

UCRB

Chapter 2

Affected Environment

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Introduction

Key Terms Used in This Section

Cluster ~ Group of subbasins where vegetative and ecological conditions and processes are similar.

ERU ~ Ecological Reporting Unit ~ A geographic mapping unit developed by the Science Integration Team to report information on the description of biophysical environments, the characterization of ecological processes, the discussion of past management activities and their effects, and the identification of landscape management opportunities.

HUC ~ Hydrologic Unit Code ~ A coding system developed by the U.S. Geological Service to identify geographic boundaries of watersheds of various sizes.

Planning Area ~ In this EIS, refers to either the UCRB EIS area or the Eastside EIS area.

Project Area ~ In this EIS, refers to the entire Interior Columbia Basin Ecosystem Management Project area, encompassing both EIS planning areas.

Subbasin ~ Equivalent to a 4th-field Hydrologic Unit Code (HUC), a drainage area of approximately 800,000 to 1,000,000 acres. Hierarchically, subwatersheds (6th-field HUC) are contained within a watershed (5th-field HUC), which in turn is contained within a subbasin (4th-field HUC). This concept is shown graphically in Figure 2-2 in Chapter 2.

Purpose and Organization of This Chapter

The purpose of this chapter is to describe the existing environment, including conditions and trends, that will be addressed by management alternatives in Chapter 3 and Chapter 4.

Descriptions focus on lands administered by the Forest Service or Bureau of Land Management (BLM) in the Upper Columbia River Basin (UCRB) (the *planning area*); however, discussion of the entire *project area* (covered by both the Eastside and Upper Columbia River Basin EISs) is often necessary to provide context.

Information about the physical, terrestrial, aquatic, and human settings is provided to:

- ◆ Show more specifically changes from historical to current times within the project/planning areas,
- ◆ Describe more fully the statement of needs explained in Chapter 1, and
- ◆ Lay the foundation for understanding and evaluating the alternatives discussed in Chapters 3 and 4.

Information in the first part of the chapter is organized by potential vegetation groups (PVGs) and summarized where appropriate by ecological reporting units (ERUs), explained below. At the end of the chapter this information is integrated and reorganized into clusters of geographical areas where overall ecological conditions, management opportunities, and risks are similar in the project area.

This chapter focuses on portions of the environment that are directly related to conditions addressed in the alternatives. The description of the affected environment is not meant to be a complete portrait of the project area, which is provided in more detail in the Integrated Scientific Assessment (Quigley, Graham, and Haynes 1996) and associated Staff Area Reports (STARs) (Quigley and Arbelbide 1996). Rather, it is intended to portray the significant conditions and trends of most concern to the public, the Forest Service, or the BLM with regard to lands administered by these two agencies within the project area, at a regional scale. Information in this chapter is based primarily on the Assessment and STAR reports. Other sources are noted where applicable.

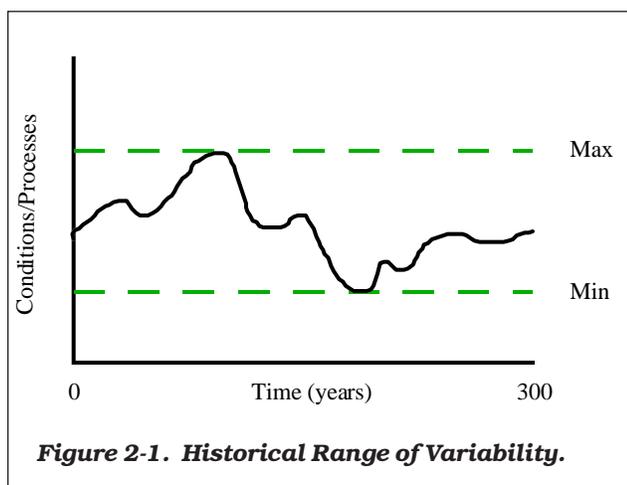
The Scientific Assessment characterizes the entire project area, regardless of ownership, to set a context within which individual BLM or Forest Service administrative units can plan and

conduct ecosystem-based management. Findings in the Assessment are best used to understand trends on the overall landscape. Descriptions of site-specific conditions can generally be found in current land-use plans available at local Forest Service or BLM offices. Readers should be aware that local conditions may reflect improved or healthier conditions, or more degraded conditions, than are discernible at the larger or regional scale addressed by this EIS.

Historical Range of Variability

Throughout this chapter, reference is made to “historical conditions” or the “range of historical variability.” “Historical” in this EIS is intended to represent ecological conditions and processes that are likely to have occurred prior to settlement of the project area by people of European descent (approximately the mid-1800s). Historical ecological conditions and processes are portrayed in this EIS for a number of variables such as forest and range vegetation types, compositions, and structures; fish and wildlife habitats and populations; and fire regimes. These historical ecological conditions would have varied over time within an estimated range of variability. For purposes of comparison to current conditions, historical ecological conditions referenced in this EIS generally represent an estimated mid-point within the historical range of variability (see Figure 2-1.)

The historical period of pre-European settlement was selected for this EIS **only as a reference point**, to establish a baseline set of ecological conditions for which sufficient scientific or



historical information is available to enable comparison to current conditions. Such a comparison is valuable to understand how ecological processes and functions operated with human uses, but prior to high human populations and contemporary technology. This can provide clues and blueprints for designing management strategies that maintain the ecological integrity of those processes under future management strategies. It is recognized that in many cases, it is neither desired nor feasible to return to actual historical conditions.

Positive Ecological Trends

The nature of the Interior Columbia Basin Ecosystem Management Project has been to focus on what is going wrong with ecosystems, then to determine what changes to management activities are necessary to improve ecological conditions. Much of the discussion in Chapter 2 emphasizes these needed changes.

Although some ecosystems have declined in health, many ecological conditions and trends have improved in the past two decades due to BLM and Forest Service management activities. Some areas where improvement has been achieved over the past 10 to 20 years on Forest Service- or BLM-administered lands are as follows:

- ◆ Soil productivity ~ best management practices in use today reflect improved understanding of the sensitivity of soils to various treatments, especially at the fine scale.
- ◆ Road construction and management ~ best management practices in use today reflect improved understanding of negative effects of roads, new road construction and maintenance of permanent roads occurs with greater understanding of drainage, erosion potential, fish passage concerns, slumpage problems, and other hazards. Much remains to address in the future especially with secondary and closed roads.
- ◆ Range management and range conditions ~ the current condition of rangelands appears to be the best it has been since the turn of the century; however, this is not agreed upon by all (National Research Council 1994). The declining condition of riparian areas has, for the most part, been slowed or stopped, and managers are acquiring a better understanding of how to alleviate the negative effects of

management practices on riparian areas. The BLM and Forest Service are placing a heavy emphasis on proper management of riparian areas in land use plans.

- ◆ Many high-profile endangered species are protected ~ species such as the grizzly bear and bald eagle have recovery plans in place, which are being implemented. Attention has shifted to those species with less public attention. Probably no vertebrate species have become regionally extinct in historical times.
- ◆ Landscape approach recognition ~ overall, land managers within the project area have recognized the need for a landscape approach to management of resources; on-the-ground managers appear ready and willing to accept the change.
- ◆ Prescribed fire techniques ~ techniques available for prescribed fire within the project area have improved. A variety of conditions can now be achieved from the application of prescribed fire using different treatments.
- ◆ Forest management approaches ~ the last 10 years have seen substantial change in the treatments applied to forested areas, both in harvest techniques and silvicultural treatments. Managers have a

wider array of options to select as treatments with more benign effects.

- ◆ Recognition of exotic species and their influence ~ the relatively recent and rapid expansion of exotic species and their impact on ecosystems is receiving more attention by resource managers, who recognize that management aimed at preventing the spread and reducing the extent of exotics is necessary. Scientists are testing and developing combinations of control methods that are promising for control of exotic plant species.
- ◆ Interaction with a wide array of publics ~ recent trends have been for managers to have more open discussions earlier in planning processes with a wide array of publics.

How Information was Gathered and Presented

Ecological Reporting Units

The project area was divided into 13 geographic areas called Ecological Reporting Units (ERUs) to provide a consistent way for all staff areas to report

Ecological Processes and Functions

The terms “ecological processes” and “ecological functions” in general refer to the flow and cycling of energy, materials, and organisms in an ecosystem. The nitrogen, carbon, and hydrologic cycles, and energy flow in terrestrial systems, are among the ecological processes discussed in other sections of this chapter. The following are some additional functions and processes that are important to ecosystem health:

- ◆ **Water capture.** Sites are able to effectively capture water when they maintain high infiltration rates and a high capacity for surface capture and storage of water.
- ◆ **Water storage.** Water is stored well when soil is stable and able to retain moisture; and when soil organic matter, well dispersed litter, and plant canopies that reduce evaporation losses from the soil are maintained.
- ◆ **Water cycling.** Water is cycled more effectively when it is released from a site in such a way that (1) low amounts of sediment are transported in runoff, (2) there is sufficient subsurface flow of water, and (3) plants and animals are able to use water for physiological functions.
- ◆ **Nutrient and energy cycling.** In healthy ecosystems, nutrients cycle and energy flows through a system in a pattern that is appropriate for the geoclimatic setting.
- ◆ **Energy capture (photosynthesis).** Plants are able to store resources necessary for drought survival, overwintering, and new growth initiation. They retain canopy cover, litter, and root systems sufficient to protect them from death or loss of vigor during stress periods.
- ◆ **Adaptation.** Animals have evolved along with their environments and have adapted to conditions on the landscape. Healthy ecosystems have sufficient food, cover, and other habitat attributes to maintain sufficient populations for reproduction, genetic interactions, and long-term survival.

their findings in the Scientific Assessment and Staff Area Reports (see Map 1-1, in Chapter 1 for ERU boundaries). The ERUs were developed specifically for consistent reporting purposes, not for analysis or implementation. The 13 ERUs were identified by a process that integrated human uses and terrestrial and aquatic ecosystem data. They are the basis for reporting information on the following: (1) the description of biophysical environments, (2) the characterization of ecological processes, (3) the discussion of past management activities and their effects, and (4) the identification of landscape management opportunities.

The UCRB planning area consists of five ERUs (8, 9, 11, 12, 13) unique to the UCRB and four ERUs whose boundaries overlap with the Eastside EIS planning area (5, 6, 7, 10). When possible, descriptions of the affected environment are described by ERU; however, not all socio-economic or ecological processes conform to ERU boundaries. Where this occurs, discussions are within the appropriate context.

Hydrologic Unit Codes

For the purposes of analyzing and summarizing much of the physiographic, aquatic, and vegetative information collected in the Scientific Assessment, watersheds and watershed boundaries were identified by the Science Integration Team as part of the Interior Columbia Basin Ecosystem Management Project process. The identification system follows the numeric coding system known as Hydrologic Unit Codes (HUCs) used by the U.S. Geological Survey (USGS) (figure 2-2). For larger watersheds ("Regions", "Subregions", "Basins", and "Subbasins", respectively coded as 1st through 4th field HUCs), boundaries and their numeric codes were adopted without change from those identified by the USGS. There are 164 fourth field HUCs in the interior Columbia Basin. Smaller watersheds ("Watersheds" and "Subwatersheds" or 5th and 6th field HUCs) were identified as part of the Interior Columbia Basin Ecosystem Management Project process. Within the ICBEMP project area there are approximately 8 to 9,000 subwatersheds or 6th field HUCs, which have an average area of approximately 20,000 acres each. (See table 2-13 in the Aquatic Ecosystems section for examples.) These subwatersheds were the basic characterization unit for the Scientific Assessment and were the basic mapping unit for identifying ERUs. Therefore, the boundaries of ERUs coincide with subwatershed boundaries. The

subwatersheds mapped as part of this project do not necessarily match those that have been previously mapped by administrative units of the Forest Service or BLM.

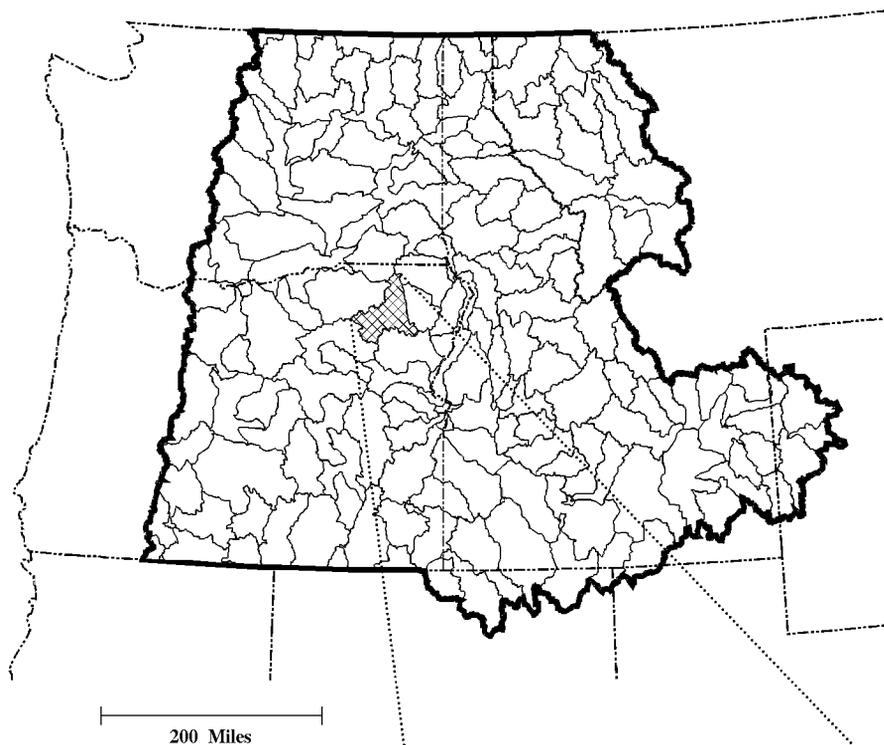
Clusters

As a final step in the analysis, to provide a more integrated picture of the affected environment, the Science Integration Team regrouped initial information to evaluate the relative integrity of ecosystems in the project area (SIT, 1/3/96 draft). Rather than simply describe the vegetation and other individual resources, this effort now attempted to answer three questions:

1. Where are the areas of high or low ecological integrity across the project area, relative to one another?
2. Where are the opportunities to improve integrity?
3. What risks to integrity exist from management actions?

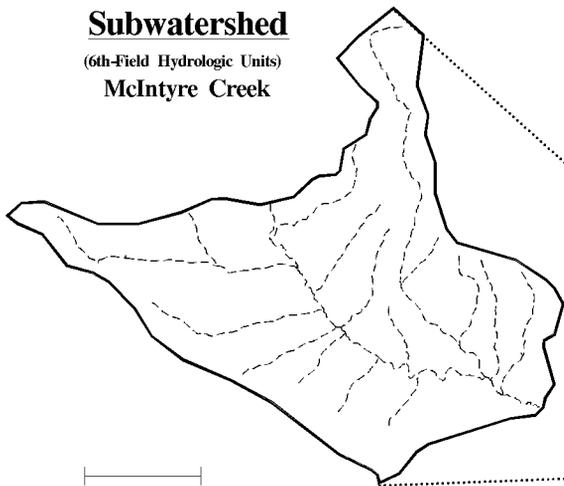
New groupings or "clusters" of subbasins were mapped, denoting forest and range ecosystems in the basin where the condition of the vegetation and ecological functions and processes are similar, and where management opportunities and risks are similar. These clusters form the basis of discussion in the last part of this chapter and for the development of alternatives in Chapter 3.

Figure 2-2. Hydrologic Hierarchy



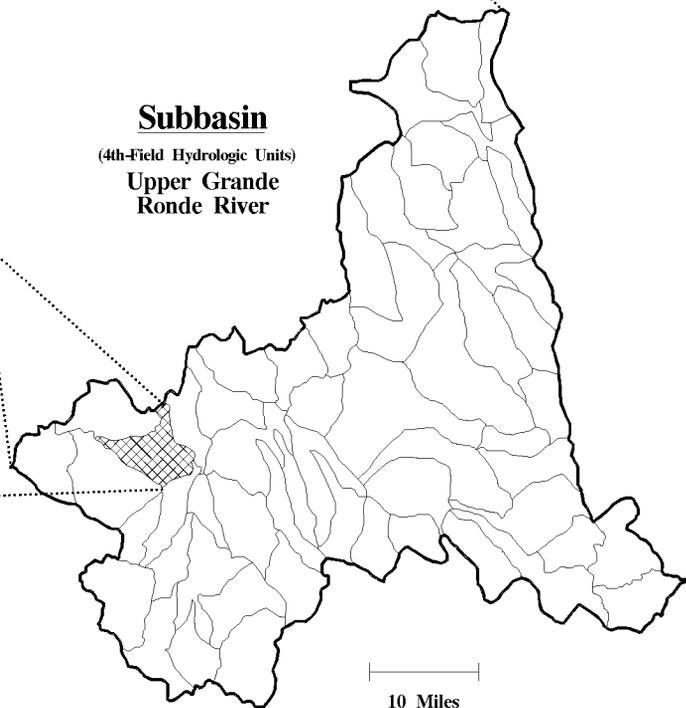
Subwatershed

(6th-Field Hydrologic Units)
McIntyre Creek



Subbasin

(4th-Field Hydrologic Units)
Upper Grande
Ronde River



LEGEND

- State Boundaries
 Outer HUC Boundary
 6th-Field Hydrologic Units
- Project Area
 4th-Field Hydrologic Units
 100k Stream Layer

Ecological Integrity and Ecosystem Health

The Science Integration Team (SIT) used the term “integrity” to refer to the ecological conditions of an ecosystem. Integrity generally means the quality or state of wholeness or being complete and unimpaired. Ecological integrity specifically was used by the SIT as a measure of the presence of physical and biological processes, patterns, and functions.

Because there are no direct measures of integrity, “proxies” or substitutes were selected to represent the broad array of functions, processes, and conditions. For example, the proportion of the area where fire severity and frequency had changed between historical and current periods was used as one of the proxies to represent such elements as consistency of tree stocking levels with long-term disturbances and the effect of wildfire on the composition and patterns of forest types. Proxies such as these were used to estimate current conditions and project trends in integrity into the future.

Ecological integrity is difficult to measure directly for several reasons. First, we can never know exactly what is in any particular ecosystem, because of the size, complexity, and ambiguous nature of most of their parts and processes. Second, the structure, function, and composition of ecosystems are always changing. Third, ecosystem changes are only partially predictable; they respond to a combination of internal processes and outside influences. And finally, the boundaries we put on ecosystems are artificial lines, making it hard to know when you are looking at an entire system or a part of one or more systems.

Therefore, integrity was estimated in a relative sense. Where forest, rangeland, and aquatic system processes and functions were present and operating best in the project area, integrity was rated higher than areas where these functions and processes were not operating. These estimates represented such elements as water cycling, energy flow, nutrient cycling, and maintenance of viable populations of plants and animals.

The notion of ecological integrity is part of the broader concept of ecosystem health used in the Draft EIS. The EIS Teams used the term “health” to refer to the capacity of forest, rangeland, and aquatic ecosystems to persist and perform as expected or desired in a particular area. Varying degrees of “wholeness” or integrity may be needed to enable a particular place to be used in the manner desired by society both now and in the future. Some uses will demand different mixes of fire regimes, water cycles, and energy flow resulting in differences in productivity, resilience, and renewability. The mix of these elements of “integrity” that would allow us to achieve a particular management objective in a particular place will define what is “healthy” for that area.

For example, in some areas such as near developed recreation sites or areas with scattered homes, restricting the presence of fire as a process may be important to achieving the broad goals for an area. The result may mean lower ecological integrity than if the fire regimes were allowed to operate fully, but might be judged as healthy from an ecosystem perspective because it is meeting the expectations of society. Another example might be managing to restrict riparian flooding, which from an ecological frame of reference would reflect lower integrity than if the flooding were to be present, yet this area might contribute to the overall ecosystem health because it is favorably contributing to society’s goals.

Ecosystem “health” thus can be thought of as encompassing both ecological integrity and what people want to do with the land. Ecosystem health includes not only how “intact” the ecological processes and functions need to be compared to their capabilities in order to accomplish current and future management objectives, but it also includes measures of social and economic resiliency, management philosophies and goals, and other human factors.

Physical Environment

Key Terms Used in This Section

Air Pollutants ~ Any substance in air that could, if in high enough concentration, harm humans, other animals, vegetation, or material. Air pollutants may include almost any natural or artificial matter capable of being airborne, in the form of solid particles, liquid droplets, gases, or a combination of these.

Air Quality ~ The composition of air with respect to quantities of pollution therein; used most frequently in connection with "standards" of maximum acceptable pollutant concentrations.

Climate ~ The composite or generally prevailing weather conditions of a region throughout the year, averaged over a series of years.

Geologic processes ~ The actions or events that shape and control the distribution of materials, their states, and their morphology, within the interior and on the surface of the earth. Examples of geologic processes include: volcanism, glaciation, streamflow, metamorphism (partial melting of rocks), and landsliding.

Geomorphology ~ The geologic study of the shape and evolution of the earth's landforms

Physiography ~ Pertaining to the study of the formation and evolution of landforms.

Soils ~ The earth material that has been so modified and acted upon by physical, chemical, and biological agents that it will support rooted plants.

Soil productivity ~ The capacity of the soil to support plant growth, due to the physical and chemical characteristics of the soil, including depth, temperature, water-holding capacity, and mineral, nutrient, and organic matter content.

Tectonic ~ Relating to, causing, or resulting from structural deformation of the earth's crust.

Introduction to Physical Environment

Geology, geologic processes, and climate form the physiographic framework in which ecological processes operate. For the most part, geologic and climatological conditions, processes, and disturbances cannot be modified by management activities. Watershed, soil, and atmosphere conditions and processes, also part of the physiographic setting, can and have been modified by management activities. All of these elements, whether they can be affected by management activities or not, must be accounted for when designing management strategies that will have a high likelihood of achieving desired outcomes.

The material presented here focuses on those geologic, soil, climatological, and air quality issues that are relevant for regional- and sub-

regional-level ecosystem management (see chapter 1 for definitions of regional and sub-regional). Much of the information forming the basis of this section is derived from the Landscape Ecology and Aquatic Staff Area Reports (1996), reports of the Eastside Forest Ecosystem Health Assessment (Everett et al. 1994), and additional sources as cited.

Geology and Physiography

The present geology and physiography of the project area is the culmination of millions of years of geologic, climatological, and ecological processes. This legacy has provided the template for current ecological conditions and has shaped and directed human uses of the varied terrains and resources within the project area.

Geologic Processes, Functions, and Patterns

At the regional scale (project area) and sub-regional scale (Ecological Reporting Units), geology, physiography, and topography are controlled by the past 1.5 billion years of plate tectonics, volcanoes, glaciers, and the resultant weathering, erosion, and sedimentation processes. It is the history and interaction of these processes that have resulted in present locations of mountain ranges, large river courses, watershed divides, and rock types exposed at the surface. These geologic and physiographic attributes exert considerable influence over climate, hydrology, and drainage pattern development. At the local scale (Sixth-field Hydrologic Unit Code or smaller), processes during the Pleistocene ice ages (last 1.6 million years) have been the influence on surface topography and soils. At the finest scale of channels and hillslopes, physiography is controlled primarily by recent (past 10,000 years) and present geomorphic processes and disturbances, such as floods, landslides, and volcanoes. The diversity of geologic environments, along with active tectonic, volcanic, and glacial processes, has been a controlling influence in the evolution and distribution of ecological systems, including patterns of human development and use.

The physiographic environment also dictates ecological potential and management options. For example, glaciated terrain commonly has steep slopes that are covered with soil and glacial sediments that are susceptible to erosion; areas near volcanoes commonly have thick, ash-rich soils that are highly productive but susceptible to compaction.

Erosion, sediment transport, and deposition are the geologic processes most relevant in day-to-day management of ecosystems in the project area. Moreover, these processes have been significantly affected by human activities. Detailed discussion of these processes are in the Aquatic Ecosystems section, because they are better viewed in the context of overall watershed processes.

Geology of UCRB Ecological Reporting Units

Geology of the entire project area is summarized in the Landscape Ecology Staff Area Report (1996), so only brief descriptions are provided here, by Ecological Reporting Unit (ERU).

Columbia Plateau (ERU 5)

Thick sequences of Tertiary basalt flows are locally covered by late-Tertiary and Quaternary sediment. During the ice-ages of the Pleistocene, the region was covered with windblown sediment, known as loess. Loess makes up the Palouse Hills and covers most of the upland surfaces. Rivers swollen with glacial meltwater and large Pleistocene floods inundated much of the Columbia Plateau, cutting into the basalt surfaces and forming the cliff-bounded valleys that contain the Columbia, lower Snake, and Deschutes rivers.

Blue Mountains (ERU 6)

The Blue Mountains are composed of a diverse suite of uplifted rocks, including Paleozoic, Mesozoic, and Tertiary sedimentary and igneous rock types. Higher mountains, such as the Seven Devils, Wallowa, and Elkhorn mountain ranges, were glaciated by alpine glaciers during the Pleistocene.

Northern Glaciated Mountains, Upper Clark Fork, and Lower Clark Fork (ERUs 7, 8, and 9)

The mountains across the northern part of the project area are underlain by a complex assemblage of Precambrian to Tertiary metamorphic, igneous, and sedimentary rocks. These rocks have been folded and faulted, resulting in broad, northwest trending ranges, commonly separated by wide downwarps such as the Okanogan, Spokane, Purcell, Bitterroot, Clark Fork, Kootenai, and Flathead Valleys. The Northern Glaciated Mountains ERU was extensively glaciated during the Pleistocene, resulting in unconsolidated glacial till covering many hillslopes, and thick fills and terraces of glacial outwash in the river valleys. Higher ranges in the Upper Clark Fork and Lower Clark Fork ERUs had Pleistocene alpine glaciers. Glacially dammed Pleistocene Lake Missoula inundated valleys of the Lower Clark Fork and Upper Clark Fork ERUs to an elevation of 4,600 feet, resulting in accumulations of fine-grained and unconsolidated lake sediment in many valley bottoms.

Owyhee Uplands (ERU 10)

The Owyhee Uplands ERU is composed of two distinct physiographic provinces—the western Snake River Plain and the Owyhee Uplands. The western Snake River Plain is a structural depression that has been filled with horizontal sheets of Tertiary basaltic lava flows that are interbedded with river and lake sediment.

Except for the canyon of the Snake River, there is little relief on the surface except for small shield volcanoes, volcanic buttes, and lava flows. The surface is mantled by loess and alluvial sand and gravel derived from surrounding mountains. Southwest of the Snake River, the Owyhee Uplands is a partly dissected and folded plateau, underlain by Tertiary volcanic rocks, and mantled by alluvial silt, sand, and gravel.

Upper Snake (ERU 11)

The Upper Snake ERU is part of the eastern Snake River Plain geologic province. The eastern Snake River Plain is a wide, featureless surface underlain by Tertiary and Quaternary basaltic and silicic volcanic rocks. The Snake River has locally cut a deep canyon along the south margin of the plain; locally flanking the river are Pleistocene gravel terraces composed of outwash from the Yellowstone Ice Cap and flooding from Pleistocene Lake Bonneville. The basalt upland surfaces are locally covered by several meters of loess. The southwest portion of the ERU consists of north-to-south trending mountain ranges separated by alluvial valleys.

Snake Headwaters (ERU 12)

The Snake Headwaters ERU contains north-to-south trending mountain ranges primarily composed of Paleozoic and Mesozoic sedimentary rocks that have been folded and faulted. The higher ranges were glaciated during the Pleistocene by alpine glaciers and the Yellowstone Ice Cap.

Central Idaho Mountains (ERU 13)

The eastern portion of the Idaho Batholith is primarily underlain by Mesozoic and Tertiary granitic and volcanic rocks that have been uplifted and dissected to form locally steep alpine ridges and breaklands. Steep topography with narrow valley bottoms discouraged roading and consequent human development. Higher mountains within the batholith were extensively glaciated by Pleistocene alpine glaciers, resulting in valleys and basins being filled with alluvium and outwash. Extensive physical and chemical weathering of the granitic rocks has resulted in a thick mantle of regolith that is readily eroded if the vegetation and soil cover is disturbed. The southeast portion of the Idaho Batholith ERU includes areas underlain by a greater variety of rock types, including Tertiary volcanic rocks and Precambrian and Paleozoic metamorphic rocks.

The physiography is dominated by northwest-trending basin-and-range mountains of the Lost River, Beaverhead, and Lehmi Ranges, separated by alluviated valleys and basins.

Soils and Soil Productivity

Summary of Conditions and Trends

- ◆ Soil productivity across the project area is generally stable to declining. Determination of the exact status of soil condition for any given area is difficult because of lack of inventory and monitoring data. Generally, greater declines in soil quality and productivity are associated with greater intensities of vegetation management, roading, and grazing.
- ◆ Soil organic matter and coarse wood (woody material greater than three inches) have been lost or have decreased as a result of displacement and removal of soils and removal of whole trees and branches.
- ◆ There has been a loss of soil material from direct displacement of soils, as well as from surface and mass erosion. Erosion can result from changed water runoff patterns from increased bare soils exposure, compaction, and concentration of water from roads.
- ◆ Changes in the physical properties of soils have occurred in conjunction with activities that increase bulk density through compaction. These changes have largely resulted in impaired soil process and function, such as decreased porosity and infiltration and increased surface erosion.
- ◆ Sustainability of soil ecosystem function and process is at risk in areas where redistribution of nutrients in terrestrial ecosystems has resulted from changes in vegetation composition and pattern, removal of the larger size component of wood, and risk of uncharacteristic fire.
- ◆ Floodplain and riparian area soils have reduced ability to store and regulate chemicals and water, in areas where riparian vegetation has been reduced or removed or where soil loss associated with roading in riparian areas has occurred. In these areas,

water quantity may be reduced during low flows, and water quality may have less buffer from pollution.

Soils form an ecologically rich and active zone at the interface between geologic materials and the atmosphere. The soil that occurs at a particular site depends on the geologic parent material, climate, relief, and organisms occurring at that site, and on the amount of time that has been available for these five soil-forming factors to interact. Soil-forming and soil-recovery processes can be slow; therefore, disruption of soils can lead to long-term changes in ecological conditions, including biological and hydrologic processes. Much of the following material is summarized from the Landscape Ecology Staff Area Report (1996), Harvey et al. (1994), and Henjum et al. (1994).

Soil Processes, Functions, and Patterns

Soil is the primary medium for regulating movement and storage of energy and water and for regulating cycles and availability of plant nutrients (Meurisse et al. 1990). The physical, chemical, and biological properties of soils regulate biological productivity, hydrologic response, site stability, and ecosystem resiliency. Soils anchor vegetation and contain mineral nutrients and water required for plant growth. Soils also contain a vast variety of microorganisms that promote decomposition of organic material, such as leaves, twigs, and large wood. This decomposition process is a critical link in the nutrient cycling process, especially for plant nutrients such as carbon, nitrogen, potassium, phosphorous, and sulfur (see sidebars on Carbon Cycle in the Forestlands section of this chapter and on Nitrogen Cycle in the Rangelands section). The diverse geology and climate of the planning area, in conjunction with natural and human disturbance, have resulted in a spatially complex pattern of soils that differ in appearance, function, and response to management activities.

Soil Horizons

Most soils in the ICBEMP project area have formed since the last ice age and are composed of several horizons, or layers. These horizons have

differing capacities for supplying nutrients and holding water, so soil productivity is not directly proportional to soil depth. Because the highest concentration of nutrients and biota are in the uppermost soil horizons, incremental removals of soil (such as by soil erosion) nearer the surface are more damaging than those of subsoils (Swanson et al. 1989). At the surface, there is commonly a thin (generally less than two inches), and sometimes discontinuous cover of decaying organic matter, such as leaves and twigs. Under this cover of litter and duff is a layer (less than a few inches) of dark, highly decomposed organic matter (humus) which covers a mineral layer of up to several feet thick. This mineral layer may contain organic matter, clay minerals, calcium carbonate, and other salts that are transported down the soil column by percolation or burrowing activities. In general, forested environments have more continuous and thicker organic matter layers consisting of litter and duff material above the mineral soil compared to rangeland soil horizons, but the thickness and amount of organic material varies considerably depending on local vegetation characteristics, climate, relief, and disturbance history (including human uses and fire). These soil horizons together cover weathered and unweathered parent materials, such as bedrock or old stream gravel. Volcanic material is a major component of many soils.

Physical Properties

Physical properties of soils, such as bulk density (dry weight per unit volume), porosity, texture, hydrologic conductivity, soil depth, and mineral content, are all factors controlling hydrologic response, water-holding capacity, and surface stability. Soil water-holding capacity is a critical factor in the project area, where growing season precipitation is low. Soils with high organic matter contents generally have high porosities and high water-storage capacities.

The physical properties of soils can be altered by disturbances such as erosion and compaction. Soil compaction results from concentrated activity, including use of heavy equipment, vehicles, pedestrian activity, and improper livestock grazing. Where soils are compacted, porosity, permeability, and hydrologic conductivity are reduced, resulting in altered runoff patterns and increased surface erosion. Natural recovery of surface compaction can take 50 to 80 years, depending on the soil type, degree of compaction, frequency of freeze-thaw cycles, and input of organic matter. Recovery of compacted subsoils usually requires upward of 200 years.

Biological Properties

Soil biological properties also profoundly affect productivity. Soil is a reservoir of fungal spores and other organisms important for decomposition and nutrient cycling. These organisms and their interactions profoundly affect forest site productivity through assimilation of nutrients, protection against pathogens, maintenance of soil structure, and buffering against moisture stress (Amaranthus and Trappe 1993). The number of species of microorganisms in the soil is far greater than above-ground plants and animals, and research has shown a critical linkage between soil microorganisms and processes and forest productivity (Molina and Amaranthus 1990). Soil moisture and temperature regimes strongly influence forest type, distribution, and soil productivity. Erosion or removal of soil surface layers, where most microorganisms reside and where most of the critical nutrient cycling processes occur, can significantly affect productivity for several decades.

Organic Matter

Organic matter, both above and below ground, is an important component for maintaining soil productivity. In general, the higher the total soil organic matter, the higher the site productivity. After carbon and oxygen, nitrogen is the element required in greatest quantity by trees and other kinds of vegetation, and nitrogen is known to be limiting in many forest and rangeland soils in the inland West. Accumulated litter and woody debris is potential fuel for wildfire, an important factor controlling soil conditions in forestlands and rangelands of the planning area, especially in drier environments where fire frequency is high (Harvey et al. 1994). The combined processes of biological decomposition and fire regulate nutrient availability and cycling.

Fire

Fire can substantially change surface soil characteristics and erosion rates, and can influence patterns of vegetation on the landscape. These patterns depend in large part on availability of soil organisms and relationships, such as mycorrhizae, to post-fire vegetation. Fire can have consequences on soil productivity by consuming organic matter and vegetation. Nutrients, such as nitrogen, can be evaporated by

fire, resulting in an immediate loss of soil productivity as well as limiting future inputs of nutrients. However, nutrients are also made available by fire, especially by converting large woody debris into smaller, more readily decomposed material (DeBano 1990). Forests in the inland west, including the project area, depend on a combination of biological and fire decomposition processes to regulate nutrient availability and cycling (Harvey 1994).

Fire can also affect soil productivity by creating bare soil or hydrophobic (water-repelling) conditions that alter infiltration, runoff, and erosion processes. In general, the more soil heating that occurs, the greater the potential for water repellency. The formation of hydrophobic conditions is not completely understood; it occurs in both burned and unburned soils. In Central Idaho, fires from 1992 and 1994 likely made hydrophobic soil conditions worse, especially where high soil heating occurred. Dry, coarse textured soils are most susceptible to becoming water-repellent, especially after high intensity fires.

Current Conditions

Detailed soil productivity information was not available for the interior Columbia Basin. For this reason, an expert panel and soil productivity indicators were used to estimate conditions and trends across the basin. The following information is from the Regional and Subregional Soil Productivity Assessment (part IV.B of Landscape Ecology STAR 1996) produced by the expert panel. The indicators used by the expert panel were: organic matter level, coarse woody material, nitrogen, bulk density, and susceptibility to soil loss.

General Trends

Soil productivity trends across the interior Columbia Basin are judged to be stable to decreasing. Determination of the exact status of soil condition for any given area is difficult because of the lack of inventory and monitoring data. In general, greater declines in soil quality and productivity are directly associated with greater loss of soil from erosion and displacement, loss of soil organic matter, changes in vegetation composition, removal of whole trees and branches, and increased bulk density from compaction. Areas where fire has not occurred in frequencies characteristic for the site, and which otherwise have not had organic matter and

vegetation removal, may have higher soil productivity currently. However, these areas are vulnerable to loss of organic matter, woody material, and nutrient reservoirs from risk of uncharacteristic fire.

General Soil Characteristics and Productivity, by ERU

Listed below are general soil characteristics and productivity summary for the UCRB planning area, by ERU. The characteristics are summarized from Bailey et al. (1984) and the General Soils Map of Oregon (USDA 1964). Each ERU contains a complex pattern of many soils, but in the general summary of soil productivity that follows, the productivity assessment is generalized for these large areas. Each ERU contains inclusions of soils that are more or less productive, erodible, or stable than the general ratings given for the entire area.

Columbia Plateau (ERU 5)

Soils in the Columbia Basin and Palouse area have primarily formed in thick accumulations of silt and sand (loess) deposited by ice-age winds. These are generally deep productive soils. They tend to be warm and dry, with thin, dark organic horizons (layers) over clay and carbonate-enriched lower horizons. These soils occur on rolling hills, and when exposed are susceptible to wind and water erosion.

Blue Mountains (ERU 6)

Most soils in the Blue Mountains are influenced by volcanic ash from Mount Mazama. The most productive soils have thick volcanic ash surface layers and occur at mid-elevations. On south-facing slopes, the ash has been mostly removed by erosion, and redeposited and mixed with loess and alluvium in valley bottoms and lake basins. At high elevations, soils are generally cold and moist, dark-colored, and have high organic-matter contents. Soils derived from glacial materials at high elevations have moderate to low productivity, being limited by nutrients and cold temperatures. At lower elevations, soils are generally cool and moist, with thick ash mantles and high clay contents. Soils at low elevations and on south slopes with minimal volcanic ash have moderate to low productivity. On the lowest mountain slopes and valley floors, soils are dry for parts or most of the summer.

Northern Glaciated Mountains (ERU 7)

Soil conditions range from cold and stony in the higher mountains to warm and dry within the major valleys. Farther east, away from the Cascade Range, the volcanic ash content is less and soils are generally less productive. Steep slopes covered with glacial deposits are susceptible to compaction and erosion.

Lower Clark Fork (ERU 8)

Soils in the Lower Clark Fork ERU generally have high volcanic ash contents, and moderate temperature and moisture regimes, resulting in generally high productivity. Many of these soils are deep and highly weathered, which also adds to their productivity. Soils are generally resilient but susceptible to compaction. Natural mass failure and natural surface erosion hazards are moderate to high.

Upper Clark Fork (ERU 9)

Soils in the Upper Clark Fork ERU are generally cold, shallow, and rocky, resulting in overall low productivity. An exception is the Bitterroot Valley, where soils are deep and productive. The limiting factors for productivity are shallow soils, large amounts of talus and rock outcrops, and low temperatures. Soils are generally less resilient and less susceptible to compaction. Natural mass failure hazard is moderate, while natural surface erosion hazard is moderate to high.

Owyhee Uplands and Upper Snake (ERUs 10 and 11)

Soils in the Owyhee Uplands and Upper Snake ERUs are generally warm and dry, with moisture being a limiting factor to plant growth. In wetter riparian and wetland areas, organic matter content is higher and soil productivity is greater than the uplands. Of the uplands, higher elevation areas are usually more productive. Soils are generally resilient but susceptible to compaction. Soils on the Snake River Plain are generally warm, dry, and shallow, with zones of substantial clay and carbonate accumulation. Some areas of low precipitation have saline or sodic soils.

Snake Headwaters (ERU 12)

The Snake River Headwaters ERU includes some of the highest elevations in the interior Columbia Basin, extending up to 13,766 feet. Soil productivity is generally moderate. Many soils

are cold, shallow to moderately deep, rocky, or stony. Where alpine areas occur they consist mostly of rock outcrop and talus. Glaciation has also produced many areas of shallow soils and rock outcrops. In stream and river valleys, soils are deeper, contain more organic matter, and have higher productivity. Soil moisture can be limiting in some areas. The soils are moderately resilient and have low to moderate susceptibility to compaction. Natural mass failure hazard is moderate to high. Interbedded sedimentary bedrock weathers to form slip surfaces. Slope stability problems are common and natural surface erosion hazard is moderate to high.

Central Idaho Mountains (ERU 13)

In the northern and western portion of this ERU, soil productivity is generally moderate. Areas having shallow soils with coarse textures and low organic matter are less productive. Areas having deep soils and/or volcanic ash accumulations are usually very productive, and are moderately resilient and moderately susceptible to compaction. Natural mass failure rating is high, while natural surface erosion hazard is moderate.

In the south central part of this ERU, soil productivity is generally moderate to low. This area includes some of the higher elevations in the interior Columbia Basin, extending up to 12,000 feet. Many soils are cold, shallow to moderately deep, rocky, and stony. Where alpine areas occur, they consist mostly of rock outcrop and talus. Glaciation has also produced many areas of shallow soils and rock outcrop. Some areas receive as little as seven inches of precipitation annually, so soil moisture is limiting in these areas. The soils have low to moderate resiliency and are moderate to highly susceptible to compaction. Natural mass failure hazard is moderate to high. Mass failures and rock falls are common at higher elevations. Natural surface erosion hazard is moderate to high.

In the eastern portion of this ERU, soil productivity is generally low. Some valley areas with deeper soils have moderate to high productivity. These soils generally have low resiliency and are moderately susceptible to compaction. Natural mass failure hazard is low, while natural surface erosion hazard is moderate to high.

Climate

The varied topography and geographic position, relative to global ocean and atmospheric circulation patterns, result in very different climates throughout the ICBEMP project area. The climate, in turn, strongly influences ecological processes such as biological productivity, fire regime, soils, streamflow, erosion, and human uses of the land and resources.

Precipitation and Temperature

Most precipitation in the project area falls in the winter when eastward moving storms enter the area. Typically, more than 80 percent of the annual precipitation falls from October to May. Expansion of the North Pacific high pressure system in the early summer effectively blocks the flow of moisture into the Pacific Northwest, resulting in generally stable, warm, and dry summers. The Cascade Range separates eastern Oregon and Washington from the maritime climate west of it, leaving the interior Columbia River Basin with a continental climate of cold winters and warm, dry summers. Map 2-1 shows the annual precipitation patterns for the project area.

Average annual precipitation values range from more than 100 inches per year at the crest of the Cascade Range to less than 8 inches per year in the low-elevation basins and plains. Substantial portions of the planning area, especially rangelands, receive less than 12 inches of precipitation per year. In these areas, recovery of vegetation and soil from human and natural disturbance takes place much more slowly than in areas with greater rainfall. The greatest amount of precipitation is in the mountain ranges, notably the Blue Mountains, the central Idaho Mountains, and the Northern Rocky Mountains across the northern part of the project area. Most precipitation falls during winter and accumulates as snow, with mean annual snowfall of 100 to 200 inches along the crest of the Cascade Range and in the Blue Mountains. Spring, summer, and fall storms provide growing season rainfall in the mountains, especially in the eastern part of the project area.

The project area experiences a wide range of temperature variation. High mountainous areas have cold winters and short, cool summers with growing seasons that are locally less than 30 days in the highest alpine areas. Intermontane valleys and plateaus have cool to cold winters and hot

summers, resulting in growing seasons that exceed 150 to 200 days in parts of the Columbia Plateau (ERU 5).

Drought

Drought is an important process that affects ecosystems. Drought is defined as an absence of usual precipitation (less than 75 percent of normal), for a long enough period that there is decreased soil moisture and stream flow, thereby affecting ecological processes and human activities. All regions experience temporary, irregularly recurring drought conditions, but dry climates are generally affected most (Barry and Chorley 1982). Year-to-year climate variability generally increases with aridity. In areas with average annual precipitation of less than 12 inches, drought years occur 20 to 40 percent of the time (Landscape Ecology STAR 1996).

Drought affects fire and rangeland management. Dry years, such as 1988 and 1994, commonly result in widespread wildfire in forested environments, especially if there have been several preceding dry years. Drought reduces forage production on rangelands, which can lead to degradation of upland and riparian areas if livestock grazing is not properly managed (Vallentine 1990). Drought can also increase the susceptibility of forestlands to insect infestation. The regional drought of 1920 to 1940 in the Pacific Northwest created substantial insect infestation problems, particularly for pine species (Agee 1993).

Climate Change

Climate change is also an important process affecting ecosystems. Climate change has been prevalent throughout history in the project area, resulting in continuing adjustments by aquatic and terrestrial ecosystems. Changes in temperature and precipitation have direct effects, such as effects on the efficiency of photosynthesis and length of growing season; they also have important indirect effects, such as alterations in fire and flood frequency. Past climate change in the project area has ranged from global-scale changes (such as the transition between glacial and interglacial periods approximately 10,000 years ago, which resulted in about a ten degree Fahrenheit increase in mean annual temperature) to smaller yet still important changes, (such as the period of generally cooler temperatures that began approximately 4,000 years ago and

culminated in the Little Ice Age of the 1700s and early 1800s). Over the past several decades in the Pacific Northwest and globally, there has been significant warming (one to three degrees Fahrenheit) that some scientists have attributed to increased carbon dioxide emissions and the “greenhouse effect.”

Vegetation is especially sensitive to climate change. Upper and lower forest boundaries in the project area have moved up and down in elevation by hundreds of feet during the past several centuries in response to temperature changes of one to three degrees Fahrenheit (Mehring 1995; Neitzel et al. 1991). In general, plants on the fringes of their distributions respond most sensitively and rapidly to climate change. Within the project area, such changes are expected to continue to greatly influence the area and extent of vegetation types, especially changes in elevation of the overlapping conifer and steppe communities (Mehring 1995). Vegetation responds to climate change in different directions and at different rates, reassembling in new and sometimes unpredictable associations that are constantly changing (Graham and Grimm 1990).

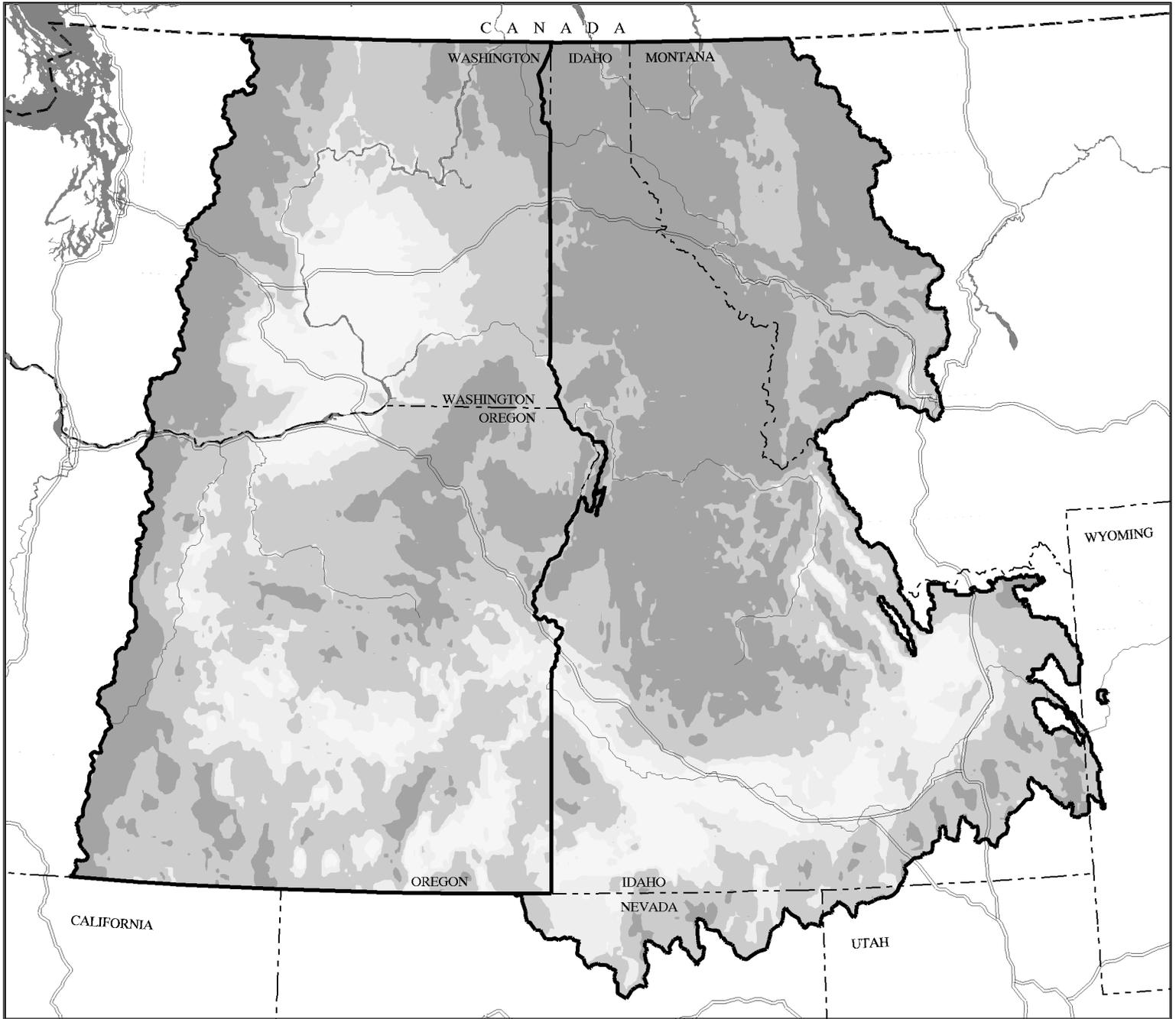
Air Quality

Summary of Conditions and Trends

- ◆ The current condition of air quality in the project area is considered good, relative to other areas of the country.
 - ◆ Wildfires significantly affect the air resource. Current wildfires produce higher levels of smoke emissions than historically, because fuel available to be consumed by wildfire has increased.
 - ◆ Within the project area, the current trend in prescribed fire use is expected to result in an increase of smoke emissions.
-

Historical Conditions

Air quality in the project area was not pristine before it was settled by Europeans in the 1800s, particularly with regard to smoke. Layers of charcoal found in the Sheep Mountain bog near

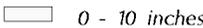
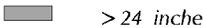


Map 2-1.
Annual Precipitation



INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

- | | | | |
|--|----------------|---|-----------------|
|  | 0 - 10 inches |  | Major Rivers |
|  | 10 - 12 inches |  | Major Roads |
|  | 12 - 24 inches |  | EIS Area Border |
|  | > 24 inches | | |

Missoula, Montana and the Williams Lake Fen north of Cheney, Washington provide evidence of wildland fire at varying intervals from 10,000 years ago to the present (Johnson et al. 1994). Fires from as long as 4,000 years ago are evident from charcoal found at Blue Lake, near Lewiston, Idaho. Several sites show significantly increased levels of charcoal starting about 1,000 years before present, attributed to burning by American Indians.

Many historical accounts refer to the presence of smoke and burned areas in the interior Columbia Basin, the Harney Basin, near the mouth of the Umatilla River, on the western slope of the Blue Mountains, and along the section of the Oregon Trail from the juncture of the Boise and Snake Rivers to the Columbia River (Robbins and Wolf 1994). Some accounts merely noted the presence of burned areas, while others attributed fire to burning by American Indians (ibid.). Levels of smoke declined as fire was excluded from forests, particularly after the advent of organized fire suppression in the 1930s. Brown and Bradshaw (1994) concluded that levels of smoke in the Bitterroot Valley, Montana were 1.3 times greater prior to settlement in the 1800s than they have been recently. Agee (1993) documents that fire has played a role as a disturbance agent in the development of Pacific Northwest ecosystems.

Current Conditions

Elements related to the Clean Air Act

The Clean Air Act, passed in 1963 by the Congress and amended several times, is the primary legal instrument for air resource management. The Clean Air Act requires the Environmental Protection Agency (EPA) to, among other things, identify and publish a list of common air pollutants that could endanger public health or welfare. These commonly encountered pollutants, referred to as “criteria pollutants,” are listed by the EPA along with the results of studies documenting the health effects of various concentrations of each pollutant. For each criteria pollutant, the EPA has designated a concentration level above which the pollutant would endanger public health or welfare. These levels are called the National Ambient Air Quality Standards (NAAQSs).

To date, NAAQSs have been established for six criteria pollutants: sulfur dioxide (SO₂), particulate matter (PM₁₀), carbon monoxide (CO), ozone (O₃), nitrogen oxides (NO_x), and lead (Pb).

There are exceptions, but generally these standards are not to be violated anywhere the public has free access within the United States. If NAAQSs are violated in an area, the area is designated as a “non-attainment area,” and the State is required to develop an implementation plan to bring it back into compliance with these standards. To help protect air quality, the Clean Air Act (Section 118) requires Federal agencies to comply with all Federal, State, and local air pollution requirements.

Pollutants such as oxides of nitrogen and sulfur are of concern to Federal land managers because of their potential to cause adverse effects on plant life, water quality, and visibility. However, the sources of these pollutants are generally associated with urbanization and industrialization rather than with natural resource management activities. Therefore, these pollutants will not be considered further in this EIS. On the other hand, particulates, carbon monoxide, and ozone are criteria pollutants that can be created by fire; these pollutants are discussed below. The pollutant of greatest concern for management activities in the UCRB planning area is particulate matter (PM).

Three elements of the Clean Air Act generally apply to management activities that produce emissions in the UCRB planning area: (1) Protection of National Ambient Air Quality Standards (NAAQSs) (Section 109); (2) Conformity with State Implementation Plans (Section 176(c)); and (3) Protection of Visibility in Class I Areas (Section 169A).

Protection of National Ambient Air Quality Standards (NAAQSs).

Particulate matter can be produced by land management activities or natural events on federally-administered lands, including wildfire, prescribed burning, road or wind blown dust, volcanic eruptions, and vehicle use. However, most particulate matter of concern is produced from fire, and most of this is less than 10 micrometers (PM₁₀) in diameter, which is the size class that is regulated.

Because fire and smoke are a natural part of forestland and rangeland ecosystems, PM₁₀ produced from fire does not seriously affect these ecosystems. However, they do have effects on human health. PM₁₀ particles can be drawn deep into the aveolar region of the lungs, the part of the respiratory

system most sensitive to chemical injury (Morgan 1989 in Sandberg and Dost 1990). Wood smoke also contains carcinogenic compounds.

Ozone is a photochemical pollutant formed on warm sunny days from nitrogen dioxide and hydrocarbon emissions. The chemistry of ozone formation is poorly understood; however, it is known that ozone is present in the plume downwind of large fires. It is also known, but difficult to quantify, that organic emissions from vegetation capture ozone~ so forested areas are both sources and sinks of ozone. Although ozone is produced as a byproduct of wildland fire, because of fire frequency and plume elevation it is generally not a significant problem for human health or vegetation resources. It is also significant to note that fire is a natural event within forestland and rangeland areas. Therefore, to some extent, ozone produced by fire is also a natural event, and these ecosystems have some natural adaptation to its effects.

Carbon monoxide is generated mainly by incomplete combustion of carbon. There have been few, if any, measured effects to the ecosystem from carbon monoxide. It is generated during wildland burning but is rapidly diluted at short distances from a fire and, therefore, poses little or no risk to community health (Sandberg and Dost 1990). However, carbon monoxide can be a health concern for firefighters on the fireline depending on concentration, duration, and level of activity. (USDA Forest Service and John Hopkins University 1989).

Many *other* non-criteria, but potentially toxic, pollutants are emitted by wildland fire, including polynuclear aromatic hydrocarbons (sometimes referred to as PAHs) and aldehydes. Effects on human health vary by levels of exposure to these pollutants emitted during combustion. Some polynuclear aromatic hydrocarbons are known to be potential carcinogens; other components, such as aldehydes, are acute irritants. Many of these air toxics dissipate or bind with other chemicals soon after release, making it difficult to estimate human exposure and consequential health effects. Additionally, the health and welfare effects of air toxics released by prescribed burning or wildfires have not been directly studied.

Conformity with State Implementation Plans

The Clean Air Act requires each State to develop, adopt, and implement a State Implementation Plan

to ensure that the NAAQSs are attained and maintained for the criteria pollutants. These plans must contain schedules for developing and implementing air quality programs and regulations. State Implementation Plans also contain additional regulations for areas that have violated one or more of the NAAQSs (non-attainment areas).

The general conformity provisions of the Clean Air Act (Section 176(c)), prohibit Federal agencies from taking any action *within a non-attainment area* that causes or contributes to a new violation of the NAAQSs, increases the frequency or severity of an existing violation, or delays the timely attainment of a standard. Federal agencies are required to ensure that their actions conform to applicable State Implementation Plans. The Environmental Protection Agency (EPA) developed and finalized criteria and procedures for demonstrating and ensuring conformity of Federal actions to State Implementation Plans. However, as written, they apply only to Federal actions that occur within non-attainment areas.

As of the printing of this EIS, none of the National Forests or BLM Districts in the UCRB planning area lie within non-attainment areas. Therefore, requirements of the conformity regulations do not apply to management actions proposed in this EIS. However, Federal actions must still comply with State Implementation Plans.

Protection of Visibility in Class I Areas

Congress, in the Clean Air Act, declared as a national goal "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution". Class I areas in the project area are Wildernesses 5,000 acres in size or National Parks 6,000 acres in size which were in existence prior to 1977. Map 2-2 shows the Federal Class I areas in the project area.

Class I areas are subject to the most limiting restrictions regarding how much additional pollution can be added to the air. Fine particulate matter, generally less than 2.5 microns in diameter (PM 2.5), is the primary cause of visibility impairment. Emissions from prescribed burning, which stay suspended for many miles, are in the 0.1 to 2.5 micron size class and generally reduce visibility.

Results of a 1990 National Park Service study of visibility in National Parks and Wildernesses in the Washington Cascade Range (Malm et al. 1994) indicated that organics (vegetation burning activity)

contributed approximately 17 percent of the impairment, with 53 percent from sulfates, 9 percent from nitrates, and 20 percent from soil and other causes. These parks are on the western edge of the project area, but information on particle composition and source regions is relevant to the project area because these fine particles are transported over long distances. It is logical to expect that emissions from land management activities would account for a larger proportion of particulates in the UCRB planning area because of lower industrial and urban emissions compared to the Puget Sound emissions that affected the Park Service study area.

Managing Emissions From Prescribed Fire

Under the Clean Air Act, State and local governments have the authority to adopt their own air quality rules and regulations. These rules are incorporated into their State Implementation Plans if they are equal to, or more protective than, Federal requirements. For example, some States have incorporated smoke management provisions for prescribed burning into their State Implementation Plans. As stated earlier, to help protect air quality, the Clean Air Act requires Federal agencies to comply with all Federal, State, and local air pollution requirements, which include State-enacted visibility protection and smoke management programs. Montana has officially adopted smoke management programs into its State Implementation Plans. In Utah and parts of Idaho, memoranda of understanding have been signed by the States and Federal land managers that establish parameters for managing emissions from prescribed burning.

Tracking Emissions

An emissions information system is used in Oregon, Washington, Montana, and northern Idaho to quantify prescribed fire emissions and to track changes in emission productions within their jurisdictions. Federal land managers have an obligation to complete smoke management reports and apply appropriate mitigation measures to reduce potential impacts on air quality (EPA 1992). Managers use, although they are not limited to, available computer software to estimate fuel consumption, emissions, and smoke dispersion from prescribed burns.

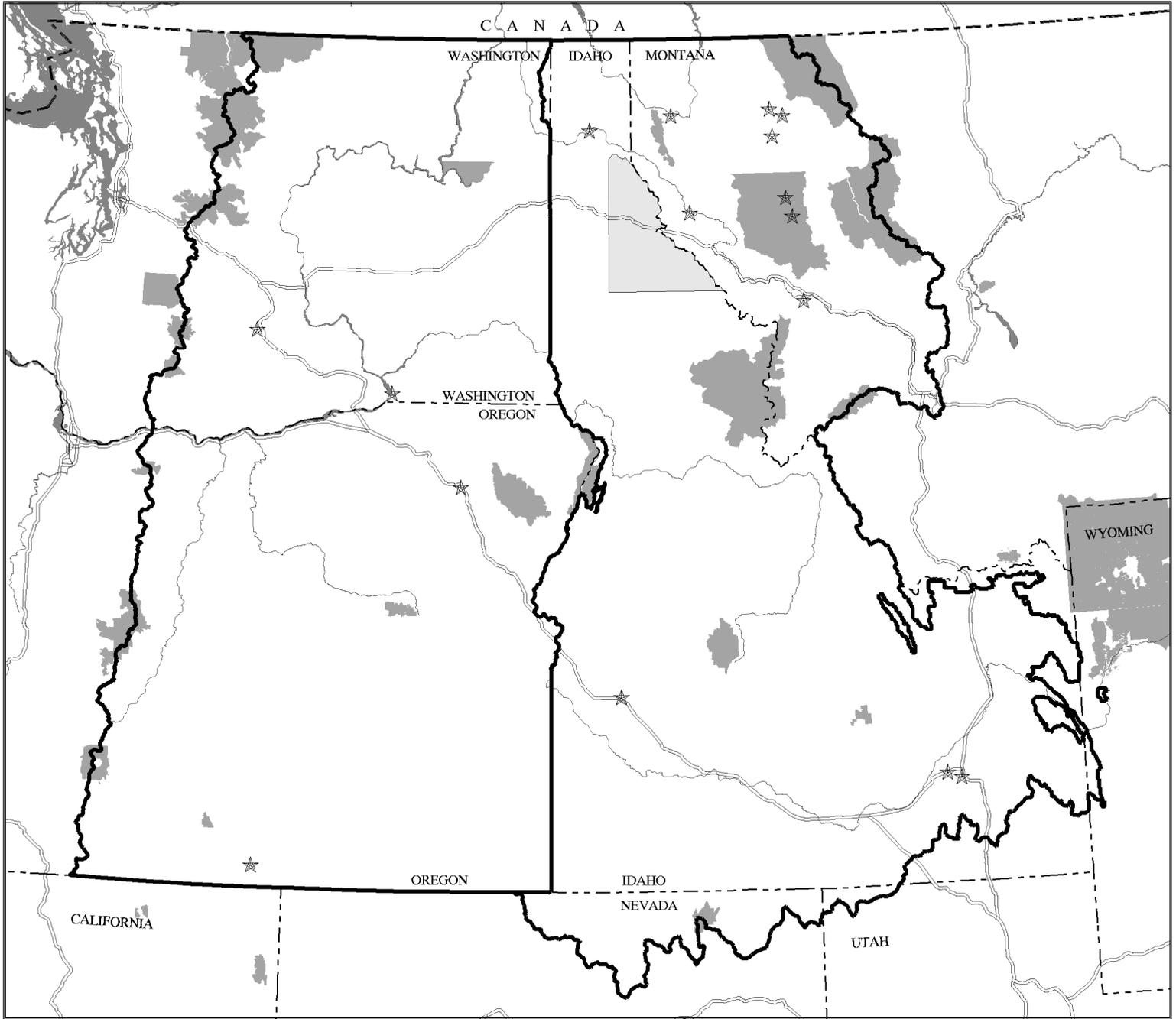
Monitoring Air Quality

Several different monitoring networks currently measure air quality in the planning area. The most extensive of these are the State and Local Air Monitoring Stations/National Air Monitoring Stations. Operated by the States, this monitoring network is used to determine whether the National Ambient Air Quality Standards are met. Monitors in this network are concentrated in population centers.

Federal agencies are also operating monitors at five sites within or near the UCRB planning area. These monitoring sites measure particulates and changes in visibility, using filters that can be analyzed to determine the relative contribution of different sources of particulate matter. In addition to monitoring pollutant concentrations, State and Federal agencies collect, and archive, the following type of data about prescribed fires: location, acres burned, moisture content of fuels, tons to be consumed, and emissions to be released.

Air Quality Tradeoffs Between Prescribed Fire and Wildfire Emissions

Wildfires currently have a significant impact on the air resource, degrading ambient air quality and impairing visibility. The wildfire regime is significantly different than it was historically, because of increased fuel loading, development of ladder fuels, and increases in stand density. Only about 10 percent of acres burn with nonlethal underburns, compared to about 31 percent historically. Fifty-eight percent of the forest in the UCRB now burns with a lethal (stand-replacing) fire regime, compared to 19 percent historically. Stand-replacing fires consume much more fuel and produce much more smoke than nonlethal fires, which usually burn with fairly low surface fire intensities in the understory. Brown and Bradshaw (1994) found that emissions were greater from current fires, even though they burned fewer acres in total than historically, because consumption of fuel per unit area burned has been greater in the current period. Figure 2-3 illustrates fire regime patterns. Table 2-1 compares historical and current fire regimes.



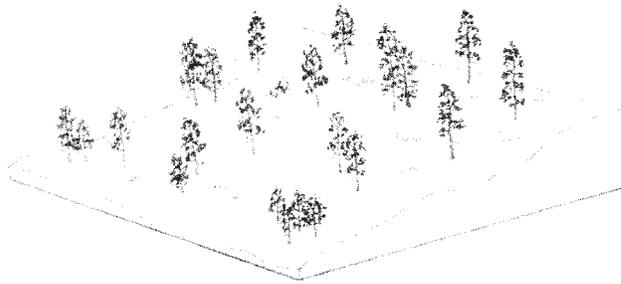
Map 2-2.
Air Quality
Class I Airsheds and
PM10 Non-attainment Areas

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996

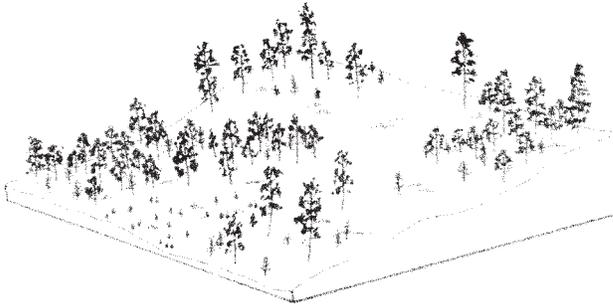


- Class One Airsheds
- PM10 Non-Attainment Areas (Counties)
- PM10 Non-Attainment Areas (Municipalities)
- Major Rivers
- Major Roads
- EIS Area Border



A. Non lethal Fire Regime

Open stand pattern.
Frequent low-severity fires.



B. Mixed Fire Regime

Patches of clumps/gaps.
Generally a greater time span between fires than the non-lethal fire regime.



C. Lethal Fire Regime

Large patches of stand-removing fire. Generally a longer time span between fires than the non lethal fire regime.

Figure 2-3. Fire Regimes/Patterns ~ Three general fire regimes create definite landscape vegetation patterns.

Table 2-1. Comparison of Historical and Current Fire Regimes in Forested Areas, in Percent of Area with Each Regime Type, for FS-BLM Lands, UCRB Planning Area

Fire Regime Type	Historical %	Current %
Nonlethal	30.9	10.5
Mixed Severity	50.1	31.3
Lethal, Stand-replacing	19.0	58.2

Source: ICBEMP GIS Data (1KM² raster data)

Prescribed fires are used to reduce the amount of carrier fuels and ladder fuels, and thus reduce the potential for lethal, stand-replacing fire. They are ignited under fuel moisture conditions that reduce total fuel consumption (see table 2-2). Prescribed fires are implemented when mixing height and winds are most favorable for smoke dispersal of emissions away from populated areas; they are not conducted during inversions. Inversions during the summer are a major cause of the worst ambient air conditions associated with wildfires in the project area.

While increased levels of prescribed fire can have temporary negative impacts on air quality, acute impacts to air quality from wildfires can be reduced in the long term (Schaaf 1996). Over the past ten years, State air regulators and scientists have measured concentrations of PM₁₀ in the long term that came from wildfires, in urban areas well over the NAAQSs, finding that these episodes commonly last several days. For example, the 1994 wildfires around Wenatchee, Washington, produced 24-hour concentrations of PM₁₀ that were more than double the Federal health standard, and conditions persisted for days. Impacts to populated areas from prescribed fire emissions can be more frequent, but the level of impact is well below established health standards for PM₁₀ (Scire and Tino 1996).

Photo 1

NOT AVAILABLE IN PDF

Photo 1. Smoke emissions from fires can stay suspended in the air for many miles, potentially affecting air quality. Photo by Karen Wattenmaker.

Table 2-2. Smoke Emissions Produced by Wildfires and Prescribed Fires.

Potential Vegetation	Fuel Loading	Smoke Emissions PM ₁₀		
		Wildfires Dry Fuels	Prescribed Fires Moist Fuels	Prescribed Fires Average Fuels
Cold Forest	29.5	514.4	303.2	385.2
Cool Shrub	6.5	118.7	74.6	84.6
Dry Forest	27	464.4	267.4	345
Dry Grass	2.9	62.4	27.6	34.2
Dry Shrub	6.4	136.9	86.8	97.2
Moist Forest	34.8	607.0	358.8	452.5
Woodland	9.6	175.4	120.7	139.6

Source: Ottmar et al. 1996

Terrestrial Ecosystems

Key Terms Used in This Section (Introduction)

Habitat ~ A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

Noxious weed ~ A plant species designated by Federal or State law as generally possessing one or more of the following characteristics: aggressive and difficult to manage; parasitic; a carrier or host of serious insects or disease; or non-native, new, or not common to the United States. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has other adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

Potential Vegetation Group (PVG) ~ In this EIS, made up of potential vegetation types, grouped on the basis of similar general moisture or temperature environment.

Potential Vegetation Type (PVT) ~ In this EIS, all the species that might grow on a specific site in the absence of disturbance; can also refer to vegetation that would grow on a site in the presence of frequent disturbance that is an integral part of the ecosystem and its evolution.

Terrestrial ~ Pertaining to the land.

Viable population ~ A population that is regarded as having the estimated numbers and distribution of reproductive individuals to ensure that its continued existence is well distributed in the project area.

Introduction to Terrestrial Ecosystems

This section provides descriptions of terrestrial ecosystems found on landscapes in the project area, separated into Forestlands and Rangelands. (Riparian areas, which also have a terrestrial component, are discussed in more detail in the Aquatic Ecosystems section of this chapter.) Discussions of plant and animal species that inhabit forestlands and rangelands are provided to help complete the picture of what makes up terrestrial ecosystems. Broad-scale or landscape level descriptions of vascular plants, non-vascular plants (bryophytes), fungi, and lichens in the project area are also included. Changes on the landscape in vegetation and habitat, with explanations of how these changes affect management decisions today, are discussed to set the stage for the alternatives described in Chapter 3. Unless otherwise noted, material for this section was derived from the Scientific Assessment Landscape Ecology Staff Area Report (1996) and Terrestrial Staff Area Report (1996).

Overview of Project Area Forestlands and Rangelands

Forestlands and rangelands in the ICBEMP project area are highly diverse, ranging from moist areas near the crest of the Cascades to the Continental Divide in the Rocky Mountains. The basin contains mountain landscapes that commonly have elevations over 9,800 feet. Within these ranges, the valley bottoms can be low and the topography steep. These mountains and valleys are underlined by a variety of rock formations, and most have been altered by mountain and continental glaciation.

The varying soils and climates of forestlands and rangelands support a diversity of plant species, from those that require moist sites ~ such as western hemlock, western redcedar, and huckleberries ~ to dry-land species such as sagebrush and bluebunch wheatgrass. In the mountains of the basin, tree species range from mountain hemlock and subalpine fir at the higher elevations, to ponderosa pine in the valley bottoms. Mixed conifer forests dominated by white fir, grand fir, or Douglas-fir occupy many of the mid-elevation forests. Lodgepole pine forests are also found throughout much of the project area.

Huckleberries, buck brush, alder, and sagebrush are some of the shrubs found in the forests of the project area. Juniper, sagebrush, bitterbrush, and associated bunchgrasses occupy many low-elevation drier sites. Included in these mosaics of vegetation are productive riparian areas supporting willow, sedges and other similar species. In addition, plant species important to American Indians for food or spiritual uses are found in many locations throughout the project area, including forestlands, rangelands, and associated riparian areas. Plants used as food, for example, include camas, bitterroot, chokecherry, onion, cattail, and elderberry.

In addition to mountain landscapes, there are vast plains, prairies, deserts and rolling hills. Their landscapes vary depending on soils and climate, but often they are highly productive. In the absence of cultivation, sagebrush and grasses dominated the prairies and plains. Native Palouse prairie vegetation today is scarce in northern Idaho, where exotic plants now dominates large areas.

Because of the wide variety of plant species and landscape forms distributed throughout the project area, habitat for a wide variety of wildlife is found in the mountains, valleys, and rangelands of the basin. More than 13,000 terrestrial plant and animal species were considered in the Terrestrial Staff Area Report (1996), of which 547 are vertebrates. In the UCRB planning area, some 109 mammals, 283 birds, 23 reptiles, 15 amphibians, and approximately 715 invertebrates were assessed. Grizzly bears, black bears, and mountain lions, are some of the more notable wildlife species. Highly prized game species include Rocky Mountain elk, mule deer, and white tail deer. The bald eagle and northern goshawk are important raptors that prey on squirrels, chipmunks, woodpeckers, and a host of other species. Prominent rangeland wildlife species are pronghorn antelope, bighorn sheep, jack rabbits, sage grouse, numerous reptiles. Wildlife species of the project area listed by the Federal government under the Endangered Species Act include the threatened bald eagle and grizzly bear and the endangered peregrine falcon, woodland caribou, and gray wolf. The spotted frog is an example of a candidate species.

Change on the Landscape

Change has always been a part of forestlands, rangelands, and riparian areas. This section provides descriptions of changes in the recent past and present conditions on the landscape. As observed by Mehringer (1995), “change is continual

and change is unpredictable.” Species have distributed and redistributed themselves across the landscape in response to influences from various disturbances. The ebb and flow of glacial activity, repeated large-scale catastrophic floods, volcanic activity, and large-scale fires, along with smaller-scale disturbances such as drought and smaller fires, have created the ever-changing vegetative composition and structure within the project area. The geologic history that influences these interactions is described in the Physical Setting section of this chapter and in more detail in the Landscape Ecology Staff Area Report.

Just as climate cycles currently affect what types of vegetation will grow well in a particular area, vegetation also responded in the past to small- and large-scale climatic fluctuations. Fossil records show that forestlands and rangelands advanced and retreated across the ICBEMP project area in response to the advance and retreat of glaciers. The boundary between forestlands and rangelands has shown the most significant movement in recent geologic history, changing in elevation as climates changed (Mehringer 1995).

Volcanic activity, some at a much larger scale than the 1980 eruption of Mt. St. Helens in the State of Washington, removed or buried vegetation under layers of ash. In areas where vegetation was completely removed by lava or covered by ash, forestlands and rangelands slowly recolonized the bare soil. As the present day landscape was being molded, changes occurred over and over, at various degrees and in different places. As vegetation patterns changed and adjusted to the different environment, the landscape gained a new look; different plant and animal relationships developed. The numbers of animal species that could be supported by the landscape changed; through time, some species gained habitat, while others lost habitat.

Change continues today. Changes to the existing landscape also result from people’s interaction with their environment. From burning fields to enhance the production of food resources, to the logging of forests to produce timber products, people have had an effect on vegetation, animals, and on people themselves.

How Vegetation was Classified

The existing vegetation within an area can be generally classified as being composed primarily of grass, forb, shrub, or tree species. Because the

vegetative cover present at any one time can vary based on past disturbances, the term *potential vegetation type* (PVT) is used to represent all of the species that might grow on a specific site in the absence of disturbance. Potential vegetation type can also refer to vegetation that would grow on a site in the presence of frequent disturbance that is

producing this mix of species, the site might instead be occupied by grasses and shrubs, ponderosa pine, and other species unique to this type.

For this project, potential vegetation types were grouped into 15 *potential vegetation groups* (PVGs). These groupings were based on similar general moisture or temperature environments, and potential vegetation types. The 15 potential vegetation groups, along with the potential vegetation types that makes up each group, are listed in table 2-3.

In this section, vegetation and habitats in terrestrial ecosystems are discussed by potential vegetation group. Dry forest, moist forest, and cold forest potential vegetation groups are described in the Forestlands section of this chapter, while dry grass, dry shrub, cool shrub potential vegetation groups are discussed in the Rangelands section. Riparian shrub and riparian woodland potential vegetation groups are addressed in the Riparian Areas section under Aquatic Ecosystems.

Agricultural, urban, water, alpine, woodland, and rock potential vegetation groups are not discussed in detail in this EIS because they are less related to, or

form extremely small components of BLM- or Forest Service administered lands in the UCRB, or are not used as major vegetation divisions for discussions in chapters 2-4.

an integral part of the ecosystem and its evolution. For example, the potential vegetation type that is called "Dry Douglas-fir with Ponderosa Pine" consists of Douglas-fir, ponderosa pine, and fescue bunch grass, which grows on these sites when disturbance is not present. If disturbance keeps the site from

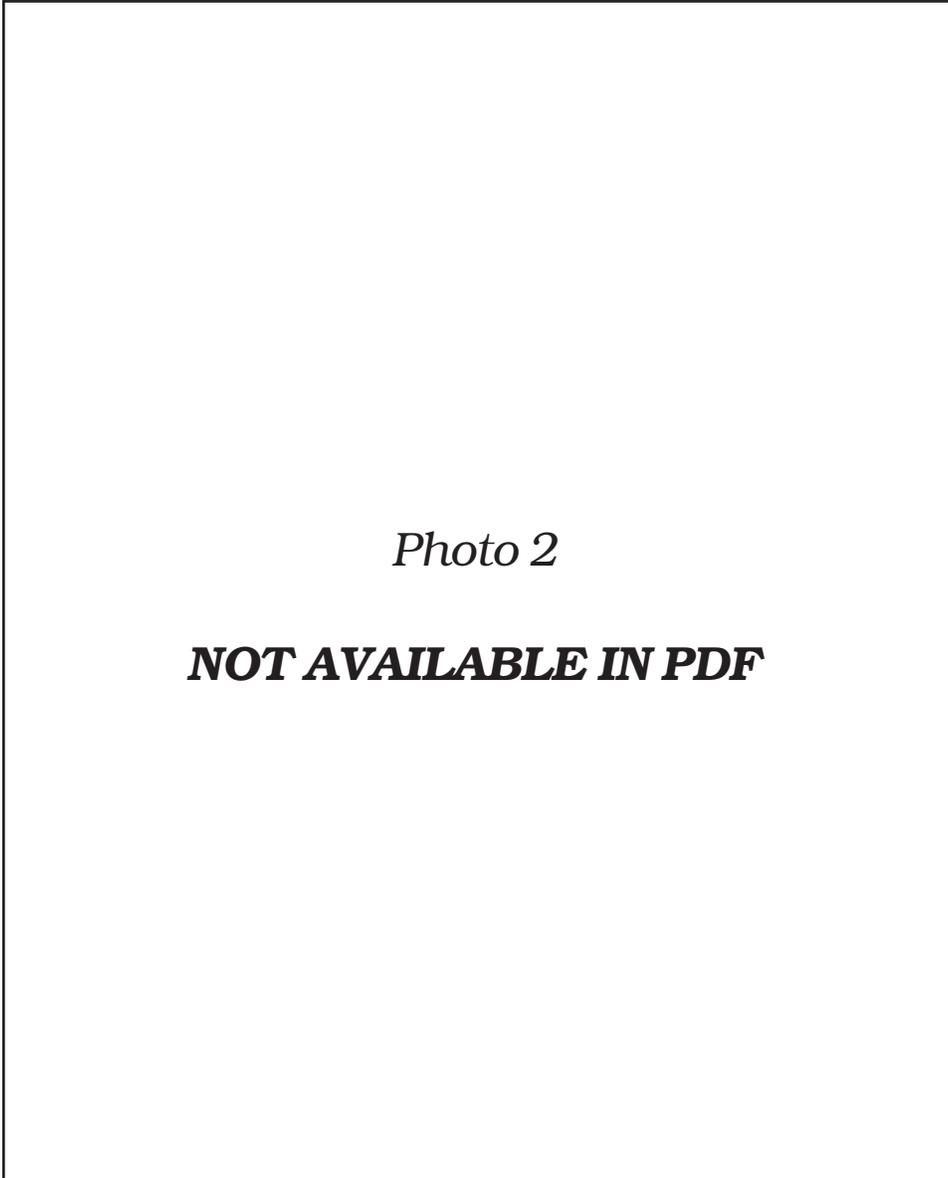


Photo 2. Project area mountains, forests, and streams support diverse plant and animal populations and offer unparalleled recreational, cultural, and economic opportunities to people. Photo by Doug Basford

Table 2-3. Potential Vegetation Types and Potential Vegetation Groups in the UCRB Planning Area

Potential Vegetation Group (PVG)	Potential Vegetation Types (PVTs)	Section in Which PVG is Discussed
Dry Forest	Dry Douglas-fir without ponderosa pine Dry Douglas-fir with ponderosa pine Dry grand fir/white fir Interior ponderosa pine	Forest
Moist Forest	Cedar/hemlock-Inland Moist Douglas-fir Grand fir/white fir-Inland Spruce-fir, wet	Forest
Cold Forest	Mountain hemlock-Inland Spruce-fir, dry with aspen Spruce-fir, dry without aspen Spruce-fir, (white bark pine greater than lodgepole pine) Spruce-fir, (lodgepole pine greater than white bark pine) White bark pine/alpine larch-North White bark pine/alpine larch-South	Forest
Dry Grass	Agropyron steppe Fescue grassland Fescue grassland with conifer	Forest
Dry Shrub	Antelope bitterbrush Basin big sage steppe Low sage-Mesic Low sage-Mesic with juniper Low sage-Xeric Low sage-Xeric with juniper Big sage-Warm Big sage-Cool Salt desert shrub Threetip sage	Rangeland
Cool Shrub	Mountain big sage-Mesic east Mountain big sage-Mesic east with conifer Mountain big sage-Mesic west Mountain big sage-Mesic west with juniper Mountain shrub	Rangeland
Riparian Shrub	Salix/carex Saltbrush riparian Mountain riparian low shrub	Riparian (Aquatics)
Riparian Herb	Riparian graminoid Riparian sedge	Combined with Riparian Shrub
Riparian/ Woodland	Cottonwood riverine Aspen	Riparian (Aquatics)
Woodland	Juniper Limber pine White oak Mountain mahogany Mountain mahogany with mountain big sage	Not addressed

Table 2-3. Potential Vegetation Types and Potential Vegetation Groups in the UCRB Planning Area (continued).

Potential Vegetation Group (PVG)	Potential Vegetation Types (PVTs)	Section in Which PVG is Discussed
Alpine	Alpine shrub-herbaceous	Not addressed
Agriculture	Irrigated crop land Dry crop/pastureland	Not addressed
Urban	Urban	Not addressed
Rock	Barren of vegetation	Not addressed
Water	Water	Not addressed

Source: Quigley and Arbelbide 1996.

Table 2-4 displays the current distribution and amount of major potential vegetation groups in the UCRB planning area. Maps 2-3 and 2-4 present the current distribution of PVGs in the UCRB planning area.

Terrestrial Species: Overview

How Wildlife are Described

Two ways to describe wildlife species were used in this project: “Key Ecological Functions” and

“Key Environmental Correlates”. Key Ecological Functions are a wide range of roles that species play in the ecosystem, such as predation, herbivory, nutrient cycling, and biomass contributions. Key Environmental Correlates are environmental factors that are either associated with or required by a given species, such as forest canopies, downed wood, snags, or piles of bark. Both Key Ecological Functions and Key Environmental Correlates are used to discuss species habitats and terrestrial species in this chapter.

Some important *Key Ecological Functions* are the following:

- ◆ major biomass accumulations in an ecosystem,
- ◆ herbivory,
- ◆ nutrient cycling,

- ◆ interspecies relations (species that depend on each other),
- ◆ soils relations (species that interact with the soil, such as moles and voles),
- ◆ wood relations (decomposers), and
- ◆ water relations (amphibians and reptiles).

Important *Key Environmental Correlates* include the following:

- ◆ forest canopy,
- ◆ mistletoe brooms,
- ◆ dead parts of live trees,
- ◆ exfoliating bark,
- ◆ snags,
- ◆ downed wood,
- ◆ bark piles at the base of trees,
- ◆ litter and duff,
- ◆ fire processes and insects outbreaks, and
- ◆ recreation activity, roads, and trails (Terrestrial STAR 1996).

Changes in vegetation composition, distribution and structure, climate, water availability and quality, soil characteristics, and human disturbance may all affect the habitats of terrestrial species. The degree to which any species is affected depends on the magnitude of the changes, the ability of the species to move to other blocks of

Table 2-4. FS/BLM Area, in thousands of acres, by PVG within each ERU, within the UCRB.

ERU	Dry Forest	Moist Forest	Cold Forest	Dry Grass	Dry Shrub	Cool Shrub	TOTAL
5	29	159	1	15			204
6	39	82	24	39	2	77	263
7	342	4,084	725	1			5,152
8	387	3,735	169				4,291
9	509	658	1,570	46		18	2,801
10	113	23	10	187	5,262	3,068	8,663
11	22	4	23	57	2,837	279	3,222
12	180		237	27	75	8	527
13	4,242	2,987	4,913	1,123	1,046	1,346	15,657
TOTAL	5,863	11,732	7,672	1,495	9,222	4,796	40,780

ERU Legend: 5-Columbia Plateau 6-Blue Mountains 7-Northern Glaciated Mountains
 8-Lower Clark Fork 9-Upper Clark Fork 10-Owyhee Uplands
 11-Upper Snake 12-Snake Headwaters 13-Central Idaho Mountains

Source: ICBEMP GIS Data (1KM² raster data)

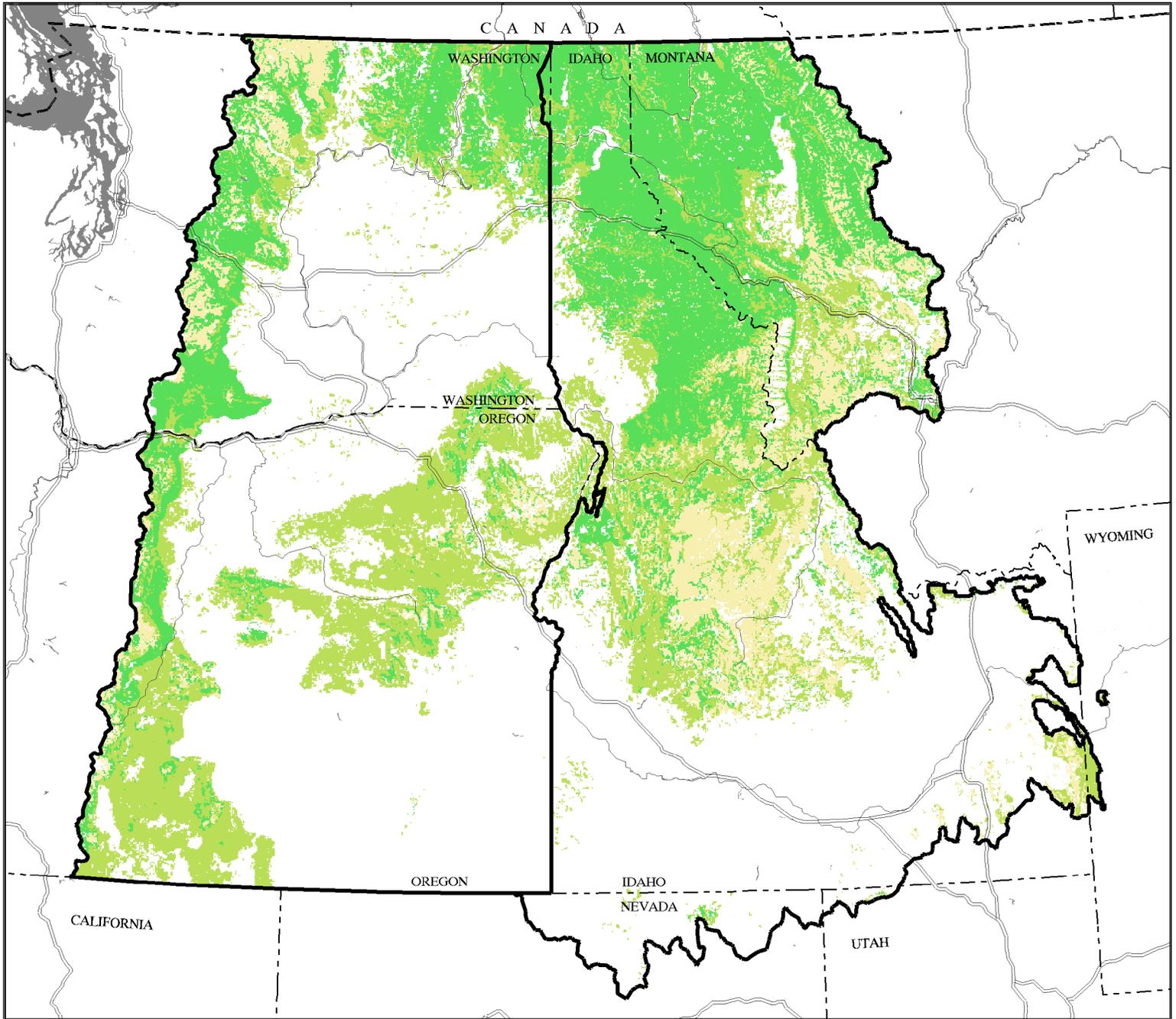
the same habitat or other habitats types, the distribution and interconnections of populations of species, the sensitivity of these species or its habitat to human activity, and many other factors that are not always well understood. Populations can increase or decrease because of habitat changes that affect their distribution, density, access to habitat, or a combination of all three. Thus, what may be harmful to one species may benefit or have no affect on another, or may affect the ways that terrestrial species interact with and affect each other (Terrestrial STAR 1996).

Terrestrial habitat trends are not meant to be interpreted necessarily as population size trends for individual species. In part this is because abundance of animals can be affected by factors other than habitat quality, quantity, or distribution. For example, even if habitat remains constant, climatic conditions during breeding or wintering may cause a change in a species population size or density. However, many local habitat changes may affect certain species or groups of species. Specific changes in wildlife habitat related to vegetation are discussed in the Forestlands and Rangeland sections.

Not all information is known about all species and their habitat needs or current conditions within the entire project area. Because of the great variation and complexity of habitats within an

area this large, it would be undesirable and unrealistic to always apply species habitat relationship needs basin wide. For example, while some species occur throughout the basin, it would be unwise to use habitat relationships in the moist forest types of northern Idaho and Montana for the same species of animal that also occurs in the dry or cold forest types of southern Idaho; some of their needs will be the same and some will not, depending on the individual species. Local habitat conditions to which most species have adapted need to be evaluated for applicability.

Plant communities and their successional stages ~ as well as many other environmental factors ~ thus provide unique environmental conditions that are ecologically important as niches for wildlife species (Thomas et al. 1979). Many terrestrial wildlife species can be located in more than one forestland or rangeland PVG, in part because in some cases the important characteristic for a particular wildlife species may be a certain vegetative structure that can be found in more than one vegetation type. (For example, some wildlife species need large diameter trees; the particular species of tree may be unimportant to some of these wildlife and important to others). Some of the information from the Terrestrial Staff Area Report (1996) data bases enabled the Science Team to discuss wildlife species or groups separately within particular forest or range potential vegetation groups. Therefore, this EIS

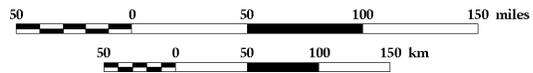


Map 2-3.
Forest Potential Vegetation Groups

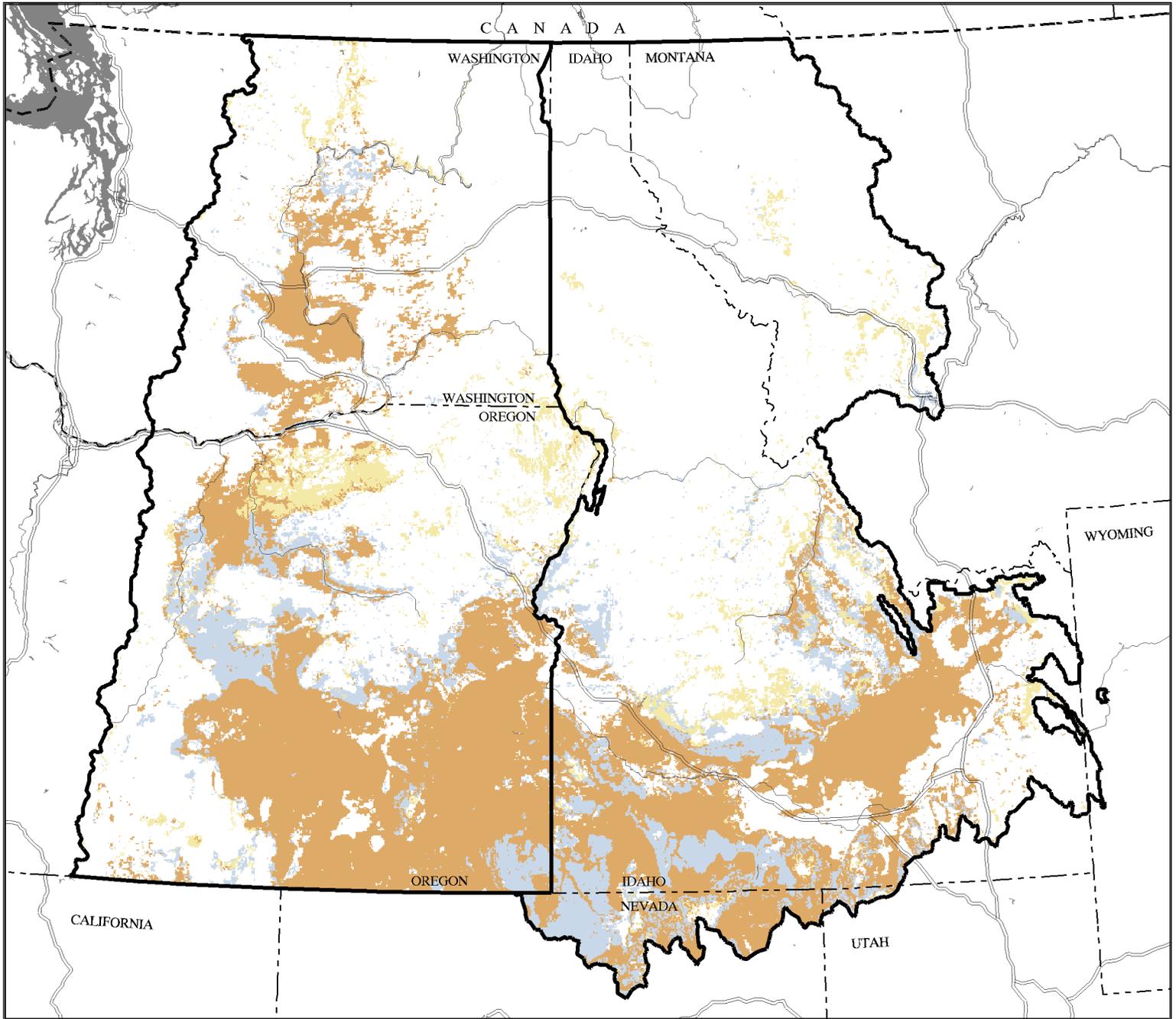
*BLM and Forest Service
 Administered Lands Only*

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996



- | | |
|--|---|
|  Cold Forest |  Major Rivers |
|  Dry Forest |  Major Roads |
|  Moist Forest |  EIS Area Border |



Map 2-4.
Rangeland Potential Vegetation Groups

*BLM and Forest Service
Administered Lands Only*

- Cool Shrub
- Dry Grass
- Dry Shrub
- Major Rivers
- Major Roads
- EIS Area Border

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

displays more detailed wildlife information by PVG where possible, for ease of tracking changes in vegetation within the landscape and the broad-scale effects of changes on terrestrial wildlife species.

Federally Listed Threatened, Endangered, and Candidate Species

Among terrestrial species in the ICBEMP project area, the bald eagle and the grizzly bear are federally listed threatened species; the peregrine falcon, woodland caribou, and gray wolf are endangered species. The Idaho ground squirrel is listed as a candidate species, with a distribution limited to localized mountain meadows in west central Idaho. All of the terrestrial listed threatened or endangered species, except the gray wolf, have recovery plans or strategies approved by the Fish and Wildlife Service. The grizzly bear, woodland caribou, and gray wolf are known to occur in northern Idaho and Montana, where they also interact with populations in British Columbia and Alberta. Although a recovery plan has not been approved for wolves, there is an EIS for reintroduction, which provided the basis for wolves being reintroduced in Idaho in 1995 and 1996. Grizzly bears and woodland caribou occur in Idaho and Montana in the Northern Glaciated Mountains (ERU 7). See Appendix E for maps of wolf and grizzly bear recovery areas and a list of threatened and endangered species within the UCRB planning area and the status of their recovery plans.

Populations of both peregrine falcons and bald eagles are static or increasing slightly in the project area. Bald eagles have recently been “down-listed” from endangered to threatened, and a similar proposal is being considered for the peregrine falcon. In both cases, the primary reason for recovery is restriction of pesticides that caused eggshell thinning and reproductive failures, but habitat improvement and road and human access management also contributed to their increase.

Not all Federal candidate species or agency Sensitive species are necessarily in decline; some species are little-known or naturally rare because of habitat rarity. It is suspected that no vertebrate species have recently gone extinct throughout their range in the project area in recent decades. Although it is possible that undescribed, locally endemic species or subspecies might have vanished before they could be studied, information on other taxa is lacking (Terrestrial STAR 1996).

For discussion of federally listed plant species, see discussion on rare plants, below.

Species Viability and Other Aspects of Terrestrial Integrity

The Science Integration Team developed three broad concepts to assess terrestrial ecosystems, which contributed to preparation of the Terrestrial Ecosystems section of this chapter. The three concepts, which have management implications at multiple scales, are the following:

- ◆ **Species viability:** *Includes threatened and endangered species, vertebrate candidate species, locally rare plants, and rare plants listed in natural heritage data bases: representing species that are commonly thought to have viability concerns.*
- ◆ **Long-term evolutionary potential:** *Includes rare species, endemic species, and high biological diversity “Hot Spots” (see maps 2-5 and 2-6): representing species that may require some level of additional management emphasis to achieve their long-term evolutionary potential. These groups of species occur in very restricted places and are highly susceptible to local extirpation.*
- ◆ **Multiple ecological scales and evolutionary time frames:** *Includes species assemblages and ecosystems that are at the edge of their ranges within the project area. Species at the edge of their ranges often develop attributes or adaptations that result from local ecological conditions not present in the heart of the range. Such “fringe” areas often are locations important to species’ evolutionary processes.*

Rare Plants, Lichens, Bryophytes

While most of the vegetation section of this chapter focuses on the more common plant communities that comprise forest and rangeland ecosystems, rare or sensitive plant species and smaller and less known (but many times critical) plants form the base of each community in the ecosystem.

The project area is known to support more than 12,000 plant species (table 2-5), including about 8,000 vascular plants and about 4,000 species of non-vascular plants and plant allies (fungi and lichens). This richness in plant diversity is a reflection of the many different habitats found in the interior Columbia River Basin, ranging from

alpine to desert conditions with different bedrock, soils, and temperature and moisture regimes. Plants are primary producers that convert the energy of the sun into food and nutrients for all living organisms, making plants the most critical component in the maintenance of ecosystems. In addition to their ecosystem function, plant communities provide the foundation for the economic and social fabric of the basin. Commercial resources critical to the region's economy are provided by plants, including trees, forage and other special plant products.

Many groups of plants and related organisms play multiple but often poorly understood roles in functional and sustainable ecosystems. Different levels of information are available for each plant,

fungus, lichen, or bryophyte group. The vast majority of plant data is available for vascular plant species that are currently listed as threatened, endangered, or sensitive. Considerably less local data is available for the bryophytes, fungi, and lichens.

Fungi

Fungi are the least understood group of plant-related organisms in the project area. A key role of fungi in ecosystems is that of decomposer, recycling nutrients within an ecosystem to make them available for use by other living organisms. Many species of fungus also play a role in facilitating moisture and nutrient absorption by plants through beneficial mycorrhizal relationships with plant roots.

Special Status Species

Special Status species include federally listed threatened or endangered species; Federal candidate species; special recognized as requiring special protection by State agencies and species managed as sensitive species by the Forest Service and/or BLM.

The Endangered Species Act of 1973 provides a program for the conservation and recovery of threatened and endangered species as well as a means to protect the ecosystems upon which such species depend. According to the U.S. Fish and wildlife Service, an **Endangered Species** is any species in danger of extinction throughout all or a significant portion of its range. A **Threatened Species** is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Species may also be designated as Candidate Species if available data suggest that T&E designation may be appropriate; **Candidate Species** are those that may be proposed (as threatened or endangered) and listed in the future. The U.S. Fish and Wildlife Service recently revised its list of candidate species (February 28, 1996 Federal Register). Under their new system, only those species for which they have enough information to support a listing proposal will be called candidates.

Other management agencies use additional terminology to identify the State or agency status of rare species. The Forest Service and the BLM maintain regional lists of **Sensitive** species for which there are significant current or predicted downward trends in population numbers, density, or habitat capability; or species with limited distribution.

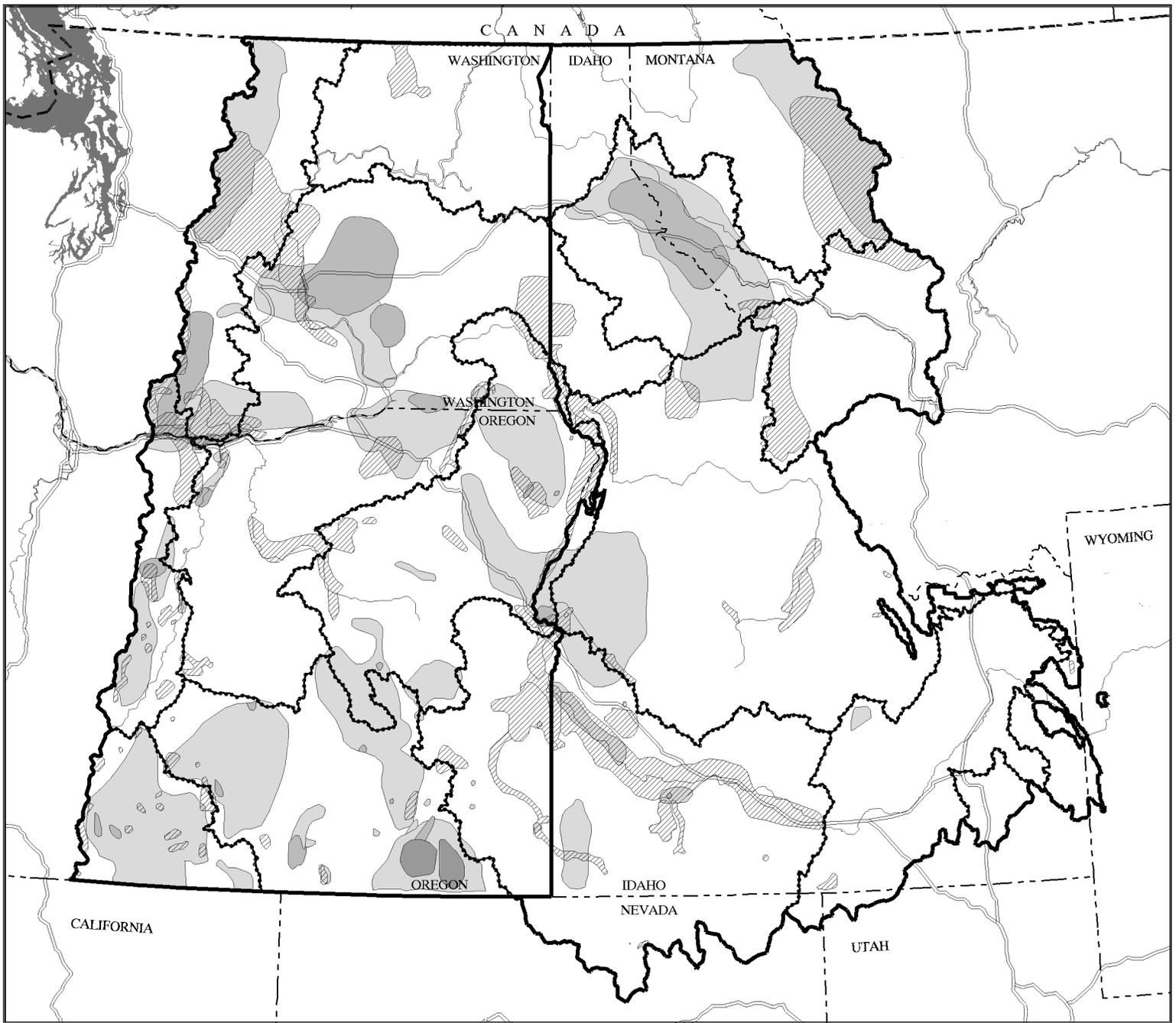
Table 2-5 provides the number of species of terrestrial organisms that exist in the project area; the number of federally listed threatened, endangered, candidate and proposed species; and BLM- or Forest Service-designated sensitive species (Landscape Ecology STAR 1996).

Table 2-5. Numbers and Status of Terrestrial Species in the ICBEMP Project Area.

Type	Total # of Species		Federally Listed, Proposed, or Candidate				FS/BLM
	Known	Est.	Threat.	Endang.	Prop.	C	Sensitive
Invertebrate	3,780	24,270	1	5	0	0	23
Amphibian	26	26	0	0	0	1	11
Reptile	27	27	0	0	0	0	9
Bird	283	283	3	2	0	1	85
Mammal	132	132	1	2	0	1	30
Plants	12,797	18,946	3	2	1	4	526

Abbreviations: Est. = Estimated Threat. = Threatened Endang. = Endangered
 Prop. = Proposed C = Candidate

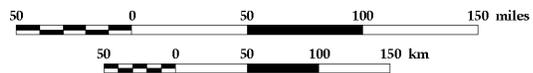
SOURCE: Terrestrial STAR 1996; Sensitive Lists (see Appendix E).



**Map 2-5.
Endemic Species**

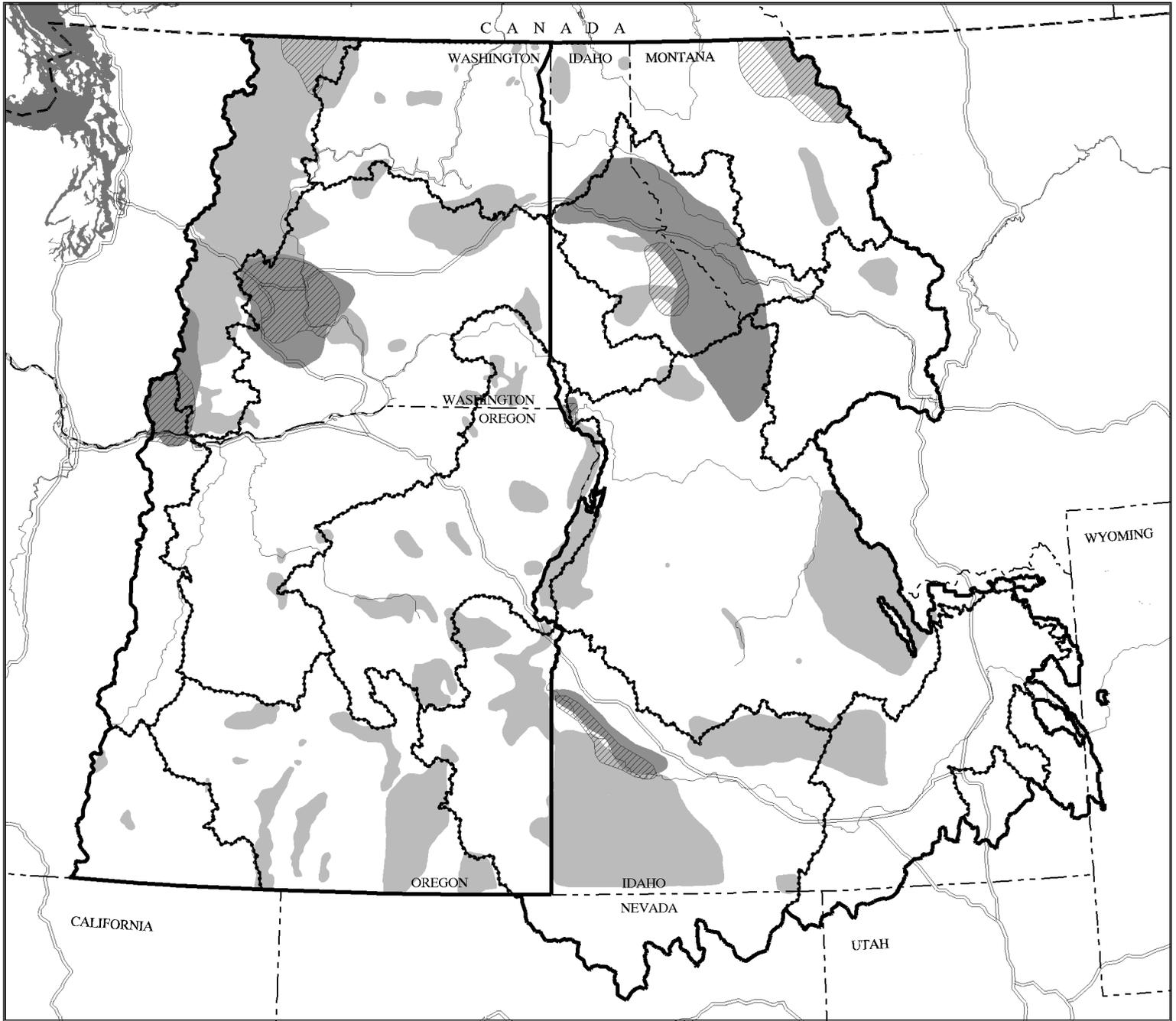
INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996



- | | | | |
|---|------------------------------|---|-----------------|
|  | One Endemic Animal Species |  | Major Rivers |
|  | Two Endemic Animal Species |  | Major Roads |
|  | Three Endemic Animal Species |  | EIS Area Border |
|  | One Endemic Plant Species |  | ERU Boundaries |

*Ecological reporting unit names and numbers are found on Map 1-1.



Map 2-6.
Areas of High Biodiversity
for Plants and Animals

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996



- | | |
|---|-----------------|
| High Plant Biodiversity | Major Rivers |
| High Animal Biodiversity | Major Roads |
| Areas of High Biodiversity for Plants and Animals | EIS Area Border |
| | ERU Boundaries |

*Ecological reporting unit names and numbers are found on Map 1-1.

Other species of fungi in the project area are of commercial value and economic importance. Because of the limited knowledge of this group of organisms in the project area, effects of management activities on fungi are difficult to determine. Hence, this group will not be discussed further in this document, but readers may refer to the Terrestrial Staff Area Report (1996) for additional information.

Lichens

Lichens, which are organisms made up of algae and fungi, are represented by at least 736 species in the project area. Lichens function in a wide variety of ecosystems as food sources for animals (such as deer, elk, caribou, flying squirrels, red-backed voles, and woodrats) and as contributors of living matter to forest and rangeland soils. Birds and small mammals use lichens as nest-building material. Lichens also absorb moisture (when attached to tree branches). Microbiotic crusts in rangeland environments consist of both lichens and bryophytes, covering and protecting what otherwise would be bare soil between grass clumps and/or shrubs. Lichens also play a role in the initial establishment of plant communities on such surfaces as bare rock, through the breaking down of rock into soil surfaces more conducive to plant growth. Some lichens are used as foods by American Indians and others are used as bioindicators for air quality, or as environmental purifiers where they accumulate heavy metals. Other species of lichens may prove to have medicinal values.

Lichens are affected when their substrate (dead plant matter, tree bark, tree trunks without bark, rock, soil) is modified such as through timber harvest, mining, livestock grazing, fire, and invasion of exotic annuals. Lichens also appear to be sensitive to the planting of uncharacteristically high numbers of trees; artificially dense forest stands create unsuitable habitat for most lichens. One lichen is currently listed as a candidate species. Basic knowledge about these species and their interactions is limited, and hence will not be discussed further in this document.

Bryophytes

Non-vascular plants (bryophytes) include mosses, liverworts, and hornworts. Like other plant relatives, bryophytes are poorly known, and some lack even the most basic information. Approximately 383 individual types are known to occur; 46 of these are considered rare or sensitive. Bryophytes are found on such substrates as: wet soil, alkali soil, calcareous

rock, peatlands, geothermal areas, and decaying wood. Since bryophytes produce chlorophyll (a green pigment that absorbs light, which is converted into food and nutrients for other living organisms), they function in ecosystems as a food source. Bryophytes, much like lichens, also play a role in the initial establishment of plant communities on such surfaces as bare rock through the breaking down of rock into soil more conducive to plant growth.

As a group, bryophytes are affected by the same activities as lichens. For species found on wet rock, or for aquatic submerged species, changes in water quality may affect bryophyte composition and distribution. Like other plant-related species, basic knowledge about bryophytes and their interactions is limited, and hence they are not discussed further in this document.

Vascular Plants

Approximately 8,000 vascular plant species are found in the project area. Vascular plants are “ordinary” plants which have roots, stems, leaves, and reproductive structures. Included in the vascular plant group are ferns, cone-bearing plants (conifers), and flowering plants. The vascular plants of the project area are remarkably diverse, with species inhabiting a wide spectrum of habitats.

Vascular plants function as the basis of the food webs that sustain life on earth. Vascular plant species also protect exposed soil from the erosive forces of wind and water through the binding action of their roots. They further serve to regulate stream temperatures by providing shade to streams, enhancing habitat for aquatic and riparian area-dependent species.

Among the vascular plant species known in the project area, 154 are regionally endemic and 87 are of concern to American Indian tribes. Approximately 526 of the species are Sensitive or of special management concern for the Forest Service or BLM. One finding of the Scientific Assessment was that plant species or groups in the native bunch grass types and low elevation cedar/hemlock forests currently have the lowest amount of habitat area and also showed the greatest negative change (loss) over time (Terrestrial STAR 1996). Species federally listed as threatened occurring in the UCRB planning area include: *Howellia* (*Howellia aquatilis*), MacFarlane’s four o’clock (*Mirabilis macfarlanei*), and Ute’s lady-tresses (*Spiranthes diluvialis*). There are no species listed as endangered.

Noxious Weeds

Approximately 862 exotic (non-native) plant species have been documented in the Columbia River Basin, of which 113 are considered noxious weeds (Terrestrial STAR 1996). "Noxious" is a legal classification rather than an ecological term. Plants that can exert substantial negative environmental or economic impact can be designated as noxious by various Government agencies. Federal and State laws require certain actions directed at the management of noxious weeds.

Vegetation in both forestlands and rangelands in the project area is being invaded by noxious weeds at an accelerating rate, jeopardizing consumptive and non-consumptive uses and public expectations, including livestock grazing, timber production, and wildlife and scenery viewing. Noxious weeds reduce these uses by displacing native plant species and lessening natural biological diversity, degrading soil integrity, nutrient cycling and energy flow, and interfering with site recovery mechanisms (such as seed banks) that allow a site to recover following disturbance.

Natural Areas

Natural Areas are defined here as areas that are managed by various landowners for a variety of purposes but that are maintained in a relatively natural state, with minimal human disturbance. Natural Areas are designated for purposes of recreation, research, monitoring, habitat protection, education, and scenic quality. They include designated Wilderness Areas, Wilderness Study Areas, Research Natural Areas, Areas of Critical Environmental Concern, Botanical Areas, and similar areas. They can occur in all categories of land allocations and can vary in management objectives and allowed uses. Natural Areas are intended to represent the spectrum of vegetation, habitat, physical settings, and land types within a region.

Natural Areas are distributed throughout the interior Columbia River Basin. Within the ICBEMP project area approximately 28 percent of the land area is within some type of Natural Area designation or category. Natural Areas in the project area tend to be in the upper elevation, forested portions of the landscape. The cold forest types represent approximately 35 percent of the area that is within Natural Areas (mainly Wilderness or Wilderness Study Areas) because of their scenic beauty, recreation demand, and lack of roads and development (Terrestrial STAR

1996). Moist and mid-elevation forests have 9 percent within Natural Areas, although some of these forests are also represented in some unroaded areas. Lower elevation forested habitats have the least representation within Natural Areas.

Of the non-forested (rangeland) areas included within congressionally or administratively designated Natural Areas, 5 percent of cool shrub, 3 percent of dry grass and dry shrub, 7 percent of riparian shrub, and 7 percent of woodland are represented. This compares to 59 percent representation of alpine areas, 35 percent of cold forest, and 55 percent of rock areas within Natural Area designations (includes all ownerships within the project area). In summary, relatively few rangeland types are being specifically managed under low human disturbance regimes for the general goals of established Natural Areas (Terrestrial STAR, in press).

The *Scientific Assessment* (Quigley and Arbelbide 1996) analyzed the size-class distribution of Natural Areas and vertebrate home ranges to determine the value of Natural Areas in maintaining vertebrate communities. All Natural Areas and species were pooled without regard for habitat composition and use difference. For this broad treatment, the simplifying assumption was made that Natural Areas were isolated from adjacent habitat that might have increased the effective area of the Natural Area for species conservation and management. In reality, this may not always be the case, as much of the land surrounding some Natural Areas also contributes suitable habitat for vertebrates species (Terrestrial STAR 1996).

Even small Natural Areas (<125 acres) would be expected to contain at least one individual, and perhaps small populations, of about 70 percent of vertebrate species. Natural Areas larger than 1,600 acres would be expected to contain 90 percent of the vertebrate species in the area. Natural Areas would have to be at least 24,710 acres in size before 99 percent of the vertebrate species would be expected to occur. Of existing Natural Areas in the project area, 16 percent are larger than 24,710 acres. Expectations of species occurrence based on home range size does not necessarily mean that a particular size Natural Area would contain viable populations of all associated species. Natural Areas would have to be several times larger than the area of an individual home range of most species to support enough individuals for a viable population. Many factors relative to species would need to be considered to ensure that Natural Areas fully address viability concerns (Terrestrial STAR 1996).

Forestland

Key Terms Used in This Section

Biophysical template ~ The successional and disturbance processes, landform, soil, water, and climate conditions that formed the native system with which species of plants and animals evolved.

Disturbance ~ Refers to events that alter the structure, composition, or function of terrestrial or aquatic habitats. Natural disturbances include, among others, drought, floods, wind, fires, wildlife grazing, and insects and pathogens. Human-caused disturbances include actions such as timber harvest, livestock grazing, roads, and the introduction of exotic species.

Downed wood ~ A tree or part of a tree that is dead and laying on the ground.

Key Ecological Functions ~ A wide range of roles that species play in the ecosystem, such as predation, herbivory, nutrient cycling, and biomass contributions.

Key Environmental Correlates ~ Environmental factors that are either associated with or required by a given species, such as forest canopies, downed wood, snags, or piles of bark.

Landscape structure ~ The mix and distribution of stand, or patch sizes across a given area of land. Patch sizes, shapes and distributions are a reflection of the major disturbance regimes operating on the landscape.

Landscape composition ~ The types of stands, or patches present across a given area of land.

Old Forest ~ (a) Old single story forest refers to mature forest characterized by a single canopy layer consisting of large or old trees. Understory trees are often absent, or present in randomly spaced patches. It generally consists of widely spaced, shade-intolerant species, such as ponderosa pine and western larch, adapted to a nonlethal, high frequency fire regime. (b) Old multi-story forest refers to mature forest characterized by two or more canopy layers with generally large or old trees in the upper canopy. Understory trees are also usually present, as a result of a lack of frequent disturbance to the understory. It can include both shade-tolerant and shade-intolerant species, and is generally adapted to a mixed fire regime of both lethal and nonlethal fires.

Patch (stand) ~ An area of homogeneous (uniform) vegetation, different from surrounding vegetation in its structure or composition

Regeneration ~ The process of establishing a new crop of trees on previously harvested land; also refers to the new crop of trees that have become established.

Seral ~ The developmental phase of a forest stand with characteristic structure and plant species composition; typically, young-seral forest refers to seedling or sapling growth stages; mid-seral forest refers to pole or medium sawtimber growth stages; and mature or old-seral forests refers to mature and old-growth stages.

Species composition ~ The mix of different types of trees that are growing in a forest. Can include both shade-intolerant and shade-tolerant species.

Shade-intolerant ~ Species of plants that do not grow well or die from the effects of too much shade. Generally these are fire-tolerant species.

Shade-tolerant ~ Species of plants that can develop and grow in the shade of other plants. Generally these are fire-intolerant species.

Stand (patch) density ~ The number of trees growing in a given area, usually expressed in terms of trees per acre.

Stand (patch) structure ~ The mix and distribution of tree sizes, layers, and ages in a forest. Some stands are all one size (single story), some are two story, and some are a mix of trees of different ages and sizes (multi-story). (See table 2-6 for structural stages used in this EIS to describe stand structure.)

Succession ~ A predictable process of changes in structure and composition of plant and animal communities over time. Conditions of the prior plant community or successional stage create conditions that are favorable for the establishment of the next stage. The different stages in succession are often referred to as "seral stages."

Summary of Conditions and Trends

The following trends have been noted in the forested areas of the project area because of departures from native disturbance and successional processes since historical times. These broad-scale changes in forest health conditions have influenced the susceptibility of forests to uncharacteristic wildfires and large-scale insect and disease events, and have affected habitat for many wildlife species.

- ◆ Interior ponderosa pine has decreased across its range, with a significant decrease in the amount of old single story structure. The primary transitions were to interior Douglas-fir and grand fir/white fir.
- ◆ Loss of the large tree component (live and dead) within roaded and harvested areas. This decrease affects terrestrial wildlife species closely associated with these old forest structures.
- ◆ Western larch has decreased across its range. The primary transitions were to interior Douglas-fir, lodgepole pine, or grand fir/white fir.
- ◆ Western white pine has decreased 95 percent across its range. The primary transitions were to grand fir/white fir, western larch, and shrub/herb/tree regeneration.
- ◆ The whitebark pine/alpine larch cover type has decreased 95 percent across its range, primarily through a transition into the whitebark pine cover type. Overall, however, the whitebark pine cover type has also decreased, with compensating increases in Engelmann spruce/subalpine fir.
- ◆ Generally, mid-seral forest structures have increased in dry and moist forest potential vegetation groups, with a loss of large scattered residual shade-intolerant tree components and an increase in density of smaller diameter shade-tolerant trees.
- ◆ There has been an increase in fragmentation and loss of connectivity within and between blocks of habitat, especially in lower elevation forests and riparian areas. This has isolated some wildlife habitats and populations and

reduced the ability of populations to move across the landscape, resulting in long-term loss of genetic interchange.

- ◆ Human access for all types of uses has increased because of increasing human population in the basin. Increased access has decreased the availability of areas with low human activities, which are important to large forest carnivores and omnivores, and increased the risk of conflicts between these wildlife species and humans.

'Forest health' is defined as the condition in which forest ecosystems sustain sufficient complexity, diversity, resiliency, and productivity to provide for specified human needs and values. It is a useful way to communicate about the current condition of the forest, especially with regard to resiliency, a part of forest health which describes the ability of the ecosystem to respond to disturbances. Resiliency is one of the properties that enable the system to persist in many different states or successional stages. Forest health and resiliency can be described, in part, by species composition, density, and structure.

Introduction to Forestlands

Forest-related issues raised by the public during the scoping process show a growing concern for wildfire, insect and disease infestations, exotic species, resource management practices, and human uses that may affect forest health and productivity. Forests are constantly changing through a combination of disturbances, such as fire, climate, insects, disease, timber harvest, and grazing. Change determines the plant and animal species that will exist in forested areas, and governs future products, recreational opportunities, habitats, and other resources provided by forests.

The forestland potential vegetation groups in this section are described by distribution, composition, and structure, historical conditions, and current conditions (departures from disturbance patterns and processes) as well as by terrestrial wildlife species and their habitats and associated changes.

Succession and Disturbance

Plants respond to influences and disturbances from animals, people, and even other plant species by growing in patterns of succession. “Succession” refers to a predictable process of changes in structure and composition of plant and animal communities over time.

Successional (or seral) stages often are described in terms of “early-”, “mid”, or “late” to reflect the species and/or condition of vegetation and animal communities generally characteristic at different times during succession.

“Disturbance” refers to events that alter the structure, composition, and/or function of terrestrial or aquatic habitats. Disturbances in the native interior Columbia River Basin system generally follow cycles of infrequent, high intensity events (such as drought, floods, or crown fires) interspersed with frequent, low intensity events (such as nonlethal underburns, annual wildlife grazing cycles, or scattered mortality from bark beetles).

Forest succession is the set of stages that plant communities go through, from young stands of trees to old forests. Table 2-6 presents the seven structural stages used in this EIS to depict forest successional stages:

Successional growth and development of vegetation, combined with disturbance, result in vegetation changes across the forested landscape. The interaction of successional and disturbance processes, constrained by the dynamics of landform, soil, water, and climate, creates the basic “native biophysical template” in which native species have evolved. Insect, disease, and fire disturbance events react differently, and affect the forested stands differently, depending on species composition, density, and structure. Regional-scale changes in landscape patterns over time can be described as changes in vegetation structure (heights, sizes, and ages of vegetation) and composition (percent of each species occurring on a site), and can characterize changes that have occurred in

Table 2-6. Forest Structural Stages

Structural Stage	Definition	In this EIS, Also Called Seral Stage:
Stand initiation	When growing space is reoccupied following a stand-replacing disturbance	“Early Successional” or “Regeneration” or “Early Seral”
Stem exclusion - open canopy	Those forested areas where the occurrence of new tree stems is moisture limited	“Mid-successional” or “Young Forest” or “Mid-seral”
Stem exclusion - closed canopy	Those forested areas where the occurrence of new tree stems is predominantly light limited	
Understory reinitiation	When a second generation is established under an older, typically early seral, overstory	
Young forest multi-story	Stand development resulting from frequent harvest or lethal disturbance to the overstory	
Old multi-story	Those forested areas lacking frequent disturbance to understory vegetation	“Late Successional” or “Mature and Old Forest” multi-story or “Late Seral”
Old single story	Those forested areas resulting from frequent nonlethal natural or prescribed underburning or other management	“Late Successional” or “Mature and Old Forest” single story or “Late Seral”

successional and disturbance processes, which may indicate changes in ecological function and overall forest health. Figure 2-4 illustrates the successional and disturbance processes in forested landscapes in the UCRB.

Species of trees that grow better in sunlight (shade-intolerant species) dominate environments that are fairly open, with little shade created by other species; they often establish in newly opened forest areas. If fires do not remove tree reproduction, stand density increases and creates shade on the forest floor, which allows seedlings of shade-tolerant species to establish. Most shade-tolerant species are readily killed by fire, especially when they are young. Where fires were frequent, the presence of shade-tolerant tree species was limited, but without such disturbance, these shade-tolerant species would grow to maturity and eventually dominate the forest. Where fire, harvest, wind, or other disturbance returned sunlight to the forest floor, shade-intolerant species would again establish. A partial list of common shade-tolerant and shade-intolerant tree species is in Table 2-7.

Successional and disturbance processes have changed considerably since settlement of the project area. New disturbances (such as harvest and the introduction of exotic species), as well as changes in the frequency or intensity of disturbance processes resulting from fire exclusion, have created conditions and disturbance regimes different from those to which native plant and animal species have adapted. Figures 2-5 through 2-10 summarize the changes in seral stages and shade tolerance by PVG that have occurred in the project area. Maps 2-7 and 2-8 show historical and current fire regimes in project area forestlands and rangelands.

Terrestrial Wildlife Species and Habitats: General Considerations For All Forest PVGs

The Forestland discussions of wildlife focus on species that provide “Key Ecological Functions” and species that depend on certain environmental factors referred to as “Key Environmental Correlates” (see Introduction to Terrestrial Ecosystems for additional details).

Many of the terrestrial wildlife species can be located in several forest PVGs, while some species are restricted to one or two PVGs. For example, woodpeckers need dead trees for nesting and feeding. For the hairy woodpecker, the species of dead tree is not as important for nest site selection as the size (it needs to be greater than 10 inches in diameter). For the pileated woodpecker, on the other hand, the size (greater than 20 inches in diameter) and species of the tree are important for nesting and feeding. Therefore, hairy woodpeckers can be found in all forest PVGs (three), but pileated woodpeckers will occur only in two of the forest PVGs because of the combined tree size and tree species limitations.

The project area forestlands include six species of large carnivores and omnivores including grizzly and black bears, gray wolves, mountain lions, lynxes, and wolverines. The grizzly bear and gray wolf are federally listed under the Endangered Species Act; the Canada lynx has recently undergone a status review by the Fish and Wildlife Service to determine whether it should be listed. Two smaller carnivore species, the Pacific fisher and American marten, are considered species of concern. Carnivores and omnivores are at the top of the food chain (figure 2-11) and are indicators of total biodiversity and ecosystem health.

Table 2-7. List of Common Shade-tolerant and Shade-intolerant Tree Species in the UCRB Planning Area

Shade-tolerant Tree Species	Shade-intolerant Tree Species
Grand fir	Western white pine
White fir	Interior ponderosa pine
Douglas-fir (sometimes)	Lodgepole pine
Engelmann spruce	Douglas-fir (sometimes)
Subalpine fir	Western larch
Western hemlock	Whitebark pine
Western redcedar	Aspen

Figure 2-4. Forest Successional and Disturbance Processes

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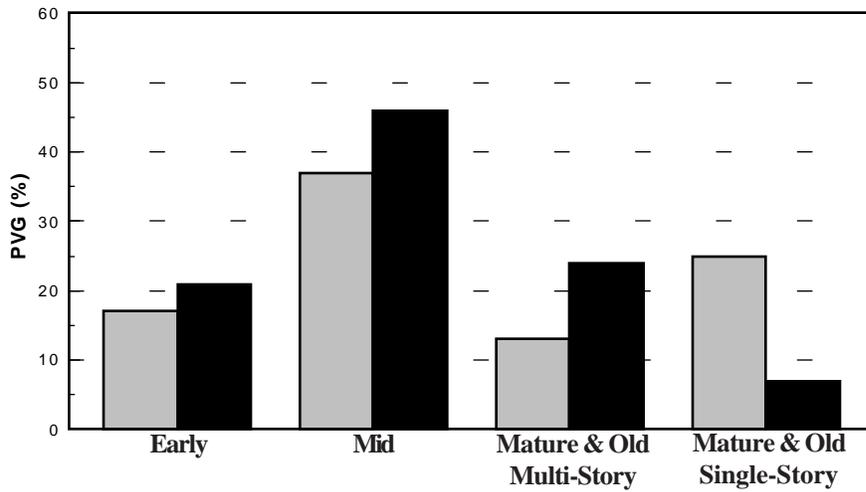


Figure 2-5. Historical and Current Seral Stages in Dry Forest PVG as Percentage of the PVG.

Figure 2-6. Historical and Current Seral Stages in Moist Forest PVG as Percentage of the PVG.

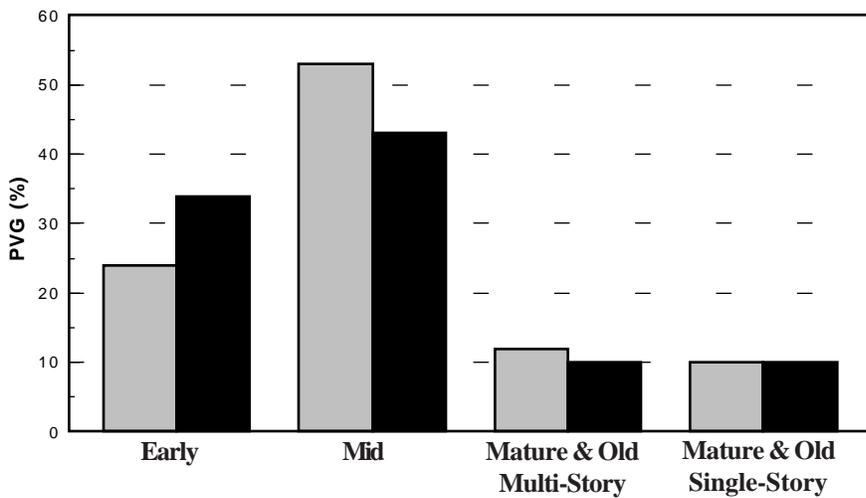
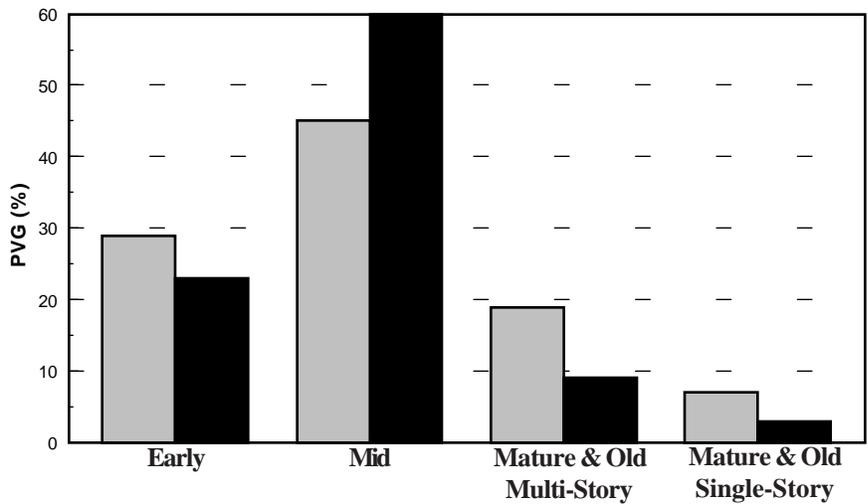


Figure 2-7. Historical and Current Seral Stages in Cold Forest PVG as Percentage of the PVG.



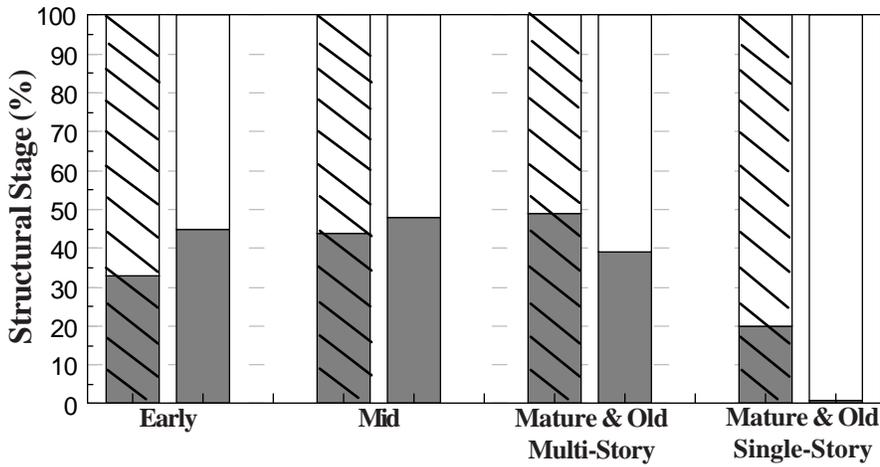


Figure 2-8. Historical and Current Shade-Tolerant and Shade-Intolerant Species in Dry Forest PVG as Percentage of the Seral Stage.

Figure 2-9. Historical and Current Shade-Tolerant and Shade-Intolerant Species in Moist Forest PVG as Percentage of the Seral Stage.

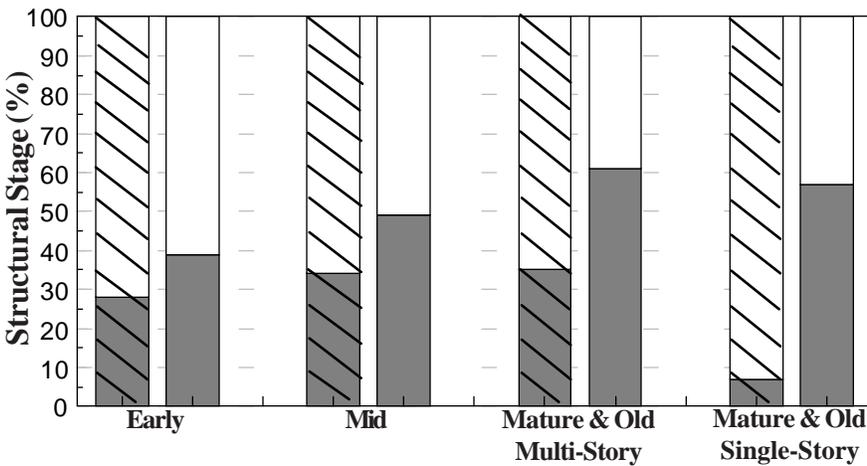
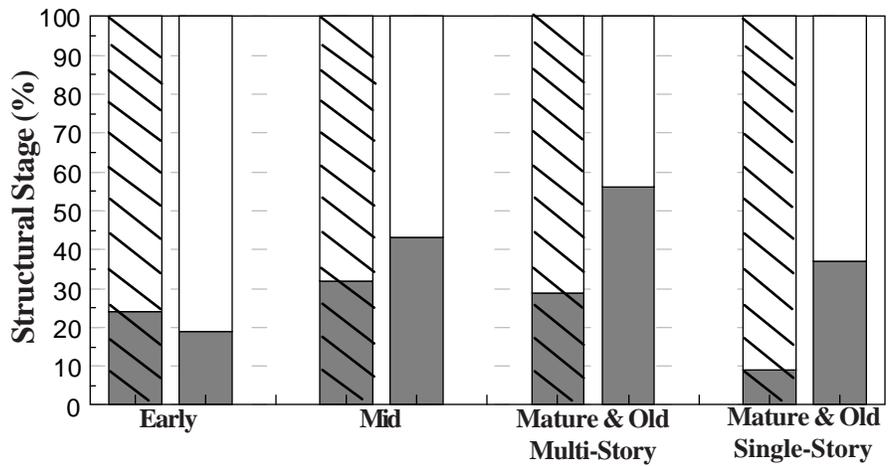
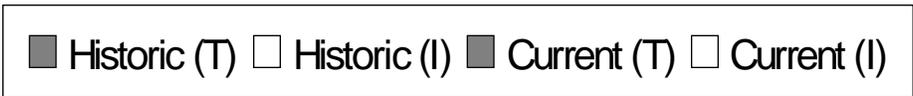


Figure 2-10. Historical and Current Shade-Tolerant and Shade-Intolerant Species in Cold Forest PVG as Percentage of the Seral Stage.



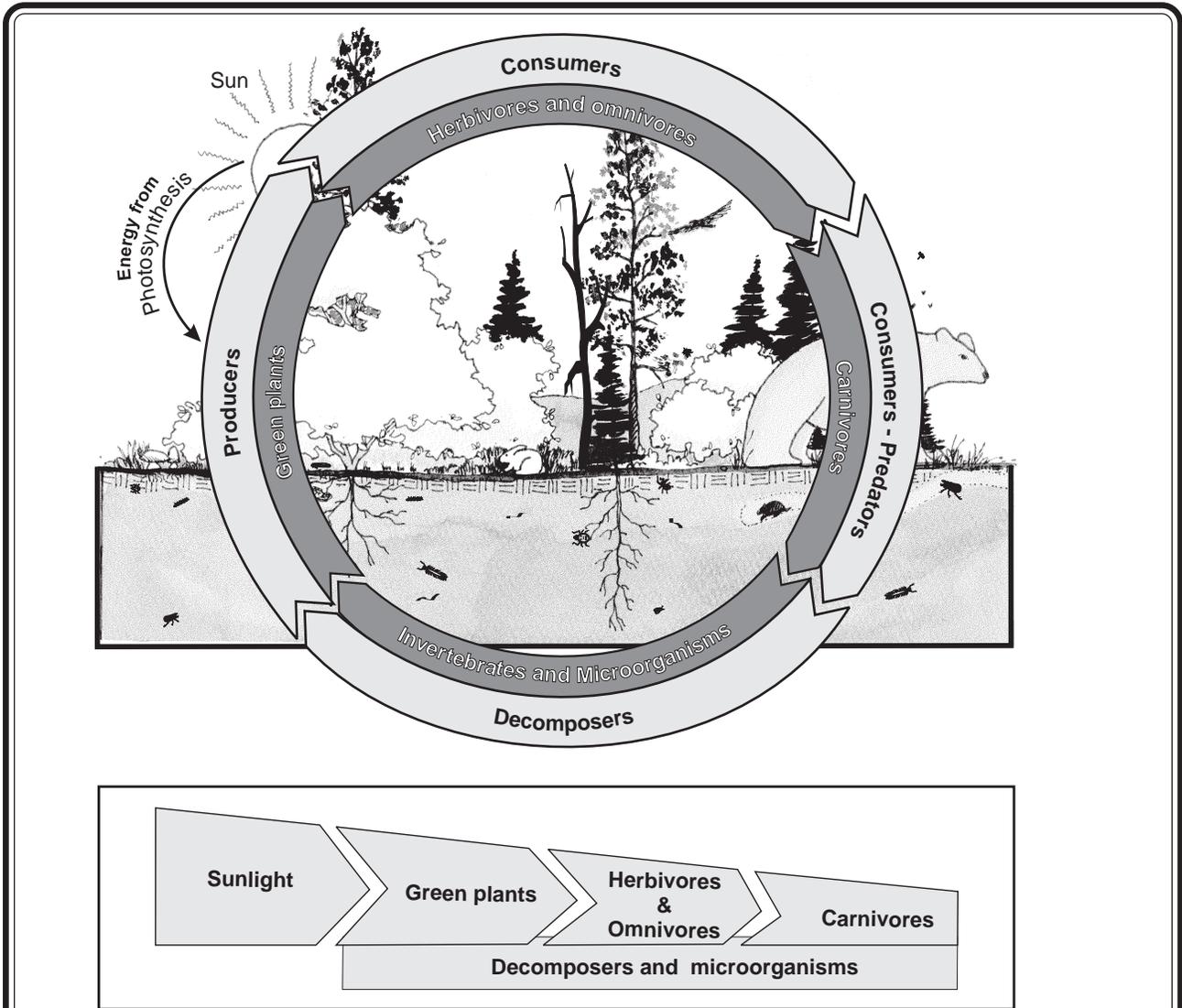


Figure 2-11. Energy Flow: Wildlife in the Food Web.

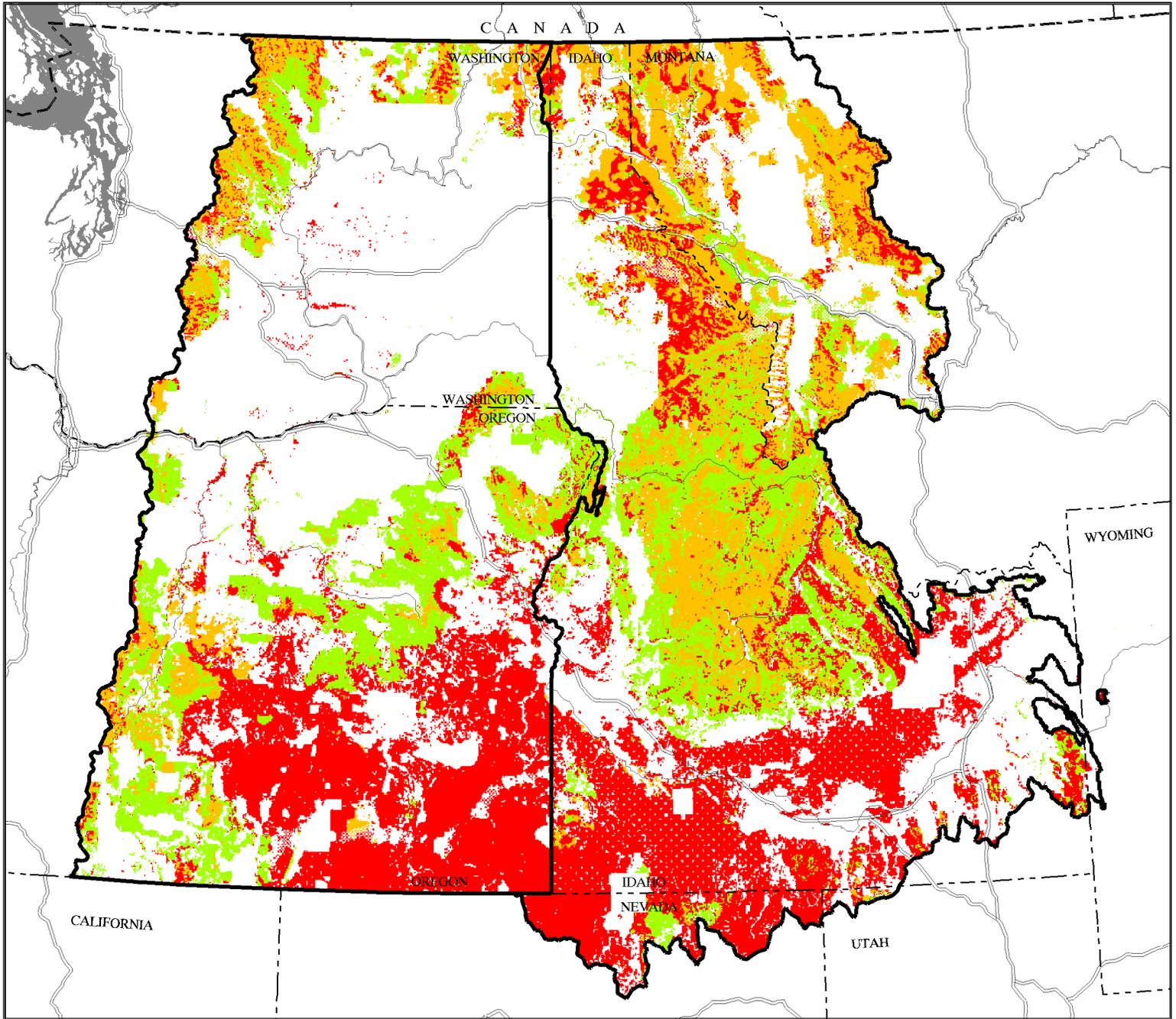
All organisms, dead or alive, are potential sources of food for other organisms. A rabbit eats a leaf, a bear eats the rabbit. . . . When the plant, the rabbit, and the bear die, they in turn are eaten by decomposers, which recycle nutrients and energy back into the system.

A series of organisms eating other organisms is called a food chain. Organisms in a natural ecosystem can be involved in complex webs of many interconnected food chains that cycle energy from the sun through producers (green plants), consumers (herbivores that eat the plants, carnivores that eat herbivores and other animals, and omnivores that eat both plants and animals), and decomposers (microorganisms), back into the environment to be used again.

Wildlife ~ ranging from insects and other invertebrates to grizzly bears and other top predators ~ are key components of all parts of the energy cycle, providing food, nutrients, and energy to each other and the system as a whole. Wildlife also contribute to the shaping of vegetation structure, composition, and density, and provide other important ecological contributions including turning over soil, pollinating flowers, dispersing seeds, and controlling pest populations of plants and animals.

Conditions and activities that change wildlife populations through modification of their habitats (positively or negatively) can affect the cycling of energy, nutrients and other ecosystem processes essential to forest and rangeland health. Such changes can also affect socio-economic health, because wildlife also contribute heavily to social and economic systems through their recreational, business, cultural, educational, and spiritual values.

Energy flow is one of the critical ecological processes in every ecosystem type. It is presented here to highlight the role of terrestrial wildlife and food webs, but energy flow is also critical in aquatic systems. Information on aquatic food webs is presented in the Fish section of this chapter.



Map 2-7.
Fire Regime Severity
Historical

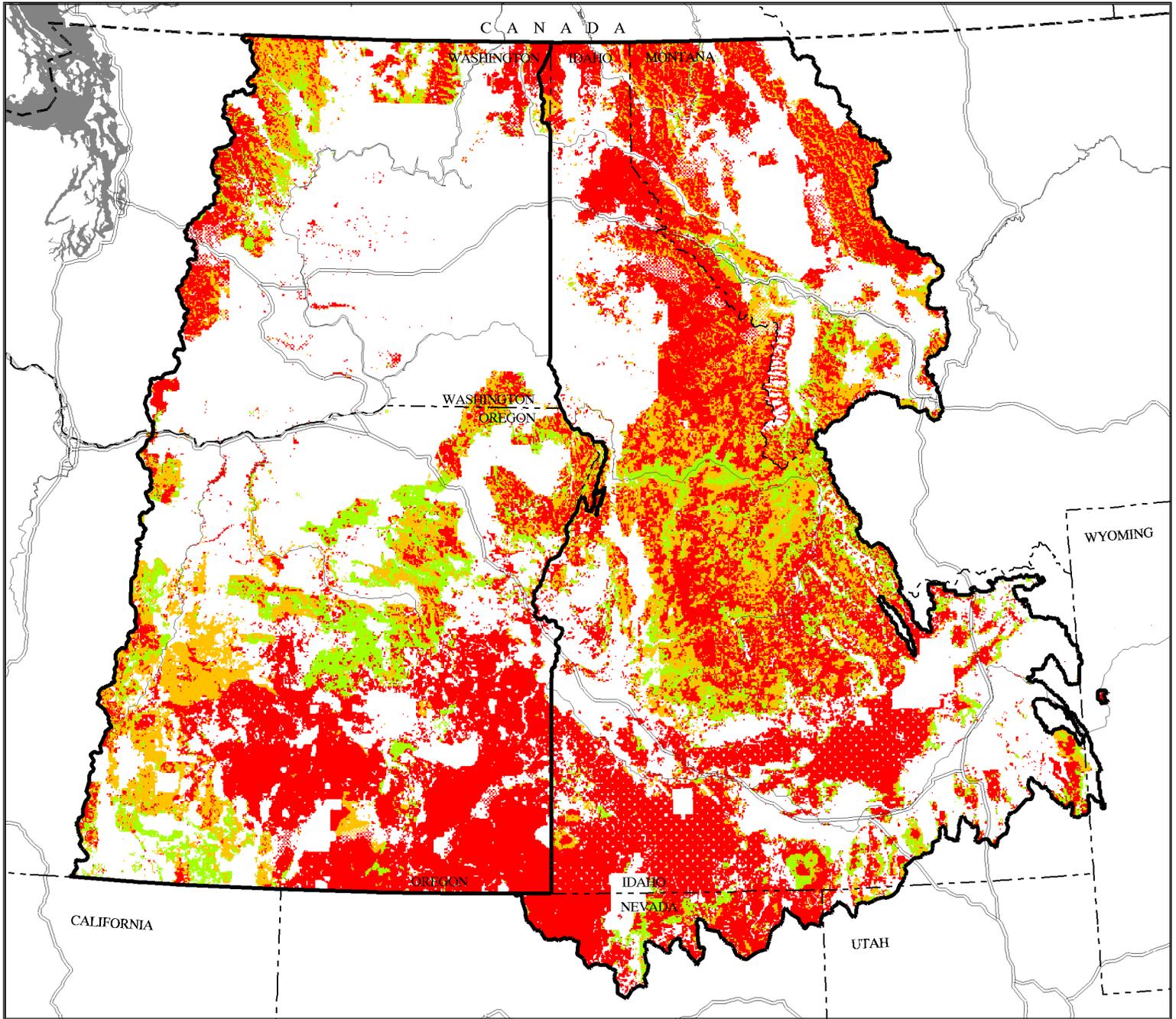
*BLM and Forest Service
 Administered Lands Only*

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996



- | | |
|---|-----------------|
| Nonlethal | Major Rivers |
| Mixed | Major Roads |
| Lethal | EIS Area Border |

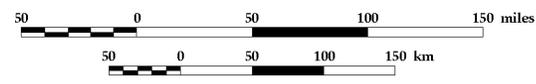


Map 2-8.
Fire Regime Severity
Current

*BLM and Forest Service
 Administered Lands Only*

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996



- | | |
|---|-----------------|
| Nonlethal | Major Rivers |
| Mixed | Major Roads |
| Lethal | EIS Area Border |

As such, they are susceptible to changes in habitat primarily associated with human activities, such as roading, traffic, recreation, logging, mining, and grazing, all of which occur in forested ecosystem PVGs. Unroaded and natural areas that are as large or larger than a species' home range (which varies by species) are important for these species. This type of habitat is especially true for those areas that connect with Canada, which provides areas of emigration to help reestablish forest carnivores and omnivores.

Species that evolved with mosaics of regeneration and old forest within their home ranges, such as the Canada lynx, now have to travel greater distances to find food and denning sites (Carnivore Report 1995). Areas with moist forests, such as the northern Glaciated Mountains, Lower and Upper Clark Fork (ERU 7, 8, 9), have become more isolated as cover needed for travel between patches is disturbed by highways, cities, rural housing, reservoirs, or other barriers to migration. These changes are affecting large, mobile species, such as the grizzly bear, wolf, wolverine, and fisher, which have lost much of their historical range (Martin et al. 1995, and Marcot et al. in Everett et al. 1994).

Some carnivores and omnivores in northern portions of the project area ~ such as the grizzly bear, gray wolf, Canada lynx, wolverine, Pacific fisher, and American marten~ have the opportunity to interact with populations in British Columbia and Alberta. The Northern Glaciated Mountains (ERU 7) ranges have large blocks of wilderness and unroaded lands in the moist forest and subalpine cover types that interconnect with habitat blocks in Canada. These areas have the greatest species richness of forest carnivores in the project area; however, because this is the southern portion of the larger carnivores' range, their populations are low (Martin et al. 1995). These large, mobile species have large home ranges and often run into conflicts with humans and livestock when wildlife habitat shrinks.

Woodland caribou in the project area occur only in the extreme northern Idaho and Washington, where two small populations exist (U.S. Fish & Wildlife Service Status Report 1995). Woodland caribou, moose, mountain sheep, and goats also may interact with populations in British Columbia and Alberta. Caribou inhabit Engelmann spruce/subalpine fir and western red cedar/western hemlock, mature, or old forest stands. Although woodland caribou

populations have been stable, there is concern that low reproductive success, increasing predation by mountain lions, poaching, and harassment from winter recreation may drive caribou to extinction (U.S. Fish & Wildlife Service Status Report 1995).

Although not required to the same degree by each of the project area's listed wildlife species, late and old forest structure and old forests are important habitats for all. This is especially true for the bald eagle and woodland caribou. More detailed discussions of ecological niches and roles, and specific habitat requirements for listed species, can be found in the appropriate recovery plans or wolf reintroduction EIS.

Peregrine falcons need high cliffs for nesting (at least 30 feet in height) where they are secure from predators. It is important to peregrines to have good bird prey populations in areas surrounding the cliffs. Bald eagles winter in Idaho and Montana, in locations that are influenced by winter weather conditions. Wintering eagles require large hardwood or conifer trees (over 16 inches in diameter) near ice-free bodies of water that contain fish. Nesting eagles need large trees in late successional forests with low levels of human disturbance. Nest habitat is usually within one mile of water that supports fish and waterfowl. Bald eagles and a variety of other predatory birds also use large dead trees for roosting (U.S. Fish & Wildlife Service 1995).

Specific discussions of wildlife by forest PVG are found under dry, moist, and cold forest sections that follow.

Rangelands in Forested Areas: Transitory Rangelands

Rangelands in forested areas are called transitory rangelands. These rangelands are lands that are suitable for grazing use; however, because transitory range changes over time, its availability changes also. Transitory rangelands are generally associated with timber harvest activities which open up the tree canopy, but they can also be created by major fires or insect and disease events. Understory plant species suitable for grazing grow well in these newly opened areas because there is less competition for sunlight and moisture. Transitory range is found in dry, moist, and cold forest potential vegetation groups.

A portion of annual forage production for livestock comes from transitory range, particularly in heavily forested areas. Although disturbance events that help create transitory range allow forage values to increase, these values will decrease over time as numbers of trees increase and as the stand reverts to pre-disturbance levels. The rate at which trees reestablish or the overstory canopy closes is directly correlated with the longevity of transitory range.

Timber practices that maintain open canopy conditions will prolong forage production on transitory range. Available forage increases are directly related to the amounts and types of timber harvest activities. Plant palatability, forage quantity, and nutrient content all increase as plants are exposed to more moisture and sunlight after reduction of the forest canopy. Usable forage within timber harvest areas can decrease in the first few years after harvest because of downed trees, slash, and disturbance to the site from harvest and slash removal. Shrubs, forbs, and grasses may require a few years for establishment to a point where plants can be grazed successfully. Livestock may be discouraged on some sites until tree regeneration is adequate and established.

Dry Forest Potential Vegetation Group

*Potential Vegetation Types (PVTs):
Dry Forest:*

- Dry Douglas-fir without ponderosa pine
- Dry Douglas-fir with ponderosa pine
- Dry grand fir / white fir
- Interior ponderosa pine

Distribution and Description

The dry forest potential vegetation group currently makes up 18 percent of the ICBEMP project area and 13 percent of the UCRB planning area, with 69 percent occurring above 4,000 feet in elevation. The Forest Service or BLM administer 56 percent of dry forests in the project area (Landscape Ecology STAR 1996). In the UCRB planning area, the dry forest PVG is primarily distributed in ERUs 13 and 9, in

central Idaho and western Montana (see map 2-3 in the Introduction to the Terrestrial Ecosystems section). Forest stands in dry forests are generally limited by low moisture, and are often subject to drought. Dry forest areas can also be stressed by limited nutrients if surface soils are eroded or displaced, or if tree density is high.

Historical conditions ~ The vegetation types, structural stages, and dynamics, and other conditions and processes, that are likely to have occurred around the time of pre-European settlement, approximately the mid-1800s. This time period is used only as a reference point to understand ecological processes and functions. In many cases it is neither desired nor feasible to return to actual historical ecological conditions.

Biophysical template ~ The successional and disturbance processes, landform, soil, water, and climate that formed the native system with which species of plants and animals evolved.

Composition and Structure

Tree species that make up dry forests are those that are capable of surviving in dry environments under, disturbances processes typical in dry forests. Ponderosa pine is widely distributed throughout dry forests in Idaho and western Montana. On the driest sites, ponderosa pine occurs in open, well-spaced stands with an understory of shrubs and herbaceous vegetation. On other sites, ponderosa pine occurs with a subdominant or co-dominant layer of interior Douglas-fir, white, and/or grand fir.

Quaking aspen is one of the non-coniferous trees associated with the dry forest potential vegetation group. Aspen is a deciduous tree species that occurs in relatively moist habitats within natural openings of forest stands. Non-tree vegetation of the dry forest PVG is diverse. On dry sites, shrubs are generally widely spaced in the understory beneath tree cover and are fire-tolerant and shade-intolerant. Spaces between shrubs are generally occupied by fire-tolerant and shade-intolerant grasses and forbs. On sites with dense tree cover, growth of shrubs and herbaceous plants can be limited by shade.

The dry forest PVG frequently shares lower elevation edges with grasslands, which form alternating vegetative patterns interspersed with tree-dominated stands. Between grassland and

*Photo 3***NOT AVAILABLE IN PDF**

Photo 3. Ponderosa pine forests historically were characterized as unbroken parklands of widely spaced tree clumps with a continuous understory of grasses and flowering plants. Photo by USFS

tree-dominated patches, shrubs may be dense. Shrub species in this ecotone or boundary area include: snowbrush, mallow ninebark, common snowberry, antelope bitterbrush, and kinnikinnik. Herbaceous species throughout the dry forest PVG include: elk sedge, Wheeler's bluegrass, cat's ear mariposa lily, harsh paintbrush, silky lupine and few-flowered pea.

Historical Conditions

When European settlement began, ponderosa pine forests could be characterized as unbroken parklands of widely spaced tree clumps with a continuous understory of grass and flowering plants. These forests were fairly extensive and experienced frequent low-intensity surface fires because of the presence of highly combustible leaf litter and cured herbaceous vegetation, along with a long season of favorable burning weather. Most stands were open and park-like, with uneven-aged stands dominated by old fire-resistant trees. Shrubs, understory trees, and downed logs were sparse. Undergrowth was primarily fire-resistant grasses and forbs, which resprouted after each fire. Pine regeneration occurred where the death of overstory trees created small openings. Sometimes seedlings grew fast enough to gain adequate resistance to survive the next fire. In most of the dry forest PVG, fire maintained the dominance of ponderosa pine by killing the more fire-sensitive seedlings and saplings of Douglas-fir, grand fir, and white fir that may have established (Arno 1995).

Historically, 91 percent of the forest would sustain nonlethal underburns, with over half of those at intervals of less than 25 years, in which the dominant fire-tolerant (shade-intolerant) overstory survived but regeneration and fire-intolerant (shade-tolerant) species often were killed. Only about one percent of the area had mixed severity fires that killed some dominant overstory trees, and about eight percent of the area had a lethal, stand-replacing fire regime. Fires lethal to the overstory usually occurred in steep or windy areas where fire would easily carry into the canopy, or on low productivity sites where trees did not grow tall enough between fires to resist flames.

Current Conditions and Trends: Departures in Composition, Structure, and Disturbance Processes and Patterns

Departures in Composition and Structure

The composition, structure, and disturbance patterns in dry forests have changed significantly through timber harvesting, fire suppression, and/or livestock grazing, even though the actual loss of the PVG from historical amounts has been slight. Human-caused disturbances have been more pronounced in the dry forest potential vegetation group than in the moist or cold forest groups. This is partly because dry forests are more accessible to housing development, logging, and grazing. Dry forests also contained tree

Photo 3a. Dry forests currently have ponderosa pine being replaced by Douglas-fir and grand fir/white fir. Photo by Doug Basford.

Photo 3a

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species historically favored by the timber market (Everett et al. 1994).

There are currently 25 percent more young tree stands than there were historically. However, these types of stands are most often created by harvesting and are missing the scattered large live and dead trees that would have been present if a fire had initiated the stand (Landscape Ecology STAR 1996). Ponderosa pine has been replaced by grand fir and white fir on 19 percent of its range, and by interior Douglas-fir on another 20 percent of its range. The old single story stage of ponderosa pine is at 25 percent or less than its historical amount. On the other hand, the old multi-story stage of Douglas-fir, grand fir, and white fir is approximately three times its historical amount, while the young forest structural stages of Douglas-fir, grand fir, and white fir are nearly double their historical amounts.

Currently, 30 percent of stands within dry forests are dominated by shade-tolerant species, or more than twice the amount that existed in the early 1800s (Landscape Ecology STAR 1996).

The clumpy character of historical stands that was created by fire has changed. Overall, stand structures changed from open park-like stands of large trees with clumps of small trees, to dense overstocked young stands with several canopy layers (Caraher et al. 1992, Gast et al. 1991 in Lehmkuhl et al. 1994). Landscapes once dominated by shade-intolerant species are nearly double their historical level.

Maps 2-9 and 2-10 show the historical and current distributions of tree species within the dry forest PVG.

Departures in Fire Regimes

Important changes have occurred in most of the dry forest PVG since 1900 due to interruption of frequent burning. Reduced fire occurrence began in the late 1800s as a result of the following: (1) relocation of American Indians; (2) fuel removal by heavy grazing of livestock; (3) disruption of fuel continuity on the landscape due to irrigation, cultivation, and development; and (4) adoption of fire exclusion as a policy. The general result has been development of dense conifer understories beneath old stands and thickets of small trees where the overstory has been removed. In many stands, duff mounds 6 to 24 inches deep have accumulated under old trees, and burning these mounds can girdle and kill the trees.

Lack of frequent nonlethal underburns has resulted in an increase in fuel loading, duff depth, and stand density, and a fuel ladder that can carry fire from the surface into the tree crowns. Levels of carbon and nutrients tied up in woody material are higher than they were historically (figure 2-12). The increase in fire intervals, without equivalent fuel reductions, has resulted in much higher fireline intensities and fuel consumption when fires do occur. This causes much higher mortality of the dominant overstory trees, as well as higher potential for soil heating and death of tree roots and other understory plants.

About 39 percent of acres currently have the potential to sustain nonlethal underburns, but they occur at frequencies greater than 76 years. Currently about 36 percent of the area has a mixed severity regime, most ranging in

occurrence between 76 to 150 years. Lethal stand-replacing fires occur on about one-quarter of the area, at a rate three times greater than historically. About 60 percent of the area that used to burn with nonlethal fires now has a mixed severity or lethal stand-replacing fire regime. (See maps 2-7 and 2-8, and table 2-8.)

Fire exclusion effects have been greatest in the most heavily roaded areas where suppression has been successful. Development of residential areas and other cultural facilities in forests of the UCRB has been most common in this PVG, which, coupled with the changed fire regime, has caused a greatly increased risk to life and property (see Human Uses and Values section for additional discussion).

Human Disturbance

In general, forests showing the most change are those that have been roaded and harvested. Large trees of high-value species, such as ponderosa pine, were selectively logged. True firs, Douglas-fir, and lodgepole pine were left in stands either because these species were not desirable on the timber market or because they were smaller trees and could not be processed efficiently. The remaining trees, which were not always the best genetic stock, provided seeds for the next generation of forest. Exclusion of fires and availability of seeds allowed shade-tolerant

trees to replace open, park-like stands with dense stands of trees. These dense stands did not receive the thinning treatment of frequent fires, resulting in competition for sunlight and nutrients. These stands now exhibit changes in forest health including a loss of growth potential due to overstocking, greater risk of severe insect and disease problems, greater risk of high severity fires, and a loss of habitat diversity in the forested site when compared to historical conditions.

The dry forest PVG is particularly vulnerable to the introduction of exotic species (noxious weeds). Noxious weeds such as knapweed are rapidly displacing native species in some places.

Insects and Disease

The insect and disease relationship as it relates to forest health in dry forests has changed as forest structure has changed. Insects and diseases always existed in forests, but the size and intensity of their attacks have increased in recent years (Caraher et al. 1992, Gast et al. 1991 in Lehmkuhl et al. 1994). With the exclusion of fire, stand densities are often much greater, and species composition has changed to dominance by trees such as Douglas-fir, grand fir, and white fir. The younger forest structure or multi-layered structure comprised of a high proportion of shade-tolerant species is highly

Table 2-8. Changes in Fire Regimes in the Dry Forest PVG, in Percent of UCRB Planning Area, FS-/BLM-Administered Lands.

Fire Regime Class	Historical Percent	Current Percent
Nonlethal underburns, very frequent (<25 years)	47.5	0.1
Nonlethal underburns, frequent (26–75 years)	23.1	0.1
Nonlethal underburns, infrequent (76–150 years)	20.0	38.4
Nonlethal Underburns	90.6	38.6
Mixed severity, frequent (26–75 years)	1.3	8.7
Mixed severity, infrequent (76–150 years)	0.1	27.0
Mixed severity, very infrequent (151–300 years)	0	0
Mixed Severity	1.4	35.8
Lethal, stand-replacing, frequent (26–75 years)	5.8	0.2
Lethal, stand-replacing, infrequent (76–150 years)	2.2	25.4
Lethal, stand-replacing, very infrequent (151–300 years)	0	0
Lethal, Stand-Replacing	8.0	25.6

Source: ICBEMP GIS Data (1KM² raster data)

susceptible to large-scale infestations of insects and disease. Overstocked stands result in moisture stress in the normal summer drought period, and make stands highly susceptible to bark beetles. Bark beetles currently often replace fire in eliminating trees growing in excess of site potential.

Susceptibility to the Douglas-fir beetle has increased in the Blue Mountains, Lower Clark Fork, and Snake Headwaters ERUs. This was attributed to increased contagious spread of shade-tolerant Douglas-fir, increased abundance of host trees of adequate size for successful bark beetle breeding, increased patch densities and layering of canopies, and increased landscape contiguity of susceptible areas. Susceptibility to fir engraver beetle increased in the Central Idaho Mountains and Upper Clark Fork ERUs and declined in the Blue Mountains ERU. While grand fir and white fir have increased in area in the Blue Mountains, that increase is occurring in the understories of multi-layered patches. Timber harvest and fir engraver mortality of productive grand fir and white fir patches have contributed to the precipitous decline in that cover type in the Blue Mountains ERU.

Susceptibility to defoliators (needle-eating insects) such as western spruce budworm and Douglas-fir tussock moth has increased in several ERUs and declined in none. The increased susceptibility was attributed to increases in shade-tolerant Douglas-fir, grand fir, and white fir and the increased density and layering of canopies. These insects have been active in all ERUs in the UCRB planning area.

Areas susceptible to Douglas-fir dwarf mistletoe increased in the Blue Mountains and Snake Headwaters ERUs and declined in the Upper Clark Fork ERUs. Increasing susceptibility was associated with increased abundance of Douglas-fir, increased canopy layering, and Douglas-fir encroachment on dry and relatively moist sites that historically had frequent understory fires. Areas susceptible to ponderosa pine dwarf mistletoe decreased with the declining area in the ponderosa pine cover type in the Blue Mountains and Northern Glaciated Mountains ERUs.

Susceptibility of dry forests to *Armillaria* root disease, laminated root rot, and S-group annosum root disease is similar to that described in the moist forest potential vegetation group, later in this section.

The increasing number of small dead trees in stands attacked by insects and diseases makes forests even more susceptible to large high-intensity fires. The stands that are most susceptible to moisture stress, insects, and disease tend to be those at the lowest elevations, which typically border private, State, tribal, or other land ownerships. Homes, private, tribal, and State forest resources, wildlife winter ranges, and other important resources are increasingly at risk from fire and insect and disease attack from lands administered by the BLM and Forest Service (Everett et al. 1994).

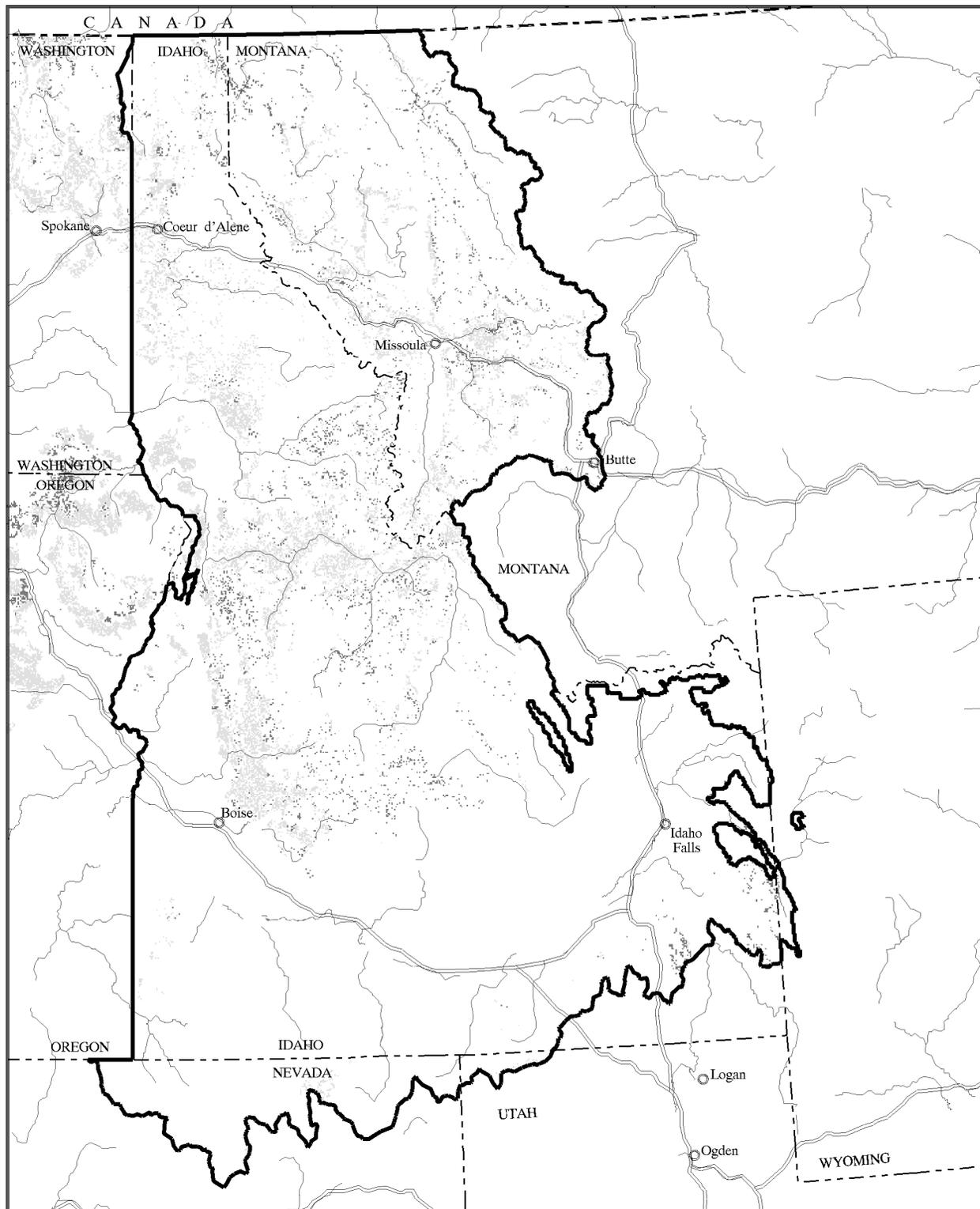
Terrestrial Species and Habitats in Dry Forests

General Trends

Species that evolved in dry forest environments adapted to changes brought on by frequent disturbances. They did so by shifting within the environment and using the mosaic of habitats and microsites (small habitat areas) created by fires and other events (Collopy and Smith 1995).

For the most part, species associated with the dry forest potential vegetation group have undergone the most change in habitat conditions over time. Habitat patches that were once large areas of pine forests are now much smaller, which makes it more difficult for animals to move to other patches of similar habitat (Collopy and Smith 1995, Everett et al. 1994). Fragmentation and loss of connection of similar habitat means that some animals have to travel farther to find suitable habitat. Some animals are limited in how far they can travel, and those that travel are more vulnerable to predators and mortality from traffic and other hazards. Fragmentation has increased isolation of different wildlife populations and limited genetic interchange between populations. Some areas were identified in the Terrestrial STAR (1996) as having several species with very limited distribution (narrow endemics); (see map 2-5, in Introduction to Terrestrial Ecosystems section). These species are especially vulnerable to local disturbance events that can endanger an entire population or species.

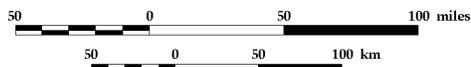
Species associated with late-successional forest and old open ponderosa pine were likely affected the most by changes in habitat conditions that occurred in dry forests over the past 100 years (Terrestrial and Landscape Ecology STARs 1996). There also has been a decline in large snags and



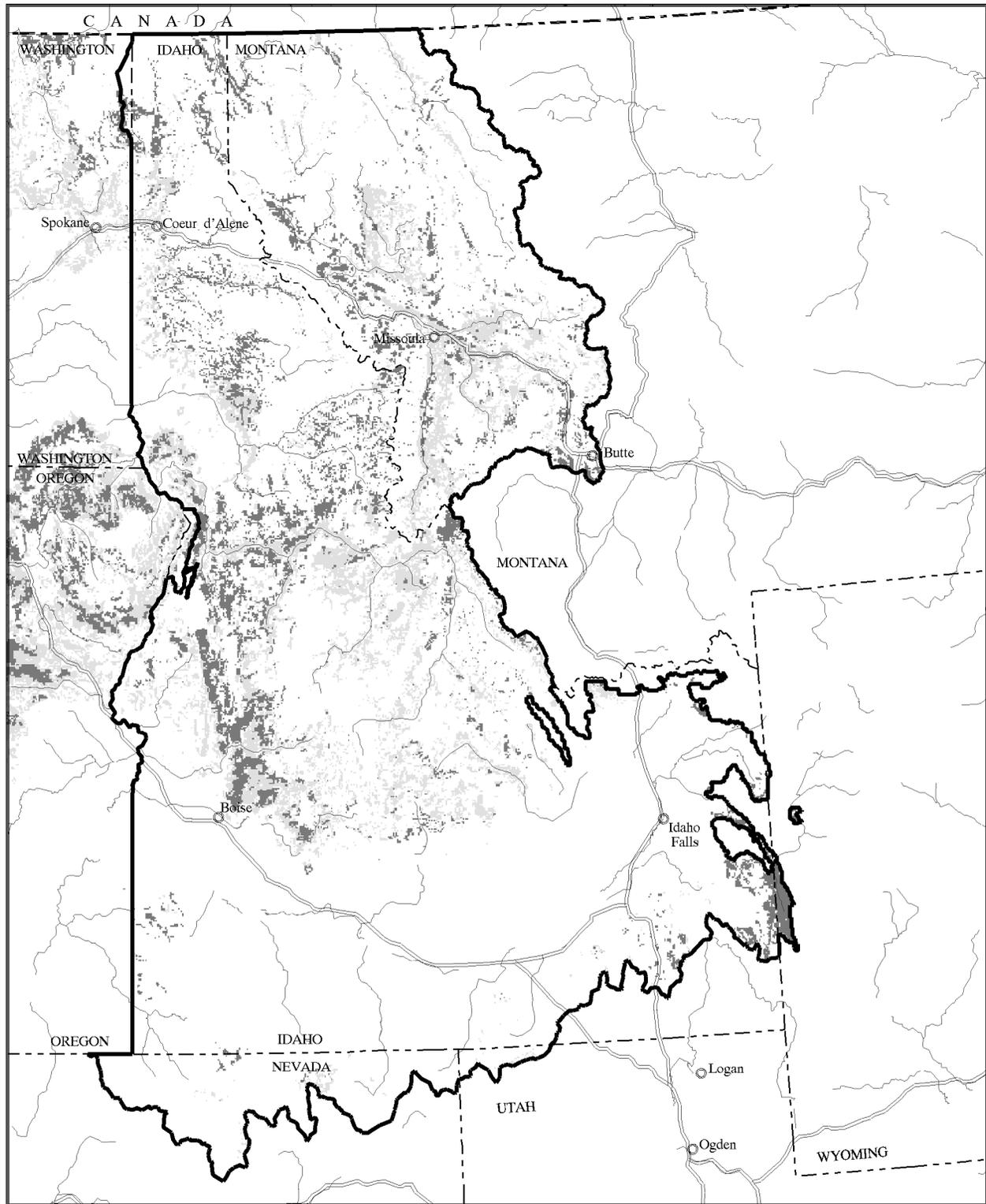
**Map 2-9.
Dry Forest Distribution
Historical**

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Draft UCRB EIS
1996



- Shade-tolerant Tree Species*
- Shade-intolerant Tree Species*
- Major Rivers*
- Major Roads*
- EIS Area Border*
- Cities and Towns*



Map 2-10.
Dry Forest Distribution
Current

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

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 1996

- | | | | |
|---|--------------------------------------|---|-------------------------|
|  | <i>Shade-tolerant Tree Species</i> |  | <i>Major Rivers</i> |
|  | <i>Shade-intolerant Tree Species</i> |  | <i>Major Roads</i> |
| | |  | <i>EIS Area Border</i> |
| | |  | <i>Cities and Towns</i> |

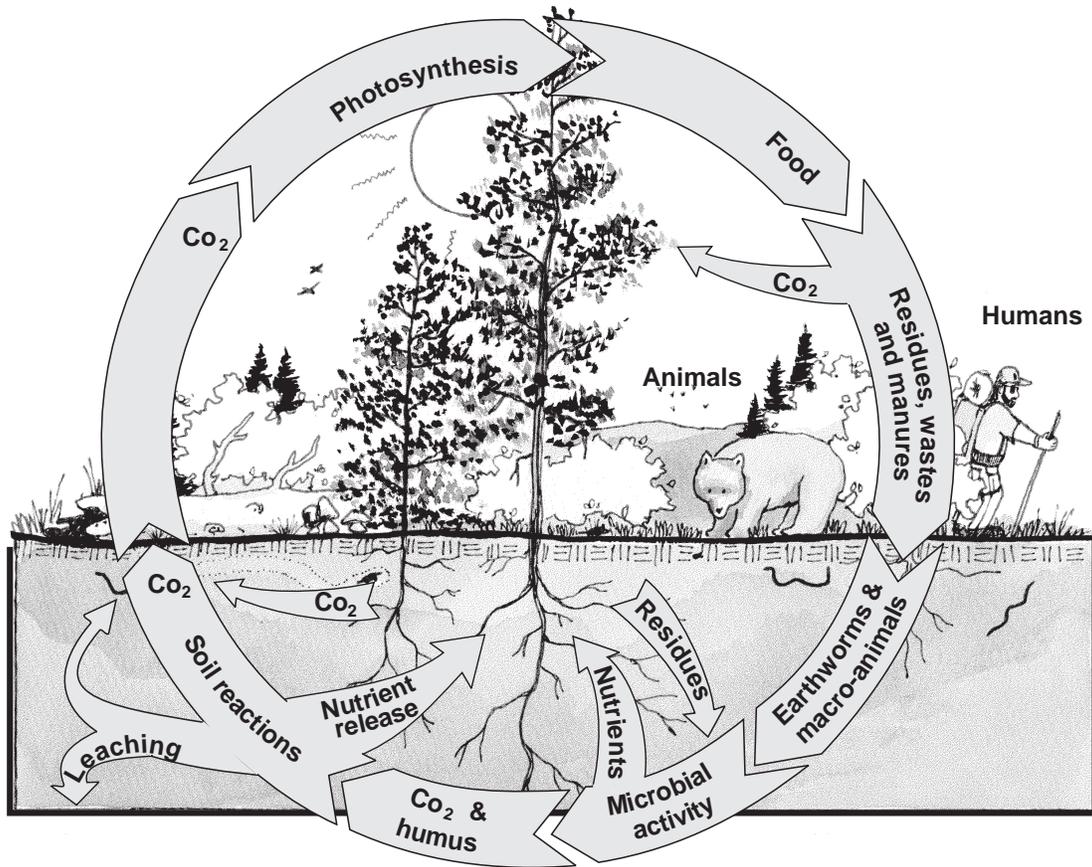


Figure 2-12. Carbon cycle and Forest Health.

A key ecological component of ecosystem health is effective cycling of energy and materials. One such cycle of particular importance in the coniferous forests of the UCRB is the carbon cycle. Carbon - the key building block in all living cells - is captured primarily through photosynthesis and stored in the form of needles, leaves, stems, twigs, branches, bark, roots, and wood fiber in trees and understory plants. Carbon can also be diverted below ground to support soil organisms and processes. Carbon is recycled through the combined processes of fire and microbial decomposition.

Historically, disturbances such as fire, insects, and disease regulated processes important to carbon cycling within forest ecosystems. Fungal disease and some insects shortened nutrient cycles or accelerated decomposition. Frequent low-intensity fires prevented build-up of carbon and nutrients in woody biomass and litter and duff layers. This was especially true for warm, dry sites characterized by ponderosa pine/Douglas-fir and ponderosa pine/western larch forests.

Without fire, carbon accumulates to levels that are higher than would have occurred historically in many places. In the UCRB, more carbon is now being accumulated and stored in denser stands of shade-tolerant, non-fire-adapted species. Insect and disease disturbance has increased and has begun to play a larger role in carbon recycling. As tree mortality increases, more carbon and nutrients are tied up in standing and downed dead woody material and in deep organic layers on the ground. Soil properties and soil-vegetation relationships also have been affected since many beneficial soil organisms depend on living trees to fuel their activities.

These changes to the carbon cycle set the stage for widespread extreme wildfire events that result in an excessive loss of carbon being released all at once and that jeopardize associated ecosystem components and functions.

Carbon and other nutrient and biophysical cycles are key ecological processes in every ecosystem type and are inextricably woven together through and across ecosystem boundaries. The carbon cycle is discussed here to highlight its importance to forest health, it also is critical to rangeland and riparian/aquatic ecosystem health.

downed logs, especially where firewood gathering and salvage logging has occurred. Most of the snag-dependent birds and small mammals are insectivorous and may play a role in regulation of insect populations. Snag-dependent species tend to increase along with the number of snags until other factors become limiting. Snag diameter and height and downed log quantity and size are important criteria for selection by snag-dependent species (Thomas et al. 1979, Torgersen and Bull 1995).

The diversity of habitat created by mosaic fire patterns is rarely present in more uniform logging units of unburned stands. Increased density of trees in dry forest stands in all structural stages has limited light, moisture, and nutrients available to understory plants and animals. Dense stands retard the ability of forests to produce large trees and snags for future habitat (Landscape Ecology STAR 1996, Collopy and Smith 1995, Henjum et al. 1994).

Animals that are most vulnerable to changes in habitat are those that depend on a narrow range of habitats, and those that are not very mobile. Mobile species and animals that use a variety of habitats can move into other habitats types or patches when disturbance occurs (Terrestrial STAR 1996). Coyotes, deer mice, robins, big brown bats, black widow spiders, and house wrens have all adapted to unique habitats created in people's backyards, where dry forests often once stood. Changes in disturbance patterns and created habitats have allowed exotic plant and animal species, such as spotted knapweed, musk thistle, starlings, and bullfrogs to invade dry forests and compete with native species. Logging, road construction, seeding of exotic grasses and forbs, and other disturbances often create opportunities for domestic livestock to graze in forested habitats, which may further spread exotic species and may compete with native wildlife for forage.

The decline in open, single-storied mature pine and larch stands has reduced habitat for the olive-sided flycatcher and Lewis's woodpecker, both of which have shown declines in the past 25 years (Saab 1995). Species closely associated with old forest stages such as the Lewis and Pileated woodpeckers and the Williamson's sapsucker are believed to have decreased because of the reduction of old forest stages (Terrestrial STAR 1996). The Townsend's big-eared bat, California myotis bat, and fringed myotis bat are believed to be affected by this

Photo 4

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Photo 4: Snags or standing dead trees have declined, with implications for wildlife species that depend on snags for habitat.

Photo by Doug Basford.

same loss of large trees for roosting. These species may help control insect populations which in turn influence tree survival. The Terrestrial STAR (1996) concluded that one tree bole feeder, five bark beetles, and 22 defoliating insects can alter plant succession and create new vegetation patterns. The decline in insect-eating birds and bats due to the change in old forest structure can have dramatic effects on structure, energy flow, nutrient cycling, and soil productivity of future forests.

Roads, especially interstate highways or other multi-laned high-traffic roads, present barriers to carnivores and other species. While the situation may be infrequent, it causes major problems where it occurs.

Invertebrates

Historically, the variety of tree species in dry forests was relatively low and patch sizes were relatively large, allowing invertebrates (species with no backbone) to distribute across a broad area. Insects sometimes play an important role, in concert with drought and fire, in shaping stand and landscape structure. Invertebrates perform vital functions in the forest by decomposing wood and litter that return nutrients to the energy cycle, and by serving as food for all other groups of animals. Other important Key Ecological Functions of invertebrates include turning over soil and increasing its productivity, pollinating flowers, and dispersing seeds (Terrestrial STAR 1996).

Invertebrates use a variety of habitat patches and microsites in forests that appear uniform. Tree canopies, downed wood material, snags, flowers, forest floor litter, and soils are important habitats for invertebrates and are considered Key Environmental Correlates in the Terrestrial Staff Area Report (1996). Many unique and some rare or endemic species (species with very limited distribution) of invertebrates depend upon talus, caves, bogs, springs, gravel, and other forest habitat features which also are Key Environmental Correlates. Even after fires, islands of unburned trees and litter and large trees with thick bark provide places for insects and other invertebrates to survive and recolonize the area.

Dense stocking of stands due to fire exclusion has reduced the amount of light to the forest floor, which has reduced understory vegetation, temperature, and decomposition rate and nature of woody debris for invertebrates. Within burned areas, mosaic patterns of habitat and unburned islands of vegetation have decreased. This limits the distribution of less mobile species of invertebrates, such as snails, and may limit recolonization of disturbed areas with invertebrate species (Terrestrial STAR 1996). Increased compaction and soil displacement during logging, grazing, and other activities have reduced habitat effectiveness for some soil invertebrates, such as earthworms, nematodes, and bacteria, and may influence long-term site productivity.

Amphibians

Many salamanders and frogs use downed wood, talus, and trees, but riparian areas and wetlands habitat within dry forests are Key Environmental Correlates for amphibians. The Terrestrial Staff

database for the area contains seven frogs, two toads, one newt, and four salamanders in the forest potential vegetation groups. Key Ecological Functions of amphibians include helping to control insects, turning over soils, creating burrows for other species, and indicating water quality and quantity (Terrestrial STAR 1996).

Many salamander and frog populations are vulnerable because of changes or reductions in available riparian habitats brought on by logging and grazing, predation by exotic fish and exotic bullfrogs, changes in invertebrate populations, and potential climate changes. The tiger salamander is used as live bait and has shown an increase in distribution, probably due to releases during fishing. The spotted frog has declined in southern Idaho, likely due to conversion of wetlands to agriculture and development of springs. The western toad is also declining in some parts of its range due to dam and spring developments in dry forest streams and seeps (Terrestrial STAR 1996).

Reptiles

Reptile distribution is influenced more by climate and terrain than by vegetation type or structure. There are two turtles, one lizard, one skink, and few snakes known that may occur at lower elevation forested sites. Most reptiles are restricted to open areas and lowlands because, as cold-blooded animals, they need warmer temperatures and rocky talus habitats; cooler temperatures at higher elevations limit their ability to regulate body temperature. Key Ecological Functions of reptiles include helping to control rodents and insects (on and below the ground surface), providing food for birds and mammals, and providing burrows for other animals (Terrestrial STAR 1996).

Reptiles are highly susceptible to changes in climate and microsite, especially in forested ecosystems, which are at the upper elevation end of their range. Downed logs, talus, and rocks are important habitat features that have been altered in some locations because of road construction. Changes in populations of invertebrates and small mammals also limits prey for some reptiles. The increased stocking density of dry forest stands provides more shade, which may be reducing habitat quality for reptiles. The common garter snake is widespread, but appears to be declining, especially in southeastern Idaho (Terrestrial STAR 1996).

Birds

Birds use all the structural stages of dry forests, from young stands and brushy openings to old forests and dead trees and logs. The presence of riparian vegetation within the forest brings in additional bird species, such as many ducks and shore birds, with some stopping only during migration (Collopy and Smith 1995). The Terrestrial Staff database lists 118 bird species that use at least some aspects of dry forests. Federally listed species that use dry forest in the planning area include the threatened bald eagle, which needs large trees for nesting and roosting, and the endangered peregrine falcon, which uses cliff habitat to nest while it preys on birds in open stands of trees in dry and other forests.

At least 11 species of woodpeckers rely on dead trees for excavation of nesting holes. A Key Ecological Function of woodpeckers is the excavation of holes that are important for many other birds and mammals that need holes for nesting but cannot excavate their own. Fourteen other species of birds use pre-excavated cavities in standing dead trees (snags). Different species of woodpeckers select different habitats, with some using trees over 16 inches in diameter, some using smaller trees, and others needing clumps of dead trees or trees of different heights. Woodpeckers, and other birds and bats that use woodpecker holes, are very important for controlling insect outbreaks and for bird watching for the interested public (Terrestrial STAR 1996, Thomas et al. 1979).

Birds with large wing-spans, such as some hawks and owls, hunt for food in openings or in open stands of trees. The tight spacing of trees in dense stands makes it difficult for them to fly between trees, and may limit populations of some prey species. Goshawks use large trees in older stands of mixed conifers, pine, Douglas-fir, lodgepole pine and aspen to nest; they also need mixed old and young forest structures with water in areas surrounding the nest for feeding and fledging of young birds (Thomas et al. 1979, Schommer and Silivsky 1994).

The decline in large trees affects nesting and roosting habitat for birds. It is believed that a decline in nesting sites and foraging areas for the goshawk, Vaux's swift, pileated woodpecker, white headed woodpecker, and flammulated owl has occurred. No quantitative data is available to compare population trends of these species from

a few decades ago (Collopy and Smith 1995). The Olive-sided Flycatcher is the only old forest species with sufficient sampling to show a long-term decline in population (Collopy and Smith 1995, Terrestrial STAR 1996). Several species that use medium to small dead trees with pre-excavated cavities ~ such as the northern flicker, tree swallow, violet-green swallow, house wren, and mountain bluebird ~ show increasing population trends. This may be correlated with the recent increase in insect and disease outbreaks and fires in densely-stocked stands that has created an abundance of small dead trees (Collopy and Smith 1995). White-headed woodpeckers and flammulated owls are among the species associated with old single story ponderosa pine. Because of loss and changes in this type of habitat, these species are believed to have declined and are considered Sensitive by Federal agencies (Terrestrial STAR 1996).

Photo 5

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Photo 5. Woodpeckers excavate holes that are important for many other birds and mammals. Photo by Doug Basford.

Brown-headed cowbirds, which are nest parasites on other birds, have increased. Species that use shrubby riparian areas and young forests increased (western wood-peewee, dusky flycatcher, northern oriole, lazuli bunting, and warbling vireo); (Collopy and Smith 1995). The reasons these species have increased are not completely understood (Terrestrial STAR 1996).

Mammals

The Terrestrial database lists 70 species of mammals in dry forests. Mammals use a wide variety of habitats, including burrows below the surface, litter, downed logs, rock outcrops, openings, young forests with or without shrubs, and middle, late, and old forests. Many squirrels, mice, woodrats, and other species rely on seeds from trees, especially large ponderosa pine seeds. Some chipmunks and other small mammals use young and dense stands because they prefer the jumble of logs and canopy cover that protects them from predation. Mule deer and elk rest, hide, and forage in tree or brush stands, but dense stands of trees often have too much shade to provide shrubs, grass, and forbs needed for food (Lyon et al. 1995). Desert and mountain bighorn sheep avoid dense stands of trees or shrubs where food (grass and forbs) is limited, sight distances are short, and sheep are more vulnerable to predators.

Thirteen species of bats use thick barked trees, especially large ponderosa pine or western larch, for roosting. Old buildings, bridges, caves, mines, tree cavities, and other small openings are

also used by bats for roosting. Bats prey on a variety of insects and may help control insect outbreaks in dry forests (Terrestrial STAR 1996).

Some mammals, such as the pocket gopher, porcupine, and mountain beaver, have benefitted from clearcut logging and plantations. As these species increased, carnivores that help control them ~ such as the fisher, marten, mink, and goshawk ~ decreased, probably because of trapping, predator control, and habitat changes (Terrestrial STAR 1996). As a consequence, animal-related tree damage in plantations has increased. Conversion of open stands of pines to densely stocked, mixed species forests has benefitted some squirrels, but the loss of understory vegetation and habitat mosaics may be affecting other species, such as the mountain cottontail and pygmy shrew. These small forest mammals are important food for hawks, owls, eagles, and other carnivores, and they help transport and plant seeds.

Historical accounts are not conclusive, but it appears that elk and white-tailed deer populations in the dry forest potential vegetation group are higher than they were before European settlement. Elk and white-tailed deer have expanded their ranges in recent times, providing increased hunting opportunities but also causing potential damage in the rural and agricultural interface on private lands. In some forest settings, elk and deer are using dense stands of shade-tolerant understory trees for cover, which they would not have used as extensively under natural fire regimes. Open road density is high

Photo 6

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Photo 6. Deer are among the wildlife that use stands of trees for cover in winter. Photo by USFS.

in the dry forest potential vegetation group, due to the gentler terrain, emphasis on timber harvest, and proximity to human habitation. People using highly roaded areas are the single biggest threat to big game populations, making them vulnerable to poaching, stress, hunting, accidents, and displacement (Lyon et al. 1995).

Bighorn sheep are also popular for hunting and viewing. While some populations are maintaining current numbers, other populations are generally declining due to widespread habitat changes, such as replacement of grass, forbs, and low shrubs with tall shrubs and trees, which bighorns avoid due to increased predation. Fire exclusion and grazing of domestic livestock make contributions to these habitat changes (Lyon et al. 1995).

Moist Forest Potential Vegetation Group

*Potential Vegetation Types (PVTs):
Moist Forest*

Cedar/hemlock-Inland
Moist Douglas-fir
Grand fir/white fir-Inland
Spruce-fir, wet

Distribution and Description

The moist forest potential vegetation group includes transitional areas between drier, lower elevation forest or woodland types in dry forests, and higher elevation subalpine forest types in cold forests (Agee 1993). Approximately 40 percent of the moist forest potential vegetation group in the project area occurs at elevations less than 4,000 feet. Moist forests cover approximately 18 percent of the project area and 29 percent of the UCRB planning area; 64 percent of that is administered by either the Forest Service or BLM (Landscape Ecology STAR 1996). In the UCRB planning area, the moist forest PVG is primarily distributed in ERUs 7 and 8 and the northern part of ERU 13 (see map 2-3 in the Introduction to Terrestrial Ecosystems).

Moist forests typically have relatively high soil moisture in the spring and early summer, followed by drought stress in the late summer and early fall. Available nutrients in the soil can

limit productivity, particularly on sites where harvest practices have caused soil loss or have removed a large proportion of wood, litter, duff, and small branches that contain the bulk of site nutrients. Tree growth rates are generally rapid, and young forests develop relatively quickly into middle-aged stands. This PVG has a productive environment which rapidly produces biomass and accumulates fuels; insects and pathogens are potentially very active.

Maps 2-10a and 2-10b show the historical and current distributions of tree species within the moist forest PVG.

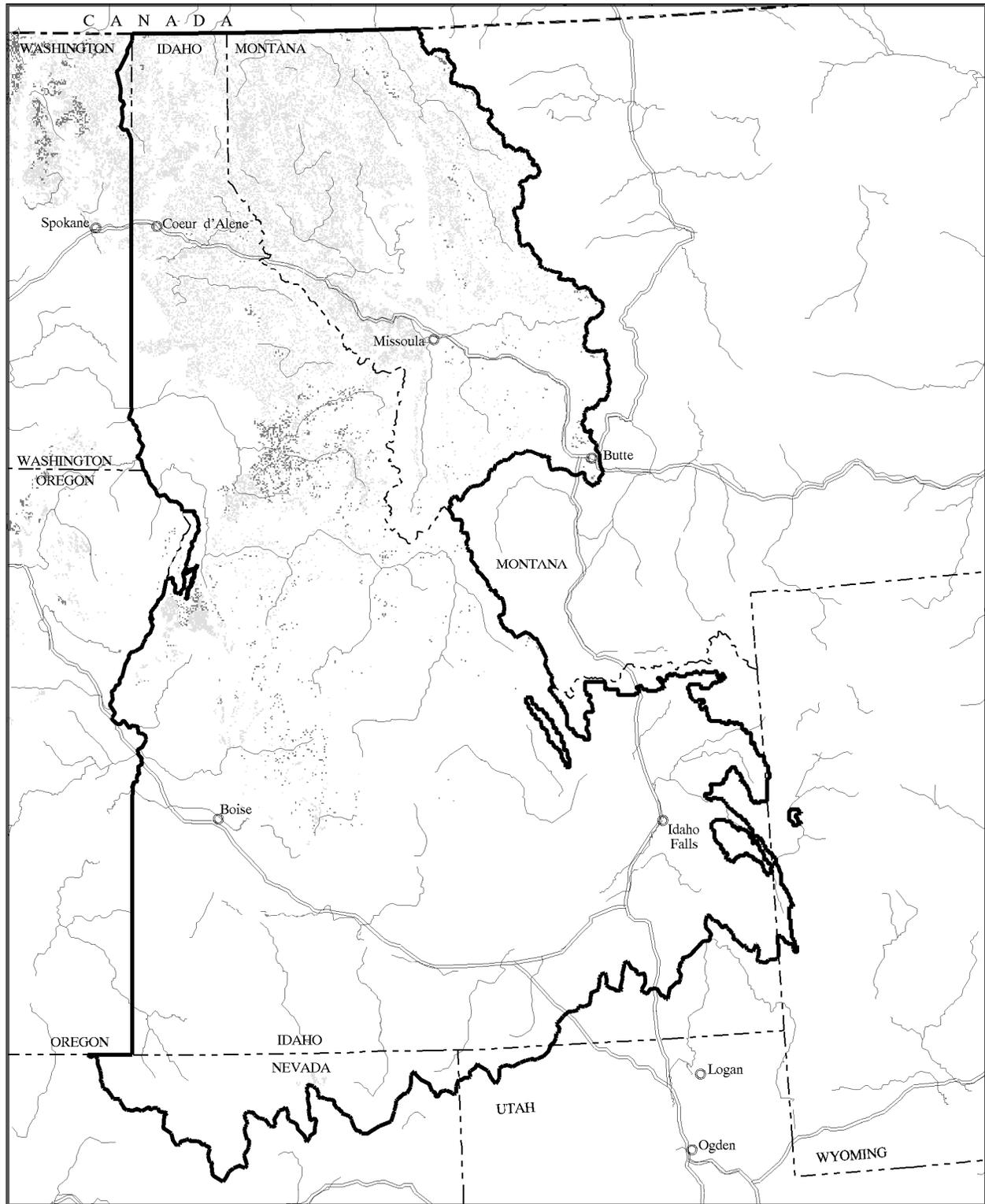
Composition and Structure

Shade-intolerant species, which historically dominated 70 to 80 percent of moist forest stands, are western white pine, western larch, lodgepole pine, interior ponderosa pine, and sometimes interior Douglas-fir. The dominant shade-tolerant species are Engelmann spruce, subalpine fir, grand fir, white fir, interior Douglas-fir, western redcedar, western hemlock, and mountain hemlock.

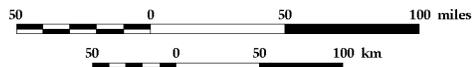
Typically in both young and old healthy moist forests, single layer forests are dominated by shade-intolerant species. Occasionally, there are long periods (50 to 150 years) between fires where shade-intolerant species shift to shade-tolerant species, because young trees growing in the shade of mature trees are not thinned out by fire. Old multi-layer stands often have a mix of shade-tolerant and intolerant species, depending on the fire history of the stand.

The adequate moisture levels, moderate climate, and presence of soils derived from volcanic ash often make moist forests ideal for tree growth and productivity. Forests within the moist forest potential vegetation group that do not have severe fires are composed of four dominant tree species: Douglas-fir, grand fir, western hemlock, and white fir. Grand fir is the most common species. These stands typically have more variety in tree species than the dry forest potential vegetation group. Stands that experience intense fires, or other disturbances that opened up the stand to sunlight, are dominated by lodgepole pine, western larch, Douglas-fir, and ponderosa pine (Johnson et al. 1994).

As in dry forest, quaking aspen can be found in the moist forest PVG. Other vegetation in moist forest is highly diverse. Shrub and herbaceous



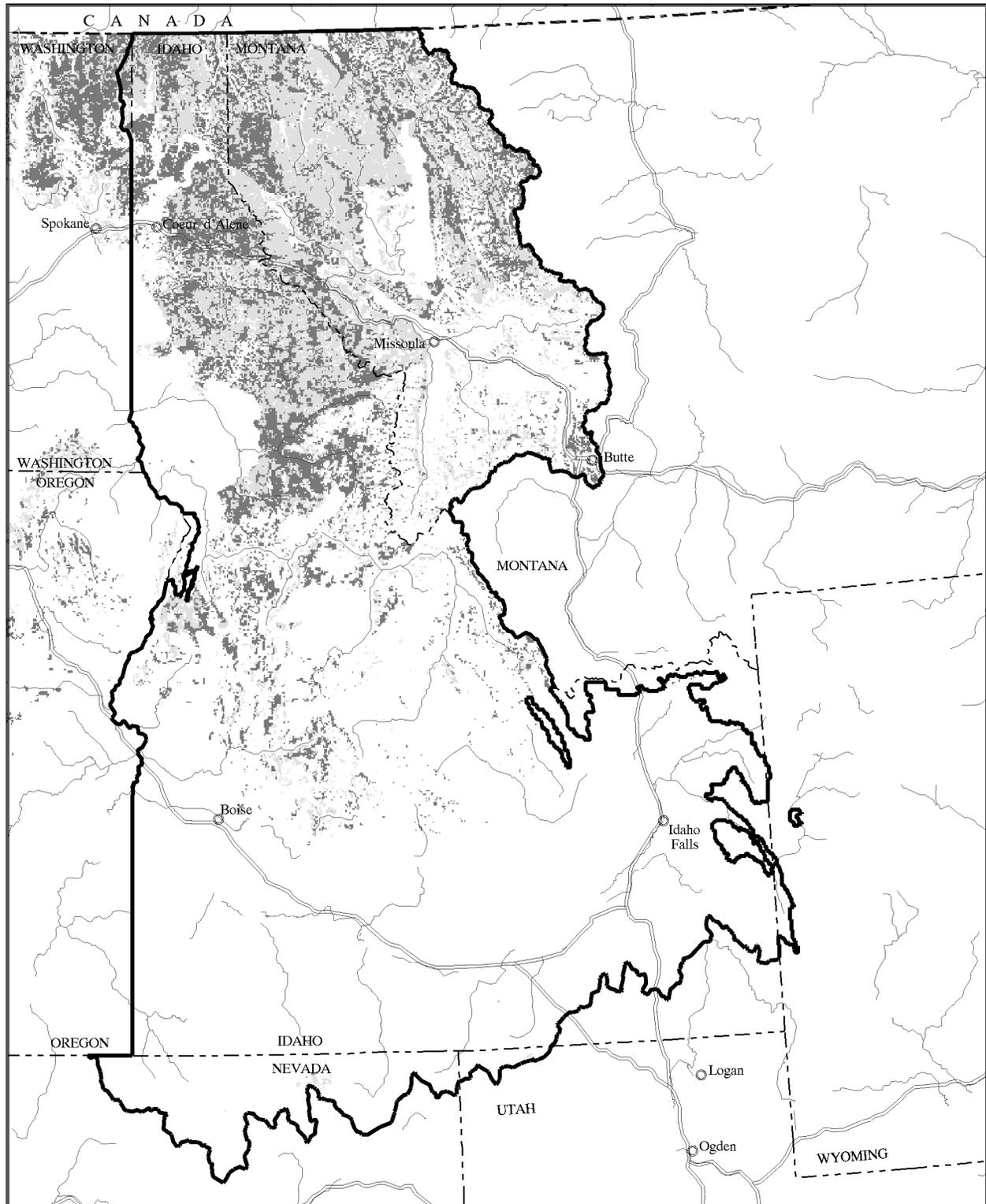
**Map 2-10a.
Moist Forest Distribution
Historical**



INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Draft UCRB EIS
1996

-  *Shade-tolerant Tree Species*
-  *Shade-intolerant Tree Species*
-  *Major Rivers*
-  *Major Roads*
-  *EIS Area Border*
-  *Cities and Towns*



Map 2-10b.
Moist Forest Distribution
Current

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 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

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 1996

- | | | | |
|---|--------------------------------------|---|-------------------------|
|  | <i>Shade-tolerant Tree Species</i> |  | <i>Major Rivers</i> |
|  | <i>Shade-intolerant Tree Species</i> |  | <i>Major Roads</i> |
| | |  | <i>EIS Area Border</i> |
| | |  | <i>Cities and Towns</i> |

understories have evolved under limited light and lower fire frequencies than in dry forest. Shrub species include: Oregon boxwood, big huckleberry, oceanspray, baldhip rose, streambank gooseberry, prince’s pine, and American twinflower. Herbaceous species are characterized by shade-tolerant herbaceous species, including: queencup beadlily, mountain lady’s slipper orchid, heart-leaved arnica, wild ginger, sword fern, white trillium, and pioneer violet. Grasses include: pinegrass, Columbia brome, and tufted hairgrass. One sedge species, Ross’ sedge, appears to be widely distributed across the project area in the moist forest PVG.

Historical Conditions

Historically, the UCRB planning area moist forests contained large stands of western white pine at elevations ranging from 2,000 to 6,000 feet. The best stands were found in wide river bottoms, gently rolling slopes, and gentle northerly slopes. Western white pine is a fire-adapted species (intermediate in terms of fire resistance). Its prevalence was due mainly to fires that destroyed other stands of tree species, allowing white pine to become established.

Historically, the most common fire regime in this PVG was mixed severity (about 58 percent), with a return interval that generally ranged from 26 to 150 years, with some up to 300 years (table 2-9). About

15 percent of the area would sustain nonlethal underburns, with half of these occurring at intervals of less than 25 years on benches and ridges. About 28 percent could sustain lethal stand-replacing fires, mostly on upland slopes at 76- to 300-year intervals. Creeping, low-intensity fires maintained the multi-layered old forest in cool, moist bottoms where fires created small openings that filled with young trees (Landscape Ecology STAR 1996).

Historical insect and disease disturbances were similar to those discussed in the dry forest potential vegetation group. White pine blister rust, an introduced disease that was not present historically, is discussed in the current conditions and trends section below.

Moist forests evolved with shade-intolerant species that dominated 70 to 80 percent of landscapes. Historically, moist forest structure was fairly dynamic, and early-seral forest structure comprised 20 to 30 percent of the area in moist forests. Young mid-seral forests generally comprised from 40 to 50 percent composition of the moist forest PVG, and were typically cycled back to early-seral structural stages by lethal fire events. Late-seral and old structures varied between 20 and 30 percent composition. In many cases, low intensity burns on the forest floor, or mixes of low and high intensity fires, maintained the young forest stage or moved it toward single layer late-seral, or old, forests. Creeping, low intensity fires maintained the multi-layered, old forest in cool, moist bottoms where fires

Table 2-9. Changes in Fire Regimes in the Moist Forest PVG, in Percent of UCRB Planning Area, FS-/BLM-Administered Lands.

Fire Regime Class	Historical Percent	Current Percent
Nonlethal underburns, very frequent (<25 years)	7.2	0
Nonlethal underburns, frequent (26–75 years)	3.7	0
Nonlethal underburns, infrequent (76–150 years)	3.7	3.2
Nonlethal Underburns	14.6	3.2
Mixed severity, very frequent (<25 years)	4.0	0
Mixed severity, frequent (26–75 years)	24.4	1.0
Mixed severity, infrequent (76–150 years)	21.7	21.7
Mixed severity, very infrequent (151–300 years)	7.8	0
Mixed Severity	57.9	22.7
Lethal, stand-replacing, frequent (26–75 years)	1.7	6.0
Lethal, stand-replacing, infrequent (76–150 years)	11.0	37.4
Lethal, stand-replacing, very infrequent (151–300 years)	14.8	30.6
Lethal, Stand-Replacing	27.5	74.0

Source: ICBEMP GIS Data (1KM² raster data)

created small openings that filled with young trees (Landscape Ecology STAR 1996).

**Current Conditions and Trends:
Departures in Composition,
Structure, and Disturbance Patterns
and Processes**

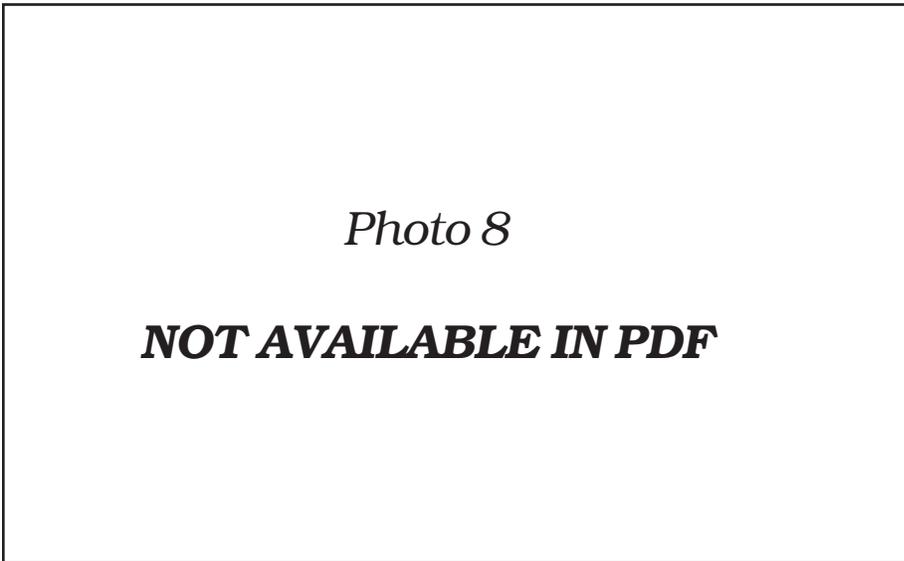
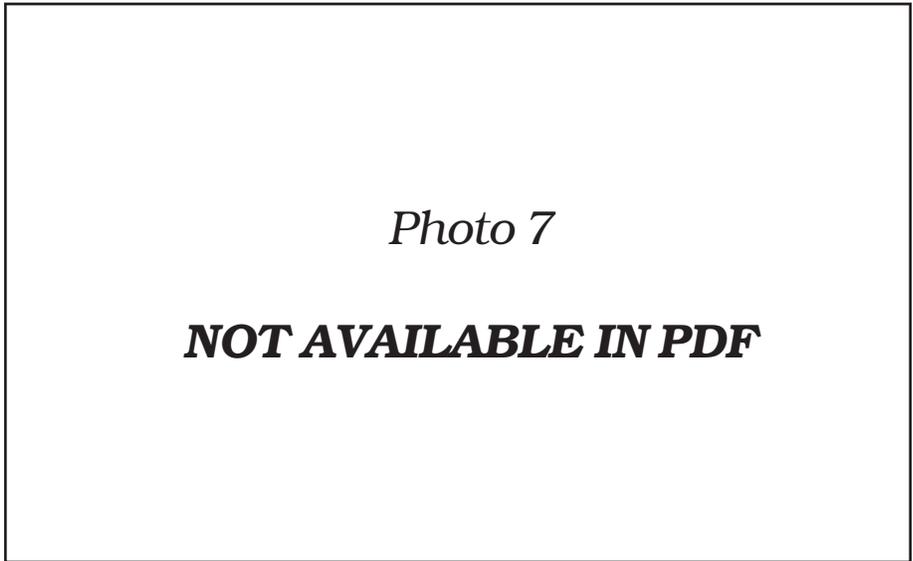
Departures in Composition and Structure

Forest succession, an increase in lethal stand-replacing fires (table 2-9), and an increase in human disturbances have changed the structure and composition of vegetation within moist forests. Because fires in moist forest were less common than in dry forests, the effects of fire exclusion on forest structure and composition are not as obvious in moist forests. Major

changes to the moist forest potential vegetation group include the network of roads and timber harvest units across the landscape; increased stand density in forests; increased dominance by shade-tolerant species; dominance of young stands of trees by even-aged grand fir, Douglas-fir, or white fir species; rapid decline in western white pine due to introduced blister rust; reductions in early-seral and old stands; and increases in young mid-seral stands. These changes have decreased productivity, increased the probability of severe or chaotic events, and decreased the similarity to the temporal, spatial, and habitat diversity of the native system.

The old single story stage of these shade-intolerant species has decreased 86 percent from historical amounts, while the shade-tolerant species have doubled from historical amounts. The old multi-story stage of these shade-

*Photo 7 (Aerial View).
Loss of old forest structures in the moist forest is evident in the fairly uniform size class of the crown as seen from the air. Photo by USFS.*



*Photo 8 (Surface View):
Predominantly young forest structures characterize the current condition of the moist forest in the UCRB planning area. Photo by USFS.*

intolerant species has decreased 67 percent from historical amounts, while the shade-tolerant species have decreased 14 percent from historical amounts. The young forest stage of shade-tolerant species is much higher in density and composition, having doubled from historical amounts, while the regeneration stage of shade-intolerant species has decreased 33 percent from historical amounts. Figure 2-9 earlier in this section shows the changes in shade-tolerant and intolerant species in moist forests by seral stage.

Landscapes are now dominated by shade-tolerant species, or a mixture of shade-tolerant and intolerant species, particularly in areas that have been harvested and fire suppression has been successful. These harvests have not generally left the snag structure that existed historically. Fire suppression has been most successful in roaded areas, which has substantially changed seral stage composition and community composition and structure.

Departures in Fire Regimes

The most important change in the fire regime has been the shift to 74 percent lethal stand-replacing fires (table 2-9). The effective exclusion of almost all nonlethal underburns (currently 3 percent) and a reduction of mixed severity fires (currently 23 percent) has resulted in the development of dense multi-layered stands with high potential for stand-replacing fires. These highly productive forests have increased amounts of carbon and nutrients stored in woody material, resulting in fires that are of higher fireline intensity and severity. Even where fires do not crown, dominant trees can be killed by consumption of large diameter surface fuels and duff layers. Potential for high amounts of soil heating and death of tree roots and other understory plants is much higher than it was historically.

Human Disturbance

In general, moist forests that have been identified with forest health problems are in areas that have been roaded and harvested. Clearcuts or partial cuts where western larch, western white pine, and ponderosa pine were harvested have changed stand structure and composition. The resulting stands have few of the large dead or live trees that historically could have remained on most sites, even after intense fire events. With the selective removal of shade-intolerant species, seed to grow new trees mainly came from shade-tolerant trees or trees with poor form

or growth. Fire exclusion reduced the thinning effect that historically favored shade-intolerant trees in the stands. Seed from poorly formed or undesired trees may pass on characteristics that will not provide the wood quality or other tree values desired in the future.

Tree harvest and fire exclusion have compounded forest health concerns through their roles in the extensive loss of western white pine to blister rust, and unsuccessful regeneration (Landscape Ecology STAR 1996). Western white pine has been replaced by grand fir and white fir (now representing 28 percent of the area in moist forest), western larch (24 percent), and shrub/herb/tree regeneration (17 percent). The aspen forest type has also declined. Aspen is a short-lived species that can be replaced by conifers; it reproduces almost exclusively by sprouting after extensive disturbance, especially fire. Causes for decline in aspen include fire suppression in regenerating aspen stands, and infestations of large aspen tortrix and satin moth in some aging aspen stands. Habitat diversity for wildlife provided by these forest types has also decreased, as have scenic qualities, recreation values, and wood products provided by species in decline. As in dry forests, large trees, early-seral stands, and old single layered stands have decreased. Young, and multi-layered old stands have increased.

Soil fertility of some sites has been depleted through timber harvest practices, or from multiple burns, which displaces or erodes surface soil, or removes much of the large woody material, litter, or duff. Forest health concerns are raised by lower productivity, higher probability of insect and disease infestation, higher probability of high intensity fires, and changes in habitat conditions (Landscape Ecology STAR 1996).

Insects and Disease

Similar to changes in dry forest systems of the project area, susceptibility to large-scale damage by insect infestations and diseases has increased in many moist forests, contributing to forest health problems. The moist forest is a productive environment where insects and disease are very active, given the right hosts (Landscape Ecology STAR 1996). Tree density has increased and vigor has decreased in moist Douglas-fir and grand fir forests, making them more susceptible to insect and disease damage. Timber harvest and mortality from fir engraver beetles in productive grand and white fir patches, has contributed to the sharp decline of

this type. Areas susceptible to western larch dwarf mistletoe decreased because the western larch cover type in the Northern Glaciated Mountains (ERU 7) also decreased (Landscape Ecology STAR 1996).

Lodgepole pine forests are more susceptible to mountain pine beetle outbreaks in the Lower Clark Fork, Upper Clark Fork, and Northern Glaciated Mountains ERUs. Increased susceptibility is associated with the effects of prolonged fire exclusion, which yields increasingly large areas of lodgepole pine of uniform size and therefore landscapes that are more synchronized in their susceptibility to fire and beetle disturbance.

An additional forest health concern is that, with few exceptions, areas susceptible to *Armillaria* root disease, laminated root rot, and S-group annosum root disease increased across the UCRB planning area. Areas susceptible to *Armillaria* root disease increased in the Central Idaho Mountains, Lower Clark Fork, and Northern Glaciated Mountains ERUs. Areas susceptible to S-group annosum root disease increased in the Central Idaho Mountains and Northern Glaciated Mountains ERUs. Increases in susceptibility to root diseases are associated with effective fire exclusion, the selective harvest of shade-intolerant species, and the contagious spread of Douglas-fir and true firs in dense, multi-layer arrangements. Historically, fires not only favored the regeneration and release of shade-intolerant species by providing large openings and bare mineral soil, but they also minimized fuel loads and effectively thinned from below, favoring lower tree densities and drought and disease tolerance (Landscape Ecology STAR 1996).

White pine blister rust is the primary introduced disease that has changed successional pathways, cover types, and/or structures of western white pine. This has seriously affected native successional potentials in at least 50 percent of the moist forest PVG, where western white pine was a dominant or common residual large tree structure.

Terrestrial Species and Habitats in Moist Forests

General Trends

Moist forests support a high level of terrestrial diversity, and have more tree species and more variety in stand structure than dry forests. This variety provides more habitat types, and therefore more available niches for different species. The wetter climate promotes more flowering plants to provide food for a variety of species. Key Environmental Correlates, such as downed logs and litter, provide habitat for species such as carpenter ants, fungi, mosses, lichens, checkered beetles, Coeur d'Alene salamander (an endemic species), rubber boas, and other snakes. These and other species contribute to the breakdown of logs, returning nutrients to the soil. They also provide food for bears, snakes, lizards, pileated woodpeckers, and other species (Terrestrial STAR 1996).

Dense stocking of stands has reduced light to the forest floor, which has reduced understory vegetation, temperature, and decomposition rate and nature of woody debris. These changes affect nutrient cycling and energy flows, which in turn reduces soil productivity, plant growth, and

Photo 9

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Photo 9. Small mammals such as chipmunks find protection from predators in the microhabitats within the jumble of small logs and canopy cover in the moist forest.

habitat for animals. The mosaic of habitat conditions and islands of unburned habitat created by fire in moist forests have been reduced. Current stands are more uniform, which may limit the reintroduction of insect and soil organisms into disturbed areas. Large shade-intolerant trees (ponderosa pine and western larch), live and dead, have decreased (Landscape Ecology and Terrestrial STARs 1996). There also has been an increase in young age classes of forests dominated by shade-tolerant tree species (fir species and Engelmann spruce).

Roads, especially interstate highways or other multi-laned high-traffic roads, present barriers to carnivores and other species. While the situation may be infrequent, it causes major problems where it occurs.

Invertebrates

Invertebrates live in the soil, litter, leaves, needles, bark, wood, understory plants, and special habitats (rock, talus, caves, etc.). These Key Environmental Correlates are more abundant in moist forests. The moisture in the forest keeps these habitats from drying out as easily as in dry forests. This creates a more favorable environment for many invertebrates, especially snails, slugs, litter and soil organisms, and wood decomposers. See the Dry Forest Potential Vegetation Group section for a more complete discussion of invertebrates.

Amphibians

Moist forests have a rich diversity of amphibians due to the damp climate and high presence of aquatic habitats. Moist forests in northern Idaho and Montana provide habitat for several species of salamanders, one species of newt, one toad, and several frog species (Terrestrial Staff database). These species use downed logs and burrows in the soil and litter but must be near water to reproduce. Spotted frogs occur in the moist forest of northern Idaho and Montana. The Coeur d'Alene salamander is a local endemic that occurs mostly in northern Idaho and limited areas in Montana. Since amphibians have permeable skins, they are good indicators of changes in water quality, climate, and microsites. Amphibians also help control insects; serve as food to fish, small birds, and mammals; provide burrows for other animals; and turn over soil.

Mining of talus and rock for road construction, large reservoir construction, and other activities are

affecting amphibians such as the spotted frog (Terrestrial STAR 1996). Activities such as timber harvest, road or trail construction, and loss of wetlands may be affecting wet areas that are seasonally important to amphibians, which require wetlands or standing water as their primary habitat. Introductions of exotic species such as fish and the bullfrog can also be causing a detrimental effect because they prey on native amphibians.

Reptiles

Habitat selection for snakes and lizards is driven more by the need for warm climates, rocks, talus, and soils suitable for burrows, than by specific vegetation needs (Terrestrial STAR 1996). Reptile habitat exists in moist forests, especially in openings, south-facing slopes, and rock outcrops. One turtle, four lizards, and several snake species use moist forests (Terrestrial Staff database).

Birds

Moist forests typically have multiple layers of trees which provide an increased variety of bird habitat over dry forest stands. Many birds nest at specific heights off the ground or in trees of a certain diameter range. The Terrestrial Staff database lists 127 species of birds that use moist forests in the project area, which increases to 150 if riparian habitats are present. Birds nest and feed in the canopies of trees, in cavities they excavate, in cavities excavated by other species, on the trunks or branches of trees, on the ground, or near water (Thomas et al. 1979). Species that use large trees include the goshawk, pileated woodpecker, Lewis' woodpecker, northern three-toed woodpecker, and boreal owl. Extensive areas with large shade-intolerant tree species alive and dead (western larch, western white pine and ponderosa pine) have been reduced because of past forest harvesting and exotic blister rust that affected western white pine (Landscape Ecology and Terrestrial STARs 1996).

Aspen stands tend to be small and scattered in moist forests, but are important for nesting and feeding habitat for many birds, including red-breasted and red-naped sapsuckers, western tanager, violet-green swallow, and Swainson's thrush (Thomas et al. 1979). In general, aspen stands fill a vital role in providing Key Environmental Correlates, and they are in decline in the project area largely due to fire exclusion.

Based on breeding bird surveys, populations of twice as many neotropical bird species in forests have increased (10 species) than have decreased

(5 species). Species that use this type of forest structure (northern goshawk, Vaux's swift, pileated woodpecker, Hammond's flycatcher, pygmy nuthatch, and Swainson's thrush) are thought to have decreased, but no data is available that shows a long-term decline of these species. Brown-headed cowbirds, which are nest parasites on other birds, have increased (Collopy and Smith 1995).

Mammals

In total, 89 species of large and small mammals use different structural stages of moist forests (Terrestrial Staff database). However, the number of species in the Blue Mountains (ERU 6) is limited by the isolation of the moist forest from other adjacent forested habitats, especially for the less mobile species (Collopy and Smith 1995).

Moist forests are used by many species of ungulates that are socially and economically important for hunting and viewing and that are used for food and other cultural and spiritual values by local American Indian tribes. Big game species are food for bears, mountain lions, wolves, other large carnivores, and humans. Elk, moose, and mule deer use moist forests, especially meadows, shrublands, and early seral forests for summer range. Bighorn sheep use cliffs and rock walls within the moist forests and feed in and move through grass and low shrub habitat, but avoid stands of trees or tall shrubs because of increased opportunity of predation (Lyon et al. 1995). Aspen sprouts and buds within moist forests provide important winter and early spring nutrition for elk, deer, bear, grouse, and hares.

Mountain bighorn sheep populations have declined in many areas due to the spread of disease from domestic sheep, conifer encroachment, and increased habitat isolation (Terrestrial STAR 1996, Lyon et al. 1995). Moose are gradually increasing in most forest habitats, especially in areas near Canadian moose populations and where transplant programs have been implemented.

The endangered Selkirk woodland caribou exists only in northeastern Washington, northern Idaho, and southwestern Canada, mostly in the Northern Glaciated Mountains (ERU 7). Caribou live in old forests of Engelmann spruce/subalpine fir and western redcedar/western hemlock, which may be affected by fires, insects and disease, logging, and other disturbances. Although these small populations have been stable, there is concern about low reproductive success, predation,

poaching, and harassment of the animals during the winter (USF&WS Status Report 1995, Terrestrial STAR 1996).

The red-backed vole, northern flying squirrel, pygmy shrew, redbelt chipmunk, and other moist-forest mammals may be declining due to the decrease in the amount of old moist forests and reduction of large dead trees, both standing and on the forest floor in areas that have been roaded and harvested. These small mammal species are important food for owls, hawks, American martens, fishers, and other carnivores, as well as for distributing and planting seeds throughout the forest (Collopy and Smith 1995).

Cold Forest Potential Vegetation Group

Potential Vegetation Types (PVTs): Cold Forest

Mountain hemlock-Inland
Spruce-fir, dry with aspen
Spruce-fir, dry without aspen
Spruce-fir, (whitebark pine greater than lodgepole pine)
Spruce-fir, (lodgepole pine greater than whitebark pine)
Whitebark pine/alpine larch-North
Whitebark pine/alpine larch-South

Distribution and Description

The cold forest potential vegetation group is a major component of vegetation at higher elevations, but it occurs on only about 10 percent of the ICBEMP project area and 18 percent of the UCRB planning area. The Forest Service or BLM administers 87 percent of the cold forest group. In the UCRB planning area, the cold forest PVG is primarily distributed in ERUs 9 and 13 in central Idaho and southwest Montana (see map 2-5 in the Introduction to the Terrestrial Ecosystems section).

Subalpine sites that support cold forests are more difficult for tree establishment and growth, and they define the upper limits of tree survival on mountains. Cold forests are generally limited by a short growing season; on some sites these forests are also limited by low available moisture. Rates of tree growth are generally slow in comparison to moist forests. Nutrients are often

limited, and loss of volcanic ash soil, litter, surface soil, or tree foliage from the site can greatly reduce productivity. Maintenance of dead and downed wood on these sites is important for nutrient cycling (Landscape Ecology STAR 1996).

Tree regeneration in the cold forest group is generally slow; mortality from stress, insects, and disease generally thins the stands and accelerates growth of the surviving trees. Cold forests extend into moist forests along stream courses, cold air pockets, or other cold sites (Landscape Ecology STAR 1996).

Maps 2-10c and 2-10d show the historical and current distributions of tree species within the cold forest PVG.

Composition and Structure

Dominant shade-intolerant species in cold forests are lodgepole pine, whitebark pine, and alpine larch. Dominant shade-tolerant species in cold forests are Engelmann spruce, subalpine fir, aspen, and interior Douglas-fir.

With an absence of disturbance, cold forests are dominated by subalpine fir or Engelmann spruce. Spruce tends to be present on moist sites and in areas with cold air pockets. Subalpine fir dominates when sites are too cold for other shade-tolerant species. Fire can maintain aspen stands by killing conifers that have established and by causing aspen to vegetatively regenerate. When fire is present as a disturbance, lodgepole pine is the principal species after intense fires kill most trees. Douglas-fir and western larch are important species on warmer, drier, disturbed sites, especially on southerly slopes at higher elevations or lower slope elevations adjacent to grand fir forests (Johnson et al. 1994).

Whitebark pine may be a codominate with subalpine fir in stands at the upper limits of tree growth (timberline). Whitebark pine forests exist in harsh areas with high winds, and can withstand severe ice and snow damage which create open or clumped stands (Johnson et al. 1994).

Other vegetation of the cold forest PVG includes shrubs and grasses which have evolved under natural cycles of fire and ice. Many of these species are perennial, surviving years in which flowering and fruiting cycles are disrupted by the early arrival of killing frosts. The transition zone between the lower elevations of cold forest, and the upper elevations of moist forest is characterized by relatively moist openings that support meadow vegetation.

Characteristic shrubs of the cold forest PVG include fool's huckleberry, grouse huckleberry, cascades azalea, laborador tea and thimbleberry. Herbaceous species include: white-coiled beak, white hawkweed, alpine hawkweed, pink elephant heads and explorer's gentian. Grasses include: green fescue, western needlegrass, Idaho fescue, and bluebunch wheatgrass.

Historical Conditions

Historically, fire intervals in the cold forest potential vegetation group were highly variable and correlated with landforms. Over three-quarters of the area of this PVG would support mixed severity fires (table 2-10), creating a mixture of lethal and nonlethal effects on the overstory at intervals of 76 to 150 years. These fires were often intermingled with other fire regimes during one or a series of fire events, and effectively reduced fuels, thinned the stand, and killed less fire-tolerant species. Less than 10 percent of the landscape burned with fires that were lethal to all of the dominant overstory. Lethal stand-replacing fires occurred at a fairly high frequency in younger forests on steeper slopes, and rarely in wet bottoms and basins with late-seral multi-story forests. Nonlethal underburns would occur on about 13 percent of the landscape, where they maintained late seral single story forests of whitebark pine and lodgepole pine, typically on ridges and flat benches.

The mixed fire regime was often intermixed with the other regimes in one fire event or through a series of fire events. The fire season for this group was, and is, short~ generally the month of August (Landscape Ecology STAR 1996). Fires that burned hot enough to kill trees changed stand composition from shade-tolerant species to shade-intolerant species, such as lodgepole pine (Lehmkuhl et al. 1994). Depending on the extent of the fire and weather that followed, substantial burned areas have remained treeless for decades unless a seed source of lodgepole pine was present at the time of the burn. Where lodgepole pine is present, tree cover is usually rapidly reestablished (Agee 1993). These severe fires also changed the old multi-layer stands that developed with low intensity fire events to single layer stands. Large fires maintained large patches of similar forest conditions within river drainages, compared with dry and moist forests that tended to have small patches created by fire events (Agee 1993).

In general, a fairly high component of the old multi-layer forest was maintained. These old forests were typically found in cold, wet bottoms or basins where fires either did not burn, or

Table 2-10. Changes in Fire Regimes in the Cold Forest PVG, in Percent of UCRB Planning Area, FS-/BLM-Administered Lands.

Fire Regime Class	Historical Percent	Current Percent
Nonlethal underburns, very frequent (<25 years)	8.9	0
Nonlethal underburns, frequent (26–75 years)	1.4	0
Nonlethal underburns, infrequent (76–150 years)	0	0
Nonlethal Underburns	10.3	0
Mixed severity, frequent (26–75 years)	4.1	0
Mixed severity, infrequent (76–150 years)	65.9	41.1
Mixed severity, very infrequent (151–300 years)	5.4	0
Mixed Severity	75.4	41.1
Lethal, stand-replacing, frequent (26–75 years)	4.5	0
Lethal, stand-replacing, infrequent (76–150 years)	1.8	14.0
Lethal, stand-replacing, very infrequent (151–300 years)	8.0	44.9
Lethal, Stand-Replacing	14.3	58.9

Source: ICBEMP GIS Data (1KM² raster data)

burned in a patchy pattern. Old single layer forests were generally maintained by frequent ground fires on benches and ridges dominated by whitebark and lodgepole pine (Landscape Ecology STAR 1996).

Cold forests historically also experienced endemic insect and disease occurrences, which occasionally grew into a localized epidemic. Mountain pine beetle historically attacked and killed large areas of lodgepole pine.

**Current Conditions and Trends:
Departures in Composition,
Structure, and Disturbance Patterns
and Processes**

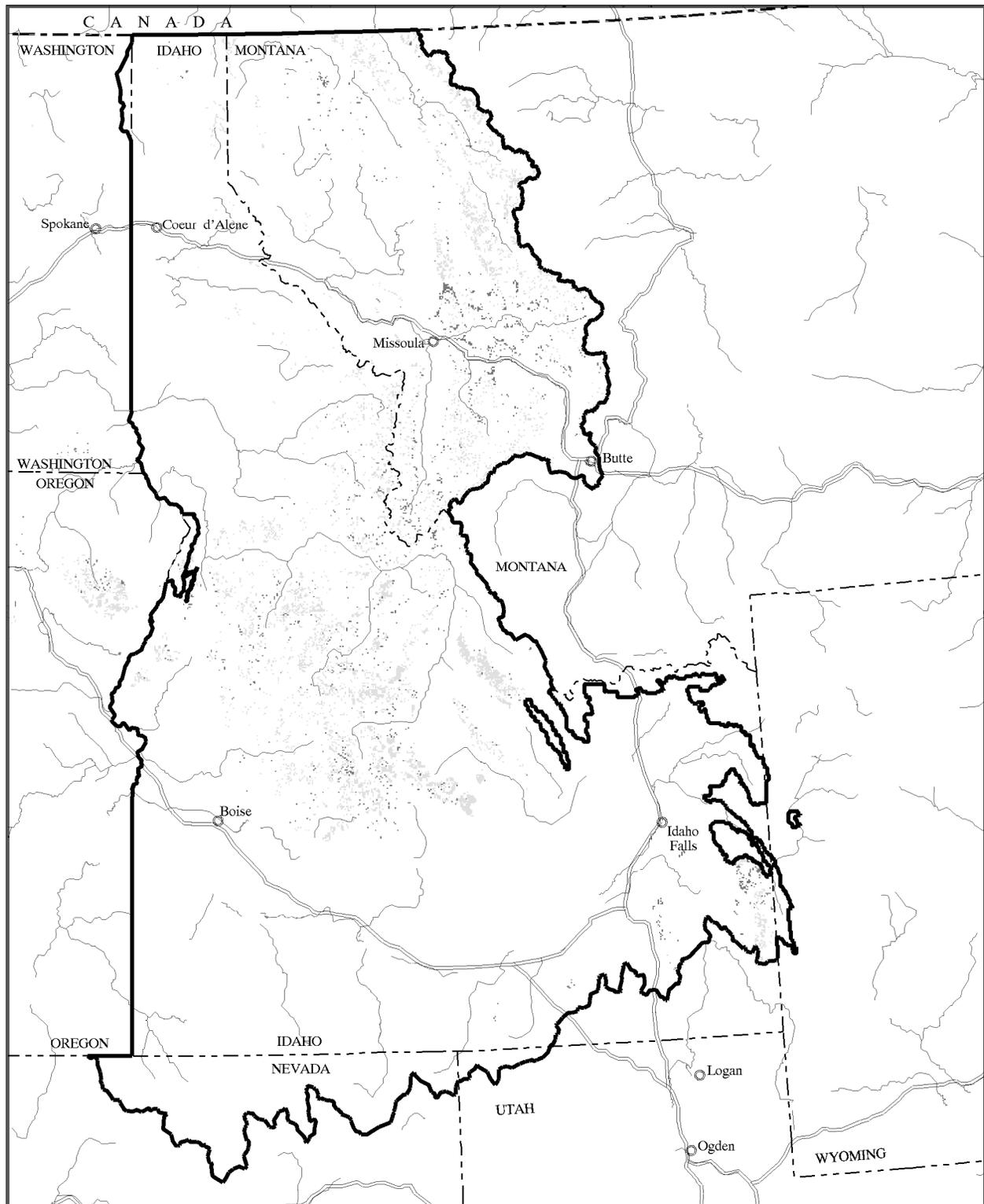
Departures in Composition and Structure

Effects of fire exclusion, logging, road building, livestock grazing, and other modifications on forest structure and composition are not as noticeable in the cold forest as in the other forest PVGs, because cold forests have longer fire intervals and fewer human-caused disturbances than dry or moist forests. The cold climate and short growing season in cold forests also slow the natural rate of change in vegetation when compared to dry or moist forests. However, some changes from historical conditions have occurred.

The PVG has generally shifted to a predominance of regeneration and young forest structural stages and has become dominant in shade-tolerant species or a mixture of shade-tolerant and intolerant species. Primary changes in vegetation composition and structure have been in response to road and timber harvest; exotic blister rust disease on whitebark pine, which has resulted in an approximately 95 percent loss of whitebark pine/alpine larch; and changes in fire type and frequency. Where whitebark pine and alpine larch have declined, they have been replaced by Engelmann spruce and subalpine fir. In particular, loss of whitebark pine and alpine larch habitat~ due to white pine blister rust and overstocking resulting from fire exclusion~ has become a forest health concern in the past ten years (Landscape Ecology STAR 1996).

Departures in Fire Regime

Changes in landscape structure and composition have typically resulted in higher surface fuel loads and greater crowning potential over larger areas. The predominant fire regime is now lethal stand-replacing fires (about 59 percent), most of which burn at very infrequent intervals of 150 to 300 years (table 2-10). About 41 percent of fires are mixed severity, and nonlethal underburns have essentially been eliminated from the present fire regime.

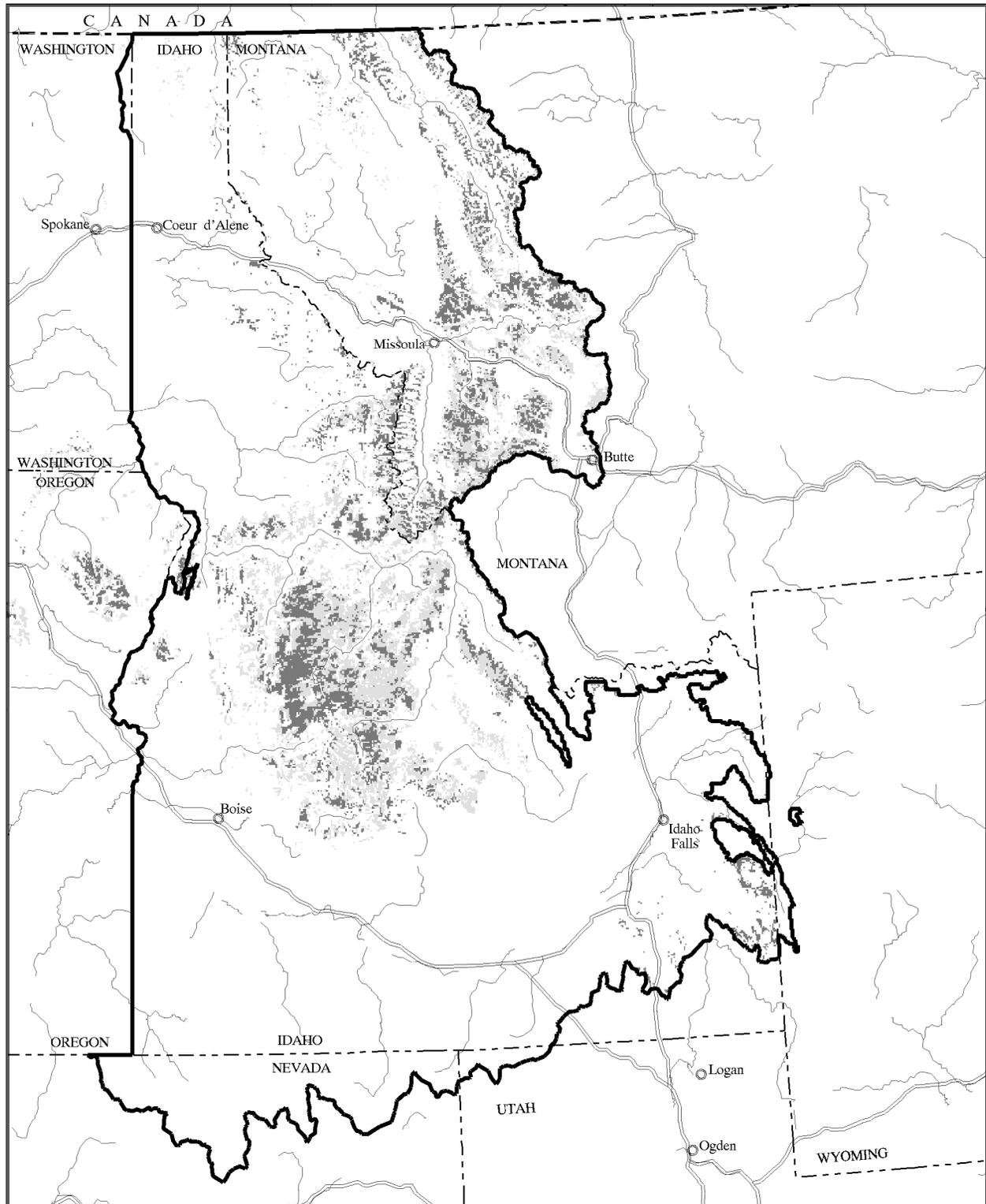


Map 2-10c.
Cold Forest Distribution
Historical

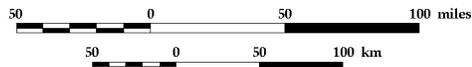
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 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Draft UCRB EIS
 1996

- | | | | |
|---|--------------------------------------|---|-------------------------|
|  | <i>Shade-tolerant Tree Species</i> |  | <i>Major Rivers</i> |
|  | <i>Shade-intolerant Tree Species</i> |  | <i>Major Roads</i> |
| | |  | <i>EIS Area Border</i> |
| | |  | <i>Cities and Towns</i> |



Map 2-10d.
Cold Forest Distribution
Current



INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Draft UCRB EIS
 1996

- | | | | |
|---|--------------------------------------|---|-------------------------|
|  | <i>Shade-tolerant Tree Species</i> |  | <i>Major Rivers</i> |
|  | <i>Shade-intolerant Tree Species</i> |  | <i>Major Roads</i> |
| | |  | <i>EIS Area Border</i> |
| | |  | <i>Cities and Towns</i> |

Human Disturbance

Some of the old multi-layer forest has been harvested. Although the old single-layer forest has not changed much, its composition is deteriorating with the loss of whitebark pine due to blister rust. Young forests have increased, generally as a result of harvesting old multi-layer forests. These harvested areas generally do not have the number of snags that occurred historically, which limits habitat for birds, mammals, and insects that need dead trees (Terrestrial and Landscape Ecology STARs 1996). Additionally, cold forests have experienced more frequent lethal fires in the past ten years than they did under historical conditions, partly due to the spread of fires from other forest types during drought periods.

Historically, shade-intolerant species dominated regeneration and young forest environments. This relationship has been altered, resulting in landscapes that now have mixed dominance or are dominated by shade-tolerant species such as extensive areas where conifers have replaced or are replacing aspen. This is especially true where timber harvest and fire exclusion have favored the establishment of shade-tolerant species. As a result, much of the area where investments have been made (roads, harvest, planting, thinning, etc.) is highly susceptible to tree mortality from fire, insects, disease, and stress (Landscape Ecology STAR 1996).

Insects and Disease

With fire exclusion, more areas of pine are in a mature, more susceptible stage. Consequently,

outbreaks of mountain pine beetle infest larger areas, for longer periods, and often with greater intensity than occurred historically. Increasing size of susceptible stands of trees have also contributed to higher levels of other insects and diseases.

White pine blister rust is the primary introduced disease that has changed successional pathways, cover types, and/or structures of whitebark pine. This has seriously affected native successional potentials in at least 50 percent of the cold forest PVG, where whitebark pine was a dominant or common residual large tree structure.

Terrestrial Species and Habitats in Cold Forests

General Trends

Cold forests areas, mostly in the Northern Glaciated Mountains and the Lower Clark Fork (ERUs 7, 8), support several rare wildlife species, or species with very limited distributions. These areas have unique habitats, such as springs, seeps, microsites for insects, and islands of alpine habitat that are isolated from other alpine habitat in Canada. These subalpine and Arctic habitats were connected at various times in history when climates cooled and glaciers advanced. Whitebark pine is an important source of seeds for grizzly bears, birds, and small mammals. Clark's nutcracker, a common bird in cold forests, is responsible for transporting whitebark pine seed for future seedlings, and squirrels and chipmunks cache seed when it is available.

Photo 10

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**Photo 10. Bears are among the wildlife species in cold forests that are particularly sensitive to human activity.
Ravi Miro Fry Photo.**

Cold forests have lower productivity, steeper terrain, and a shorter growing season than do dry or moist forests. Therefore, they have had less timber harvest, road construction, and grazing, and thus fewer associated impacts on terrestrial wildlife species, habitats, and functions. The cold forest has not been modified as much as the dry and moist forest types. Although lower road densities limit some human activities, snowmobiling, helicopter skiing, downhill skiing, and dirt biking in cold forests can displace and stress wildlife from the noise and associated activities. Bighorn sheep, mountain goats, lynx, wolverine, and bears are particularly sensitive to human activity and need areas of refuge from roads and activities. Although mountain goats have extended their range into areas where they have not been historically, some populations have declined for unknown reasons (Terrestrial STAR 1996).

Invertebrates

See the Moist Forest Potential Vegetation Group section.

Amphibians and Reptiles

Cold forests and subalpine areas are generally too cold, with too short a breeding season, to provide much habitat for reptiles and amphibians. Four species of salamander, one newt, one toad, and seven frogs use the cold forest type in the UCRB planning area (Terrestrial Staff database), but in small numbers. The western toad and Pacific treefrog, which use some cold forest areas, are sensitive to changes in wetlands, springs, and ponds. No reptile species were listed in the Terrestrial Staff database as cold-forest inhabitants.

Birds

The Terrestrial Staff database lists 103 species of birds that use cold forest habitats. Although most species use both cold and moist forests, fewer birds use cold forests than use moist forests. This is due to climatic conditions caused by elevation that produce conditions such as lower diversity in tree species, fewer insects for food, and the shorter growing season. Some of the common birds found in higher elevation forests are the following: fox sparrow, dark-eyed junco, blue grouse, lazulibunting, and rufous and calliope hummingbirds. These species are found in different stages of forest development, from young to old.

Boreal owls and great gray owls occur in the cold forests in Idaho and Montana. As well as the rest of the project area. Long-eared owls nest in subalpine fir forests. Red-tailed hawks and great horned owls feed on voles and squirrels that inhabit these forests. The higher frequency of snags, especially larger diameter snags, in cold forests are important for hairy woodpeckers, Williamson's sapsucker, black-backed woodpeckers, and three-toed woodpeckers. These species create cavities used by northern flying squirrels, mountain chickadees, and they help control insect outbreaks and distribute seeds (Terrestrial STAR 1996).

Cold forests tend to have more downed logs and other woody material because of less extensive logging, less road access, slower decomposition rate, and longer fire intervals. Moisture, insects, fungi, and wildlife in search of insects affect the decomposition of logs. Franklin's, blue, and ruffed grouse, which are upland game birds, use logs in cold forests for cover and nesting areas. Logs are also used by vagrant shrews, amphibians, and many insects, fungi, and bacteria that are important to soil productivity and nutrient cycling (Terrestrial STAR 1996).

Mammals

As with birds, most mammal species that use moist forests also use cold forests. The Terrestrial Staff database lists 73 mammals in cold forests. American pika, lynx, wolverine, bog lemming, snowshoe hare, and the northern flying squirrel are closely tied to cold upper elevation forest habitats.

More than 35 percent of the cold forest is included in Wilderness, Wilderness Study Areas, or other Natural Areas (Terrestrial STAR 1996). In addition to this percentage, significant portions of cold forests are within unroaded habitat that has not been classified as Wilderness, Wilderness Study Areas, or other Natural Areas. Natural fires are more likely to be allowed in Wilderness or unroaded areas, which helps retain diversity in structural stages and create habitat mosaics in cold forests for the future. Many unroaded areas and areas with lower road densities and steeper terrain make these important refuge areas for species such as elk, bighorn sheep, mountain goat, grizzly bear, wolverine, and other species that can use this habitat to escape human

activity. Grizzly bears feed in avalanche chutes, wet meadows, talus, and downed logs in summer months. (Terrestrial STAR 1996)

Large mobile carnivore species with extensive home ranges often run into conflicts with humans and livestock when their habitat is reduced or affected by roads and other activities. Roads, especially interstate highways or other multi-laned high-traffic roads, present barriers to carnivores and other species. While the situation may be infrequent, it causes major problems where it occurs. In some cases roads have been a direct cause of mortality (Terrestrial STAR 1996, Martin et al. 1995). Although some large carnivores typically use mature forest habitat, others are habitat generalists and can use a variety of habitats (Terrestrial STAR 1996). In either case, the key to their survival appears to be large, interconnecting blocks of habitat with few human disturbances, which have become more scarce. Such habitat blocks reduce vulnerability to mortality and provide quality riparian areas and good sources of food such as deer, elk, carrion, hare, forbs, roots, and fish. Declines in whitebark pine have resulted in declines in an important food source for grizzly bears. (Terrestrial STAR 1996)

Because many of these animals are at the southern portion of their range (from Canada) and have low population normally, they are increasingly vulnerable to being killed. Attitudes of humans towards carnivores such as grizzly bears and wolves are likely more important for their well being than habitat conditions. In the past, Government-sponsored programs such as Animal Damage Control greatly contributed to the reduction of wolves and other predators. Sport hunting and trapping also may have reduced local populations of large carnivores.

Most of the smaller carnivores do not face such high negative public attitudes; thus, for these species, habitat conditions are more important. Species such as the American marten and Pacific fisher need late successional forest with abundant snags and downed logs. Wolverine may be affected by increasing human disturbance and use of subalpine communities in the cold forest and accidental mortality from trapping. Lynx require early seral stage boreal forest habitat supporting high populations of small mammals such as snowshoe hare, and older forest stages for denning (Terrestrial STAR 1996).

Summary of Changes from Historical to Current by Ecological Reporting Unit, by Potential Vegetation Type, and by Terrestrial Community for BLM/Forest Service-Administered Lands.

ERU 5 ~ Columbia Plateau

Cold Forest PVG.

- ◆ A 35 percent decrease in early seral subalpine forest.
- ◆ A 65 percent decrease in mid-seral subalpine forest.

Dry Forest PVG.

- ◆ A 65 percent increase in mid-seral montane forest.

Moist Forest PVG.

- ◆ A 45 percent increase in mid-seral montane forest.

ERU 6 ~ Blue Mountains

Dry Forest PVG.

- ◆ A 35 percent increase in early seral montane forest.

Moist Forest PVG.

- ◆ A 40 percent increase in early seral montane forest.

ERU 7 ~ Northern Glaciated Mountains

Dry Forest PVG.

- ◆ A 40 percent increase in mid-seral montane forest.

Moist Forest PVG.

- ◆ A 40 percent increase in early seral montane forest.

ERU 8 ~ Lower Clark Fork

Cold Forest PVG.

- ◆ A 50 percent increase in mid-seral subalpine forest.

Dry Forest PVG.

- ◆ A 60 percent increase in mid-seral montane forest.

ERU 9 ~ Upper Clark Fork

Dry Forest PVG.

- ◆ A 30 percent increase in mid-seral ponderosa pine forest.

ERU 10 ~ Owyhee Uplands*Cold Forest PVG.*

- ◆ A 55 percent decrease in early seral montane forest.

Dry Forest PVG.

- ◆ A 30 percent increase in mid-seral montane forest.

Moist Forest PVG.

- ◆ A 25 percent decrease in late seral ponderosa pine single layer forest.
- ◆ A 35 percent decrease in mid-seral ponderosa pine forest.
- ◆ A 70 percent increase in early seral montane forest.

ERU 11 ~ Upper Snake*Cold Forest PVG.*

- ◆ A 45 percent decrease in mid-seral subalpine forest.

ERU 12 ~ Snake Headwaters*Dry Forest PVG.*

- ◆ A 30 percent decrease in early seral montane forest.
- ◆ A 55 percent increase in mid-seral montane forest.

Source: ICBEMP report ah43e_uc.rtf

Rangelands

Key Terms Used in this Section

Grazing pressure ~ The ratio of forage demand to forage available, for any specified forage, at any point in time. Thus, as forage demand increases relative to forage available, grazing pressure increases, and vice-versa.

Herbivore ~ An animal that subsists principally or entirely on plants or plant materials.

Invasion (plant) ~ The movement of a plant species into a new area outside its former range.

Key Ecological Functions ~ A wide range of roles that species play in the ecosystem, such as predation, herbivory, nutrient cycling, and biomass contributions.

Key Environmental Correlates ~ Environmental factors that are either associated with or required by a given species, such as downed wood, piles of bark, fire processes, and insect outbreaks.

Noxious Weed ~ A plant species designated by Federal or State law as generally possessing one or more of the following characteristics: aggressive and difficult to manage; parasitic; a carrier or host of serious insects or disease; or non-native, new, or not common to the United States. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has other adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

Summary of Conditions and Trends

The following ecological trends have occurred in the rangeland areas of the project area because of changes to native disturbance and successional processes since historical times:

- ◆ Rangeland noxious weeds are spreading rapidly and in some cases exponentially in every Range Cluster.
- ◆ Woody species encroachment and/or increasing density by woody species (sagebrush, juniper, ponderosa pine, lodgepole pine, Douglas-fir), especially on the dry grassland and cool shrubland vegetation types, have reduced herbaceous understory and biodiversity.
- ◆ Cheatgrass has taken over many dry shrubland vegetation types, increasing soil erosion and fire frequency and reducing biodiversity and wildlife habitat. Cheatgrass and other exotic plant infestations have simplified species composition, reduced biodiversity, changed species interactions and forage availability, and reduced the system's ability to buffer against change or act as wildlife strongholds in the face of long-term environmental variation.
- ◆ Degradation of riparian areas and subsequent loss of riparian vegetation cover has reduced riparian ecosystem function, water quality, and habitat for many aquatic and terrestrial species. (See Aquatics section for riparian area discussion.)
- ◆ Expansion of agricultural and urban areas on non-Federal lands has reduced the amount of some rangeland vegetation types, most notably dry grassland, dry shrubland, and riparian. Changes in some of the remaining habitat patches because of fragmentation, exotic species, disruption of natural fire cycles; overuse by livestock and wildlife; and loss of native species diversity have contributed to a number of wildlife species declines, some to the point of needing special attention (such as sage grouse, Columbian sharp-tailed grouse, California bighorn sheep, pygmy rabbit, kit fox, Washington and Idaho ground squirrels).
- ◆ Increased fragmentation and loss of connectivity within and between blocks of habitat, especially in the shrub steppe and riparian areas, have isolated some habitats and populations and reduced the

ability of populations to move across the landscape, resulting in long-term loss of genetic interchange.

- ◆ Slow-to-recover rangelands (usually rangelands that are in the <12" precipitation zone, such as dry shrublands with little herbaceous understory) are not recovering naturally at a pace that is acceptable to meet management objectives and are either highly susceptible to degradation or already dominated by cheatgrass and noxious weeds.
- ◆ Increasing human populations in the project area have resulted in an increase in access and human activity for all types of uses. In some places road density has increased over the density threshold (approximately one mile of road per square mile) above which many species will displace to avoid human activity. These uses can increase wildlife displacement and vulnerability to mortality, can fragment habitat, and can allow for access of exotic plants into new locations.

Introduction to Rangelands

Unless otherwise noted, information in this section is derived primarily from the Scientific Assessment Landscape Ecology Staff Area Report (1996) and Terrestrial Staff Area Report (1996).

BLM- or Forest Service-administered rangelands make up about 37 percent of the project area and

about 35 percent of the planning area.

Rangelands encompass grasslands, shrublands, woodlands, and the various riparian areas around permanent and non-permanent water. Only a few tree species are native to rangelands, and these typically are located in wetter areas, especially in riparian areas and areas close to forests. Before Europeans colonized the region, climate and fire played major roles in directing the way rangeland vegetation appeared on the landscape. Since the mid-1800s, humans have altered fire and its effects on vegetation, and have added new forces responsible for changes observed on rangelands. The non-forested landscape of the project area was historically a frequently changing mosaic of habitats that supported 350 vertebrate wildlife species and countless invertebrate species.

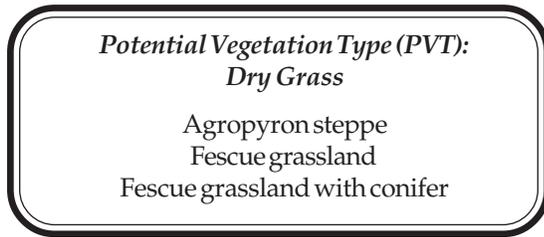
Rangeland vegetation has been combined into potential vegetation groups (PVGs) for discussion at this level of analysis. There are 29 potential vegetation types (PVTs) representing the rangeland or non-forested plant community, which have been divided into the following potential vegetation groups: dry grass, dry shrub, cool shrub, woodland, alpine, riparian shrub, and riparian woodland. Table 2-3, in the Introduction to Terrestrial Ecosystems section, lists the Rangeland PVGs that are discussed here. Woodland and alpine PVGs were not specifically discussed in this chapter because they represent very small portions of the project area and they have not changed significantly from historical times. Riparian shrub and Riparian woodland PVGs are discussed in the Riparian section later in this chapter.

Rangeland Health ~ A Definition

Rangeland health is defined "as the degree to which the integrity of the soil and the ecological processes of rangeland ecosystems are sustained." Rangeland health is synonymous with ecological health as discussed in Chapter 1 and the introduction to Chapter 2, but is applied strictly to rangeland ecosystems. Health has been used to indicate the proper function of complex systems; the term is increasingly applied to ecosystems to indicate a condition in which ecological processes are functioning properly to maintain the structure, organization, and activity of the system over time.

Soil integrity is critical for rangeland health and depends on an intact soil profile (layers of soil) and the condition of the soil surface. Important ecological processes in rangelands include the nutrient cycle, nitrogen cycle, and carbon cycle (see Figure 2-13, Nitrogen Cycle, later in this section; Figure 2-12, Carbon Cycle, in the Forestlands section); energy flows and the terrestrial food web (Figure 2-11, Terrestrial Food Web, in the Forestlands section); and plant community dynamics such as succession (Figure 2-14, Succession in the Sagebrush Steppe, later in this section).

Dry Grass Potential Vegetation Group



Distribution and Description

The dry grass PVG is not currently a major group, making up only four percent of the project and UCRB planning areas, compared to nine percent for the project area historically. The BLM and Forest Service manage 44 percent of what is remaining in this group within the project area. The dry grass PVG can be found in all ERUs, but most is in the Columbia Plateau, Central Idaho Mountains, and Blue Mountains ERUs (map 2-4, in the Introduction to Terrestrial Ecosystems section).

Composition and Structure

Dry grasslands in the project area are dominated by perennial bunchgrasses, such as wheatgrass steppe, fescue grassland, and vegetation types that have the potential to be invaded by dry forest vegetation. Dry grasslands also include crested wheatgrass, an exotic perennial grass that was seeded in the project area to rehabilitate poor condition dry shrubland and provide a dependable grass forage for livestock.

In general, dry grasslands are limited by low rainfall and shallow, rocky, or clay soils. Native dry grassland communities are very diverse, hosting a variety of grasses, forbs, and reeds. In years with good winter or spring moisture, grasslands can be fairly productive, but drought is common. Droughts generally last for three to five very dry years over a ten- to twenty-year period, with moist and dry years scattered in between. Most moisture falls in the cool winter and spring seasons; summers are typically dry. In areas with cloudy or foggy winters, dry grasslands are common, possibly because sagebrush and other shrub species need sunlight in the winter months. Grassland plants depend on storage of winter moisture in soils, because most of their growth is during the spring and early summer. Grassland plants do not have deep root systems needed to tap retreating soil moisture. Therefore,

they go dormant until fall rains stimulate another growth period (Terrestrial STAR 1996).

Historical Conditions

Dry grasslands have evolved over the past 10,000 years, and plants and animals that inhabited them lived in a constantly changing environment. Historically, disturbances from climate and fire caused the lowlands to be dominated by sagebrush, and included periods of expansion for grasslands, juniper, and shadscale desert (shrublands with sparse rainfall, vegetation, and shallow soils).

Historically, almost two-thirds of fires in this type were nonlethal, occurring in cured herbaceous-dominated layers. The majority were at less than 25-year intervals. About one-third of fires were mixed severity (a mixture of nonlethal and lethal) at 26- to 75-year intervals.

Current Conditions: Departures in Composition, Structure, and Disturbance Patterns and Processes

Departures in Composition and Structure.

This PVG has a high degree of overall departure from historical succession and disturbance regimes. The primary causes of this departure are related to conversion to agriculture and urban use (private lands), improper grazing, invasion of exotics, and changes in fire regimes due to fire exclusion and grazing. Generally this results in lower productivity, higher probability of severe or chaotic events, and lower similarity to the diversity of the native system (for example, noxious weed, cheatgrass encroachment). Large dominant bunchgrasses such as bluebunch wheatgrass and Idaho fescue are being replaced by smaller bunchgrasses such as Sandberg bluegrass, forbs, and exotic species.

Departures in Fire Regime. The current fire regime reflects the encroachment of trees and shrubs, particularly ponderosa pine, Douglas-fir, and mountain big sagebrush, caused by fire exclusion. Presently, only about 55 percent of fires are nonlethal—not very different from historically except that they occur at less frequent intervals. Mixed severity fires occur in about the same proportion and frequency as historically. Fires at longer intervals are more likely to have relatively severe effects on the soil surface and herbaceous plants, particularly when they occur in extremely dry years.

Terrestrial Species and Habitats in Dry Grasslands

General Trends

Species associated with native perennial bunchgrass communities have declined as much or more than any group in the project area. Some associated plant and animal species have been identified as at risk in the Terrestrial Assessment. Some of these species, including the Columbian sharp-tailed grouse, California bighorn sheep, pygmy rabbit, kit fox, and Idaho ground squirrel, need special attention to prevent the need to list them as threatened or endangered. Native grasslands and shrublands have all but disappeared in the Palouse Prairie of Idaho, Mission, Flathead, and Bitterroot Valleys of Montana (Landscape Ecology STAR 1996).

Invertebrates

Little is known about individual invertebrate species, so it is important to provide a diversity of habitat composition and structure to ensure habitat that supports all species is not lost. Some of the common groups of invertebrates include arthropods, mollusks, earthworms, protozoa, and nematodes. Soil structure and chemistry is important for soil invertebrates. Factors that have caused some invertebrate declines include the use of pesticides, loss of litter and dead plant material, and decline in forbs due to grazing, range treatments, fire exclusion, and disturbance of springs, wetlands, talus slopes, caves, and other special habitats (Terrestrial STAR 1996).

Grazing can reduce grass, seeds, forbs, and dead plant material available to invertebrate herbivores and pollinators. Improper livestock use has caused localized soil compaction, especially in wet areas, which has affected soil dwelling species such as earthworms, nematodes, snails, and slugs (Terrestrial STAR 1996). Except for species that are being considered for special species status, impacts from these disturbances on invertebrates are largely unknown. The largest change to invertebrate habitat in non-forested cover types is the conversion of grasslands and shrublands on private land to agriculture for crop production. The resulting simplification of plant species, use of pesticides, and removal of biomass have dramatically altered invertebrate abundance, composition, genetics, and distribution on lands surrounding public lands.

According to species estimates made for the project area (Terrestrial STAR 1996), only about 15 percent of potential invertebrate species have been identified. Of those identified, few have been studied, quantified, or had their ranges mapped. Of the known species, many have been accidentally or intentionally introduced. The small size and mobility of invertebrates make them easy to introduce by vehicles, cargo, animals, wind, and other means. Exotic invertebrate species pose an increasing threat to native invertebrates, through competition, displacement, and interbreeding, and they also pose threats to other plants and animals that they may attack. Invertebrates perform Key Ecological Functions in the environment by decomposing wood and litter that return nutrients to the energy cycle and by serving as food for all other groups of animals. Other Key Ecological Functions of invertebrates including turning over soil and increasing its productivity, pollinating flowers, and dispersing seed (Terrestrial STAR 1996). The scale of the landscape in which invertebrates function is inappropriate for deriving prescriptive management direction for them. (See Introduction to Terrestrial Ecosystems for more discussion of key ecological functions.)

Amphibians

The key for most amphibians is seasonal and permanent wetland habitat, which is a limited habitat in dry grasslands. Salamanders are rare in this potential vegetation group; the tiger and long-toed salamanders are found in wet areas. The Great Basin spadefoot toad, Woodhouse's toad, and spotted frog are limited to wetlands and pond habitat. The introduction of bullfrogs and exotic predatory fish species along with water quality problems have caused a decline in native frog abundance and distribution (Terrestrial STAR 1996). Many constructed ponds, catchments, and spring developments on rangelands have increased frog habitat, but groundwater developments and water diversions into troughs and tanks have altered other habitat areas. The spadefoot toad has been affected by the loss of perennial grassland habitat, increases in bullfrogs, and loss of wetland habitat (Collopy and Smith 1995). Key Environmental Correlates and Key Ecological Functions (See Introduction to Terrestrial Ecosystems section) include helping control insects, turning over soil, creating burrows for other species, and serving as indicators of water quality and quantity (Terrestrial STAR 1996).

Reptiles

Many reptiles are on the northernmost limits of their ranges in the project area and are more common in the Great Basin and Mojave deserts to the south. In general, reptile diversity is high in non-forested areas, but species on the edge of their ranges appear to be especially susceptible to habitat degradation and climate change (Collopy and Smith 1995). Since their habitat in the lowlands is influenced more directly by elevation, aspect, and physical features (rock, talus, terrain, and soil characteristics) than by vegetation, some of the vegetation changes due to overgrazing, exotic species invasion, and fire suppression may not have affected reptiles as much as other species. Common reptiles found in dry grasslands include the common garter snake, western fence lizard, short-horned lizard, yellow-bellied racer, striped whipsnake, gopher snake, and ringneck snake. Highways, reservoirs and other human-created structures are barriers to movement for reptiles and amphibians. Changes in physical features may be more important to these species than changes in vegetation. Reptiles are functionally important as predator and prey species to insects, small mammals, and birds. Key Ecological Functions of reptiles include helping to control rodents and insects, providing food for birds and mammals, and providing burrows for other animals (Terrestrial STAR 1996).

Birds

Some 111 bird species in the project area are associated with dry grasslands; 38 of these birds showed significant declines during population censuses over the past 26 years. Neotropical migratory birds breed and nest within the project area, but winter in south and central America. Thus, a reduction in species may be associated with changes both within and outside of the project area. The greatest impact to birds appears to be the loss of riparian and wetland habitat, but native grasslands may be linked to some species' declines. Riparian vegetation is used by 64 percent of these species. Until recently, killdeer, olive-sided flycatcher, willow flycatcher, red-winged blackbird, western meadow lark, and Brewer's blackbird, showed consistent long-term declines. The two species mainly associated with riparian habitat degradation, the flycatchers, are likely influenced by Federal land management (Neotropical Migratory Bird Report in press 1995, Terrestrial STAR 1996). Recent upward trends may indicate a gradual recovery in riparian habitats (Collopy and Smith

1995), which may account for the recent upward trend in long-billed curlew numbers, although the reasons are unclear. Brown-headed cowbirds and red-tailed hawks have increased in population during the same time period.

Loss of native grasslands and reduction in grassland cover have reduced plant and insect forage, nesting habitat, and hiding cover for several species. Habitat changes have caused declines in Columbian sharp-tailed grouse, upland sandpipers, mountain quail, and grasshopper sparrows (Terrestrial STAR 1996). Sharp-tailed grouse were once a common game bird in several locations in Idaho, but the conversion of grass and shrubland to agriculture and loss of native habitats from a wide variety of problems led to the extirpation of these birds in some locations. Sharp-tailed grouse have been reintroduced in one location in southern Idaho, but it is too early to determine if this effort has been successful. Sharp-tailed grouse in southeastern Idaho have recently increased (indicated by increased hunter harvest); it is believed this increase is due to undisturbed grass and shrub habitats created by the Conservation Reserve Program. This program was begun in 1985 to reduce soil erodibility by placing certain agricultural lands in permanent vegetative cover for 10-year periods. Sharp-tail grouse populations not within areas of the Conservation Reserve Program have not experienced similar harvest increases, and populations are currently small and isolated (Hemaker 1995; A. Sands, BLM, pers. comm. 1995).

Improper livestock grazing and increased fire frequency due to the spread of annual exotic species (such as cheatgrass) also may damage nests of ground-nesting birds, such as killdeer and sandpiper, in grassland habitats (Collopy and Smith 1995). Livestock grazing, succession, and increases in fragmentation of habitats have favored the cowbird, a nest parasite of many species. In fragmented habitats the cowbird has an advantage and reduces the reproductive success of other species. Cowbirds appear to be increasing at the expense of other species, by taking advantage of habitat changes. The western meadowlark, loggerhead shrike, lark sparrow, and Brewer's blackbird, important for controlling insects and distributing seeds, have declined (Collopy and Smith 1995).

Low elevation areas have a rich diversity of predatory birds (hawks, eagles, and owls), especially the Owyhee Uplands ERU (Terrestrial STAR 1996). Canyon walls of the Snake River provide nesting habitat for one of the highest densities of predatory birds in the world.

Some earlier declines in predatory birds due to impacts from pesticides, human-caused mortality, capture, and vegetation conversion have been reversed. Some species – such as the Swainson’s hawk, golden eagle, red-tailed hawk, burrowing owl, ferruginous hawk, peregrine falcon, and bald eagle – are showing increases. Loss of riparian vegetation and reduced prey forage due to grazing continue to affect some predatory birds (Collopy and Smith 1995). These predators help control gophers, ground squirrels, deer mice, and other small mammals.

The introduction and expansion of exotic plants, such as cheatgrass, in selected habitats has played a key role in the establishment and expansion of an exotic game bird, the chukar. Conversion of native habitats to croplands, especially for grain crops, has also supported populations of the introduced Chinese pheasant.

Mammals

Seventy-three species, or about three-quarters of the mammal species in the UCRB planning area, use non-forested habitat. Many small mammals rely on grassland ecosystems. Ground squirrels in the area tend to have many subspecies with very narrow distributions, and loss of native plants, poisoning, and soil compaction due to grazing are affecting Idaho ground squirrels and others by reducing available habitat. Conversion to crested wheatgrass and exotic weed species, changes in fire intensity and frequency, and expansion of juniper woodlands have reduced the diversity of small mammals (Collopy and Smith 1995).

Lowlands support a high diversity of bats, which help control insect populations. Bats typically roost in crevices and caves, but structures such as bridges, mines, and buildings have expanded roosting areas for bats. These additional roosting areas may help offset human disturbance to bat habitat, such as from exploration of caves and old mine shafts. Insect control efforts reduce prey for bats. Few bat populations have been monitored and their status is generally unknown (Terrestrial STAR 1996).

Big game species have high social values, as indicated by the amount of money spent annually on wildlife related activities. Elk occupy some areas of the grasslands, especially for winter range. White-tailed deer have benefitted from some human disturbances and have made a western expansion into grasslands in riparian corridors, shrubby riparian areas, and agricultural areas. Competition between

livestock and big game has increased where winter ranges are in degraded condition. Livestock grazing management can benefit populations of big game by changing plant species composition, density, and vigor; by providing additional water, salt, and nutrient sources; and by inhibiting the spread of woody vegetation. Livestock grazing management can also have negative impacts to big game if livestock compete for forage and water or increase the spread of disease. Forage competition can be reduced by managing the season of use, intensity of use, and the conversion of shrubs and forbs to annual grasses and other exotic species. Conversion of wintering areas to agriculture and urban areas can intensify conflicts with livestock and ungulates on remaining native low elevation ranges. (See Livestock/Big Game Interaction section, for more information.)

Many of the current high populations of some ungulates can be partially attributed to access management programs that control the use of roads by hunters and selective harvest strategies. Access management strategies among agencies to reduce vulnerability to mortality associated with roads is common for elk management. Increases in the density and use of roads across the project area provide a major factor in human-caused mortality in all big game species (Lyon et al. 1995, Terrestrial STAR 1996).

There are several successful reintroduction of California bighorn sheep populations within the project area, but some sheep reintroduction have been unsuccessful and most historical populations have declined in the Blue Mountains, Owyhee Uplands, and Upper Snake ERUs. Competition and disease transmission from direct contact with domestic sheep and changes in habitat are believed to be the primary causes for decline in bighorn sheep. However, during the winter of 1995–96, a major die-off of bighorn sheep occurred near the Snake river in Hells Canyon which was not attributed to disease transmission from domestic sheep. Bighorn sheep are valued for hunting and viewing opportunities (Lyon et al. 1995).

Fire is an important element in big game range, since it changes the composition and distribution of vegetation. Fire also improves the palatability and nutritional value of forbs, grasses, and some shrubs; and increases early spring green-up, which is important nutrition for pregnant animals. In contrast, fire suppression and change in fire regimes due to exotic plant

invasions have reduced the quality of many big game habitats (Lyon et al. 1995).

Carnivore (predator) populations have fluctuated in response to control efforts and changes in food availability. With the removal of gray wolf and grizzly bears from all but the higher elevation forest areas, coyotes, foxes, and skunks have increased. In some areas, packs of domestic dogs and wolf hybrids are causing increased predation and interbreeding with wild dogs. Mountain lion populations have been reduced in a few areas, especially where there is predation on livestock. The Government-sponsored Animal Damage Control program and non-Government-sponsored activities such as sport hunting and trapping can reduce local populations of carnivores such as mountain lions, coyotes, and other predators. However, overall there has been an increase in lions in the rural interface zone, causing concern for human safety. Any future decline in food ~ especially deer, rabbits, pronghorns, and ground squirrels ~ may cause more carnivores to move into areas with livestock grazing and human habitation (Collopy and Smith 1995, Terrestrial STAR 1996).

Dry Shrub PVG

*Potential Vegetation Type (PVT):
Dry Shrubs*

- Antelope Bitterbrush
- Basin big sage steppe
- Low sage-mesic
- Low sage-mesic with juniper
- Low sage-xeric
- Low sage-xeric with juniper
- Wyoming big sage-warm
- Wyoming big sage-cool
- Salt desert shrub
- Three tip sage

Distribution and Description

Dry shrub is currently a major group in the project area, making up 23 percent, compared to 30 percent historically. Within the UCRB planning area, this group makes up 19 percent. Agriculture and urban development have decreased this group by about 30 percent on lands not managed by the BLM or Forest Service;

the two agencies manage 55 percent of what is remaining in this group. The majority of this group is found in the Owyhee Uplands, Central Idaho Mountains, and Upper Snake ERUs (map 2-4, in the Introduction to Terrestrial Ecosystems section).

Composition and Structure

As with the dry grassland potential vegetation group, dry shrublands are limited by low rainfall or shallow, rocky, or clay soils. Native plants are diverse, with many species of shrubs mixed in patterns with grasses, forbs, and reeds. Moisture falls primarily in the winter and spring, and most shrubs have deep roots that can tap soil moisture deep in the profile. Evergreen shrubs, such as sagebrush and juniper, continue to grow during winters with favorable moisture and ground temperatures, if there is adequate sunlight to allow photosynthesis.

Historical Conditions

The patterns and composition of shrubs with trees, grasses, and forbs varied historically as climate and fire regimes changed. Historically, grasses and forbs covered 10 to 60 percent of the dry shrublands. Shrubs covered the remaining 40 to 90 percent of the area. The patchy pattern of mixed shrub and grass areas tended to exist in rocky areas and rough terrain. Areas of gentle terrain and deeper soils tended to have more continuous patterns (Terrestrial STAR 1996).

In the absence of fire for long periods, trees, such as juniper and ponderosa pine, sometimes invaded dry shrublands. With frequent fire, grasses and forbs have an advantage because they respond quickly to nonlethal fires by sprouting from bunchgrass root crowns, seeds, or runners whereas tree seedlings are easily killed by most fires. The mixed patterns of trees, shrubs, grasses, and forbs provided a variety of food and cover for animals (Terrestrial STAR 1996).

Historically, 93 percent of fires in the dry shrub PVG were lethal to the dominant shrub overstory, with most (62 percent) occurring at 76- to 150-year intervals. About 6 percent of fires were nonlethal at less than 25-year intervals, likely burning in herbaceous-dominated stages. There was a fire-induced cycle between upland herb and shrub-dominated stages, with no development of early and late seral woodlands.

The native grazing regime appears to have varied from relatively high intensity, short duration grazing by herds of native ungulates, to low intensity grazing by scattered native ungulates animals, to seasonal, moderate levels of grazing by groups of native ungulates. Grazing was strongly influenced by seasonal weather. Grasslands, shrublands, and woodlands were historically mosaics of habitats which were not influenced to any great extent by large grazing animals until horses, and later cattle and sheep, were introduced less than 300 years ago (Collopy and Smith 1995).

**Current Condition:
Departures in Composition,
Structure, and Disturbance Processes
and Patterns**

Departures in Composition and Structure

Similar to the dry grass PVG, this group has a high degree of overall departure from historical succession and disturbance regimes. The primary causes of this departure relate to conversion to agriculture and urban use, improper grazing, and changes in fire regimes attributable to exclusion and grazing. This generally results in lower productivity, higher probability of severe or chaotic events, and lower similarity to the diversity of the native system (for example, noxious weed, cheatgrass encroachment).

Since implementation of fire exclusion, improper livestock grazing, invasion of exotics, and conversion to agricultural and urban land use, this type has

gone through significant change. Exotics are common components in most plant communities of this group. Woodlands have not increased significantly. The most profound effect is the general change in composition and structure within the upland shrub and herb plant communities as a result of heavy early season or season-long livestock grazing and seeding to perennial exotic grasses, especially crested wheatgrass.

Departures in Fire Regime

Averaged for the entire dry shrub group, the current fire regime has not changed much from the historical regime. However, fire frequency has increased in locations where exotic annual grasses have invaded.

Currently about 11.5 percent of fires are nonlethal. Eighty-four percent of the area has a lethal fire regime. Fire frequency is still 76 to 150 years in 38 percent of the area, but it has increased in 43 percent of the area to less than 25 years. This must be at least partially caused by the current dominance of exotic annual grasses in many locations.

**Rare, Endemic, and Special Dry
Shrub Habitats**

Certain areas were identified in the Terrestrial Assessment as having several plant or animal species that are rare and/or have very limited distribution (narrow endemics; see map 2-5, in the introduction to Terrestrial Ecosystems). These areas include salt desert shrub and other dry shrub habitats in Idaho. Only small remnant salt desert shrub areas exist on BLM-

Photo 11

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Photo 11: The dry shrub PVG is currently a major group in the UCRB planning area (about 19 percent). M. Pellant photo.

administered lands, although several rare species need these habitats. Important habitat also includes some of the dry shrublands in Owyhee Uplands ERU. These not only contain remnant habitat areas on BLM- or Forest Service-administered lands, but also have thermal hot springs, potholes, lava flows, caves, alkali lakes, and other limited habitats. There are also important habitat areas in the canyons and uplands surrounding the Upper Snake River ERU on the border between Oregon, Idaho and Nevada. This area has remnant dry shrublands and perennial grasslands on BLM-administered lands, and it is also on the convergence with the Great Basin, Klamath, Cascade, and Rocky Mountain species ranges. The Snake River Canyon creates unique microsites (small, local variations in habitat) and acts as a corridor to some species moving in the canyon, while posing a barrier to others trying to cross it.

Areas with relatively intact native populations of species with high biodiversity were also identified in the Terrestrial Assessment (see Map 2-6, in the introduction to Terrestrial Ecosystems). Dry shrublands in Idaho are included because they represented some of the last relatively large undisturbed shrub habitat that has not been converted to agriculture. The lower Snake River, areas in north central Idaho, and the Continental Divide areas of Montana also contain many different species. The uplands are also in this category due to the high number of native species, some of which are on BLM lands and wildlife refuges (U.S. Fish and Wildlife Service). These areas represent sources of plant and animal species to recolonize neighboring habitat areas, as well as important areas for research and monitoring (Terrestrial STAR 1996).

Terrestrial Species and Habitats in Dry and Cool Shrublands

Terrestrial species and habitat sections for the dry and cool shrublands have been combined for ease of discussion. Most of the animal species that exist in the dry shrublands also exist in the cool shrubland and move between the two habitats based on annual weather and climate changes. An example may be a species that needs shrubs for nesting such as the Brewer's sparrow. This species will not nest in trees or on the ground in grasslands but can be located in both the dry and cool shrubland types. Some information from the Terrestrial Assessment data bases was able to separate species within these two shrubland

habitat groupings; when possible, this separation will appear in the text of this section.

Amphibians

The key for most amphibians is seasonal and permanent wetland habitat, which is a limiting factor in the dry shrublands. Salamander diversity is low, with three species, and probably always was in dry shrublands of the project area. Frog diversity is higher with six frog species and two toad species in the project area. The cooler climate of cool shrublands limits amphibians. Two species of salamanders are found in cool shrublands and have probably always been rare in this group.

Birds

Dry shrublands support some 93 bird species, which increases to 132 if riparian and wetland areas are included within this type. Over the past 26 years, surveys of banded birds show some population trends. For example, population increases of birds that use riparian areas within dry shrublands ~ such as MacGillivray's warbler, killdeer, olive-sided flycatcher, willow flycatcher, Brewer's blackbird, western meadowlark, and Lazuli bunting ~ have increased, indicating some recovery in riparian systems. Northern flicker, house wren, mountain bluebird, American robin, and grey flycatcher also have increasing population trends, partly due to expansion in juniper woodland habitat (Collopy and Smith 1995).

Declines in species such as sage grouse, Brewer's sparrows, and sage sparrows can be attributed to changes in shrubland structure, abundance, and distribution. Habitat is becoming more and more disjunct (areas have become isolated from each other), and blocks of habitat are becoming smaller islands. Changes in riparian and wetland habitat, and native grasslands, are also linked to some species declines. Loss of grass and shrub cover, and loss of structural diversity, have significantly reduced plant and insect forage, nesting habitat, and hiding cover for several species, including declines in sage grouse, sharp-tail grouse, upland sandpipers, mountain quail, and grasshopper sparrows (Terrestrial STAR 1996). The expansion and increased density of juniper woodlands has caused the deterioration of sagebrush and grassland habitats which appears to have affected the rock wren and chipping sparrow (Collopy and Smith 1995).

Sage grouse were once common across southern Idaho and northern Nevada. Some populations

have declined based on harvest records and other information. The loss and fragmentation of shrubland due to conversion to agriculture has been common in the Upper Snake ERU and to a lesser extent in Owyhee Uplands. Also, this habitat is additionally fragmented because of recent extensive fires and increases in exotic weeds and other problems. The problem is complex because sage grouse also need grass, forbs, and insects, especially in the spring when they raise their young; sage grouse populations are in decline (Collopy and Smith 1995).

Mammals

Seventy-two species of mammals use the dry shrub potential vegetation group (Terrestrial Staff database). Many small mammals rely on the sagebrush steppe and grassland ecosystems. Several ground squirrels in the area have subspecies with very limited distributions. Loss of native plants, rodent poisoning, and soil compaction due to improper grazing are affecting several species such as Washington and Idaho ground squirrels, pygmy rabbits, and white-tailed jackrabbits. The pygmy rabbit is considered a special status species because of its rapid decline. This rabbit’s survival is linked to critical remnant areas of shrub steppe vegetation, which is declining because of conversion to crested wheatgrass, extensive planting of introduced grasses (1.4 million acres in Idaho), introduction of exotic weed species, and changes fire intensity and frequency. Increased density of juniper woodlands has reduced sagebrush and bunchgrass understory, which may reduce habitat diversity for small mammals in dry shrublands (Collopy and Smith 1995).

About 66 species of mammals use cool shrublands (Terrestrial Staff database). Conversion to agriculture, invasion of exotic weed species, changes in fire intensity and frequency, and expansion and increasing density of juniper woodlands may negatively affect some small mammals (Collopy and Smith 1995). Bushy-tailed woodrats, yellow-bellied marmots, mantled ground squirrels, northern pocket gophers, and deer mice are common mammals that provide food for predatory birds and mammals and help distribute seeds and spores of plants. Porcupines use cool shrublands extensively and help limit the invasion of conifers and other trees into this type.

Like most native ungulates, populations of pronghorn antelope were decimated by unregulated hunting between 1850 and 1920. Since then populations have increased because of regulated hunting and improved range

conditions. Available pronghorn habitat has been affected by loss of habitat, fire suppression, increase in coyotes and dogs, transportation systems, human habitation, grazing, and fencing that is not compatible with pronghorn movements (Lyon et al. 1995). Populations of this lowland species have become more disjunct (populations have become isolated from each other), and blocks of habitat are becoming islands.

Populations of the bobcat and other fur-bearing species appear to be increasing with reductions in demand for their fur. Bobcats have an important interaction with black-tailed jackrabbits and cottontail rabbits in the shrub steppe areas, and may help to reduce crop damage during periods of high jackrabbit population cycles (Collopy and Smith 1995). In some areas, packs of domestic dogs and wolf or coyote hybrids are causing increased damage to livestock and big game herds.

For more information on terrestrial invertebrates, reptiles, and carnivore species, see the Dry Grasslands Potential Vegetation Group.

Cool Shrub PVG

*Potential Vegetation Type (PVT):
Cool Shrub*

- Mountain big sage-mesic-east
- Mountain big sage-mesic-east with conifer
- Mountain big sage-mesic-west
- Mountain big sage-mesic-west with juniper
- Mountain shrub

Distribution and Description

The cool shrub PVG is somewhat a minor group in the project area, occupying 8 percent of the project area compared to 9 percent historically. Within the UCRB planning area, this group makes up 9 percent. The cool shrub PVG has declined by about 11 percent as a result of agriculture and urban development on non-Federal lands; the BLM or Forest Service manages 66 percent of what is remaining of this group. This group is found in nearly every ERU with the majority of the group found in the Blue Mountains, Central Idaho Mountains, Owyhee Uplands, Snake Headwaters, and Upper Snake ERUs (map 2-4, in the Introduction to Terrestrial Ecosystems section).

Photo 12

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Photo 12: The cool shrub PVG is generally limited by shorter growing seasons and lack of late summer moisture. USFS photo.

Composition and Structure

The cool shrub PVG is represented by mountain big sagebrush and mountain shrub potential vegetation types. This PVG is generally limited by shorter growing seasons and lack of late summer moisture. Soils are often shallow, rocky, or high in clay content, which limits soil moisture and encroachment of trees in some areas. Historically, cool shrublands had fairly short cycles of dominance by either grasses and forbs or by shrub species.

Historical Conditions

Grasslands, shrublands, and woodlands were historically mosaics of habitats that were not influenced greatly by large grazing animals until horses, and later cattle and sheep, were introduced less than 300 years ago (Collopy and Smith 1995). The native grazing regime appears to have varied from relatively high intensity, short duration grazing by herds of big game animals, to low intensity grazing by scattered animals, to seasonal, moderate levels of grazing by groups of game animals. Grazing was strongly influenced by seasonal weather.

Historically, about 82 percent of the fires in this type were lethal to the dominant shrub overstory, with 62 percent occurring at intervals of 25–75 years. About 15 percent of acres were burned by nonlethal fires, occurring in herbaceous vegetation at intervals of less than 25 years, particularly in the Central Idaho Mountains ERU.

Grasses and forbs covered from 10 to 40 percent of the cool shrub, and shrubs covered the remaining 60 to 80 percent, depending on the occurrence of fire. Conifers occupied from about 3 to 10 percent of the area of the cool shrub PVG.

Current Condition: Departures in Structure, Composition, and Disturbance Processes and Patterns

Departures in Structure and Composition

This group has a high degree of overall departure from historical succession and disturbance regimes. The primary causes of this departure relate to improper grazing, changes in fire regimes due to exclusion and grazing, and exotic forb and grass dominance. This generally results in lower productivity, higher probability of severe or chaotic events, and lower similarity to the temporal, spatial, and habitat diversity of the native system (for example, noxious weed encroachment). Where declines have occurred, the large dominant bunchgrasses have generally been replaced by native forbs and by exotic forbs and grasses such as Kentucky bluegrass. Woodlands have increased to cover 25 to 30 percent of cool shrublands, and upland grass and forb areas have generally been lost, with only four percent remaining.

Departures in Fire Regime

The current fire regime is 86 percent lethal fires and 9 percent mixed severity, reflecting the

decrease in grass- and forb-dominated stages to only about 4 percent, and the increase in woodlands. Nonlethal, very frequent fires have declined to about 6 percent of total burned acreage. Invading conifers include western juniper, particularly in the Blue Mountains and Owyhee Uplands ERUs; Douglas-fir (Gruell 1983) and ponderosa pine in southwestern Montana; and Douglas-fir and lodgepole pine in eastern Idaho.

Terrestrial Species and Habitats in Cool Shrublands

See discussion under “Terrestrial Species and Habitats in Dry and Cool Shrublands.”

Key Factors Influencing Rangeland Vegetation

Major elements that influence how rangeland vegetation appears include: (1) livestock grazing; (2) fire and fire exclusion; (3) introduction of noxious weeds, exotic plants and introduced forage grasses; (4) Soils and their productivity; and (5) climate. These elements act together to create the vegetation patterns seen on the landscape.

Although vegetation in the project area has always been grazed by herbivores, the introduction of large numbers of livestock into the region in the late 1800s subjected the vegetation to stresses with which it had not adapted. Fire, sometimes fanning out over large expanses of rangeland, was frequent before the arrival of Europeans. The introduction of livestock resulted in consumption of a portion of the vegetation that had provided fuel for fires. Fire frequency declined in some areas as a result of this and because of subsequent fire suppression efforts in some places. Plant communities formerly composed of native species are now being converted in many areas to exotic weed species. Most of these exotic plants require some sort of disturbance to become established, but once established they will often displace native species.

Soils and their productivity are integral to the productivity of rangeland plants and to plant composition within communities (figure 2-13). Soil productivity depends on both soil (for example, depth, texture, supply of nutrients) and non-soil (for example, slope and rainfall) factors, and these factors vary greatly across rangelands. Certain rangeland soils are fertile, but because of

low rainfall are not highly productive of vegetation. Some rangeland soils are shallow and do not retain soil water for long periods of time, thus these soils are not highly productive either. See Soils section of the Physical Environment section earlier in this chapter for a more in-depth discussion on soils.

Climate, especially drought, is a frequent but unpredictable force that plays a major role in the pattern, composition, and structure of vegetation. The effects of livestock grazing, fire or its exclusion, exotic plants, soils and their productivity, and other factors that alter vegetation are only fully expressed if climate is considered, because climate governs the full response of vegetation.

Livestock Grazing

Rangeland vegetation in the Intermountain West, including the project area, adapted to relatively light grazing pressure compared to the vegetation of current times and to the vegetation in the Great Plains. Although large herbivores were present in the project area prehistorically, we do not have accurate estimates of the prehistoric population sizes of the various herbivores and their distributions on the land, especially compared to historical and current livestock numbers and distributions. Historical and prehistorical herbivory, as proposed by Burkhardt (1994, in Leonard and Karl 1995a) was strongly influenced by seasonal weather on Intermountain rangelands. Under this scenario, low elevation valleys were grazed in winter. Herbivores moved to higher elevations in spring with growth of herbaceous species, permitting regrowth in the lower elevations in spring and early summer and fuel accumulation for periodic summer fire. The animals then moved back to lower elevations in fall. The native wild ungulate grazing regime included relatively high intensity, short-duration grazing by herds; low intensity grazing by scattered animals; and seasonal moderate levels of grazing by groups of animals.

Horses were introduced by humans about 300 years ago, and cattle and sheep were introduced later when extensive settlement of the West began. Unlike wildlife species, livestock do not migrate. Livestock tend to stay in place as long as they have food, water, and other needs; this can damage vegetation, soils, streams, and other resources. Current land ownership patterns and grazing permits (forage allocations on grazing

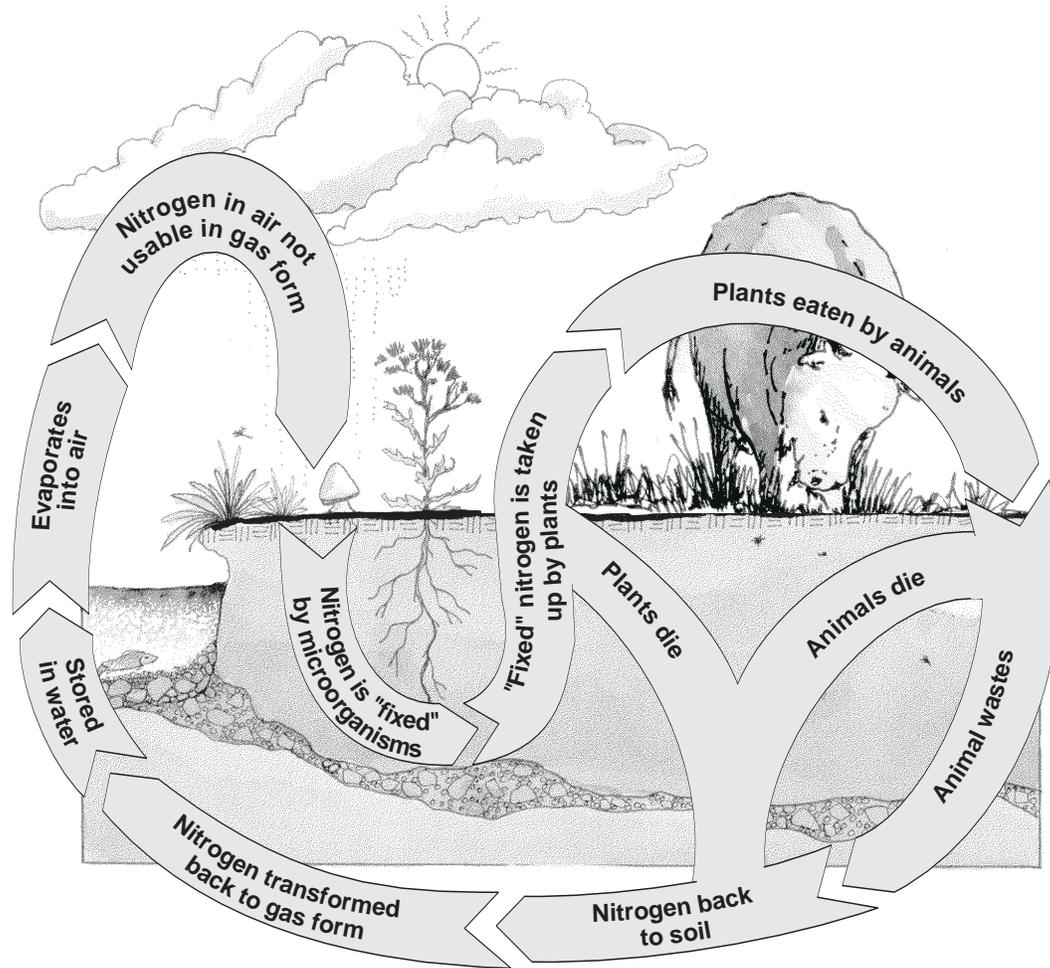


Figure 2-13. Nitrogen Cycle and Rangeland Health.

Plants depend not only on energy captured through photosynthesis but also on nutrients in soil. Nutrients such as nitrogen are cycled continually among plants, animals, and microorganisms. The amount of nitrogen available and the rate at which it cycles is a fundamental factor in rangeland health.

After water, nitrogen is the most limiting factor in rangeland ecosystems because nitrogen in the air must be captured and transformed (or “fixed”) by specific bacteria or algae into a form useable for biological processes. Legumes (such as peas, clover, beans) and a few other plant species host specific nitrogen-fixing organisms in their root hairs, producing a root enlargement called a nodule, where the conversion of gaseous nitrogen to useable forms occurs. Other species of bacteria and fungi decompose organic materials such as plant litter or dead animals, reincorporating previously fixed nitrogen into the soil where it can be used by plants and other organisms through the nutrient cycling process.

A close, interdependent relationship exists between nitrogen and carbon. The proportions of each element play an important role in regulating the decomposition rate of organic matter and in controlling the rate at which nitrogen and other nutrients are cycled (Debano 1990). Therefore, factors that affect the nitrogen cycle will also have effects on the functioning of the carbon cycle (see figure 2-12 in the forestlands section).

A variety of conditions prevalent on rangelands within the UCRB planning area contribute to reduction or loss of useable nitrogen. One such condition is soil erosion, which reduces the total organic matter available and thus the potential total nitrogen content of the soil. Another observed condition is the conversion of sites to monocultures of shallow-rooted (often exotic) species, which affects the depth to which plant roots can deposit nitrogen in the soil (National Research Council 1994).

Nitrogen and other nutrient and biophysical cycles are key ecological processes in every ecosystem type and are inextricably woven together through and across ecosystem boundaries. The nitrogen cycle is discussed here to highlight its importance to rangeland health, but it also is critical to forest and aquatic/riparian health.

allotments) add complications that make it difficult for livestock to move seasonally and thereby graze rangelands as they probably were grazed historically. The sedentary behavior currently observed of livestock in riparian areas would have been discouraged in wild herbivore populations by the abundance of predators.

Current scientific thinking regarding livestock grazing pressure and its relation to vegetation succession typically falls into two general categories of models. The first and older model of vegetation succession is the traditional “climax” model. The second, and more recent model is the “state and transition model”. The climax model asserts that reduction or elimination of livestock grazing pressure will permit improvement in rangeland vegetation through secondary succession. Range scientists are beginning to accumulate convincing evidence, however, that not all rangeland vegetation types respond according to the climax model. Relatively new models, of which the “state and transition” model of vegetation succession regarded by Laycock (1994, in Leonard and Karl 1995a) as most useful, have been proposed as operative on many arid and semiarid rangeland vegetation types. See Appendix F for a more detailed discussion of these two models.

Grazing management in the project area has been guided by principles of the climax model during the 20th century. Potential vegetation types on rangeland in the project area that best fit this model of successional advancement of vegetation succession include: (1) all riparian types (willow/sedge, Saltbrush Riparian, Mountain Riparian Low Shrub, Riparian Graminoid, Riparian Sedge, Cottonwood Riverine, and Aspen); (2) grasslands, (such as Agropyron Steppe, Fescue Grassland, and Fescue Grassland with Conifer); (3) cool shrub types (such as Mountain Big Sagebrush, Mountain Shrubs); and (4) open ponderosa pine-grasslands (such as Interior Ponderosa Pine). There are exceptions within these types where improvement may not be observed, especially in cases of extreme past grazing abuse, noxious weed invasion, and within the drier portions of these vegetation types that are adjacent to even drier vegetation types such as Wyoming Big Sagebrush.

Succession of vegetation in some places and vegetation types does not necessarily parallel changes in livestock grazing pressure. For example, arid and semiarid potential vegetation

types on rangeland can remain stable at a successional stage lower than climax for long periods of time after reduction or elimination of livestock grazing pressure. These vegetation types apparently fit the state and transition model more so than the climax model. Examples of these vegetation types include dry sagebrush steppe potential vegetation types, with or without juniper (that is, Basin Big Sagebrush, Wyoming Big Sagebrush, and Low Sagebrush), and Salt Desert Shrub. In much of the Intermountain Region, past livestock grazing pressure probably has contributed to increased dominance of sagebrush species and to encroachment or increased dominance of juniper (Archer 1994, in Leonard and Karl 1995a). This occurs through modification of the following: microclimate, plant competitive interactions, soil fertility, and fire frequency and severity caused by livestock consumption of grasses and forbs that acts as fuel. Reduction or elimination of livestock grazing pressure will not necessarily convert dominance by woody plants to dominance by grasses and forbs, especially on sites with dense woody plant cover and sparse grass and forb understory. Adjustments in livestock grazing pressure or rest from livestock grazing can, however, result in improved soil stability, soil water levels, and nutrient levels, especially on sites that have yet to reach a peak in woody plant cover. In the project area, an example of increased dominance by woody plants is the expansion of western juniper, which is most notable in Upper Klamath, Northern Great Basin, Columbia Plateau, Blue Mountains and Owyhee Uplands ERUs. Further discussion of this topic can be found in “Western Juniper and other Woody Species Expansion/Density Concerns,” later in the rangelands section.

Some potential vegetation types, especially Wyoming big sagebrush warm and more recently salt desert shrub, are susceptible to invasion by exotic annual grasses such as cheatgrass and medusahead, which are flammable. If they dominate a site, a deceptively stable vegetation state results, because these flammable exotics create fire-return intervals as low as five years, which do not permit perennial grasses or shrubs to establish and produce seed, even if a seed source is nearby. Reduction or elimination of livestock grazing pressure can make the situation worse by allowing grass and forb plant material to accumulate and provide fine fuels for fire. These conditions of flammable exotics are found in the more arid portions of the UCRB

planning area, especially the Owyhee Uplands and Upper Snake ERUs.

Achieving the goal of sustainability of the rangeland resource with grazing management should involve stocking rates and grazing intensities compatible with drought frequency and magnitude. Flexibility within the grazing system is required as part of any grazing strategies intended to prevent rangeland vegetation from becoming more degraded, especially because of climate variability on rangeland. In this regard, continued stocking at near normal levels during moderate to severe drought is probably the greatest cause of range deterioration (Vallentine 1990, in Leonard and Karl 1995a).

The potential for drought-related damage to rangelands in the project area is high, especially in dry shrublands such as Wyoming sagebrush sites in the Owyhee Uplands and Upper Snake ERUs. Drought-related degradation is a concern on BLM-administered lands where livestock are normally already out on the range before it is realized that a drought is in effect. By the time a drought is inevitable, livestock have been out on the range for months, and the ability for most livestock operators to round up their cattle and take them to another area or home is limited. Therefore, much effort has been taken to try and accommodate cattle on BLM-administered lands, which increases the potential for drought-related damage to the dry shrubland types. Reduced grazing pressure during drought and for some time after drought may be necessary to minimize damage and hasten recovery of perennial vegetation.

For a detailed discussion of livestock grazing in riparian areas, see the Aquatic Ecosystems section of this chapter.

Changes in Fire Regimes

Alterations in natural fire regimes have greatly influenced the location, composition, and structure of rangeland vegetation. In many locations the frequency of fire has decreased because of fire suppression and removal of carrier fuels by livestock grazing. Changes resulting from decreased fire frequency include: (1) encroachment of conifers into non-forested vegetation at the forest-steppe boundaries, for example ponderosa pine and Douglas-fir; (2) increased tree density in former savanna-like stands of juniper and ponderosa pine; and (3)

increased density and/or coverage of big sagebrush and other shrubs, with accompanying loss of herbaceous vegetation. In contrast, fire frequency has increased in other areas, particularly in drier locations where exotic annual grasses such as cheatgrass have become established. These changes in the fire regime have caused greater homogeneity or simplification of many landscapes.

Increased fire frequency has caused a loss of shrub cover, particularly sagebrush and bitterbrush, and reduction in bunchgrasses. At the same time, frequent fire has favored dominance by exotic annual grasses. More fuel for fires accumulates under encroaching shrubs and trees or in grasslands where fires have been suppressed and grazing has not helped remove build-up in plant material. This added fuel makes it more likely that future fires will be lethal and will kill the root crowns of bunchgrasses, which will make it easier for exotic species, annuals, and conifers to displace native grasses.

In dry grasslands where fire typically has been absent, shrubs are more competitive than grasses, in part because shrubs have deeper root systems than grasses, allowing them to tap soil moisture in dry years. When dry grassland sites are invaded by shrubs or trees, soil characteristics and nutrient cycling that developed under grassland ecosystems are disrupted. Cover on the soil (vegetation and litter) decreases, which in turn exposes more soil to erosion (Landscape Ecology STAR 1996). Improper grazing of the remaining grasses and forbs can further expose the soil, and erosion by wind and water can lead to permanent gully formation and changes in water tables.

Noxious Weeds, Exotics, and Introduced Forage Grasses

Noxious Weeds

The beginning of agriculture, including livestock grazing in the project area, permitted introduction of seeds of exotic plants onto rangelands. Today, exotic plants, including legally declared “noxious weeds,” are spreading rapidly and in some cases exponentially on rangeland in every ERU in the project area. The establishment and spread of these species is fostered by disturbance to the soil surface. Noxious weeds, in general, are opportunists.

Photo 13

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Photo 13: Increased fire frequency has caused a loss of shrub cover, particularly sagebrush and bitterbrush, and reduction in bunchgrasses. Frequent fire also has favored dominance by exotic grasses, which provide more fuel for fires and make it more likely that future fires will be lethal. USFS photo.

They are typically prolific producers of seed, which are usually dispersed often for long distances by vehicles, wind, wildlife, livestock, water, machinery, and pack animals. Noxious weeds are commonly referred to as “pioneer” species because after a disturbance to the soil surface which results in loss of the native plant cover, they are often the first species to arrive and colonize. They typically germinate under a wide variety of conditions, and show fast seedling growth; thus, they establish quickly and take up water and nutrients that become unavailable for native species. Some noxious weed species, however, currently are showing ability to invade relatively undisturbed sites as well, including Wilderness Areas. Some of the densest infestations of noxious weeds are near roads, which provide a route for spread of noxious weeds by human-related actions and for an increase in the amount of exposed bare ground. Noxious weeds can reduce the diversity and abundance of native vegetation, reduce forage, reduce diversity and quality of wildlife habitat, increase erosion, and decrease water quality.

Many noxious weeds already are present on rangelands in nearly every county of the project area. These weeds include: bull thistle, Canada thistle, dalmatian toadflax, diffuse knapweed, hoary cress (whiteweed), leafy spurge, musk thistle, Russian knapweed, Scotch thistle, spotted knapweed, yellow starthistle, and yellow toadflax. Many of these same weeds are also a problem in forest areas, as discussed in the introduction to this chapter. Rangeland cover types (plant communities) in the project area that have declined in area from historic to

current, partly because of the invasion by noxious weeds, can be found in table 2-11. Weeds that are relatively recent invaders or soon will be new invaders of rangeland in the project area, and are of critical concern to weed experts, include but are not limited to: Syrian bean-caper, African rue, Iberian starthistle, purple starthistle, distaff thistle, squarrose knapweed, camelthorn, saltcedar, and matgrass.

Dewey et al. (1991) propose that “The precision and usefulness of federal weed control Environmental Assessment (EA) and Environmental Impact Statement (EIS) documents would be significantly improved by knowing the exact location and extent of lands vulnerable to specific noxious weeds.” In this regard, a measure of the susceptibility of rangeland cover types to invasion by 25 weed species (24 noxious weeds plus cheatgrass) is presented in Karl et al. (1995) along with regional (Washington, Oregon, Idaho, Montana, and Wyoming) distribution maps of these 25 species at the county scale. These county maps show the distribution of each species over the past 121 years (1875–1995). The susceptibility of rangeland cover types to invasion by noxious weeds and cheatgrass was coded and defined as follows: (1) Disturbed = moderate susceptibility - cover type is susceptible to invasion by weed species following disturbance that affects the soil surface or removes the canopy cover; (2) Invasive = high susceptibility - cover type is susceptible to invasion by weed species even in the absence of disturbance; (3) Closed = negligible susceptibility - cover type does not provide suitable habitat for the weed species to typically

Table 2-11. Rangeland Cover Types (plant communities) in the Project Area That Have Declined in Area from Historical to Current, In Part Because of the Noxious Weeds Listed for Each Type.

Rangeland Cover Type	Associated Potential Vegetation Group ¹	Noxious Weeds
Agropyron Bunchgrass	Dry Grass	diffuse knapweed, spotted knapweed, yellow starthistle, rush skeletonweed, sulfur cinquefoil, medusahead, Dyers woad, dalmatian toadflax, yellow toadflax, common crupina
Fescue-Bunchgrass	Dry Grass	spotted knapweed, leafy spurge, sulfur cinquefoil, oxeye daisy
Antelope Bitterbrush-Bluebunch Wheatgrass	Dry Shrub	diffuse knapweed, cheatgrass ² , dalmatian toadflax, rush skeletonweed, sulfur cinquefoil
Big Sagebrush	Dry Shrub	cheatgrass ¹ , medusahead, diffuse knapweed, rush skeletonweed, dalmatian toadflax, Dyers woad, Mediterranean sage, yellow starthistle
Herbaceous Wetlands	Riparian Herb	Kentucky bluegrass ¹ , Canada thistle, purple loosestrife, leafy spurge, saltcedar, musk thistle, Russian knapweed, spotted knapweed, Scotch thistle, yellow starthistle, hoary cress (whiteweed), Mediterranean sage
Shrub Wetlands	Riparian Shrub	Canada thistle, leafy spurge, musk thistle, purple loosestrife, saltcedar, Russian knapweed, Mediterranean sage

¹ Column two shows the associated potential vegetation group in which the cover type resides.

² Not legally declared noxious in project area.

invade; and (4) Unknown = negligible susceptibility - data were insufficient to allow a determination of susceptibility.

Appendix F includes tables called *SUSCEPTIBILITY* and *COVER TYPE*, which display the information on susceptibilities of the rangeland cover types, for the use of land managers and the concerned public. These rangeland cover types are described in table *COVER TYPE* and are recognized by the Society for Range Management. Rangeland cover types are plant communities characterized by the existing vegetation on the area. Thus these cover types represent the vegetation that is on the ground and are useful for land managers and others who are interested in searching for and

controlling infestations of these weeds. The rangeland cover types that are coded as moderate or high susceptibility in table *SUSCEPTIBILITY* are what are referred to in the standards of the noxious weed section of Chapter 3. Information from tables *SUSCEPTIBILITY* and *COVER TYPE* is summarized here in table 2-12. Table 2-12 shows, for each of 15 selected noxious weed species assessed in Karl et al. (1995), the rangeland cover types that are most susceptible to invasion.

Specific location and current acreage information is not available for the project area at this time for noxious weeds. In addition, susceptibilities of rangeland cover types to each weed, in table *SUSCEPTIBILITY*, will require further revision as

more knowledge becomes available. Predicting noxious weed distributions in the future requires that we know specifically what rangeland cover types are susceptible to invasion by each weed and where these types lie on the landscape in relation to where the noxious weeds are currently distributed.

Noxious weed control on BLM- or Forest Service-administered lands generally has been ineffective. Limited budgets; lack of consistency and coordination by all concerned entities such as private, county, State, and Federal; and an inability to get ahead of the weed problem have allowed noxious weeds generally to continue to spread throughout the project and planning areas. Control methods have focused on mechanical and chemical efforts usually along major roads and Rights of Way, as funding allows. Both large and small noxious weed infestations have been the focus of efforts in the past, mostly treated through contracts with the counties. In some cases, noxious weeds are treated by qualified Federal agency personnel of the administering agencies. The cheapest, most effective, and highest priority weed management technique is prevention, especially prevention of new infestations of noxious weeds and establishment of new exotic weeds not currently residing in the region. The magnitude and complexity of noxious weeds on rangelands in the project area, combined with their cost of control, necessitates using Integrated Weed Management (IWM). Integrated Weed Management involves the use of several control techniques in a well-planned, coordinated, and organized program to reduce the impact of weeds on rangelands. The IWM strategy is discussed in more detail in Appendix F.

Exotics: Altered Sagebrush Steppe
(Primarily taken from Pellant 1995.)

Altered sagebrush steppe represents a landscape where invasion of exotic annual grasses and forbs into some sagebrush communities has resulted in plant communities where native perennial plants are lacking and annuals dominate the site. Past overgrazing of the perennial grasses and forbs in these sagebrush communities made these areas more susceptible to invasion from exotic annuals such as cheatgrass, medusahead, Russian thistle, and mustards. As the annuals increased in these communities, so did the fire frequency. Where these sagebrush communities would normally burn every 25–100 years in the past, they now can burn every five years as a result of the dominance of annuals. This short-duration fire cycle, in combination with overgrazing, reduces the presence of perennial plants in the community and increases the dominance of annuals. In addition, adjacent areas susceptible to invasion from annuals also can burn, which expands the size of the annual-dominated rangeland. Invasion of annuals is most serious in the Owyhee Uplands and Columbia Plateau ERUs, where cheatgrass has literally taken over some range sites.

Cheatgrass is an annual grass that was probably introduced to western rangelands via contaminated grain from Europe in the late 1890s. Currently, cheatgrass exists in every county within the project area. Given its high seed production and highly germinable seed, cheatgrass is a successful intruder of native plant communities that are under stress or have been disturbed. The litter and standing dead

Photo 14: Altered sagebrush steppe represents a landscape where exotic annual grasses and forbs have invaded sagebrush communities. Photo by USFS.

Photo 14

NOT AVAILABLE IN PDF

Table 2-12. Noxious Weeds in the Project Area¹.

Noxious Weed	Rangeland Cover Types Most Susceptible to Invasion
Bull Thistle	Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Idaho Fescue-Threadleaf Sedge Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue Riparian
Canada Thistle	Idaho Fescue Alpine Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Idaho Fescue-Tufted Hairgrass Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue Riparian Aspen Woodland Tufted Hairgrass-Sedge
Dalmatian Toadflax	Bluebunch Wheatgrass Bluebunch Wheatgrass-Sandberg Bluegrass Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Curlleaf Mountain Mahogany
Cheatgrass ¹	Bluebunch Wheatgrass Bluebunch Wheatgrass-Sandberg Bluegrass Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue Antelope Bitterbrush-Bluebunch Wheatgrass Antelope Bitterbrush-Idaho Fescue Bitterbrush-Bluebunch Wheatgrass Bitterbrush-Idaho Fescue Bitterbrush-Rough Fescue Big Sagebrush-Bluebunch Wheatgrass Big Sagebrush-Idaho Fescue Big Sagebrush-Rough Fescue Mountain Big Sagebrush
Dyers Woad	Bluebunch Wheatgrass Bluebunch Wheatgrass-Sandberg Bluegrass Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Idaho Fescue-Threadleaf Sedge Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue

Noxious Weed	Rangeland Cover Types Most Susceptible to Invasion
Dyers Woad (continued)	Basin Big Sagebrush Crested Wheatgrass Black Sagebrush Low Sagebrush Bluegrass Scabland Stiff Sagebrush Wyoming Big Sagebrush Big Sagebrush-Bluebunch Wheatgrass Threetip Sagebrush-Idaho Fescue Threetip Sagebrush Big Sagebrush-Idaho Fescue Big Sagebrush-Rough Fescue Mountain Big Sagebrush Bittercherry Snowbrush Chokecherry-Serviceberry-Rose
Halogeton	Salt Desert Shrub
Leafy Spurge	Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue Riparian
Mediterranean Sage	Bluebunch Wheatgrass Bluebunch Wheatgrass-Sandberg Bluegrass Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Wyoming Big Sagebrush Curlleaf Mountain-Mahogany
Musk Thistle	Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Idaho Fescue-Threadleaf Sedge Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue Riparian
Purple Loosestrife	Riparian
Spotted Knapweed	Bluebunch Wheatgrass Bluebunch Wheatgrass-Sandberg Bluegrass Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue Riparian Idaho Fescue-Tufted Hairgrass Tufted Hairgrass-Sedge

Table 2-12. Noxious Weeds in the Project Area (continued).

Noxious Weed	Rangeland Cover Types Most Susceptible to Invasion
Squarrose Knapweed	Crested Wheatgrass
Sulfur Cinquefoil	Bluebunch Wheatgrass Bluebunch Wheatgrass-Sandberg Bluegrass Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Idaho Fescue-Slender Wheatgrass Idaho Fescue-Threadleaf Sedge Rough Fescue-Bluebunch Wheatgrass Rough Fescue-Idaho Fescue Idaho Fescue-Tufted Hairgrass Tufted Hairgrass-Sedge
Yellow Starthistle	Bluebunch Wheatgrass Bluebunch Wheatgrass-Sandberg Bluegrass Idaho Fescue Idaho Fescue-Bluebunch Wheatgrass Curlleaf Mountain-Mahogany

¹ Society for Range Management cover types listed in Shiflet (1994).

Source: Summarized from Appendix F and Marcot et al. (1996).

material produced by cheatgrass produces a flammable fuel that results in more frequent wildfires compared with fire frequency before the arrival of Europeans. As a result of frequent fire, critical big game winter range and habitat supporting North America's densest concentration of nesting raptors has been reduced, native sensitive plant species are threatened, native plant diversity is reduced at both the local and landscape scale, and recovery periods are extended. Cheatgrass has adapted to the post-fire environment and uses the abundant nutrients and soil water to establish an environment that is less favorable to perennial plants. Cheatgrass has adapted to many communities including low elevation salt desert shrub and higher elevation ponderosa pine. Populations of cheatgrass also differ genetically, which contributes to the evolution of specialized types adapted to different environments. The "cheatgrass-wildfire cycle" presents the greatest risk to the Wyoming big sagebrush portion of the big sagebrush cover type and to the more moist salt desert shrub plant communities within the salt desert shrub cover type. Figure 2-14 illustrates the altered sagebrush steppe cycle.

Cheatgrass has a short growing season, from fall to June the next year, but during that period it can produce more plant material than native vegetation or seeded forage wheatgrass species. However, the variability from year to year associated with production of cheatgrass is greater than native or introduced perennial grasses. The short growing period means that cheatgrass is palatable and nutritious for herbivores for a considerably shorter time than native perennial species on rangeland.

Once established, cheatgrass can inhibit the growth of perennial plants native to the site, thereby perpetuating the cheatgrass fire cycle and causing depletion of volatile nutrients and accelerated soil erosion. Livestock grazing can reduce the amount of cheatgrass on the range and thus the spread of fire, because if cheatgrass is grazed down in the spring, less cheatgrass is available to burn later. However, it is not desirable to allow continuous spring grazing, which may cause a further decrease of native perennial grasses. Once native perennial grasses are lacking to the point of being only remnants on the site,

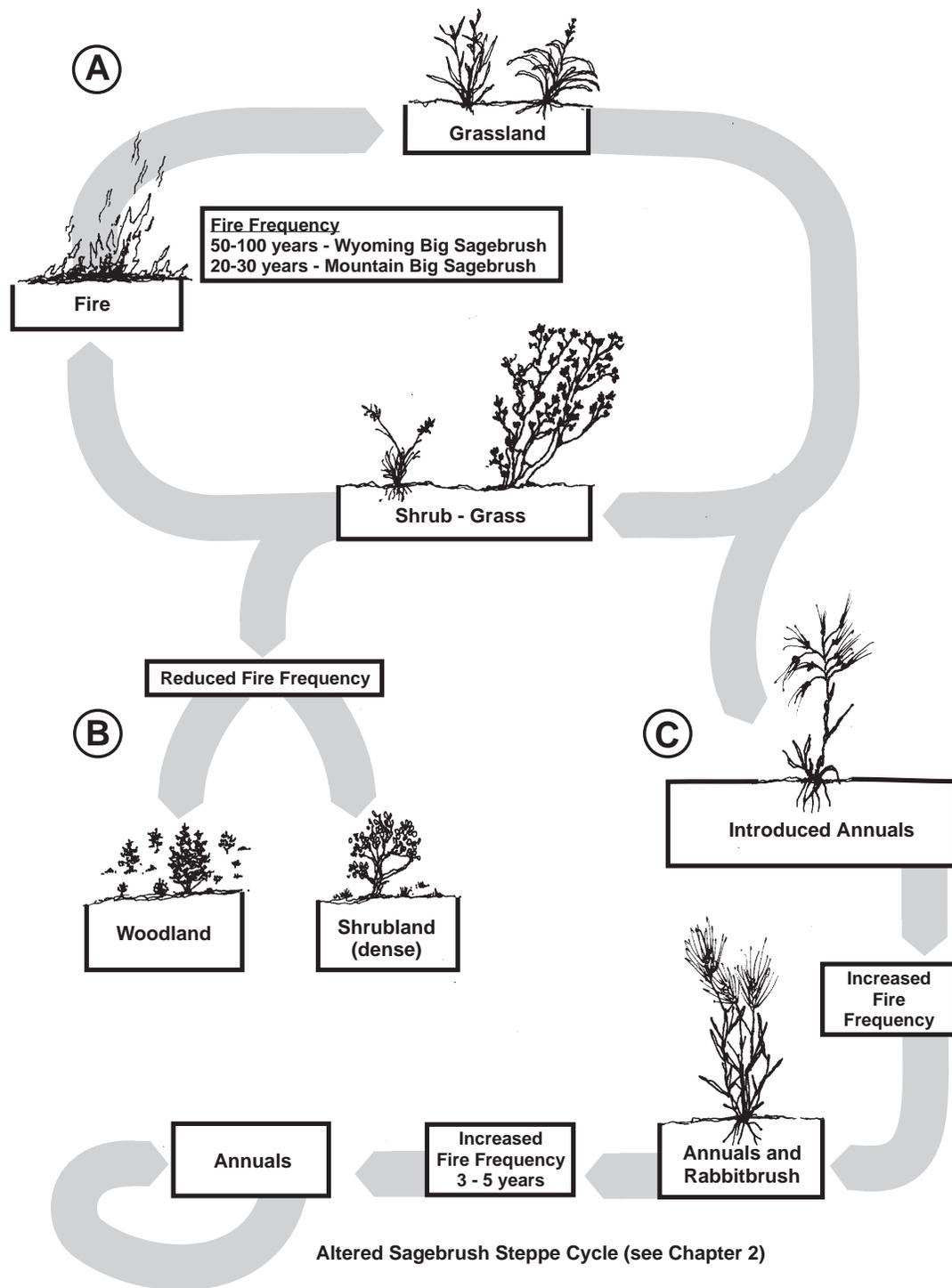


Figure 2-14. Sagebrush Steppe Succession - three common pathways of succession in the sagebrush steppe. Pathway A represents a succession from a grassland to a shrub-grass dominated plant community, with fire acting to move the shrub-grass community back to a grassland. Pathway B represents succession of a shrub-grass dominated plant community to either a woodland (dominated mostly by juniper) or a shrubland, caused by a reduction on fire occurrence. Pathway C represents succession of a shrub-grass dominated plant community to a community dominated by introduced annual grasses, characterized by an increase in fire occurrence. Introduced annual grasses have invaded these communities partially as a result of excessive grazing pressure. Once dominated by introduced annual grasses, the community tends to remain this way because of the frequent fire, which prevents shrubs from establishing. (Adapted from Vavra et al. (editors). 1994. *Ecological Implications of Livestock Herbivory in the West*).

then methods involving seeding would be the only recourse if the objective is to use perennial plants to reestablish rangeland function.

Cheatgrass continues to expand, including into forests and deserts. Although once established it tends to form a stable state, with frequent fire maintaining the stand, even less desirable weeds such as medusahead and yellowstar thistle are now invading cheatgrass-dominated rangeland and are further degrading site potential. This scenario has been referred to as the “downward spiral” and places even more urgency on controlling or rehabilitating cheatgrass rangeland.

Introduced Forage Grasses

(Primarily taken from Miles and Karl 1995a.)

Environmental and site conditions including climate, geomorphology, soil type, salinity, slope, aspect, seed sources, existing vegetation, and human impacts and management determine the fate of a plant species on a site. Plants are most competitive in environments where they are best adapted, and competitiveness declines as the environment becomes less favorable. At the extreme, even the most “aggressive” of plants do not exist in areas outside their tolerance limits.

Rangeland damage has prompted management decisions to plant introduced forage grasses. In arid regions, hydrology is altered, soils erode, and soil and nutrient processes are impaired when the vegetative cover is removed. In the absence of native species that are adapted to human-altered environments, the planting of introduced forage grasses can help to stabilize soils, provide forage for livestock and wildlife, and preserve ecosystem processes in general.

However, the introduction of forage grasses creates biodiversity concerns. Certain seeded species (such as crested wheatgrass, the intermediate-pubescent wheatgrass complex, Kentucky bluegrass, hard fescue, and orchardgrass) have become established as monocultures in situations where (a) all competing vegetation was removed before seeding and (b) no other well adapted species, such as noxious weeds, are present that potentially would encroach and take over the new seeding. Therefore, if vegetation has been removed by fire, grazing, or cultural practices before seeding of introduced forage grasses, the likelihood is increased that a monoculture will form as a result of the seeding. (In general, there is little likelihood that the introduced forage grasses

themselves would encroach into undisturbed areas or replace existing vegetation.) Converting vegetation types from a variety of native species to one or a few selected species has been a strategy to protect watershed function following wildfires, and to provide forage, mainly for livestock. But in most cases, the seeding of the rangelands has initially resulted in less plant and animal diversity than what was there historically. Such changes in diversity and structure can markedly alter the food sources and the thermal and visual cover for wildlife, resulting from a new habitat of more uniform height and spacing. These changes affect the abundance and numbers of wildlife species that were dependent on the vegetation that was there historically.

Within the Montana, Idaho, Washington, and Oregon portions of the project area, about 2.25 million acres of BLM-administered land have been seeded to introduced forage grasses ~ 1.41 million in Idaho and 840,000 in Oregon and Washington east of the Cascades. Crested wheatgrass is the predominant species that was seeded, mostly in the dry shrubland PVG within the Owyhee Uplands and Upper Snake ERUs.

Climate and Disturbance Stresses

(Primarily taken from Leonard and Karl 1995b.)

Climate is a driving variable affecting site susceptibility to stresses on both vegetation and soils and affecting resiliency to recover from stresses. Arid areas that receive less than 12 inches of average annual precipitation (map 2-1, in the Physical Environment/Climate section), in particular, are subject to extremes and/or episodic events that in conjunction with other ecosystem stresses can lead to degradation and inhibit recovery. While the exact status of soil and vegetation indicators must be determined by on-site investigations, there are indicators of relative susceptibility to disturbance stresses. Soil properties that may make certain sites more susceptible to range health stress include erodibility by water or wind, salinity and sodium content, and shrink-swell potential. Vegetation indicators of susceptibility might include composition of flammable exotic or noxious weed species; however, these plant community characteristics are more appropriately analyzed at the mid-scale utilizing inventory data or on-site determinations.

The 10 to 12 inch precipitation zone in the project area appears to be particularly susceptible to

invasion by exotic annuals. (However, this zone is proposed as *moderately* susceptible, rather than *highly* susceptible, because it is at the lower range for reseeding of perennial species, provided that soil factors are not limiting.) An annual precipitation zone less than 10 inches may be somewhat less susceptible to initial invasion by annuals, but once established, the likelihood of recovery by reseeding or other means is exceedingly diminished.

Leonard and Karl (1995b), summarize the frequency of drought and occurrence of favorable years for seedling establishment for climate divisions in the project area. Periodic drought may facilitate woody plant establishment and canopy development or result in high weed biomass, including flammable exotics, in succeeding years of high rainfall. The more arid the area the more frequent is the occurrence of drought years. Seedling establishment of perennial species usually requires two or more favorable years in a row, which occurs infrequently and unpredictably in the project area and in most cases is preceded or succeeded by at least moderate drought conditions. Frequent incidence of drought and few favorable periods of precipitation for plant recruitment can worsen grazing disturbances if not managed properly. Regardless of grazing strategy, continued stocking at near normal levels during moderate to severe drought is probably the greatest cause of range deterioration. Areas that are especially susceptible to range deterioration in the UCRB planning area are dry shrublands in the Owyhee Uplands and Upper Snake ERUs, where thousands of acres of rangeland have been taken over by altered sagebrush steppe. Reduced grazing intensities during drought, and presumably for some time following, are necessary to minimize damage and hasten recovery of perennial vegetation.

Other Factors Influencing Rangeland Health

Western Juniper and other Woody Species Expansion/Density Concerns

(Primarily taken from Karl and Leonard 1995.)

Western juniper is a relatively small- to medium-statured native tree of the Pacific Northwest. Since the late 1800s, western juniper has increased its acreage approximately 3–10 times, with most of the current acreage lying within the Owyhee Uplands ERU. Western juniper also has increased in density.

Climate and fire contributed to the prehistoric expansion and contraction of western juniper's distribution. Settlers initiated fire exclusion policies which probably contributed to the expansion of young juniper woodlands. The loss of fine fuels to carry fire, caused in large part by improper livestock grazing, probably played a larger role in fire frequency reduction than did active suppression. The combined impacts of improper livestock grazing, reduced fire frequency, and possibly climate change probably are responsible for expansion of western juniper woodlands during the past 100 years. The result is a reduction in grasses, forbs, shrubs, and young juniper that provide forage for livestock and protection from soil erosion.

As western juniper woodlands increase in density, understory vegetation production declines. Conversely, after reduction of western juniper density, site productivity of understory species typically increases. However, undesirable species, especially cheatgrass and noxious weeds, increase following juniper removal if they were present before removal.

Healthy western juniper woodlands, with a full complement of understory non-vascular species (for example, species composing microbiotic crusts), grasses, forbs, and shrubs, represent one of the most diverse plant communities in the project area. However, biodiversity is reduced on sites where western juniper has increased in density to the point that understory vegetation is excluded. Therefore, the expansion and increasing density of western juniper within native plant communities poses a threat to species that depend on the habitat within those communities.

Western juniper expansion also has affected hydrologic functions. Western juniper intercepts rain and snow with its canopy, which results in less water reaching the soil surface, especially in low intensity storm events. On sites where western juniper has excluded understory vegetation, particularly in spaces between canopies, infiltration has probably declined and runoff and erosion have probably increased, especially under high intensity storm events. The hydrological effects of western juniper increase are difficult to separate from those resulting from improper livestock grazing, but where improper livestock grazing has contributed to the decline in understory vegetation it has probably contributed to increased runoff and erosion.

The reduction of fires, as a result of fire suppression or the reduction of the amount of flammable fuels, has also affected other woody species. Conifers (ponderosa and lodgepole pine and Douglas-fir) have encroached at various rates onto mostly grassland, cool shrubland, and meadow type habitats primarily in the eastern Idaho-Western Montana areas and in the Cascades. Fire exclusion and climate have been considered the main reasons for this encroachment. Sagebrush, mainly Mountain Big Sagebrush within the cool shrublands types, have increased in density in many areas throughout the project area, especially in eastern Idaho and western Montana and the higher elevation areas in western Idaho and eastern Oregon. As with juniper, the more dense these woody species get the more of an effect there is to the understory vegetation. Productivity is normally reduced in the more dense areas, with biodiversity reduced as a result of the understory being out-competed for available nutrients and water by the larger and deeper-rooted woody species. If fire is reintroduced into these dense areas prior to the loss of the native understory vegetation, then productivity and biodiversity can be enhanced. But if undesirable exotic vegetation such as cheatgrass becomes a major component of the understory, then fire may lead to Altered Sagebrush Steppe. In addition, if most of the understory is lost or lacking to the point of not providing a seed source, then the removal of the woody species may expose the soil to accelerated erosion until either native or exotic species get a foothold in the area.

Microbiotic Crusts: Ecology and Implications for Rangeland Management

(Primarily taken from Leonard et al. 1995.)

Microbiotic crusts consist of lichens, mosses, algae, fungi, cyanobacteria, and bacteria growing on or just below the soil surface in a thin layer in open spaces between larger plants. These crusts play a role in nutrient cycling, soil stability and moisture, and interactions with vascular plants. Microphytic plants in the crusts provide forage for invertebrates, and some lichens growing on or at the soil surface (such as non-attached lichens) provide forage for big game species during critical winter periods. Some microphytic plants are also potential environmental indicators. The ecological role of microbiotic crusts is probably most notable on sites that support relatively sparse vegetation cover. These sites are mostly found in the Owyhee

Uplands and Upper Snake ERUs. Potential vegetation types in the project area associated with substantial microbiotic crust components include: (1) all plant communities within salt desert shrub, (2) many of the sagebrush types, and (3) the drier juniper types.

Soils stabilized by microbiotic crusts tend to have greater concentrations of organic material, nitrogen, exchangeable manganese, calcium, potassium, magnesium, and available phosphorous. Microbiotic crusts can be the major source of nitrogen in juniper-sagebrush woodlands that apparently contain no other nitrogen-fixing organisms. However, in a natural setting, questions remain about the availability to vascular plants of nitrogen fixed by microbiotic crusts.

Microbiotic crusts can comprise 70 to 80 percent of the ground cover in some areas. They can contribute to soil structure, and thus soil stability, by binding soil particles within the physical structures of the microphytes, and by trapping soil particles.

The influence of microbiotic crusts on infiltration and soil moisture has been noted as positive, negative, or neutral, and this is not conclusive. This is because many factors have a bearing on infiltration and soil moisture, including: soil type, degree of microbiotic crust development and types of organisms in the crust, climate, disturbance history, and state of wetness of a given soil type when it is rewetted. Generally, however, the presence of microbiotic crusts will improve infiltration. The fact that microbiotic crusts will develop quite well on soil types characterized by clay and fine silt with an inherently low capacity for soil water infiltration confuses the picture and makes it more difficult to truly depict the crust's role in infiltration.

Soil surface-disturbing activities ~ for example, grazing, off-road recreational and military vehicle use, and recreational hiking ~ reduce the maximum potential development of microbiotic crusts. Fire also depletes microbiotic crusts, at least temporarily. Except where habitat is completely displaced such as in urbanization or dominance by exotic annuals, recovery of microbiotic crusts ranges from a few years to 100 years after removal of the activity. Following fire, algal components of the crust can recover substantially within 5 to 10 years, whereas lichens and mosses take 10 to 20 years or more. Average return frequencies of natural fire of 50

years in the shrub steppe, to as high as 100 years in the more arid Snake River Plain, are adequate to restore advanced development of crust components. Current fire intervals of less than five years can occur on the annual grasslands (altered sagebrush steppe) of the Snake River Plain, because the cover of exotic annuals, for example cheatgrass and medusahead, and their associated litter, perpetuates the fire cycle. This results in substantial risk to microbiotic crust. Management practices that reduce fire size and frequency would enhance microbiotic crust development.

Desired levels of microbiotic crusts should be based on site capability and rangeland health indicators of site stability and nutrient cycling. Additional research is needed to establish realistic microbiotic crust objectives in most potential vegetation types. Grazing strategies that incorporate rest or deferment during optimal growing conditions for crust organisms (spring-early summer) and that minimize surface disturbances when microbiotic crusts are most vulnerable (dry season), may help to enhance microbiotic crust cover.

Microbiotic crusts are generally lacking in the sagebrush and salt desert shrub potential vegetation types in the project area, especially on altered sagebrush steppe in the Owyhee Uplands and Upper Snake ERUs. Inappropriately high livestock grazing pressure during the dry seasons is believed to be responsible to a large degree.

The role of microbiotic crusts in the project area is not conclusive at this time. Most of the studies of microbiotic crusts have been conducted in the southern Great Basin and Colorado Plateau. Strict extrapolations of findings from these studies to the project area, and prescriptive management direction, at this time would be premature until more definitive studies of microbiotic crusts are conducted in the project area. For these reasons, microbiotic crusts are discussed in the Guidelines appendix to Chapter 3 but not in the objectives and standards section.

Livestock ~ Big Game Interactions

(Primarily taken from Miles and Karl 1995b.)

Concerns over livestock use of big game ranges and vice-versa have been debated between rangeland professionals and wildlife biologists for years. When mismanaged, either big game (for this discussion, referring to elk, mule deer,

pronghorn antelope, and bighorn sheep) or livestock can have substantial effects on the other, especially during critical times of the year on rangeland in poor condition. An understanding of livestock and big game habitat, diet, dietary overlap, and impacts on vegetation is necessary to minimize conflicts between livestock and big game.

Dietary and habitat overlap does not necessarily mean that serious (population reduction) competition is occurring. Patterns of use, time of use, condition of the range, health of the wildlife population, weather, and closeness to water affect the seriousness of the situation. Competition between livestock and big game is increased where winter ranges are in degraded condition that limits the type, quality, and quantity of forage available for both livestock and big game.

Elk and cattle competition has the potential to be highest on foothill rangelands used by cattle in the fall and by elk in the winter. However, cattle prefer the bottoms and lower slopes whereas elk prefer the upper slopes and steeper terrain. Elk foraging habitats may sometimes be influenced by cattle presence or use, and stocking rates and types of grazing systems may substantially alter elk foraging habits. Elk and sheep competition has the potential to be highest on winter range used by both species. Summer range use by both species also has potential for competition because of high forb use by both species, although elk may use different species of forbs in their diet than do sheep. Deer and cattle have the greatest potential for competition in the winter and spring. Competition is especially high on winter ranges lacking in browse, or on those winter ranges that are in degraded condition and lack grass cover.

Bighorn sheep and cattle have the highest potential for competition where cattle make substantial use during fall and winter of bighorn winter range. Detailed information is lacking on domestic sheep and bighorn sheep social tolerance and forage competition. The negative effects of disease transmission between the two species probably overshadows potential negative effects from forage competition. The largest impediment to restoring bighorn sheep is the potential for disease transmission from domestic sheep that graze near or within historical and occupied bighorn sheep ranges.

Pronghorn antelope and cattle have the greatest potential for competition on degraded rangelands

where browse is the main forage and grasses are lacking. Otherwise a dietary overlap seldom exceeding 25 percent precludes serious competition between these two ungulates.

Stocking rate and type of grazing system affect the quantity and quality of key forage species in the project area. Light stocking rates increase production of some grasses and browse species, especially in riparian and forest habitats, compared to heavier stocking rates. Heavy, long-term stocking rates decrease the amount of key forage plants and increase the amount of less desirable plants. Heavy livestock use of grasses increases shrub cover. Heavy livestock use of browse, such as aspen, bitterbrush, and willows, decreases the competition with grasses.

Big game overbrowsing of shrub and tree species in riparian zones alters the plant composition or in some cases eliminates the shrub or tree species. In general, big game have had negative effects on riparian areas on both winter and summer ranges. Big game negatively affect stands of native grasses where heavy winter and spring use occurs because of high population levels.

Specific locations where livestock/big game conflicts are a serious concern in the project area have not been identified in the Scientific Assessment. Generally, these conflicts occur throughout the UCRB planning area where limited habitat is available for wildlife. The potential for conflicts can be high, especially during severe winters on limited winter range, where large populations of big game exist, such as in eastern Idaho, in the Upper Snake and Snake Headwaters ERUs. In addition, increasing big game populations, such as elk and pronghorn, have caused conflicts with farming interests since big game have had impacts on crops during drought years. Serious conflicts occur when winter ranges are degraded to conditions where biodiversity is lacking, such as in areas of altered sagebrush steppe, and when winter conditions become severe. Serious conflicts between livestock and big game can be prevented by managing habitat, especially winter range, so that vegetation health and diversity are maintained, and by providing forage diversity so that many species are available for both wildlife and livestock forage use.

Summary of Changes from Historical to Current by Ecological Reporting Unit, by Potential Vegetation Type (PVG), and by Terrestrial Community for BLM/Forest Service-Administered Lands.

ERU 6 ~ Blue Mountains

Dry Grass PVG.

- ◆ An extensive invasion of exotic species.

Dry Shrub PVG.

- ◆ A 40 percent increase in upland shrub.

ERU 9 ~ Upper Clark Fork

Cool Shrub PVG.

- ◆ A 70 percent decrease in upland shrub.

ERU 10 ~ Owyhee Uplands

Dry Shrub PVG.

- ◆ An extensive invasion of exotic species.

ERU 11 ~ Upper Snake

Cool Shrub PVG.

- ◆ A 35 percent increase in upland shrub.

Dry Shrub PVG.

- ◆ A 25 percent decrease in upland shrub.

- ◆ An extensive invasion of exotic species.

ERU 12 ~ Snake Headwaters

Cool Shrub PVG.

- ◆ A 70 percent decrease in upland shrub.

Dry Shrub PVG.

- ◆ A 90 percent decrease in upland shrub.

ERU 13 ~ Central Idaho Mountains

Cool Shrub PVG.

- ◆ An extensive invasion of exotic species.

Dry Shrub PVG.

- ◆ An extensive invasion of exotic species.

Source: ICBEMP report ah43e_uc.rtf

