maintain their current abundances and spatial patterns. Although these assumptions are acknowledged to be broad and general in scope, it is not possible and would be inherently speculative to make more precise assumptions. The assumption about the U.S. Forest Service reserves does not account for natural disturbances (similar to the modeling of the BLM-administered lands) or the slow structural development on poor sites. The assumption on other lands overestimates harvesting on the U.S. Forest Service harvest base lands, because it does not account for riparian reserves. The prediction of specific harvesting practices on state lands and private lands would be complex and largely speculative (Spies et al. 2007, Kennedy and Spies 2005, Nonaka and Spies 2005). Nevertheless, the broad assumptions allow the analysis to provide context sufficient for making a reasonable evaluation of the relative effect of the different BLM management actions on the structural stage abundances and spatial patterns across all ownerships.

The value of the analysis across all ownerships is in the relative results that compare the future conditions under the different alternatives. Absolute results from the abundance and spatial analysis should be interpreted with great caution. Measurements of spatial patterns are strongly influenced by:

- definition of the elements of the analysis (e.g., the landscape boundaries)
- scale of the spatial analysis

- definition of patch types
- basis for delineating patches

In addition, this analysis integrates two different data sources to construct the landscape: modeling outputs for the BLM-administered lands, and Interagency Vegetation Mapping Project data for all other lands. These two data sources use slightly different parameters to define structural stages and are measured at different scales; these differences influence the spatial pattern results. Therefore, these abundance and spatial pattern results should not be compared directly to results from other studies, but should only be used to describe relative effects of different alternatives.

All alternatives, combined with the effect of the management on other lands consistent with the assumptions described above, would contribute to a decrease in stand establishment forests and young forests from the current condition and an increase in the mature & structurally complex forests. These changes would move the landscape in the direction of the historic average conditions. However, the structural stage abundance across all ownerships would not reach average historic conditions in 100 years under any alternative. The stand establishment forests would remain above the average historic condition, and the mature & structurally complex forests would remain below the average historic condition in all alternatives. See *Figure 4-17 (Comparison of all ownerships by 2106 with average historic conditions and current conditions by alternative)*. This conclusion is consistent with the research on the Coast Range landscape conditions that modeled alternative future management scenarios on all ownerships, rather than broad assumptions described above (Nonaka and Spies 2005). Modeling alternative future management scenarios on all ownerships across the planning area similar to the research in Nonaka and Spies (2005) is not possible or appropriate in this EIS, because Nonaka and Spies (2005) only addressed the Coast Range Province and used methods more appropriate to scientific research than an EIS. Also:

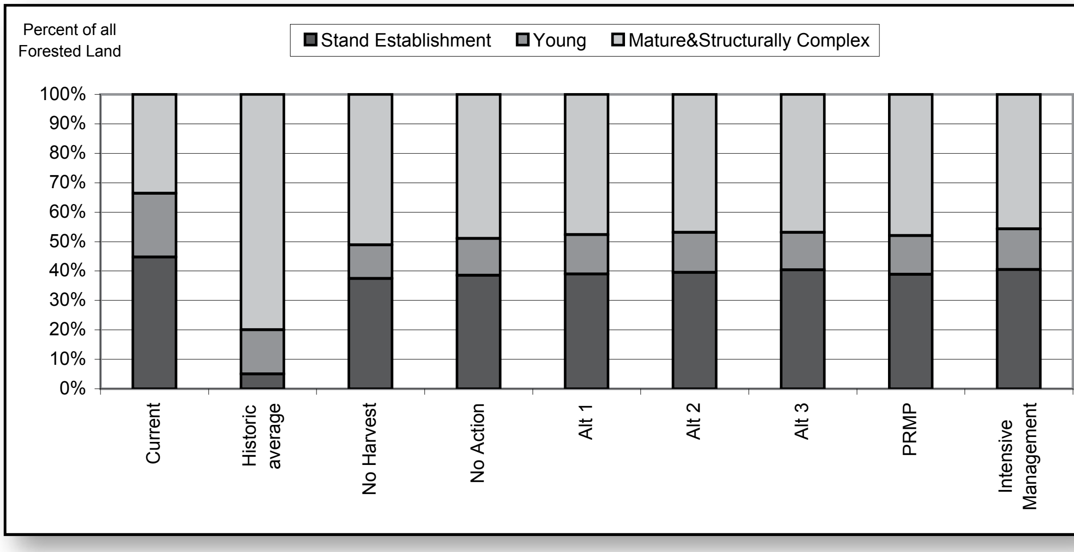
- There is less data available on existing forest conditions and forest growth and yield for other provinces in the planning area.
- The natural disturbance regime and historic conditions for other provinces are more complex and less well-studied in other provinces in the planning area.
- Detailed modeling on all ownerships across the planning area would be exorbitantly expensive and unreasonably time-consuming. The detailed modeling in Nonaka and Spies (2005) was part of, and also dependent on, a long-term joint research project begun in 1994 (Coastal Landscape Analysis and Modeling Study. *Overview.* URL: http://www.fsl.orst.edu/clams/overview.html [accessed June 2008]).
- Detailed modeling on all ownerships would require speculation about future management on other ownerships. Although such speculation may be appropriate in research, it would not be appropriate in an EIS analysis, which must be based on reasonably foreseeable actions.

The structural stage abundances across all ownerships would vary only slightly among the alternatives for two reasons:

- The BLM-administered lands comprise only 16% of all forested land within the planning area, which is too small an area to substantially shift the structural stage abundances across all ownerships.
- The effect of the alternatives on the BLM-administered lands, though quantitatively different, would make similar overall changes to the structural stage abundance, resulting in a decrease in the young forests and an increase in the mature & structurally complex forests.

As a result, none of the alternatives would result in more than a 1% shift in the structural stage abundances across all ownerships. Even the reference analyses of no harvesting and intensive management on most commercial timber lands would result in only an additional 1 to 2% shift in the structural stage abundances across all ownerships. There are differences among the alternatives that are masked by grouping all mature and structurally complex forests together, and these differences are detailed in the analysis of the BLM-

Figure 4-17. Comparison Of All Ownerships By 2106 With Average Historic Conditions And Current Conditions By Alternative



administered lands above. At the broad scale of analysis across all ownerships, however, the management of the BLM-administered lands does not substantially alter the condition of the entire forested landscape.

The principal controls on the condition of the entire forested landscape are the development of the U.S. Forest Service reserves into mature & structurally complex forests and the continued intensive management of the nonfederal forests. For example, the No Action Alternative would add an additional 684,000 acres of mature & structurally complex forest on the BLM-administered lands in 100 years, whereas development of the U.S. Forest Service reserves would add more than twice that amount (1,786,000 acres) of mature & structurally complex forest over the same time period.

The abundances of the structural stages over time shows slightly more difference among the alternatives at the province scale than for the entire planning area. Nevertheless, the alternatives still only shift the abundances at the province scale less than 3% in 100 years. See *Figure 4-18 (Comparison of all ownerships by 2106 with average historic conditions and current conditions by province by alternative)*.

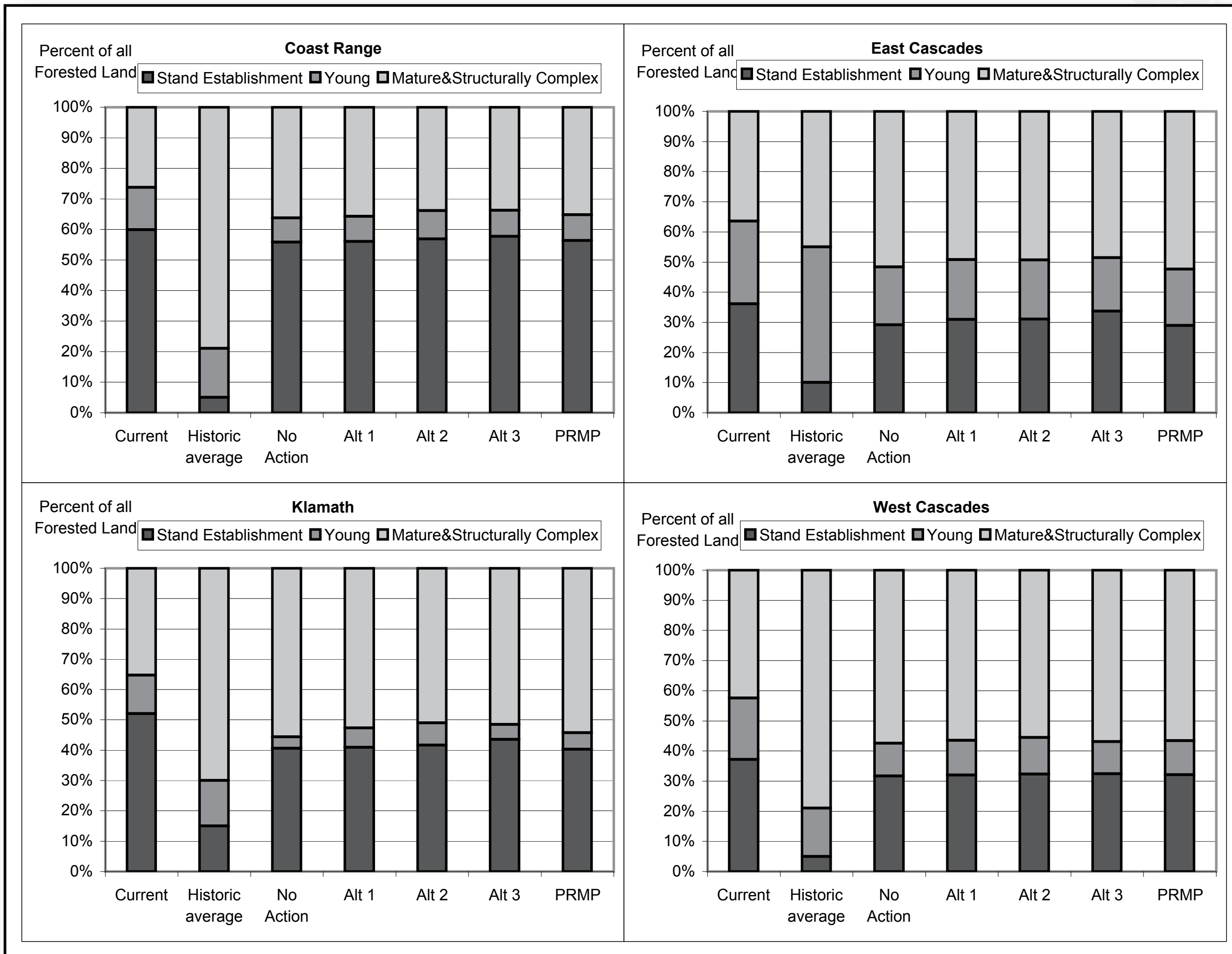
The spatial patterns of the structural stages across all ownerships would reveal more differences among the alternatives than the abundances of the structural stages.

The stand establishment forest average patch size across all ownerships would decrease in some alternatives in some provinces and increase in others.[6] See *Figure 4-19 (Change in the mean patch sizes from the current condition by 2106 by the forest structural stages on all ownerships)*. Alternative 3 would contribute to an increase in the stand establishment patch size in all provinces. The PRMP would contribute to the largest increase in the stand establishment patch size in the Coast Range and West Cascades Provinces, and the largest decrease in the stand establishment patch size in the Klamath Province. This is consistent with the overall trend in the abundances across all ownerships. Nevertheless, the changes in stand establishment average patch size represent small relative changes in patch size over time under all alternatives.

The young forest average patch size across all ownerships would decrease in all alternatives in all provinces consistent with the overall trend in abundances.

[6]The mean patch size across all ownerships was calculated using eCognition for the PRMP and FRAGSTATS for the other alternatives. The two methods yield similar results and can be directly compared, as detailed in Appendix B – Forest Structure and Spatial Pattern.

Figure 4-18. Comparison Of All Ownerships By 2106 With Average Historic Conditions And Current Conditions By Province By Alternative



The mature & structurally complex forest average patch size across all ownerships would increase in all alternatives in all provinces consistent with the overall trend in abundances. Development of the Forest Service reserves into mature & structurally complex forests would produce very large mature & structurally complex forest patches that would contribute to the increase in mean patch size, but there would still be a measurable difference among the alternatives. Among the alternatives, the No Action Alternative would contribute to the most increase in mature & structurally complex forest patch size in most provinces, and Alternative 3 would contribute to the least increase in most provinces. The PRMP would contribute to the most increase in the East Cascades Province and the least increase in the West Cascades Province. The PRMP would contribute to almost as much increase as the No Action Alternative in the Klamath Province. The No Harvesting reference analysis would contribute to more difference in the mature & structurally complex forest patch size than in the overall abundance of the mature & structurally complex forest across all ownerships. The no harvesting reference analysis would contribute to mature & structurally complex forest mean patch sizes that would be much larger than under Alternative 3 (i.e., 35% larger in the Coast Range Province, 23% larger in the West Cascades Province, 120% larger in the Klamath Province, and 32% larger in the Eastern Cascades Province). The differences among the alternatives would be greatest in the Klamath Province, in part because the BLM-administered lands comprise a higher portion of the Klamath Province than any other province.

Figure 4-19. Change In The Mean Patch Sizes From The Current Condition By 2106 By The Forest Structural Stages On All Ownerships