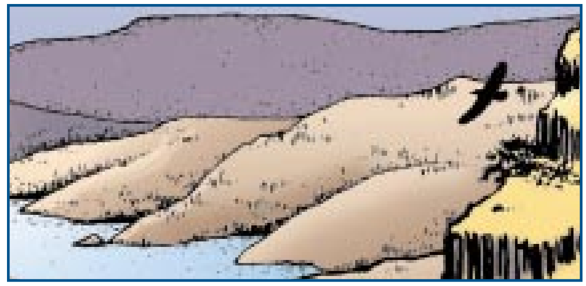


AMERICAN INDIAN PEOPLES

This section focuses on American Indians in the Basin, their relationships with the natural environment, and trends regarding agency relations with the project's affected American Indian tribes. These topics have particular significance for Federal land managers for two reasons: (1) Forest Service and BLM management actions affect resources and areas of concern to American Indians; and (2) the Federal Government holds certain trust responsibilities and obligations to tribes based on various legal agreements, including treaties, which have implications for ecosystem management. There is a great deal of overlap between issues expressed by American Indians and those voiced by the general public regarding ecosystem management. However, the legal status of American Indians, the sovereignty of tribal governments, and the nature of reserved tribal rights merits separate attention. There are 22 federally recognized tribes and a number of off-reservation traditional Indian communities that have interest in lands within the ICBEMP assessment area.

The intense interest of Indian peoples and their tribal governments in the region's ecosystems and natural resources is founded in their long-term relationship with and spiritual attachment to the land. Although various Indian societies in the region differ in many ways, they hold a common belief about their relationship with the land and water. All groups in the area stress the placement of their peoples in this landscape by the Creator. Thus, the Indian ancestry in the Basin extends from "time immemorial," a long-term attachment that is reflected in modern Indian culture.

The Indian peoples of the northern intermontane regions are part of a large, loose social web strengthened by their shared experience of the Columbia River basin and associated ecosystems. The traditional subsistence economy is broad-based. It includes fishing, fowling, hunting, trapping, livestock grazing, and gathering of terrestrial and aquatic resources, over very large geographic areas encompassing a diverse range of important places. The full range of resources needed to sustain families and Indian cultures was found in their socially and culturally important traditional-use areas. Living cultural traditions are embedded in these older understandings of the land, resources, landforms, habitats, and landscapes. Consequently, Indian peoples have accrued a "detailed, encyclopedic knowledge of their environment" through the millennia.

The intense interest of Indian peoples and their tribal governments in the region's ecosystems and natural resources is founded in their long-term relationship with and spiritual attachment to the land.

The lower Klickitat River gorge near its confluence with the Columbia is one of the sites still used by American Indians for dip net fishing from traditional wooden platforms.

The intimacy with and length of attachment to the land and the totality of landscape importance has contributed to a strong sense of place for Indian peoples. Places of significance are created by an intersection of nature, cultural uses, social systems and cultural meanings. Knowledge of places is passed to each succeeding generation through oral traditions, performance of rituals, and personal experiences.

Resource acquisition activities such as fishing, hunting, and plant and mineral gathering are usually done within the context of traditional sociocultural and economic systems. For many Basin tribes, a series of spring and summer root, salmon, and berry feasts mark high points in Indian religious calendars. In addition to these substantial feasts, numerous other occasions occur throughout the year (often held in community longhouses, shorthouses, Indian Shaker churches, or private homes) and are supplied with traditional foods. These native foods are collected usually from a tribe's or traditional community's homeland and its socially and/or traditionally significant ecological places—typically places on reservation or public lands.

The importance of native plants has received relatively little recognition compared to other native resources, although use of plant resources as food in historical times was at least equal to, if not greater, than fisheries. In fact, food-plant resource locations, not fishery habitats, have been considered the critical variable for determining the placement of historic settlements in the Nez Perce region. Plants continue to be valued and their parts used for purification, ceremonial, subsistence, commercial, and medicinal purposes and for creating objects of personal use, trade, gift-giving or sale.

Some of the plants identified by the ICBEMP as of tribal interest are characterized as habitat generalists and associated with terrestrial community types found widely distributed in the Basin. However, plants are considered significant in a given culture on the basis of how people recognize a plant and assign it values and/or uses. A plant like camas may be known to live in several habitat types, but only found in few places in the quality and quantity appropriate for harvest practices. A plant may occur in abundance in one tribe's area of interest and though known as a highly valued plant by another tribe, both cultures may not value it in the same way or to the same degree.

The aquatic/terrestrial world has cultural significance to tribes beyond its value as a source of food, medicine, textiles and other material resources. Its cultural significance is much more complex, involving social values and meanings that intertwine traditional societal, political, religious, and economic areas of modern native cultures.

Camas is an important plant for many American Indian groups.

Legal Context

The relationship of the United States government with American Indian tribes is based on legal agreements between sovereign nations, Federal recognition of their dependent sovereignty status, principles of jurisprudence, international law, and prevailing views of society and government policies toward American Indians. The body of this formal relationship involves the whole span our country's history and its ties with European culture and conventions in law.

A series of Indian trade and intercourse acts, initiated in 1790 and permanently adopted in 1834, became the cornerstone of Federal Indian policy. The Marshall Trilogy (three Supreme Court decisions made between 1823 and 1831) is another significant early contribution to Indian law. It established: (1) only the Federal Government has the pre-emptive right to procure Indian land; (2) the Federal Government has trust responsibilities toward American Indian tribes; and (3) treaties take precedence over state laws.

In 1855, some Indian nations within the Basin entered into treaties with Isaac Stevens, Governor and Superintendent of Indian Affairs for the Territory of Washington. These ratified treaties provided for apportionment of land and natural resources and still serve that purpose today. Tribes affected by these treaties include the Confederated Tribes of both the Colville and Umatilla reservations; Confederated Tribes and Bands of the Yakama Nation; Nez Perce Tribe; Kootenai Tribe of Idaho; and the Salish and Kootenai Tribes of the Flathead reservation. The Blackfeet Tribe, located adjacent to the Basin and potentially affected by the project, also made treaties with Governor Stevens in 1855. These treaties

After the Modoc Indian War this traveling group was organized to awaken the nation to the plight of the Indian, circa 1875.

contain similar language that reserves for tribes certain pre-existing rights. One such example is from the treaty with the Nez Perce:

> *The exclusive right of taking fish in all the streams running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places, in common with citizens of the Territory, and of erecting temporary buildings for curing; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land*.

Significant to public land management is that treaty reserved rights and retained aboriginal use rights directly involve BLM- and FS-administered lands. Tribes and traditional Indian communities have areas of interest that are based on prehistoric and historic land use patterns. These not only extend beyond reservation boundaries, but often beyond lands that tribes ceded to the United States because ceded lands were typically delineated by non-Indians and were not accurate representations of tribal homeland areas, and customary land uses routinely extended beyond Indian homelands.

The rights retained by tribes are viewed by them as an assurance by the U.S. Government to

Through legal agreements, tribes received promises of Federal protection for their lands, resources, and people.

allow for the continuation of traditional land uses. Thus what is reserved are the supports of a way of life for Indian communities, not just resource uses. Through legal agreements, tribes received promises of Federal protection for their lands, resources, and people. These are viewed as promises that constitute Federal Government fiduciary responsibilities, also called trust responsibilities/ obligations. The benefits that were gained by the United States, establishing legal rights to Indian lands and providing U.S. citizens with a basis for economic, political, and social development in the Northwest, were considerable.

In 1974, the U.S. Washington District Court reaffirmed off-reservation fishing rights and their priority over other uses. Upheld by the Supreme Court in 1979, tribes were allowed up to a 50 percent share of harvestable fish passing by accustomed traditional fishing places. It also recognized the sovereign right of tribes to regulate their off-reservation treaty rights; states regulate tribal use for conservation purposes only. An important aspect of this decision is the surmised right of tribes to take part in the protection of fish habitats, helping to ensure that the resource persists and in quantities available for fishing.

A number of Federal regulatory acts passed in recent decades have increased the roles of tribes in public land management decision-making processes. That portion of case law pertaining to off-reservation tribal interests and Federal agency land management is reflected in recent Federal administrative policy and guidance.

Implications for Ecosystem Management

Tribal governments have an increasing influence on the formulation of public land policy through agency recognition of their legally established rights as well as their unique trust relationship with the United States Government. In recent years, there has been an increased understanding about the sovereign status of tribes and government-to-government relations between tribes and agencies have been established. Because of this status, American Indians do not view themselves as another "special interest" that needs to be factored in (or traded off) with other interests when Federal agencies develop a land management plan. This has developed into increased tribal participation in all agency planning levels. Increased opportunities to contribute to implementation and monitoring stages of projects are also seen as important.

Recognition of the uniqueness of each tribe has placed the burden on agencies to become knowledgeable and sensitive to Indian interests on an individual tribal basis. Variation among tribes is notable in their demographic characteristics, the nature of their reserved rights, and their interest in and dependence on public land resources. An ongoing dialogue would benefit agency-tribal relations if established "locally" over and beyond the notification and consultation requirements associated with regulatory acts.

With passage of the Self-Governance Act late in 1994, increased emphasis is being placed on involving tribes in the Federal management processes, including development and implementation of land use plans, preparation of budget

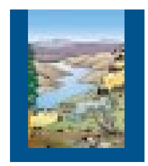
Recognition of the uniqueness of each tribe has placed the burden on agencies to become knowledgeable and sensitive to Indian interests on an individual tribal basis.

Meaningful dialogue through an effective consultation process is an important issue among tribes. Consultation is not a single event, but a process that leads to a decision.

proposals, and carrying out other activities on public lands on behalf of the agencies. Tribes also now have the option to consider incorporating programs or functions (otherwise under Federal agencies) into their tribal responsibilities if they are interested and can provide justification. Indian tribes are a valuable source of expertise on local resources, having built staffs with academic credentials blended with knowledge passed down through generations. This expertise can be applied to public land planning, implementation, and monitoring.

Meaningful dialogue through an effective consultation process is an important issue among tribes. Consultation is not a single event, but a process that leads to a decision. Consultation serves at least four purposes: (1) to identify and clarify the issues; (2) to provide for an exchange of existing information and identify where information is needed; (3) to identify and serve as a process for conflict resolution; and (4) to provide an opportunity to discuss and explain the decision.

Consultation means different things to different tribes. It can be a formal process of negotiation, cooperation, and policy-level decision-making between tribal governments and the Federal Government, or a more informal process. Consultation can be viewed as an ongoing relationship between an agency (or agencies) and a tribe(s) characterized by consensus-seeking approaches to reach mutual understanding and resolve issues. Developing a consistent approach to consultation that meets tribal needs is one of the challenges of ecosystem management.



BIOPHYSICAL SETTING AND LANDSCAPE DYNAMICS

The Basin's biophysical environment is composed of its geologic, geoclimatic, climatic, potential vegetation, soil, and hydrologic systems. These are important to ecological assessment of the Basin because they help describe terrestrial and aquatic ecosystems that behave in a similar manner, have similar potentials for production, and exhibit similar hazards and management limitations. Areas with common characteristics respond to disturbance processes and management activities in a similar manner.

Biophysical characteristics such as climate, potential vegetation, and geology do not change readily over time. Therefore, they provide a useful basis for comparing elements that do change over time (for example, vegetation) in response to disturbance or management activities.

Elevation and topography within the Basin vary considerably, from just above sea level to over 13,000 feet, and from flat plains to steep mountain ranges (see map 1). Much of the present landscape of the Basin was shaped by processes and events during the Pleistocene epoch (1.6 million years to 10,000 years ago). This was a time of multiple cycles of major climate variation, ranging from ice ages to warm interglacial periods. The climax of the last cold period was 20,000-14,000 years ago, when average summer temperatures in the Pacific Northwest were 9 to 12 ^{0}F cooler and winter temperatures were about 18 to 27 ^{0}F lower than today. During these cooler and moister times, large ice sheets formed in the Northern Hemisphere that covered most of Canada and the northern United States.

Alpine glaciers shaped valleys along much of the northern part of the Basin. Many of these glaciated landscapes are now covered with a mantle of glacial till. Downstream from glaciers (and in the wake of retreating glaciers), thick sedimentary layers of silt, sand, and gravel outwash were left as valley fill and terraces that now contain the glaciated headwaters of many rivers. Valley bottoms inundated by glacier-dammed lakes currently have thick mantles of silt and sand lake deposits.

Potential Vegetation

This is the vegetation that would likely develop on a given site if all successional sequences were completed without human interference under present site conditions. Potential vegetation types (PVTs) are the species that might grow on a given site in the absence of disturbance. Potential vegetation groups (PVGs) are made up of potential vegetation types, grouped on the basis of similar moisture or temperature environment, such as warm / dry or cold / wet forests, or cool / dry and warm / moist shrublands. For example, lodgepole pine is associated with dry forests, mountain hemlock with cold forests, fescue with dry grasslands, and mountain big sage with cool shrublands.

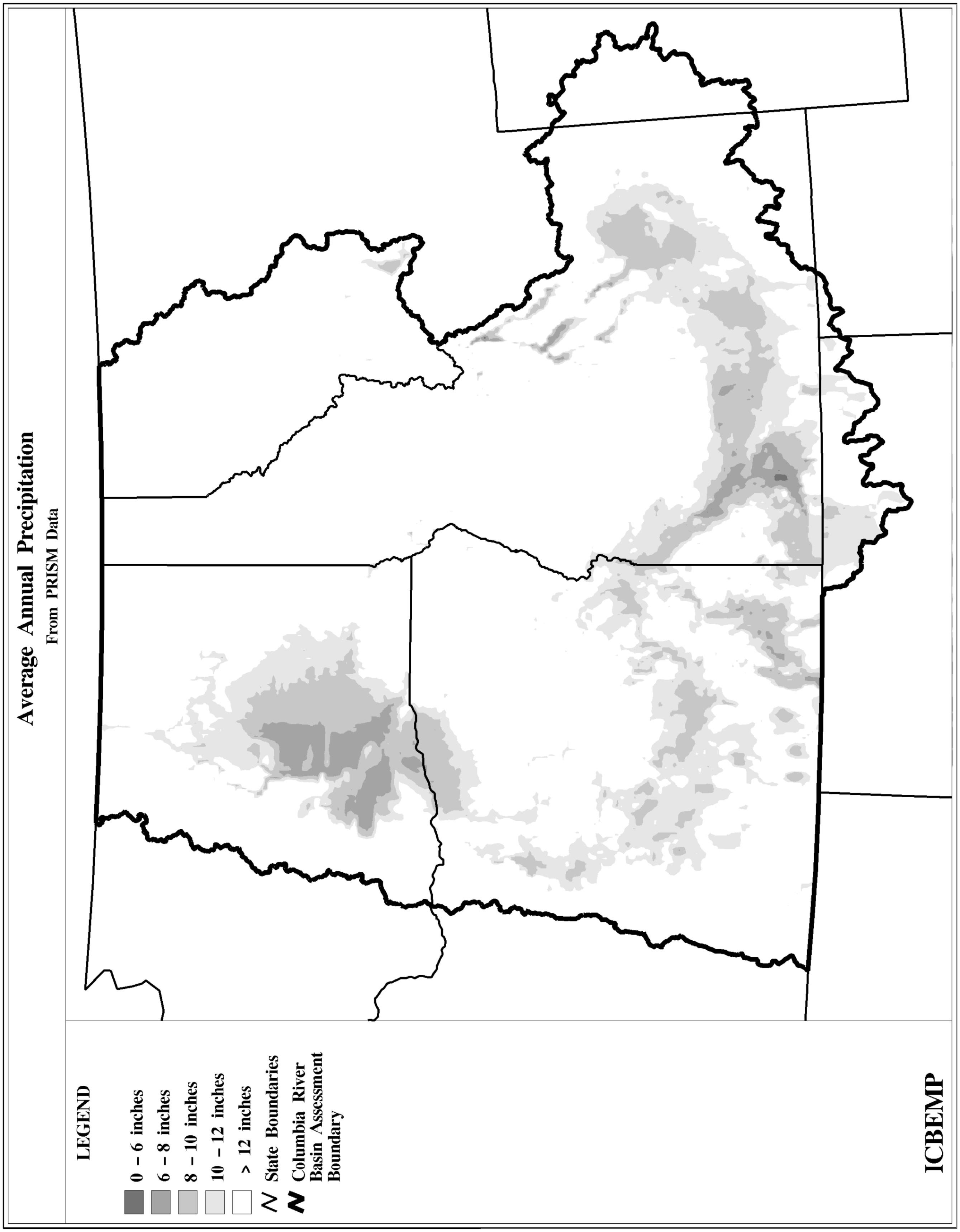
Portions of the Basin that receive less than 12 inches of precipitation annually are more susceptible to the effects of drought or human land use activities; vegetation takes longer to recover.

During the Pleistocene ice ages, silt and fine sand outwash from alpine and continental glaciers and glacial floods were redeposited by wind as thick blankets of loess. These loess deposits, which locally dominate many landscapes of the Basin, form highly productive soils. The rolling hills of the Palouse in eastern Washington are composed entirely of loess, which has been deposited over the last two million years and is locally over 250 feet deep. Similar deposits of loess cover much of the Columbia Plateau and Snake River plain.

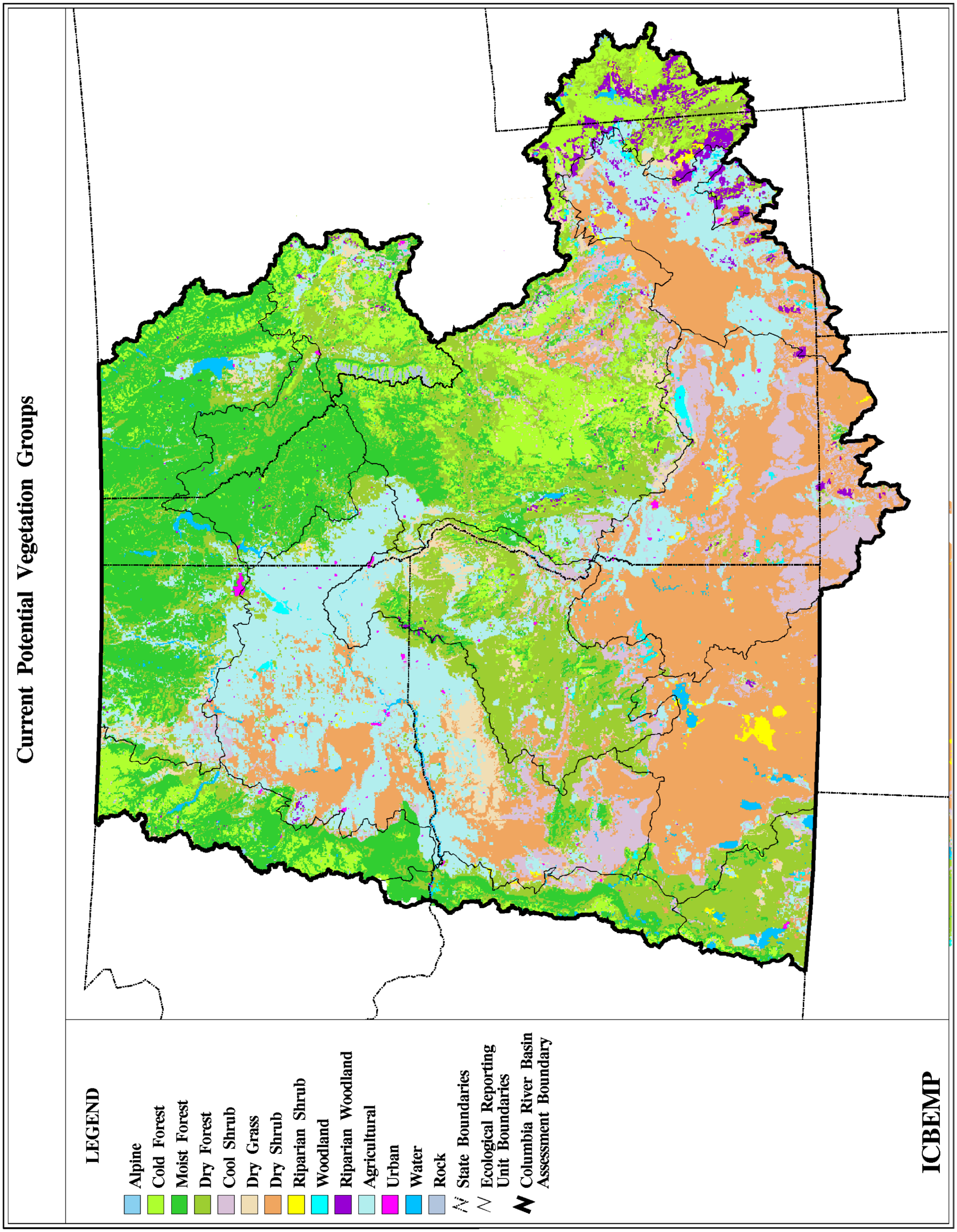
The wetter climate of the last ice age led to the formation and expansion of large freshwater lakes in closed basins throughout the western United States. The presence of these lakes resulted in deposition of silt and clay on inundated valley floors. These lake systems rapidly evaporated at the end of the Pleistocene, and by 10,000 years ago, most lakes approximated their present size. The reduction in size of these lakes substantially altered the patterns of hydrologic connectivity between now-separated basins, strongly affecting the distribution of many aquatic species within the Basin.

The Basin's climate influences Basin resources and their uses. Proceeding from west to east, the climatic gradients generally have more moisture. Proceeding from north to south, the climate generally becomes dryer, and glaciation had less effect on landforms and soils. Weather observations and the general retreating of glaciers since the late 1800s indicate a general warming trend. Map 7 displays average annual precipitation for the Basin. Along with other characteristics, climate determines the type of vegetation that can grow in a given area, as well as how vegetation and other ecosystem components respond to disturbance (map 8). For example, portions of the Basin that receive less than 12 inches of precipitation annually are more susceptible to the effects of drought or human land use activities; vegetation takes longer to recover.

Woody debris along the John Day River in central Oregon.



Map 7—Precipitation.



Map 8—Current potential vegetation groups.

View of Mount Rainier from the Cascade Crest, the western most extent of the Basin.

Regional Variation

Northeastern Washington, northern Idaho, and northwestern Montana are mountainous, with elevations that range from approximately 1,200 to 9,500 feet. This area has a maritime-dominated climate except in the east where a continental climate has greater influence. The average annual precipitation varies from about 15 to 25 inches, most falling in winter. The warm/dry, cool/moist, and cool/dry forest potential vegetation groups (PVGs) are currently dominated by cedar/hemlock, ponderosa pine, western white pine, and Douglas-fir forest cover types. Soil productivity is generally good because of the volcanic ash soils and the presence of favorable temperatures and precipitation (maritime climate and low-to-moderate elevations). The dominant valley bottom settings include both steep, confined valleys with step-pool and rapids-dominated streams, and broad, gently sloping valleys with meandering streams in well developed floodplains at lower elevations.

Central Idaho, west-central and southwestern Montana, and northeastern Oregon range from approximately 1,000 to 12,000 feet; most of the

Palouse River of eastern Washington. The river breaks and scablands of eastern Washington have not been extensively developed for agriculture because of thin or rocky soils. This picture provides us with an idea of what the landscapes of the Columbia Plateau looked like prior to development for agriculture.

Rangelands of southeastern Washington and eastern Oregon. Because of thin soils much of this rangeland has not been developed for agriculture and in eastern Oregon much of the range is in public ownership.

Remnant native grassland in eastern Washington. Most of the very diverse, productive native grasslands with deep soils have been developed for agriculture.

Walla Walla and the Blue Mountains. Transition from the plains of the Columbia Plateau to the Rocky Mountains.

Rocky Mountains of western Montana and Wyoming.

higher elevations have been glaciated. The landscape includes mountains with narrow valleys, basins, alpine meadows, and breaklands. Maritime climate, westerly winds, and mountainous terrain yield less than 20 inches of precipitation at the lowest elevations to over 30 inches in mountainous areas. The warm/dry, cool/moist, cold/wet, cold/moist, and cool/dry PVGs are currently dominated by Douglas-fir, ponderosa pine, and grand fir forest cover types and by sagebrush and fescue/wheatgrass grassland cover types. Soils are only moderately productive because of shallow depths associated with cold temperatures and low precipitation in many areas. The most productive soils occur in valleys and basins where they are often deep and have high volcanic ash content. Heavy fuel accumulations and dense stand conditions in some areas place long- and short-term soil productivity potential at risk from wildfire. The dominant valley bottom settings include both steep, confined valleys with step-pool and rapids-dominated streams, and broad, gently sloping valleys with meandering streams in well developed floodplains at lower elevations.

The plains, tablelands, and plateaus in central Washington, southcentral and southeastern Oregon, and southern Idaho range from approximately 200 to 8,000 feet. This area has a semi-arid, cool climate, with average annual precipitation varying from about 5 to 25 inches. The warm/dry, cool/dry, and cool/moist shrubland and warm/dry herbland PVGs are currently dominated by sagebrush steppe and grassland cover types. Low productivity soils are common because of the sparse precipitation and low soil organic matter throughout much of the area. The dominant valley bottom settings consist mainly of steep, confined valleys with step-pool and rapids-dominated streams, and broad, gently sloping valleys with meandering streams in well developed floodplains at lower elevations. Entrenched, gully-like streams and braided streams also occur.

The eastern slopes of the Cascades in Oregon and Washington, along with the upper Klamath portion of the Modoc Plateau in southern Oregon, average about 10 to 40 inches of precipitation annually, falling primarily during winter. Elevations range from approximately 300 to 9,500 feet. The warm/dry, cool/moist, cold/moist, hot/moist, cool/very dry, and cool/dry forest PVGs are currently dominated by a mixed coniferous forest cover type consisting mainly of Douglas-fir and ponderosa pine. These forests have moderate to high productivity, but large portions of this area accumulate substantial amounts of fuels and have high probabilities of stand replacement wildfires. Stands in this condition are at high risk to losses of organic matter, coarse woody debris, and nitrogen. The dominant valley bottom settings consist mainly of steep, confined valleys with step-pool and rapids-dominated streams, and broad, gently sloping valleys with narrow, sinuous meandering streams in well developed floodplains at lower elevations. Wetlands and lakes also are common features.

Southeastern Idaho and western Wyoming have been shaped by overthrust faulting and glaciation, creating steep, rugged mountains with narrow to broad valleys having general north-south orientation. Most of this area occurs within 6,500 to 9,000 feet elevation with some of the highest peaks exceeding 13,000 feet. The climate is a semi-arid steppe with most of the 15 to 40 inches of annual precipitation occurring in the fall and winter as snow. The warm/dry, cool/dry, hot/very dry, and cool/dry forest PVGs and the warm/dry, cool/dry, and warm/moist shrubland PVGs are occupied by mixed, coniferous forest and sagebrush/grassland steppe. Douglas-fir, lodgepole pine, and aspen often occupy the northern aspects, while grasses and shrubs are found on southern aspects. Soils are generally moderately productive. The greatest productivity limitations are cool temperatures and short growing seasons due to the high elevations. Although less extensive, similar conditions of fuel accumulation and dense stand conditions occur as in the eastern Cascades. The dominant valley bottom settings include both steep, confined valleys with step-pool and rapids-dominated streams, and broad, gently sloping valleys with meandering streams in well developed floodplains at lower elevations. Braided streams also occur, but are far less common.

Landscape Dynamics

The landscape components of ecosystems are by no means static; sometimes changes occur quickly, such as from floods, fires, windstorms, or volcanic eruptions. Other times, the changes are slower and more subtle. Certain types of landscapes are prone to natural disturbances.

Biophysical environments and associated disturbance dynamics are very complex because of the diversity of topography and geology as well as the change in climatic gradients across the Basin. A disturbance is an event that changes the trend of ecosystem development; a disturbance such as a flood plays many roles in ecosystem functioning, including flushing debris and accumulated fine sediment, or delivering material for soil development to the floodplain. When disturbance events are detrimental to humans, we attempt to control them or minimize their effects—often disrupting the normal functions of the disturbance.

Historical Range of Variability

Historical range of variability (HRV) is a term used by ecologists to describe the natural fluctuation of ecosystems over time. In this project, HRV refers to the range of conditions and processes likely to have occurred prior to settlement of the Basin by Euro-Americans (about the mid-1800s). HRV serves as a reference point from which change can be measured, rather than a condition that ecosystem management tries to attain. In fact, science findings suggest that such a condition could not be achieved. This misunderstanding about HRV is common, as is the tendency to equate HRV with "natural" conditions. As discussed above, American Indians altered the landscape in many ways, though nowhere near the scale of change as populations increased, land uses evolved, and technology for altering the environment was developed.

Many human activities, such as construction of roads, dams and related facilities, introduction of exotic flora and fauna, conversion of land to agriculture or other uses, and exclusion of fire, can change the disturbance regimes and successional pathways of ecosystems. In many cases, human activities interact with natural disturbances to produce an entirely new effect.

Humans have had profound effects on Basin landscapes.

Humans have had profound effects on Basin landscapes. When humans change biophysical conditions by altering the topography, soil or parent material, introducing exotic species, or accelerating species or genetic extinctions, biophysical systems are subsequently changed, thus promoting changes in disturbance and succession regimes. Timber harvesting and livestock grazing, the introduction of exotic species and white pine blister rust, and the exclusion of fire have resulted in substantial changes in succession/disturbance regimes and associated vegetation composition, structure, and pattern. These regime changes are typified by more frequent disturbance with higher cumulative effects over time than those associated with historic regimes. There has been substantial simplification of the Basin's landscape composition, structure, and pattern; ecosystem responses to disturbances are now less predictable.

***Landscape Patterns*—**Examination of current landscape patterns reveals that only 3 percent of Basin lands still have a pattern similar to historical patterns. Approximately 16 percent of the Basin has a reserve-type pattern. These areas include lands where passive management (such as that which takes place in designated Wilderness) has dominated and where few fires were allowed to burn except in the largest wild areas. These areas now experience disturbances that are less frequent but more severe, and have greater cumulative effects

A pattern of vegetation that is associated with traditional timber management. These disturbances, and the traditional placement of the road system, result in relatively severe effects on small patches each year that over many years accumulate into effects that are often negative to the soils, aquatic systems, and native species of wildlife and plants. Ecosystem management would attempt to mimic more natural patterns and effects.

than under the historical pattern. Sixty-four percent of the Basin has a commodity-induced pattern. In forested landscapes, this includes areas of timber management emphasis and fire exclusion, resulting in more frequent disturbance and greater effects than those of historical patterns. Seventeen percent of the Basin has other types of patterns (water, rock, urban, agriculture and other land uses). On BLM and FS lands, 5 percent of the area is in a pattern similar to the historical pattern, 29 percent is in a pattern similar to reserves, and 66 percent is in a pattern similar to commodity management.

On forested lands, managers of BLM/FS-administered lands commonly tried to accelerate the regeneration process of areas harvested or (to a lesser degree) burned by lethal fires. These regeneration policies shortened the regeneration period that was common to native systems, thereby reducing the extent of stand initiation structures. Precommercial thinning, another practice common to areas managed under traditional forestry strategies, was not extensive enough to mimic the maintenance and accelerated-cycling regimes of the native system. Consequently, successional sequences of many areas that were thinned stagnated until they were cycled by a disturbance event that was lethal to the overstory. Harvest patterns on lands administered by the U.S. Forest Service have been somewhat constrained since the National Forest Management Act of 1976. The restrictions limiting the size of harvest patches, and the trend towards smaller patches more recently, has led to the systematic fragmentation of forest landscapes.

There are different patterns of vegetation. This photo shows a natural pattern of vegetation that is associated with natural disturbance. The soils, aquatic systems, and native species of wildlife and plant have developed in concert with the type and intensity of disturbances associated with this type of pattern.

Traditional reserve or wilderness management has generally emphasized a passive approach to management, and thus involved little direct vegetation management, and a very conservative prescribed natural fire program. The guidelines for prescribed natural fires typically only allowed fires to burn that are lightning-ignited and that have a high likelihood of remaining within the reserve. Few lightning-caused fires meet the prescription guidelines. Consequently, the extent of current fire disturbances were well below those of the historical period. Therefore, traditional reserve management has also caused substantial changes in succession/disturbance regimes and the associated vegetation structures and composition. As with traditional timber management, measurable fire disturbances in reserves were less frequent, but more severe than they were in the native system.

On many rangelands, introduction of exotic plants, exclusion of fire, and traditional livestock management has also resulted in more frequent disturbances that have greater effects, substantially changing the succession/disturbance regime associated with historical patterns. These changes can affect long-term productivity and increase the likelihood of disturbances perceived as catastrophic.

On rangelands, the effects of traditional grazing or reserve management also had predictable patterns of changed succession and disturbance regimes associated with non-forest areas (figure 6). Traditional livestock grazing practices, fire

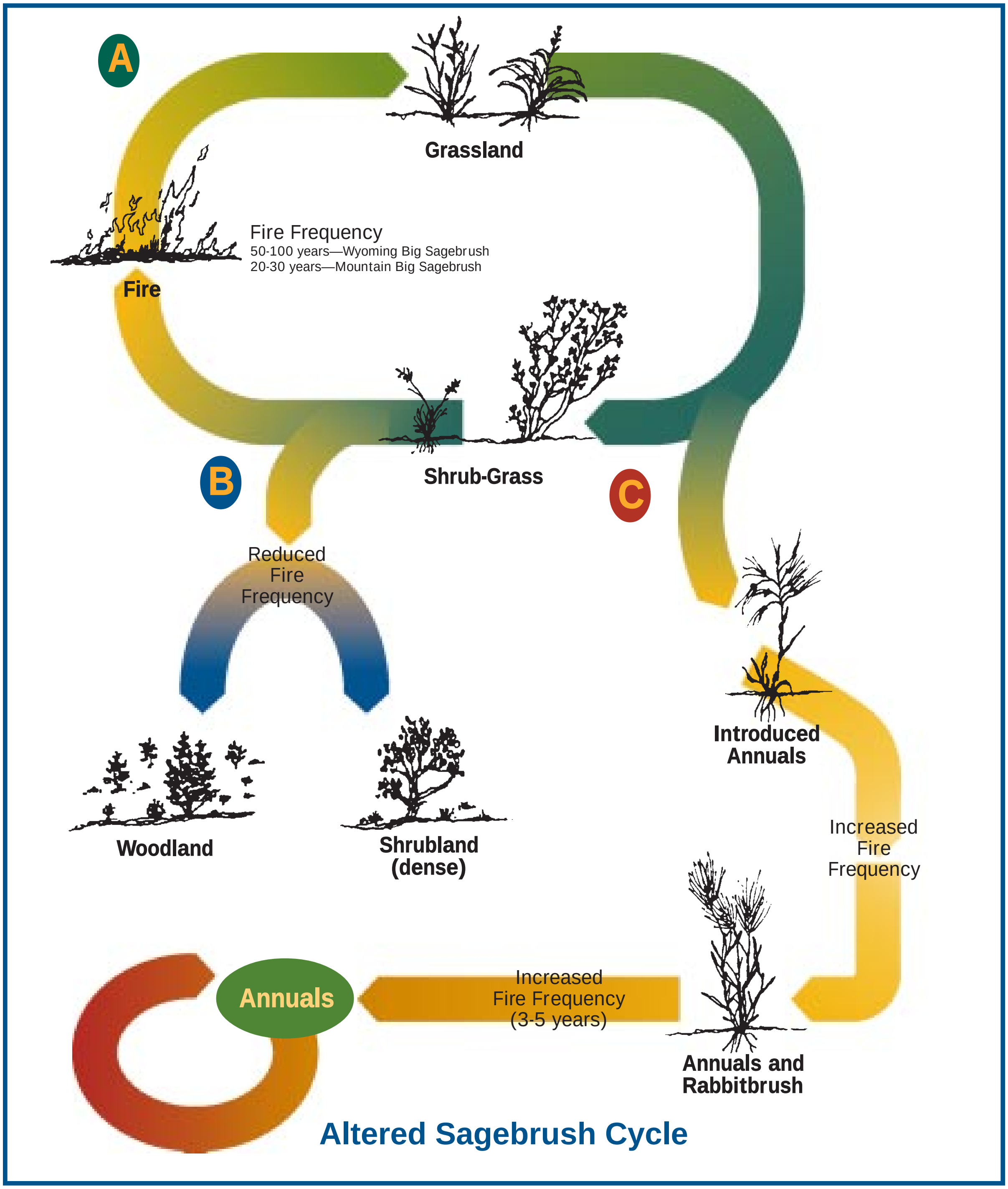


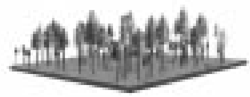
Figure 6—Sagebrush Grassland Succession: Three common pathways of succession in the sagebrush grassland. Pathway A represents a succession from a grassland to a shrub-grass dominated plant community, with fire acting to move the shrub-grass community back to a grassland. Pathway B represents succession of a shrub-grass dominated plant community to either a woodland (dominated mostly by juniper) or a shrubland, caused by a reduction in fire occurrence. Pathway C represents succession of 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 livestock grazing pressure. Once dominated by introduced annual grasses, the community tends to remain this way because of frequent fire, which prevents shrubs from establishing. (Adapted from Vavra and others. 1994. *Ecological Implications of Livestock Herbivory in the West*.)

This photo shows a pattern of vegetation that is associated with fire suppression and exclusion of disturbance. When fires occur they are usually very intense because of accumulations of continuous heavy fuel. The soils, aquatic systems, and native species of wildlife and plants are often negatively affected by the intensity of these events.

exclusion, and the introduction of exotic weeds substantially altered the patterns and areal extent of lands affected by the succession and disturbance regimes. The succession and disturbance regime of the ridge landform, for example, changed from a maintenance regime to a long-cycling regime due to fire exclusion. As a result, the herb-dominated communities that commonly occurred historically have been replaced by communities dominated by conifers or junipers. In areas that do not have the potential to support trees, the herb-dominated communities are now dominated by dense, decadent shrubs. In either case, ignition probabilities declined substantially due to the lack of fine grass fuels. When these newer communities burn it is typically only during very dry conditions, rather than during the fire intervals common for the native system. Furthermore, the fires generally burn more severely than they did historically due to the increased amount of woody fuels that is now common to the ridge landforms. The more severe fires commonly kill the sparse understory of perennial grasses and forbs.

Landscapes that are dominated by a mosaic of both forest and rangeland PVGs have inherently more diverse succession and disturbance regimes, and vegetation patterns than the forest or rangeland dominated landscapes. Although the individual landform, PVG, and succession/disturbance regime relationships were generally the same as in the forest or rangeland dominated landscapes, the effects at the landscape level were substantially

Stand Initiation (SI)
Forest growing space is reoccupied by young trees following a stand-replacing disturbance (e.g., fire).

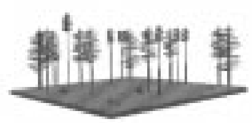


Stem Exclusion, Open Canopy(SEOC)
Occurrence of new trees is excluded (moisture-limited situation); the forest canopy is broken and tree crowns are open-growing.

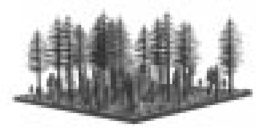
Stem Exclusion, Closed Canopy (SECC)
Occurrence of new trees is excluded (light-limited situation); the forest canopy is closed and tree crowns are abrading.

Understory Reinitiation (UR)
A new age group of trees establishes under the mortality-induced openings of the older overstory.

Young Forest, MultiStory (YFMS)
Several age groups are established; large trees are generally absent.



Old Forest, Single Story (OFSS)
Understory trees generally are absent; large trees are present and significant in the overstory.



Old Forest, MultiStory (OFMS)
Diverse horizontal and vertical distributions of tree sizes occur; with large trees also present and significant in the overstory.

Figure 7—Structural Stage Definitions.

different. The forest-rangeland landscape mosaic has many complex ecotonal and contagion relationships among the different kinds of environments and communities.

In general, the changes that occurred in forest-rangeland landscapes have been more substantial than the observed changes in either the forest or rangeland landscapes because the energy gradients are steeper, the disturbance regimes are more dynamic due to the forest-rangeland mosaic, and the diversity of species are higher.

***Vegetation dynamics*—**This analysis described vegetation by structural stages (figure 7; table 3). Both the late-seral multi-layer and single-layer structural stages have declined substantially, and the late-seral multi-layer that now occurs is generally occupying a different place on the landscape. Historically, late-seral multi-layer forested types were in moist areas such as bottoms and benches and were maintained by succession and disturbance regimes. Timber harvesting and the exclusion of fire have resulted in late-seral multi-layer forest developing on the dryer slopes. The amount of small dead-standing and down material has increased. Considerable small-diameter timber volume remains, providing opportunities for harvest that could be accomplished in an ecologically beneficial manner with appropriate technology. Whether revenues from these harvests will exceed treatment costs is dependent on site-specific conditions, timber markets, and costs of treatment.

Figure 8 summarizes changes in landscape elements in the Basin. Across the Basin, the greatest change is from the expansion of agriculture, which

Figure 8—Current and historic landscape elements.

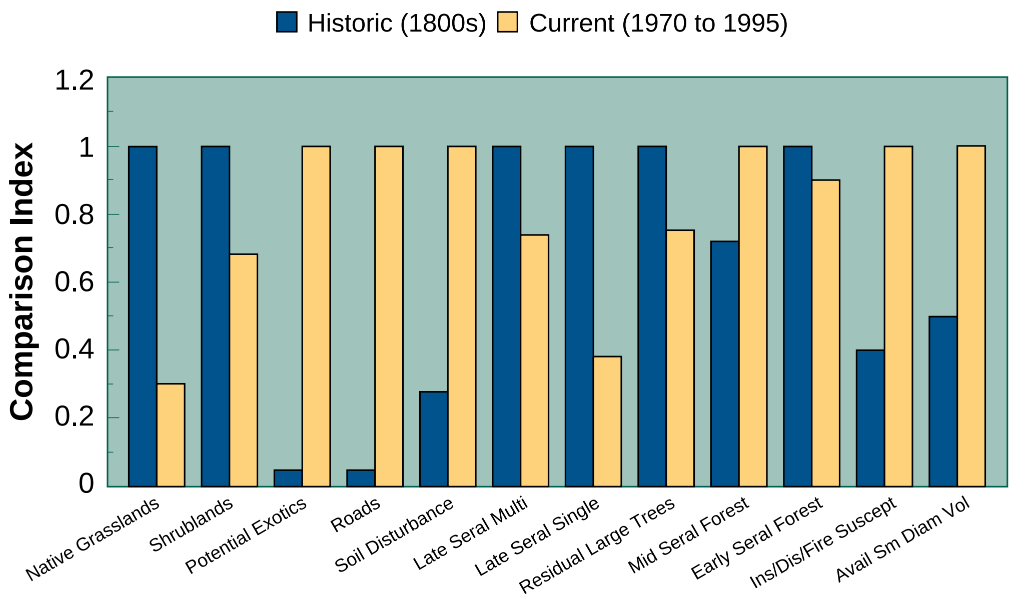


Table 3—Structural stages often used to describe changes in forest vegetation structure over time.

Structural Stage	Definition	Also Referred to As:
Stand initiation	When land is reoccupied by trees following a stand-replacing disturbance.	Early-successional Early-seral Regeneration
Stem exclusion-open canopy	Forested areas where the occurrence of new trees is predominantly limited by moisture.	Mid-successional Mid-seral Young forest
Stem exclusion-closed canopy	Forested areas where the occurrence of new trees is predominantly limited by light.	Mid-successional Mid-seral Young forest
Understory reinitiation	When a second generation of trees is established under an older, typically seral, overstory.	Mid-successional Mid-seral Young forest
Young forest multi-story	Stand development resulting from frequent harvest or lethal disturbance to the overstory.	Mid-successional Mid-seral Young forest
Old multi-story	Forested areas lacking frequent disturbance to understory vegetation.	Late-successional multi-story Late-seral multi-story Old forest multi-story
Old single-story	Forested areas resulting from frequent non-lethal prescribed or natural underburning, or other management	Late-successional single-story Late-seral single-story Old forest single-story

occurred primarily in the upland shrubland and upland herbland terrestrial communities of the dry shrub, dry grass, and cool shrub potential vegetation types. Upland shrubland and upland herbland declined substantially across the Basin as a whole, but on lands administered by the BLM or FS, the upland shrubland type increased while the upland herbland decreased, due to the exclusion of fire from woodlands and shrublands. The upland woodland type increased substantially over the Basin as a whole, also a result of fire exclusion.

Native grasslands also have declined substantially. This has occurred not only on non-forested rangelands but also in grassland areas within the forest. Shrublands have also declined substantially, generally displaced by exotic plant species such as cheatgrass. Exclusion of fire, timber harvest practices, and introduction of white pine blister rust in the moist forest potential vegetation types has resulted in near elimination of western white pine as a dominant species, increased intervals between fires, and increased severity of fires.

Exclusion of fire and introduction of blister rust in the cold forest potential vegetation types has virtually eliminated whitebark pine as a dominant species, increased intervals between fires, and increased severity of fires. Exclusion of fire, shifting of grazing from low-intensity, dormant-season grazing to high-intensity, growing-season grazing, and introduction of the exotic Kentucky Bluegrass in the cold forest and riparian woodland zones have resulted in substantial reduction of communities that were dominated by aspen between the fire cycles.

Reserve and wilderness management also have caused substantial changes in succession/disturbance regimes and the associated vegetation structures, although not to the extent of commodity management. In general, the disturbances are of lower frequency, are more acute, and have higher severity in cumulative effects than under historical regimes. Typically, both community structure and patch diversity decline under reserve and wilderness management.

Early-seral shrub, herb, and tree seedlings with dead standing trees from a crown fire one year ago. Natural succession occurs rapidly on most disturbed areas. Only one year after the fire, this area is now covered with shrub and herb regeneration and has many tree seedlings. Many of the native plants seen here can only grow in a post-fire environment because their seeds are stored in soil and only germinate with the heat effects of the fire.

Mid-seral stand of pole size trees with an understory of shrubs and herbs. Successional growth to dominance by trees occurs within 30-50 years. These mid-seral stands are typically fairly dense, but are naturally thinned by ground fires, insect and disease attacks, or stress. Generally, the trees that are less healthy die, allowing the healthier trees more moisture and nutrients, which accelerates their growth.

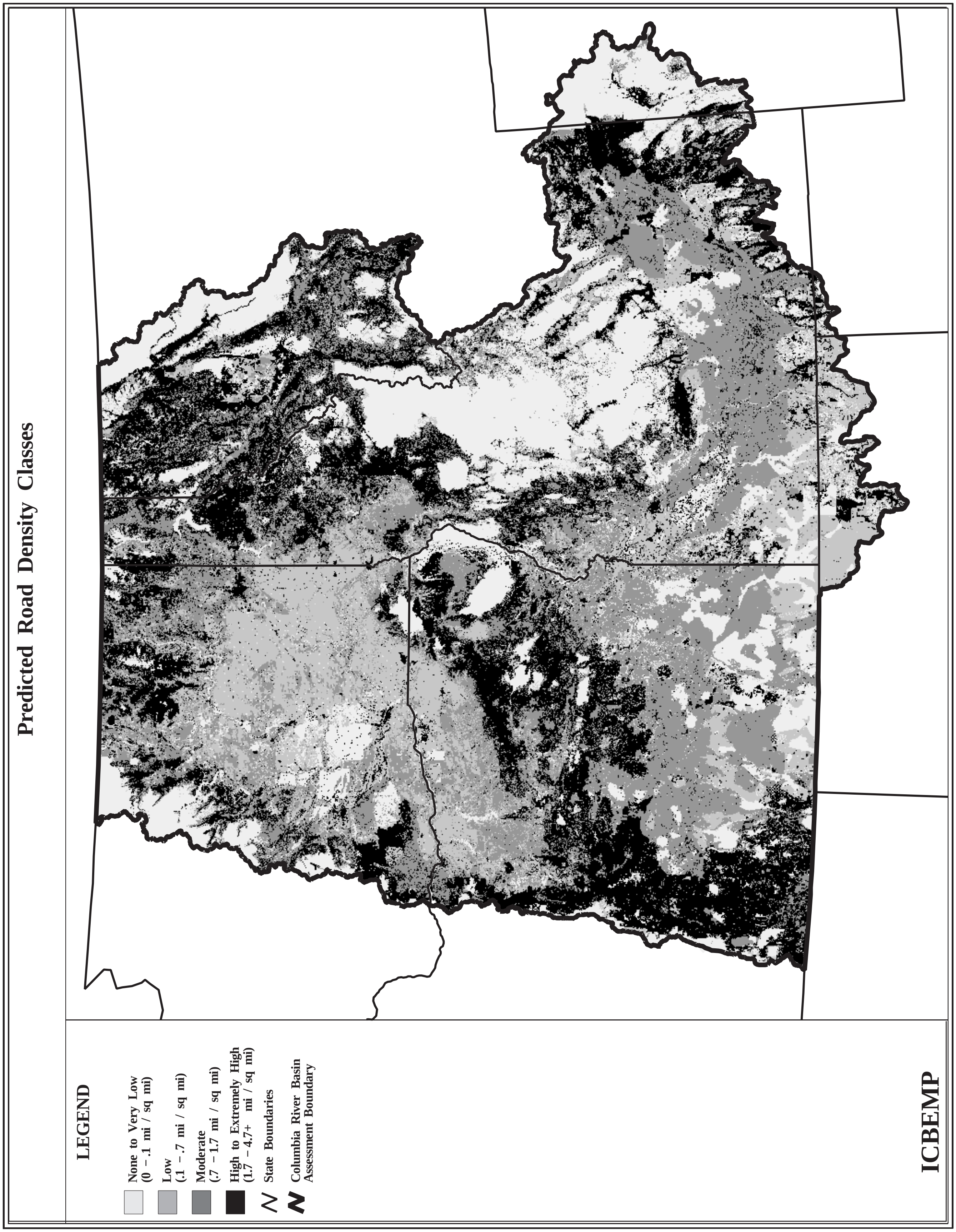
Harvest patterns, along with exclusion of fire, have converted much of the late-seral communities to mid-seral communities.

Late-seral stand of larger trees with snag and understory of shrubs and herbs. Successional growth to later-seral large trees with snags and a more open canopy occurs over the next 40-80 years. Natural disturbances thin and promote growth of the large trees and eventually may cycle the stand back to the early-seral stage. Rangelands and riparian systems have similar dyna-mics of disturbance, such as large ungulate grazing, fire, insects, disease, and floods, with similar stages of successional response from post-disturbance to dominance by herbs or shrubs.

As a result of blister rust mortality of whitebark pine, the early-seral subalpine forest increased substantially. The late-seral montane forest converted to mid-seral forest as a consequence of timber harvest patterns, fire exclusion, and loss of western white pine to blister rust. A similar trend of increased mid-seral forest occurred in the lower montane forests.

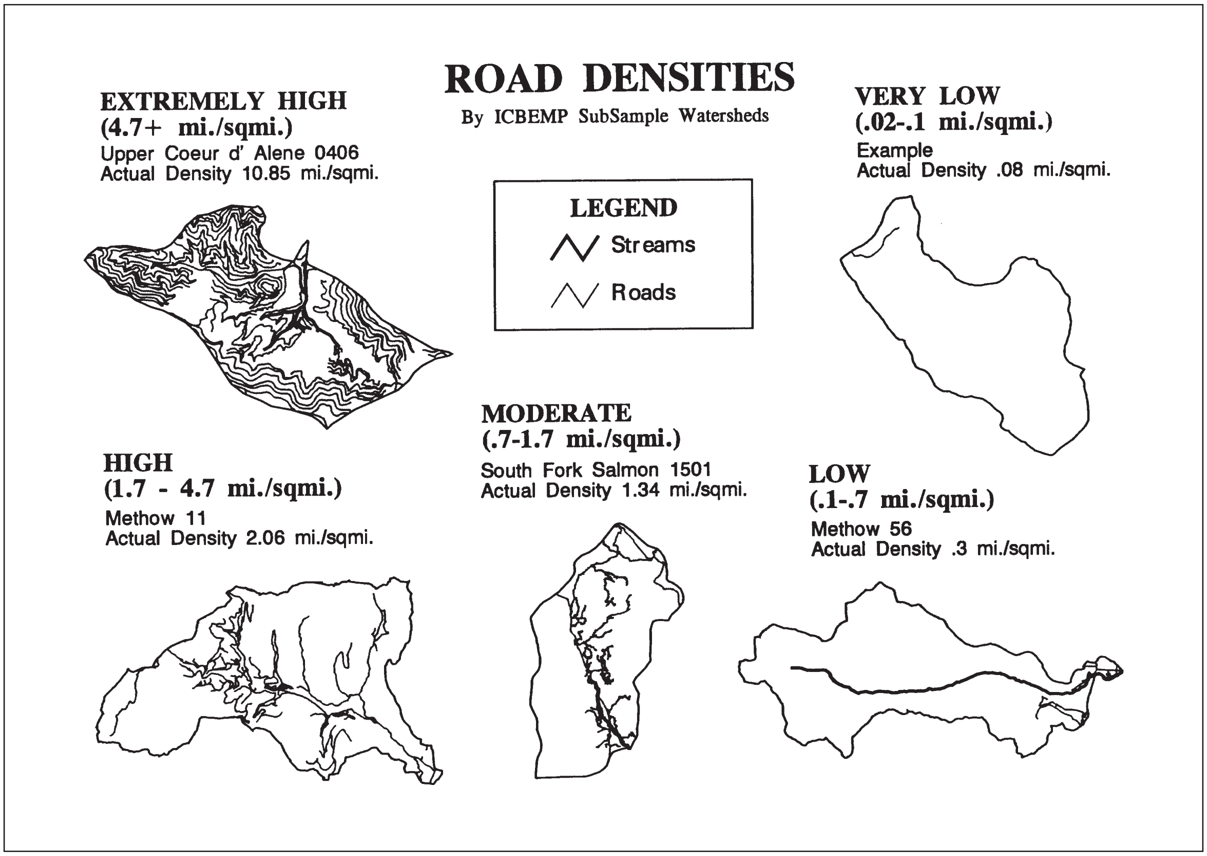
Large trees that are shade intolerant and fire-, insect-, and disease-resistant species have generally been harvested from both the mid-seral and late-seral communities either selectively or as part of even-age treatments (clearcuts, seed tree cuts). Fire detection and control efforts have largely excluded fire from these areas. Late-seral communities developed over long periods of time, and experienced periodic fires that typically burned through the understory and maintained open park-like communities of large shade-intolerant trees with low susceptibility to mortality from stress, fire, insect, or disease. Harvest patterns, along with exclusion of fire, have converted much of the late-seral communities to mid-seral communities. Historically, the mid-seral communities either burned with crown fires and cycled back to early-seral communities or developed into late-seral communities. Not only is there a large increase in the mid-seral communities, but the current communities are more dense and have higher mortality, higher fuel loadings, and higher susceptibility to crown fire than historical communities.

There has been a decrease in diversity associated with exclusion of fire, intrusion from exotic biota, and/or heavy grazing during the growing season. This has caused a decline in communities that were historically dominated by western white pine, whitebark pine, ponderosa pine, western larch, aspen, cottonwood, riparian willows, bluebunch wheatgrass, bitterbrush, mountain mahogany, and the salt desert shrub complex.



Map 9—Predicted road density classes.

Figure 9—An example of road densities for subwatersheds within the Basin.



Roads—Roads cover enough of the Basin to be considered a component of the biophysical environment; in some wildland areas, road densities make up as much as 5 to 10 percent of the land base. Because a complete road inventory was not available for analysis, road density was predicted from models (map 9). The vast majority of FS and BLM roads are gravel or dirt and are passable only by high-clearance vehicles. Areas with no roads are found primarily in Wilderness, semi-primitive roadless areas, and national parks. Very low densities (figure 9) occur primarily in the rangelands of the valleys and plains, while low densities occur primarily in agricultural lands. High road density is found primarily in the intensively managed forestlands of both public and private ownership, and the highest density typically occurs in developed urban/rural areas.

High road densities and their locations within watersheds are typically correlated with areas of higher watershed sensitivity to erosion and sediment transport to streams. Road density also is correlated with the distribution and spread of exotic annual grasses, noxious weeds, and other exotic plants. Furthermore, high road densities are correlated with areas that have few large snags and few large trees that are resistant to both fire and infestation of insects and disease. Lastly, high road densities are correlated with areas that have relatively high risk of fire occurrence (from human caused fires), high hazard ground fuels, and high tree mortality.

The vast majority of FS and BLM roads are gravel or dirt and are passable only by high-clearance vehicles.

Roads create an environment that is uniquely human. These types of environments are often associated with a high degree of disturbance in terms of soil erosion and runoff that can carry sediment to streams. Roads also act as a barrier to many wildlife species, although they can be designed to mitigate these effects. This road has been designed on a type of land that has low risk for causing negative effects.

In contrast, this road has high potential for negative effects.

Fire—At present, fire frequency and intensity are approaching or exceeding those experienced in the early 1900s, when many wildfires occurred. The advent of improved technology for fire detection, prevention, and suppression led to a decline in fires in the 1960s. However, with steadily increasing fuel conditions, the amount of wildfire has increased since then. The average cost of wildfire suppression, fatalities of firefighters, and amount of high-intensity fire during the period of 1970 to 1995 are double the corresponding amounts occurring from 1910 to 1970.

Map 7 shows areas of the Basin that receive an average of less than 12 inches of precipitation annually. These lands are highly susceptible to disturbance from drought, invasion of exotic annual grasses, and wildfire. Combining this overlay with roaded dry shrub and dry grass potential vegetation types in valley and plains environments reveals areas that have typically been affected the most by the combined effects of past overgrazing and drought. Management of livestock on these ranges has substantially improved since the 1930s, but response of vegetation is very slow and the technology for restoring these systems is generally not available.

The combination of potential vegetation types and road density makes many portions of the Basin susceptible to invasion by exotic weeds (map 10). The dry forest, cool shrub, dry shrub, dry grass, and riparian potential vegetation groups are all potentially susceptible to exotic weed invasion.

One of the key results of many of these alterations across the Basin has been the corresponding change in fire potential and behavior. In general, lethal fires have increased. In particular, the lethal, very-frequent fire regime class has increased substantially, while nonlethal, very frequent fires have declined from historic conditions. Maps 11 and 12 show the portions of the basin most affected.

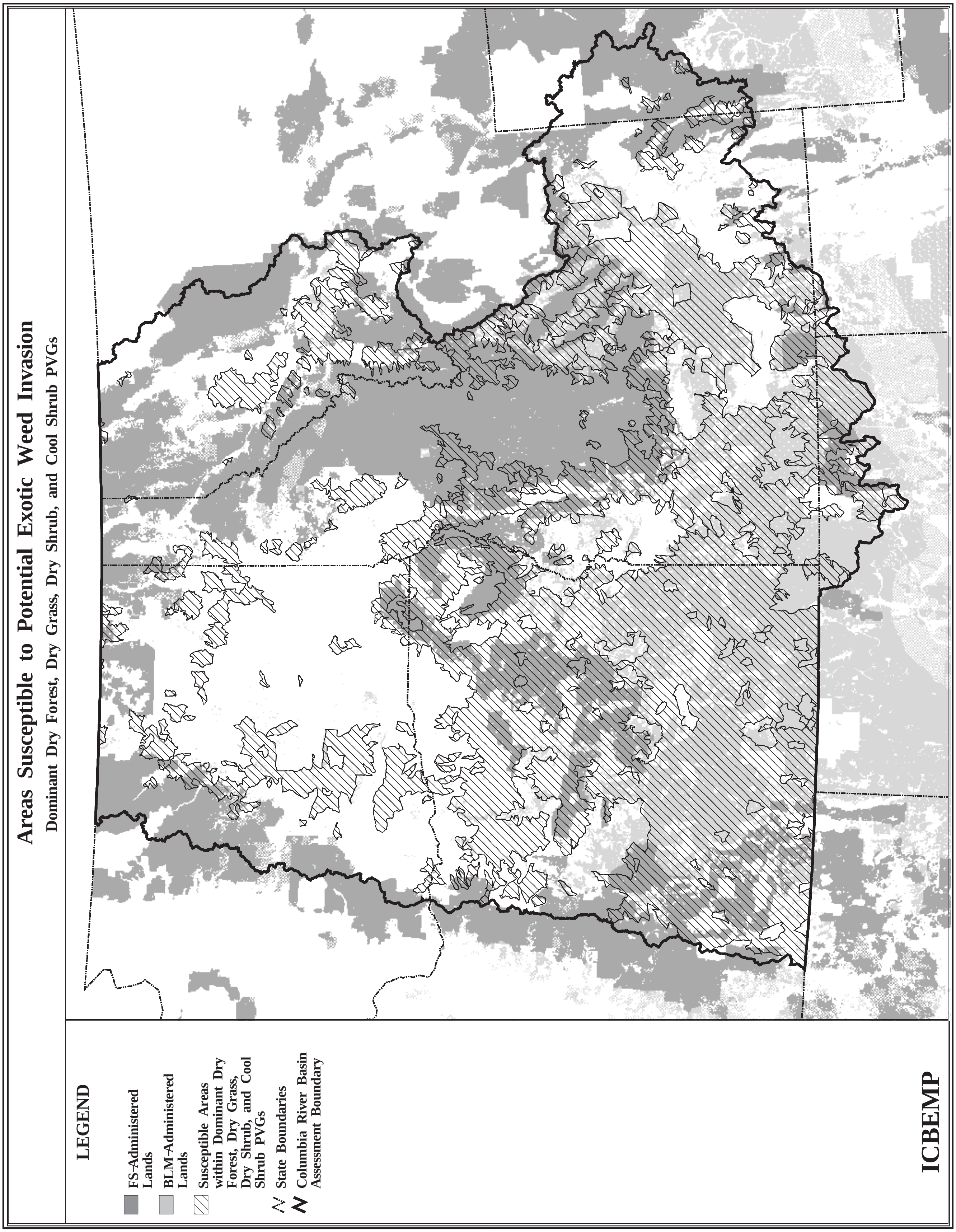
Complex changes have occurred in rangelands resulting in increases in the nonlethal infrequent and mixed infrequent classes. In these environments, livestock grazing reduced fine grass fuels that contributed to less frequent fires. However, improved fire detection and control techniques have resulted in the increase of woody fuels, causing higher severity when fires occur. Additionally, introduction of annual grasses has increased flammability in areas that are not grazed.

The occurrence and intensity of wildfires are correlated with lightning storm routes, fuels, local wind patterns, terrain complexity, and roads. Wildland areas with complex terrain or a moderate or high road density have moderate or higher risk of wildfires. Foothill and mountain terrain facing west or east typically have high potential for wind that can cause rapid spread of wildfires. Areas with fuels, roads, and complex terrain that are on lightning storm routes have the highest risk of wildfire. The areas in the moderate category often have a lower probability of wildfire in any one year, but have high fuel accumulations, such that the fires can be very large and intense.

Another change is that more people live in urban and rural settings adjacent or within an area of wildland vegetation that has high risk of fire (map 13). Those areas are of concern relative to providing for the safety of people and protection of homes as well as for the cost of fire suppression and safety of firefighters.

Fire Frequency and Severity

Fires can be described by their effects on vegetation and how often these effects occur. The severity classes are non-lethal (does not kill the dominant layer of plants), mixed (mixed effects), lethal (kills the dominant layer of plants), and rarely burns. An interval of 0 to 25 years is considered very frequent, 26 to 75 years frequent, 76 to 150 years infrequent, 151 to 300 years very infrequent, and greater than 300 years extremely infrequent.

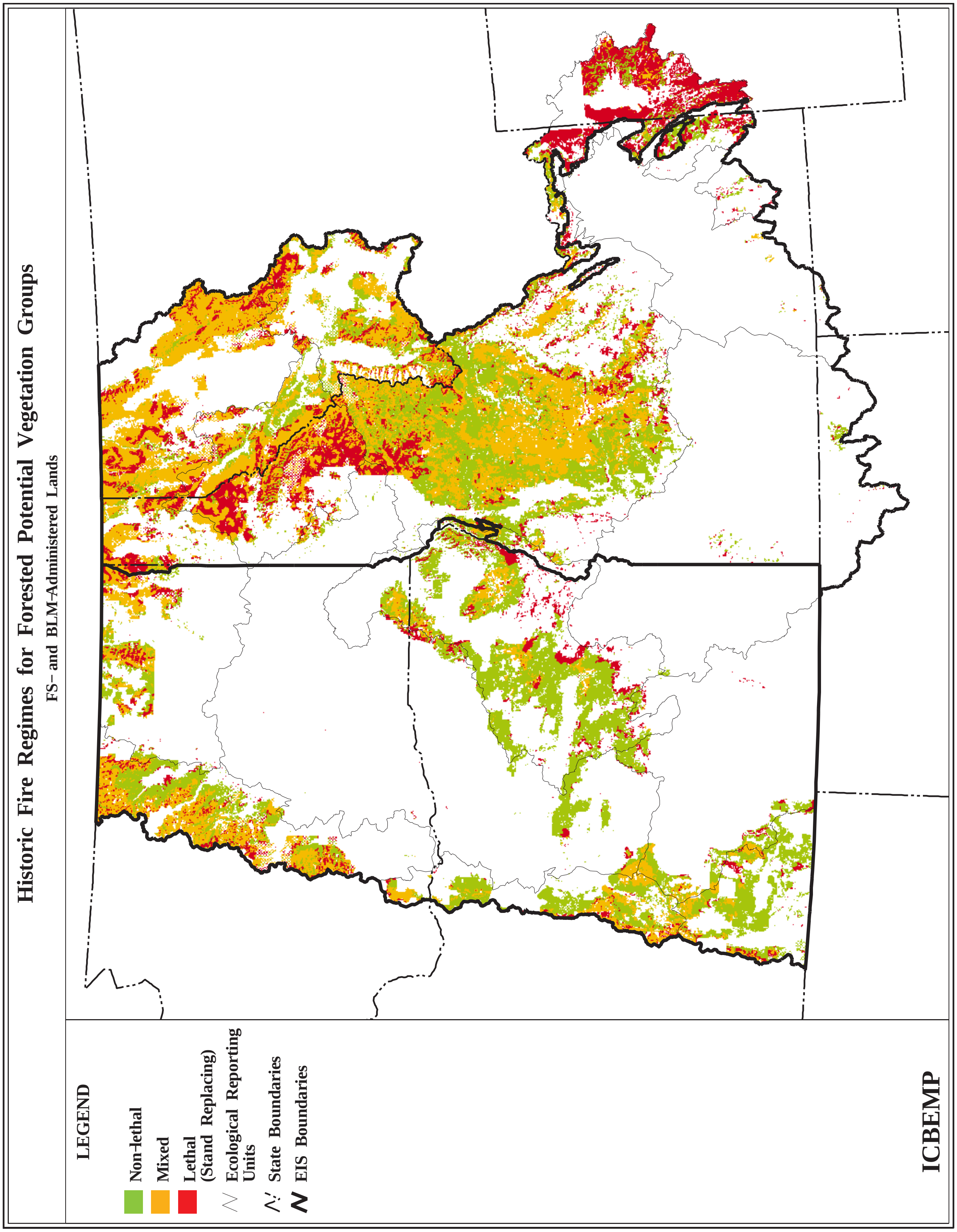


Map 10—Areas susceptible to exotic weed invasion.

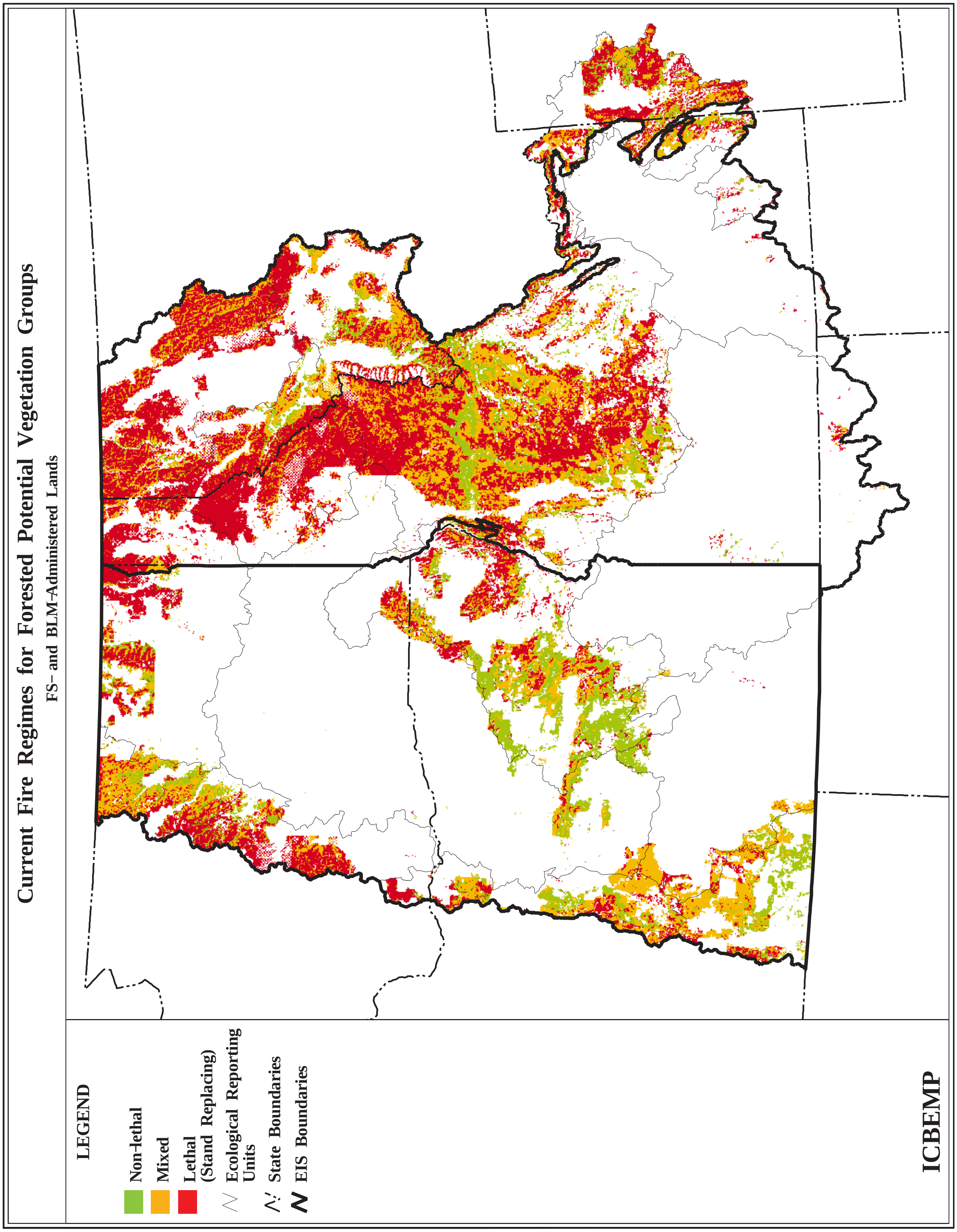
Ground fire. Disturbances result in dynamic changes in vegetation, animal habitats, effects on aquatics, and effects on resource values. This is a ground fire disturbance which has very different effects from crown fires.

Post-crown fire dead standing trees and ash. Although a burned over stand of dead trees appears to be lifeless, it is still a very dynamic place. Birds such as the black-backed woodpecker actively seek out these areas for feeding. Nitrogen released from the burned foliage is available for seedlings and resprouting vegetation. Many plants are actively regenerating in this environment.

Crown fire. Crown fire burns through the tops of the trees, killing the overstory. Past efforts at fire exclusion have allowed fuels to accumulate in many areas that burn as crown fires, rather than as ground fires. Crown fires have much more severe effects on the soil, vegetation, terrestrial habitats, aquatic habitats, and resource values to humans, than ground fires.

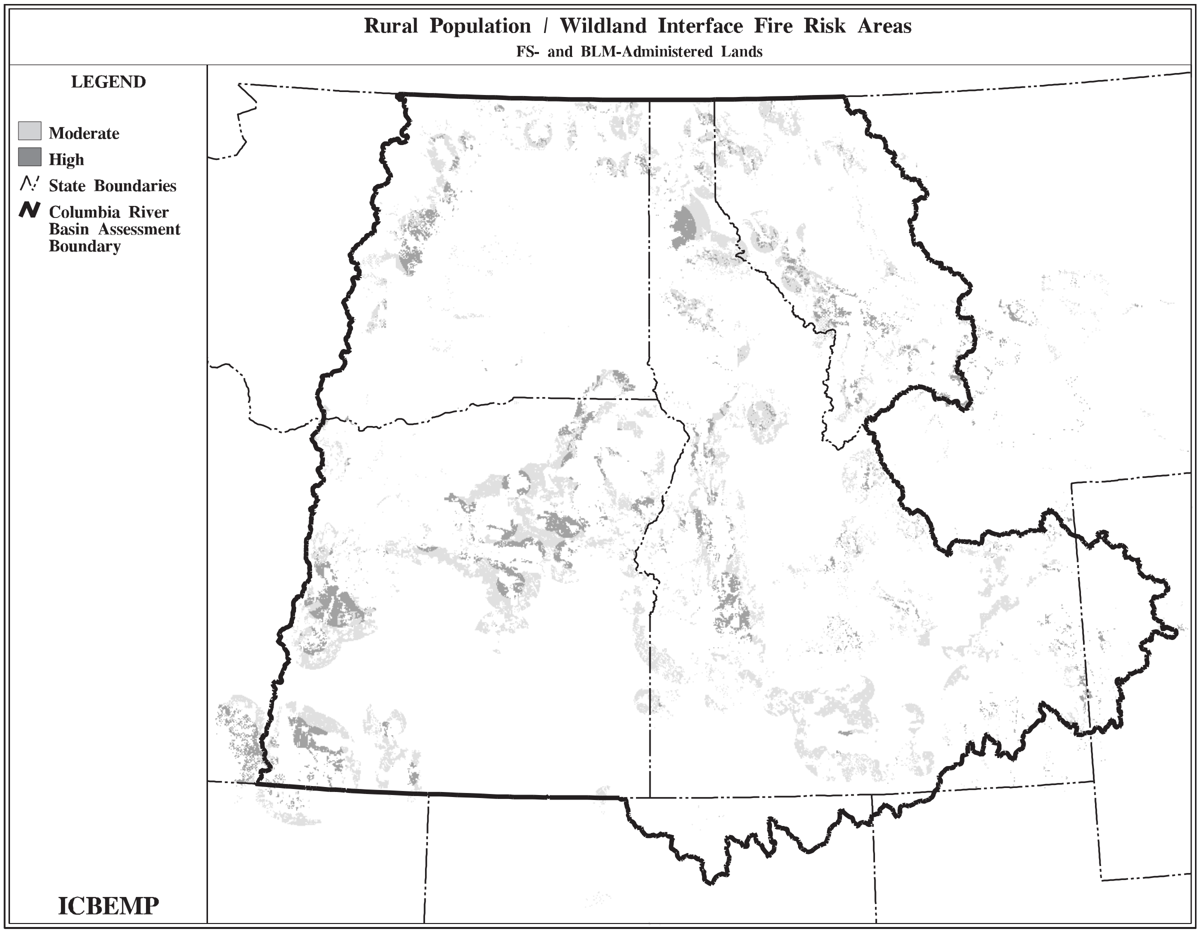


Map 11—Historic fire regime for forested potential vegetation groups.



Map 12—Current fire regime for forested potential vegetation groups.

Map 13—Rural population/wildland interface fire risk areas.



Implications for Ecosystem Management

Traditional forestry and grazing practices, introduction of blister rust, introduction of exotic plants, and exclusion of fire, have substantially changed succession/disturbance regimes and the associated vegetation structure and composition. Typically, the change of disturbance regime was associated with longer intervals of more severe disturbances. Traditional reserve strategies, in conjunction with fire exclusion, introduction of blister rust, and exotic plants, has also substantially changed the succession/disturbance regimes and associated vegetation structures and composition. Once again, the disturbances typically had longer intervals and were more severe than the disturbance regimes of the native system.

Only 24 percent of FS- and BLM-administered lands are in conditions such that managers could manage for the historical range of variability if that were the objective. Of this area, most of the existing patterns are similar to reserve patterns. Often the capital, in terms of large trees or native bunchgrasses, is gone from areas that have commodity patterns; long periods of time would be required to restore the vegetative structures in these areas. In areas with reserve patterns, managers and the public may still have the option of retaining large trees and native bunchgrasses, if they are not preempted by a severe disturbance event. The remaining BLM- and FS-administered land is in a landscape pattern and disturbance regime system that is not completely predictable as a result of change in the biophysical environment. However, it is possible to improve this limited predictability through assessments, research, and adaptive management approaches.