Aquatic Ecosystems

Key Terms Used in This Section

Anadromous fish ~ Fish that hatch in fresh water, migrate to the ocean, mature there, and return to fresh water to reproduce; for example, salmon and steelhead.

Beneficial Uses ~ Any of the various uses of water including, but not limited to, domestic water supplies, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics. The beneficial use is dependent upon actual use, the ability of the water to support a nonexistent use either now or in the future, and its likelihood of being used in a given manner. The use of water for the purpose of wastewater dilution or as a receiving water for a waste treatment facility effluent is not a beneficial use.

Best Management Practices (BMPs) ~ Practices designed to prevent or reduce water pollution.

Biota ~ The animal and plant life of a particular region.

Coarse woody debris (CWD) ~ Pieces of woody material having a diameter of at least three inches and a length greater than three feet (also referred to as large woody debris, or LWD).

Endemic species ~ Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality. "Endemism" is the occurrence of endemic species in an area.

Extinction ~ Complete disappearance of a species from the earth.

Extirpation ~ Localized disappearance of a species from an area.

Headwaters ~ Beginning of a watershed; unbranched tributaries of a stream.

Hybridization ~ The crossbreeding of unlike individuals to produce hybrids.

Hydrologic ~ Refers to the properties, distribution, and effects of water. "Hydrology" refers to the broad science of the waters of the earth—their occurrence, circulation, distribution, chemical and physical properties, and their reaction with the environment.

Large woody debris ~ Any piece of woody material that intrudes into a stream channel, whose smallest diameter is > three inches, and whose length is > three feet.

Pools ~ Portion of a stream where the current is slow, often with deeper water than surrounding areas and with a smooth surface texture. Often occur above and below riffles and generally are formed around stream bends or obstructions such as logs, root wads, or boulders. Pools provide important feeding and resting areas for fish.

Riparian areas ~ Area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

Salmonid ~ Fishes of the family Salmonidae, including salmon, trout, char, whitefish, ciscoe, and grayling.

Sediment ~ Solid materials, both mineral and organic, in suspension or transported by water, gravity, ice, or air; may be moved and deposited away from their original position and eventually will settle to the bottom.

Sensitive species ~ Species identified by a Forest Service regional forester or BLM state director for which population viability is a concern either (a) because of significant current or predicted downward trends in population numbers or density, or (b) because of significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution

Uplands ~ The portion of the landscape above the valley floor or stream.

Watershed ~ 1) The region draining into a river, river system, or body of water; 2)In this EIS, a watershed also refers to a drainage area of approximately 50,000 to 100,000 acres, which is equivalent to a 5th-field Hydrologic Unit Code (HUC).

Wetlands ~ In general, an area soaked by surface or groundwater frequently enough to support vegetation that requires saturated soil conditions for growth and reproduction; generally includes swamps, marshes, bogs, wet meadows, mudflats, natural ponds, and other similar areas. For legal definitions, see Glossary.

TABLE OF CONTENTS

Introduction

This section summarizes the condition of aquatic ecosystems in the project area by first describing the hydrologic environments of watersheds, water bodies, riparian areas, and wetlands, then describing the status of fish species that use and are affected by these environments. Within the sections describing hydrologic environments, there are descriptions of key processes and conditions that act to form and modify the physical and vegetational characteristics of aquatic ecosystems, such as streamflow, sedimentation, erosion, channel formation, and riparian vegetation. Those processes and conditions that can be affected by regional-scale management decisions are emphasized. A summary of current conditions in each of these hydrologic environments is also included.

The section describing fish focuses on past and current conditions of many fish species in the entire project area. Special attention is given to native fish species, especially wide-ranging salmon and trout species, as well as local and rare species that inhabit the Northern Great Basin (ERU 1) and Upper Klamath Basin (ERU 3). Similar to the descriptions of the hydrologic environments, aspects of native fishes that are particularly affected by regional-scale management decisions are emphasized. Issues discussed include: (1) the overall status of native fish species in the region; (2) management of habitat for rare and endangered species ~ especially wide-ranging species; (3) genetic diversity; and (4) introduction of non-native species.

Unless otherwise noted, information in this section is derived primarily from the *Landscape Dynamics* (Hann et al. 1996) and *Aquatics* (Lee et al. 1996) chapters of the *Assessment of Ecosystem Components*; Henjum et al. 1994; Wissner et al. 1994, and other sources as cited.

Hydrology and Watershed Processes

Summary of Conditions and Trends

- Environmental changes within landscapes commonly cumulate and appear on a watershed basis.
- Management activities throughout watersheds in the project area have affected the quantity and quality of water, processes of sedimentation and erosion, and the production and distribution of organic material, thus affecting hydrologic conditions. On federally managed lands, the most pronounced changes to watersheds are due to water diversions and impoundment, road construction, vegetation alteration (including silvicultural practices, fire suppression, forage production, and improper livestock grazing).

Watersheds are natural divisions of the landscape and the basic functioning unit of hydrologic systems (see Figure 2-13). Watersheds are hierarchical ~ smaller ones nest within larger ones. In this EIS, the terms most often used to describe this hierarchy are sub-basin (4th-field Hydrologic Unit Code [HUC]), watershed (5th-field HUC), and subwatershed (6th-field HUC). These terms are shown in Table 2-3 and Figure 2-1. Hydrologic unit codes are described in the Introduction to this chapter. Landforms contained within watersheds are also hierarchical. Valleys nest within watersheds, and their form is in part controlled by watershed physiography and geologic history. Streams and rivers flow through valleys, and channel form is influenced by interactions between streams and valleys. Individual features within stream channels, such as pools and riffles, reflect stream-channel processes and history, and as a result, are the culmination of watershed processes at multiple scales.

These natural hierarchies make watersheds an appropriate context for considering many ecologic processes. Physical processes such as rainfall, streamflow, erosion, and sedimentation interact within watershed boundaries to shape and form the landscape. Watershed boundaries have meaning for living organisms as well. Most aquatic species, such as fish, do not cross watershed divides. Other species, particularly riparian area species such as the beaver, can be considered watershed residents. Human residence and use patterns are also strongly tied to locations of lakes, rivers, and streams.

Environmental changes commonly cumulate and appear on a watershed basis. Changes in soil, vegetation, topography, and human uses

TABLE OF CONTENTS

result in changes in the quantity and quality of water, sediment, and organic material that flow through a watershed. The response of a particular watershed to environmental change varies considerably because each watershed is unique. Factors that govern how a watershed may respond to environmental change include the size and location of these changes, the physical and biological characteristics of the watershed, and the history of natural and human disturbances.

Streams, Rivers, and Lakes

Summary of Conditions and Trends

- Banks and beds of streams, rivers, and lakes have been altered by bank and shore structures, including urban development, transportation improvements, instream mining activities, flood-control works, and alteration of riparian areas. In general, the changes have been greatest for the larger streams, rivers, and lakes.
- Water quantity and flow rates have been locally affected by dams, diversions, groundwater withdrawal. More subtle, but widespread changes in water quantity and flow patterns on federally managed lands have probably been caused by road construction, and changes in vegetation due to silvicultural practices and livestock grazing.
- Within the eastern Oregon and Washington planning area, 11 percent of Forest Service-administered streams and 13 percent of BLM-administered streams are "water quality limited" as defined by the Clean Water Act. On Forest Service-administered lands, the primary water quality problems are sedimentation, turbidity, flow alteration, and high temperatures. On BLM-administered lands, high sediment, turbidity levels, and temperatures are the primary reasons for listing as water quality limited.
- Streams and rivers are highly variable across the project area, reflecting diverse physical settings and disturbance histories. Nevertheless, important aspects of fish habitat, such as pool frequency and large woody debris abundance, have decreased throughout much of the project area. Pool frequency and wood frequency are generally less in areas with higher road densities, and in areas where timber harvest has been a management emphasis.

Movement of water is one of the fundamental ways to transfer energy and materials in ecosystems. Water in streams and rivers transports sediment, organic material, nutrients, and aquatic organisms, resulting in constant redistribution and shaping of landforms and stream channels. Figure 2-13 illustrates this movement of water, also known as the hydrologic cycle. The wide variety of water bodies, with their associated energy and food sources, provide abundant and diverse habitats for water-dependent plant and animal species.

Streams, rivers, and lakes are also a focus for human activities. As human populations increase, and demands for food, energy, transportation networks, and recreation opportunities expand, uses of stream and river systems increase. These uses have resulted and will continue to result in escalating conflicts over water and stream channels, both between competing human uses, and between human uses and ecologic requirements of the native biota. Resolution of many of these conflicts is outside the authority of BLM and Forest Service decision-makers, and is therefore outside the scope of this EIS. However, there are some critical regional issues regarding streams and stream channels that are affected by BLM and Forest Service decision-making. These issues have to do with water quantity and quality, riparian and a aquatic habitat quality, and stream channel processes.

Water Quantity and Quality

Water quantity and quality are important components of aquatic and riparian habitats. Moreover, the primary influence land managers have over the condition of aquatic ecosystems on Forest Service- and BLM-administered lands is through management of water quantity and quality.

Water Quantity

Within eastern Oregon and Washington, there are approximately 137,100 miles of streams

TABLE OF CONTENTS

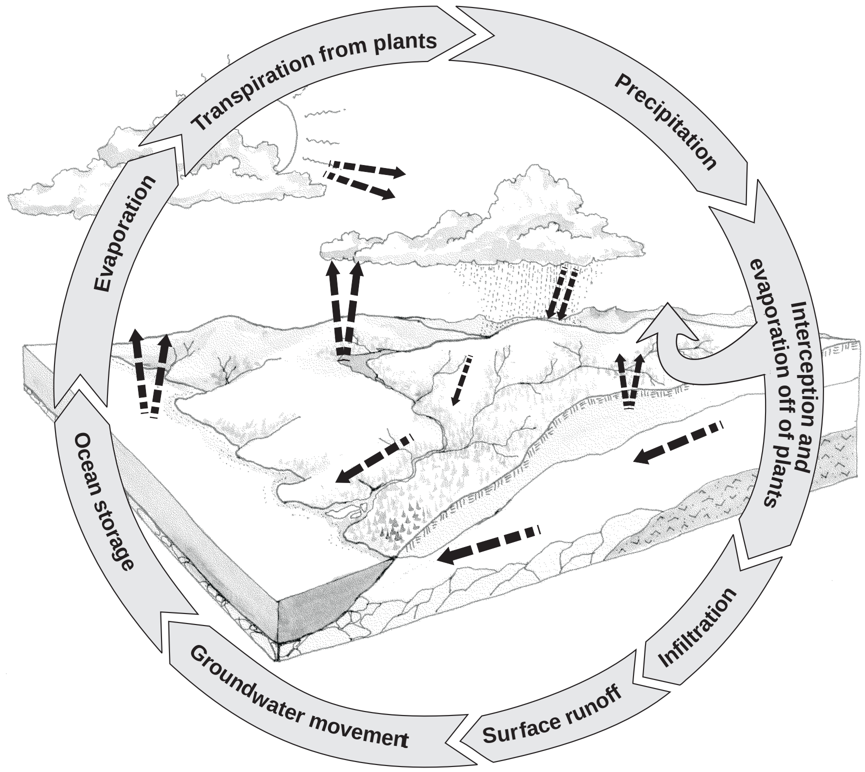


Figure 2-13. Hydrologic Cycle - A complex interdependent system called the hydrologic cycle links atmospheric, surface, and groundwater, and controls the distribution and movement of water in all ecosystems. The interactions of components within the hydrologic cycle provide the key to processes, such as flooding, that route and deliver water, wood, and sediment to streams. These interactions also connect streams to their floodplain, adjacent riparian areas, and uplands.

and rivers (including larger irrigation canals) and several thousand lakes mapped at the scale of 1:100,000. Most of the lakes are small (surface areas less than 12 acres) and are at high elevations (greater than 5,000 feet). Thirty percent of these streams and a majority of the lakes are on Forest Service- and BLM-administered lands. Most of these streams ultimately drain into the Columbia River, which has a drainage area of 237,000 square miles (152 million acres) and an average annual discharge of 140 million acre-feet at the town of The Dalles, Oregon. Approximately 35 percent of the flow at The Dalles originates from Canada. A large part of the flow from the southeastern portion of the project area enters the Columbia River via the Snake River, which has a drainage area of 108,500 square miles (69 million acres) and an average annual discharge of 40 million acre-feet near its confluence with the Columbia River in south-central Washington. Within eastern Oregon and Washington, but outside of the Columbia River Basin, are portions of the Klamath River drainage (Upper Klamath ERU 3) and the closed basins of south-central Oregon (Goose Lake Basin in ERU 3 and the Northern Great Basin ERU 1).

Most surface runoff results from snowmelt and/or rainfall in mountainous regions, resulting in spring and summer annual peak discharges. The vast majority of streamflow originates on public lands, especially higher elevation Forest Service-administered lands. In eastern Oregon and Washington, elevations below 2,000 feet, including most BLM-administered lands, usually do not contribute significantly to streamflow (Wissmar et al. 1994). There is substantial year-to-year variability in streamflow quantity, because of variability in rainfall and snowfall accumulation (McIntosh et al. 1994).

Most streamflow in eastern Oregon and Washington results from surface runoff or shallow groundwater flow into streams. A few streams, however, in the volcanic provinces of the Columbia Plateau (ERU 5), Upper Klamath Basin (ERU 3), Northern Cascades (ERU 1), and Southern Cascades (ERU 2) have significant components of inflow from groundwater. These groundwater-influenced streams provide unique terrestrial and aquatic habitats because of their relatively constant flows of cold, clear, and high-quality water.

Scarcity of streamflow during the growing season, year-to-year streamflow variability, and the general aridity of low-elevation valleys and plains have spurred flow regulation and storage, water diversions, and groundwater withdrawal throughout the planning area. These human modifications range from massive federal storage and irrigation projects, such as the Columbia Basin and Klamath Basin projects, to numerous small headwater reservoirs (stock tanks) used for livestock grazing. These projects help assure reliable water supplies for irrigation, livestock, and human use in addition to providing flood control and hydropower benefits. Reservoirs associated with these projects are extensively used for a variety of recreation activities. In total, about seven million acres in the Columbia River Basin are presently irrigated, resulting in a seven to ten percent net reduction of annual flow volume. As a result of impoundments and diversions, most streams in the planning area, especially larger ones, have significantly altered flow regimes resulting in changed habitat conditions, especially for those species that have survival strategies adapted to natural flow patterns. Altered flow regimes also affect channel stability by changing the rates and timing of sediment and organic-material transport.

On Forest Service- and BLM-administered lands, management activities that have altered flow are impoundments (dams and reservoirs), water withdrawal (diversions and pumping), road construction, and vegetation manipulation. Timber harvest, fire suppression, livestock grazing, and associated activities have altered the timing and volume of streamflow by changing on-site hydrologic processes (Keppeler and Ziemer 1990; Wright et al. 1990). Changes can be either short- or long-term depending on which hydrologic processes are altered and the intensity of alteration (Harr 1983).

Vegetation manipulation activities can change rates and amounts of evaporation and transpiration (water use by plants), and, in some areas, can change rates and volumes of snow accumulation and snowmelt. These effects are best understood for forested environments, where, within clearcuts, snow tends to accumulate in greater amounts and melt faster than in forested areas, leading to larger and earlier peak flows (Harr 1986, King 1994). These effects are greatest in association with rain-on-snow events, which are most common at altitudes of less than 5,000 feet in eastern Oregon and Washington. Although there is less clearcutting now, the hydrologic effects of past clearcuts can persist for three to four decades, depending on vegetation characteristics (FEMAT 1993). Soil compaction due to improper livestock grazing (Platts 1991) and timber harvesting activities, such as yarding and heavy equipment operation, can also result in decreased soil permeability and increased runoff (Chamberlin et al. 1991).

The past history of fire suppression may have also affected flow quantity and quality. On rangelands, fire suppression is partly responsible for expansion of western juniper. Expansion of western juniper and increasing density can result in decreased understory vegetation, which is believed to contribute to decreased soil infiltration and increased peak discharges during intense rainfall. In forested environments, increased above-ground vegetation due to fire suppression may also have resulted in increased evapotranspiration rates and decreased runoff. Additionally, past fire suppression practices may have increased the risk of uncharacteristically high intensity fires in some parts of the planning area. High intensity fires can result in decreased soil porosity thus increasing runoff and soil erosion (McNabb and Swanson 1990). Fire can also cause water-repellent layers to form

TABLE OF CONTENTS

in soils, resulting in temporarily increased runoff (DeBano et al. 1976).

A management activity in forested environments that has probably had a significant effect on runoff and streamflow has been road construction, although most studies investigating this issue have been outside the project area. The relatively impermeable surfaces of roads, associated cutbanks, and roadside ditches result in decreased infiltration and more surface runoff. Roadcuts also intercept subsurface flow and route it quickly to stream channels. Roadside ditches and newly-formed gullies downstream from culverts extend the channel network (Harr et al. 1975, 1979; Megahan et al. 1992; Jones and Grant, 1996; Wemple 1993; Ziemer 1981).

Water Quality

As specified in the Clean Water Act of 1948 and subsequent amendments, water quality includes all attributes that affect existing and designated uses of a body of water. Included are human uses such as recreation, hydropower, and water supply, and other uses such as maintenance of fisheries and riparian habitats. As a result, water quality attributes that are considered under the Clean Water Act include traditional physical and chemical constituents such as pH, bacteria concentration, temperature, discharge, and parameters relevant to aquatic habitat such as the abundance of large woody debris, pool frequency, and riparian canopy density.

The Clean Water Act requires that every two years each state review all available information on water quality as part of a statewide water quality assessment. Where application of current Best Management Practices or technology-based controls are not sufficient to achieve designated water quality standards, the body of water is classified as "water quality limited." Of the 137,100 miles of streams and rivers in eastern Oregon and Washington, approximately 12,000 miles (11 percent) are "water quality limited." On Forest Service- and BLM-administered lands in eastern Oregon and Washington, about 13 percent of stream mileage is determined to be water quality limited.

On public lands in eastern Oregon and Washington, non-point sources of pollution are the primary cause of degraded water quality. A non-point source of pollution is water pollution whose source(s) cannot be pinpointed, but that can be best controlled by proper soil, water, and land management practices. On Forest Service-administered lands, the primary water quality problems are sedimentation, turbidity, flow alteration, and high temperatures. On BLM-administered lands, high sediment, turbidity levels, and temperatures are the primary reasons for listing as water quality limited.

Water temperature is considered under the Clean Water Act and is a regionally-important facet of aquatic habitat on Forest Service- and BLM-administered lands within the project area. The relationship between land-use practices, water temperature, and effects on fish species is better understood than for any other aspect of water quality (Rhodes et al. 1994). Water temperature influences metabolism, behavior, and mortality of aquatic species (Beschta et al. 1987; Bjornn and Reiser 1991). Salmonids (salmon and trout) are cold-water fish that are particularly sensitive to increases in temperature; sustained water temperatures of greater than 64 to 80° Fahrenheit are lethal for most species. In eastern Oregon and Washington, where summer

Water Quality and the Clean Water Act

Water quality is regulated by state environmental agencies under authority granted by the Clean Water Act (1948) and subsequent amendments. Under the Clean Water Act, federal agencies are, in general, required to meet state requirements. In eastern Oregon and Washington, the Forest Service and BLM are the responsible management agencies for water quality on lands they manage, as described in memoranda of understanding (MOUs) with state environmental agencies. These MOUs require federal agencies to meet water quality standards, monitor activities to assure they meet standards, report results to the states, and meet periodically to recertify Best Management Practices (BMPs). The primary mechanisms for regulating and controlling non-point sources of pollution are adopting and implementing (1) Best Management Practices, (2) numeric and narrative water quality standards, and (3) the antidegradation policy (40 CFR 131).

TABLE OF CONTENTS

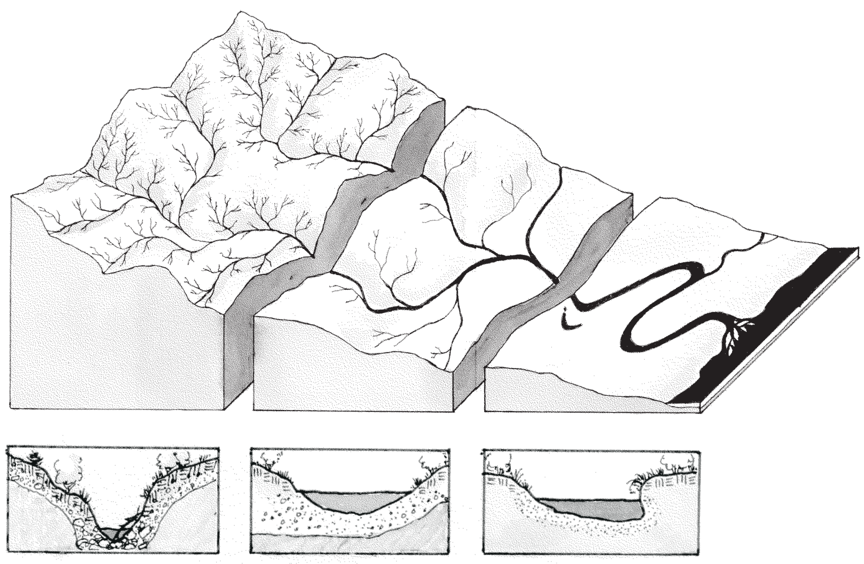
air temperatures are generally much greater than 80° Fahrenheit, many streams have lost their capability to support cold-water fish, and salmonid mortality in streams that still support salmonids is common due to elevated water temperatures (Henjum et al. 1994).

Stream Channels

Water, sediment, solutes (dissolved materials), and organic material derived from hillslopes and their vegetative cover flow into and through streams and rivers. The shape and character of stream channels constantly and sensitively adjust to the flow of these materials by adopting distinctive patterns such as pools-and-riffles and meanders (Leopold et al. 1964; see Figure 2-14). The vast array of physical channel characteristics combined with energy and material flow, provide diverse habitats for a wide variety of aquatic and riparian-dependent species.

Stream Channel Processes, Functions, and Patterns

The varied topography within the planning area, coupled with the irregular occurrence of channel-affecting processes and disturbance events such as fire, debris flows, landslides, volcanic activity, drought, and extreme floods, results in a mosaic of river and stream conditions that are dynamic in space and time under natural conditions (Reeves et al. 1995). The primary consequence of most of these disturbances is to directly or indirectly provide large pulses of sediment and wood into stream systems. As a result, most streams and rivers in the planning area probably undergo cycles of channel change on timescales ranging from years to hundreds of years in response to episodic inputs of wood and sediment. The types of disturbance, such as fire, flood, or debris flow, that affect the condition of a particular channel depends



Steep mountain headwater streams flow swiftly through and cut a deep "V" shaped valleys. Rapids, small pools and waterfalls are common and densly spaced.

Foothill streams flow through moderately confined valleys. Pools and riffles are common. The valley broadens and the river begins to meander.

The river continues to meander slowly across a broad, nearly flat valley with wide floodplains. Large pools, and off-channel standing water is common.

Figure 2-14. Steep Mountain Headwaters ~ Stream channels change in shape and velocity based on the steepness of the ground slope and the amount of surface water. In general, steeper channels are commonly found in the headwater or mountainous portions of a landscape.

TABLE OF CONTENTS

on watershed characteristics, channel size, and position of the channel within the watershed (Reeves et al. 1995; Grant and Swanson 1995). Many Pacific Northwest aquatic and riparian plant and animal species have evolved in concert with the dynamic nature of stream channels, developing traits, life-history adaptations, and propagation strategies that allow persistence and success within landscapes that experience harsh disturbance regimes.

In order to guide understanding and management of streams and rivers, stream classification systems (for example Rosgen 1994; Montgomery and Buffington 1994) have been established on the basis of distinctive patterns of stream behavior. These classifications are primarily derived from consideration of stream slope and confinement (relating to the stream's ability to move and erode its banks and bed). In general, stream types range from steep and confined channels that generally consist of (1) step-pool and cascade-dominated streams (Rosgen "type A"; Montgomery and Buffington "source"), through (2) moderate gradient and moderately confined rapid-dominated channels (Rosgen "type B"; Montgomery and Buffington "transport"), to (3) low gradient, unconfined, pool-and-riffle dominated channels (Rosgen "types C, D, and E"; Montgomery and Buffington "response"). Other stream types include (4) gullied, or streams actively eroding their streambeds and streambanks (Rosgen type G) and (5) low gradient, entrenched, wide streams (Rosgen type F).

In general, steeper channels (slopes greater than four percent) are commonly found in the headwater or mountainous portions of a landscape, and are less sensitive to watershed disturbances because of their high degree of confinement and their position high in the watershed. Once disturbed, however, steep and confined streams may take considerable time to recover to their previous condition. Channels with slopes between two and four percent generally contain abundant rapids and steep riffles. Lower-gradient streams (slopes less than two percent) are generally larger, and under natural conditions, meander and migrate freely within wider valleys. Low gradient streams and rivers commonly have numerous side channels and high water channels, and generally contain the most biologically productive aquatic ecosystems. These low-gradient channels are generally sensitive to cumulative and local watershed disturbances, but commonly recover quickly where there are natural hydrologic and sediment regimes.

Current Conditions

Within eastern Oregon and Washington, humans have extensively altered stream channels by direct modifications such as channelization, wood removal, diversion, and dam-building, and also by indirectly affecting the incidence, frequency, and magnitude of disturbance events. This has affected inputs and outputs of sediment, water, and wood. These factors have combined to cause pervasive changes in channel conditions throughout the planning area, resulting in aquatic and riparian habitat conditions significantly different than those that existed prior to extensive human alteration (Henjum et al. 1994; McIntosh et al. 1994; Wissmar et al. 1994). In general, the largest rivers such as the Columbia and Snake rivers, have been converted from free-flowing streams to a series of reservoirs. Many intermediate-sized rivers, such as the Grande Ronde, Methow, Wenatchee, and Deschutes rivers, are now important transportation corridors that are flanked by roads, railroads, or both with floodplains that have been encroached upon by transportation features, urbanization, agriculture, and other human structures and activities.

Indirect effects of past land management activities are also pervasive in the planning area. Mining, timber harvest, livestock grazing, beaver trapping, and road-building have all altered channels by affecting the rate with which sediment, water, and wood enter and are transported through stream channels. Almost all Forest Service- and BLM-administered lands outside designated wildernesses have been entered at some level for resource extraction since the early 1800s. Most of the large-scale and intense operations, such as in-stream dredging and severe overgrazing, that significantly and adversely impacted channel morphology were halted by the early 1900s (Wissmar et al. 1994). Nevertheless, the effects of past management activities continue to affect channel morphology today.

The *Aquatics* (Lee et al. 1996) chapter of the *AEC* addresses the current status of stream channel morphology in the project area, and its relation to management actions through analysis of aquatic habitat inventories. These analyses include repeated surveys of 105 streams inventoried in the 1930s and 1940s (see Figure 2-15), and more than 6,000 stream inventories completed in the last five years that summarized stream conditions across a spectrum of physiographic environments and management histories (see Figure 2-16). Key findings from analysis of both data sets are that stream channel morphology is highly variable, depending on stream type and biophysical environment, but there are significant correlations between management intensity and stream channel morphology over time and space.

Aspects of channel morphology in eastern Oregon and Washington that have apparently been affected by land management practices include the frequency of pools, the frequency of large pieces of wood in the channel, and the composition of substrate (especially the amount of fine sediment). Low gradient (slopes less than two percent) and larger streams are apparently the most sensitive to management activities. Pool frequency and wood frequency are generally less in areas with higher road densities, and in areas where timber harvest has been a management emphasis. Additionally, where measured, the percent of

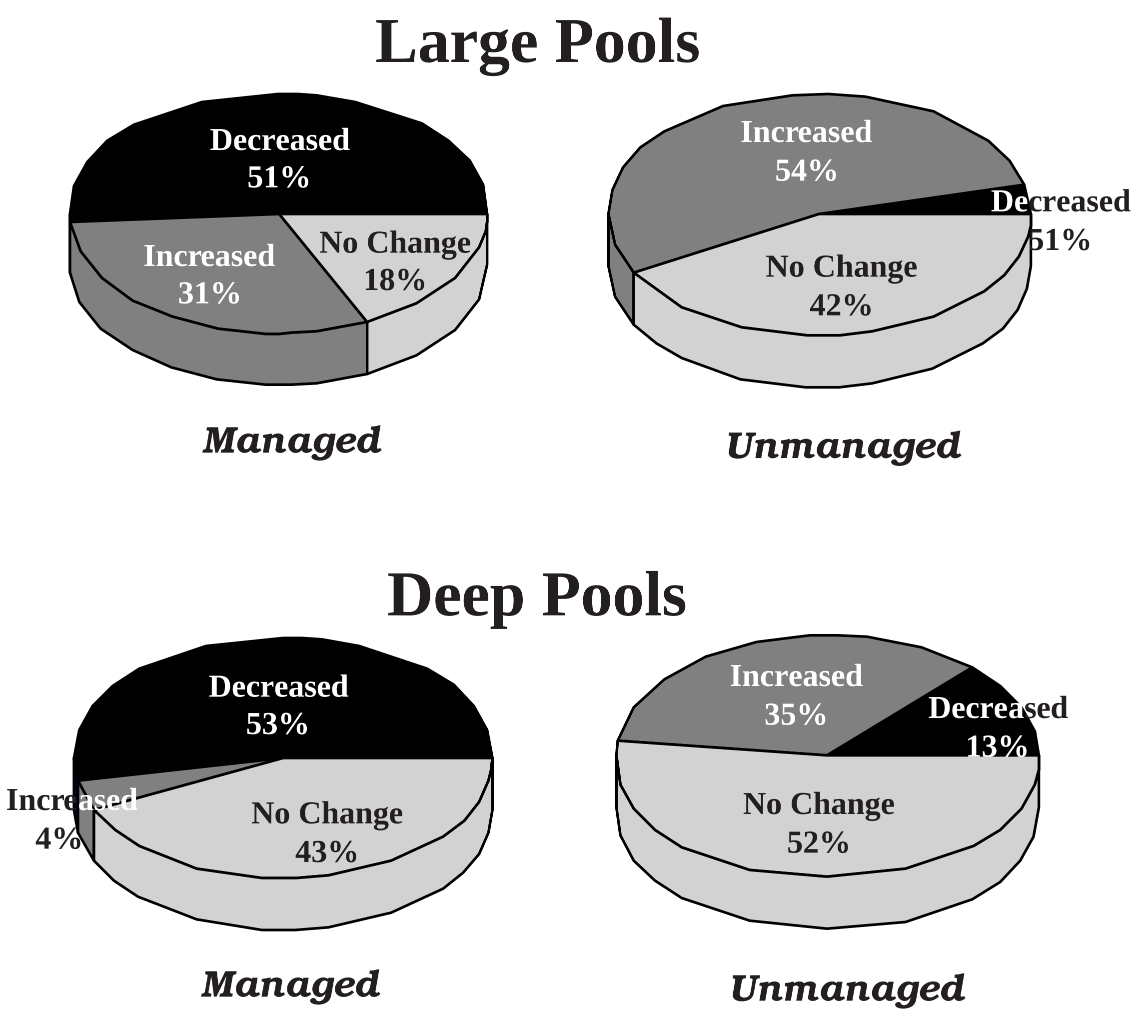
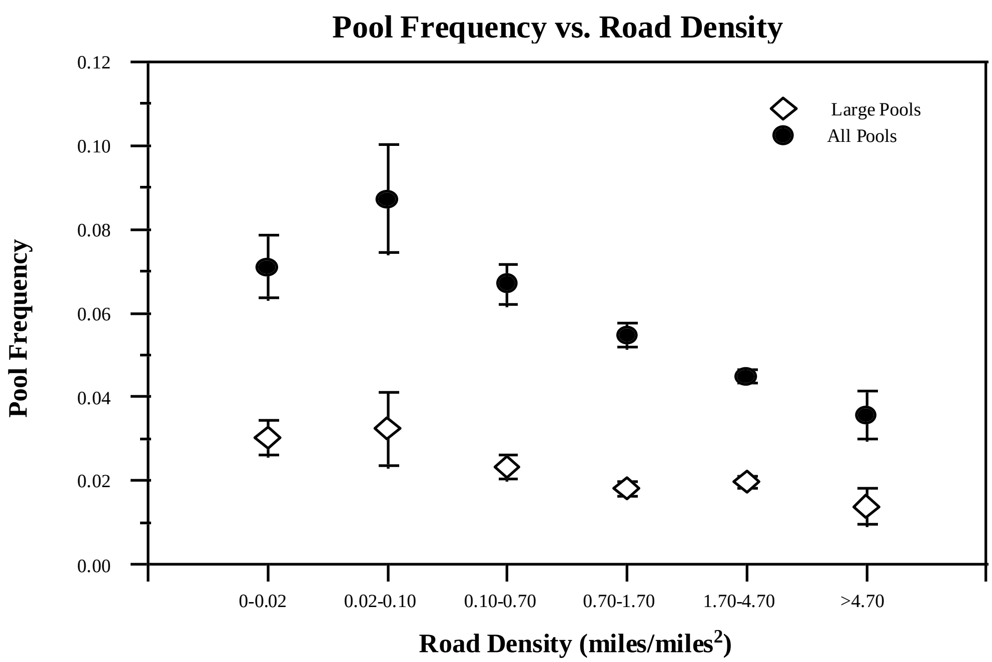


Figure 2-15. Results of Repeat Surveys - Comparison of changes in pool frequency between 1935 through 1945, and 1991 through 1994. Large pools are greater than 215 feet² and deeper than 2.6 feet; deep pools are greater than 215 feet² and deeper than 5.2 feet. Stream basins were classified as "managed" - significant management activities during the last 50 years, or "unmanaged" - little active management during the last 50 years. (Modified from the Aquatics chapter of the AEC.)



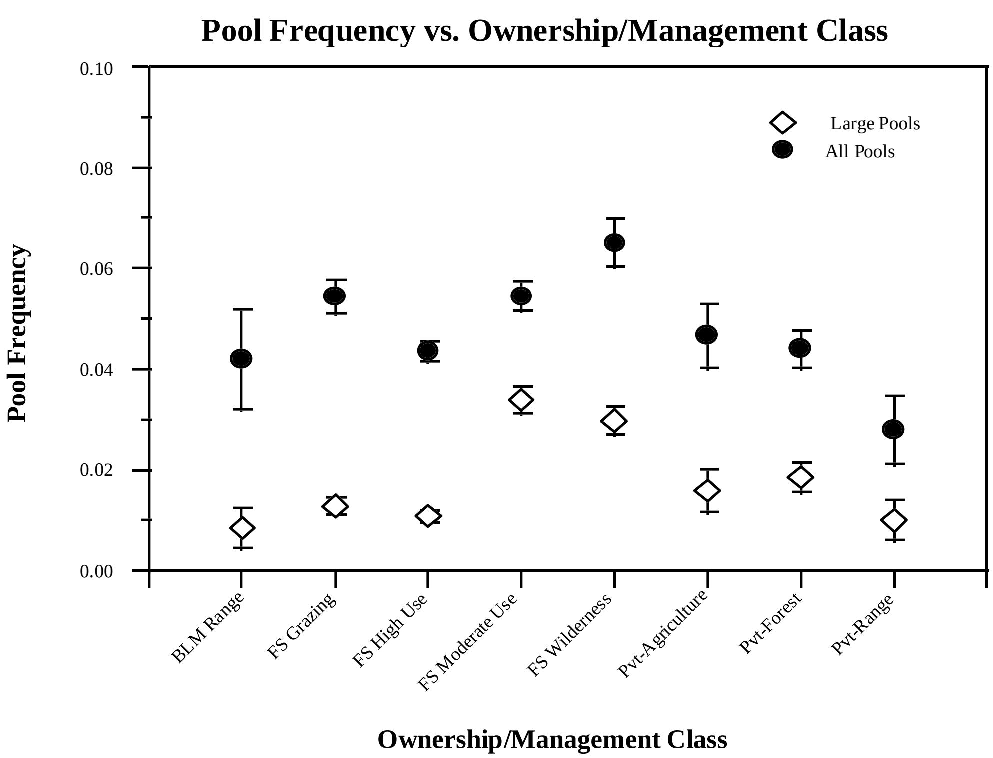


Figure 2-16. Pool Frequency ~ Comparison of pool frequency measured in 1989 through 1994 stream inventories for various road densities and management emphasis)modified from Aquatics chapter of the AEC. Larger pools are greater than 215 feet² and deeper than 2.6 feet. "Pvt" indicates private lands.

TABLE OF CONTENTS

the channel bed covered with fine sediment (less than 0.25 inch) increases with road density. These findings are consistent with observations from site-specific analyses that indicate that improper road construction, livestock grazing, and timber harvest practices increase delivery of fine sediment to stream channels, filling the pools and causing stream channels to fill with sediment (Furniss et al. 1991; Hicks et al. 1991).

In addition to these specific changes to streams and rivers, and those discussed in the *Scientific Assessment* (1996), land management practices have caused an overall change in the scale and frequency of landscape disturbance, resulting in a distinctly different character of watersheds and their stream systems when viewed from a regional perspective. Instead of individual and isolated watersheds, riparian areas, and stream channels being episodically affected by large disturbances, such as floods, fire, and insect infestations, with other neighboring watersheds remaining largely unaffected, past land management practices of widespread flow impoundment, road construction, improper livestock grazing, and timber harvest have led to increased levels of watershed disturbances spread over time and space. Consequently, most watersheds contain stream channels and aquatic habitats that are now subject to continuing cumulative effects of watershed disturbance. This contrasts with the more pulse-like pattern of disturbance that most streams and associated species evolved with. As a result, most stream channels are in a somewhat unnatural condition, with habitat conditions that are less than optimal for aquatic and riparian-dependent species that evolved in environments that probably had many more high-quality habitat areas spread across the landscape.

Lakes

Within the project area, lake conditions have been most affected by recreation and residential development. Recreation activities such as backpacking, horsepacking, recreational vehicle use, and road and trail development have resulted in damage to lake environments, particularly beaches and other near-shore areas. Recreation activities have commonly led to introduction of non-native plant and animal species, resulting in local extinction of native invertebrates, amphibians, and fish. Recreational boating has led to the introduction of numerous non-native plants, such as Eurasian watermilfoil. Large mid-elevation lakes, such as Klamath Lake and Lake Odell in central Oregon and Lake Chelan in central Washington, have been the most affected from a growing regional population seeking to live, ranch, or recreate near lakes.

Water transfers and diversions for potable or irrigation water supply have affected many lakes in eastern Oregon and Washington, especially the closed lake basins in the Upper Klamath Basin (ERU 3) and Northern Great Basin (ERU 1), where drought and diversion of inflow have resulted in very low lake levels during the last several years. Dozens of moderate-sized lakes have their shorelines influenced by modification and control of their outlet streams or rivers. Regulation of lake level for water supply purposes has had effects on near-shore aquatic and wetland plant and animal communities, and the spawning success of near-shore spawning fishes. Additionally, inter-basin water transfers have promoted the continued spread of non-indigenous plants and animals while inhibiting natural migration routes of native species.

Riparian Areas and Wetlands

Summary of Conditions and Trends

- ◆The overall extent and continuity of riparian areas and wetlands has decreased, primarily due to conversion to agriculture, but also due to urbanization, transportation improvements, and stream channel modifications.

- ◆Riparian ecosystem function, determined by the amount and type of vegetation cover, has decreased in most sub-basins within the project area.

- ◆A majority of riparian areas on Forest Service and BLM-administered lands are either "not meeting objectives," "non-functioning," or "functioning at risk." However, the rate has slowed and a few areas show increases in riparian cover and large trees.

- ◆Within riparian woodlands, the abundance of mid-seral vegetation has increased

TABLE OF CONTENTS

whereas the abundance of late and early seral structural stages has decreased, primarily due to fire exclusion and the harvest of large trees.

- Within riparian shrublands, there has been extensive spread of western juniper and introduction of exotic grasses and forbs, primarily due to processes and activities associated with improper livestock grazing.
- The frequency and extent of seasonal floodplain and wetland inundation has been altered by changes in flow regime due to dams, diversions, and groundwater withdrawal, and by changes in channel morphology due to sedimentation and erosion, channelization, and installment of transportation improvements such as roads and railroads.
- There is an overall decrease in large trees and lake seral vegetation in riparian areas.

Riparian and Wetland Processes, Functions, and Patterns

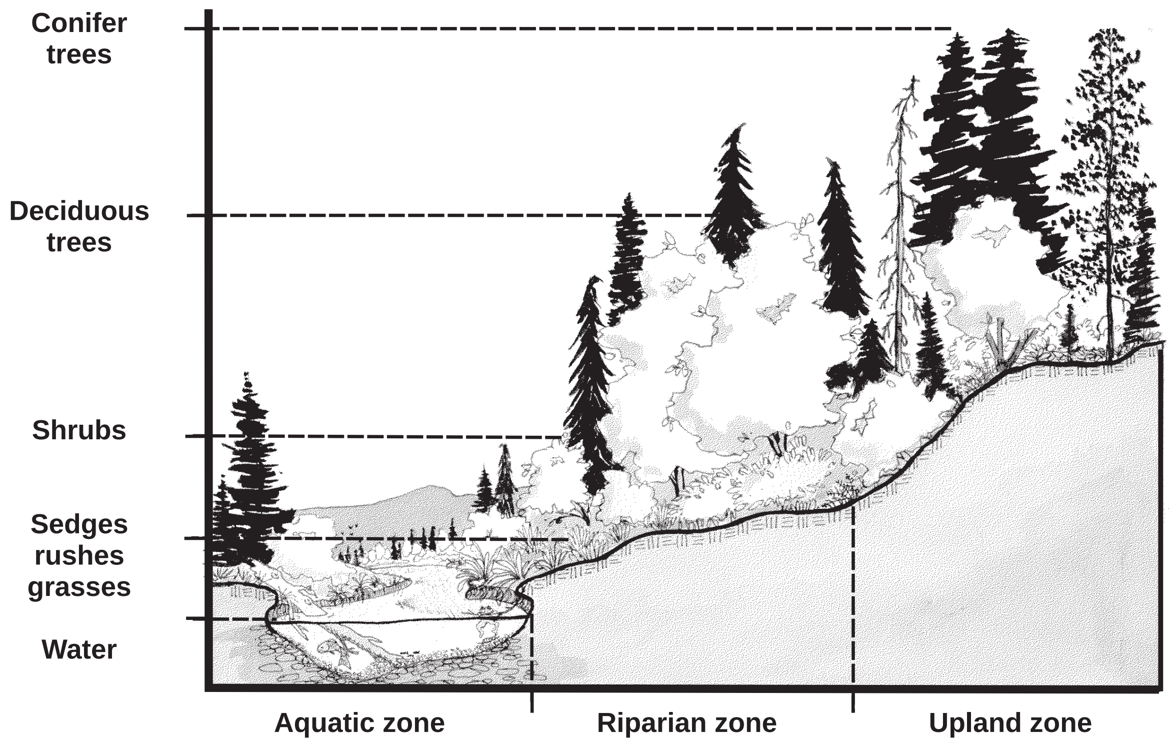
Riparian areas are water-dependent systems that consist of lands along, adjacent to, or contiguous with streams, rivers, and wetland systems (see Figure 2-17). Riparian ecosystems are the ecological links between uplands and streams, and terrestrial and aquatic components of the landscape. Many riparian areas have wetlands associated with them. While riparian areas are defined primarily on the basis of their nearness to streams and rivers, wetlands occur wherever the water table is usually at or near the ground, or where the land is at least seasonally covered by shallow water. Wetlands in the project area include marshes, shallow swamps, lake shores, sloughs, bogs, and wet meadows. Riparian areas and wetlands cover a relatively small portion of eastern Washington and Oregon ~ less than four percent of the total land area. Their ecological significance, however, far exceeds their limited physical area because of the major contributions that riparian areas and wetlands provide to ecosystem productivity and structural and biological diversity, particularly in drier climates (Elmore and Beschta 1987).

The largest existing wetland systems are within the Northern Great Basin (ERU 4) and Upper Klamath Basin (ERU 3), where wetlands occupy the bottoms of closed basins. These large lake/wetland systems naturally shrink and expand in response to climate, and now are also affected by irrigation and water withdrawal. Many small, isolated wetlands exist in alpine areas in the Upper Klamath Basin (ERU 3), Northern Cascades (ERU 1), Southern Cascades (ERU 2), Blue Mountains (ERU 6), and Northern Glaciated Mountains (ERU 7). These wetlands are mostly remnants of small lakes, or have formed in small closed depressions formed by glaciation, landslides, or lava flows.

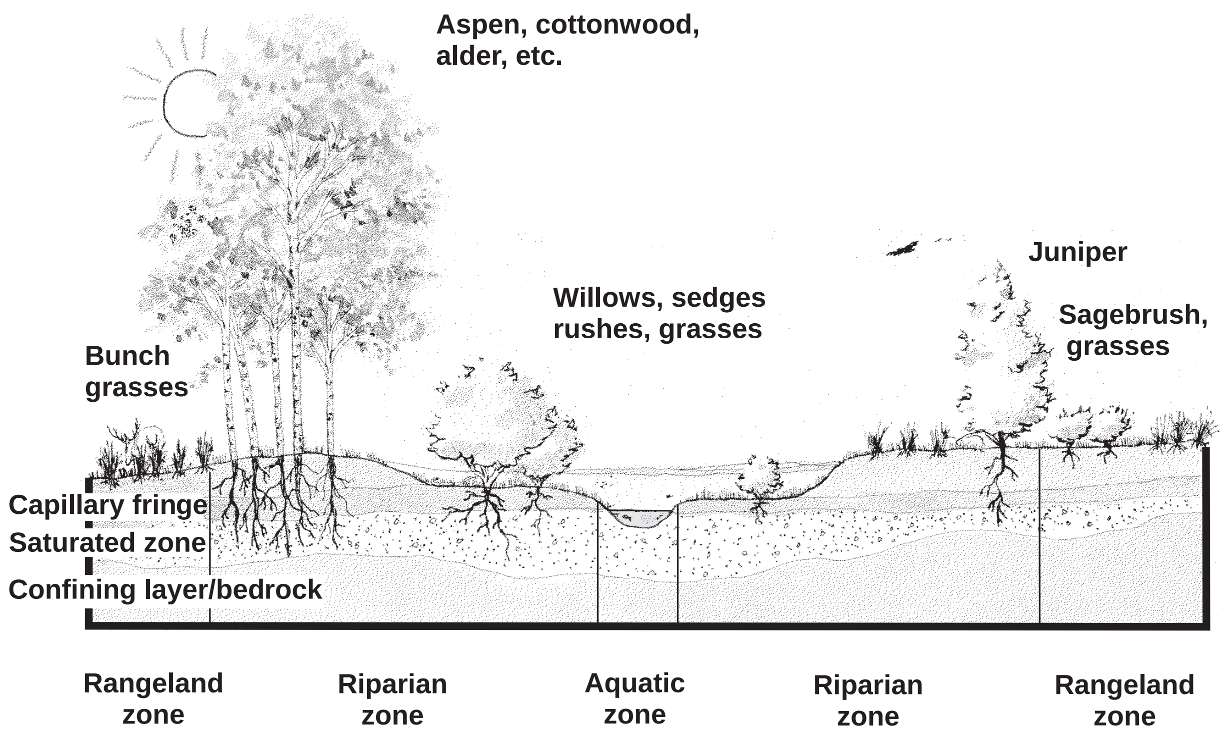
Physical Processes in Riparian Areas and Wetlands

Important physical processes in riparian areas primarily reflect the interactions between stream channels, adjacent valley bottoms, and riparian vegetation. These processes depend largely on the extent and frequency of flooding. Water that infiltrates into floodplains during periods of high flow, returns to the channel during periods of low flow, contributing a cool source of summer base flow for many streams, especially in low-elevation alluvial valleys. Seasonal inundation of floodplain results in overbank deposition and enrichment of riparian soils. Inundation of the floodplain also reduces water velocities during flooding and aids in reducing downstream flood peaks, both factors that reduce the risk of channel erosion. Inland wetlands perform many of the same functions, such as detaining storm runoff, reducing flow peaks and erosion potential, retaining and filtering sediment, and augmenting groundwater recharge by storing water and releasing it more slowly, later into the dry season.

Riparian vegetation also plays a role in many physical processes within riparian areas. Vegetation shades streams and moderates water temperatures by helping keep waters cool in the summer and providing an insulating effect in the winter. Densely-vegetated riparian areas buffer the input of sediment from hillslopes and filter fertilizers, pesticides, herbicides, and sediment from runoff generated on adjacent lands. Riparian vegetation also promotes bank stability and contributes organic matter and large woody debris to some stream systems, which is an important



A. *Forested Riparian Characteristics*



B.*Rangeland Riparian Characteristics*

Figure 2-17. Forested and Rangeland Characteristics ~ Relationships and key components of riparian areas and adjacent aquatic and upland zones for (a) forested and (b) rangeland environments.

Wetlands ~ A Definition

The U.S. Army Corps of Engineers, Environmental Protection Agency, U.S. Fish and Wildlife Service, and Natural Resource Conservation Service (formerly the Soil Conservation Service) worked together to develop common language and criteria for the identification and delineation of wetlands in the United States (Federal Interagency Committee for Wetland Delineation 1989). The four federal agencies defined wetlands as possessing three essential characteristics: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology, which is the driving force creating all wetlands. The three technical characteristics specified are mandatory and must all be met for an area to be identified as a wetland.

Hydrophytic vegetation is defined as plant life growing in water, soil, or substrate that is at least periodically deficient in oxygen as a result of excessive water content. Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic (without oxygen) conditions in the upper part of the soil profile. Generally, to be considered a hydric soil, there must be water saturation at temperatures above freezing for at least a week during the growing season. Wetland hydrology is defined as permanent or periodic inundation of water, or soil saturation to the surface, at least seasonally. The presence of water for a week or more during the growing season typically creates anaerobic conditions in the soil, which affects the types of plants that can grow and the types of soils that develop (Hansen et al. 1994).

component of instream habitat conditions (Gregory et al. 1991; Henjum et al. 1994; Hicks et al. 1991; Kovalchick and Elmore 1992; Sedell et al. 1990). Complex off-channel habitats, such as backwaters, eddies, and side channels, are often formed by the interaction of streamflow and riparian features such as living vegetation and large woody debris (Gregory et al. 1991). These areas of slower water provide critical refuge during floods for a variety of aquatic species, and serve as rearing areas for juvenile fish.

Riparian and Wetland Vegetation

The broad-scale analysis of vegetation conducted as part of *Scientific Assessment* (1996) identified three potential vegetation groups associated with riparian areas: riparian woodland (dominated by cottonwood, aspen, ponderosa pine, and Douglas-fir), riparian shrub (dominated by alder and willow), and riparian herb (including sedges, forbs, and grasses; see Table 2-16). The smallest pixel (resolution of data) analyzed in the broad-scale analysis was one square kilometer, or 250 acres. Because riparian vegetation grows in thin strips along streams and rivers, it was difficult to accurately determine the areal extent using the broad-scale data. Consequently, the three potential vegetation groups were lumped into one group (riparian potential vegetation group) for descriptive and analytical purposes in this EIS.

Under natural conditions, riparian plant communities have a high degree of structural and compositional diversity, reflecting the history of past disturbances such as floods, fire, wind, grazing, plant disease, and insect outbreaks (Gregory et al. 1991). Historically (prior to the 1900s), disturbance regimes along riparian areas were dominated by floods and fires, with some grazing by native ungulates (large, hoofed mammals, such as mule deer, elk, bighorn sheep, and pronghorn antelope). Within the riparian woodland potential vegetation group, fires were normally infrequent but severe, occurring at 65- to 150-year recurrence intervals when there were appropriate weather, fuel, and ignition conditions. In the riparian shrub potential vegetation group, fire was typically more frequent, occurring every 25 to 50 years. Because predators typically used riparian habitat as cover, native ungulates typically remained on the uplands and only made dispersed visits to riparian areas for water. However, during drought periods, riparian areas were more intensively grazed by native ungulates.

Riparian Habitat and Terrestrial Species

Riparian areas contain the most biologically diverse habitats on federal lands attributable to a variety of structural features, including live and dead vegetation and their close proximity to water bodies. Riparian areas are valuable to wildlife for food, cover, and water (Bull 1977; Thomas et al. 1979), and provide important habitat for approximately 80 percent of the

Table 2-16 Riparian/Woodland Vegetation Classifications.

Potential Vegetation Group	Potential Vegetation Types
Woodland	Juniper Limber Pine Mountain Mahogany Mountain Mahogany with Mountain Big Sagebrush White Oak
Riparian Woodland	Aspen Cottonwood Riverine
Riparian Shrub	Mountain Riparian Low Shrub Salix/Carex Saltbrush Riparian
Riparian Herb	Riparian Graminoid Riparian Sedge

Source: Hann et al. (1996).

wildlife species in eastern Oregon and Washington (Elmore and Beschta 1987; Thomas et al. 1979). They provide nesting and brooding habitat for birds; and thermal cover and favorable microclimates due to increased humidity, a higher rate of transpiration, shade, and increased air movement helping in homeostasis (a condition where energy expenditure is minimized), especially when surrounded by non-forested ecosystems (Thomas et al. 1979). Common deciduous trees and shrubs in riparian areas, such as cottonwood, alder, willow, and red osier dogwood, are important food sources for deer, elk, moose, hares, rabbits, voles, beavers, and other animals. In riparian areas that are dominated by aspen and cottonwood, 24 species of amphibians, 145 species of birds, 62 species of mammals, and 10 species of reptiles are also found (SER Model 1996). Riparian areas serve as big game migration routes between summer and winter range; provide travel corridors or connectors between habitat types for many species, including carnivores, birds, and bats; and play an essential role within landscapes as corridors for dispersal of plants (Bull 1977; Gregory et al. 1991; Heinemeyer and Jones 1994; Thomas et al. 1979; Vogel and Reese 1995; Washington Department of Fish and Wildlife 1995).

Riparian habitat is used by more bird species than any other habitat type within the project area (Neotropical Migratory Bird Report in press). Fifteen neotropical migrant bird species (species that breed in North America and winter in Central or South America) use riparian habitat either exclusively or in combination with only one other habitat type. Within the project area, 84 of the 132 breeding migrant birds use riparian vegetation for nesting, brooding, or foraging.

Cottonwood, willow, and aspen provide critical food for beavers. Before the 1900s, prior to being trapped to very low population levels, beavers were a critical component of nearly all riparian areas along perennial streams. Beaver activity can significantly affect physical processes and habitat conditions within riparian areas. Beaver dams lead to flooding and expansion of floodplains, and the creation of wetland-riparian areas. These features help dissipate the erosive power of floods, trap sediment, and affect plants and animals associated with these areas. Beaver ponds provide and promote important habitat for many birds, mammals, and fish.

Wetlands also provide important habitat for a variety of species, including resident and migratory birds (for example swallows, flycatchers, waterfowl, and shorebirds), mammals (bats, ungulates, and beavers), unique plant species (cattails, sedges, rushes, pond lilies, and willows), amphibians (salamanders and frogs), invertebrates (caddisflies, mayflies, and dragonflies), and fish (chubs, suckers, and dace). Approximately 35 percent of the threatened, endangered, rare, and sensitive plant and animal species in the United States either reside in wetland areas or are otherwise dependent on them. Within eastern Oregon and Washington, terrestrial vertebrate species associated with wetland habitats include 28 neotropical migrant birds, 26 amphibians, and 2 reptiles (SER Model 1996). Seasonal wetlands are often shallow and fill up quickly in early spring with the onset of groundwater recharge or thawing conditions. These areas provide critical habitat for birds because conditions are favorable for production of invertebrates, an important food supply for migratory birds. Permanent wetlands are usually deeper water bodies that provide habitat and food for animals throughout the spring and summer.

Current Conditions of Riparian Areas and Wetlands

Fur trappers, early surveyors, and settlers during the early 1800s reported extensive stands of cottonwoods, willows, and alders growing across valleys and along moist gulches and draws; and wide, wet meadows along stream systems throughout eastern Oregon and Washington. The Ochoco Mountains take their name from an American Indian word meaning "streams lined with willows" (Elmore 1992). Over the past 100 to 150 years, riparian areas and wetlands have been subject to increasingly concentrated and competing resource demands, including water withdrawal, mineral, sand and gravel extraction, human settlement, agricultural practices, timber harvest, livestock use, wildlife, and recreation. Because of this, many riparian areas and wetlands are considerably altered from conditions noted by the first explorers. Riparian and wetland systems are responsive and dynamic, and when modified, can significantly affect adjacent aquatic and terrestrial ecosystems.

Riparian Areas

In the western United States, 66 percent of inventoried BLM-administered riparian areas are either "non-functioning" or "functioning at risk" as defined in the process for assessing Proper Functioning Condition. Likewise, more than 75 percent of riparian areas administered by the Forest Service in the western United States are not "meeting or moving toward objectives" (Rangeland Reform '94 Final EIS).

Key broad-scale trends identified in the *Assessment* (1996) are that riparian areas have been reduced in abundance and that there has been a significant increase in habitat fragmentation. Conversion of shrublands to cropland in deep soil areas, and to pastureland elsewhere, has been the major factor reducing the present extent of riparian areas. The ecological reporting units in eastern Oregon and Washington that have had the greatest loss of riparian shrublands are the Blue Mountains (ERU 6) and Columbia Plateau (ERU 5).

Proper Functioning Condition - A Definition

In response to the growing concerns over the integrity of ecological processes in many riparian areas and wetlands, the BLM has developed a process for assessing "Proper Functioning Condition." The BLM's Riparian-Wetland Initiative for the 1990s (USDI 1991) establishes national goals and objectives for managing riparian-wetland resources on BLM-administered lands. This initiative's two-part goal is to: (1) restore and maintain existing riparian-wetland areas so that 75 percent or more are in Proper Functioning Condition by 1997, and (2) to achieve and provide the widest variety of habitat diversity for wildlife, fish, and watershed protection.

Riparian-wetland areas achieve Proper Functioning Condition when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows. This thereby (1) reduces erosion and improves water quality; (2) filters sediment, captures bedload, and aids floodplain development; (3) improves floodwater retention and groundwater recharge;
(4) develops root masses that stabilize streambanks against cutting action; (5) develops diverse ponding and channel characteristics to provide habitat and water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and (6) supports greater biodiversity. The functioning condition of riparian-wetland areas is a result of the interaction among geology, soil, water, and vegetation (USDI 1993).

By analyzing aerial photographs collected over the last 20 to 50 years, conducted as part of the *Scientific Assessment* (1996) of the project area, it was found that the successional and structural stage composition of riparian vegetation, particularly the coniferous forest riparian vegetation, has significantly changed. The extent of mid-seral riparian woodland has increased significantly over the last few decades, while the other seral stages are currently less abundant. These changes are primarily due to fire exclusion and suppression activities, and the harvest of large trees. The Northern Cascades (ERU 1) and Blue Mountains (ERU 6) have had particularly significant decreases in the large tree component of riparian areas.

Two other patterns in riparian areas evident from the *Assessment* (1996) analysis are: (1) the conversion of shrublands to juniper woodlands, exotic grasses, and forbs; and (2) the conversion of aspen, cottonwood, and willow to conifer cover types. Juniper encroachment in riparian areas is likely a consequence of the combination of improper livestock grazing (which reduces competition, ground cover, and fine fuels), and the exclusion of fire. Expansion of western juniper has been most pronounced in the Columbia Plateau (ERU 5), especially in central Oregon. There has also been significant conversion of deciduous vegetation, such as cottonwood and willows, to conifers, mainly Douglas-fir, above approximately 4,000 feet. This change is significant because deciduous trees tend to grow toward the light and more efficiently occupy openings above stream channels, thus creating more effective shade. Deciduous trees also annually supply extensive litter fall into streams, which is an important factor controlling local aquatic nutrient levels.

On Forest Service- and BLM-administered lands within the planning area, major factors contributing to the decrease in riparian area function are improper livestock grazing, timber harvesting, fire management, conversion to crop and pastureland, road development, and dams, diversions, and/or pumping. In eastern Oregon, improper livestock grazing strategies have been identified by the Oregon Environmental Council (Hanson 1987) as the most important factor in contributing to deterioration of riparian areas in 11 different river basins. On forested landscapes, silvicultural practices (including fire suppression) and road building have had the most significant adverse effects on riparian areas. Most of these activities have affected riparian area processes and functions by changing flow regimes and channel morphology, thus resulting in changed interactions between the channel and floodplain; and by changing the structure, pattern, and composition of riparian vegetation, thereby changing the functions and habitats provided by native riparian vegetation.

To a lesser extent, disturbances associated with recreational uses, urban development, and mining have also contributed to the decrease in functioning riparian areas at the scale of the planning area.

Wetlands

Since Euroamerican settlement, many wetlands have been drained, filled, sprayed with herbicides and pesticides, or logged, primarily to develop lands for agriculture, but also for residential, commercial, and industrial development. Oregon has lost 38 percent of its wetlands, and Washington has lost 31 percent (Dahl 1990). In Washington, Dahl (1990) estimated that 90 percent of existing wetlands are in a "degraded" state and have a high degree of exotic plant and animal species invasion. Most of the remaining high quality wetlands in eastern Oregon and Washington are on BLM- and Forest Service-administered lands, primarily in alpine or sub-alpine environments, and on other federally managed lands such as National Wildlife Refuges managed by the U.S. Fish and Wildlife Service.

Artificial wetlands contribute significantly to wetland habitats. These areas, such as Malheur Lake in eastern Oregon and those in the Columbia Plateau (ERU 6), were created by flow impoundment, irrigation ponds, stream diversion, and agricultural wastewater. Additionally, wetland habitats have been affected by the invasion of non-native plants (such as purple loosestrife, saltcedar, and Russian olive) and introduced wildlife (including bullfrogs). On many sites, these non-native species have become well established, commonly replacing native species or exerting large influences on the functional dynamics of existing native habitats.

TABLE OF CONTENTS

Fish

Key Terms Used in This Section

Anadromous ~ Fish that hatch in fresh water, migrate to the ocean, mature there, and return to fresh water to reproduce; for example, salmon and steelhead.

Assemblage ~ A group of species.

Biogeographic ~ Distribution of plants and animals in their environment over time and space. In recent years, this term has included the interactions between humans and the ecosystem.

Endemic ~ Said of an organism that is restricted to a particular area or region under normal circumstances of environment.

Eutrophication ~ Changes that occur in a lake or other body of water due to excessive supplies of nutrients such as nitrates and phosphates, usually from runoff from the surrounding land.

Hybridization ~ The crossbreeding of unlike individuals to produce hybrids.

Introgression ~ The introduction of genes from one species to another species; hybridization.

Refugia ~ Areas that have not been exposed to great environmental changes and disturbances undergone by the region as a whole; refugia provide conditions suitable for survival of species that may be declining elsewhere.

Resident fish ~ Fish that spend their entire life in freshwater.

Salmonid ~ Fish of the family Salmonidae, including salmon, trout, chars, whitefish, ciscoes, and grayling. In general usage, the term often refers to salmon, trout, and chars.

Strongholds (fish) ~ Watersheds that have the following characteristics: (1) presence of all major life-history forms (for example, resident, fluvial, and adfluvial) that historically occurred within the watershed; (2) numbers are stable or increasing, and the local population is likely to be at half or more of its historical size or density; (3) the population or metapopulation within the watershed, or within a larger region of which the watershed is a part, probably contains at least 5,000 individuals or 500 adults.

Summary of Conditions and Trends

- The composition, distribution, and status of fishes within the planning area are substantially different than they were historically. Some native fishes have been eliminated from large portions of their historical ranges.
- Many native nongame fish are vulnerable because of their restricted distribution or fragile or unique habitats.
- Although several of the key salmonids are still broadly distributed (notably the cutthroat trouts and redband trout), declines in abundance, loss of life history patterns, local extinctions, and fragmentation and isolation in smaller blocks of high quality habitat are apparent.
- Wild chinook salmon and steelhead are near extinction in a major part of their remaining distribution, in large part because of the construction and operation of mainstem dams on the Columbia and Snake rivers.
- Habitat, hydropower, harvest, hatchery management, and irrigation withdrawals all affect the survival of remaining anadromous fish populations within the interior Columbia River Basin to different extents. Land management activities have affected the habitat for wild chinook and steelhead and have limited their spawning and rearing success. The contribution of freshwater habitat to declines in anadromous fish populations

would be least in central Idaho (for example wilderness areas and other protected areas), which is affected by the most dams between spawning and rearing areas and the ocean, and the northern Cascades, but greater in the lower Snake and mid-columbia drainages. The influence of hydropower on anadromous fish populations increases upriver where there are more dams between freshwater spawning and rearing areas and the ocean. Harvest, which has been curtailed in recent years, has less effect today than it did historically. Hatcheries are an important element throughout the basin, but their effect on native stocks is variable.

- ◆ Core areas for rebuilding and maintaining biological diversity associated with native fishes still exist within the planning area.

Fish are the dominant aquatic vertebrates and a key component of aquatic ecosystems. Fish are a critical resource to humans and have influenced the development, status, and success of social and economic systems within the project area. Fish are sensitive to disturbance, including the effects of landscape and watershed processes over large regions. The diversity and integrity of native fish communities provide useful indicators of aquatic ecosystem structure, function, and health.

Current Conditions

Like many portions of western North America, the project area has a moderately-sized, locally diverse fish fauna. The varied characteristics and distribution of native fishes mirror the diverse and dynamic physiography and geologic history of the region. The native fish fauna of the Columbia River drainage is unusual in that it clearly is not a single faunal unit, but rather is composed of several sub-basin faunas with limited species overlap among sub-basins.

There are seven ichthyological (fish) provinces within the project area. Five are within the Columbia River Basin: upper Snake, Wood River, Glaciated Columbia, middle Columbia, and lower Columbia. The other two are the Klamath and Great Basin provinces. The upper Klamath Basin aquatic province is characterized by the upper Klamath and Agency lakes, which harbor a diverse community of specialized catostomid (sucker) fishes. The Great Basin contains multiple sub-basins which have been isolated from each other and the ocean since the Pleistocene Age, approximately 1.6 million years ago. Each basin is now characterized by largely or wholly internal drainage, resulting in highly endemic fish faunas. The distinctive native faunas of both the upper Klamath and Great basins bear little resemblance to that of the Columbia River Basin. Additionally, the Goose Lake Basin in southern Oregon could be considered a separate province. Goose Lake historically overflowed into the Pit River in California and shares some species elements with the Sacramento River system as well as with the Great Basin.

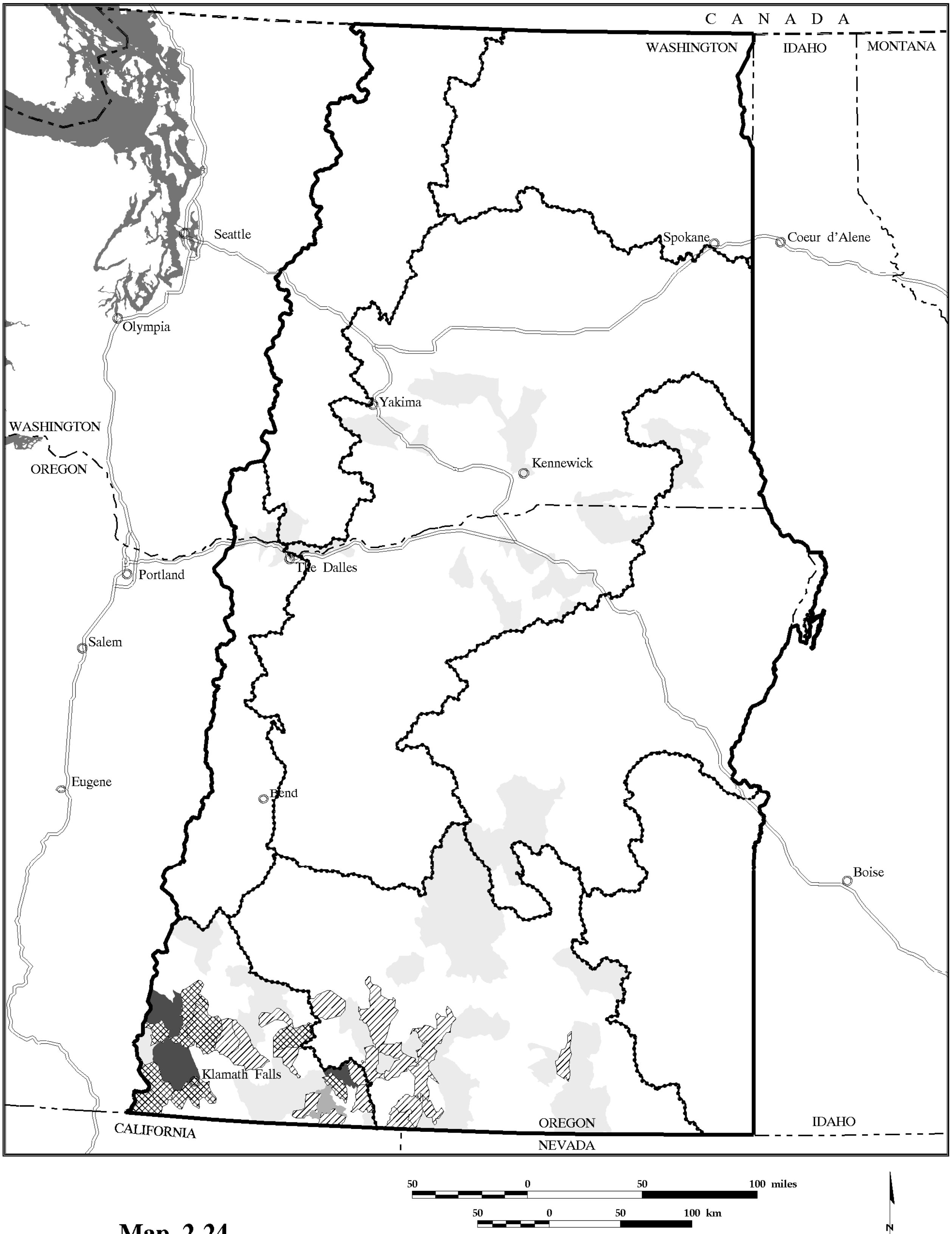
A number of fish species are also very narrowly distributed and indigenous either to the project area or to basins or sub-basins within the project area (see Map 2-24). These species, commonly called narrow endemic species, are found principally in Oregon and southern Idaho. The upper Klamath Basin is a particularly important area for endemism with up to six species found in a single watershed. Many of these species are associated with closed basins and many are truly isolated in relatively small watersheds.

Native Fish Species

There are presently 142 recognized species, subspecies, or races of fish reported within the project area. Eighty-seven of these fish species are native and 55 species are non-native. Within the five aquatic provinces in the Columbia River Basin, there are 52 native fish species, 13 of which are found in no other river systems. Compared to other large river systems, species richness (number of species) within the Columbia River Basin is quite low, which may be a reflection of the isolation of western rivers and the dynamic geologic history of the area compared to other large river basins with greater species richness.

Native fish species tend to fall into two groups. The first group consists of 15 to 20 species that

TABLE OF CONTENTS



Map 2-24. Narrow Endemic Fish Species

Number of Species:

- 1
- 2
- 3
- 4
- 5

- Major Rivers
- Major Roads
- EIS Area Border
- Ecological Reporting Unit Border*
- Cities and Towns

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Draft EASTSIDE EIS
1996

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

TABLE OF CONTENTS

are widely distributed or are reported in 20 percent or more of the project area. The second group of roughly 60 species includes the narrow endemic or rarer species that have restricted ranges or are infrequently reported. These species are generally found in less than five percent of the project area.

In individual watersheds (5th-field hydrologic units) within the project area (see Table 2-3), the total number of native species ranges from 0 to 28. The largest number of native species is found in the large river corridors, particularly the lower and mid-Columbia and lower Snake rivers. Fewer native fish species are found in headwater watersheds in the Blue Mountains (ERU 6).

Many species of native fish and other aquatic biota are considered imperiled. There are 47 special status species in the project area. Special status species include federally listed threatened or endangered species; federal candidate species; species recognized as requiring special protection by the States of Oregon, Washington, Idaho, or Montana; species managed as sensitive species by the Forest Service and/or BLM; and species recognized by the American Fisheries Society. Ten species in the project area are listed as threatened or endangered under the Endangered Species Act of 1973, one qualifies for listing (bull trout), and one has been petitioned for listing (steelhead). Within the Eastside planning area, nine species are listed as threatened or endangered under the Endangered Species Act. The threatened species in the Eastside planning area are: Hutton tui chub, Foskett speckled dace, Warner sucker, and Lahontan cutthroat trout, and Spring, Summer, and Fall chinook salmon. The endangered species are the Snake River sockeye salmon, Borax Lake chub, Lost River sucker, and shortnose sucker. Appendix 2-1 contains maps showing the historical and current distributions of the chubs, suckers, dace, and trout. Salmon distribution maps are found later in the chapter.

The list of special status species in the project area includes the white sturgeon (Acipenseridae); five lampreys (Petromyzontidae); sockeye, chum and coho salmon (Salmonidae); coastal and Lahontan cutthroat trout (Salmonidae); pygmy whitefish (Salmonidae); burbot (Gadidae); 11 minnows (Cyprinidae); six suckers (Catostomidae); eight sculpins (Cottidae); and Sunapee char, an introduced species (see Table 2-17). Twenty-two of these species occur in the Great Basin and Klamath Basin portions of the project area. Within the Columbia River Basin, eight occur entirely or primarily in the mainstem river system, three are restricted to the upper Snake River system (including the Wood River), two are restricted to the upper Columbia River (primarily in the Northern Glaciated Mountains ERU 7), two occupy streams in the middle and upper Columbia Basin, and one is restricted to the Blue Mountains in the middle Columbia River Basin.

Many factors contribute to the current condition of depressed fish populations and reduced distribution of native species. (See Table 2-18.) Hydroelectric development disrupts migration of anadromous forms. Irrigation diversions and water withdrawal, and the loss of wetlands, marshes, and interconnected waterways alters habitats for many species, especially in arid regions. Silvicultural practices, improper livestock grazing, and urbanization degrade habitat by changing flow patterns, changing patterns of sedimentation and erosion, increasing water temperatures, and causing eutrophication. Especially threatened are those species (such as the Foskett speckled dace and Hutton tui chub) that are dependent on springs.

Management of many special status fishes is hindered by the agencies' lack of information. The best information available is for the salmonids and for a few select species that have attracted the attention of researchers. In many cases, species distribution, life history, and habitat characteristics are uncertain. More detailed information for wide-ranging salmonids is presented in the section entitled Salmonids.

Introduced Species

In addition to the native fishes, numerous non-native fish species now occupy the project area.

Table of Contents

Table 2-17. Narrow Endemic and Special Status Fish Species in the Project Area.

Narrow Endemic	Conservation Status (as of July 1, 1996)	Common Name
X	3	Alvord chub
X	1,2	Borax Lake chub
	3	Bull trout
	2	Burbot
X	3	Catlow tui chub
	3	Catlow Valley redband trout
	3	Chum salmon
	3	Coastal cutthroat
	3	Coho salmon
X	1,2	Foskett speckled dace
X	3	Goose Lake lamprey
X	3	Goose Lake sucker
X	3	Goose Lake tui chub
X	1,2	Hutton tui chub
	3	Interior redband trout
X		Klamath Lake sculpin
	3	Klamath largescale sucker
X		Klamath River lamprey
X		Klamath speckled dace
	1,2	Lahontan cutthroat trout
X	1,2	Lost River sucker
X	3	Malheur sculpin
X	3	Margined sculpin
	1,2	Ocean-type chinook salmon
X	3	Oregon Lakes tui chub
	2	Pacific lamprey
	3	Pit roach
X	3	Pit sculpin
	3	Pygmy whitefish
X	3	Sand roller
X	3	Sheldon tui chub
	3	Shorthead sculpin
X	1,2	Shortnose sucker
X	3	Slender sculpin
	1,2	Sockeye (kokanee) salmon
	1,2	Stream-type chinook salmon
X	3	Summer Basin tui chub
	3	Summer steelhead
	3	Torrent sculpin
	3	Warner Basin tui chub
X	1,2	Warner sucker
	3	Warner Valley redband trout
	3	Westslope cutthroat trout
	1,2,3	White sturgeon
	3	Winter steelhead

1 = federally listed as endangered or threatened
2 = state listed as endangered or threatened
3 = candidate and/or species of concern

Source: Lee et al. (1996).

Table 2-18. Key Factors Influencing Status for Rare Fish in Eastern Oregon and Washington.

Species	Dams	Water quality	Water quantity	Harvest	Livestock	Forestry practices	Hatchery	Non-native interactions	Limited distribution
Alvord chub			X		X			X	
Borax Lake chub		X	X		X				X
Burbot	X								
Catlow tui chub			X		X				X
Chum salmon	X	X		X		X			
Coastal cutthroat trout				X		X	X	X	
Coho salmon	X	X	X	X		X	X		
Foskett speckled dace					X				X
Goose Lake sucker	X	X	X		X	X			
Goose Lake lamprey			X		X				
Hutton tui chub		X			X				X
Klamath largescale sucker	X	X	X		X	X		X	
Klamath River lamprey	X		X						
Lahontan cutthroat trout		X	X		X			X	
Lost River sucker	X	X			X	X		X	
Malheur sculpin		X			X	X		X	
Margined sculpin		X			X	X			
Oregon Lakes tui chub			X		X			X	
Pacific lamprey	X	X		X		X			
Pit roach		X	X					X	
Pit sculpin		X			X	X			X
Pit-Klamath brook lamprey		X			X	X			
Pygmy whitefish		X				X			
River lamprey	X								
Sand roller		X						X	
Sheldon tui chub					X				X
Shorthead sculpin		X			X	X			
Shortnose sucker	X	X			X	X		X	
Slender sculpin		X						X	X
Sockeye salmon	X		X	X					
Summer Basin tui chub			X		X			X	X
Torrent sculpin		X	X		X	X			
Warner sucker	X		X		X			X	
White sturgeon	X			X					

Source: Lee et al. (1996).

Table of Contents

The History of Forest Service and BLM Management of Anadromous Fish

Federally managed lands in the Columbia River Basin contain more than 60 percent of the remaining accessible spawning and rearing habitat for anadromous salmonids. In response to the evidence for declining populations, and the importance of Forest Service- and BLM-administered lands for maintenance and rebuilding of existing populations, these agencies have developed and implemented several strategies intended to maintain and enhance anadromous fish habitat. One objective of these plans was to meet the goals and objectives of the Northwest Power Planning Council (NWPPC), which was chartered in 1981 to restore a sustainable anadromous fishery within the Columbia River Basin. The Forest Service and BLM have cooperated with the NWPPC, the Bonneville Power Administration (BPA), state fish and game agencies, and tribal governments in an effort to manage anadromous fish habitats.

The Forest Service and BLM have existing land use plans that were prepared prior to 1990 which address anadromous and resident fish habitat management. These plans are not species- or watershed-specific. They provide for Forest Service and BLM management to maintain and enhance habitat and to meet existing federal laws such as the Clean Water Act.

In January 1991, the Forest Service developed a Columbia River Basin Anadromous Fish Policy which set forth a consistent plan for management of anadromous fish habitat within the Columbia River Basin. The policy contained a policy implementation guide which outlined procedures for establishing objectives for anadromous fish production, described desired future conditions, identified habitat inventory needs, and developed monitoring strategies. This policy is still in place, but will be replaced by direction from the Record of Decision developed from this EIS.

The Forest Service and BLM participated in the Hatfield Salmon Summit coordinated by the NWPPC. On May 1, 1991, at the conclusion of the Summit, a Salmon Accord was signed by all of the participants. As a participant in the Accord, the Forest Service was committed to full implementation of the policy implementation guide. The Forest Service and BLM jointly committed to (1) accelerate range management practices to benefit anadromous fish habitat, (2) provide the NWPPC with a listing of private land holdings within Forest Service- and BLM-administered lands that were possibly available for acquisition, (3) provide the NWPPC a listing of all unscreened irrigation diversions and require that when existing permits were renewed, screening would be a condition of the permit, and (4) intensify mineral management administration. Of these commitments, both the Forest Service and BLM were able to provide the NWPPC with a listing of diversions, their screening status, and a listing of lands potentially available for acquisition. Full implementation of the policy implementation guide, and accelerated range and mineral management were not achieved due to funding limitations and new priorities such as development of the Northwest Forest Plan, PACFISH, and consultation for listed sockeye and chinook in the Snake River Basin (under section 7 of the Endangered Species Act).

In 1992, the Regional Foresters requested the Chief of the Forest Service assist in the development of a comprehensive anadromous fish strategy for all lands administered by the Forest Service in Alaska, California, the Pacific Northwest, and Rocky Mountains. Before completion of this task, however, Alaska was withdrawn from this process. In March 1993, The Forest Service and BLM announced their commitment to develop a common strategy for management of Pacific salmon and steelhead habitats (PACFISH). The strategy encompassed approximately 15 million acres of Forest Service- and BLM-administered lands in the Columbia River Basin and 1 million acres of Forest Service- and BLM-administered lands in California.

The development of the Northwest Forest Plan postponed completion of PACFISH from April 1993 to early 1994 , as many of the technical staff previously assigned to PACFISH were needed to complete the Northwest Forest Plan. The Record of Decision for the Northwest Forest Plan was signed April 13, 1994, greatly reducing the area covered by PACFISH, because the aquatic strategy in the Record of Decision covered the range of the northern spotted owl (see Map 1-3).

In 1993, the BLM developed their anadromous fish strategy. It remains in place and is being updated in 1996. Their strategy includes all BLM-administered lands supporting anadromous fish.

The PACFISH strategy, signed by the Chief of the Forest Service and the Director of the BLM in February 1995, outlined and established a short-term strategy for anadromous fish habitat management to be replaced by long-term direction developed through the Eastside and Upper Columbia River Basin (UCRB) Environmental Impact Statements. PACFISH established interim goals and objectives, identified areas that most influence the quality of water and fish habitat, provided special protective standards to guide management activities that may damage those areas, outlined monitoring requirements to track how well agencies follow the standards, and evaluated the effectiveness of these measures.

An inland native fish strategy (INFISH) was developed and implemented in July 1995 to protect resident fish outside of anadromous fish habitat on Forest Service- and BLM-administered lands in eastern Oregon, eastern Washington, Idaho, western Montana, and portions of Nevada (see Map 1-3). This strategy is similar in content to PACFISH, and will also be replaced by decisions from the Eastside and UCRB EISs.

Most of these non-native species have been purposely introduced to promote sport fishing opportunities. Introduced salmonids (such as hatchery rainbow trout), centrarchids (such as bass and sunfish), and percids (such as walleye) support much if not most of the sport fishing opportunity in the project area. The introduced species are permanent components of the aquatic ecosystem and have social and economic importance. They tend to be well-adapted to altered conditions in aquatic environments, and have contributed to the decline of native fish and other native aquatic biota through competition, predation, and hybridization.

Some of these non-native fish species are now pervasive. The most frequently reported fish species in the project area is introduced rainbow trout, occupying 78 percent of the watersheds. Introduced brook trout is also well distributed, occupying 50 percent of the watersheds in the project area. Sixteen (32 percent) of the 50 most-reported species are game fishes.

Recreation centered on non-native fisheries is highly valued within the project area, and many watersheds support important wild trout fisheries for introduced salmonids such as brook, brown, rainbow, and lake trout. Habitat in these watersheds remains suitable for natural reproduction of salmonids, although native salmonids may be depressed or extinct because of displacement by non-native game fish. For example, in the upper Deschutes River in Oregon a renowned wild trout fishery of non-native brook, brown, rainbow, and lake trout has at least partly displaced native salmonids.

Salmonids

Historical Overview

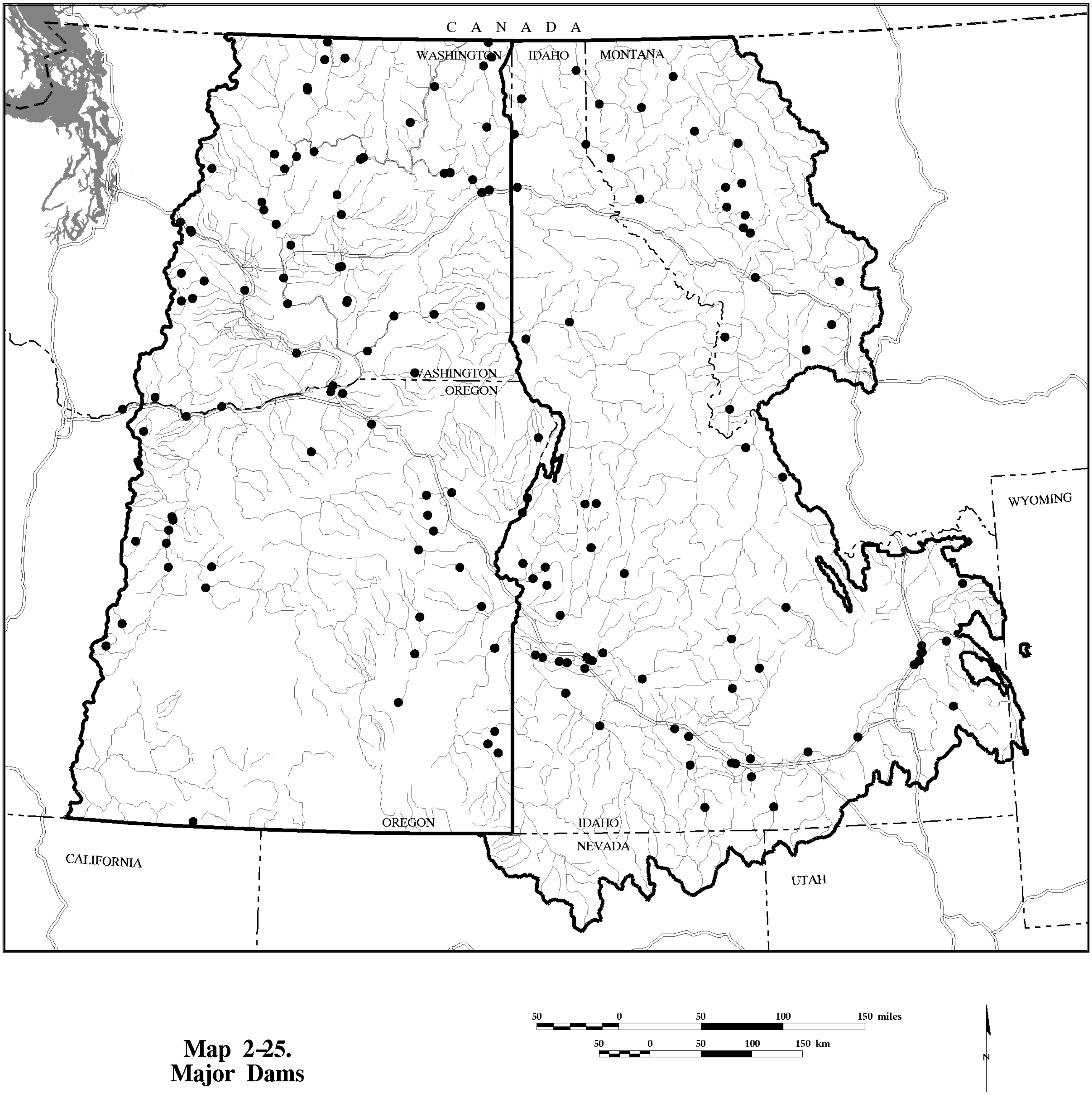
Salmon, perhaps more than any other single resource, have helped define the Pacific Northwest. Most native peoples shared a major dependence on salmon as a subsistence and ceremonial resource. Historically, salmon occurred in nearly every primary stream and river not blocked by major falls. Before the first white settlers arrived (in the early 1800s), salmon were abundant and diverse. Estimates of historic run size for all species of salmon and steelhead in the Columbia River ranged from 10 to 16 million adults. The first commercial cannery operations began on the Columbia in 1866 and production soon exceeded sustainable levels. Commercial catches of chinook salmon peaked during 1883, when 43 million pounds of fish were landed. Coho, sockeye, chum and steelhead were also abundant in the Columbia River Basin. The catch of coho salmon peaked at 6.8 million pounds in 1895, whereas the catch of sockeye and steelhead peaked at 4.5 million and 4.9 million pounds respectively.

Overfishing was blamed for broad declines in chinook salmon runs by the late 1800s, and by 1900 certain fishing gears were banned to provide some protection to spawning runs. By that time, however, impacts from mining, timber harvest, livestock grazing, and agriculture (including irrigation diversions) had begun. Construction of massive mainstem dams and dams on smaller streams followed. During and immediately after World War II, timber harvest and road building rapidly increased. Urbanization pressures, river channelization, pollution, and other impacts from the increasing human population began to become evident by the 1960s. Numerous stocks of all species of salmon, steelhead, and sea-run cutthroat trout have declined significantly. The Snake River sockeye salmon is now federally listed as endangered under the Endangered Species Act of 1973.

Mainstem dams and hydropower operations are cited as dominant factors in the decline of the region's fisheries. Construction and operation of mainstem dams on the Columbia, Snake, and Klamath rivers is considered the major cause of decline of anadromous fish. Hydroelectric development changed Columbia and Snake river migration routes from mostly free-flowing in 1938 to a series of impoundments by 1975, and reservoir storage activities have reduced flows in most years during smolt migration. Major dams in the project area are shown on Map 2-25.

Many resident salmonids (non-anadromous forms such as bull trout), which are not subject to the migratory pressures exerted on anadromous fish by hydropower operations, are also declining. Bull trout, once widely distributed in central Oregon, Washington, Idaho, and western Montana has been determined by the U.S. Fish and Wildlife Service to warrant protection under the

TABLE OF CONTENTS



Map 2-25.
Major Dams

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

Endangered Species Act. Bull trout is currently a candidate species ~ a species for which U.S. Fish and Wildlife has enough information to support a listing proposal. Strong and genetically pure populations of westslope cutthroat trout now occupy only a fraction of their range in the project area. Redband trout within the project area are poorly understood, yet many sub-basins appear to contain declining populations of genetically unique strains. The significant declines in resident stream salmonid populations are indicative of broad changes in aquatic conditions. Overall changes in the distribution of salmonid species is portrayed in Maps 2-26 and 2-27.

For the following discussion, "strong" watersheds have the following characteristics: (1) all major life history forms that historically occurred within the watershed are present; (2) numbers are stable or increasing and the local fish population is likely to be at half or more of its historical size or density; and (3) the fish population or metapopulation within the watershed, or within a larger region of which the watershed is a part, probably contains at least 5,000 individuals or 500 adults.

Bull trout, westslope cutthroat trout, Yellowstone cutthroat trout, resident redband trout, steelhead, and ocean-type and stream-type chinook are seven "key salmonids" selected by the Science Integration Team as being *broadly* representative of the state of aquatic biota in the project area. The *Assessment* (1996) focused on a select group of salmonids for several reasons: (1) This group of fishes has important social and cultural values; (2) knowledge about these fishes is greater than for other species, and thus environmental relationships are likely to be more apparent; (3) these fishes are widely distributed, which allows for broad-scale comparisons; (4) salmonids act as predators, competitors, and prey for a variety of other aquatic and terrestrial species, and are therefore likely to influence the structure and function of aquatic ecosystems, and may serve as links to energy and nutrient flows with terrestrial systems; (5) different salmonid species and life stages often use widely divergent habitats that expose individual populations to a wide variety of threats, thus integrating cumulative effects of environmental change over broad areas; and (6) the status of these key salmonids can be thought of as a general indicator of aquatic ecosystem health. Problems encountered by these species probably can be assumed to be similar to those facing many aquatic species throughout the project and planning areas.

Key Salmonids

Bull Trout

Bull trout are recognized as a species of special concern by state management agencies and the American Fisheries Society, and as a sensitive species by the Forest Service and BLM. The U.S. Fish and Wildlife Service considers bull trout a candidate species under the Endangered Species Act. Bull trout are found in many of the major river systems within the project area, but spawning and rearing populations are believed to be primarily restricted to cold and relatively pristine waters, often headwaters of most basins. Current and historical distributions of bull trout are illustrated on Map 2-28.

The historical range of bull trout is restricted to North America. Within the project area, bull trout have been recorded in the upper Klamath Basin in Oregon, and throughout much of interior Oregon, Washington, Idaho, and western Montana. It is estimated that the historical range of bull trout included about 60 percent of the project area. It is unlikely, however, that bull trout occupied all accessible streams at any one time due to climate and habitat selection.

Bull trout are presently known or estimated to occur in 44 percent of historically occupied watersheds. Bull trout are still widely distributed throughout the project area, with the largest population blocks in north central Idaho and northwestern Montana. Bull trout also remain within the Northern Cascades (ERU 1), Southern Cascades (ERU 2), Upper Klamath (ERU 3), and Owyhee Uplands (ERU 10). Current information indicates that despite its relatively broad distribution, this species has experienced widespread decline. There is evidence of declining trends in some populations, and recent extinctions of local populations have been reported. Distribution of existing populations is often patchy, even where numbers are still strong and habitat is good.

TABLE OF CONTENTS

Spawning and rearing of bull trout appears to be limited to the coldest streams or stream reaches. The lower limits of habitat used by bull trout are strongly associated with gradients in elevation, longitude, and latitude that may approximate a gradient in climate across the project area. The patterns indicate that variation in climate has and will strongly influence habitat available for bull trout. While temperatures are probably suitable throughout much of the northern portion of the range, spawning and rearing habitat is restricted to increasingly isolated high elevation or headwater "islands" toward the south.

Management-related changes influencing stream temperatures and hydrologic regimes are all likely to be important to some, if not most, populations. Populations are likely to be most sensitive to changes in headwater areas encompassing critical spawning and rearing habitat and remnant populations.

More than 30 non-native species occupy the present distribution of bull trout. Brown trout, brook trout, and lake trout have probably depressed or replaced many local bull trout populations. Brook trout are an especially important competitor and may progressively displace bull trout through hybridization and a higher reproductive potential. Brook trout now occupy the majority of watersheds representing the current range of bull trout. These non-native fish may pose the most risk to native species at sites where habitat has been affected by other disturbances.

Historically, bull trout populations were well connected throughout the Columbia River Basin. Habitat available to bull trout has been fragmented, and in many cases, entirely isolated. Dams have isolated whole sub-basins throughout the project area. Irrigation diversions, culverts, and degraded mainstem habitats have eliminated or seriously affected migratory corridors, thus depressing migratory populations and effectively isolating remnant populations in headwater tributaries. Loss of suitable habitat through watershed disturbance may also increase the distance between quality habitats and between strong populations, thus reducing the likelihood of effective dispersal and gene mixing. Further isolation of populations will probably lead to increasing rates of extinction that are disproportional to the simple loss of habitat area.

Summary by Ecological Reporting Unit. The core of the remaining bull trout distribution is in the Upper Columbia River Basin planning area (Central Idaho Mountains, ERU 13), with important strongholds still evident or likely within the Northern Glaciated Mountains (ERU 7), Blue Mountains (ERU 6), Upper Clark Fork (ERU 8), and Lower Clark Fork (ERU 9). Bull trout in the Owyhee Uplands (ERU 10) represent an important area of genetic diversity.

Yellowstone Cutthroat Trout

The Yellowstone cutthroat trout is one of the seven key salmonids studied by the Science Integration Team; however it does not inhabit the Eastside planning area so it is not discussed in the Eastside EIS. See the Upper Columbia River Basin Draft EIS or the *Assessment* (1996) for more information.

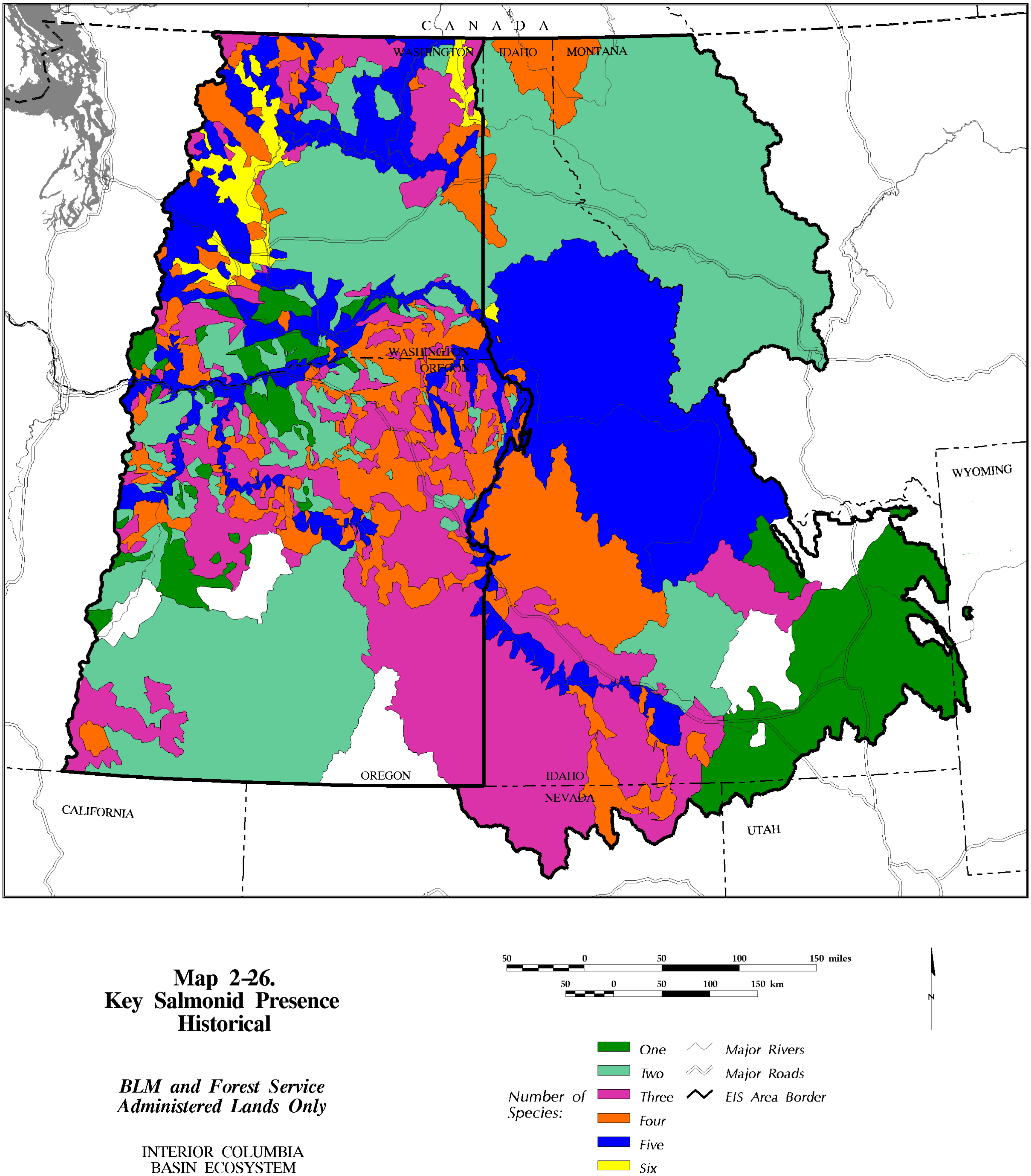
Westslope Cutthroat Trout

Westslope cutthroat trout were once abundant throughout much of the north and central Columbia River Basin. Although still widely distributed, remaining populations may be seriously compromised by habitat loss and hybridization. They are presently considered a sensitive species by the Forest Service and BLM, and of special concern by both the U.S. Fish and Wildlife Service state management agencies in Washington, Oregon, Idaho, and Montana. Current and historical distribution of westslope cutthroat trout are illustrated on Map 2-29.

Westslope cutthroat trout had the largest historical distribution of all subspecies of cutthroat trout. Cutthroat trout were first recorded by the Lewis and Clark expedition. From early explorer accounts, it is believed they were extremely abundant. Wherever habitat is suitable and watersheds are accessible, westslope cutthroat trout are commonly found. Westslope cutthroat trout probably also occupied most of the large natural lakes within the range. The historical range of westslope cutthroat trout encompassed about 35 percent of the project area.

Westslope cutthroat trout are still widely distributed within their historical range, with some extension through hatchery introductions. It is estimated that westslope cutthroat trout are still present in at least 85 percent of their historical range. This broad

TABLE OF CONTENTS



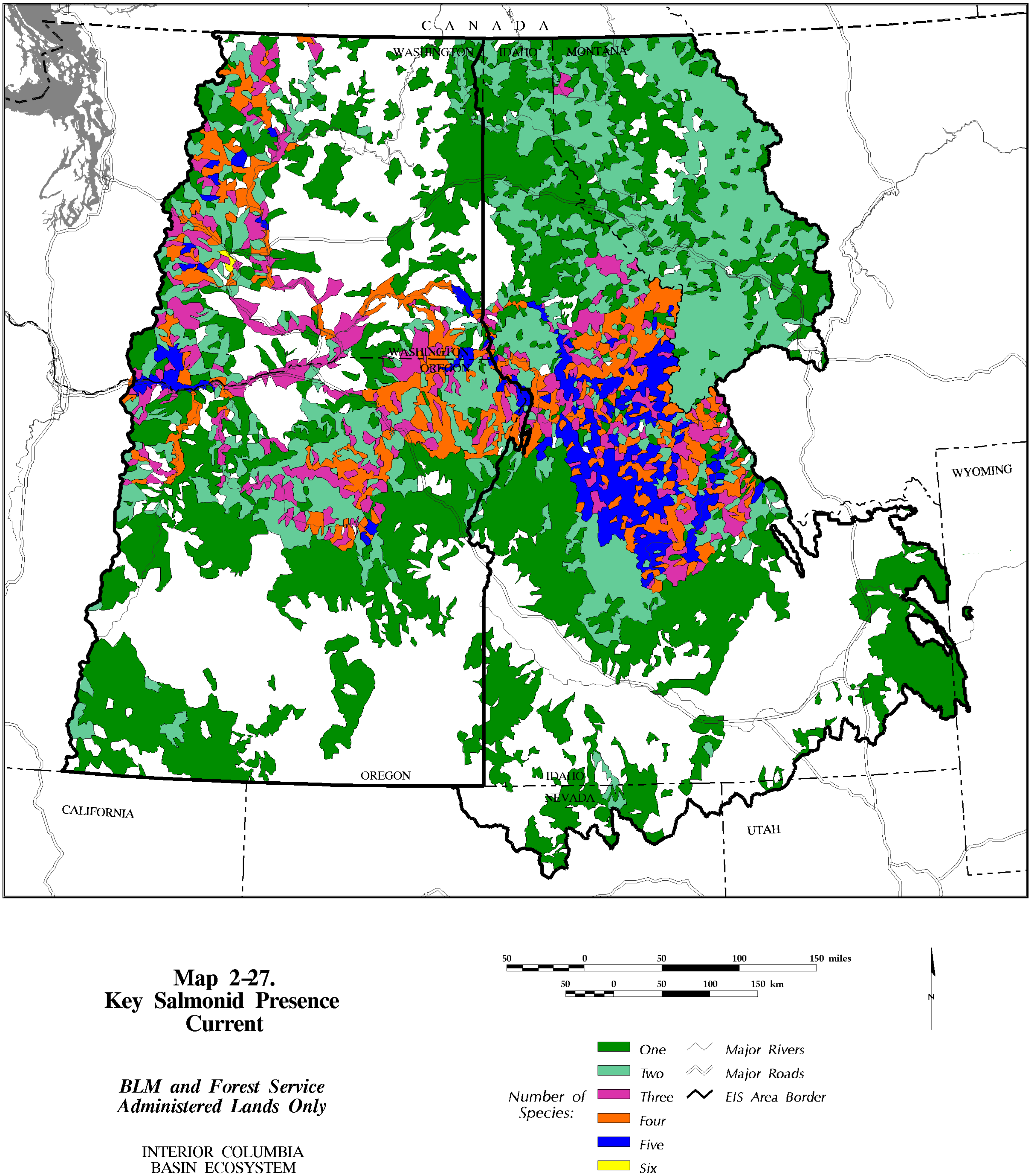
Map 2-26.
Key Salmonid Presence
Historical

BLM and Forest Service Administered Lands Only

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS



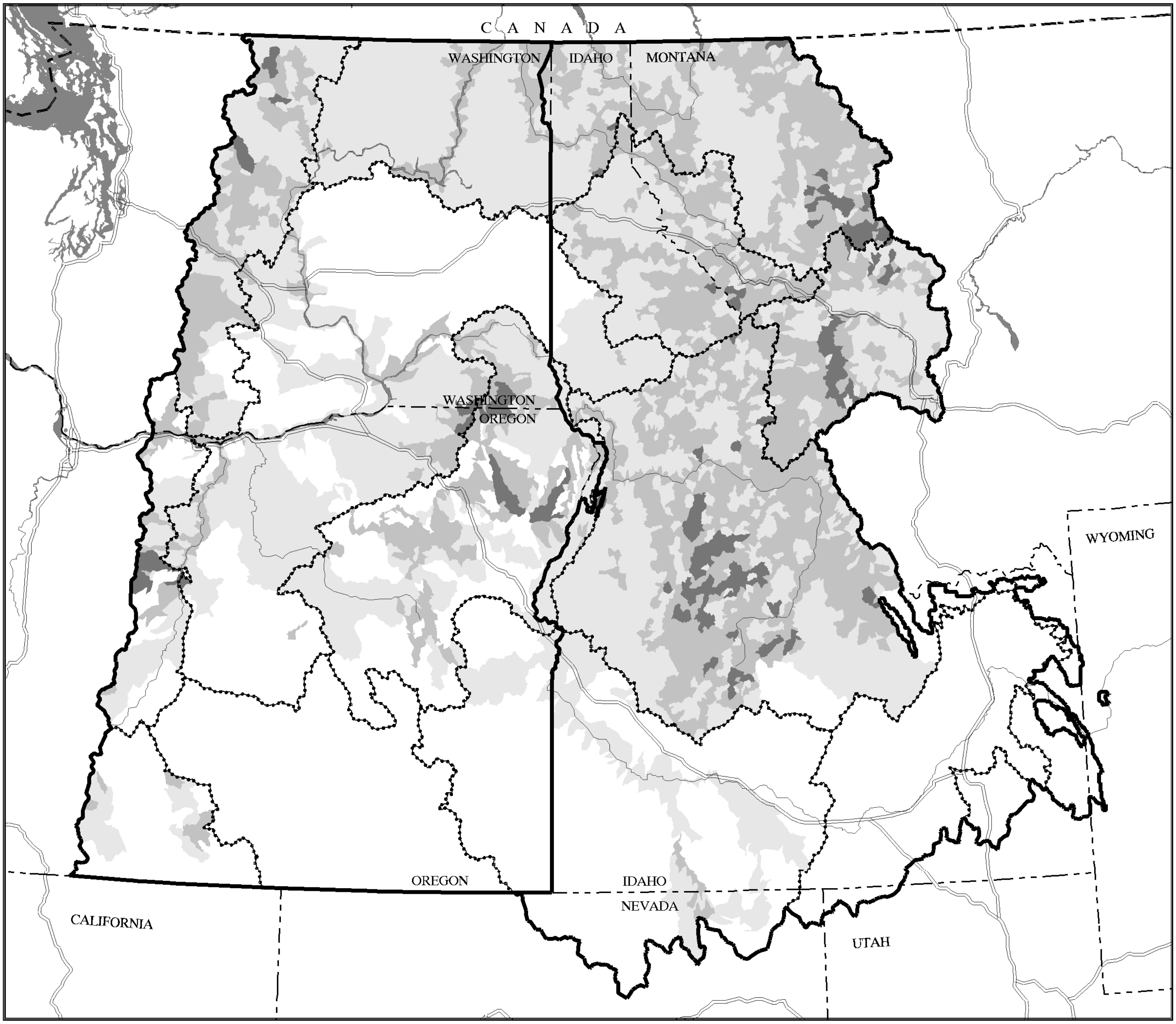
Map 2-27. Key Salmonid Presence Current

BLM and Forest Service Administered Lands Only

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS



Map 2-28. Distribution of Bull Trout

50 0 50 100 150 miles

50 0 50 100 150 km

N

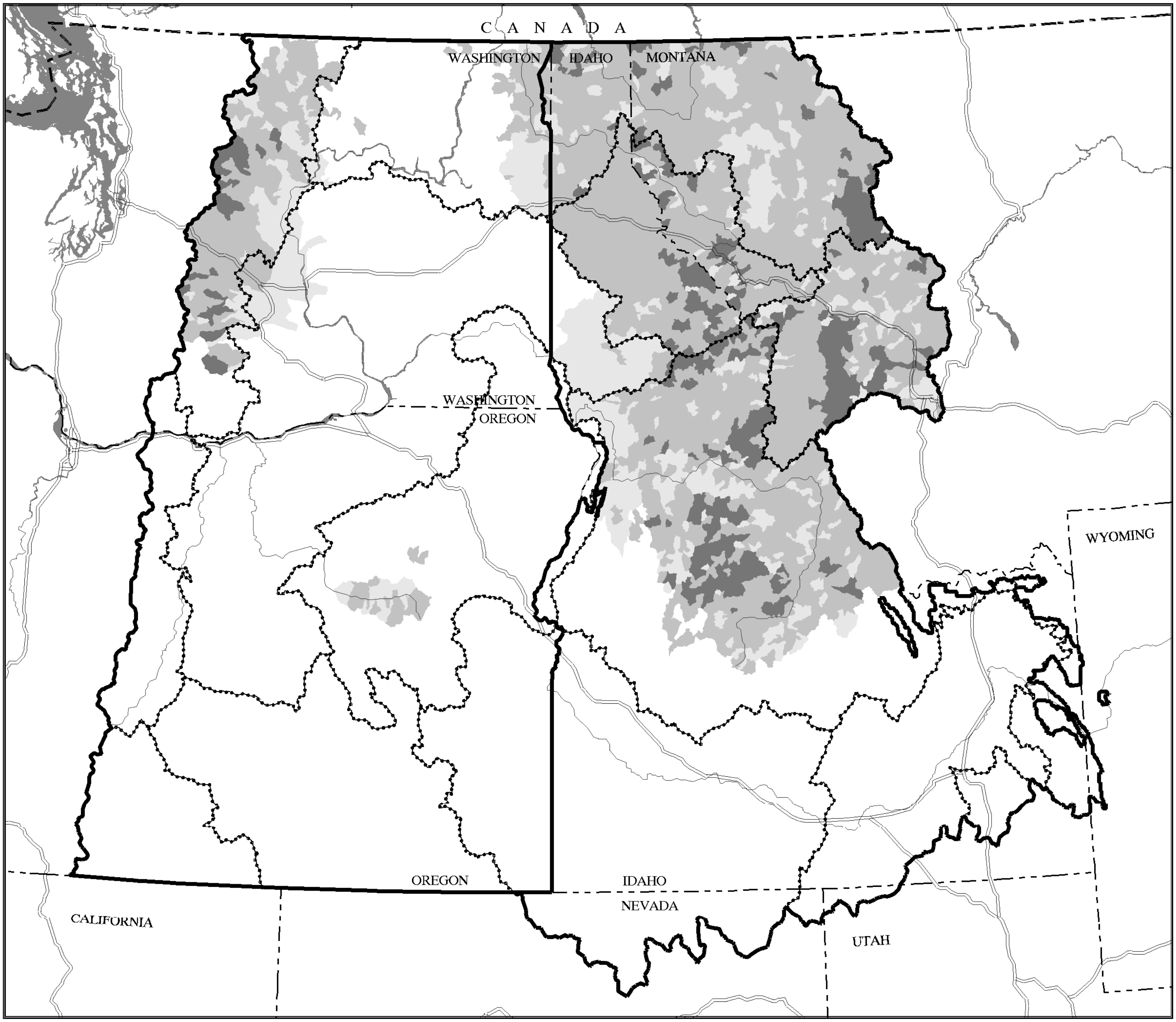
Historical Range
Current Range
Known Strong Populations
Major Rivers
Major Roads
EIS Area Border
Ecological Reporting Unit Border*

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

Project Area
1996

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

TABLE OF CONTENTS



Map 2-29. Distribution of Westslope Cutthroat Trout

50 0 50 100 150 miles

50 0 50 100 150 km

N

- Historical Range
- Current Range
- Known Strong Populations
- Major Rivers
- Major Roads
- EIS Area Border
- Ecological Reporting Unit Border*

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

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

TABLE OF CONTENTS

distribution suggests that, overall, westslope cutthroat trout are secure, but this conclusion must be tempered by uncertainty regarding the genetic integrity of remaining populations. Most current wild populations are depressed, and hybridization, fragmentation, and the loss of migratory populations have limited healthy populations to a much smaller proportion of their historical range.

Cutthroat trout and rainbow trout are closely related, but they have remained reproductively distinct where they co-evolved. Where non-native rainbow trout have been introduced, hybridization is widespread.

Westslope cutthroat trout are a prized game fish. Fishing has probably led to the elimination of some small populations, especially migratory fish in some river systems. Consequently, special fish harvest restrictions have been implemented to improve or maintain most westslope cutthroat trout populations.

Construction of dams, irrigation diversions, or other migration barriers have isolated or eliminated westslope cutthroat trout habitats that were once available to migratory populations. Resident forms may persist in isolated segments of streams, but the potential for long-term persistence is compromised by the loss of migratory life-history and connectivity with other populations potentially important to gene flow or population dynamics.

Most existing strong fish populations are largely in roadless areas designated wildernesses, and National Parks, suggesting that human disturbances have influenced distribution and abundance. In general, strong populations are thought to be primarily associated with areas of limited human influence and the associated potential effects of fishing, watershed disturbance, and non-native fish introductions.

Summary by Ecological Reporting Unit. The core distribution for presently strong populations is in the UCRB Planning area (Central Idaho Mountains ERU 13) where many populations appear secure. Other important blocks of known or likely strongholds are in the Northern Glaciated Mountains (ERU 7) and Upper Clark Fork (ERU 8). Persistence of westslope cutthroat trout in ERUs 7 and 8 appears likely, although these areas are also more fragmented and restricted to a relatively small portion of the historical distribution. The Northern Cascades (ERU 1) may support important populations of westslope cutthroat trout which are geographically distinct from the main distribution. Westslope cutthroat trout probably were never widely distributed within the Blue Mountains (ERU 6) or Columbia Plateau (ERU 5) where only remnant or isolated populations exist now.

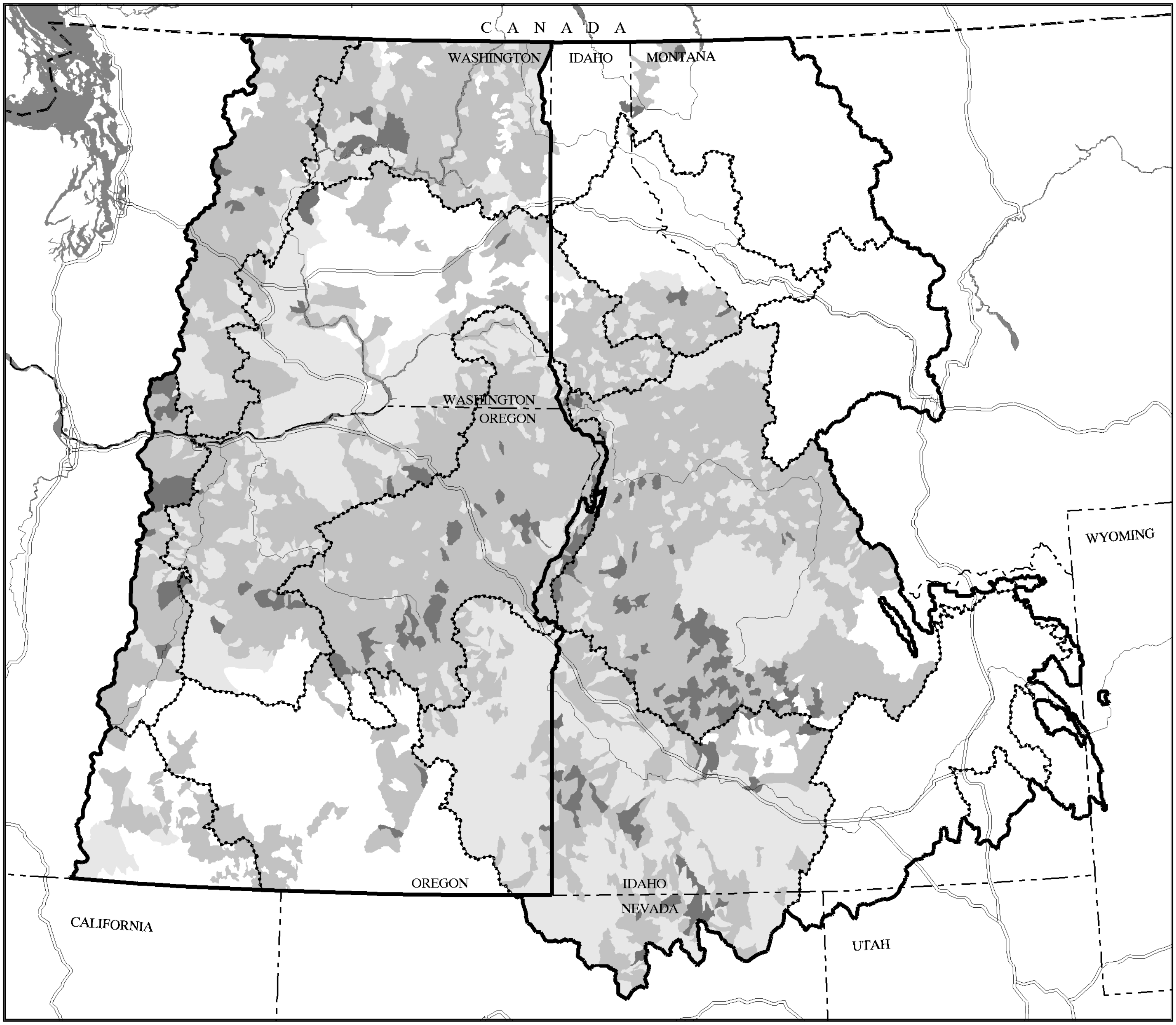
Redband Trout ("Resident" and "Resident-Interior")

The redband trout (native rainbow trout) is a widely distributed western North America native salmonid. Of the seven key salmonids, redband trout originally had the widest distribution, occupying 73 percent of the watersheds within the project area. The only major portions of the project area that historically did not support redbands were the Snake River upstream from Shoshone Falls, tributaries to the Spokane River above Spokane Falls, and portions of the northern Great Basin in Oregon.

Redband trout within the project area have two distinct life histories, anadromous (steelhead) or non-anadromous (freshwater resident). For purposes of the *Scientific Assessment* (1996), freshwater resident redbands were further divided into resident-interior and resident. The "resident-interior" subdivision encompasses native non-anadromous redband trout outside the range of the steelhead, whereas the "resident" form encompasses those populations that exist within the range of steelhead. Both current and historical distributions of redband trout are illustrated on Map 2-30.

Resident and resident-interior redband trout are considered species of special concern by the U.S. Fish and Wildlife Service, American Fisheries Society, and all states within their historical range, and are classified as sensitive species by the Forest Service and BLM.

Collectively, resident and resident-interior redband trout currently may be the most widely distributed key salmonid in the project area. The known and estimated distribution of both forms of redbands include 65 percent of the historical range. Resident redbands are the more widely distributed of the two forms; the known and estimated distribution includes 69 percent of the historical range. The largest areas of unoccupied historical habitat are in the Owyhee Uplands



50 0 50 100 150 miles
50 0 50 100 150 km

N

Map 2-30. Distribution of Redband Trout

Historical Range
Current Range
Known Strong Populations
Major Rivers
Major Roads
EIS Area Border
Ecological Reporting Unit Border*

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

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

(ERU 10) and Columbia Plateau (ERU 5). Resident-interior redbands are not as widely distributed and are currently found or anticipated in 50 percent of the identified historical range. The distribution and status of native redband trout may be more depressed than these estimates indicate because of hybridization with stocked rainbow trout. Preliminary status reviews in Idaho, Oregon, and Montana generally support this concern.

Less is known about the current distribution of redband trout than any of the other key salmonids. One reason for the lack of information is the inability to differentiate juvenile steelhead and resident redbands. Therefore the status of resident redbands was considered "unknown" when steelhead were present in a watershed.

Despite their broad distribution, relatively few strong resident redband populations exist. Known or predicted strong areas include 17 percent of the historical range and 24 percent of the present range. Only 30 percent of the watersheds supporting spawning and rearing populations were classified as having strong populations. Resident-interior redband trout also have few remaining strong populations ~ current strong populations encompass 10 percent of their historical range and 20 percent of their present range.

Interior redband habitats have been altered by a variety of land use practices. Reduction in streamflow because of water diversion for irrigation threatens many populations in the southern portion of their range. Increased water temperatures have also been a factor, especially in drier, warmer areas. Temperature increases largely are due to loss or conversion of riparian vegetation.

There have also been extensive channel alterations associated with flood-control projects, floodplain development, and road construction within the range of redbands. Channel alterations adversely affect stream hydraulics, nutrient pathways, invertebrate production, and fish production. Redband trout appear to have evolved over a broader range of environmental conditions than the other key salmonids, and appear to have less specific habitat requirements. Their apparent persistence even in some heavily disturbed basins suggests they are more resilient than other species. Therefore, the loss of a redband population could be a strong indication of disruption in the aquatic ecosystem processes.

Summary by Ecological Reporting Unit. Resident redbands (those associated with or derived from steelhead) are known or predicted to be widely distributed in large blocks of suitable habitat in the Northern Cascades (ERU 1), Blue Mountains (ERU 6), and Central Idaho Mountains (ERU 13). These watersheds represent the core of the distribution associated with or derived from steelhead and appear to be relatively secure, although hybridization with introduced rainbow trout is a potentially serious, but unevaluated threat. There are also known or suspected populations within the Southern Cascades (ERU 2), Upper Klamath (ERU 3), Owyhee Uplands (ERU 10), and Northern Glaciated Mountains (ERU 7) that have all been recently isolated from steelhead by dams. These populations appear to be far more fragmented and probably less secure than populations within the core. Because these latter populations are within the fringe of the range of redbands historically associated with steelhead, these populations may represent important sources of genetic diversity.

Resident-interior redband trout (those that evolved outside the range of steelhead) within portions of the Northern Glaciated Mountains (ERU 7), Northern Great Basin (ERU 4), Columbia Plateau (ERU 5), Central Idaho Mountains (ERU 13), and Owyhee Uplands (ERU 10) have been isolated from steelhead over geologic time. Resident-interior redband populations appear to have declined most in the Northern Great Basin (ERU 4) and Columbia Plateau (ERU 5), where 72 percent of their historical range is presently unoccupied and there are few remaining strong populations. Remaining populations appear to be severely fragmented and restricted to small blocks of known or potential habitat. These areas likely represent a critical element of the evolutionary history for this species.

Steelhead

Interior steelhead, the anadromous form of redband trout, are distributed within the Columbia River Basin as two major forms, Winter and Summer; although interior steelhead are primarily Summer-run. Winter-run steelhead enter fresh water three to four

TABLE OF CONTENTS

months prior to spawning, and Summer-run steelhead enter fresh water nine to ten months prior to spawning.

The distribution and abundance of steelhead have declined from historical levels as a result of mortality at and between dams, habitat degradation, loss of access to historical habitat, overharvest, and interactions with hatchery-reared and exotic fishes. Most of the current populations are hatchery-reared. Numerous state and federal management agencies list remaining wild steelhead populations as species of special concern. The American Fisheries Society considers all stocks of winter steelhead upstream from Bonneville Dam to be at high or moderate risk of extinction, and most summer steelhead stocks are considered to be at moderate risk of extinction or of special concern. Concern for the persistence of steelhead stocks resulted in 1994 petitions to the National Marine Fisheries Service for review of the species status under the Endangered Species Act. Steelhead represent a key species because of their broad distribution, value as a sport and commercial fish, and importance as a tribal ceremonial and subsistence resource. Current and historical distributions of steelhead are illustrated on Map 2-31.

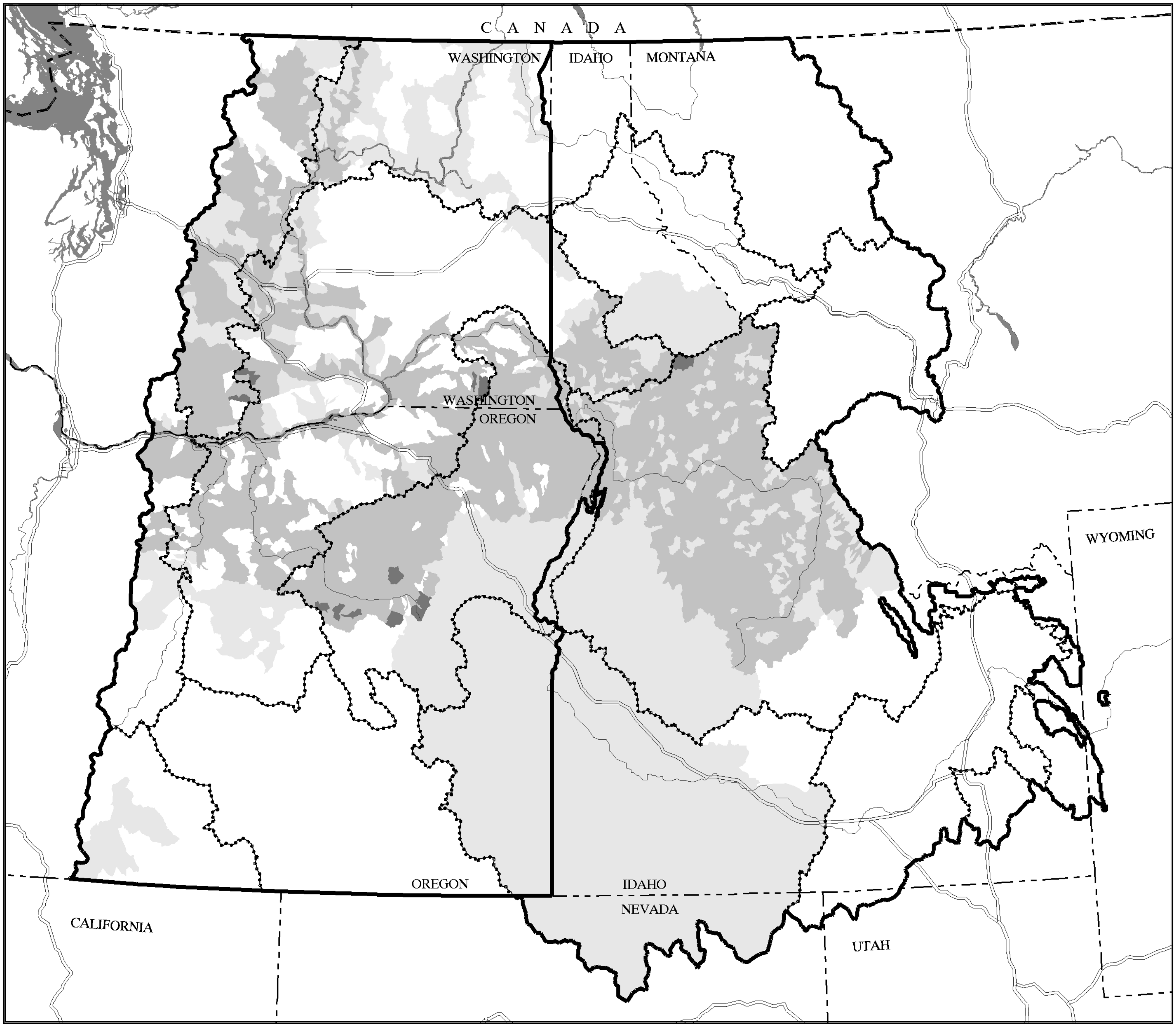
The historical range of steelhead includes all fresh water west of the Rocky Mountains, extending from northwest Mexico to the Alaska Peninsula with access to the Pacific Ocean. Steelhead were present in most streams, including many intermittent streams, that were accessible to anadromous fish, occupying approximately 50 percent of watersheds in the project area including the Klamath Basin. This included all accessible tributaries to the Snake River downstream from Shoshone and Spokane Falls and accessible tributaries to the Columbia River. In total, approximately 10,523 miles of stream were accessible to steelhead in the Columbia River Basin including Canada, although it is unlikely that steelhead occupied all reaches of all accessible streams because water temperature factors may have restricted distribution. Steelhead formerly ascended the Snake River and spawned in reaches of Salmon Falls Creek, Nevada, more than 900 miles from the ocean.

Historical steelhead runs were large. It is reported that the commercial steelhead catch peaked in the late 1890s at 4.9 million pounds. Initial estimates of run sizes were derived after Bonneville Dam was constructed in 1938. In 1940, 423,000 Summer steelhead passed the dam. Annual sport harvests averaged 117,000 Summer-run and 62,000 Winter-run fish from 1962 to 1966.

Steelhead are still the most widely distributed anadromous salmonid in the project area; however, they are extinct in large portions of their historical range. Presently occupied watersheds encompass approximately 45 percent of the historically occupied watersheds. Steelhead are extinct in the Lower Clark Fork and Owyhee Uplands. Within the Columbia River Basin in the United States and Canada, approximately 75 percent of the stream mileage within their historical range is no longer accessible. Within their current distribution, few healthy wild steelhead populations exist. Watersheds known or estimated to support strong spawning and rearing populations of wild steelhead represent 0.6 percent of the historical range and 1.3 percent of the current range. Some 98 percent of the watersheds where steelhead spawn and rear are classified as containing depressed populations of wild steelhead.

Existing steelhead populations are composed of four main types: wild, natural (non-native progeny spawning naturally), hatchery, and mixes of natural and hatchery fish. Production of wild anadromous fish in the Columbia River Basin has declined by about 95 percent from historical levels. Most existing steelhead production is supported by hatchery and natural fish as a result of large-scale hatchery mitigation production programs. By the late 1960s, hatchery production surpassed wild production in the Columbia River Basin. Wild fish, unaltered by hatchery stocks, are rare and are present in only 10 percent of the historical range and 25 percent of the current distribution. Remaining wild stocks are concentrated in reaches of the John Day River Basin in Oregon and the Salmon River in Central Idaho.

Steelhead must navigate past as many as eight mainstem dams. Adults are delayed during upstream migrations, and smolts may be killed by turbines; become disoriented or injured, making them more susceptible to predation; or become delayed in the large impoundments



Map 2-31. Distribution of Steelhead Trout

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

Project Area
1996

50 0 50 100 150 miles
50 0 50 100 150 km

N

Historical Range
Current Range
Known Strong Populations
Major Rivers
Major Roads
EIS Area Border
*Ecological Reporting Unit Border**

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

TABLE OF CONTENTS

behind dams. Smolt-to-adult return rates declined from approximately 4 percent in 1968 to less than 1.5 percent from 1970 to 1974. In 1973 and 1977, low flows resulted in 95 percent mortality of migrating smolts.

Non-native fish and hatchery operations have also affected wild steelhead populations. Hatcheries have been widely used in attempts to mitigate losses of steelhead caused by construction and operation of dams. Hatchery operations affect wild steelhead populations through genetic hybridization and loss of fitness, creation of mixed-stock fisheries, competition for food and space, and increased diseases. Introduced rainbow trout also have the potential to mature and hybridize with steelhead, and this species has been introduced throughout the current steelhead range. Supplementation of native stocks with hatchery fish have typically resulted in replacement, not enhancement, of native steelhead.

Biotic factors including predation and competition also may influence the abundance of steelhead. More than 55 exotic fish species have been introduced within the current range of steelhead. Because exotic fish species did not co-evolve with steelhead, there has been no opportunity for natural selection to lessen competition or predation. Dams have created habitat that is suitable for a variety of native (northern squawfish) and non-native predators and potential competitors. The abundance and distribution of native predators may also be influenced by human habitat alterations.

More than 95 percent of the healthy native stocks of anadromous fish are believed to be threatened by some degree of habitat degradation. Fish habitat quality in most watersheds has declined. As described in previous sections, pool frequency has decreased and fine sediment has increased in many project-area watersheds. In addition to hydroelectric development, most alterations of steelhead habitat can be attributed to human land-disturbing activities as a result of mining, timber harvest, agriculture, industrial development, and urbanization.

Summary by Ecological Reporting Unit. Steelhead are still relatively widely distributed in the project area, but they are extinct in nearly 60 percent of the historical range. Although steelhead are widespread throughout the remaining accessible range, most populations are severely depressed and heavily influenced by hatchery supplementation. Wild stocks are rare; core areas for remaining wild populations include the Salmon and John Day river basins. The only remaining strong populations are found among wild stocks, primarily in the Columbia Plateau and Blue Mountains (ERU 6). Within the Central Idaho Mountains (ERU 13), recent steelhead runs have been critically low.

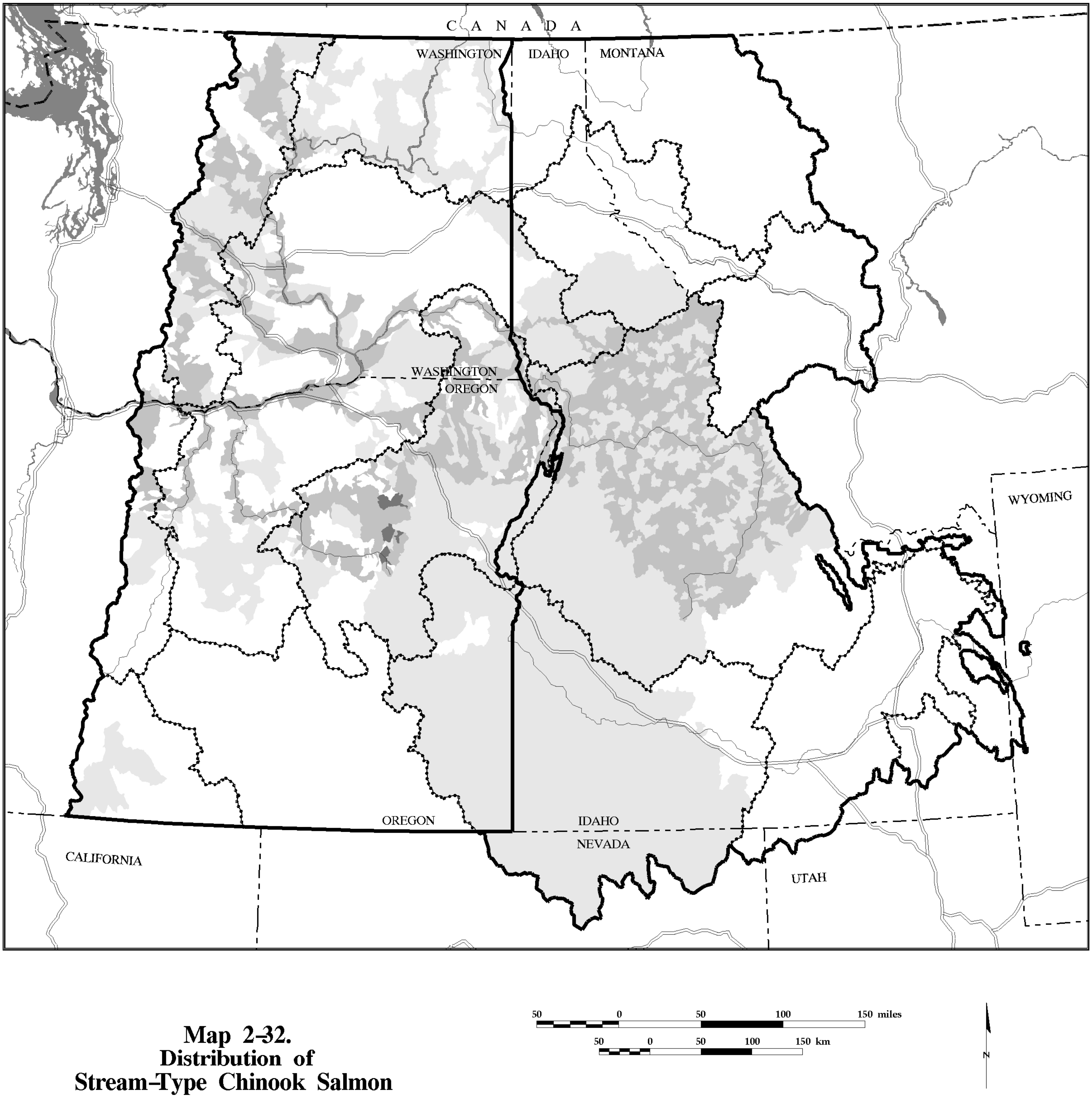
Chinook Salmon

Chinook salmon in the project area are traditionally described as spring, summer, and fall runs, distinguished primarily by their time of passage over Bonneville Dam. These names have led to some confusion because stocks of similar run timing may differ considerably between the Snake and Columbia rivers in their spawning areas, life histories, behavior, and genetic characteristics. For the purposes of the *Integrated Scientific Assessment* (1996), chinook salmon that migrate seaward as yearlings are called “stream-type” and those that migrate as subyearlings are called “ocean-type.” Snake River chinook salmon (stream- and ocean-types) were listed as threatened under the Endangered Species Act in 1992. Current and historical distributions of stream-type and ocean-type chinook salmon are illustrated on Maps 2-32 and 2-33.

The historical range of chinook salmon in North America includes the eastern Pacific and Arctic oceans and accessible fresh water. Like steelhead, chinook salmon were found in all accessible areas of the Snake River downstream from Shoshone Falls, and they formerly ascended and spawned in reaches of Salmon Falls Creek, Nevada, more than 900 miles from the ocean. An estimated 10,523 miles of stream were accessible to chinook salmon in the Columbia River Basin in the United States and Canada.

Stream-type chinook salmon were widely distributed, occupying about 45 percent of the watersheds in the project area, and occurring in all ecological reporting units except the Northern Great Basin (ERU 4), Upper Clark Fork (ERU 8), Snake Headwaters (ERU 12), and Upper Snake (ERU 11) above Shoshone Falls. Ocean-type chinook salmon were much less widely distributed, occupying approximately 7 percent of the available watersheds and

TABLE OF CONTENTS



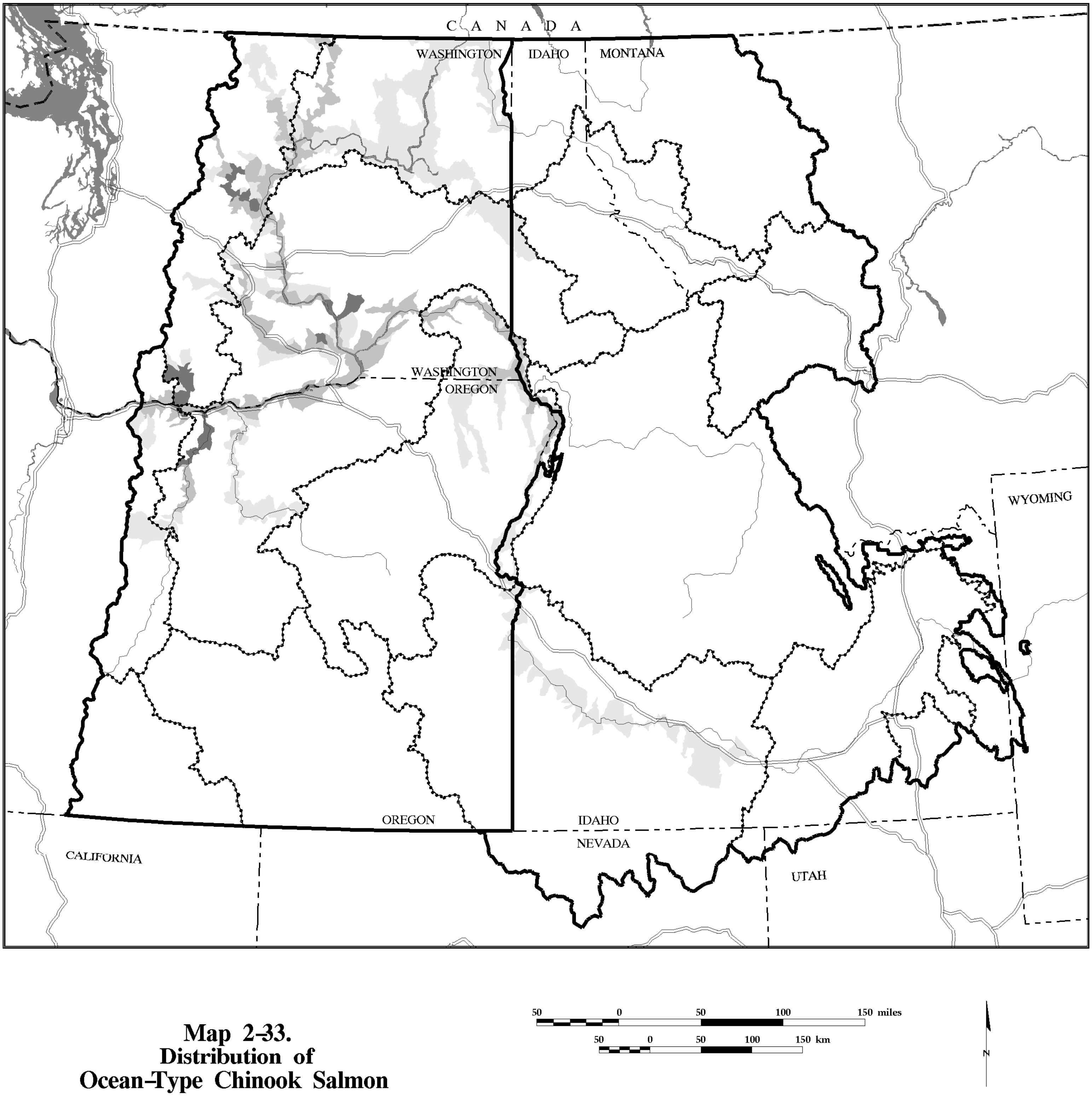
Map 2-32.
Distribution of
Stream-Type Chinook Salmon

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

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



Map 2-33.
Distribution of
Ocean-Type Chinook Salmon

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

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

occurring in 6 of 13 ecological reporting units. Within accessible watersheds, chinook salmon distribution may have been restricted by unsuitable water temperatures at high elevations, and the need for relatively large areas of suitable spawning gravel. Chinook salmon juveniles also prefer low gradient, meandering stream channels, which may have further restricted their distribution.

Historical runs of chinook salmon were immense; estimates of the size of annual runs prior to 1850 range from 3.4 to 6.4 million fish. Most native peoples in the project area shared a major dependence on salmon as a subsistence and ceremonial resource. Commercial harvest of chinook salmon in the mainstem Columbia River peaked in 1883 at 2.3 million fish, and the average yield was approximately 1.3 million fish from 1890 to 1920.

Chinook salmon are presently the most endangered of the key salmonids, with populations lost in large portions of their historical range. Construction of Grand Coulee Dam in the early 1940s and the Hells Canyon dam complex in 1967 eliminated chinook salmon from much of their former ranges within the Upper Columbia and Snake River drainages. In total, about 75 percent of historically accessible streams are no longer accessible to chinook, primarily because of dam blockages. Current known and estimated distributions of stream-type and ocean-type chinook salmon include 28 percent and 30 percent, respectively, of their historical ranges. Stream-type chinook are extinct in all of the Owyhee Uplands (ERU 10) and Lower Clark Fork (ERU 9); and in large portions of other ecological reporting units that currently support populations. Ocean-type chinook are extinct in large portions of several ecological reporting units, and in all of the Owyhee Uplands (ERU 10).

Most existing chinook salmon stocks in the remaining accessible range are severely depressed and at risk. For stream-type chinook salmon, watersheds known or estimated to support strong spawning and rearing populations represent 0.2 percent of the historical range and 0.8 percent of the current range; approximately 99 percent of the current stream-type chinook spawning and rearing populations are classified as depressed. The only remaining strong populations appear to be restricted to small areas of the John Day River Basin in the Blue Mountains (ERU 6). Note that only those watersheds in the project area containing spawning and rearing populations sustained by wild stocks are classified as strong. Ocean-type chinook are found in a more restricted range associated mainly with the mainstem rivers and larger tributaries. For ocean-type chinook salmon, watersheds known or predicted to support strong spawning and rearing populations represent 5 percent of the historical range and 16 percent of the current range; approximately 70 percent of current ocean-type chinook salmon spawning and rearing populations are classified as depressed. In the Snake River, an estimated 1,882 wild stream-type chinook salmon reached Lower Granite Dam in 1994 as compared to an estimated production of 1.5 million fish in the late 1880s. From 1985 to 1993, an average of 387 naturally produced ocean-type chinook salmon reached Lower Granite Dam.

Construction and operation of mainstem dams on the Columbia, Snake, and Klamath rivers is considered the major cause of decline of chinook salmon (see Map 2-25). Besides reducing accessible habitat, hydroelectric development changed Columbia and Snake River migration routes from mostly free-flowing in 1938 to a series of impoundments by 1975, and reservoir storage activities have reduced flows in most years during smolt migration. Like steelhead, chinook adults are delayed during upstream migrations, and smolts may be killed by turbines; become disoriented or injured, making them more susceptible to predation; or become delayed in the large impoundments behind dams. Development and operation of hydropower facilities in the Columbia Basin has reduced salmon and steelhead production by about eight million fish: four million from blocked access to habitat above Chief Joseph and Hells Canyon dams, and four million from ongoing passage losses at other facilities. Passage losses are cumulative depending on the number of dams; chinook salmon in the project area must pass between one and nine dams. Losses of mid- and upper-Columbia ocean-type chinook salmon were estimated to be approximately 5 percent per dam for adults and 18 to 23 percent per dam for juveniles.

TABLE OF CONTENTS

The Effects of Hydropower, Hatcheries, Harvest and Habitat on Interior Columbia River Anadromous Fishes

Introduction

Anadromous fish are the focus of this sidebar because of their current scarcity resulting from influences of hydropower, hatcheries, harvest, and habitat. These four activities which impact or limit the survival of anadromous fishes, have been broadly grouped as the "Four H's (Idaho Department of Fish and Game et al. v. NMFS et al. 1994). Due to the cumulative effect of the "Four H's" on Snake River spring/summer chinook salmon, the National Marine Fisheries Service (NMFS) listed the Snake River stock as threatened in 1992 pursuant to the Endangered Species Act (ESA). In public scoping for this draft EIS an important question surfaced about how hydropower, harvest, and hatcheries (factors outside the land management agencies' jurisdictions), would be considered in the development of alternative Forest Service and BLM land management strategies which affect anadromous fish habitat. The Executive Steering Committee for the ICBEMP directed that the EISs specifically address the following:

1. *What are the relative contributions of habitat, hydropower, hatcheries, and harvest on the current state of populations within the interior Columbia Basin?*

2. *If all other factors were held constant, would a further degradation of habitat increase the risks of extirpation or extinction?*

3. *If all other factors were held constant, would an improvement in freshwater habitat conditions increase fish abundance and reduce the risks of extirpation or extinction?*

4. *If nothing is done to restore habitat and mitigation of major factors such as the dams is successful, would there be sufficient habitat available to accommodate increasing fish numbers?*

Habitat for anadromous fish is also important for numerous other aquatic and riparian resources and human uses, including: native trout, amphibians, recreation, and clean water. Alternative land management strategies will consider these important resource values in addition to the anadromous fish issues discussed below.

This summary, based on a Science Integration Team report (Lee and Rieman In prep.) and other relevant sources cited in the text, responds to the above four questions. It provides an overview of the effects of habitat, harvest, hydropower and hatcheries on interior Columbia River anadromous fishes. It does not apply to resident native fish such as bull trout and cutthroat trout, which do not migrate to and from the sea. The information is generally applicable to spring/summer and fall chinook, sockeye, and steelhead in the interior Columbia Basin.

Hydroelectric development is generally regarded as a major factor in the decline of anadromous populations, irrespective of changes in freshwater habitat (Northwest Power Planning Council 1986 in Lee and Rieman In prep., Raymond 1988 in Lee and Rieman In prep.). Explicit recognition of the role of hydroelectric development contributed to passage of the Northwest Power Planning and Conservation Act of 1980, and to development of the Northwest Power Planning Council's Fish and Wildlife Program, a regional effort to simultaneously address the four principal factors affecting anadromous fish.

Habitat is another major factor in supporting anadromous fish populations. The information provided by the broad-scale assessment of aquatic habitats and species within the interior Columbia Basin and presented in the Aquatics chapter (Lee, D.; Sedell, J.; et al. 1996) of the Scientific Assessment lends support to a scientifically credible view that is emphasized repeatedly in the literature: habitat change *is pervasive and at times dramatic, but impacts are not evenly distributed across the landscape. For instance, high-quality areas, generally associated with wilderness or other protected areas, remain that are capable of supporting anadromous fishes at near historical levels in these areas. In many other areas habitat has been degraded and survival of the freshwater life stages has been compromised. To support recovery of populations of anadromous fish, it will be necessary to expand and reconnect areas of high quality habitat. Restoration of depressed populations cannot rely on habitat improvement alone, but requires a concerted effort to address causes of mortality in all life stages. These include freshwater spawning, rearing, juvenile migration, ocean survival, and adult migration.*

1. ***What are the relative contributions of habitat, hydropower, hatcheries, and harvest on the current state of populations within the interior Columbia Basin?***

   The question of relative contributions of the "Four H's" to anadromous fish mortality cannot be answered precisely. Simultaneous changes in a variety of factors, combined with the lack of historical data, prevents estimation of the proportionate influence of each factor across the entire basin. It is expected that the contribution of freshwater habitat changes to declines in anadromous fish populations is least in the less disturbed areas of central Idaho (such as in wildernesses or other protected areas), where there are the most dams between spawning and rearing areas and the ocean, and in the northern Cascades, but greater in the lower Snake and mid-Columbia drainages. Similarly, the contribution of hydropower to fish mortality declines downriver where there are fewer dams between freshwater spawning and rearing areas and the ocean (Lee, D.; Sedell, J.; et al. 1996). Hatcheries are an important element throughout the basin, but their effects on native stocks are quite variable. Harvest, which has been much curtailed in recent years, has less of an effect today than it did historically. In some sub-basins such as the Umatilla, irrigation withdrawals may be the major contributor to declines in naturally reproducing populations.

2. ***If all other factors were held constant, would a further degradation of habitat increase the risks of extirpation or extinction?***

   Yes, regardless of the contributions of other factors, spawning and juvenile rearing habitat remains an important component in the viability equation. Freshwater habitat can be most important in ensuring viability of stocks that are depressed through a combination of other factors.

3. ***If all other factors were held constant, would an improvement in freshwater habitat conditions increase fish abundance and reduce the risks of extirpation or extinction?***

   Yes, although the magnitude of the effect would vary greatly from sub-basin to sub-basin. In areas where present habitat is degraded and hydropower effects are smaller, such as the John Day and Deschutes Rivers, habitat improvements could result in immediate increases in numbers of fish. In areas where habitat is degraded and hydropower effects are large, such as in the Grand Ronde River and some tributaries of the Salmon River (for example Panther Creek), increases in population numbers due to habitat restoration would be more modest and gradual. In other areas where there is abundant high-quality habitat but few adult spawners, such as in the middle Fork Salmon River, immediate increases in fish abundance would not be expected. One aspect of habitat improvement that could have long-term repercussions, if not immediate benefits, is that increased availability of high-quality habitats reduces the chances that a random, catastrophic event such as a large fire followed by flooding would wipe out all of the best available habitat. A wider distribution of high-quality habitats also improves the likelihood of increased genetic diversity ~ an additional benefit over the long term. In general, while additional high quality habitat alone could increase the abundance of individual fish, it would not likely reverse current negative population trends in the short term.

4. If nothing is done to restore habitat, and mitigation of major factors such as the dams is successful, would there be sufficient habitat available to accommodate increasing fish numbers?

The answer varies across the basin. Population numbers in much of the interior Columbia Basin are far below what current habitat conditions could likely support under a scenario of increased downriver survival. Some remote areas (for example central Idaho and northern Cascades) potentially could support hundred-fold increases or better in the number of adult fish, but this is not the case everywhere. There are disturbed areas where increased adult numbers would lead to compensatory declines in freshwater survival rates, thus reducing the per capita productivity of the population and limiting the effectiveness of downstream improvement efforts. If the objective is to fully realize the benefits of downstream improvements, then commensurate increases over current availability and distribution of high-quality habitat will be necessary.

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Like steelhead, many remaining chinook salmon populations have been influenced by hatchery-reared fish. Production of wild anadromous fish in the Columbia River Basin has declined by approximately 95 percent from historical levels. As a result, wild populations unaltered by hatchery stocks are rare; they are present in 4 percent of the historical range and 15 percent of the current range of stream-type chinook salmon, and 5 percent of the historical range and 17 percent of the current range of ocean-type chinook salmon.

The overall pattern of decline of chinook salmon suggests the species is very sensitive to habitat degradation throughout its entire range. Improper livestock grazing, timber harvest, and irrigation diversions have been important factors. Forest management practices, including timber harvest activities, have reduced salmon habitat quantity and complexity, increased sedimentation, and eliminated sources of woody debris needed for healthy salmon habitat. Improving the quality of remaining refugia is less important than restoring connectivity in reaches of lower sub-basins.

Predation is one of the major causes of mortality to juvenile chinook salmon. Exotic species may prey upon and compete with native fishes. Many of the middle and lower reaches of the Columbia River are dominated by exotic fish species. Northern squawfish, a native predator, has become well adapted to the habitat created by dams. It has been estimated that 15 to 20 million juvenile salmonids in the Snake and lower Columbia rivers are lost to northern squawfish predation annually. Additional information will be provided that answers the question regarding the relationship of chinook salmon habitat to other limiting factors; for example, if all the habitat is fixed, will there be more fish, and vice versa, if all other limiting factors (harvest, hatcheries, and hydropower) were removed will there be more fish and enough habitat.

Summary by Ecological Reporting Unit. Chinook salmon are the most imperiled of the key salmonids. Both forms of chinook salmon are extinct in more than 70 percent of the historical range. The distribution of stream-type chinook appears to be widespread throughout the remaining accessible range, but most populations are depressed and influenced by hatchery supplementation. The only remaining strong populations are within the Blue Mountains (ERU 6) and are restricted to relatively small areas of the John Day River Basin. Within the Central Idaho Mountains (ERU 13), recent runs of stream-type chinook salmon have been critically low, and most populations are believed to be on the brink of extinction. Ocean-type chinook salmon are found in a more restricted range tied principally to mainstem rivers and larger tributary systems. Populations associated with the Snake River Basin in Idaho are also considered on the verge of extinction. The remaining distribution of spawning and rearing habitat includes very few watersheds in each occupied ecological reporting unit and the blocks of contiguous occupied habitat are small and disjunct.

Sockeye Salmon

Sockeye salmon were not considered a "key salmonid" as part of the *Assessment* (1996) because of their extremely limited present distribution. Nevertheless, they are an important species because of high associated social, economic, and ecologic values.

Sockeye salmon exhibit two dominant life history forms, an anadromous form and a resident form called kokanee. The distribution of kokanee coincides with that of the anadromous form, probably indicating that kokanee populations have developed from anadromous populations.

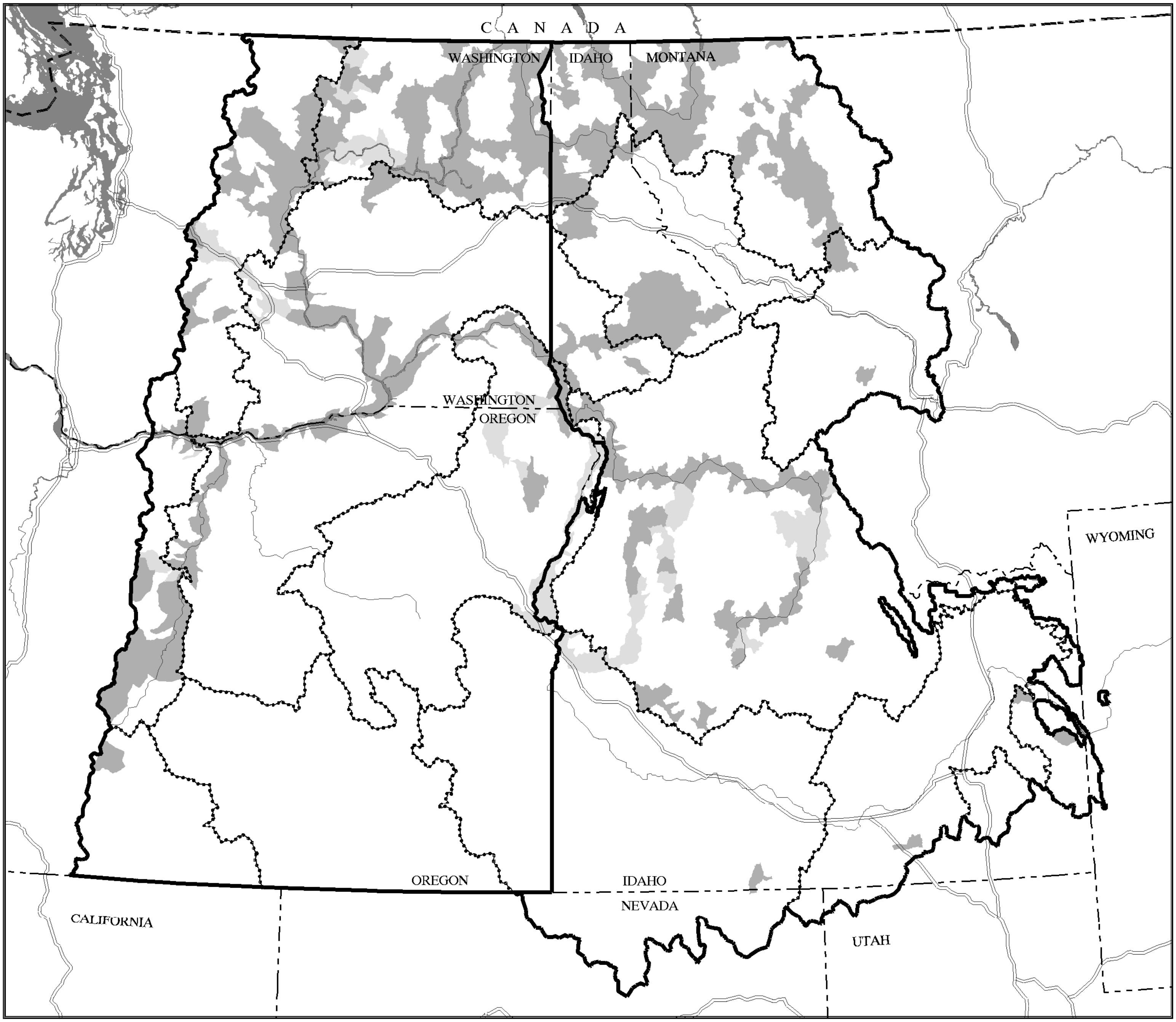
The historical range of sockeye extended across the northern rim of the Pacific Ocean, down the west coast of North America as far south as the Sacramento River in California (see Map 2-34). The historical range included large segments of the interior Columbia Basin where natural lakes and surrounding watersheds are connected by river systems to the Pacific Ocean. It is believed that 11 major watersheds and at least 24 lakes supported sockeye salmon within the project area. Currently only Lakes Wenatchee and Osoyoos in the upper Columbia River produce large numbers of wild anadromous sockeye. A single remnant population of anadromous sockeye remains in Redfish Lake in the upper Snake River Basin. The number of adults returning to Redfish Lake has numbered from 0 to 8 adults since 1990. This remnant population is federally listed as endangered under the Endangered Species Act.

Similar to steelhead and chinook, much of the decline in anadromous sockeye is attributed to dams blocking access to spawning and rearing streams and increased mortality of juveniles in the migratory corridors of the Snake and Columbia rivers. Other factors influencing abundance include loss of lake habitat, historical commercial fisheries, ocean productivity, and forest management.

Native Species Richness, and Biotic and Genetic Integrity

The specific conditions regarding fish species and groups of fishes that are outlined in preceding sections can be integrated in various manners to provide an overall picture of aquatic conditions in the project area. Some key attributes include native species richness, and genetic and biologic integrity. These overall views of the project area can help prioritize management actions through watershed categorization or designation of key watersheds. Key (or priority) watersheds have been identified for previous salmon recovery plans. For the purposes of this EIS, the Science Integration Team developed watershed categories that summarize current aquatic conditions, especially with regard to management opportunities and priorities. These categories are described later in this section.

TABLE OF CONTENTS



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Map 2-34. Distribution of Sockeye (Kokanee) Salmon

Historical Range
Current Range
Major Rivers
Major Roads
EIS Area Border
Ecological Reporting Unit Border*

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

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

Species Richness

The number of native fish species present in a watershed is an important element of biodiversity. A high degree of overlap in species is characteristic of strong habitat diversity. Even considering a fairly narrow group of species such as the salmonids, each species relies on different habitats and environments. The occurrence of several salmonids indicates suitable habitats over relatively large landscapes. High richness may also indicate critical habitats that serve as common corridors, wintering areas, or seasonal refuges for varied life histories. The largest remaining regions of high species overlap are associated with the Blue Mountains (ERU 6), Northern Cascades (ERU 1), Central Idaho Mountains (ERU 13), and their connecting river corridors. Overlap of strong populations for multiple native salmonids indicates areas of high species richness that have not yet experienced extensive declines in fish population. Presently within the project area, less than 0.01 percent of the subwatersheds concurrently support three strong salmonid populations, three percent support two populations, and approximately 20 percent support one. The largest block of contiguous or clustered subwatersheds supporting strong populations is within sub-basins in the Blue Mountains (ERU 6), Central Idaho Mountains (ERU 13), and Snake Headwaters (ERU 12). Smaller blocks are found in the extreme eastern fringe of the Northern Glaciated Mountains (ERU 7) and Upper Clark Fork (ERU 8). Most of the watersheds supporting strong populations are found on Forest Service-administered lands (75 percent), and a portion (29 percent) is located within protected areas such as designated wildernesses or National Parks. Watersheds with multiple strong populations are more commonly under Forest Service management than other ownerships. Map 2-35 illustrates the current locations of salmonid strongholds in the project area. (See Map 1-1 for Forest Service- and BLM-administered lands.)

Biotic Integrity

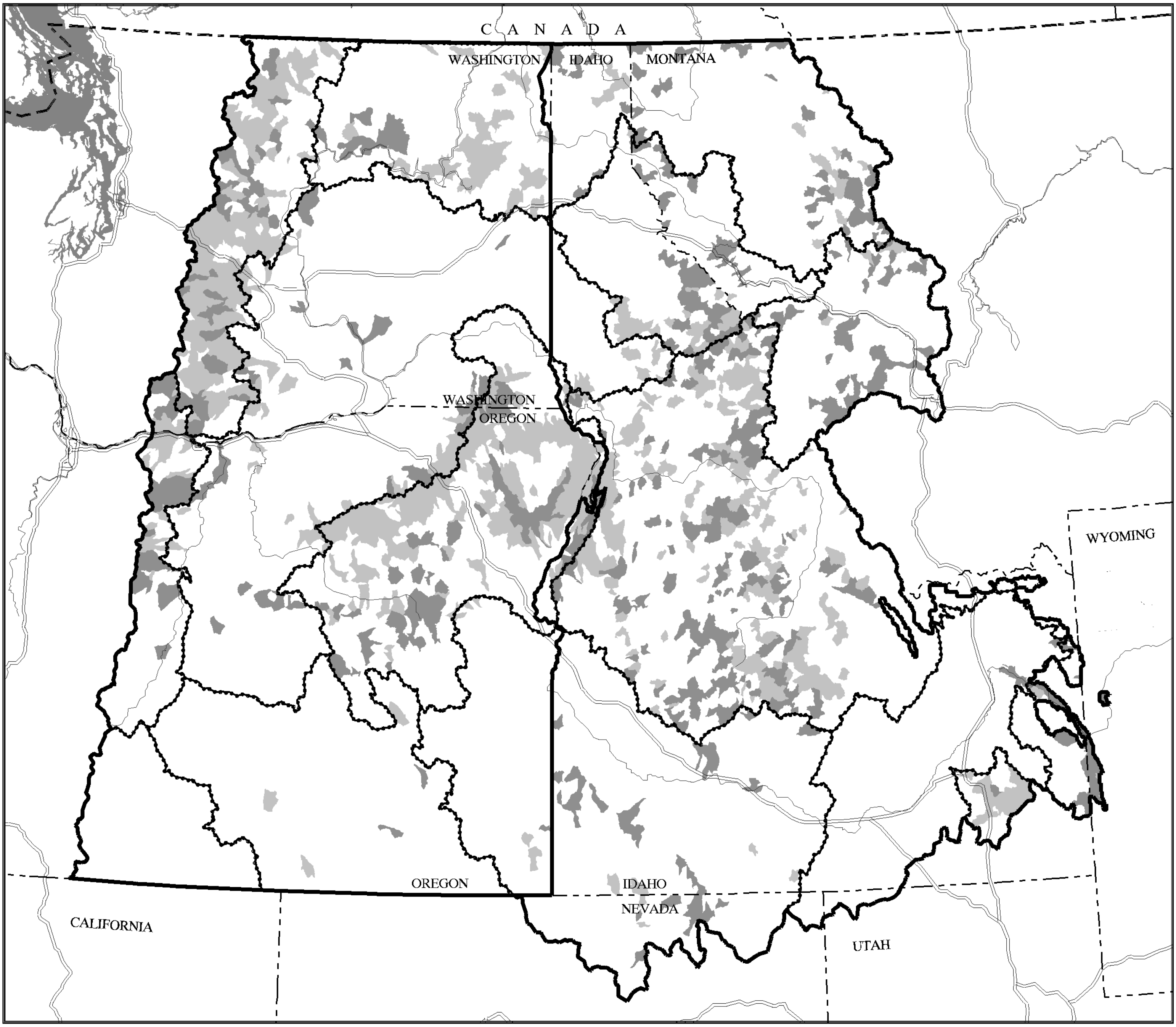
The concept of biotic integrity has been proposed to evaluate the loss of natural diversity, and to define those remaining portions of the landscape that could be most valuable in maintaining or closely approximating historical levels of natural diversity. Biotic integrity has been generally defined as “the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region ” (Karr and Dudley 1991). Integrity specifically refers to *native* biota that reflect natural evolutionary and biogeographic processes. Several measures of biotic integrity have been developed, often reflecting different attributes for communities of invertebrates and amphibians as well as fish (Fisher 1989; Lyons et al. 1995).

Because project-wide aquatic species information was limited to fish in the *Scientific Assessment* (1996), a relatively simple measure of integrity reflecting the diversity and structure of the native fish community at both the life-history and species levels of organization was developed (for further information on methods refer to the *Scientific Assessment* 1996). The highest concentration of high integrity values were found in the Northern and Southern Cascades (ERUs 1 and 2), Blue Mountains (ERU 6), the southern edge of the Columbia Plateau (ERU 5), and Central Idaho Mountains (ERU 13). Smaller blocks of high values were also found in the Lower Clark Fork (ERU 8). One readily apparent trend is that many of the high-value integrity areas are found in forested areas within the range of anadromous fish. Rangeland and agricultural areas tended to have lower integrity values.

Genetic Integrity

Hatchery programs may erode genetic diversity and alter certain gene complexes that evolved together and that are characteristic of locally adapted stocks of salmonids. The effects may include a loss of fitness or performance (growth, survival, and reproduction), and a loss of genetic variability important to long-term stability and adaptation in varying environments. The analysis of genetic integrity is incomplete and would require a finer level of analysis for a consistent application to resident salmonids, but in general the areas important to the genetic integrity of the anadromous salmonids are found principally within the Blue Mountains (ERU 6) and Central Idaho Mountains (ERU 13).

TABLE OF CONTENTS



Map 2-35.
Key Salmonid Strongholds

BLM and Forest Service Administered Lands Only

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

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

TABLE OF CONTENTS

Sub-basin Categories

To assist with an ecosystem approach to the management of watersheds and aquatic resources, the Science Integration Team developed a simple classification of sub-basins throughout the Interior Columbia Basin Ecosystem Management Project area (ICBEMP). Sub-basins were used as the primary classification unit because they commonly approximate complete aquatic ecosystems, supporting most of the life-history diversity expected over larger river basins (see the Introduction to this chapter for an explanation of sub-basins and 4th field Hydrologic Unit Codes). Three broad categories of sub-basin condition (as pertaining to aquatic ecosystems) have been defined, recognizing that a continuum of conditions exists. Sub-basins were categorized along a gradient of conditions and integrity relative to highly functional aquatic ecosystems. Highly functional systems or systems with high integrity were defined as sub-basins with a full complement of native fish and other aquatic species, well distributed in high-quality, well connected habitats.

The categorization is intended to set the stage for a broad-scale analysis of management needs and opportunities that can focus the requirement for finer-scale analysis. It is intended to facilitate the discussion of management opportunity and conflict by providing a description of aquatic issues and needs that could be associated with similar descriptions for terrestrial ecosystems. It is not intended to be all-inclusive, final, or inflexible. The classification is based on the integration of current data as well as local knowledge of watershed connectivity and condition that is not expressed quantitatively. Map 2-36 shows the watershed categories (aquatic integrity) developed by the Science Integration Team for analysis.

Category 1 Sub-basins

These high integrity sub-basins most closely resemble natural, fully functional aquatic ecosystems. In general they support large, often continuous blocks of high-quality habitat and watersheds with strong populations of multiple species. Connectivity among watersheds and through the mainstem

Fringe Environments

"Fringe" environments at the extreme edges of a species distribution may support a disproportionately large part of the genetic diversity within a species because of the genetic adaption needed to survive in a variable environment. Populations that represent native gene complexes and the widest possible diversity probably offer the best resources for reestablishing extinct populations in similar environments. They are also important for sustaining the most important components of overall genetic diversity characteristic of these species.

The fringe of the range for westslope cutthroat trout is in the Blue Mountains (ERU 6). Watersheds within the Columbia Plateau (ERU 5) technically qualify as part of the westslope cutthroat fringe distribution, but those watersheds are really part of a much larger distribution of cutthroat in the upper portions of that basin. For that reason the Columbia Plateau (ERU 5) was not included as part of the fringe for westslope cutthroat trout. The fringe defined for bull trout includes the Southern Cascades (ERU 2), the Upper Klamath (ERU 3), the Owyhee Uplands (ERU 10), and the Walla Walla and Umatilla drainages within the Columbia Plateau (ERU 5).

The Upper Klamath (ERU 3), Northern Cascades (ERU 1), and Owyhee Uplands (ERU 10) are recognized as fringe areas in the remaining distribution of resident-interior redband trout. No watersheds are considered to represent a fringe for Yellowstone cutthroat trout or resident redband trout. Any further loss of current distributions within the Upper Snake (ERU 11) or Upper Klamath (ERU 3) would make these areas of concern, however.

The Northern Glaciated Mountains (ERU 7) was identified in the Assessment (1996) as the fringe for steelhead. Population declines within the Southern Cascades (ERU 2) could make that area important for steelhead as well. The Southern Cascades (ERU 2) and Northern Glaciated Mountains (ERU 7) are important for stream-type chinook salmon. The distribution of ocean-type chinook salmon within the project area is so restricted that all of the remaining distribution qualifies as part of the fringe.

TABLE OF CONTENTS

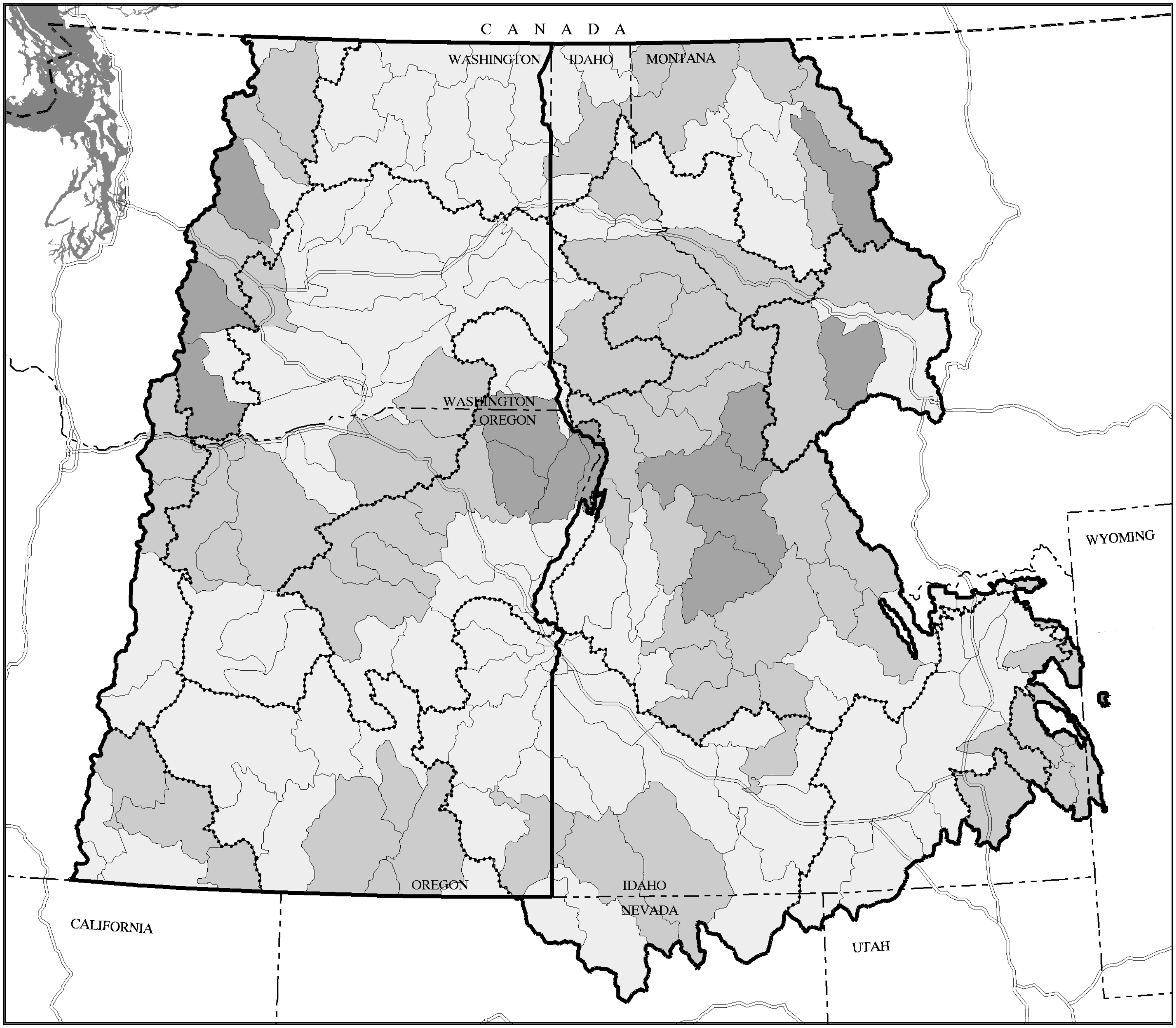
river corridor is unimpeded, and all life histories, including migratory forms, are present and important. Native species predominate, though introduced species may be present. These sub-basins provide a system of large, well dispersed habitats resilient to large-scale disturbances. They provide the best opportunity for long-term persistence of native aquatic assemblages and may be important sources for refounding other areas.

Category 2 Sub-basin

These moderate integrity sub-basins support important aquatic resources, and often have watersheds classified as strongholds for one or more species scattered throughout. The integrity of the fish assemblage is high or moderate. The most important difference between Category 1 and Category 2 watersheds is increased fragmentation in Category 2 that has resulted from habitat disruption or loss. These sub-basins have numerous watersheds where native species have been lost or are at risk. Connectivity among watersheds exists through the mainstem river system, or has the potential for restoration of life-history patterns and dispersal among watersheds. Because these sub-basins commonly fall in some of the more intensively managed landscapes, they may have extensive road networks. Stronghold watersheds that require conservative protection are scattered rather than contiguous. These sub-basins are more likely to have the opportunities to explore or experiment with watershed restoration through active manipulation, or through attempts to produce more episodic disturbance followed by long periods of recovery.

Category 3 Sub-basins

These low integrity sub-basins may support populations of key salmonids or have other important aquatic values, such as threatened and endangered species, narrow endemics, and introduced or hatchery supported sport fisheries. In general, however, these watersheds are strongly fragmented by extensive habitat loss or disruption throughout the component watersheds, and most notably through disruption of the mainstem corridor. Major portions of these sub-basins are often associated with private and agricultural lands not managed by the Forest Service or BLM. Although important and unique aquatic resources exist, they are usually localized. Opportunities for restoring connectivity among watersheds, full expression of life histories, or other large-scale characteristics of fully functioning and resilient aquatic ecosystems are limited or nonexistent in the near future. Because the remaining aquatic resources are often strongly isolated, risks of local extinction may be high. Conservation of the remaining productive areas may require a disproportionate contribution from federal management agencies, because these sub-basins often include large areas of non-federal land.



50 0 50 100 150 miles

50 0 50 100 150 km

N

Map 2-36. Sub-basin Categories (Aquatic Integrity)

Category 1 (High)
Category 2 (Moderate)
Category 3 (Low)
4th HUC Boundaries
Major Roads
EIS Area Border
Ecological Reporting Unit Border*

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

Project Area
1996

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

TABLE OF CONTENTS

Human Uses and Values

Key Terms Used in This Section

Allowable Sale Quantity (ASQ) ~ The quantity of timber that may be sold from a designated area covered by a Forest Service or BLM land use plan for a specified time period.

Animal Unit Month (AUM) ~ The amount of feed or forage required by one "animal-unit" grazing on a pasture for one month. An animal-unit is one mature cow plus calf, or one horse, or five domestic sheep.

In-migration ~ The movement of new residents into an area.

Out-migration ~ The movement of former residents away from an area.

Resiliency (resilient) ~ (1) The ability of a system to respond to disturbances. Resiliency is one of the properties that enable the system to persist in many different states or successional stages. (2) In human communities, refers to the ability of a community to respond to externally induced changes such as larger economic or social forces.

Summary of Conditions and Trends

- The planning area is sparsely populated and rural, especially in areas with a large amount of agency lands. Some rural areas are experiencing rapid population growth, especially those areas offering high quality recreation and scenery. Population growth can stimulate economic growth, provide new economic opportunities, and promote economic diversity in rural areas.
- Development for a growing human population is encroaching on previously undeveloped areas adjacent to lands administered by the Forest Service and BLM. New development can put stress on the political and physical infrastructure of rural communities, diminish habitat for some wildlife, and increase agency costs to manage fire to protect people and structures.
- Recreation is an important use of agency lands in the planning area in terms of economic value and amount of use. Most recreation use is tied to roads and accessible water bodies, though primitive and semi-primitive recreation is also important and becoming scarce relative to growing demand.
- Industries customarily served by agency land uses, such as logging, wood products manufacturing and livestock grazing, no longer dictate the economic prosperity of the region, but remain economically and culturally important in rural areas. The economic dependence of communities on these industries is highest in areas that are geographically isolated and offer few alternative employment opportunities.
- The public has invested substantial land and capital to develop road systems on agency lands, primarily to serve commodity uses. On forest lands, commercial timber harvest has financed 90 percent of the construction cost and 70 percent of maintenance cost. Recreation now accounts for 60 percent of the use. Trends in timber harvesting and new road management objectives make the cost of managing these road systems an issue of concern.
- For those counties that have benefited from federal sharing of gross receipts from commodity sales on agency lands, changing levels commodity outputs can affect county budgets.
- Agency social and economic policy has emphasized the goal of supporting rural communities, specifically promoting stability in those communities deemed dependent on agency timber harvest and

TABLE OF CONTENTS

processing. Even-flow of timber sales, timber sale bidding methods, timber export restrictions, and small business set-asides of timber sales have been the major policy tools on Forest Service-administered commercial forestlands. Regulation of grazing practices has been important on BLM-administered rangelands.

- ◆The factors that appear to help make communities resilient to economic and social change include population size and growth rate, economic diversity, social and cultural attributes, amenity setting, and quality of life. The ability of agencies to improve community resiliency depends on the effectiveness of agency land uses and management strategies to positively influence these factors.
- ◆Predictability in timber sale volume from agency lands has been increasingly difficult to achieve. Advancing knowledge of ecosystem processes, changing societal goals, and changing forest conditions has undermined conventional assumptions underlying the quantity and regularity of timber supply from agency lands.

Introduction

This section describes the social and economic components of ecosystems in eastern Oregon and Washington. Emphasis is on the relationship of social and economic systems to Forest Service- and BLM-administered lands in the planning area. The economic and social setting described here establishes the context for making land use choices compatible with human needs and expectations for these lands.

The discussion begins with a description of population characteristics and trends for both the Eastside planning area and for the project area as a whole. The population discussion is followed by an overview of how Forest Service- or BLM-administered (agency) lands in the planning area have been used to meet the social and economic needs of people. Employment generated by agency land uses is then described at both regional and county levels. The discussion then turns to communities, with special attention given to community stability, resiliency, and quality of life. The federal laws and policies aimed at supporting rural communities are part of this discussion. Public attitudes, beliefs, and values regarding the use of agency lands are then examined, including the attachment that people feel for special places. The Human Uses and Values section concludes with a discussion of the role the public plays in Forest Service and BLM planning and management.

Material in this section was derived from the *Economics* (Haynes and Horne 1996) and *Social* (McCool et al. 1996) chapters of the *Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins* (Quigley and Arbelbide et al. 1996b; *AEC)*; other sources are referenced as needed. In this section, "agencies" refers to the Forest Service and BLM, and "agency lands" refers to lands administered by the Forest Service or BLM, unless otherwise specified.

The Analytical Context for Human Uses and Values

A comparison of economic, social, and political systems is necessary to provide the proper context for agency decisions regarding economic and social objectives. People-oriented policies of the Forest Service and BLM have historically had a local focus, emphasizing the well-being of individuals, user groups, and communities that are economically or socially connected to agency lands. The local emphasis of Forest Service and BLM policy suggests that social rather than economic policy is the appropriate context for decisions affecting human uses of agency lands.

Economic and Social Systems

Social, political, and economic systems are described and analyzed differently one from the other. Social and political systems are made up of individual units that together form at least a rough hierarchal structure. Social units include individuals, families, small groups, societies, and cultures. Political units include communities, cities, counties, states, and the nation. The administrative units of the Forest Service and BLM are also political entities that exhibit a hierarchal structure. While political leaders and agency managers seek to influence economic events in pursuit of their respective objectives, the nature of economic systems limits this influence. Economies change; resources constantly shift to more efficient uses

TABLE OF CONTENTS

according to market forces, changing technologies, and public tastes. Rather than a hierarchal structure of separate "units," economies are a complex web of interdependent economic relationships operating across many jurisdictions, both public and private, over a large area. The ability of political leaders and agency managers to achieve their economic objectives is limited by their ability to anticipate, account for, and influence larger economic forces.

Another factor relevant to economic and social objectives is the geographic scale at which planned land management activities and outputs are specified. Effects of land use activities cannot reasonably be predicted with more detail than used in assigning those activities. For example, if the location of planned timber harvest is a broad scale multi-county area, such as the ecological reporting units (ERU) used for this Draft EIS, the effects on timber-related employment cannot be reliably predicted at a finer scale, such as a single county, city, or community (Map 1-1 shows the ERU names, numbers, and boundaries). Thus, fine-scale economic impact analysis is incompatible with the broad-scale approach of this Draft EIS. The methodology for fine-scale analysis exists and can be used for local planning problems. For example, a recent study by Robison and McKetta estimated community-level job impacts for a portion of northern Idaho using a set of timber supply scenarios for federal lands (Robsion and McKetta 1996). While these supply scenarios do not correspond to activity levels for timber harvest presented in this document nor what might result from future federal land management plans, they provide examples of how local economic impact analysis might be approached.

Economists on the Interior Columbia Basin Ecosystem Management Project (ICBEMP) concluded that multi-county trade regions developed by the Bureau of Economic Analysis (BEA) were the smallest geographic areas that could be used as a reasonably "closed" economic system. Bureau of Economic Analysis regions are based on commuting distances and newspaper circulation (see Map 2-37). Since this Draft EIS uses ERUs for displaying outputs, BEA-type data were adjusted to these units. This section provides more detailed county-level economic data for its historic value in describing the affected environment, but similar detail was not used to project future economic effects of management alternatives (in Chapter 4). The discussion that follows addresses either planning area (eastern Oregon and Washington) or project area (both EIS planning areas) conditions, whichever is appropriate to the context of the discussion and the available data.

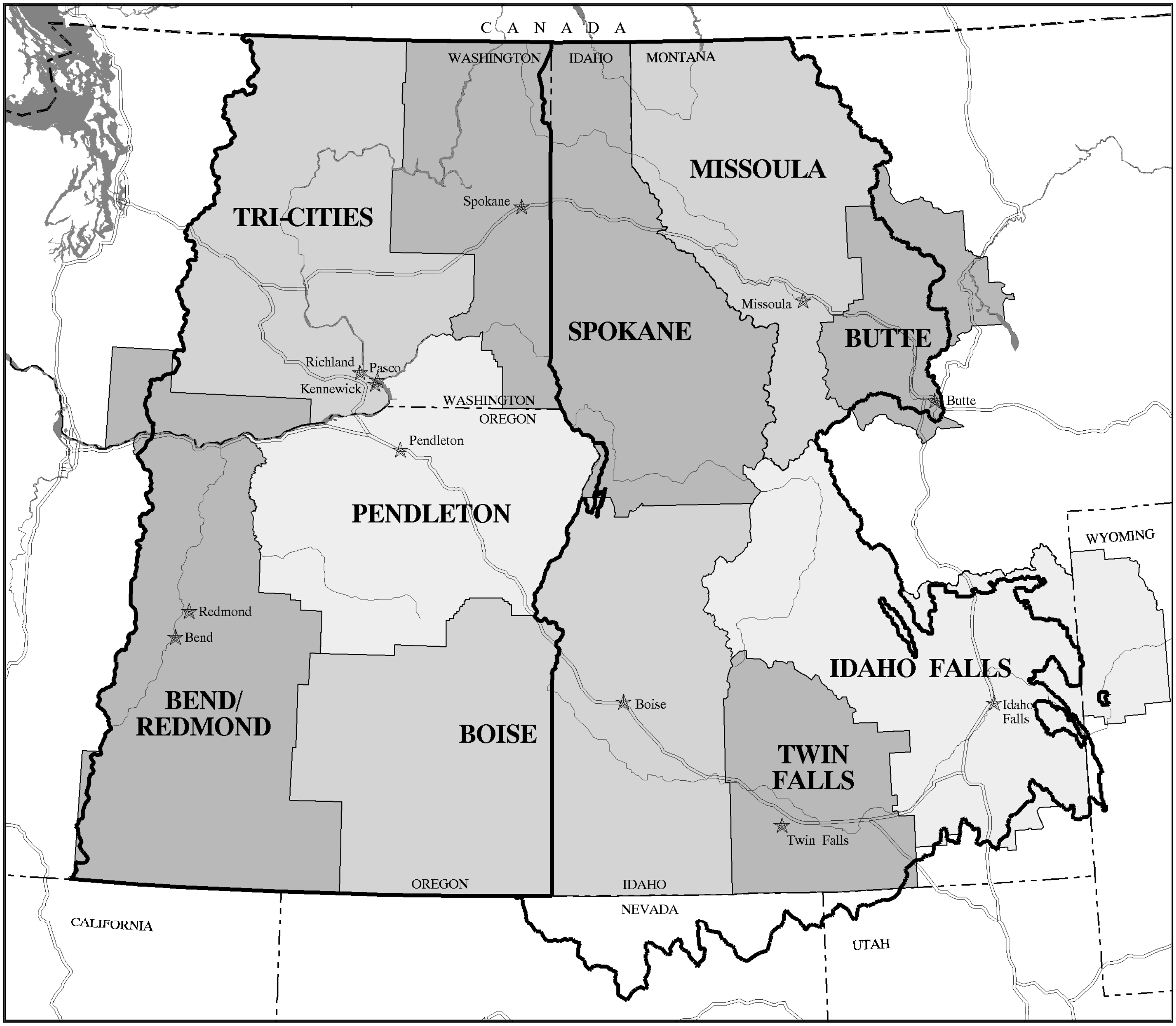
Population

Population density, distribution, and change, along with the demographics of the project area population, are useful factors for describing past and potential economic growth and community resiliency. These factors are also useful for understanding how changing agency land uses could affect cultural and social values of people living in the project area.

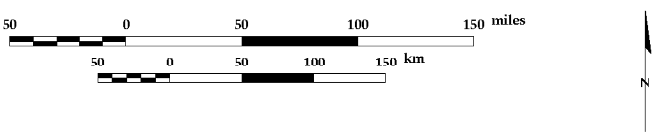
Characterization

The project area is sparsely populated, with a density of approximately 11 people per square mile compared to the national average of 70. Population density in eastern Washington is 27 people per square mile, compared to just 6 people per square mile in eastern Oregon. Population density also differs greatly by county. Nearly half of the population of the project area is located in 12 of the 102 counties, showing a very uneven distribution of population. Only six counties have sufficient population to be classified as metropolitan counties. Only one of these, Spokane County, is in the Eastside planning area. The total 1990 population in the project area was just under three million people (USDC 1991a,b). Washington residents comprise 38 percent of the project area population, compared to 27 percent in southern Idaho, 12 percent in Oregon, 11 percent in Montana, 7 percent in northern Idaho, and 5 percent in Wyoming, Utah, and Nevada. The most populated county is Spokane, Washington (361,400). High population density can be an important indicator of the resiliency of economic systems because it generally corresponds to areas with high economic diversity. A more detailed discussion of the relationship between population and economic conditions is addressed later in this section under the Communities heading.

The age distribution of project area residents is very similar to that of the nation, but contains



Map 2-37.
Bureau of Economic Analysis Economic Subregions



Trade Centers
Economic Subregion Boundaries
Major Rivers
Major Roads
EIS Area Border

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

a larger proportion of people under 18 and a smaller proportion of people who are in prime wage-earning years of 25 to 49 (McGinnis and Christensen 1996). Between 1980 and 1990, the age structure of project area residents changed significantly. The 65-and-over age group increased by a greater proportion (28 percent) than other age groups, while the 18 to 24 group declined by 20 percent. This reflects both the aging of baby boomers and the higher age of people migrating into the area.

The project area contains a larger proportion of Caucasians (92 percent) and American Indians (2.4 percent) than the United States (80 percent and 0.8 percent respectively), and a smaller proportion of African Americans (0.6 percent, compared to 12 percent nationally), and Hispanics (6.7 percent, compared to 9 percent nationally). Hispanics are the largest non-Anglo group in the project area; from 1980 to 1990 the Hispanic population increased by 69 percent.

The project area contains or overlaps with 19 American Indian Reservations and one Colony, some with and some without trust lands ~ a total of approximately 89,600,000 acres, or five percent of the project area. In six counties, reservation and trust lands account for more than 40 percent of the land base. In 1990, approximately 115,000 people (four percent of the project area population) lived within the borders of these lands. Appendix 1-2 and Hanes (1995) contain a list of Indian tribal governments with interests in the region.

Trends

Population growth in the project area over the last 45 years has reflected national trends. Between 1950 and 1970 there was a significant out-migration from rural to urban settings; over one-third of the counties showed population losses. During the 1970s, however, most counties reported population increases, reflecting the "rural renaissance" occurring for the nation as a whole. The 1980s demonstrated a return to traditional urban migration and population patterns (Johnson 1993) also evident in the project area, where 41 percent of the counties decreased in population.

In the early 1990s, another urban-to-rural migration began. Between 1990 and 1994, both eastern Oregon and eastern Washington grew at well above the national rate of 2.6 percent. Population growth occurred throughout the project area, with 96 percent of counties increasing in population between 1990 and 1994; small metropolitan counties grew the fastest at 6.3 percent, followed by nonmetropolitan counties adjacent to metropolitan ones at 5.8 percent. Metropolitan counties in eastern Washington are Benton, Franklin, Spokane, and Yakima; none of the eastern Oregon counties are considered to be metropolitan. Counties in which recreation and tourism play a large role in the economy (Johnson and Beales 1994) accounted for 24 percent of the population increase in the project area. Recreation counties in eastern Oregon are Deschutes, Hood River, and Wasco; and in eastern Washington are Chelan and Okanagon. The vast majority of all towns (86 percent) in the project area also have increased in population since 1990 (Harris 1995).

This high population growth resulted from both higher than average natural rates of increase and in-migration. Johnson and Beales (1994) reported that nationally approximately 43 percent of the population growth in nonmetropolitan counties between 1990 and 1992 was due to migration, as opposed to natural increase (number of deaths subtracted from number of births). Between 1990 and 1994, this percentage was closer to 64 percent for the project area, showing an even greater rate of in-migration.

While many eastern Oregon and Washington communities and counties are growing, some traditionally agricultural counties (such as Gilliam and Sherman in Oregon) have been experiencing population declines, and counties far from metropolitan areas have generally experienced slower growth. Eastern Oregon counties are showing much lower growth rates than eastern Washington counties.

McCool and Haynes (1995) described two projections of future population growth, one based on conservative projections done by the Bureau of Economic Analysis (BEA) and one done by ICBEMP scientists that reflects the more rapid growth actually occurring in the project area (see Figure 2-18). Project area population in many areas already exceeds the BEA projection for 5 to 15 years from now, suggesting that the BEA projections may be too conservative. Under the high estimate, the project area's population would double by the year 2040, although the overall population density would still remain well below the national average.

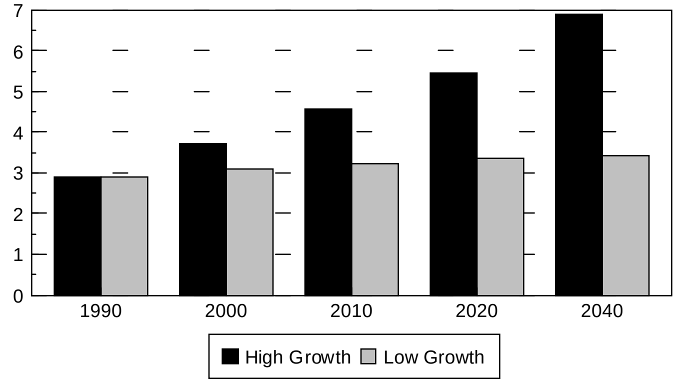


Figure 2-18. Future Population Growth in Project Area - Population of the project area by decade using two different projection assumptions.

Wildland/Urban Interface

Rapid growth in numbers of residential dwellings near forested landscapes has presented new challenges in fire prevention and suppression for federal and local agencies. Recent and projected population growth is highest in locations where developed private land meets undeveloped agency lands known as the wildland/urban interface. As the population of the United States grows older, and more individuals and businesses access markets electronically or through airline and other shipping/delivery services, this trend of increasing migration to high quality of life rural areas is expected to continue. The resulting growth in numbers of residential dwellings near forested landscapes has the potential to fragment habitat, and increase conflicts with wildlife. Fire protection in the wildland/urban interface is a significant enough issue that the Western Governors' Association recently initiated an effort with diverse interests to develop a "Wildland/ Urban Interface Fire Policy Action Report." Federal land managers are called upon in the report to manage fuels in the interface areas (Western Governors' Association 1995). For example, in 1995, the BLM Prineville District began a plan amendment to address such issues in rapidly-growing central Oregon.

Land Ownership and Uses

Of the 68 million acres of land in the eastern Oregon and Washington planning area, 43 percent is administered by the Forest Service or BLM. The ownership pattern of the remaining lands is 46 percent private, 6 percent state or other federal, and 5 percent tribal. The proportion of agency land varies considerably by county (see Tables 2-22 and 2-23 later in this section). In eastern Oregon, 70 percent or more of Deschutes, Harney, Lake, and Malheur counties are administered by the Forest Service or BLM. The proportion is 50 percent or greater in Baker, Crook, Grant, Hood River, Klamath, and Wallowa counties. In eastern Washington, Skamania and Chelan counties have greater than 70 percent of their lands under agency jurisdiction. Columbia, Ferry, Okanogan, and Pend Oreille counties have from 30 to 60 percent under agency jurisdiction. Although economic contributions from agency lands to the regional economy is proportionally far less than the land ownership percentages, the local dominance of these lands has important local economic implications, and perhaps even greater social and cultural implications.

Recreation and Scenery

Supply of Recreation

The project area provides recreational opportunities of local, regional, national, and international importance. It has, on average, substantially greater amounts of available outdoor recreation opportunities compared to the national average, much of it supplied by federal lands (Molitor and Bolon 1995). The BLM and Forest Service provide more than 90 percent of the federally managed recreation acres in almost every ecological reporting unit.

Molitor and Bolon (1995) inventoried recreation opportunities on public lands in the project area using the Recreation Opportunity Spectrum (ROS), which considers characteristics such as road access, amount of development, density of recreation users, level of facility development,

TABLE OF CONTENTS

and natural resource management (Clark and Stankey 1979). McCool and others (1995) collapsed the traditional ROS classes into three broad categories because more detailed classifications have not been uniformly mapped across the planning area. Categories included Primitive/Semi-Primitive (combining primitive, semi-primitive non-motorized, and semi-primitive motorized classes), Roaded Natural (roaded natural and roaded modified classes), and Rural/Urban (rural and urban classes).

Federal land supplies large amounts of primitive and semi-primitive recreation opportunities (see Map 2-38), much of which has been given special status by the Congress. Of roughly 12 million acres that provide primitive-type recreation, approximately 5 million acres are designated as Wilderness or Wilderness Study Areas, Wild and Scenic River Areas, National Scenic Areas, National Recreation Areas, or are administered by the National Park Service. The project area contains 70 percent of the unroaded areas 200,000 acres or larger in the lower 48 states. Few regions in the lower 48 states can match this combination of large-scale, undeveloped areas and low human population density. Access to wildland-based recreation opportunities is important to the rural-oriented lifestyle of area residents and contributes importantly to the region's identity.

The ROS is a convenient way to inventory and display recreation settings, but it does not include the main attractions that draw people to recreation settings, such as water, fish, and wildlife. The presence of water has been and will continue to be the most important draw for recreation visitors. The project area contains an abundance of wild and remote water environments; the average for the project area is nearly three times the national average. In the future, the project area is expected to continue to have proportionately greater amounts of available recreation resources compared to the nation as a whole (English et al. 1993).

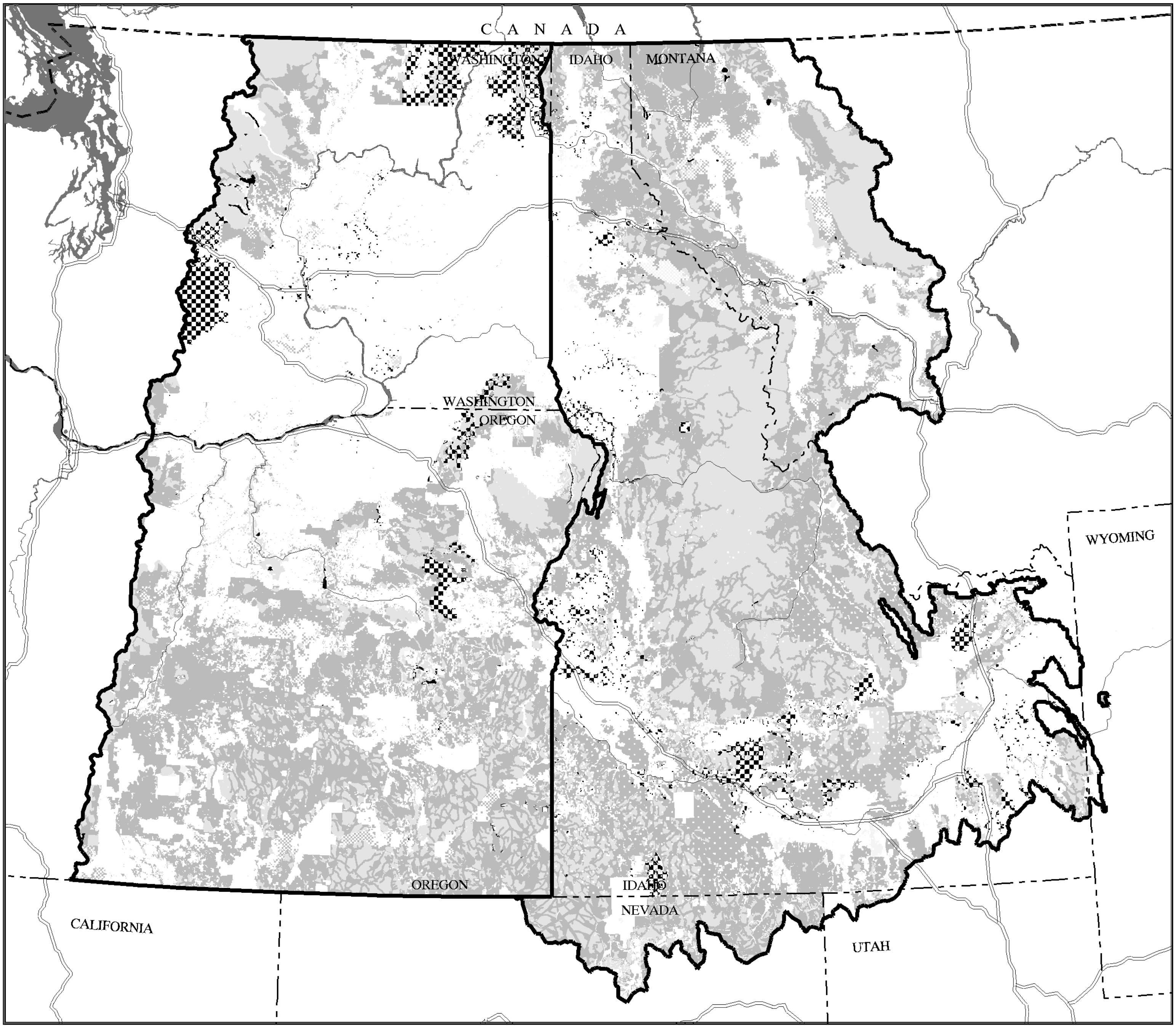
Recreation Use

Between 1991 and 1993 an average of 200 million recreation activity days per year occurred on Forest Service- and BLM-administered lands in the project area. Half of this use occurred in the Eastside planning area, where day use and motor viewing accounted for 45 percent of the recreation activity days. Camping, fishing, trail use, and hunting were the next most popular recreation activities. Approximately one third of this activity occurred in the east Cascade Mountains. Recreation activity also played a major role in the Northern Glaciated Mountains (ERU 7) and Blue Mountains (ERU 6). Roaded natural settings receive approximately 75 percent of all activity days. Activities such as trail use occur mainly in primitive/semi-primitive areas, while camping is mixed, with about half of the visits occurring in roaded natural settings and one-quarter each in primitive/semi-primitive and rural/urban settings. Table 2-19 shows how these visits were distributed by activity across ecological reporting units in the Eastside planning area.

Among National Forests in the planning area, the Wenatchee and Deschutes Forests dominate recreation use, experiencing 30 and 22 percent of total visits respectively. The Wallowa-Whitman, Colville, Umatilla, and Okanogan Forests make up the second tier, experiencing from 13 to 6 percent of total visits. The Winema, Malheur, Fremont, and Ochoco Forests experience the least recreation visits in the planning area. This recreation use data was used in developing the "Importance Index" presented later. Similar figures were not available for BLM-administered lands, which generally receive much less use than National Forests.

Project area residents participate in many outdoor recreation activities at rates higher than national averages.

According to the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation conducted by the U.S. Fish and Wildlife Service, just over 6 million people annually were estimated to have participated in wildlife-oriented activities within the project area. Approximately 20 percent of these visitors were not residents. A substantial amount of the overall non-resident visitation to the area originates from nearby metropolitan areas--Seattle, Portland, and Salt Lake City. Because of its proximity to Canada, the project area attracts over 3 million Canadian visitors annually. Wildlife viewing, photographing, and related wildlife activities were more popular than hunting and fishing in Oregon, Washington, Idaho, and Montana. Projections made by all four states in their Statewide Comprehensive Outdoor Recreation Plans showed that trail use, a majority of which takes



50 0 50 100 150 miles
50 0 50 100 150 km

N

Map 2-38.
Recreation Opportunity Spectrum

BLM and Forest Service Administered Lands Only

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

Not Inventoried
Primitive/Semi-Primitive
Roaded Natural
Rural/Urban
No Data
Major Rivers
Major Roads
EIS Area Border

TABLE OF CONTENTS

Table 2-19. Recreation Activity Days by Ecological Reporting Unit, Averaged 1991-1993.

Activity	Northern Cascades ERU1	Southern Cascades ERU2	Upper Klamath ERU3	Northern Great Basin ERU4	Columbia Plateau ERU5[1]	Blue Mountains ERU6	N. Glaciated Mountains ERU7[1]	Owyhee Uplands ERU10[1]	**Total**
Trail use	2,215,467	1,052,879	252,476	204,648	661,633	1,346,378	2,279,461	462,287	**8,475,229**
Camping	2,838,089	1,628,728	904,477	683,951	872,307	2,580,500	3,648,963	1,010,427	**14,167,442**
Hunting	436,590	504,206	120,455	330,435	791,075	4,519,573	2,347,280	1,209,796	**10,259,410**
Fishing	135,664	1,368,209	137,894	406,263	2,725,315	1,531,059	2,955,824	1,323,905	**10,584,133**
Non-motor	64,574	839,377	50,900	100,618	360,887	103,829	191,698	26,382	**1,738,265**
Viewing wildlife	119,154	1,314,081	48,313	111,811	934,597	435,531	2,498,405	134,763	**5,596,655**
Day use	2,234,015	3,623,842	1,757,594	701,225	3,434,809	3,185,049	11,818,900	737,851	**27,493,285**
Motor boating	95,699	73,817	87,884	190,470	55,449	246,517	3,037,015	818,016	**4,604,867**
Motor viewing	6,762,177	3,804,620	290,988	838,391	1,377,152	1,794,295	5,689,239	970,497	**21,527,359**
ORV use	446,160	93,947	17,464	116,022	79,135	191,414	383,089	288,540	**1,615,771**
Winter sports	846,252	1,237,132	62,672	128,128	137,742	1,027,098	391,823	535,814	**4,366,661**
Snowmobiling	214,450	104,562	36,185	32,506	43,272	165,547	263,901	47,767	**908,190**
Total	**16,408,291**	**15,645,400**	**3,767,302**	**3,844,468**	**11,473,373**	**17,126,790**	**35,505,598**	**7,566,045**	**111,337,267**

Abbreviations used in this table:
ORV = off-road vehicle
ERU = Ecological Reporting Unit

[1] Figures shown are for entire ERU, not just the portion in the Eastside planning area.

Source: Haynes and Horne (1996).

Table of Contents

place in less-developed settings, is expected to be one of the fastest growing activities.

Scenery

Scenery is important to both residents of and visitors to the project area, contributing to quality of life and supporting economic benefits through recreation and tourism. According to the Forest Service 1990 Resources Planning Act (RPA) program update, viewing scenery has the highest participation rate of any recreation activity in the United States, with approximately 21 percent of the population participating. The demand for natural-appearing landscapes is expected to outpace the demand for modified landscapes. Washington and Oregon State Comprehensive Outdoor Recreation Plans identified a need for nearly 19 million acres of natural-appearing landscapes to meet projected recreational demands by the year 2000. This compares to a need for approximately 5 million acres of more developed landscapes (FEMAT 1993). Of the 144 million acres within the project area, more than 37 million have been altered by agricultural and industrial development. Most of these changes are found on private land.

The supply of scenery in the project area was measured in terms of landscape themes and degree of scenic integrity. Landscape themes were identified for each of the 394 ecological subsections within the project area. An ecological subsection is a geographic subdivision that has similar climate, topography, vegetation, and other physical features. Map 2-39 shows the primary landscape themes for each ecological subsection in the project area. Table 2-20 shows the acres in each scenic integrity class, and Map 2-40 shows their location.

Issues in Recreation Supply and Management

The most recent Statewide Comprehensive Outdoor Recreation Plans (SCORP) for Oregon, Washington, Idaho and Montana were surveyed to help define other current recreation issues for BLM and Forest Service, such as the need for cooperation and coordination among land management agencies, funding problems, and maintenance and development of facilities. Several other common issues, though not among all state SCORPs, include access, education and information, and liability.

Perhaps the issue of biggest concern is financial. The supply and quality of recreation opportunities will decline relative to increases in population and use without continued investment and maintenance of recreational resources and facilities. Forest

Table 2-20. Scenic Integrity in the Project Area.

Scenic Integrity Level	Present Situation[1] (x 1,000 acres)	% All Ownerships	% Forest Service- or BLM-administered Land
Very High	30,727	21	31
High	30,631	21	27
Moderately High	44,634	31	32
Moderately Low	13,254	9	8
Low	1,788	1	1
Not Classified[2]	23,437	16	<1

Abbreviations used in this table:
BLM = Bureau of Land Management

[1] Existing scenic integrity.
[2] Data is not currently available for determining scenic integrity levels for lands within *Agricultural* or *developed* themes; therefore, they were not classified in McCool et al. (1996).

Source: ICBEMP GIS data (calculated from predicted road density and coarse scale vegetation, 1 km^2 raster data).

TABLE OF CONTENTS

Service and BLM budgets for recreation are declining, making it difficult to adequately staff and maintain existing facilities and settings (Lundgren 1995). In response, federal land managers are contracting out more and more recreation operations, from large-scale recreation and wilderness planning efforts to management of campgrounds and reservation systems for river running and other activities.

Cultural Resources

Cultural resources are the nonrenewable evidence of human occupation or activity as seen in any area, site, building, structure, artifact, ruin, object, work of art, architecture, or natural feature, which was important in human history at the national, state, or local level. There is, however, more than one view of what constitutes cultural resources. The academic and legal definitions tend to focus on tangible evidence such as sites and artifacts. American Indians find this definition too narrow. They view their entire heritage, including beliefs, traditions, customs, and spiritual relationship to the earth and natural resources as sacred cultural resources (Columbia River System Operations Review FEIS 1996).

The project area has been occupied by humans for more than 12,000 years, hence it has much evidence of human activity. By its nature this evidence is site-specific. The detail of site-specificity is beyond the scope of the broad-scale nature of this document, and therefore management objectives, standards, and guidelines were not developed for cultural resource sites. This in no way detracts from the significance of cultural resources or the need to appropriately protect them. The inventory, detailed descriptions, and protection or mitigation of site-specific cultural resources are better discussed on a site-specific level, and will be addressed in BLM and Forest Service management plans, activity plans, and other finer-scale environmental and ecosystem analyses.

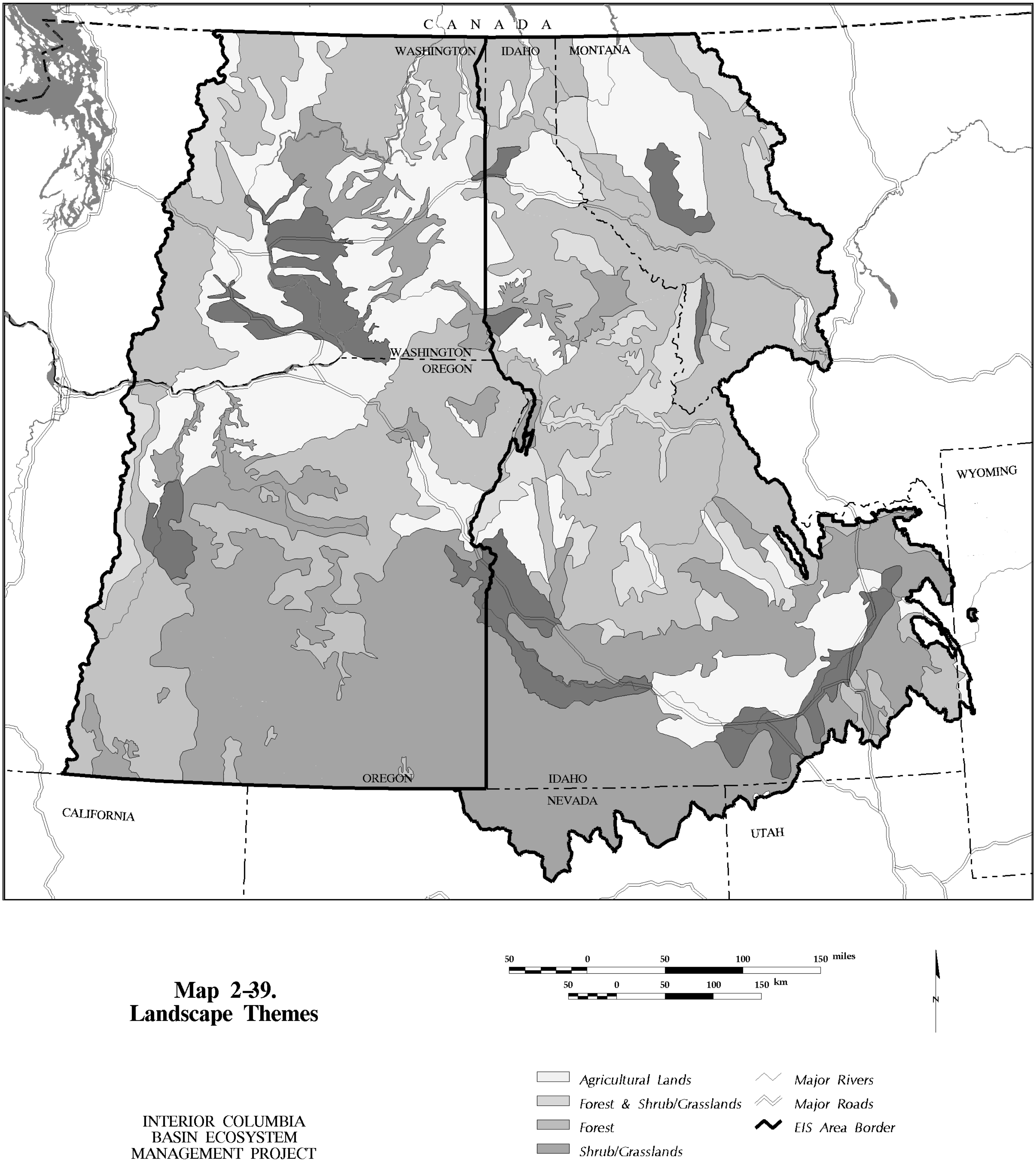
Livestock Grazing

Livestock grazing is historically important in the planning area both culturally and economically, although the contribution from agency lands is small relative to total production. In Oregon, 1,790 federal permittees use agency forage for 23 percent of total feed. In Washington, 450 permittees use agency forage for 13 percent of total feed. Holders of BLM or Forest Service grazing permits typically run larger, more profitable operations than non-permit holders (Frewing-Runyon 1995). In 1993, BLM rangelands produced 463,000 Animal Unit Months (AUMs; see Key Terms) in the planning area. National Forest rangelands produced 293,000 AUMs.

Ranchers in 28 of 40 Eastside counties relied on Forest Service and BLM for less than 10 percent of their total forage needs. Ranchers in 11 counties relied on less than 1 percent. The average was 11.2 percent for eastern Oregon and 1.4 percent for eastern Washington, showing that ranchers in eastern Oregon counties experience a greater use of agency forage than ranchers in eastern Washington counties (Frewing-Runyon 1995). Skamania and Chelan counties in Washington were significantly above the Washington average, using Forest Service and BLM forage for 48 and 33 percent of total forage respectively. Reliance on agency forage, as a percent of total forage needs, was used in developing the “importance index” introduced later. Sales of cattle raised on BLM and Forest Service forage, at least in part, account for an average of two percent of

Landscape Themes

Landscape themes range from an essentially natural landscape, such as wildernesses, to one that is highly developed, such as an urban area. Themes indicate how people perceive environments in a very general sense. Themes are images formed by combining landscape character (natural attributes) and scenic condition (human or cultural attributes). They are not goals for future management, but show what currently exists. The five themes used to describe project area landscapes are Forest and Shrub/Grasslands (Naturally Evolving), Forest Lands (Natural Appearing), Shrub/Grasslands (Natural Appearing), Agricultural Lands, and Developed Areas (Galliano and Loeffler 1995a).

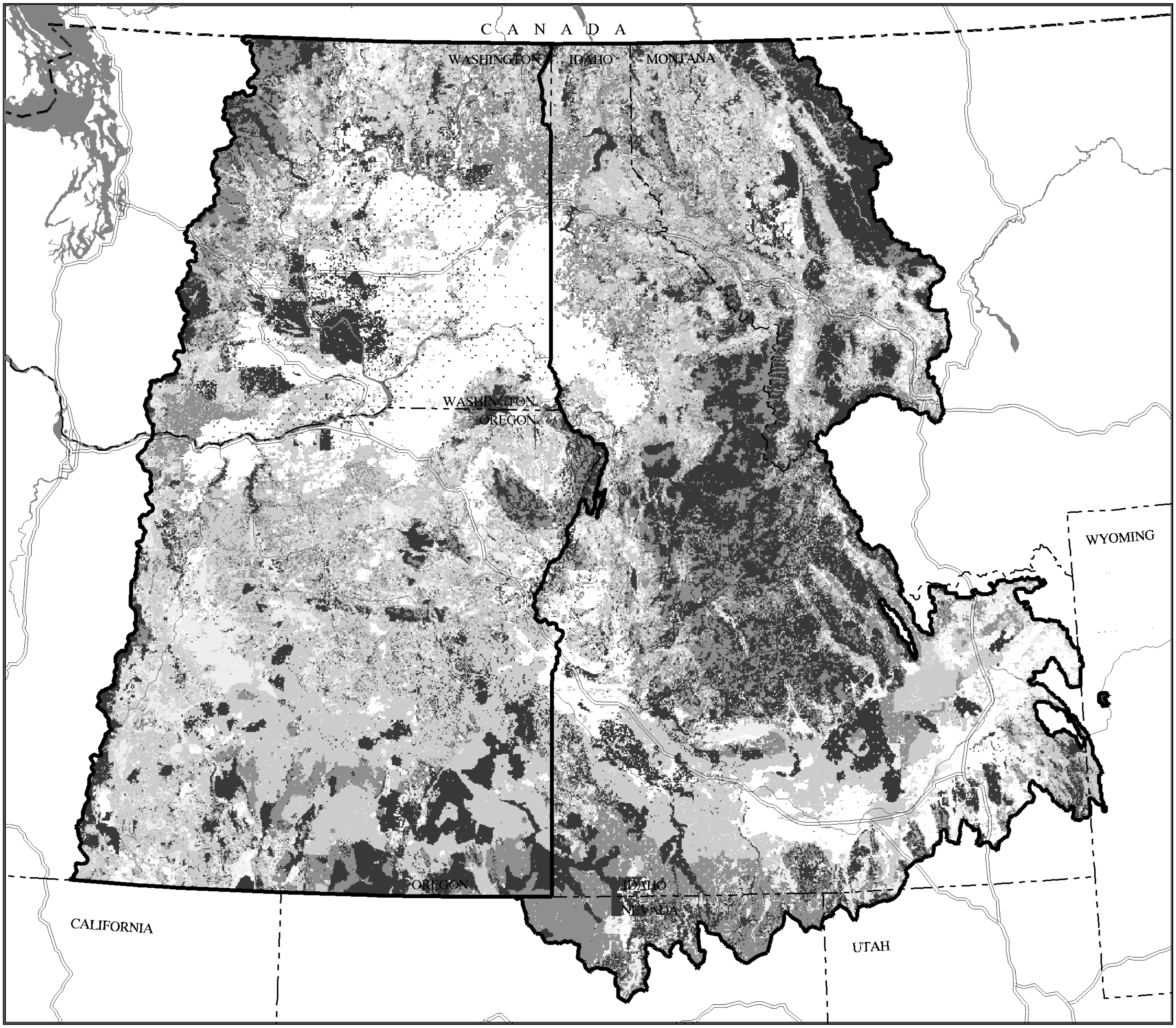


Map 2-39.
Landscape Themes

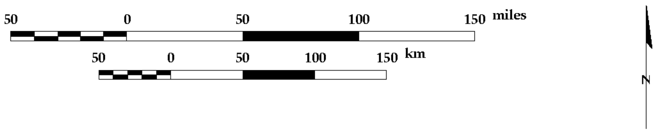
INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

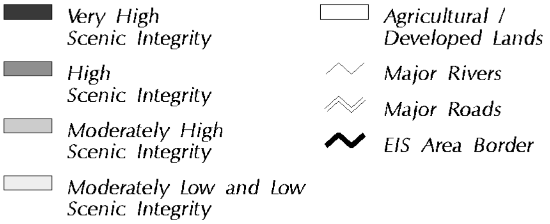
Project Area
1996

TABLE OF
CONTENTS



Map 2-40.
Scenic Integrity Classes





INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

Scenic Integrity

Scenic integrity in the project area was described using five categories, ranging from very high, where the landscape is visually intact with only minute deviations, to low, where the landscape is heavily fragmented and human activities and developments strongly dominate the landscape character. Scenic integrity is not necessarily the same as high quality scenery. For example, large expanses of open grassland that contain few developments may score high on integrity, but may not be the type of landscape typically associated with high scenic quality. Similarly, landscapes may contain roads and other types of developments, and still be considered highly scenic (Galliano and Loeffler 1995a).

total agricultural sales in the project area. Table 2-21 shows the relative contribution of livestock production in agricultural sales for the BEA regions dominant in the planning area, and the importance of agency forage to that production (Frewing-Runyon 1995).

The Departments of the Interior and of Agriculture expect the number of cattle grazing on public lands to decline by approximately one percent per year for the next 20 years. Evidence indicates that, as ranchers grow older, more leave the field than enter it. In some rural areas experiencing rapid population growth, base properties (home ranches) where herds overwinter are being converted to resort or residential developments, or to dairy operations. For sheep, the elimination of the wool subsidy resulted in some marginally profitable operations selling off all of their lambs rather than retaining female lambs as replacement ewes. These, and other ongoing trends, are acting to reduce the size of herds and flocks operating on the public lands (USDI, USDA 1994).

Seasonal Forage Use

Total Forest Service and BLM forage use underestimates the importance of this forage to livestock operators. Agency forage is often more relied upon by ranchers than suggested by total supply figures because of their seasonal grazing patterns. It is not the total feed, but the number of livestock feeding part of the year on agency rangelands that many stress as an important factor. Seasonal use of Forest Service- and BLM-administered lands occurs approximately 25 to 30 percent during spring, 24 to 30 percent during summer, 21 to 27 percent during fall, and 2 to 7 percent during winter. Later in this section, Tables 2-22 and 2-23 display Forest Service and BLM forage used by livestock in each county in eastern Oregon and Washington.

Grazing Fees

Grazing fees for most western public lands administered by the BLM or Forest Service is $1.35 per AUM in 1996, down $0.26 from 1995. The formula used for calculating the fee, established by the Congress in the 1978 Public Rangeland Reform Act, has continued under a presidential executive order issued in 1986, in which the grazing fee cannot fall below $1.35 per AUM. The annually adjusted grazing fee, which takes effect every March 1, is computed by using a 1966 base value of $1.23 per AUM, which is then adjusted according to three factors ~ current private grazing land lease rates, beef cattle prices, and the cost of livestock production. The fee decreased for 1996 because of lower beef cattle prices and higher production costs.

Commercial Timber Harvest

Regional Trends

Timber supply and demand are determined by the simultaneous interaction of global, national, regional, and local consumers, producers, and land owners. Timber harvest levels in the project area have been declining since the early 1960s as a proportion of the total United States harvest, currently standing at ten percent of total. Combined timber harvests for all owners in the planning area declined by roughly seven percent since 1986 and are expected to decline by another five percent by the end of the decade (1990 RPA). More timber was harvested from forest industry-owned land than from other private lands.

TABLE OF CONTENTS

Table 2-21. Relative Importance of Livestock Production in Agricultural Sales for Dominant Eastside BEA Regions.

Trade Regions	Farm/Ranch Income as Percent of Total Labor Income	Value of Agricultural Products Sold (millions of 1992 dollars)	Cattle/Calf Sales as Percent of Total Agricultural Output	Dependency on Federal AUMs[1]
Tri-Cities	12.3	2,196	22.3	1.4
Spokane	3	646	14.5	2.5
Pendleton	9.5	780	30	6.6
Redmond-Bend	5	388	30.1	9.1

Abbreviations used in this table:
BEA = Bureau of Economic Analysis
AUMs = animal unit months

[1] Use includes that portion of total forage consumed by cattle and sheep in an area provided by permitted use of Forest Service- and BLM-administered lands. Use percentages understate rancher dependency on this forage due to seasonal grazing needs and the number of cattle in feedlots and dairies that also consume feed and contribute to total cattle/calf sales.

Source: Frewing-Runyon (1995).

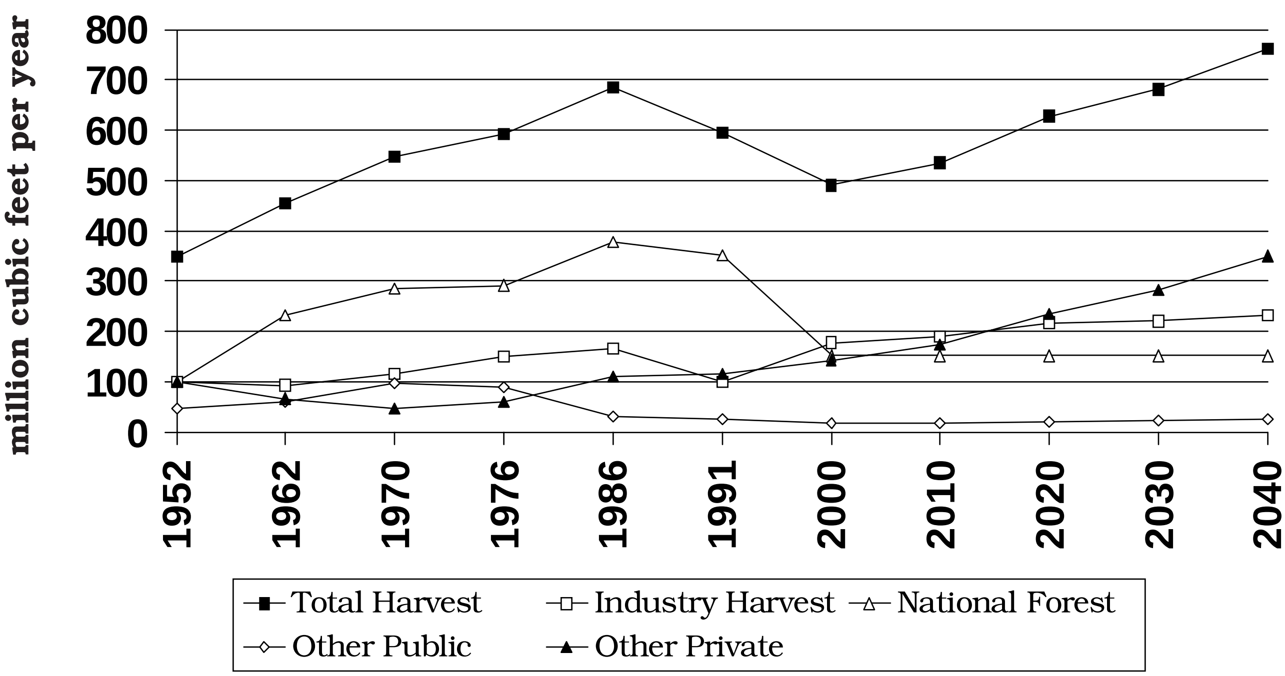


Figure 2-19. Timber Harvest by Owner - Historic and projected timber harvest in eastern Oregon and Washington by owner group.

Timber harvest from agency-administered lands accounted for 59 and 65 percent of the total for the planning area in 1991 and 1994 respectively. The dominance of federal supply is expected to change in the next 50 years, as forest industry and other private harvest becomes relatively more important. The amount of federal timber production in the planning area has historically been dominated by harvest from National Forest System lands. Timber production on BLM-administered lands is only significant on the Klamath Falls Resource Area (Lakeview District) in Klamath County, Oregon where it has contributed from two to nine percent of total county harvest since 1978. Forest Service and BLM timber harvest volume relative to the total harvest in the planning area is shown in Figure 2-19.

Timber Supply by County

The proportion of National Forest timber harvest as a percentage of total harvest varies considerably by county and state as measured by the average of harvest between 1978 and 1993 (see Tables 2-22 and 2-23 later in this section). Eastern Oregon counties rely to a greater extent on Forest Service timber harvest than eastern Washington counties. For example, Forest Service harvest volume accounts for 74 to 95 percent in Crook, Deschutes, Grant, and Harney counties; 41 to 60 percent in Umatilla, Morrow, Union, Hood River, Klamath, Wallowa, Wheeler, and Lake counties; and 27 and 36 percent in Wasco and Jefferson counties. In eastern Washington, Forest Service harvest accounts for greater than 40 percent in only 5 counties, including Asotin, Columbia, Chelan, Skamania, and Garfield counties. Yakima, Ferry, Kittitas, Pend Orielle, and Okanogan counties experience 26 to 34 percent Forest Service harvests. The percentage of Forest Service timber harvest in each county is used in developing the "importance index" described later.

Other Forest Products

Because of the long history and economic significance of logging and milling, the role of special forest products is sometimes overlooked. The collection of forest plants for commercial processing and trade is a small but growing industry. It is estimated that this industry is already producing several hundreds of millions of dollars per year in product sales. More than three-fifths of this value came from floral greens and Christmas ornamentals. Other significant special forest products include wild edible mushrooms, huckleberries, and medicinals. In this industry, an estimated 70 percent of jobs involve low-paying and seasonal harvesting activities. The other 30 percent of jobs, which are better paying, are in processing and marketing (Schlosser and Blatner 1994).

The number of permits granted to collect special forest products is expected to increase substantially. This will result in the need to manage the resource to assure it remains sustainable. Adjustments to silvicultural practices to support the growing conditions of species that comprise special forest products may be necessary.

Mineral and Energy Resources

For more than a century, deposits of gold, silver, and base metals, including copper, lead, and zinc, have contributed to the regional economy and, by extension, to the nation's wealth. Most mining activity has occurred in the Upper Columbia River Basin portion of the project area; however, gold placers have been worked in many places within the planning area since the 1800s. Other metals including aluminum, molybdenum, tungsten, nickel, chromium, magnesium, and antimony have played substantial roles in regional and local economies; potential for new discoveries is high. Non-metallic mineral products including phosphate rock, gemstones, and a wide range of construction and industrial minerals have been mined in the planning area.

Development of coal, oil, natural gas, and geothermal resources has been locally significant in the past and may be expanded in the future. Mining and mineral processing in the United States are subject to increasingly complex and time-consuming requirements from federal and state laws; as a result, the mining industry is shifting more and more of its exploration and production activities to other nations. Costs include lost opportunities for income and employment in the U.S., and possible environmental degradation in other countries.

Aluminum reduction is a worldwide industry with a significant portion of world production coming from the United States, particularly the Pacific Northwest. Four aluminum smelters

TABLE OF CONTENTS

are located in the planning area. Smelters in Washington include ALCOA in Wenatchee, Kaiser in Mead, and Columbia Aluminum in Goldendale; Northwest Aluminum is in The Dalles, Oregon. These plants, along with one in Montana, have made up between 17 and 21 percent of the United States operating capacity available since 1981.

Approximately 11 tons of sand, gravel, and stone are produced annually per capita in the project area. Sand, gravel, and stone form the base for infrastructure and other construction. Any economic or population expansion in the region necessarily will be accompanied by expanded demand for these construction materials; the result will require increasing production at operating sites and possibly creating the need to develop new sites.

Additional information on minerals and energy resources can be found in Appendix 2-3.

Geothermal

Geothermal energy is used at approximately 120 sites in the project area. The greatest number of sites are at resorts and swimming pools, but 44 sites are district utilities or space heating projects, principally in southern Oregon and Idaho. In addition, 25 greenhouse and aquaculture sites have been developed, mainly in Idaho, but also in Oregon and Nevada. Three sites in Oregon and one in Nevada have been put to industrial use. The first geothermal-electric power generating station in the project area was announced in 1995. The plant, in southern Harney County near Fields, Oregon, is planned to go on line in 1998. The second power generation project (Newberry Crater) was approved by the Oregon Energy and Facility Siting Council in 1996 and is scheduled to be on line between 1998 and 1999.

Oil and Gas

Exploration for oil and gas has been conducted in the project area since the early 1900s. Approximately 3,000 test wells have been drilled. Most activity in the last 30 years has been in the Upper Columbia River Basin portion of the project area. Geophysical exploration in the planning area in the 1970s detected potential natural gas reservoirs under basalt lava flows in the central Columbia Plateau (ERU 5).

Coal

Coal has been mined from 13 fields within the project area; none are currently in operation. The only three fields in the Eastside planning area are in eastern Washington. Little coal is present in eastern Oregon, with the exception of the Grande Ronde lignite field.

Economic Value

The value of recent mineral production in eastern Oregon for 1992, 1993, and 1994 was $214 million, $226 million, and $254 million respectively. For the same years in eastern Washington, the production value was $469 million, $505 million, and $556 million. Mining directly contributes approximately 0.1 percent for Oregon and 0.3 percent for Washington (1990). The mining contribution to overall output in the project area was 4.2 percent. The majority of this was from nonfuel minerals, with the mineral fuels accounting for less than one quarter of the mining contribution. In Washington, the value of mineral production has increased steadily, especially in the late 1970s and 1980s. While part of this increase was due to expanded gold production, most was a result of strong demand for construction materials, especially cement, sand, gravel, and crushed stone. Nearly 100 percent of Oregon's modest mineral production value has been created from construction and industrial minerals. The mining sector's contribution to employment in Oregon and Washington ranged from approximately 0.1 to 1.5 percent of the individual state totals. Mining earnings ranged from 0.2 to 3 percent of total earnings for the project area.

Project area counties produced nonfuel minerals valued at nearly $913 million in 1992 (3 percent of total United States mineral production value). Twenty counties (including a few just outside the project area) accounted for more than 90 percent of this value in the last decade. The production of metals represented the dominant portion (75 percent) of nonfuel minerals, mostly from the production of gold. Silver, copper, molybdenum, magnesium, lead, zinc, phosphate, and sand and gravel also feature prominently in the project area.

Utility Corridors

The utility industry is an integral part of the socio-economic structure of the Pacific Northwest. Economic viability of the region is due to the ability of the industry to provide adequate, efficient, economic, and reliable energy and communications services. Utility services have played a major role in bringing major industries to the region and to the establishment of financially viable communities which are essential to the region's socio-economic well-being. In addition to providing basic energy and communication services, other benefits include flood control, navigation for shipping Northwestern products nationally and internationally, irrigation, and recreation opportunities.

Forest Service- and BLM-administered lands in the project area contain thousands of linear miles of land that serves as transportation and utility corridors, including state and federal highways, county roads, electric power lines, natural gas pipelines, and other infrastructure which link human communities in the region. Hydroelectric facilities on federal lands are licensed pursuant to the Federal Power Act of 1920. Designation of Scenic Byways on BLM- and Forest Service-administered lands was recognized in the Intermodal Surface Transportation Efficiency Act of 1991. Designation of utility corridors through land use plans was included in the Federal Land Policy and Management Act of 1976.

Utility corridors (electric, pipeline, and communications) connect generation sources (such as hydroelectric dams) with customers. Regulations require the consideration of designating corridors in the land use planning process.

The designation of utility corridors through land use plans can help minimize the proliferation of such rights-of-way that might occur if there were no planning. Congress recognized environmental and socio-economic concerns in the 1970s, at a time of rapid growth in energy development in the western United States, and authorized both the Forest Service and the BLM to issue regulations for lands they administer. In the project area, corridors associated with the development of the region's hydropower system have affected a substantial amount of land. Maintenance of the existing infrastructure, including reducing hazards from vegetation growth, requires access to maintain utility services. In addition to the existing corridors in use, other corridors have been designated for possible future expansion when warranted.

Road System

A discussion of the road system currently in place on National Forest and BLM lands is included because road access is important to many users, supports the bulk of economic activity generated from agency lands, and represents a substantial public investment. This discussion describes the amount and type of roads on agency lands, construction and maintenance costs for the road system, and the human uses and values attributed to unroaded areas.

Road Inventory

The inventoried road system on Forest Service- and BLM-administered land in the project area includes approximately 91,300 miles of roads ~ 90 percent of which are on National Forest System lands. The 62,900 mile road system in eastern Oregon and Washington National Forests is well-developed relative to National Forests in the project area as a whole, accounting for 76 percent of total road miles. In the planning area, 85 percent of roads serve high clearance vehicles (roads designed and maintained to a *low standard*), leaving only 15 percent of roads for passenger vehicles (roads designed and maintained to a *high standard*). This ratio is fairly consistent with agency lands in the project area. The 85 percent of low standard roads in the planning area provides for most operational needs of land and resource management and protection, plus they provide dispersed, roaded recreation. The remaining 15 percent of high standard roads serve both management and concentrated recreation use. It is estimated that 28 percent of the low standard roads are closed to the public by gates or earth barriers for all or most of the year.

Construction and Maintenance Costs

Roads are tangible physical and financial assets that represent a substantial commitment of land and capital as well as a considerable and expensive public investment to facilitate use of Forest Service- and BLM-

Table of Contents

administered lands. This is shown by the following Forest Service-derived costs. Roads in the planning area typically cost from $10,000 to $150,000 per mile to construct and $100 to $1,600 annually per mile to maintain, depending on the topography and type of road built. Based on current construction costs, the road system would cost approximately $1.75 billion to build today. Historically, commercial timber harvest paid for 90 percent of construction costs and 70 percent of maintenance costs. The rest was paid for by congressional appropriations. In the absence of commercial use, maintaining the existing road system at current standards would continue to cost an estimated $10 million annually. Maintenance costs are highest for high standard roads averaging $550 per mile (Abernathy 1996). In addition to out-of-pocket costs, roads reduce or eliminate the productive capacity of those acres committed to the road prism and waste areas.

Currently in the Pacific Northwest, National Forests are approximately 30 to 50 percent short of funds to maintain the current road system to existing standards. Construction and deconstruction funds have decreased from approximately $200 million in 1980 to $25 million in 1995. This reflects both lower appropriated funding as well as declines associated with purchaser credits from timber sales (which declined from 5.2 billion board feet in 1980 to less than 1 billion in 1995). The use of the transportation system in Pacific Northwest National Forests has changed over the last decade. In the 1980s, system usage was approximately 70 percent timber harvest, 20 percent recreation, and 10 percent administrative traffic. Since the reduction in timber sale programs, this has shifted to 35 percent timber, 60 percent recreation, and 5 percent administrative traffic (Kozlow 1995).

Roads in the planning area have enabled almost all of the economic activity generated by federal lands to take place, and will continue to be critical in this respect. Roads also supply or enable the majority of recreation use, including winter recreation. However, the increasing scarcity of unroaded areas and appreciation for unroaded benefits puts substantial, if intangible, value on unroaded lands. The benefits of unroaded areas can include high quality water, habitat for wildlife and fish, ecosystems with limited human disturbance, scenery, and primitive recreation. The extent to which road systems are developed is critical when determining whether an area is to be considered for wilderness or similar designation. Building roads in areas previously valued for their unroaded condition generates a cost for lost opportunity, in addition to added benefits associated with automobile access. Looking to restore or protect certain environmental conditions, road management options now include various degrees of road closures, lower maintenance levels, and full road obliteration. This “disinvestment” approach is also a logical response to reduced funding for road maintenance that can be expected if commercial use decreases. Costs of this strategy include the cost of closing and obliterating roads, costs of short-term environmental considerations, and lost access for managers and the public. The total cost of lost access depends on miles of roads lost, road maintenance class, and location.

Local, Regional, and National Use

A discussion of the different kinds of economic contributions that National Forest and BLM-administered lands provide society is necessary because land use choices will benefit people differently. Recognizing these differences is essential for achieving economic and social goals.

Generating Wealth versus Generating Value

There is a difference between valuing Forest Service- and BLM-administered lands based on how they serve national demands versus economic contributions they make locally. The economic value and societal importance of these lands continues to increase as use increases and as the unique attributes they provide become scarcer. However, this increased value does not necessarily generate local income or funds to support local government investments in infrastructure or social services. Much of the value is enjoyed by those living elsewhere, who either travel to federal lands to recreate, use water downstream from federal lands, catch fish spawned in federally managed streams, or benefit from the protection of important federally managed ecosystems. A complete accounting of economic benefits would include value obtained by people who may not ever visit the project area, but who benefit from knowing it exists now and in the future. Often referred to as existence or preservation values (Duffield 1994), these indirect benefits can range from 3 to 20 times greater than benefits flowing from direct use of a resource. The magnitude of the numbers are subject to dispute, but there is no question that project area resources have value aside from their role in the marketplace.

Traditional commodity uses of Forest Service- and BLM-administered lands have favored local use and generated local income. Uses that are growing in importance favor regional and national users and generate benefits accordingly. This can be interpreted as a shift of Forest Service- and BLM-administered lands from being primarily local and regional assets to being national assets. While these lands have always been national assets by definition, the actual use and the way the lands are valued increasingly reflect this.

Payments to Local Government

The Forest Service and BLM make payments to local governments to compensate them for the non-taxable status of the federal lands in their jurisdiction. These are known as PILT, or Payments in Lieu of Taxes. The formulas used to calculate the amount of money received varies by agency and product. Generally there is a "per acre" payment associated with county population plus an additional "revenue-sharing" amount available if revenues exceed a certain threshold. While the PILT payment is fixed, the extra money from revenue sharing is important to some counties. Schmit (1995) has recently shown that 15 counties in eastern Oregon and 9 counties in eastern Washington received money in excess of per acre PILT payments from the sale of products from Forest Service- and BLM-administered lands. The percentage of total county budget derived from these federal payments was used in the development of the "Importance index" presented next. Potential reductions in these payments resulting from changes in agency land uses are a concern to county governments accustomed to this revenue. For counties within the jurisdiction of the Northwest Forest Plan, the Congress has legislated special appropriations to partially offset revenue losses stemming from reductions in agency timber sale receipts. Only a few counties in the planning area qualify for these off-setting payments.

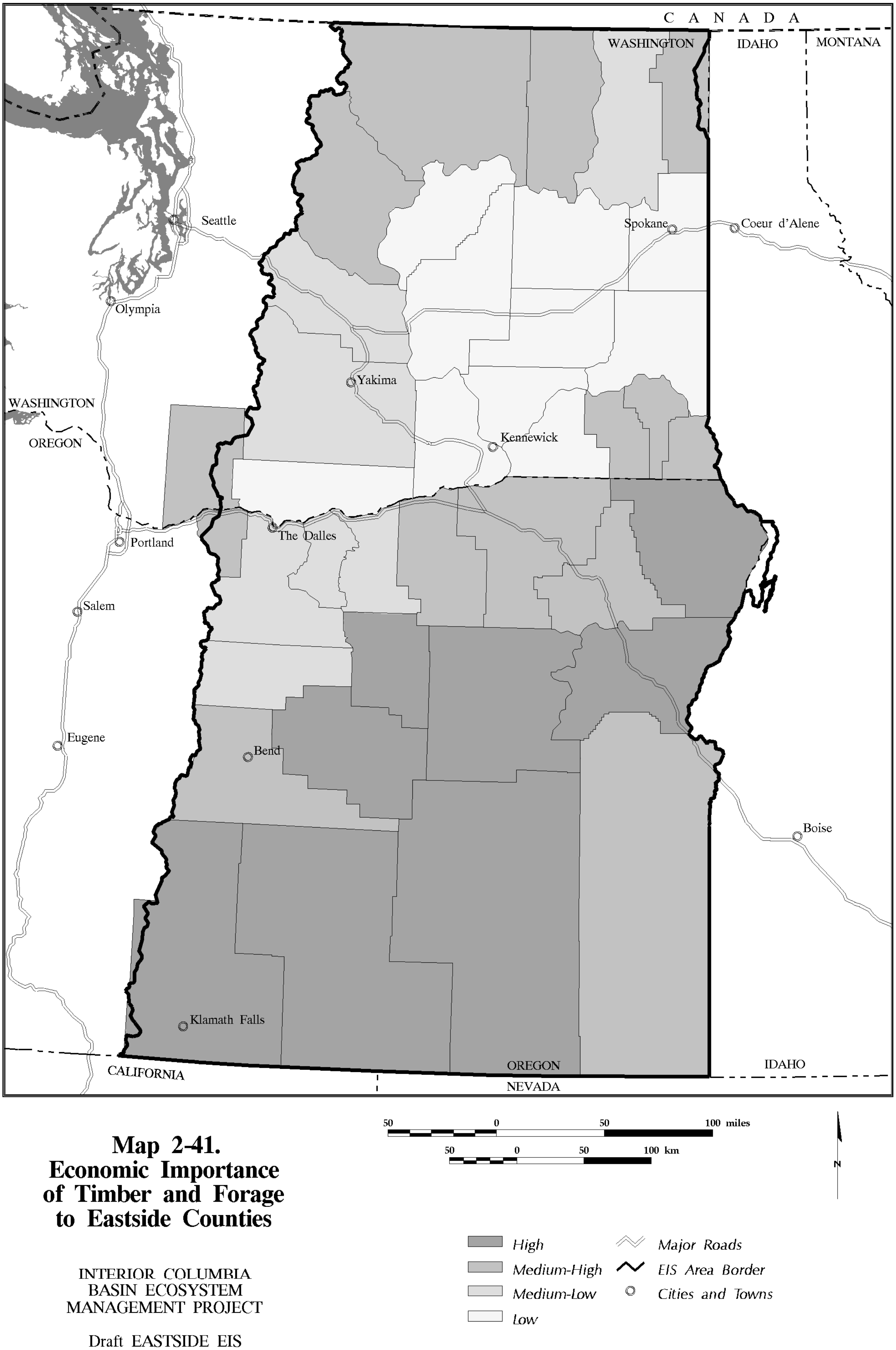
Economic Importance of Agency Timber and Forage to Counties

Relating the use of agency lands to economic conditions locally (the county or community level) is of vital concern to the public and to local governments. While economies operate over much larger areas, agency economic and social policy generally focuses on communities. The "timber and forage importance index" presented here provides a partial but useful picture of the historical relationships between agency land uses and local economic activity.

Reyna (1995) developed the "importance index" to compare the relative economic value of timber and forage supply from Forest Service- and BLM-administered lands to counties in the planning area (see Map 2-41 and Tables 2-22 and 2-23). This index represents the economic importance to individual counties, not to the regional economy. The index categories are low, medium low, medium high, and high importance. Assigning a county to a category is based on the summed score of five factors: county population change; percent of Forest Service- and BLM-administered land in the county; percent of Forest Service and BLM forage and timber supply; percent of county budget from federal land payments; and recreation visits. Population growth and high recreation use reduce the economic score, while high percentage of land ownership, forage and timber supply, and federal payments to counties increase the score. The score-lowering effect of high population growth and recreation visits stems from the assumption that they generate economic activity independent of forage and timber use. While it is recognized that Forest Service- and BLM-administered lands are very important to recreation use, the index assumes that recreation visits can be compatible with forage and timber use, an assumption based in part on recent recreation use and timber harvest data from National Forests in the planning area.

Additional insights can be gained by relating the county importance index to other economic measures such as employment, county economic resiliency, and personal income (these data are shown in Tables 2-24 through 2-28 and Map 2-42 [later in this section]). For example, Washington's Klickitat and Stevens

TABLE OF CONTENTS



Map 2-41. Economic Importance of Timber and Forage to Eastside Counties

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

Draft EASTSIDE EIS
1996

TABLE OF CONTENTS

counties are rated low and medium low in Forest Service/BLM timber and forage importance, but have large wood products manufacturing sectors (14 and 13 percent employment respectively). This may mean that mills are processing Forest Service timber harvested from neighboring counties or from private forest lands.

Overview of Employment

A discussion of the contribution that agency lands make to economic growth and employment is included because growth and employment are affected by agency land use choices and are key elements of major public issues.

Regional Employment

The economy of the project area has undergone substantial change over the past three decades. In terms of job formation, it has grown much faster than the nation as a whole. The number of jobs have increased even during periods when employment in historically important job sectors such as manufacturing, mining, logging, farming, and ranching was either stagnant, falling, or moving erratically (Rasker 1995). Employment in service industries has increased substantially. The number of households receiving "nonlabor income" (income from transfer payments, dividends, interests, and rents) has also grown. Increases in service employment includes gains in recreation and tourism plus gains in business, education, management, and engineering services generated by new residents who moved to the area. Evidence of this change is shown in part by the 61 percent of the job growth since 1969 in services, retail sales, and finance, insurance and real estate (see Table 2-26). Rapid employment growth is also found in advanced technology, retail trade, transportation services, and construction.

A focus on regional employment gains as done by Rasker (1995), Power (1996), and others, while necessary to understand structural change in the economy, can mask job losses in rural areas that are not sharing in regional growth (Harris et al. 1995). This is pertinent to the project area, where employment gains have been centered in metropolitan counties and counties experiencing rapid population growth.

Employment figures aggregated over the project area sometimes do not reflect employment for individual counties. For example, three eastern Washington counties and seven eastern Oregon counties had greater than 10 percent employment in wood products manufacturing in 1990, far more than the project area average of 2.5 percent. Four counties in the planning area had greater than one percent employment in mining, more than the 0.45 percent for the project area. County employment data for 12 major industry groups are shown in Tables 2-27 and 2-28.

Employment Associated with Forest Service- and BLM-administered Lands

Direct employment generated from Forest Service- and BLM-administered lands falls mostly into job categories such as manufacturing (especially wood products), agriculture (especially livestock grazing), agricultural services (including forestry services), mining, and federal employment. Another employment sector affected by agency land use is recreation and tourism, an industry not directly measured by employment data. Together, these employment categories are those most likely to be measured as an effect of changing agency land uses. Currently, over 220,000 jobs are associated with livestock grazing, recreation, and timber harvest on lands administered by the Forest Service or BLM. It was estimated that recreation accounts for 87 percent of these jobs, timber harvest for 12 percent, and livestock grazing for 1 percent.

Manufacturing

Wood products manufacturing, a job category closely tied to agency timber harvest, falls into the manufacturing sector. Manufacturing is still perceived by many to dictate the economic health of the overall regional economy, though this view no longer fits. The reduced regional significance of wood products manufacturing is due more to rapid growth in other sectors of the economy than decline in the wood products industry. Wood products manufacturing employment is still locally vital to many places in the planning area.

Manufacturing employment makes up a smaller percent of total employment in the planning area than nationally, suggesting that the area is not comparatively strong in

TABLE OF CONTENTS

manufacturing. This is not the case for wood products manufacturing (one component of the manufacturing sector), where all Bureau of Economic Analysis regions covering the planning area have wood products employment above national levels. The highest percentage is found in the Redmond-Bend Bureau of Economic Analysis region at 5.5 percent, while the lowest is the Tri-Cities BEA region at 1 percent. The national level is approximately 0.5 percent. In 1982, 1986, 1990, and 1993, timber industry employment for eastern Oregon and Washington ranged from 16,500 to 23,100 jobs (Haynes 1995). For all of Oregon and Washington, timber industry employment peaked in 1977 at about 170,000 jobs. It has since declined to slightly more than 118,000 workers in 1994. Reductions in employment were due to several factors, including legally imposed reductions on federal timber sales, the recession of 1990, technological improvements, and changes in the mix of products manufactured by the region's timber industry. Changes in milling technology and competitive product marketing are longer range forces gradually reducing the industry's employment (Rheiner 1996).

Agricultural Services and Farm Employment

Unlike the manufacturing group, the agricultural services group has a higher percent of total employment in the planning area than nationally (2.5 percent versus 1.1 percent), showing the comparative economic importance of this employment in the planning area. Individually, all BEA regions except the Spokane region show an employment percentage greater than national levels. The highest percent employment in agricultural services for eastern Oregon and Washington occurs in the Tri-Cities region at 4.4 percent of total. Farm employment for the project and planning areas is greater than nationally. Project area-wide farm employment is 7.8 percent compared to national farm employment of 2.2 percent. The Pendleton, Tri-Cities, and Redmond-Bend BEA regions, representing most of eastern Oregon and Washington, have farm employment at 13.0, 12.2, and 8.5 percent respectively, showing the benefit of farm employment to the economy of the planning area.

Minerals

The mineral industry generally provides less employment in the planning area than nationally. Both individually and collectively, the BEA regions representing eastern Oregon and Washington have a smaller percentage of mining employment than does the nation. The Pendleton and Redmond-Bend regions have no measurable mining employment. Highest is the Spokane region, where mining contributes 0.61 percent of jobs, still less than the 0.66 percent nationally, but more than the project area-wide level of 0.45 percent.

Recreation

Recreation-based employment, while not directly measured by the Bureau of Economic Analysis, is estimated to generate approximately 15 percent of employment in the planning area. Recreation employment must be estimated from the proportion of other industry group employment that supports recreation, for example, amusement, retail, lodging, eating and drinking, and gas stations.

Project area-wide recreation supports an estimated 190,000 jobs. Hunting supported the greatest number of jobs with 49,000, followed by 40,000 jobs associated with pleasure driving activities, and 34,000 jobs associated with day use. A regional economic study conducted by the Forest Service in the central Rocky Mountains recognized the export nature of some tourist-related service industries. The effect of these service/tourist industries on the local economy was found to be similar to the earnings returned to a local firm from the export of physical commodities (DeVilbiss 1992).

Forest Service and BLM Employment

Federal employment associated with Forest Service and BLM management of public lands can be vital locally, both in terms of job numbers and wages per job. This results from agency policy, particularly with the Forest Service, to locate administrative units in small, rural communities. The estimated 9,000 to 10,000 Forest Service and BLM jobs in the project area may not be substantial regionally, but 250 jobs in Prineville, or 51 in Ukiah, Oregon are very significant to the vitality of these rural communities.

Employment and Wages

Economic activity can be measured by the number of jobs or by income (choices being per capita income, personal income, and household

Table 2-22. Factors Used to Score the Timber/Forage Importance Index for Eastern Oregon Counties.

Eastern Oregon Counties	Population Change[1] 1979-1995	Recreation Visits to National Forests	National Forest Lands[2]	BLM-admin Lands[1]	FS/BLM Timber Supply[3]	FS/BLM Forage Supply[4]	Federal Lands Payments (% of Total County Budget)[5]	Forage/Timber Importance Index	Economic Resiliency[6]
Baker	1.2%	high	32.9%	18.4%	64.7%	7.8%	4.5%	high	med
Crook	23.3%	low	22.7%	26.5%	74.3%	9.6%	15.2%	high	low
Deschutes	55.4%	high	50.1%	25.1%	74.6%	17.4%	3.4%	med high	high
Gilliam	-9.5%	—	0.0%	7.0%	0.0%	1.2%	0.4%	med low	low
Grant	-1.3%	low	54.3%	6.4%	85.1%	14.9%	30.9%	high	low
Harney	-11.3%	low	8.0%	62.0%	94.9%	20.2%	21.3%	high	low
Hood River	10.4%	high	61.7%	0.1%	49.7%	1.5%	5.5%	med high	high
Jefferson	36.8%	high	14.3%	3.3%	36.1%	17.1%	2.6%	med low	med
Klamath	3.2%	low	42.7%	6.2%	52.3%	4.2%	8.1%	high	high
Lake	2.8%	low	19.3%	48.7%	60.3%	15.1%	20.0%	high	low
Malheur	4.6%	low	0.1%	72.8%	0.0%	18.3%	1.5%	med high	low
Morrow	-8.3%	med	10.9%	0.2%	46.4%	3.3%	1.1%	med high	low
Sherman	-9.5%	—	0.0%	10.2%	0.0%	1.3%	0.7%	med low	low
Umatilla	9.9%	med	19.4%	0.6%	41.4%	1.5%	0.6%	med high	high
Union	6.0%	med	7.8%	0.5%	48.6%	4.6%	2.3%	med high	med
Wallowa	7.1%	med	57.1%	1.1%	55.6%	17.5%	9.7%	high	med
Wasco	6.6%	low	11.1%	4.5%	27.1%	2.1%	3.9%	med low	med
Wheeler	0.0%	med	15.4%	13.0%	56.9%	4.6%	32.3%	high	low

Abbreviations used in this table:
- BLM = Bureau of Land Management
- admin = administered
- FS = Forest Service

[1] Source: McGinnis and Christensen (1996).
[2] Source: Forest Service publication, "Land Areas of the National Forest System." 1993.
[3] Total timber harvest from Oregon and Washington state harvest reports. National Forest timber harvest from Forest Service records. Average value for 1978, 1979, 1985, 1990, 1991, 1992, and 1993. BLM harvest not reported by county in Washington.
[4] Source: Frewing-Runyon (1995).
[5] Source: Schmit, Wilderness Society, forthcoming (draft, 1995).
[6] Based on the Shannon-Weaver Resiliency Index.

Table of Contents

Table 2-23. Factors Used to Score the Timber/Forage Importance Index for Eastern Washington Counties.

Eastern Washington Counties	Population Change[1] 1979-1995	Recreation Visits to National Forests	National Forest Lands[2]	BLM-admin Lands[1]	FS/BLM Timber Supply[3]	FS/BLM Forage Supply[4]	Federal Lands Payments (% of Total County Budget)[5]	Forage/Timber Importance Index	Economic Resiliency[6]
Adams	9.5%	—	0.0%	0.0%	0.0%	0.0%	0.0%	low	low
Asotin	20.0%	med	13.3%	2.7%	46.3%	1.4%	0.2%	med high	med
Benton	24.4%	—	0.0%	1.2%	0.0%	0.2%	0.0%	low	med
Chelan	25.9%	high	70.4%	1.1%	59.3%	32.7%	0.8%	med high	high
Columbia	5.1%	med	29.2%	0.1%	45.9%	2.2%	1.3%	med high	low
Douglas	39.5%	—	0.0%	3.1%	0.0%	1.9%	0.1%	low	low
Ferry	22.8%	med	33.8%	0.8%	25.7%	14.0%	1.2%	med high	low
Franklin	25.6%	—	0.0%	2.5%	0.0%	0.2%	0.0%	low	med
Garfield	-11.5%	med	21.0%	0.0%	75.1%	2.7%	1.3%	med high	low
Grant	30.6%	—	0.0%	2.5%	0.0%	14.9%	0.1%	low	med
Kittitas	20.2%	low	24.1%	1.2%	29.1%	0.8%	0.9%	med low	low
Klickitat	13.8%	—	1.2%	1.4%	3.6%	0.4%	0.1%	low	low
Lincoln	1.1%	—	0.0%	0.5%	0.0%	0.3%	0.1%	low	low
Okanogan	19.7%	med	44.2%	1.7%	33.6%	10.1%	1.3%	med high	low
Pend Orielle	21.2%	med	58.3%	0.2%	31.4%	3.9%	1.2%	med high	med
Skamania	8.4%	—	79.2%	0.0%	66.6%	47.8%	16.8%	med high	low
Spokane	18.2%	—	0.0%	0.0%	0.0%	0.0%	0.0%	low	high
Stevens	35.3%	med	13.9%	1.8%	12.9%	1.2%	0.4%	med low	high
Walla Walla	13.6%	—	0.3%	0.1%	0.0%	0.0%	0.0%	low	high
Whitman	-0.8%	—	0.0%	0.1%	0.0%	0.0%	0.0%	low	low
Yakima	22.9%	—	1.4%	1.0%	25.7%	0.3%	0.4%	med low	high

Abbreviations used in this table:
BLM = Bureau of Land Management
admin = administered
FS = Forest Service

[1] Source: McGinnis and Christensen (1996).
[2] Source: Forest Service publication, "Land Areas of the National Forest System." 1993.
[3] Total timber harvest from Oregon and Washington state harvest reports. National Forest timber harvest from Forest Service records. Average value for 1978, 1979, 1985, 1990, 1991, 1992, and 1993. BLM harvest not reported by county in Washington.
[4] Source: Frewing-Runyon (1995).
[5] Source: Schmit, Wilderness Society, forthcoming (draft, 1995).
[6] Based on the Shannon-Weaver Resiliency Index.

Table of Contents

Table 2-24. Economic Data for Eastern Oregon Counties (1992).

Eastern Oregon Counties	Economic Diversity[1]	Per Capita Income[2]	Total Personal Income[2]	Non-Farm Income[2]	Property Income[2]	Transfer Payments[2]	Farm Income[2]
		in thousands of dollars					
Baker	med	14,109	238,750	52%	20%	26%	1%
Crook	low	14,962	243,711	58%	20%	20%	2%
Deschutes	high	16,981	1,541,896	62%	21%	17%	0%
Gilliam	low	15,831	29,832	42%	23%	19%	16%
Grant	low	15,282	129,435	60%	16%	21%	3%
Harney	low	14,786	110,967	60%	16%	22%	3%
Hood River	high	15,597	289,738	56%	20%	18%	7%
Jefferson	med	14,091	221,360	60%	16%	21%	4%
Klamath	high	14,555	922,859	59%	16%	22%	3%
Lake	low	14,983	117,056	51%	17%	22%	11%
Malheur	low	13,567	396,260	52%	18%	23%	7%
Morrow	low	13,665	119,587	50%	13%	18%	19%
Sherman	low	18,212	38,128	31%	20%	20%	29%
Umatilla	high	14,250	939,413	59%	13%	22%	6%
Union	med	14,693	382,042	60%	15%	22%	3%
Wallowa	med	16,495	128,774	50%	19%	21%	10%
Wasco	med	15,808	378,643	55%	18%	22%	5%
Wheeler	low	14,638	22,707	26%	28%	22%	24%

[1] Shannon-Weaver Diversity Index using Employment Data (Source: Greg Alward and IMPLAN database).
[2] From McGinnis and Christensen (1996).

income). Income is generally more difficult to measure than employment. Recognizing that wages differ by job type, it is often noted that the types of jobs created or lost might be more relevant than the number of jobs. The generation or protection of "family wage jobs" in a community is often stated to be an advantage.

One way to examine the relationship of Forest Service- and BLM-administered land uses to income is to compare the industries most likely to be directly affected by federal land management choices with the industries that contribute the highest total wages and wages per job. For the top five wage jobs in six eastern Oregon counties having close ties to lands administered by the agencies, lumber and wood products manufacturing and federal government employment are the most frequently occurring high wage jobs (Oregon Employment Department). Wood products manufacturing and federal government employment also show up in the top five for total income (wage per job times the number of jobs). Most other high wage and high total income job categories for these counties are not directly tied to lands administered by the agencies. Frequent top five finishers for "per job" wages include utilities, local and state government, communications, heavy construction, and trucking. Frequent top five finishers for total income include state and local government, utilities, health services, and automobile related industries.

Recreation, a recognized growth industry tied to Forest Service- and BLM-administered lands in the project area, shows how employment growth may not offer equivalent income growth. An estimated 15 percent of employment in the project area is supported by recreation ~ more than either wood products manufacturing or

Table of Contents

Table 2-25. Economic Data for Eastern Washington Counties (1992).

Eastern Washington Counties	Economic Diversity[1]	Per Capita Income[2]	Total Personal Income[2]	Non-Farm Income[2]	Property Income[2]	Transfer Payments[2]	Farm Income[2]
		in thousands of dollars					
Adams	low	17,340	267,409	42%	15%	20%	23%
Asotin	med	15,779	314,757	55%	17%	27%	1%
Benton	med	18,666	2,422,679	71%	12%	15%	2%
Chelan	high	18,304	1,064,715	54%	18%	21%	7%
Columbia	low	17,400	74,222	35%	18%	26%	21%
Douglas	low	15,606	480,330	56%	15%	19%	11%
Ferry	low	12,501	90,562	54%	10%	26%	10%
Franklin	med	14,490	632,679	52%	12%	23%	13%
Garfield	low	17,844	42,761	32%	29%	23%	16%
Grant	med	15,110	957,292	47%	15%	23%	15%
Kittitas	low	15,075	453,603	53%	20%	23%	4%
Klickitat	low	14,818	273,893	48%	17%	27%	8%
Lincoln	low	18,777	182,255	34%	30%	21%	15%
Okanogan	low	16,218	599,087	47%	14%	26%	14%
Pend Orielle	med	13,289	138,041	49%	16%	34%	2%
Skamania	low	15,893	147,326	61%	18%	19%	1%
Spokane	high	16,762	6,887,560	62%	16%	21%	0%
Stevens	high	13,402	481,933	56%	14%	26%	4%
Walla Walla	high	15,408	838,458	54%	18%	23%	6%
Whitman	low	13,990	578,444	54%	20%	20%	7%
Yakima	high	15,827	3,378,772	53%	14%	23%	10%

[1] Shannon-Weaver Diversity Index using Employment Data (Source: Greg Alward, IMPLAN data base).
[2] From McGinnis and Christensen (1996).

mining. However, many service industries supported by recreation activity, such as amusement, retail, lodging, eating and drinking, gas stations, and others, generally provide lower wages than manufacturing, mining, forestry and federal employment, the other employment sectors closely tied to land uses of the agencies (Oregon Employment Department).

Communities

The well-being of rural communities economically or socially connected to Forest Service- and BLM-administered lands has been an increasing, perhaps dominant, factor driving the social policy of these agencies. Given this, an understanding of the relationship between past agency social policy, land use choices, and rural communities is an invaluable component of the affected environment. Concern about the future of rural communities, especially those with high employment in industries that rely on management of resources on Forest Service- and BLM-administered lands, was reflected by a congressional hearing in Grangeville, Idaho (July 5, 1995). The topic, "Endangered Communities," illustrates the nature of the subcommittee's concerns.

The Bureau of Census recognizes 476 communities within the project area, including 29 cities with more than 10,000 people and 49 Census-Designated Places ~ locations that are unincorporated but have an identity to the local population. Of the other 398 small rural communities, 68 percent are communities of

TABLE OF CONTENTS

Table 2-26. Employment by Industry in the Project Area.

Item	1969	1992	% Change
Total Employment	908,954	1,619,923	78.2
Farm and Ranch Employment	120,504	112,264	-6.8
Nonfarm Employment	788,450	1,507,659	91.2
Agriculture Services, Forestry, Fisheries and Other	9,308	35,208	278.3
Mining	8,590	10,372	20.7
Construction	42,243	81,929	93.9
Manufacturing	119,703	176,067	47.1
Transportation, Communications and Utilities	44,931	67,304	49.8
Wholesale Trade	38,110	72,826	91.1
Retail Trade	141,661	279,555	97.3
Finance, Insurance and Real Estate	51,879	90,684	74.8
Services	153,587	411,911	168.2
Federal Civilian	29,178	37,965	30.1
Military	28,188	25,391	-9.9
State and Local	116,924	206,629	76.7

Source: Bureau of Economic Analysis, Regional Economic Information System (CDROM).

1,500 or fewer people ~ the smallest size class. These range from 22 to 1,500 people, with an average population of 520.

For the Interior Columbia Basin Ecosystem Management Project, many types of information about communities in the project area were collected. Harris (1995) contains a complete description of this information, which included Community Self-Assessments ~ interviews with 1,350 community leaders and residents in nearly half (198 out of 476) of the project area's communities. Profiles of the economic structure of each community were developed (Robison, as cited in Harris 1995). These will be a valuable source of information for the Forest Service and BLM to use in future planning, and can benefit the communities themselves.

Conventional Notions of Community Stability

The concept of stability, in reference to economy, community, and industry, has long been the dominant theme of social and economic policy for the Forest Service, and somewhat less so for the BLM. In examining community economic stability, the distinction between the business needs of industry and community economic needs is often overlooked (Society of American Foresters Report 1989). While employing local residents, industry interests inevitably differ somewhat from the communities in which they are located. Both communities and industry are substantially affected by forces beyond their control. For

Communities

The term "community" has several definitions. Communities can be groups of like-minded people who gain strength from their relationships and associations. Communities of interest are people employed in a similar profession, people who participate in the same activities, or those who share a set of values--for example, the "ranching community" or the "environmental community." As used in this section, communities has a more traditional definition--spatially-defined places such as towns. The community is where people socialize, work, shop, and raise their children. It is often the focus of their social lives. Counties are an integral political scale to consider, but leaving the discussion at that level would mask many differences among communities within a given county.

Table 2-27. Employment Data for Eastern Oregon Counties.

Eastern Oregon Counties	Total employed persons	Agriculture[1]	Mining	Construction	Mfg. Non-Durable Goods	Mfg. durable Goods	Transportation[2]	Trade[3]	Finance[4]	Business Services[5]	Entertain. Services[6]	Other Services[7]	Public Admin[8]
							percent						
Baker	6,154	18.0	1.4	5.4	2.2	10.3	5.6	21.8	4.3	8.7	0.5	10.4	11.3
Crook	5,968	13.7	0.1	4.9	2.5	28.9	4.3	19.6	3.4	7.0	0.9	7.0	7.8
Deschutes	35,860	4.3	0.2	8.5	2.4	15.9	5.2	24.0	6.5	9.8	2.0	11.8	9.5
Gilliam	785	27.5	0.0	5.9	1.3	2.0	15.3	15.4	3.2	4.7	0.9	5.4	18.5
Grant	3,302	22.0	0.7	5.9	0.5	15.0	5.3	16.0	2.7	7.0	1.5	8.8	14.6
Harney	3,051	19.0	0.3	5.9	0.7	18.7	4.1	16.9	2.3	7.1	0.2	8.2	16.7
Hood River	7,720	20.2	0.2	3.9	3.1	11.1	9.7	20.5	3.0	8.4	1.6	8.2	10.2
Jefferson	5,598	12.8	0.3	3.8	2.3	20.7	4.3	19.4	2.9	6.4	0.9	10.0	16.0
Klamath	23,638	8.5	0.1	4.8	1.9	17.5	6.9	24.4	4.1	8.0	1.1	9.3	13.4
Lake	3,182	25.5	0.3	4.5	1.7	11.4	5.0	19.1	3.5	7.2	0.8	6.3	14.9
Malheur	10,794	22.9	1.3	4.6	8.7	4.2	5.3	21.2	3.4	7.3	1.2	8.5	11.4
Morrow	3,238	26.0	0.1	4.8	11.2	7.1	7.6	13.4	2.7	6.1	0.7	6.2	14.2
Sherman	774	31.0	0.0	5.2	1.3	4.7	7.0	23.6	1.8	6.1	0.3	5.2	14.0
Umatilla	25,612	13.1	0.2	4.3	10.5	6.7	7.0	20.7	3.9	7.7	1.0	11.1	13.9
Union	9,920	8.4	0.4	5.2	1.9	14.2	7.6	21.4	3.5	9.2	0.9	10.6	16.7
Wallowa	2,892	21.4	0.1	4.8	1.0	17.1	4.4	15.9	3.6	7.9	1.6	10.8	11.4
Wasco	8,811	11.2	0.3	5.9	2.8	12.1	7.0	21.2	3.6	9.8	0.9	13.0	12.2
Wheeler	499	30.3	0.0	10.2	0.8	6.6	5.6	13.4	2.2	6.0	1.6	3.4	19.8

Abbreviations used in this table:
BLM = Bureau of Land Management
FS = Forest Service
Mfg. = manufacturing
Admin. = Administration
Entertain. = Entertainment

[1] Agriculture, forestry, fishing.
[2] Transportation, communications, and other public utilities.
[3] Trade, wholesale, and retail.
[4] Finance, insurance, and real estate.
[5] Business, repair, other professional and related services.
[6] Entertainment and recreation services.
[7] Personal and health services.
[8] Public administration and educational services.

Source: Haynes and Horne (1996).

Table of Contents

Table 2-28. Employment Data for Eastern Washington Counties.

Eastern Washington Counties	Total employed persons	Agriculture[1]	Mining	Construction	Mfg. Non-Durable Goods	Mfg. durable Goods	Transportation[2]	Trade[3]	Finance[4]	Business Services[5]	Entertain. Services[6]	Other Services[7]	Public Admin[8]
							percent						
Adams	5,847	26.7	0.2	3.9	10.2	1.7	7.1	21.2	3.4	5.6	0.3	7.9	11.8
Asotin	7,111	4.7	0.1	5.5	6.7	10.2	3.9	26.1	4.7	9.5	1.1	14.2	13.3
Benton	52,440	5.2	0.0	5.7	7.8	4.0	11.5	20.0	3.7	21.1	1.0	8.5	11.5
Chelan	23,004	13.6	1.0	6.1	3.8	4.8	6.8	26.1	4.3	9.7	1.8	11.5	10.5
Columbia	1,570	21.0	0.4	6.9	15.2	3.5	5.4	11.7	2.5	5.4	2.9	11.4	13.7
Douglas	11,664	16.7	0.8	5.2	3.6	4.6	8.8	25.2	4.2	8.1	1.8	10.4	10.5
Ferry	2,296	11.5	11.4	9.1	0.9	10.6	4.0	14.1	3.8	8.8	0.9	6.4	18.6
Franklin	15,686	21.4	0.0	4.5	12.3	2.0	8.1	18.6	2.1	11.6	0.9	6.2	12.3
Garfield	969	28.9	0.2	7.5	0.9	1.1	3.8	18.9	3.6	6.4	0.8	13.4	14.3
Grant	22,289	20.6	0.4	5.0	9.1	3.7	8.4	20.6	3.0	7.5	0.7	7.8	13.3
Kittitas	11,882	10.2	0.1	5.2	3.0	3.7	6.8	25.4	3.0	7.3	1.7	9.2	24.5
Klickitat	6,437	13.3	0.2	5.4	2.0	18.3	8.2	19.3	2.2	7.8	0.7	10.0	12.6
Lincoln	3,614	25.1	0.1	5.3	1.6	2.7	5.4	18.8	3.7	8.1	0.9	12.2	16.3
Okanogan	13,632	19.3	0.4	6.1	1.3	9.7	5.8	22.2	2.8	6.8	1.1	9.9	14.6
Pend Orielle	2,841	7.8	0.5	8.0	5.1	19.6	8.7	18.3	1.8	6.9	0.9	7.5	14.8
Skamania	3,328	8.9	0.5	8.7	6.3	23.0	6.7	14.8	3.2	7.8	1.0	6.2	13.0
Spokane	157,142	1.8	0.2	5.0	3.1	9.5	6.9	24.9	6.7	11.9	1.6	14.6	13.8
Stevens	11,583	8.9	0.9	6.1	1.5	19.2	5.6	19.6	3.6	8.6	1.5	10.1	14.5
Walla Walla	21,076	8.6	0.0	5.2	6.2	5.0	4.8	20.8	4.6	9.9	1.2	12.7	20.9
Whitman	17,167	10.7	0.0	2.4	2.2	1.1	3.4	19.2	2.6	8.7	1.2	6.9	41.5
Yakima	77,366	14.9	0.1	4.2	6.7	5.9	7.3	22.6	3.5	9.5	1.2	10.8	13.4

Abbreviations used in this table:

BLM = Bureau of Land Management
FS = Forest Service
Mfg. = manufacturing
Admin. = Administration
Entertain. = Entertainment

[1] Agriculture, forestry, fishing.
[2] Transportation, communications, and other public utilities.
[3] Trade, wholesale, and retail.
[4] Finance, insurance, and real estate.
[5] Business, repair, other professional and related services.
[6] Entertainment and recreation services.
[7] Personal and health services.
[8] Public administration and educational services.

Source: Haynes and Horne (1996).

Table of Contents

communities, the effect is cumulative. The community has little influence on the business decisions made by firms operating in their area, while the firms have little influence on macroeconomic forces that influence their operations. As such, rural communities often find themselves vulnerable to boom/bust cycles, commodity price fluctuations, and national and regional recessions (DeVilbiss 1992). Among economic factors that affect the relationship between a community and local wood products firms are alternative sources of supply, geographic isolation (proximity to larger labor markets), inter-mill competition for timber supply, inter-community competition for jobs, and changing technology.

Berck et al. (1992) sought to examine the influence of timber industry characteristics on community stability against that of larger business cycles by separating the effects of being a small, isolated county with an open economy from the effects of being dependent upon timber. Results showed that the timber industry has surprisingly low variation in employment ~ not much above that of manufacturing as a whole and much lower than agriculture or fisheries. What is different about forestry is the historical extreme reliance of communities on the timber industry alone, and that forestry is usually practiced in isolated areas (Berck 1992). A study that included several counties in the project area by Ashton and Pickens (1995) found it was not the presence of resource use employment in a county that caused communities to be vulnerable to change, but the absence of other jobs that would contribute to a more diverse economy. Ashton found that areas with proportionately high resource use employment and Forest Service involvement tend to be less diverse. More favorably, Ashton found that these counties tend to be diversifying more rapidly than others. This was attributed to the agency multiple use policy that provides an environment which attracts both tourists and permanent residents to the area (Ashton 1995).

Timber Dependency

An issue closely tied to community stability is timber dependency, commonly put in the context of "timber-dependent communities." Timber dependency is a broadly recognized and studied economic relationship between federal lands (most notably National Forest System lands), rural communities, and regional economies. It is an issue deeply entrenched in the conventional wisdom of federal land use in the West and frequently mentioned by the public in the project area. The issue of community dependency on the livestock grazing industry has not received the same attention as timber dependency.

Defining the resource dependency of communities generally stems from two factors. First is the size of the community ~ a variable usually associated with rural, geographically isolated communities highly influenced by outside economic forces and typically tied to one or few resource-based industries. Second is the percent of employment associated with timber harvest and processing ~ especially employment generated from National Forest timber. Dependency of wood processing mills on National Forest timber grew after World War II when National Forests increased the volume of timber for sale. This made it possible for an increasing number of facilities to get established without any timber land of their own, relying only on National Forest timber for their supply (Dana and Fairfax 1980).

In 1987, the Forest Service identified communities thought to be dependent on National Forest timber as required by the National Forest Management Act of 1976, including 66 communities in eastern Washington and Oregon. The criteria used for the list was that forest products employment in a community was at least 10 percent and that local wood processing firms used at least 50 percent National Forest timber. Currently, 18 communities in eastern Oregon and 8 in eastern Washington have greater than 10 percent employment in wood processing. The percentage of National Forest timber used could not be determined, although mill surveys for Oregon and Washington show that the number of mills relying heavily on National Forest timber has generally decreased in the last decade.

Recognizing that the 1987 list did not account for population size, population growth, or geographic isolation, ICBEMP scientists reassessed the 1987 list using these additional criteria. The rationale was that communities judged to be most at risk to changes in federal forest timber supply were those with small populations, located in counties

TABLE OF CONTENTS

with low population densities, and judged to be relatively isolated (Rheiner 1996). Of the original 66 communities on the 1987 list, 29 were determined to be small (population less than 10,000), isolated, and in areas of low or negative population growth. These 29 communities are thought to especially depend on employment generated by harvesting and processing National Forest timber. In eastern Oregon, the towns of Burns, Heppner, John Day, Lakeview, Long Creek, Mt. Vernon, Paisley, and Prairie City were identified. In eastern Washington, the towns of Colville, Ione, Kettle Falls and Republic were identified (*AEC* 1996).

Predictability of Supply and Processing of National Forest Timber

Public scoping has shown that predictability in the volume of timber offered for sale from agency lands is a key public issue. Predictability is essential to industries that harvest and process timber and to communities with substantial employment in these industries. An explanation of this issue is necessary to understanding the economic and social conditions relevant to agency decisions.

Limited Predictability

Predictability in timber sale volume offered from lands administered by the Forest Service and BLM is difficult to achieve. Advancing knowledge has undermined old assumptions about sustaining timber harvest volume relative to newer goals for sustaining forest ecosystems. Unpredictable natural disturbances such as wind storms, forest fires, insect and disease epidemics, and even volcanic eruptions can change the amount and rate of timber volume that can be offered for sale. The same holds true for social disruptions such as lawsuits, new laws resulting from realignments of political power, and changing national budget priorities ~ all of which can affect timber sale volume.

Expectations of Timber Supply

Historically, the timber industry interpreted the allowable sale quantity (ASQ) projections presented in land use plans as a schedule of future supply. Agencies intended ASQ to represent a maximum capability, not a timber supply schedule. The industry position was reinforced by Forest Service even-flow supply policies; historical agency timber outputs at ASQ level; timber program funding by the Congress; and specific supporting language in the National Forest Management Act (NFMA) regulations (36 CFR 219.16). Also, ASQ projections were the only numbers offered to represent potential future supply until the Northwest Forest Plan first used the term "probable sale quantity" or PSQ to portray the expected level of harvest (as opposed to the ASQ "ceiling"). Like ASQ determination, the probable sale quantity was based on regulating the acres available for timber harvest to calculate a "sustainable" supply, but timber volume reductions were factored into the PSQ projection to account for new silvicultural practices and operational limitations (Johnson 1994).

Even if the flow of timber sale volume were predictable, it could not be assumed that local mills would be the successful bidder for agency timber sales, nor that local communities would receive logging and processing jobs as a result of those sales. In today's market, the destination of federal timber is unpredictable as processors reach far to supply their mills. Log sorting yards and high efficiency mills disperse logs differently than was customary, directing logs to their most profitable use. These conditions undermine confidence that federal timber supply policy is capable of supporting jobs in specific communities.

Timber Projections for the Eastside Draft EIS

The timber supply estimates developed for the Eastside Draft EIS are different than the ASQ-type projections found in land use plans and the PSQ-type projection used in the Northwest Forest Plan. Eastside Draft EIS estimates in Chapter 4 are derived from a vegetation succession model rather than a traditional harvest regulation model as used in land use plans. Using a conventional interpretation of sustained yield, the sustainability of Chapter 4 timber volume estimates cannot be verified at this scale. The estimates in this plan are not specific to National Forests or BLM Districts, nor do they account for changes in land allocations that may result from upcoming land management planning. NFMA-mandated ASQ determinations, not applicable to this Draft

EIS, will be calculated through the land use planning on individual national forests. Similar determinations will be made on BLM Districts with a commercial timber component. It is expected that probable sale quantities (PSQs) will be determined and displayed in supply schedules separate from land use plans.

Federal Policy and Actions Supporting Community Stability

Supporting rural communities through management of public lands is primarily a social goal, though it is often framed in terms of economic objectives, such as sustaining jobs or income. An examination of past agency policy and efforts supporting this goal helps to establish a basis for future decisions. Key factors include the willingness and ability of the Forest Service and BLM to manage the lands and resources under their jurisdiction for the benefit of communities.

Neither the Forest Service nor the BLM have a specific legal mandate to provide economic stability to rural communities. Both agencies have legislative direction that permits and encourages consideration of community economic stability when planning or implementing plans. Contemporary legislation guiding both agencies ~ the National Forest Management Act and Federal Land Policy and Management Act ~ is oriented toward land use planning rather than specifying economic or social policy goals (Dana and Fairfax 1980). Thus, the Forest Service and BLM have discretion, absent additional guidance from the Congress, to establish economic and social goals appropriate to their agency's missions and available resources.

Rangelands Administered by the BLM

The dominant use on BLM-administered rangelands has been livestock grazing, a use that preceded the Taylor Grazing Act of 1934 by 60 years. The Taylor Grazing Act brought regulation to livestock grazing on the public domain lands and gave the BLM a legislative mandate to stabilize the livestock industry dependent on the public range (Dana and Fairfax 1980). The strong ownership felt by the livestock operators for the public range did not diminish with regulation. The relatively low productivity of the public domain rangelands under the jurisdiction of the BLM has limited other commodity uses of these lands in addition to livestock grazing. Thus, regulating livestock operators has been the primary focus of the BLM on these lands.

In the 1960s the BLM began to expand from regulating grazing to a more comprehensive land management approach. This trend continued with the passage of the Federal Land Policy and Management Act of 1976 (FLPMA), which promoted multiple-use and sustained yield management. This Act also sought to promote stability in livestock grazing by authorizing 10-year grazing permits and requiring 2-year notices of cancellation. It readjusted the distribution of grazing fee funds, with 50 percent going toward range improvements; at least half of that had to be spent in the BLM district where it was collected. The Act also authorized loans to state and local governments to relieve social and economic impacts of mineral development (Dana and Fairfax 1980).

Forest Service Timber Policy and Communities

Use of the National Forests for national and regional growth and development was the federal policy when the Organic Act was passed in 1897, and has remained so. Early policy represented a belief that resources existed for the benefit of the local residents who needed them. The 1905 Forest Service's Use Book listed "protecting local residents from unfair competition in the use of forest and range" as a principal objective of the Forest Reserves, apparently in response to concern about the influence of big industry.

The Forest Service was an early promoter of using a sustained yield even-flow timber policy to promote the stability of forest communities (Society of American Foresters Report 1989). The Congress, in the White Pine Blister Rust Protection Act of 1940, mentioned for the first time maintaining community stability as the purpose of an act of the federal government. The idea of community stability was firmly connected to timber supply in terms of sustained yield, in the Sustained Yield Forest Management Act of 1944 (Force 1993; Society of American

Foresters Report 1989). This Act gave authority to establish Cooperative Sustained Yield Units to "promote the stability of forest industries, of employment, of communities, and of taxable forest wealth" intending to support the stability of communities primarily dependent on federal timber. This act applied equally to forest lands administered by either the Forest Service or the BLM.

In order to protect domestic wood processing jobs and promote small businesses, the Congress restricted log exports from federal lands and set aside timber for sale to companies with 500 or fewer employees. The "Morse Amendment" of 1968 prohibited the export of unprocessed logs from National Forests west of the 100th meridian ~ a prohibition still in effect today. Beginning in the early 1970s, the Forest Service and the U.S. Small Business Administration implemented a Small Business Set-Aside program. This program set aside a percentage of Forest Service timber sales for exclusive bidding and purchasing by small firms.

The National Forest Management Act (NFMA) of 1976 added substantially to Forest Service community stability policy. It solidified a traditional but contentious even-flow timber supply strategy for National Forests through the sustained yield and nondeclining even-flow (NDEF) provisions in section 11 (36 CFR 219.16) of that law. Both sustained yield and nondeclining even flow were designed in part to address community stability issues (Dana and Fairfax 1980). Community stability also surfaced in section 14 (e)(1) of NFMA, requiring bidding methods for timber sales to "consider the economic stability of communities whose economies are dependent on such National Forest materials," with regulations requiring "dependent communities" to be one of several factors considered (36 CFR 223.88). From this, in 1977 and 1987 the Forest Service developed lists of communities expected to better retain wood products employment if nearby National Forests had the option of using either oral or sealed bidding to sell timber (from Forest Service correspondence 1977 and 1987).

The National Forest-Dependent Rural Communities Economic Diversification Act in the 1990 Farm Bill sought to provide assistance to rural communities located near National Forests that fit a specified definition of "economically disadvantaged" due to the loss of jobs or income derived from forestry, the wood products industry, or related commercial enterprises such as recreation and tourism in the National Forest (Ashton 1995). Similarly, the Northwest Forest Plan, announced by President Clinton in July 1993, included an economic assistance component designed to help workers, businesses and communities in the northern spotted owl region adapt to the Plan's timber supply levels (Rheiner 1996).

Even Flow and Timber Supply

The remedy favored by the Forest Service for the "boom and bust" cycles has been to maintain an even flow of timber sales, transferring a large share of cyclic economic adjustment costs from the community to the Federal Treasury (Boyd 1989). As applied to the community stability problem, this meant maintaining a constant supply of timber so that macroeconomic-induced changes in timber demand did not shut down the mills (and jobs) in rural western communities.

The even-flow approach was also used to support existing processing capacity (and jobs) in rural areas aside from dampening the effects of business cycles. In one case, this was formally pursued by authorization of sustained yield units under the 1944 law. In other cases, it became a consideration in agency decisions. A proposed 1991 Forest Service policy on below-cost timber programs (timber that the Forest Service sold at a financial loss) specifically allowed extending below-cost programs to lessen effects on dependent mills. The 1977 and 1987 NFMA lists of timber-dependent communities were based more on sustaining customary use than the notion of dampening cyclical effects.

Results of Even-Flow Policy

Literature is ambiguous regarding the relationship of sustained timber yields and community stability, as measured by employment in the timber industry (Force 1993). Many factors undermine the potential use of even-flow supply of timber to stabilize rural communities regarded as timber-dependent. Macroeconomic forces are at work that are beyond local control. Federal managers are unable to deliver an even-flow of timber according to projections because of the need to manage for other uses and meet changing public desires. Stabilizing an

TABLE OF CONTENTS

industry is not the same as stabilizing a community. Lastly, federal timber can be purchased and transported long distances rather than purchased locally and used to provide jobs in the community.

Community Resiliency

Recently, many social scientists documenting challenges facing rural communities throughout the country have concluded that stability is just one way to achieve the broader goal of prosperous, vital communities:

> *Community adaptability may be a more useful concept than community stability in assessing which communities will thrive in our rapidly changing world. Levels of human capital, the imagination of community leaders, the ability to access information, and the availability of a flexible, diverse resource base are variables that will likely affect community adaptability (Beckley 1994).*

Community resiliency, the ability to successfully deal with the inevitable, multiple social and economic changes that are evident in our society, is a primary indicator of a community's health and vitality. Harris et al. (1995) described resiliency as consisting of population size, economic diversity, attractiveness and surrounding amenities, strong leadership, and other factors such as community residents' ability to work together and be proactive toward change. This definition of resiliency is similar to the concept of community capacity (FEMAT 1993).

Harris et al. (1995) used the Community Self-Assessment information to develop a relative scale of community resiliency for rural communities of less than 10,000 people, to measure how well-equipped communities are to deal with change. The most resilient communities tended to be larger in population, have an economy based on a mix of industries, view themselves as autonomous, and to have worked as a community to develop strategies for the future. Many communities are beginning to work together to identify ways of capitalizing on their location and other characteristics to cope with the many changes affecting their health and vitality. The data showed that there are many paths to achieving resiliency.

The population of a community and rate of change of that population are often used as indicators of economic diversity, economic resiliency, community vitality, and whether the community is prospering or in decline. Haynes used population growth as a proxy for economic growth. The "Forest Service/BLM Timber and Forage Importance Index" introduced earlier in this section does the same. Generally, this assumption is reasonable.

Population and Community Resiliency

Larger Population

Communities with larger populations lead to more businesses such that many industries are represented with many firms each. Employment opportunities follow. This economic diversity provides a cushion to job losses in declining industries because the economy does not depend heavily on any single industry or firm. A larger economy also means that less money leaves the local economy to pay for goods purchased from outside. The result is a more economically resilient community. It is unlikely that land use decisions of the Forest Service or BLM substantially affect communities with larger populations and diverse economies. This is confirmed by the findings in the *AEC* (1996).

Smaller Population

The converse of the above is generally true for communities with small populations, having fewer industries and fewer firms per industry. Even where many industries are represented, each may include only a few firms. A decline in one industry or loss of a firm, especially if a major employer, can mean high job loss in the community until adjustments are made. This can be especially disruptive if the community is geographically isolated with few alternative employment opportunities. This situation describes many rural communities with a high proportion of employment in agriculture and natural resource commodity industries. It is reasonable to expect that the Forest Service and BLM land use decisions can affect industries that are important to smaller communities near lands administered by these agencies, especially where the communities are geographically isolated. This is why ICBEMP economists identified a set of isolated, timber dependent communities that may warrant special attention in agency land use decisions.

Population Growth or Decline

Population growth is usually associated with economic growth and vice versa, but not always. Some agricultural communities are losing population as greater efficiencies in farming decrease labor demands without decreasing economic output. Gilliam County in Oregon is thought to be an example of this condition. Additionally, a community can experience rapid growth followed by rapid decline ("boom and bust"), a situation well known in the West. Finally, it must be determined whether economic growth is driving population growth or the other way around. The ICBEMP scientists assumed the latter. The premise was that high levels of environmental amenities, such as clean water and scenic views (mostly attributed to federal lands) provides a quality of life that invites in-migration. Economic growth is thought to follow this amenity-driven in-migration, with substantial credit given to empowering computer and communication technologies.

Analysis of population change by Haynes and McCool (unpublished) predicted rapid population growth for the project area. This growth could not be shown to be affected by land use decisions of the Forest Service or BLM. While agency land uses may influence population change in particular places, projections of population growth were not conducted for areas smaller than BEA multi-county regions.

Economic Diversity

Economic diversity is considered an important component of economic resiliency, whether measured at community, county, or regional levels. Economic diversity is considered vital to quality of life attributes provided by economic opportunity and services, including infrastructure, medical care, education, commercial services, and the critical presence of job opportunities (Rojek et al. 1975). The following discusses economic diversity at different geographic scales.

County and Regional Economic Diversity

A measure of economic diversity using the Shannon-Weaver Diversity Index (Alward 1995) is available for each county and BEA trade region in the planning area. This index is derived from the number and variety of industry sectors and associated employment using data from the IMPLAN input/output model. An economic system with a higher diversity index (more diversity) is thought to better absorb and rebound from changing conditions than systems with a lower index. The system with the higher index is therefore more economically resilient. Each county in the planning area has been rated as having low, medium, or high economic resilience based on the Shannon-Weaver diversity index for that county. These resiliency ratings are displayed on Map 2-42.

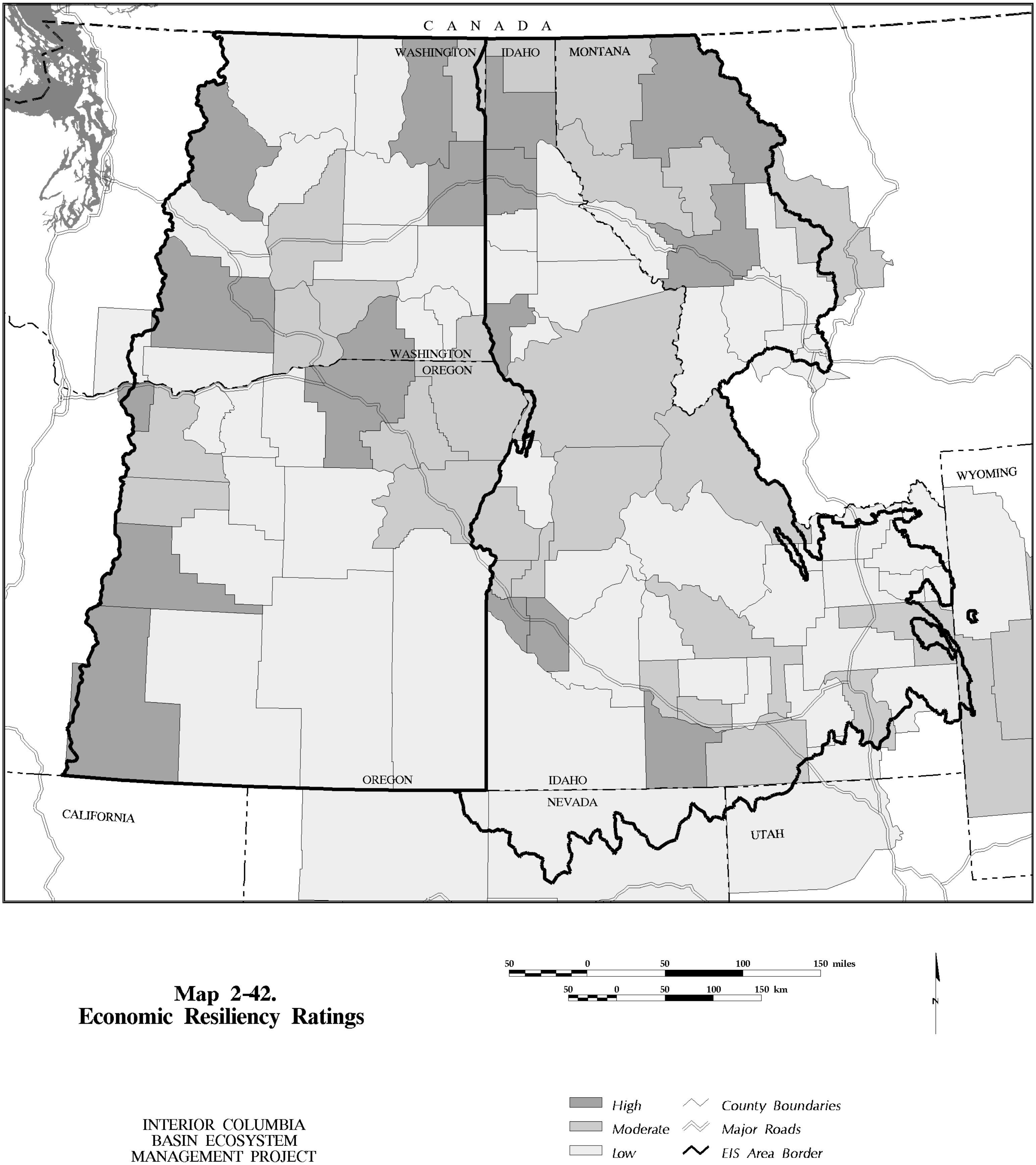
Community Economic Diversity

The type and amount of employment in nearly 400 communities in the project area with less than 10,000 people was measured to develop local indices of economic diversity using methodology developed by Robison and Peterson (1995). The resulting economic diversity values represent a relative index of the employment structure of the measured communities. It is an index based on the number of industries reported in a town and the proportion of the workforce in any single industry. The greater the number of industries and the higher the distribution of the workforce across industries, the higher the index value. This index is a useful characterization of the current employment structure. It is less useful for predicting future change.

Perceptions of Economic Diversity

As part of the Community Self-Assessment (Harris et al. 1995), participants were asked about their perceptions of the employment profile of their community. People perceived farming and agriculture as first in terms of dependence of employment on natural resources, followed by grazing and ranching, outdoor recreation and tourism, forest products, and mining and mineral resources. People perceived that most towns' employment was linked to a mix of natural resources; only nine percent of the communities were perceived as highly independent of farming and ranching, 13 percent independent of tourism and recreation, and 37 percent independent of timber. Approximately 25 percent of all communities were viewed as having an employment profile not dominated by any one industry.

TABLE OF CONTENTS



Map 2-42.
Economic Resiliency Ratings

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

Perceptions were compared with the actual employment profiles of each community. Overall, people were fairly accurate in their perceptions, but they tended to underestimate the diversity of their economy and overestimate the importance of traditional industries. There could be several explanations: people could simply be overestimating dependence on timber; people could be basing their perceptions on income effects or social influence instead of percent of employment; or job growth in non-traditional industries has not been fully recognized.

Importance of Scale in Measuring Economic Diversity

The size of area over which economic diversity is measured is critical. The larger the area considered, the greater the economic diversity and expected economic resiliency, especially if it means including a large metropolitan area (trade center). This is illustrated by the fact that individual counties in a BEA region are each less economically resilient than the BEA region as a whole. This explains why a multi-county region can be highly resilient whereas individual counties in the region are not. Neither counties nor communities are considered "functional" economies because they do not include enough parts of the economy to be even a moderately complete system. This is why trade regions like those developed by the Bureau of Economic Analysis consist of large multi-county areas.

Community Social and Cultural Attributes

Population size and growth, employment and wages, and economic diversity are factors of resiliency. Based on the responses of participants in the Community Self-Assessment Workshops, community social and cultural attributes are other factors to be considered. These include:

Strong civic leadership ~ A high commitment of leaders and groups to community, active involvement in creating and/or responding to change; and a strong sense of local control regardless of external events or influences.

Positive, proactive attitude toward change ~ Residents either promote change and thus vitality in community development or, if change is occurring on its own, residents respond positively and create a desirable future.

Strong social cohesion ~ A high degree of consensus in values and goals for a desired future; and working together to achieve goals.

Based on these data, together with economic profiles (measuring diversity) of each community, Harris developed a relative scale of community resiliency for rural communities of less than 10,000 people in the project area. His intent was to use the resiliency index to measure how well-equipped the community is to deal with change. The communities were divided into four classes, with 25 percent of the communities in each class; low, moderately low, moderately high, and high resiliency. This methodology is new and as yet unreviewed, but is felt to be useful in that some common characteristics emerged; more-resilient communities tended to be larger, have an economy based on a mix of industries, be more autonomous, rated by residents as having a local government responsive to the public, and to have plans for dealing with change (Harris 1995).

Some of the things people typically base their evaluations on include feeling a part of the community, having a sense of control over decisions that affect their future and the future of their community, knowing that local government is acting in ways that benefit people equitably rather than acting for a privileged few, living without fear of crime or environmental hazards, and feeling confident that one's children have a fair start in life (Branch et al. 1982). Forest Service and BLM land uses have little direct effect on these conditions.

Amenity Setting

A high degree of physical amenities ~ the historic character and attractiveness of a community's downtown, the attractiveness of the community's setting regarding scenic and recreational opportunities, and the lack of negative elements such as air or water pollution ~ is another component of resiliency (Harris et al. 1995).

The presence of desirable environmental amenities, and especially the types supplied by

TABLE OF CONTENTS

public lands, can contribute to an area's population and economic growth. Scientists differ in their interpretation of the value of this benefit, which can differ depending on the scale at which it is measured. Because tourism and recreation, retirement settlement, and other uses of Forest Service- and BLM-administered lands can provide significant sources of jobs, income, and personal enjoyment, communities value these agency and other public lands for these uses (Society of American Foresters Report 1989). Some evidence to support this relationship is the high population growth occurring in areas with high recreation use (Johnson and Beales 1994). Ashton found that recreation counties tend to be diversifying more rapidly than non-recreation counties, attributing this to Forest Service- and BLM-administered land multiple-use policy which provides an environment that attracts both tourists and permanent residents to the area (Ashton 1995).

Rasker (1994), Power (1994), and others have emphasized the role of a high quality natural environment, scenic beauty, and recreation opportunities in influencing population growth and shaping the emerging economy of the project area. For example, Rasker (1995), writing about the project area, stated that,

> *As we approach the twenty-first century, there is a striking change in how the region's forests, mountains, streams, rivers, and grasslands contribute to the economic life of its residents. Once, settlers were attracted to the region by the promise of logging, ranching, mining, and farming. Now, the magnet that draws new residents and holds the region's existing inhabitants is environmental quality: clean air and water, handsome scenery, and native wildlife...the region's economy is growing less dependent on resource extraction and more dependent on less tangible qualities: environmental quality, education, entrepreneurship, and capital.*

Quality of Life

Machlis and Force (1994) identified a number of indicators of social conditions regularly monitored by various agencies that provide indirect measures of quality of life. Usually collected at the county level, these indicators include conditions such as crime rates, income and employment levels, pollution, and voting rates. Only employment and income can be closely linked to uses of Forest Service- and BLM-administered lands.

Quality of life assessments take into account people's perceptions. Considerations include perceptions about the attractiveness and aesthetics of the local environment (Pulver 1989) and the quality of services such as infrastructure, medical care, education, and commercial services (Rojek et al. 1975). Many of these characteristics could be summed up as "small town values." However, many local residents who participated in the Interior Columbia Basin Ecosystem Management Project suggested that many other factors were meaningless if they did not have a job.

One measure of baseline conditions regarding quality of life in rural communities was provided by participants in the Community Self-Assessment workshops (Harris et al. 1995; the Community Resiliency section describes these data). These community leaders and residents generally rated quality of life in the project area as high; 80 percent believed that their community was "safe, friendly, and a good place to live; few rural communities can match its quality of life."

Attitudes, Beliefs, and Values

This section summarizes what is known about some of the public attitudes (favorable or unfavorable views of objects or events), beliefs (what people think is true), and values (the things people hold dear to them) associated with ecosystem management. It is included in this chapter because not only have the physical, biological, social, and economic resources and opportunities in the project area changed, but people's perceptions of them have as well. Trends in these attitudes and values are important components of the social setting.

Riley and Scarce (1991) examined trends in attitudes toward environmental issues over the past 20 years, including issues such as threats posed by environmental problems, support for government actions, willingness to pay for environmental protection, perceived seriousness of environmental problems, and tradeoffs between environmental protection and economic development. They concluded that, as of 1991,

> *Public concern for environmental quality has reached an all-time high. While questions about the strength of environmental concern remains unclear, growing majorities see environmental problems as serious, worsening, and increasingly threatening to human well-being.*

Dunlap and Van Liere (1978) called this set of attitudes the new environmental paradigm, which rejects the notion that nature exists solely for human use. Recent national surveys have found that a majority of the American public supports the environment and believes environmental issues should be a high social priority. A 1995 survey of Northwest residents (Harris and Associates 1995) found that 57 percent considered themselves an "environmentalist" while 41 percent did not. Some types of respondents (older people, democrats, and people who attended college) were more likely to consider themselves environmentalists, but the finding was consistent whether people were residents of major cities or of small, rural communities.

However, support for environmental issues may be lower than it was several years ago, as more people question the costs of environmental protection. People today appear to be looking for a balance between restoration of natural processes and continued social and economic direct-use benefits. Most people believe such a solution is possible (Roper Starch 1994).

Support for endangered species laws and regulations is strong, but may have decreased slightly over the past three years. The public is increasingly concerned with seeking a balance between species protection and costs to society. A majority of Pacific Northwest residents support reauthorization of the Endangered Species Act, yet believe it is only somewhat effective in protecting plants and animals (Harris and Associates 1995). Support for salmon recovery, and a willingness to accept resulting socioeconomic impacts, seemed to be stronger than that for endangered species in general. However, most people perceive that the major barriers to recovery are dams and overfishing, rather than lack of suitable habitat.

Survey research typically finds differences in opinions between residents of small, rural towns and residents of larger urban areas, or the national public in general. National samples tend to be stronger on environmental protection, and less sympathetic to local economic impacts than are local residents ~ perhaps because they share more in the benefits than the costs. For example, residents of small towns in the Pacific Northwest were less likely than city residents to favor strengthening the federal role in resource protection (Harris and Associates 1995).

However, there are many issues on which these populations are similar, and one should not assume that project area residents will always have a certain set of opinions. Both locally and nationally, people believe that local residents and others who are most affected by public land management should participate and have a strong say in the outcome. The 1995 Harris Poll, for example, found that support for increased environmental protection is greater when state or local governments take the initiative than when the federal government does.

Another important change in societal values is the broader acceptance of biocentric viewpoints. Steel et al. (1994) surveyed the national public, including Oregon residents, to explore the distinction between these approaches:

> *One school of thought, derived from such important early foresters as Bernhard Fernow and Gifford Pinchot, approaches natural resource management with a utilitarian or resource conservation focus. This view advocates the wise use of forests for the betterment of humankind and is based mostly on anthropocentric assumptions. The other, contrasting view of forestry is related to the ideas of John Muir and Aldo Leopold. This approach to forest management is more biocentric in orientation and favors the extension of ethical consideration to all parts of the forests, including birds, mammals, plants, insects, and such elements as forests, streams, and soils (p. 138).*

Both the Oregon and national samples tended to be more biocentric (philosophical view of emphasizing natural biological systems over commodity production and other human uses) than anthropocentric (philosophical view emphasizing human uses in the ecosystem,

TABLE OF CONTENTS

such as commodity production over natural biological systems), but the national sample was significantly more likely to have stronger biocentric views toward forests than the Oregon sample. People with biocentric orientations were more likely to support bans on clearcutting, creation of wilderness, and protection of old growth areas, while anthropocentric thinkers were more likely to set aside endangered species laws to preserve jobs or to give economic concerns a higher priority in forest decision making. Additional survey research conducted for this project showed a preference for biocentric as opposed to anthropocentric viewpoints.

Sense of Place

Another type of value to be considered in ecosystem management is sense of place (*Scientific Assessment* 1996) Forest Service- and BLM-administered lands in the planning area contain many places that have special meaning to area residents and visitors. Sense of place refers to how people define specific landscape locations based on their meanings and images. The importance of place is embedded in American Indian culture as reflected in the languages which link land, water, and maintenance of cultural identity. Place names relay traditional knowledge of land and resources by referring to plants and animals which characterize a location, the actions of people at a location, the spiritual role of the location, or some other attribute of the site.

Recreation visitors develop attachments to places based on their past experiences. These attachments can pass from one generation to another. People who make their living from public land resources and opportunities typically develop close relationships to the land base on which their livelihood depends. Community residents and other social groups tend to develop collective definitions of places.

Place assessment is a way to inventory the locations, names, and broad meanings of the attachments that people share for geographic areas. The concept of place has not been widely or uniformly used by federal land management agencies, either within or outside the project area. Specific areas, such as Hells Canyon National Recreation Area, have place assessments conducted for specific planning projects. The task of defining places has proven to be a positive process for involving community residents and spurring discussion about common visions for public land management (Galliano and Loeffler 1995b). The goal in such efforts was not to protect the places identified, or to allocate federal lands to one use or another based on them, but simply to have another source of information available when making resource management decisions.

Galliano and Loeffler (1995b) and others (Williams 1995, Tuan 1975) recommended that, for the purpose of public land management, place assessment should occur at a community level, avoiding defining places that have meaning only to a few individuals or places that are so broad they have little meaning in a management context. This was tested at two locations within the planning area ~ the Silvies Basin area near Burns, Oregon, and the Yakima Basin near Yakima, Washington (Galliano and Loeffler 1995b). After interviewing 30 federal employees and 53 residents or visitors to the two areas, they successfully mapped a finite number of places that had similar meanings and boundaries to many of those interviewed. This exercise suggested that places could be defined at a community scale.

Role of the Public

While not typically part of a description of the Affected Environment, the role of the public is an existing condition that is undergoing change with the Forest Service and BLM. It is also an issue voiced repeatedly by members of the public during development of this planning document.

Public participation in Forest Service and BLM land management decisions is guided by the National Environmental Policy Act (NEPA), National Forest Management Act, Federal Land Policy and Management Act, and other laws that contain legal requirements for incorporating public input into natural resource decision-making. For example, in situations where an environmental impact statement is required, NEPA calls for an early and open process to facilitate effective communication with the public.

In a survey conducted for the Interior Columbia Basin Ecosystem Management Project, the public was asked about their preferred level of participation in planning. The results were quite uniform across all respondents: the greatest support was for acting as a full and equal partner (chosen by 32 to 39 percent); followed closely by serving on advisory boards (chosen by 30 to 32 percent). Providing suggestions and making the decisions were chosen by roughly equal numbers (about 10 to 18 percent), with none (letting agency managers decide) chosen by just 1 to 3 percent.

The public also was concerned about the efficiency of public participation. During EIS scoping and subsequent requests for comments, many people said, "Yes, ask us for our knowledge and opinions in a balanced, representative way ~ but don't spend all the time talking about what to do, make sure things happen on the ground."

Many collaborative groups have formed in the past few years to address natural resource issues. Wondolleck and Yaffee (1994) conducted an extensive study of increased collaboration between the Forest Service and other public land stakeholders. These included many well-known efforts that took place in or adjacent to the planning area: the Applegate Partnership; the Blue Mountains Natural Resources Institute; the Nooksack River Partnership; the Tonasket Citizens Council; the Yakima Resource Management Cooperative; New Meadows Community Outreach; and Willamette Forest Plan Implementation Monitoring.

Wondolleck and Yaffee stated that increased collaboration accomplished many objectives: it allows agencies to acquire needed information from the public; generates sound resource decisions; builds support for resource management decisions; influences public knowledge and values; broadens the workforce available to get projects done on the ground; and makes agencies better neighbors. Other benefits of increased collaboration are increased predictability in resource outputs and conditions; public participants can gain a better understanding of the issues, likelihood of implementation, and other information that helps them be better informed and able to anticipate changes. Predictability of resource flows is an issue the public is very interested in.

The Northwest Forest Plan's creation of Province Advisory Committees was a move toward a new approach to public participation. Each of the 12 Provinces has an advisory committee made up of federal employees and members of the public. The BLM and Forest Service in Oregon and Washington are beginning an effort that parallels the intent of the Province Advisory Committees. In the portions of Oregon and Washington not covered by the Province Committees, two Resource Advisory Councils (RACs) are being developed, each one covering a distinct geographic area.

Formed under the Federal Advisory Committee Act, the RACs are designed to make recommendations to the Forest Service and BLM on ecosystem management, watershed planning, and other local or regional natural resource issues. The list of objectives for the RACs includes collaborating in resource management across Forest Service- and BLM-administered lands, promoting partnerships and working groups to develop regional solutions to management issues, assisting with educational efforts, sharing science and other information, and encouraging and supporting local groups to implement ecosystem management (Draft 1784 Handbook on Advisory Committees, March 20, 1995 version).

Krannich et al. (1994) emphasized the importance of people working together to make ecosystem management successful:

> *It is not merely computers full of social indicator data, GIS maps, or species distributions and habitat effectiveness trends that will determine the success or failure of ecosystem-based management. Rather, it will hinge on whether or not we are able to craft policy mechanisms within which we can mix that scientific information, assign it meaning, sort it out, and then chart a course for ourselves...the participants themselves ~ both in and out of agencies ~ are ultimately responsible for the outcome and are the judges of its adequacy.*

TABLE OF CONTENTS

American Indians

Key Terms Used in This Section

Band ~ A band is a group of people who share a culture, territory, and sense of mutual recognition. Bands are primarily those pre-treaty-making period American Indian groups.

Beneficiary ~ The recipient of payment or entitlement based upon an agreement, contract, or treaty. Indian tribes in the project area signed treaties and agreements with the United States in exchange for promises by the United States to "secure" or guarantee rights the Indians reserved in these treaties and agreements.

Ceded Lands ~ Lands the tribes granted to the United States by treaty in exchange for reservation of specific land and resource rights, annuities, and other promises in the treaties.

Consultation ~ (1) An active, affirmative process which (a) identifies issues and seeks input from appropriate American Indian governments, community groups, and individuals; and (b) considers their interests as a necessary and integral part of the BLM and Forest Service decision-making process. (2) The federal government has a legal obligation to consult with American Indian Tribes. This legal obligation is based in such laws as NAGPRA, AIRFA, and numerous other Executive Orders and Statutes. This legal responsibility is, through consultation, to consider Indian interests and account for those interests in the decision. (3) Consultation also refers to a requirement under Section 7 of the Endangered Species Act for federal agencies to consult with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service with regard to federal actions that may affect listed threatened or endangered species or critical habitat.

Lifeways ~ The manner and means by which a group of people lives; their way of life. Components include language(s), subsistence strategies, religion, economic structure, physical mannerisms, and shared attitudes.

Tribe ~ Term used to designate a federally recognized group of American Indians and their governing body. Tribes may be comprised of more than one band.

Trustee ~ One who holds legal title to property to administer it for the benefit of another. The federal government trust responsibility arises from promises made in treaties, executive orders, and agreements. Certain lands and resources of Indians are entrusted to the United States government through those treaties and agreements.

Summary of Conditions and Trends

- There is low confidence and trust that American Indian rights and interests are considered when decisions are proposed and made for actions to be taken on BLM- or Forest Service-administered lands.
- American Indian values on Federal lands may be affected by proposed actions on forestlands and rangelands because of changes in vegetation structure, composition, and density; existing roads; and watershed conditions.
- Indian tribes do not feel that they are involved in the decision-making process commensurate with their legal status. They do not feel that government-to-government consultation is taking place.
- Culturally significant species such as anadromous fish and the habitat necessary to support healthy, sustainable, and harvestable populations constitute a major, but not the only, concern. American Indian people have concern for all factors that keep the ecosystem healthy.

Introduction

This section describes the cultural history, legal context, and existing federal agency relations with the project area's affected American Indian tribes. The ways in which American Indians use Forest Service- and BLM-administered lands is

TABLE OF CONTENTS

Native Americans, First Nations, and American Indians

Native Americans, First Nations, and American Indians are all terms used to describe Indian people in the project area. **Native Americans** are people who were the first inhabitants of the western hemisphere. **First Nations** refers to pre-European Native Americans that were self-governing, independent (sovereign), and organized, with social and/or political structure. **American Indian** is a legal term in federal law and regulation referring for the most part to members of federally recognized tribes.

discussed in the context of their cultural, social, economic, religious, and governmental interests. The United States government has a unique responsibility to Indian tribes. Implications from this responsibility for Forest Service and BLM decision-makers are described as they relate to ecosystem-based management in the project area.

Cultures

People rely on their culture in order to live, relate to others as collective groups, and understand and function in their world. A culture includes religious, economic, political, communication, and kinship systems. Together these guide group behaviors and instruct members of the group. Culture is the whole set of learned behavior patterns common to a group of people, their interactive behavior systems, and their material goods. A Culture Area is an area where groups of people and their cultures, in this case American Indian tribes or bands, share similar cultural traits and networks.

Most of the prehistoric cultures of the project area belonged to either the Plateau or Northern Great Basin Culture Areas. The Pit River and Shasta tribes, who are associated with the Klamath Tribe, are grouped within the Californian Culture Area. Over thirty Plateau bands historically occupied the northern portion of the interior Columbia Basin and part of the Klamath Basin. Many bands, including the three Northern Great Basin bands ~ the Bannock, Northern Paiute, and Shoshoni ~ occupied most of the project area's southern half. Differences existed among cultures, especially between tribal culture areas. An example of how diverse these cultures were can be seen in the area's 13 distinct native languages, which were associated with 8 separate language families. (In comparison, Europe has only 3 native language families.) Jargon and sign languages helped people communicate across language and cultural barriers, especially for trade purposes. Map 2-43 shows the project area's federally recognized tribes; Table 2-29 shows the tribes, Culture Areas, and bands within each tribe. Appendix 1-2 contains more information on each tribe.

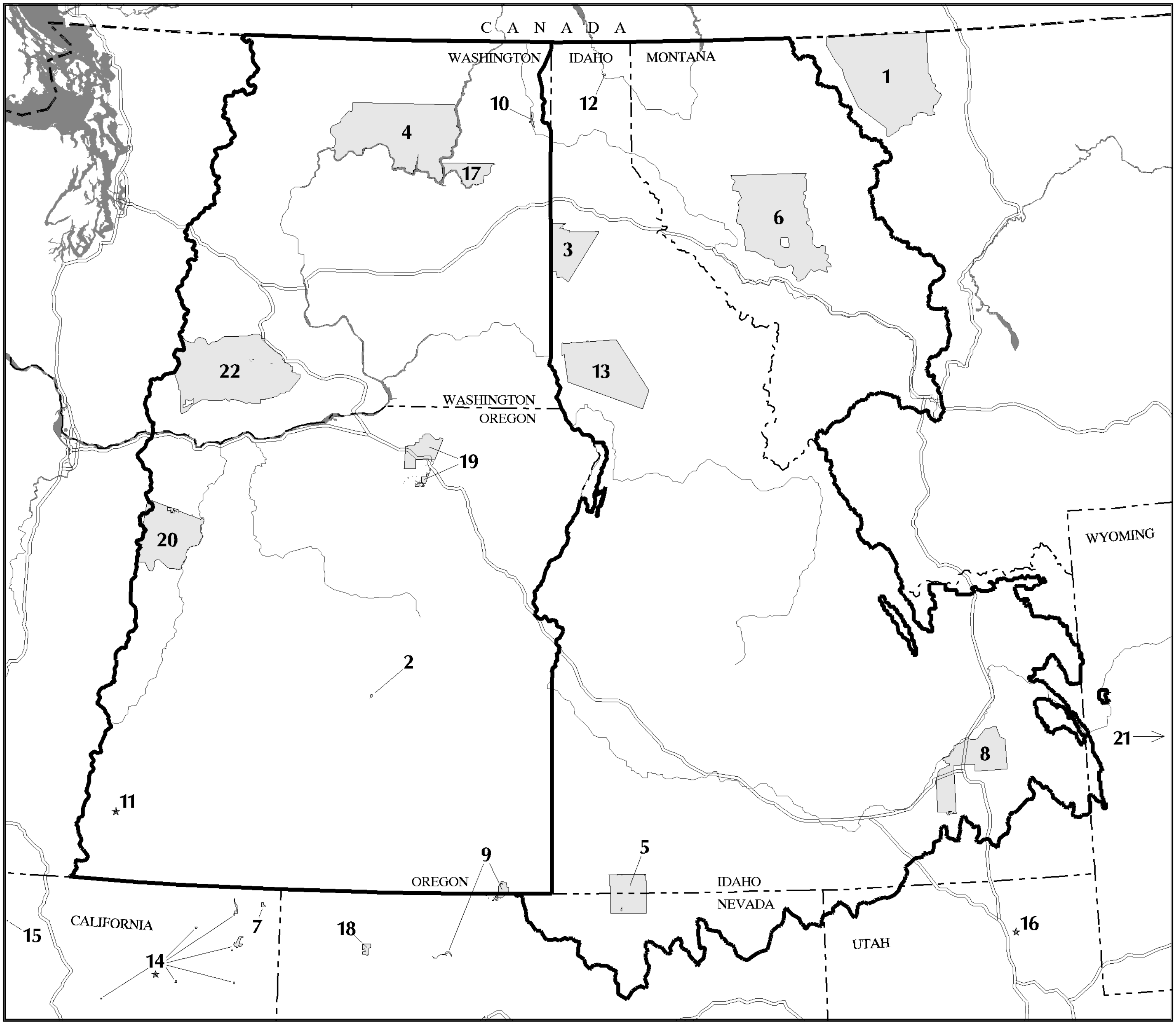
Cultural Significance

Cultural significance refers to a whole set of relationships between a group of people, their culture, and their world (landscapes, places, and living and inanimate things). These relationships define and are defined by the values, use, meanings, and relevance people hold for their world, behaviors, activities, or events. Culturally significant things should be understood and treated within the context of the culture that identifies, manages, and values them.

The cultural significance of salmon in American culture is multi-dimensional. It is a food source, a symbol of persistence and fortitude in a life cycle struggle, an economic industry, a prized game fish, a regional political and environmental issue, and a symbol of the Pacific Northwest region. Additional significance of salmon for many American Indians is founded in their religions, socio-cultural values, and identity as a community or a people.

A better understanding of significance is found in how people relate to salmon through any of the above ways. For sports fishermen, salmon are revered for their size and fight; a single large catch brings individual esteem. Fishing stories provide social bonding and bravado. Indian fishermen revere salmon (steelhead included) as a divinely provided food; it is a "lead-fish" essential on the tables at community dinners. A large catch of fish (enough to both sell and give away) brings social esteem to both the fisherman and the skilled salmon handlers who prepare and serve the catch. Stories about salmon bonds together individuals, family, society, places, and land.

TABLE OF CONTENTS



Map 2-43. Federally-Recognized Tribes

	Tribal Lands	5	Duck Valley	14	Pit River
	Major Rivers	6	Flathead	15	Quartz Valley
	Major Roads	7	Fort Bidwell	16	Shoshoni NW Band
	EIS Area Border	8	Fort Hall	17	Spokane
*	Tribal Headquarters	9	Fort McDermitt	18	Summit Lake
1	Blackfeet	10	Kalispel	19	Umatilla
2	Burns Paiute	11	Klamath	20	Warm Springs
3	Coeur d'Alene	12	Kootenai of Idaho	21	Wind River
4	Colville	13	Nez Perce	22	Yakama

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

Table 2-29. Affected Tribes and Bands in the Project Area.

Name of Federally Recognized Tribe[1]	Culture Area	Names of Bands Within Tribe
Blackfeet Tribe	Plains	Southern Piegean, Bloods, Siksika, Northern Piegean
Burns Paiute Tribe	Great Basin	Wada Tika, Hunipui, Walpapi, Koa'agai, Kidu
Coeur d'Alene Tribe	Plateau	Coeur d'Alene, Spokane, San Joe (St Joseph) River
Confederated Salish & Kootenai Tribes	Plateau	Salish (Flathead), Kootenai, Upper Pend d'Oreilles
Confederated Tribes of the Colville Reservation	Plateau	Methow, Sanpoil, Lakes (Senijextee), Colville (Sweelpoo), Kalispel, Spokane, Entiat (Pisquouse), Nespelem, Chelan (Kow-was-say-ee), Columbia (Senkaiuse), Chief Joseph band of Nez Perce, Wenatchee (Wenatshapam/Pisquouse), Southern Okanogan (Sinkaietk), Palus (Palouse)
Confederated Tribes of the Umatilla Indian Reservation	Plateau	Umatilla, Cayuse, Walla Walla
Confederated Tribes of the Warm Springs Reservation	Plateau	Wasco, Dalles (Kigal-twal-la), Dog River, Warm Springs (Taih) or Upper Deschutes, Lower Deschutes Wyam, Tenino, John Day River (Dock-Spus)
	Great Basin	Northern Paiutes
Confederated Tribes of the Bands of the Yakama Indian Nation	Plateau	Klickitat, Klinquit, Liay-was, Kow-was-say-ee, Oche-chotes, Palouse, Shyiks, Pisqouse, Se-ap-cat, Skinpah, Wishram, Wenatshpam, Yakama, Kahmilt-pah
Fort Bidwell Indian Community of Paiute Indians	Great Basin	Gidutikad
Fort McDermitt Paiute and Shoshone Tribes	Great Basin	Northern Paiute, Shoshone
Kalispel Tribe of Indians	Plateau	Aqulispi'lem, Slate'ise
Klamath Tribe of Oregon	Plateau Great Basin	Klamath, (Ma'klaks), Modocs, Yahooskin, Wal-pah-pai

TABLE OF CONTENTS

Table 2-29. Affected Tribes and Bands in the Project Area (continued).

Name of Federally Recognized Tribe[1]	Culture Area	Names of Bands Within Tribe
Kootenai Tribe of Idaho	Plateau	Upper and Lower Kootenai
Nez Perce Tribe	Plateau	Nez Perce (Ni mi pu), Upper and Lower Wallowa (Pikunema, Lamata)
NW Band of Shoshoni Nation	Great Basin	Eastern Shoshone (Washakie)
Pit River Tribe of California	California	Ajumawi, Aporige, Astariwawi, Atsuge, Atwamsini, Hammawi, Hewisedawi, Illmawi, Itsatawi, Kosalektawi, Madesi
Quartz Valley Indian Community	California	Shasta, Karok
Shoshone Tribe of the Wind River Reservation	Great Basin	Eastern Shoshone, Arapahoe (not affected)
Shoshone-Bannock Tribes (Fort Hall Reservation)	Great Basin	Eastern Shoshone (including Lemhi), Bannock
Shoshone-Paiute Tribes (Duck Valley Reservation)	Great Basin	Western Shoshone, Northern Paiute
Spokane Tribe	Plateau	Upper Spokane (Snxwemi'ne), Middle Spokane (Sqasi'lni), Lower Spokane (Sineka'lt), Chewelah
Summit Lake Paiute	Great Basin	Paiute

Band names in parentheses are either used in treaty or executive order documents, or are names recognized by tribes. Legally recognized or most common spellings were used for most tribe and band names.

[1] A tribe is a federally recognized distinct grouping of American Indian people, with a continuous political organization. Federal recognition has implications for trust obligations and entitlement to many federal Indian services. Federal recognition may arise from treaty, statute, executive order, administrative order, or from the course of the federal governments dealing with a group as a political entity.

Source: Keith and Perkins (1996).

The economic, political, religious, and social systems of the First Nations were interdependent and integrated. Native peoples traditionally organized by families, autonomous villages, and to a lesser degree, bands. Their associations and alliances were often greatest with neighboring villages. Political, economic, and subsistence strategies focused on local environments. However, trade networks, trade centers, and task groupings, which interacted with surrounding Culture Areas, extended the focus of bands and villages.

Access to and availability of natural resources was crucial to native people. Many places were visited during a yearly cycle of seasonal migrations (see Figure 2-20) to collect food, medicines, and other materials, as well as for religious practices and social gatherings. Plants, usually gathered from scablands, meadows, canyons, aquatic environments, and forestlands, are thought to have provided over half of native peoples' diets. The rest of their diet came from fish, animals, and birds, which were available in varying amounts. These and other natural resources were an integral part of tribal culture, and are still culturally significant to American Indians.

Well-traveled routes between villages, temporary camps, resources, and gathering places were used for seasonal migrations. Winter and summer villages, which served as residential bases, were established based on the availability of water, shelter, food, and other resource needs. Resources were not found in the same abundance in each band's subsistence area. The annually varying abundance of anadromous fish, subsistence animals, and food plants in known gathering areas was balanced by trade with other bands. The geography and distribution of resources in each band's subsistence areas along with differing family strategies created unique seasonal migration patterns.

Both Plateau and Great Basin groups had resource areas that drew groups together to share resources in particularly rich places. The Columbia, Snake, and Klamath rivers; The Dalles/Celilo Falls, Kettle Falls, Upper Klamath Lake, and Boise Falls had premier fisheries. Well-known plant gathering places in the project area included the Grande Ronde Valley in Oregon, Idaho's Camas Prairie, and meadows and prairies south of the Spokane River in Washington. These places were also significant meeting areas, trade centers, or habitation sites.

Changes in Uses of and Relationships with the Land

Although early populations are difficult to estimate, the project area's tribal population was likely greatest in the mid 1700s. American Indian populations have passed through a number of cycles, generally increasing in areas and time periods that had abundant natural resources, and decreasing during long periods of scarce resources.

The introduction of the horse in the 1700s and early 1800s increased people's ability to collect and store food, increasing native populations. In the 1800s, diseases introduced by European settlers and missionaries significantly reduced native populations by as much as 90 percent in large regions in the project area. This decimated societies and cultures.

By the 1860s, the Oregon Trail and military roads opened the way for mass Euroamerican settlement, and Indian people were no longer the majority population in the project area. The culture and philosophy of these new people were quite different from the native peoples' system of seasonal migrations and interdependence with natural resources. In general, the new Americans settled in one place year-round, which created different impacts on the landscape compared to the seasonal migratory patterns of American Indians.

Native people set fires to modify their environment at certain times of the year. These fires differed in intensity, timing, and location from current fires in project area ecosystems. The new settlers introduced additional disturbances to native systems, including sheep and cattle grazing, large-scale resource extraction, and fire suppression, among others. Specific modifications to native systems are described briefly in the introduction to this chapter, in more detail throughout this chapter, and in still greater detail in the Science Integration Team report,

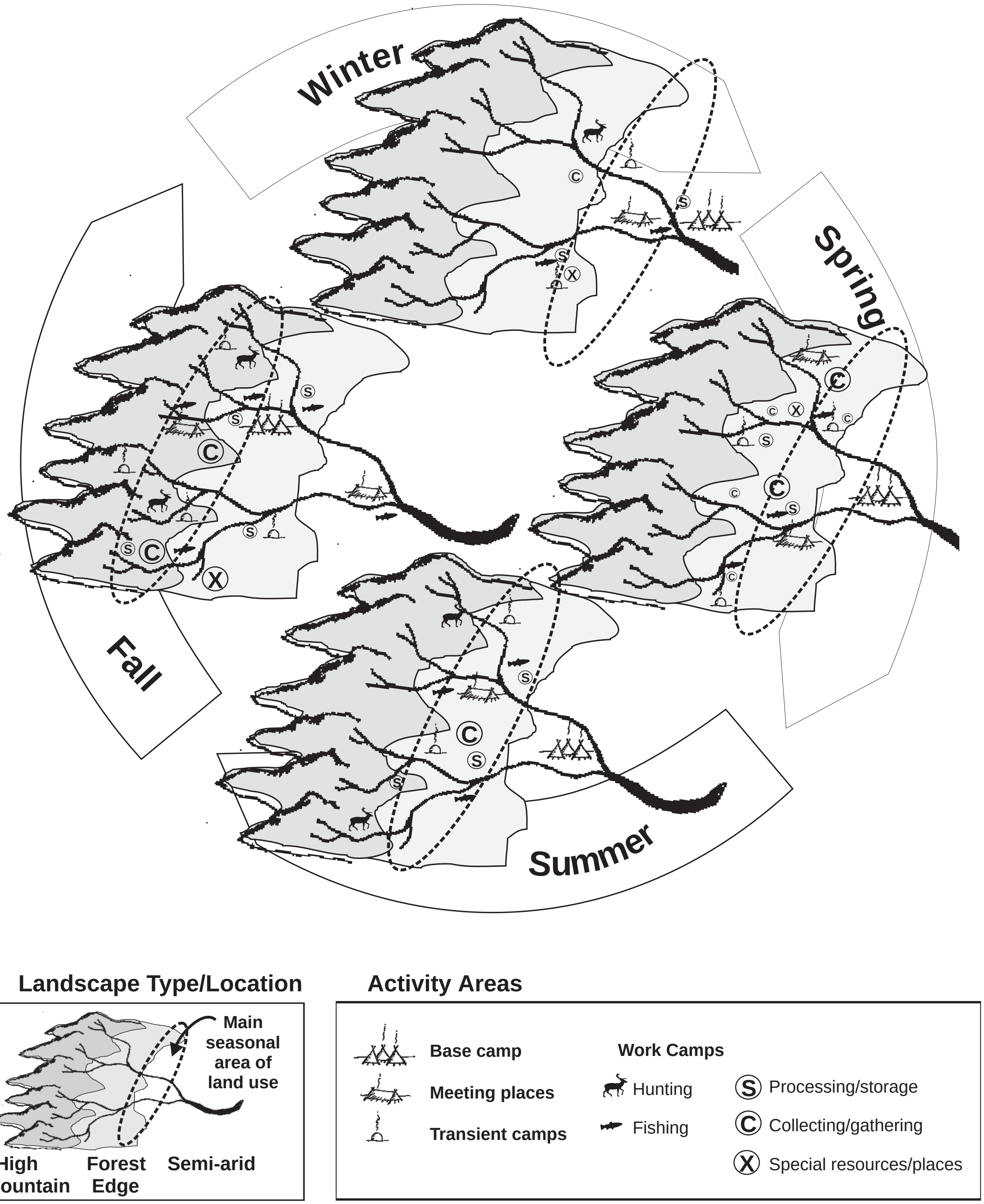


Figure 2-20. Seasonal Rounds - An example of how a Native American band might have travelled across the land within and beyond their homeland. As each season progressed, family units left their lowland winter residence and followed the seasonal cycle of plant, animal, and aquatic life forms as they became available for harvest.

TABLE OF CONTENTS

the *Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins (AEC;* Quigley and Arbelbide 1996b).

Land uses and seasonal migration patterns for Indian people were altered as a result of the influx of new settlers with new cultures. The steady growth of Euroamerican populations caused conflicts over resource use and availability, as well as pressure to change American Indian cultures.

The competition and conflict between native and Euroamerican people in the 1800s resulted in a treaty-making period between tribes and the United States government. Treaties are agreements between sovereign nations, and are considered part of the supreme law of the land in the United States Constitution (Article VI). When the federal government signed treaties with American Indians, it assumed a legal obligation in which the Indians trusted the United States to fulfill commitments in exchange for cession of Indian claims to land.

In signing treaties, most tribes ceded lands in exchange for set-aside, exclusive-use reservations, services, and promises of access to traditional land uses such as hunting, fishing, gathering, and livestock grazing. The tribes hoped this would preserve their cultural and subsistence activities and traditional economic lifeways for current and future generations. Indian reservations were seen by both tribes and government as a way to limit conflicts and allow tribes to have their own land.

American Indian use of the land became restricted by removal from their homelands and a shift onto Indian reservations. Many tribes lost their ability to remain self-sufficient because they were deprived of a land base large enough to supply a subsistence, and they became dependent on federal government's assurances in the treaties. Bands, communities, and even families were divided among reservations, often further separating them from their traditional use areas and resources. However, many Indians continued off-reservation use of their homelands, and some even maintained off-reservation communities.

Traditional lifeways persisted even as the Indians increasingly conformed to regional non-Indian lifestyles. The largely separate reservation communities often imitated and interacted with counterpart, non-Indian communities. Even the internal conflicts and divisions that accompanied cultural changes were limited by social forces based on family ties, a shared heritage, and cultural background. These same factors bound people and their communities to certain off-reservation lands.

American Indians seasonally sought out familiar resources and places, regardless of ownership. They developed understandings with landowners and trade opportunities with those communities they encountered. During economically depressed periods, such as the Great Depression, renewed reliance on traditional foods and other practices helped sustain many tribal economies. Inevitable conflicts over land use led to reduced tribal access to resources and traditional places.

American Indians changed along with regional developments and governmental regulations. For example, many Indian families came to depend increasingly on automated modes and routes of travel. Various new federal agencies' management actions and policies for public lands in the early 1900s have changed and continue to change American Indian uses of lands in many ways. By the mid 1900s, the effect of assimilation policies and influences caused traditional cultures and values to become narrower aspects of American Indian life. Most traditional uses of public lands today, however, continue to have roots in earlier native cultures and socio-economic practices.

Legal Agreements

Federal Trust Responsibility

The trust responsibility is difficult if not impossible to define. Pevar in his book says "The federal government obligation to honor its trust relationship and fulfill its treaty commitments is known as its trust responsibility" (Pevar 1992). The legal concept known as "trust" originated in England in the Middle Ages. It meant that ownership of land placed in trust was in the hands of one person, the trustee, who had the responsibility to manage the land for the benefit of another person, the beneficiary.

TABLE OF CONTENTS

The modern concept of trust responsibility grows out of the 1814 Treaty of Ghent, in Chief Justice Marshall's decision in *Cherokee Nation v. Georgia* 1831. Justice Marshall characterized American Indian tribes as "domestic dependent nations" involving (1) the government or nation-state status of tribes, and (2) a special tribal relationship with the United States (Cohen 1982). Marshall described the trust relationship as one that "resembles that of a ward to his guardian." This relationship has been consistently recognized by federal courts ever since and has been described as "special," "unique," "moral," and "solemn" (Indian Tribes 1981).

In addition, the rights reserved by the tribes in treaties and agreements, or which were not expressly terminated by the Congress, continue to this day. These governmental rights and authorities extend to any natural resources which are reserved by or protected in treaties, executive orders, and federal statutes. The courts have developed the Canons of Construction, guiding premises, that treaties and other federal actions "should when possible be read as protecting Indian rights in a manner favorable to Indians (Cohen 1982).

The interpretation of tribal rights and treaty language continues to evolve and define federal legal responsibilities. For example, a 1994 court decision involving shell fishing rights determined that treaty-reserved resources were not limited to those actually harvested at treaty time because the right to take any species, without limit, pre-existed the treaties (*United States v. State of Washington* 1994).

The primary focus of the federal government trust responsibility is the protection of Indian tribes' natural resources on reservations, and the treaty rights and interests that tribes reserved on off-reservation lands. In fulfilling the trust obligation, the Congress also adopted laws and policies that protect tribes' rights to self-determination, and promote the social well-being of tribes and their members. Under various laws and policies, agencies have a responsibility to implement federal resource laws in a manner consistent with a tribes' ability to protect their members, to manage their own resources, and to maintain themselves as distinct cultural and political entities. These responsibilities can be readily applied to resources and lands administered by the Forest Service and BLM. Forest Service and BLM trust responsibilities apply to those actions under their authority. For example, they can affect activities on lands they administer relative to plant and animal habitats.

The federal government trust responsibility compels agencies to conduct their activities consistent with obligations set forth in treaties and statutes. In carrying out their trust responsibilities, the BLM and Forest Service must assess proposed actions to determine potential impacts on treaty rights, treaty resources or other tribal interests. Where potential impacts exist, the agencies must seek consultation with affected tribes and explicitly address those impacts in planning documents and final decisions. Consultation with the tribes, described later in this section, is essential in carrying out that trust responsibility. A key issue is the federal government's trust obligation to ensure that tribal treaty rights and interests will be protected. Agencies often consider that trust is carried out when tribal interests have been considered prior to making land use decisions. However, consultation and consideration in and of themselves may not be enough to fulfill federal trust responsibilities. Tribes contend that treaty resources must actually be protected before land management activities can proceed. Despite the legal disputes between processional duties associated with project decision-making processes and substantive duties consisting of guarantees, Federal fulfillment of trust is ultimately measured by the actual effects of Federal actions.

Meeting the purpose and need for action as described in Chapter 1 of restoring and maintaining the long-term ecosystem health and integrity on the lands administered by the Forest Service or BLM, while still supporting the economic and/or social needs of people, cultures, and communities at sustainable and predictable levels of products and services from those lands, is consistent with, if not equal to, meeting the government's federal trust responsibilities.

Other Agreements

Although the treaty-making era ended in 1871, negotiations with tribes continued and resulted in agreements ratified by both houses of the Congress. Like treaties, agreements and statutes are the supreme law of the land, creating rights and liabilities that are virtually identical to those established by treaties

TABLE OF CONTENTS

(Cohen 1982). Executive orders were signed in the late 1800s and early 1900s with the intent to reserve lands for tribal use, identify certain services, and occasionally to identify rights for non-treaty tribes. With regard to the applicability of the basic trust doctrine, the Congress has not drawn distinctions between treaty and non-treaty tribes (Cohen 1982).

Tribal Governments

Tribal governments have broad social and natural resource responsibilities toward their membership and often operate under different cultural and organizational goals than federal agencies. Enrolled tribal members are entitled to exercise those reserved rights and benefits held by a tribal government, but are subject to tribal government regulations. Differences in the character of tribal organizations exist among tribes based on how they were given federal recognition, provided reservations, and whether they adopted the Indian Reorganization Act of 1934. This act encouraged tribes to organize themselves under formal constitutions approved by the federal government.

Tribes have interest in reservations (owned communally by a tribe), Indian allotments (owned by an individual), and off-reservation lands, where no legal title to the land remains; however, the nature of interest and legal rights vary. Some tribes have a legal right to fish at all usual and accustomed places (specified in treaties) for both on and off-reservation ceded lands, regardless of property ownership.

In the past, the Bureau of Indian Affairs (BIA) represented virtually the entire governing authority over Indian tribes, including housing, schooling, and various other aspects of their social structure. The Self-Determination and Education Assistance Act, passed in 1975, authorized the tribes to contract to operate BIA Programs. Since then, the Act has been amended three times (1988, 1991, and 1994), giving participating tribes even broader authority to manage and operate Bureau of Indian Affairs and other Department of Interior agency programs.

Tribes' traditional and complex cultural ties to public lands still generate tribal concerns on how those lands are managed. Tribal governments, now with enhanced governing authority, directly address the broad social and natural resource concerns of their citizens. Most tribes are developing internal organizations and deliberative processes to deal with land management agencies. Many are asking federal agencies to take a more proactive role on their behalf, especially in the areas of treaty rights, trust resources, and ecosystem health.

Current Federal Agency Relations

The existing relationships between tribes and federal agencies have evolved rapidly in the last three years. Empowerment of tribal governments and numerous federal court cases involving treaty-reserved fishing rights in the past two or three decades are partially responsible. The momentum to advance federal agency-tribal relations in the project area has increased since 1993. This evolution responds to new legal interpretations, legislation, executive orders, and departmental direction that encourages recognition of tribal government issues, government-to-government consultation, and resolution of tribal concerns through consensus-seeking approaches. A chronology of these events can be found in Appendix 1-2.

Current Forest Service and BLM relations with tribes vary across the project area. The frequency of agency-tribe contacts often depends more on the nature of an established relationship than whether an agency is proposing actions with potential effects on tribal interests. When an agency such as the BLM or Forest Service initiates an action, such as developing this EIS, they consult with affected American Indian tribes. Agencies tend to only consult tribes who have overlapping ceded lands or neighboring reservation lands, although affected Indian groups are those with interests in land management action(s) ~ even if they are non-federally recognized American Indian communities.

Federal law requires the BLM and Forest Service to consider tribal interests when conducting actions that may affect natural resources on tribal lands and/or the socio-economic well-being of its people. Examples of these interests and assets include, but are not limited to, air quality, water quality and quantity, anadromous fish runs, migrating wildlife, and cultural and religious interests of the tribe. Agencies must carry out their activities in a manner that protects Indian trust assets, avoids adverse impacts when possible, and mitigates impacts where they cannot be avoided. Federal policies also require explicit discussion and consideration of Indian trust assets in environmental assessments and impact statements (Columbia River System Operations Review FEIS 1995).

American Indian Issues

"Secretarial Order No. 3175 and Executive Order 13007 directs agencies to consult with potentially affected tribal governments concerning possible impacts on tribal interests and to explicitly address anticipated effects in the planning, decisional and operational documents that are prepared for the project. Agencies are also directed by the Secretarial Order to consult with the Bureau of Indian Affairs and the Office of the Solicitor if any impacts on tribal interests are identified. The following issues have been identified and assessed through implementation of such an approach since December 1993.

Many tangible and intangible resources and values that interest American Indians are the same as those that interest members of the general public, which are described in Appendix 1-4 and summarized in Chapter 1. Some issues are unique to American Indians because of tribal interests, land ownership, and other characteristics that are different from those of the general public. Many of these issues are complex and often sensitive, and each tribe emphasizes issues specific to its interests. Although many of these issues are similar among tribes, how they would like them addressed by land management agencies may vary. A number of federal agencies have developed revised policies to respond to Indian issues. Tribal expectations are defined and understood through consultation.

Trust Obligation

The most fundamental tribal issue identified during the course of the project involves differing perceptions between the tribes and the Federal government regarding "trust obligations" of the Federal government in regard to off-reservation settings. The U.S. courts have been reluctant to define the precise scope of the federal-Indian trust relationship. Tribes consider the trust obligation as a substantive duty, one that should ensure protection of tribal interests on public lands as well as trust lands, or at least an adherence to a policy of prioritization in which protection of tribal interests enjoys a standing priority over certain forms of other interests. Tribes contend that the federal land management agencies have not historically and currently manage natural resources in accordance with Indian treaty rights or federal trust responsibility. Tribes assert Federal agencies must exercise their authorities in a manner which will protect and restore the habitat needed to support resources on which meaningful exercise of treaty rights depends.

Because trust responsibilities remain undefined, agencies are unsure when a responsibility is met. Therefore, the Federal interpretation of trust obligations primarily focuses on a procedural duty in which protection of treaty rights and tribal interests is taken into account by the agencies commonly through a government to government consultation process with tribal governments. This interpretation of trust responsibilities has been recently identified in Department of Interior Manual release 512 DM 2 (December 1, 1995). The Department of Agriculture has similar policies expressed in Departmental Regulation No. 1020-6 (October 16, 1992). Agencies must identify if any proposed activity poses an impact on Indian interests on public or trust lands, ensure such impacts are explicitly addressed, consult with affected tribes and document potential conflicts fully incorporating tribal views, and explaining how a decision is consistent with the government's trust responsibility. Resources located outside reservation boundaries are considered "in common" resources in regard to treaty rights, hence considered as "treaty resources" rather than "trust resources." From this federal perspective, off-reservation resources of interest to tribes may be subject to competing and conflicting uses which in some circumstances may be more compelling and supersede the tribal rights and interests. Aside from these divergent legal interpretations, treaty rights and trust obligations do serve to establish a unique inter-governmental relationship requiring at minimum that federal agencies must identify tribal interests and needs and fully account for these in their decisions.

Consultation/Participation

As noted above, the intergovernmental consultation process serves as the primary means for the federal agencies to carry out their trust obligations. Historically, agencies, when they have attempted to consult with tribes, have pursued consultation on the agencies' perception of what consultation constitutes. In sum, consultation is often an ill-defined, erratically implemented process at best. In actuality there are as many definitions for consultation and fulfillment of trust as their are Indian nations. For that reason, consultation is conducted with each tribe individually. For example, the Confederated Tribes of the Umatilla Indian Reservation define consultation as a formal process of negotiation, cooperation and policy-level decision-making between sovereigns on a government to government basis aimed at reaching mutual decisions that will protect tribal lifestyle, culture, treaty rights, religion and economy. Tribal governments cannot formally consult on every site-specific federal project. Thus policy level decision making that will be applied to all projects must ideally occur. A need exists for government to government coordination to establish mutually agreeable procedures.

While most tribes appreciated the direct contact with ICBEMP staff and project leaders, many tribes feel they should have had a more integral role in the whole ICBEMP process, with tribal scientist involvement and tribal participation in development of alternatives. Funding was identified as one factor in this failure. The tribes assert that the agencies are not meeting their trust responsibilities because of not funding tribal participation. From the tribal perspective, effective project participation must include participation in the project implementation process as well with full representation on intergovernmental oversight groups that may be established.

Community Well-Being

Project area tribal issues need to be viewed relative to agency effects on Indian reservations and allotments, ceded lands, traditional homelands, areas of tribal interest, and areas of mutual interest with other tribes; cultural survival; treaty rights; trust assets and resources; American Indian religious practices; cultural heritage resources and places; and tribes' socio-economic well-being. Tribal community health and well-being are based on a number of factors, including economic growth, freedom to pursue traditional uses of the land, effective trust relationship with the federal government, and lack of infringements on religious practices. Shortfalls in any of these areas can lead to effects on community well-being, and may be reflected in social measures such as unemployment, substance abuse, and suicide.

Sensitive Tribal Species

The availability of culturally significant species and access to socially and/or traditionally important habitats (ethno-habitats) support the well-being of Indian communities as many social, cultural, and economic activities center on the harvest, preparation, trade, and consumption of such resources. The occurrence of culturally significant species can be predicted through their known associations to types of landscapes and habitats. The presence and health of ethno-habitats can be assessed by using ecological information and the cultural expertise of a tribe and traditional users. The degree of access to resources and places can be determined by examining the potential effects of physical obstacles, administrative barriers, and/or behavior constraints that management actions may impose.

Restoration

Restoration of native species' habitats is central to many tribal interests. However, the tribes have asserted that "restoration" means many things to many people. Consequently, the tribes wish to see that a definition of restoration be developed, then objectives and standards be written to implement restoration activities. However, the tribes have voiced concerns that the ICBEMP concept of restoration includes more habitat degradation, for example sacrificing fish and wildlife values in efforts to restore an historic mix of tree species. The tribes are concerned that timber and grazing activities still predominate land management considerations to the detriment of other resources. Many tribes are dissatisfied with the lack of adequate protection measures and absence of restoration in PACFISH (from which much of the aquatics strategies are derived). There is great concern that what comes out of the ICBEMP will be even less protective than

TABLE OF CONTENTS

PACFISH. Most Tribes have their own restoration plans, the Upper Grande Ronde Plan is an example. They assert that significant restoration of degraded habitats must occur before other land use activities that would degrade the habitat are allowed.

Tribes contend that the federal trust responsibilities and statutes require the development and adoption of an alternative that allows unimpeded recovery of all damaged habitats and complete protection of high quality habitat. In regard to riparian protection, measures are recommended including: (1) provision that only actions that have low risk be allowed in riparian areas; (2) prohibition of new roads, logging or mining, in riparian areas; (3) suspension of grazing until habitat standards are met in watersheds; (4) establishment of riparian reserves as actual land allocations in agency land use plans; and (5) creation of minimum buffers, such as the lesser of 300' slope distance from floodplain or top of topographic divide on all streams (Classes I-IV).

Tribes place emphasis on the analysis of cumulative effects, including: (1) assessment of ongoing impacts in watersheds resulting from current and past BLM/Forest Service land management activities; (2) full inventory of watershed/riparian conditions and activities, such as stream crossings, road density, grazing, mining, logging and estimated sediment delivery; (3) correlation of stream conditions with habitat standards based on surveys of all listed fish bearing streams; and, (4) suitability determination for grazing. In regard to the latter, tribes contend that agencies should not employ “Proper Functioning Condition” as a standard for grazing compatibility or riparian health.

Tribes assert that the real forest health crisis is associated with degraded conditions of watersheds, decreased salmonid populations, and loss of old growth ponderosa pine and general old growth structure, as opposed to current stand composition and fuel load conditions. They, therefore, believe that forest health should be re-defined as watershed health and emphasize the use of fire as a tool for changing stand conditions. The tribes are concerned that significant logging will occur under the name of salvage. Various tribes recommend no further cutting of larch and ponderosa pine. Salvage logging should be limited to small diameter, remain outside roadless and riparian areas, not develop new roads, and not enter after fire until the ecosystem is stabilized.

Place Attachment

Indian people have long held pronounced and special attachments to the land, which are understood and expressed through their relationships with culturally significant places. Consequently, traditional land uses usually occur in the context of culturally significant places, through which place attachments and values have become embedded elements in Indian cultures and religious beliefs. Tribal interests in the integrity of such places involve a range of area types: areas of interest, landscapes, traditional use areas and localities such as ethno-habitats, burial sites, and archeological sites. Cultural places may be valued at the community, tribal, and inter-tribal levels.

Harvestability

The health and availability of resources are of great interest to American Indian cultures. A key issue raised by tribes for this project relates to sustainability of tribally sensitive species and involves the concept of “harvestability” which serves as an expansion on Federal concepts of species “viability.” A difference of opinion exists between the federal government and tribes regarding what constitutes “harvestability.”

The tribes assert that the BLM/Forest Service must comply with federal obligations under the Pacific Salmon Treaty and *U.S. v. Oregon* as well as the rebuilding goals established by the Northwest Power Planning Council and conformance with the Clean Water Act, NFMA, and ESA. The Columbia River tribes seek agency conformance with the Tribal Restoration Plan which contains specific, quantified objectives. The tribes make use of “harvestable” species population to define a desired level of harvest for subsistence, commercial, spiritual and cultural needs. Harvestable populations of salmonids and other fish, wildlife and plant species important to the tribes must be the goal of any adopted alternative. Harvestability, in this manner, constitutes a tribal desired future conditions. The Forest Service management responsibilities are to provide for “viable populations” of existing native and nonnative vertebrate species. The determination of a "viable population" level also defines the level of escapement required for conservation purposes, which in turn is used to determine the "harvestable population." Certainly, the disparity between viability and harvestability is most critical for anadromous fish species as opposed to terrestrial big game and cultural plant species. The extent to which there may be a legal obligation imposed on the Federal government to provide habitat capable of supporting "harvestable" levels of resources from the public lands is not an issue which will be resolved in this document. Information and population trends for a sample of species of concern are shown in Table 2-30.

Cultural Resource and Cultural Practices Protection

Agencies and tribes offer differing definitions for cultural resources as addressed in Chapter 2. In addition to protection of archaeological sites, agencies should include efforts to rehabilitate gathering sites and restore native plant communities and restore watershed health and function by meeting minimum legal requirements such as water quality standards. In addition, tribes have requested that all Forest and BLM administrative field offices develop and implement agreements on implementing legal requirements for cultural resource protection (such as NAGPRA, NHPA and ARPA), including plans for locating and evaluating Traditional Cultural Properties (pursuant to NPS Bulletin 38) under Section 106 of NHPA, and allow for full participation of tribes in performance of cultural resource inventories.

Accountability

Tribes consider that the draft ICBEMP standards and objectives give too much flexibility to local decision makers to do activities that may damage aquatic and other resources to which the tribes retain rights or interest. Leaving development of objectives and standards to site-specific projects, or allowing changes in the standards and objectives following watershed analysis, leads to subjective, inconsistent decision making that can result in further degradation. Consequently, tribes assert that standards must be enforceable, measurable and accountable, rather than simply advocating more assessment processes. Tribes contend that standards must ensure full protection of high quality habitat and restoration of degraded habitat. Such standards for fish habitat should include threshold values for substrate, bank stability and water temperature that require management changes needed to meet these standards, such as foregoing and suspending activities that retard attainment in watersheds where standards are not met.

Consultation

Consultation is not a single event, it is a process that leads to a decision, for example, the Record of Decision for this EIS. Consultation means different things to different tribes. It can be either a formal process of negotiation, cooperation, and policy-level decision-making between tribal governments and the federal government, or a more informal process. Tribal rights and issues are discussed and factored into the decision. Consultation can be viewed as an ongoing relationship between an agency (or agencies) and a tribe (or tribes), characterized by consensus-seeking approaches to reach mutual understanding and resolve issues. It may concern issues and actions that could affect the government's trust responsibilities, or other tribal interests.

Consultation serves at least five purposes:

- to identify and clarify the issues,
- to provide for an exchange of existing information and identify where information is needed,
- to identify and serve as a process for conflict resolution and,
- to provide an opportunity to discuss and explain the decision.
- to fulfill the core of the federal trust obligation.

Legal requirements for federal agencies to consult tribes and American Indian communities has its basis in federal law, court interpretations, and executive orders (see Appendix 1-2).

Table 2-30. Species Population Trends in the Project Area.

Species Name	Population Trend	Regulation	Comments
Anadromous salmonids	Declining	Federal, state, and tribal	Primary cause for decline is due to human-caused effects on habitat from hatcheries, dams, and harvests. Some species are currently listed as threatened or endangered, such as Snake River sockeye, and spring and fall chinook salmon.
Resident salmonids, whitefish	Declining	Federal, state, and tribal	Primary cause for decline is human-caused degradation of headwater and main-stem habitat and hatchery influences. Research on metapopulation interactions of species is still needed.
Sturgeon, lamprey	Declining	Federal, state, and tribal	Main-stem hydroelectric dams have changed free flowing systems into slack water environments, and these dams impede local migration. Much information is still needed on these species. Freshwater habitat degradation is thought to have a negative effect.
Sucker, sculpin, mussel	Unknown	Federal, state, and tribal	Detailed, accurate information is lacking on many of these species. Species endemic to portions of the project area are facing immediate threats to survival because of poor recruitment and water rights issues.
Mule deer, elk, black-tailed white-tailed deer, pronghorn, and moose	Significant increase from over-hunting in late 1800s. Current populations stable. White-tailed deer and and elk increasing range. Pronghorn and moose recovering some lost historic range.	State and tribal for hunting numbers and seasons	In general, these ungulates have increased due to control of commercial hunting in the late 1880s and their adaptability to early seral vegetation and edge habitat created by logging. Intensive management of habitat, as well as control over harvest, have increased populations. Roads, dogs, fire management, urban sprawl into winter ranges, poaching, and grazing competition with livestock are all concerns which could cause declining populations in the future.
Mountain goat	Declining populations, although historic range has increased into other habitats.	State and tribal for harvest	This species was impacted by competition for forage from domestic sheep and trophy poaching. Forage has not regenerated well due to fire suppression.
Bighorn sheep	General decline from historic populations, although some local gains in recent decades.	State and tribal for harvest	Bighorn sheep have declined due to disease transmission from domestic sheep, conifer encroachment, and fragmentation of seasonal range by roads and houses. They have also been impacted by competition for forage from domestic sheep and trophy poaching. Forage has not regenerated well due to fire suppression.

Table of Contents

Table 2-30. Species Population Trends in the Project Area (continued).

Species Name	Population Trend	Regulation	Comments
Grizzly bear, gray wolf	Declining since the mid 1800s to near extinction. In the past 30 years, increasing due to protection and immigration from Canada. Populations stable.	Protected by U.S. Fish and Wildlife Service as threatened (grizzly) or endangered (gray wolf)	Grizzly bears are isolated in large blocks of relatively undisturbed moist and cold forest in northern Washington, Idaho, Montana, and the Yellowstone ecosystem. Wolf populations are increasing in the same habitat areas and starting to move into other habitats in northern portions of the project area. There is concern for poaching, public fear of predators, road access to habitat, prey base stability, isolation of populations, and conditioning of predators to human foods and livestock.
Black bear	Variable by state. Some states have changed hunting regulations, and populations have increased. Stable elsewhere.	State and tribal for harvest	Black bears are habitat generalists and have benefitted from early seral vegetation and edge habitat created through logging. Population trends are not well known, nor is the impact of baiting, human conflicts, and harvest. Fire suppression and changes in berry production and habitat structure may impact bears. Competition between bears and domestic sheep for vegetation is a concern.
Jackrabbit, Nuttail's cotton-tail, pygmy rabbit, snowshoe hare, sage grouse, sharp-tailed grouse, marmot	Decreasing	State for harvest	Significant decline in shrub steppe and desert salt shrub communities, along with exotic species invasion and livestock grazing, have seriously decreased forage and cover for grouse and rabbits. Snowshoe hares have been impacted by fire suppression and decreases in young lodgepole pine, riparian shrub, and hardwood stands.
Forest grouse (blue grouse, spruce grouse, and ruffed grouse)	Decreasing	State and tribal for harvest	Fire suppression, increasing stand density, decreasing shrub and riparian vegetation, and a decreasing large tree component have all impacted blue and spruce grouse. Ruffed grouse may be increasing in dense mid-seral stands, but there is a lack of data.
Bald eagle, golden eagle, other raptors, Swainson's hawk, ferruginous hawk	Most are increasing. Rangeland hawks decreasing due to conflicts for winter range.	U.S. Fish and Wildlife Service and tribal	Raptors that declined due to pesticide use and human mortality have generally increased with regulation of pesticides and public education. Decline in the large tree component; old-forest, open stand structure; and prey species is still a concern. Swainson's and ferruginous hawks and others dependent on large open areas have declined due to conflicts in winter range.
Canada goose, ducks, coot, heron, swans	Geese are increasing. Ducks declined until a recent upward trend.	State, tribal, and U.S. Fish and Wildlife Service	Canada geese have responded well to artificial nest boxes, grazing, agriculture, and domestic grasses. All waterfowl have been impacted by a decline in wetlands, de-watering, lead shot, disease, and poaching.

Table of Contents

Bitterroot, biscuitroot, mariposa, yampah	Stable, some locally impacted.	Tribal	Scabland species are generally not affected by livestock grazing or fire. Some areas are impacted by road construction and other ground disturbances. Some local losses noted for mariposa and yampah from past intensive grazing. Grazing time can conflict with tribal gathering practices.
Willows, tules, cattails, wocas (lilypods), wappatoo	Decreasing	EPA, U.S. Fish and Wildlife Service, and tribal for wetlands	Degradation and loss of riparian and wetland habitat due to grazing, timber harvest, dewatering, mining, and roads have all caused declines in these species.
Camas, yampah, beargrass	No data	Tribal	In general, upland herblands and meadows have decreased due to fire suppression, grazing, conifer encroachment, soil disturbance and compaction due to logging, and exotic species invasions. Impacts on herbs from historically heavy sheep grazing are gradually showing recovery.
Mushrooms, elephant ears, morels, and other fungus sporocarps and beargrass	Unknown, wild mushrooms are a product of diverse and complex interactions within natural ecosystems.	Federal and state (wild mushroom harvesting falls under tribal regulation)	Commercial mushroom harvest, land management activities, and catastrophic events such as fire, disease, and insect epidemics all play a role in fungi productivity. There has been an increase in the harvest of special forest products and conflict with tribal gathering practices. There is a need for long-term study and monitoring of many commercially harvested species to understand their role in the productivity of ecosystems.
Huckleberry, elderberry, buffalo berry	Decreasing	Some units limit huckleberry gathering	These species and other forested shrubs have declined due to suppression of fire, grazing, increased stand density (limiting light, water, and climate), and competition for harvest.
Chokecherry, serviceberry	Variable. Serviceberry expanded in some areas, but age and structure diversity is lower. Chokecherry in riparian areas has declined.	None	Changes to berry production and other qualities important to tribes are unknown. There have been increases in chokecherry harvests by the public. Increasing ages of shrubs due to fire suppression is a concern.
Juniper	Increasing in distribution, but decreasing structural diversity.	None	Juniper has invaded other habitat types and stands have become denser, older, and less diverse with fire suppression and livestock grazing
Mountain mahogany	Declining	None	Mountain mahogany is declining in some places and not regenerating. Stands are becoming older and lack structural and age diversity. Some areas are heavily browsed. Research on regeneration is needed.

TABLE OF CONTENTS

Integrated Summary of Forestland, Rangeland, and Aquatic Integrity

Key Terms Used in This Section

Cluster ~ In this EIS, refers to a group of sub-basins denoting forestland and rangeland ecosystems where the condition of the vegetation and ecological functions and processes are similar, and where management opportunities and risks are similar.

Ecological integrity ~ In general, ecological integrity refers to the degree to which all ecological components and their interactions are represented and functioning; the quality of being complete; a sense of wholeness. Absolute measures of integrity do not exist. Proxies provide useful measures to estimate the integrity of major ecoststem components (forestland, rangeland, aquatic, and hydrologic). Estimating these integrity components in a relative sense across the project area, helps to explain current conditions and to prioritize future management. Thus, areas of high integrity would represent areas where ecological function and processes are better represented and functioning than areas rated as low integrity.

Sub-basin ~ Equivalent to a 4th-field Hydrologic Unit Code (HUC), a drainage area of approximately 800,000 to 1,000,000 acres.

Subwatershed ~ Equivalent to a 6th-field HUC, a drainage area of approximately 20,000 acrs. Hierarchically, subwatersheds 6th-field HUC) are contained within a watershed (5th-field HUC), which in turn is contained within a sub-basin (4th-field HUC). This concept is shown graphically in Figure 2-1 in Chapter 2.

Strongholds (fish) ~ Watersheds that have the following characteristics: (1) presence of all major life-history forms (for example, resident, fluvial, and adfluvial) that historically occurred within the watershed; (2) numbers are stable or increasing, and the local population is likely to be at half or more of its historical size or density; (3) the population or metapopulation within the watershed, or within a larger region of which the watershed is a part, probably contains at least 5,000 individuals or 500 adults.

Introduction

Unless otherwise noted, information in this section is based on the *Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basins* (Quigley et al. 1996a) and a more detailed paper describing the integrity work (Sedell et al. on file at the Walla Walla Office of the ICBEMP).

Up to this point, Chapter 2 has presented background descriptions of historical and current conditions of various components and processes in the project area. Information on forestland, rangeland, and aquatic ecosystems was organized by potential vegetation groups or watersheds and summarized by ecological reporting unit (ERU) where possible.

While ERUs provide a convenient way to summarize initial scientific information by geographical area, understanding the bigger picture across a large, complex landscape requires a more integrated summary to show how the existing conditions relate to each other and to identify where overall ecological conditions, opportunities, and risks are similar. To provide this integrated picture, the Science Integration Team evaluated all the information available and summarized current conditions around groupings or "clusters" of 4th-field Hydrologic Unit Codes (HUCs), also known as sub-basins. (See Table 2-3 and the Introduction to Chapter 2 for more information on HUCs.)

Each sub-basin was rated for various levels of "integrity" from separate aquatic, terrestrial, and hydrological viewpoints. These viewpoints, or integrity layers, were then analyzed together, or integrated, to provide a more unified view. This effort revealed groups or clusters of sub-basins that exhibit a similar set of conditions or characteristics, reflecting a common management history; terrestrial and aquatic conditions, and management needs, opportunities, risks, and conflicts.

The integrated cluster summaries provide a project-wide context for the EIS Teams to tailor alternatives and evaluate their effects on a more site-specific scale (a few million acres) within the 144-million-acre project area. The cluster analysis also provides a context for evaluating cumulative effects. The information will help provide a context for land managers to set priorities and assess opportunities to contribute goods and services to the nation, by answering relevant questions such as:

- What is the current condition of the project area?
- Where are the areas in the best or worst shape?
- Where are forestlands and rangelands least departed from (most similar to) historical conditions?
- Where are fish communities and/or species most connected?
- Where are the healthiest watersheds from a hydrological perspective?
- What opportunities and risks present themselves on the current landscape for future management?

Measuring Integrity

Precise definitions of "integrity" or wholeness of a system do not exist. Estimates of integrity are derived using proxies that represent the ecological functions and processes, and whether they are present and operating. In general, for the purposes of the Interior Columbia Basin Ecosystem Management Project, aquatic and terrestrial systems with "high integrity" were defined as those that consist of a mosaic of plant and animal communities, and have well connected, high quality habitats that support a diverse assemblage of native and desired non-native species that adapt to a variable environment.

Measures were developed by the Science Integration Team using direct and indirect variables to indicate how much various elements have departed from historical conditions. For the purposes of this analysis, "high departure" signifies that an area is significantly different than the condition expected for its biophysical environment, and roughly indicates "low integrity."

In measuring integrity, the Science Integration Team looked primarily at landscape features and fish communities, because they encompass most of the significant planning issues that were identified through the scoping process. Chapter 1 describes the issues and the scoping process.

Landscape Features

- *Potential vegetation* ~ how vegetation has changed through time, historic and current; how structure and composition changed through time.
- *Fire and other disturbance regimes* ~ how fire and other disturbance regimes have changed; how they affect vegetation, aquatics, and other resources; and how they might respond to future management actions.
- *Road densities* ~ degree of roaded access; how integrity relates to roads.
- *Hydrologic function* ~ resiliency of watersheds to disturbance; degree of past management disturbance.

Fish Communities

- *Connectivity* ~ how well current fish communities represent the full range of diversity and life histories; how well fish communities are still connected in high quality habitats (which also represents in part the condition of hydrologic systems and other aquatic species).

The emphasis on landscape features and fish provides a geographically explicit, ecologically driven context for discussion of management alternatives. This approach allowed an evaluation of the range of integrity of forestlands, rangelands, watersheds, fish communities, and terrestrial habitats. Following are the individual integrity layers developed by the Science Integration Team:

TABLE OF CONTENTS

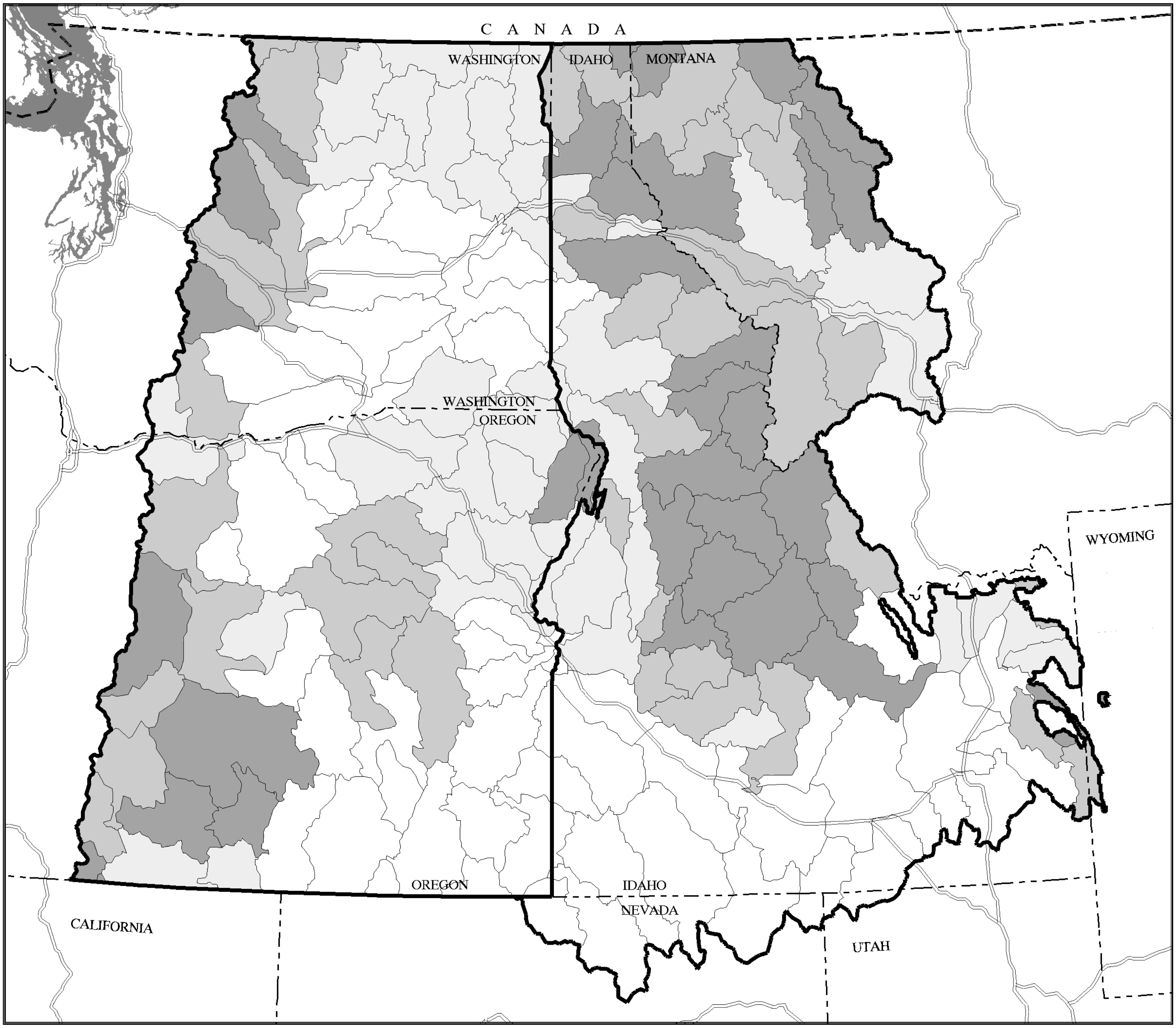
- **Aquatic systems with high integrity** (highly functional) were held to be those with a full complement of native fishes and other aquatic species, well distributed in high quality, well connected habitats. (See discussion of Watershed Categories in the Aquatic Ecosystems section of this chapter.) Category 1 Watersheds have the highest integrity; Category 2 Watersheds have intermediate integrity; and Category 3 Watersheds have the lowest integrity (see Map 2-36).
- **Hydrologic integrity** was measured on the basis of resiliency of watersheds to disturbance, and estimates of past management disturbances. Hydrologic resiliency (the ability to recover following impacts) was further rated according to degree of impact already incurred, the sensitivity of stream and riparian vegetation to impacts, and probable riparian area disturbance on rangelands. Areas with high hydrologic impact and high stream and riparian sensitivity are considered to have the lowest probable hydrologic integrity across the project area. Map 2-44 shows areas with high, moderate, and low hydrologic integrity ratings.
- **Forestland ecosystem sub-basins with highest integrity ratings** were those that are largely unroaded and comprised of moist and/or cold forest potential vegetation groups. Forest integrity measures included the percent in each potential vegetation group, proportion in wilderness, unroaded areas impacted by fire exclusion, and proportion of the area where fire severity increased and/or fire frequency declined significantly from historical to current times. Map 2-45 shows high, moderate, and low integrity ratings for forestlands.
- **Rangeland ecosystems with the highest overall integrity** ratings were those upland shrublands that are less developed, less roaded, and more remote. In addition to these measures, rangeland integrity was based on the proportion in dry grasslands and dry shrublands, and the proportion of area in cover types affected by encroachment of western juniper and big sage. Map 2-46 shows high, moderate, and low integrity ratings for rangelands.

Terrestrial Habitat Departures

Departure values for terrestrial community types were developed to estimate the magnitude of broad-scale habitat changes in forestlands and rangelands within sub-basins. This was done to infer risks to current and future species viability. The availability of habitat within a sub-basin was compared to the historic range of conditions. It was assumed that species persistence within a sub-basin was not at risk if the current area of that species' primary habitat was within 75 percent of the data for historical condition. Risk to species persistence was assumed to increase substantially when current habitat availability fell below the 75 percent range of historical data, and persistence likelihood within a sub-basin was considered to increase as habitat availability exceeded the 75 percent range of historical data. Departure values were not determined for cropland, exotic, urban, alpine, rock, or riparian community types.

The Clusters

When the Science Integration Team analyzed individual sub-basin conditions (levels of integrity) together, several common patterns were revealed across the landscape. Six dominant clusters or sets of conditions focus on forestlands (sub-basins containing at least 20 percent forestland potential vegetation groups ~ dry, moist, and cold forests; see Map 2-47), and six clusters focus on rangelands (sub-basins comprised of at least 20 percent rangeland potential vegetation groups ~ dry forest, dry grasslands, dry shrublands, cool shrublands, woodlands, riparian shrublands, and riparian woodlands; see Map 2-48). The clusters are neither mutually exclusive nor all-encompassing. Some sub-basins contain both range and forested landscapes, which may be in very different ecological condition; where a sub-basin falls into both range and forest clusters, the implication is that the forest parts of that sub-basin were evaluated as part of a "forest cluster," and the range parts of the sub-basin were evaluated as part of a "range cluster" analysis. Some sub-basins thus represent a clear set of conditions, while others are a mix of several conditions and risks.

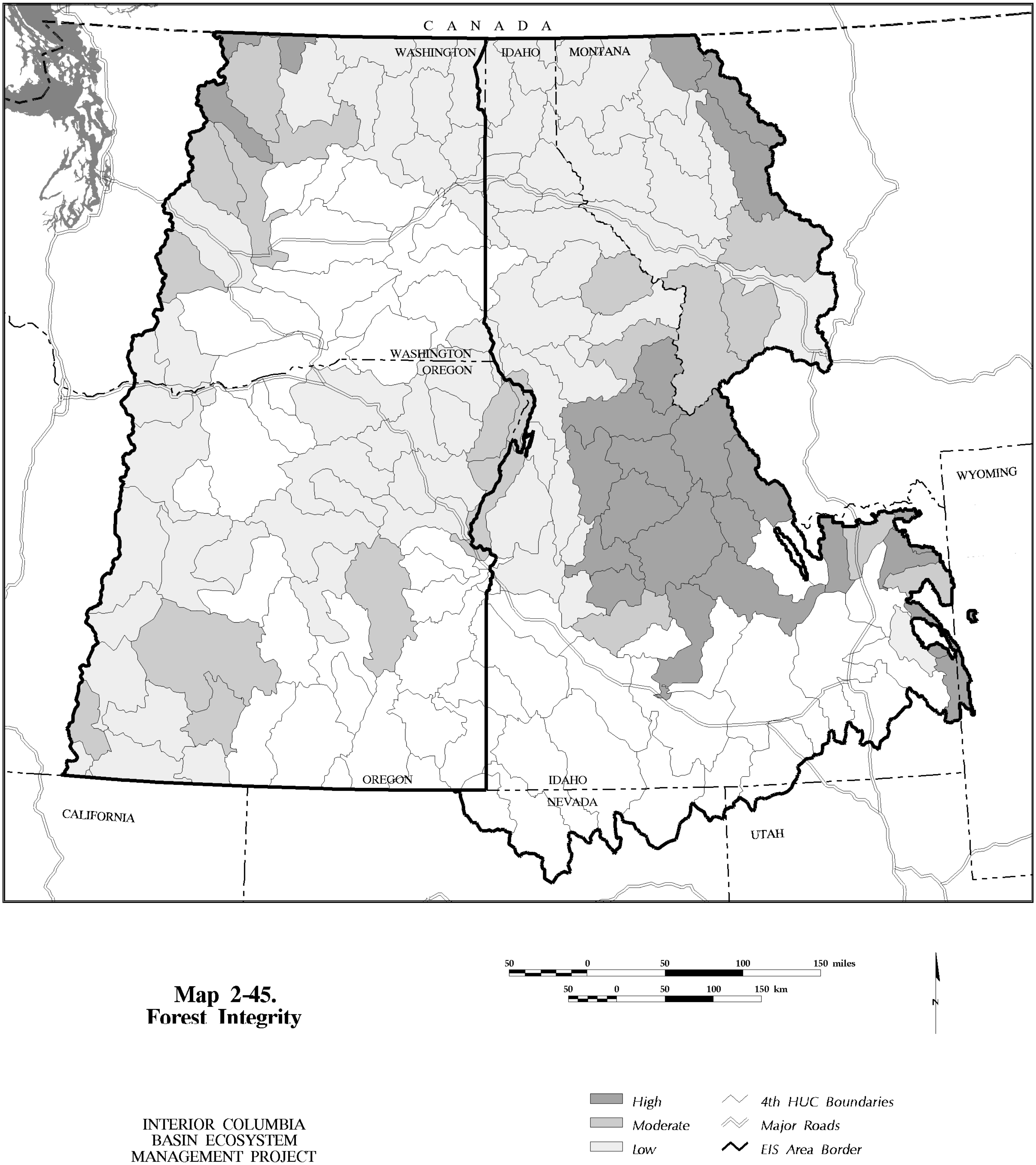


Map 2-44. Hydrologic Integrity

INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

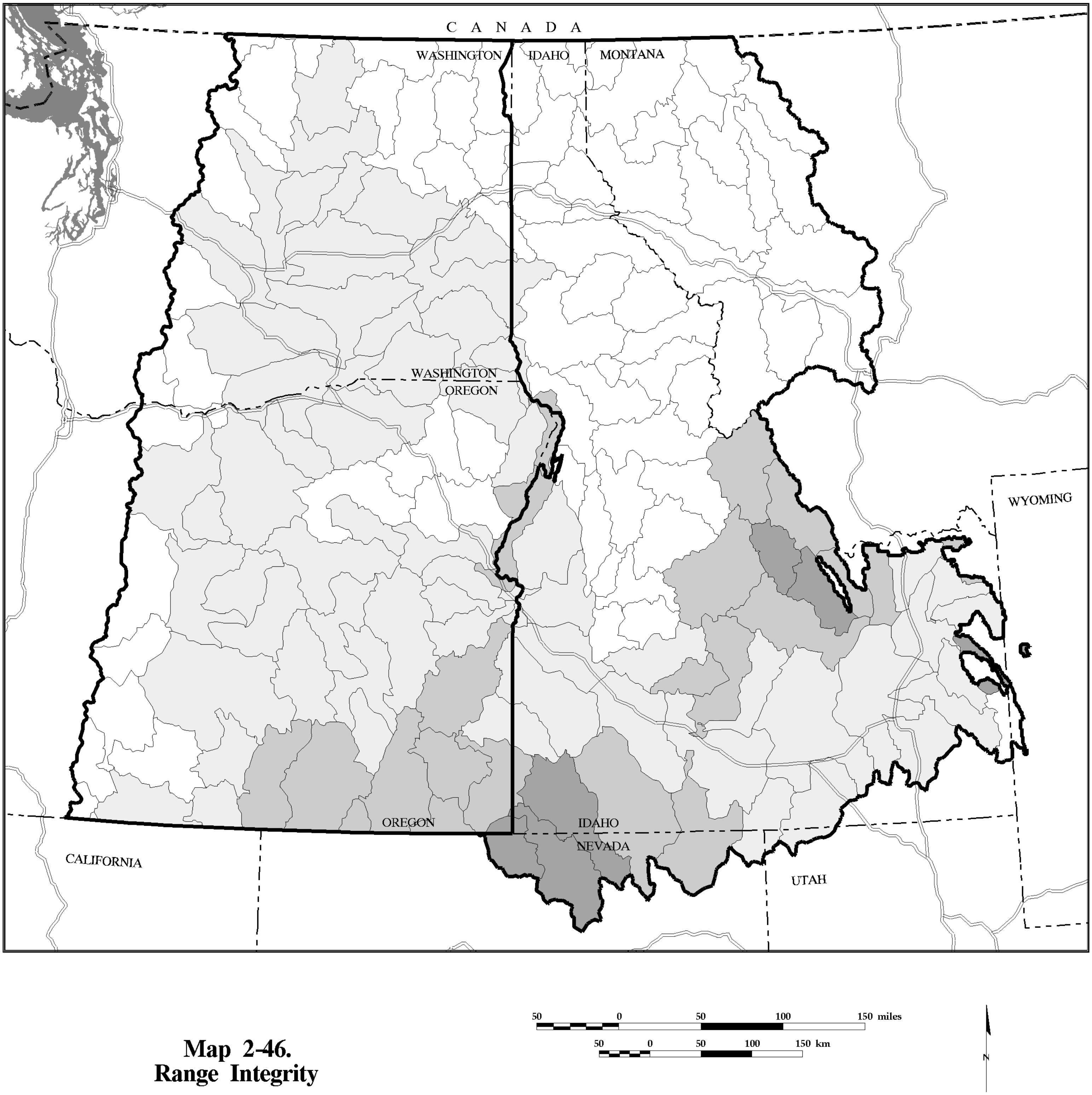


Map 2-45.
Forest Integrity

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS



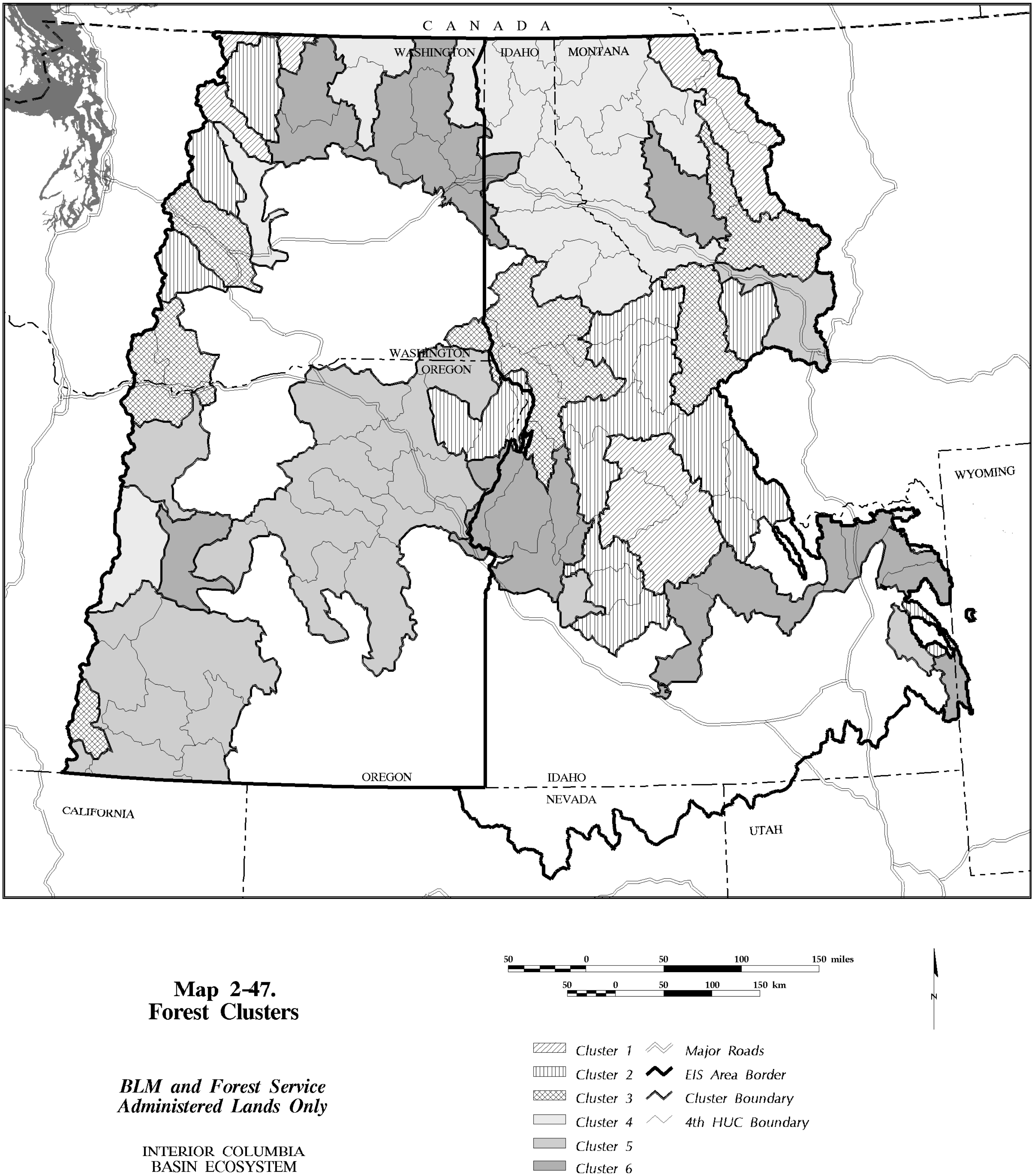
Map 2-46.
Range Integrity

High
Moderate
Low
No Integrity Rating
4th HUC Boundaries
Major Roads
EIS Area Border

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS



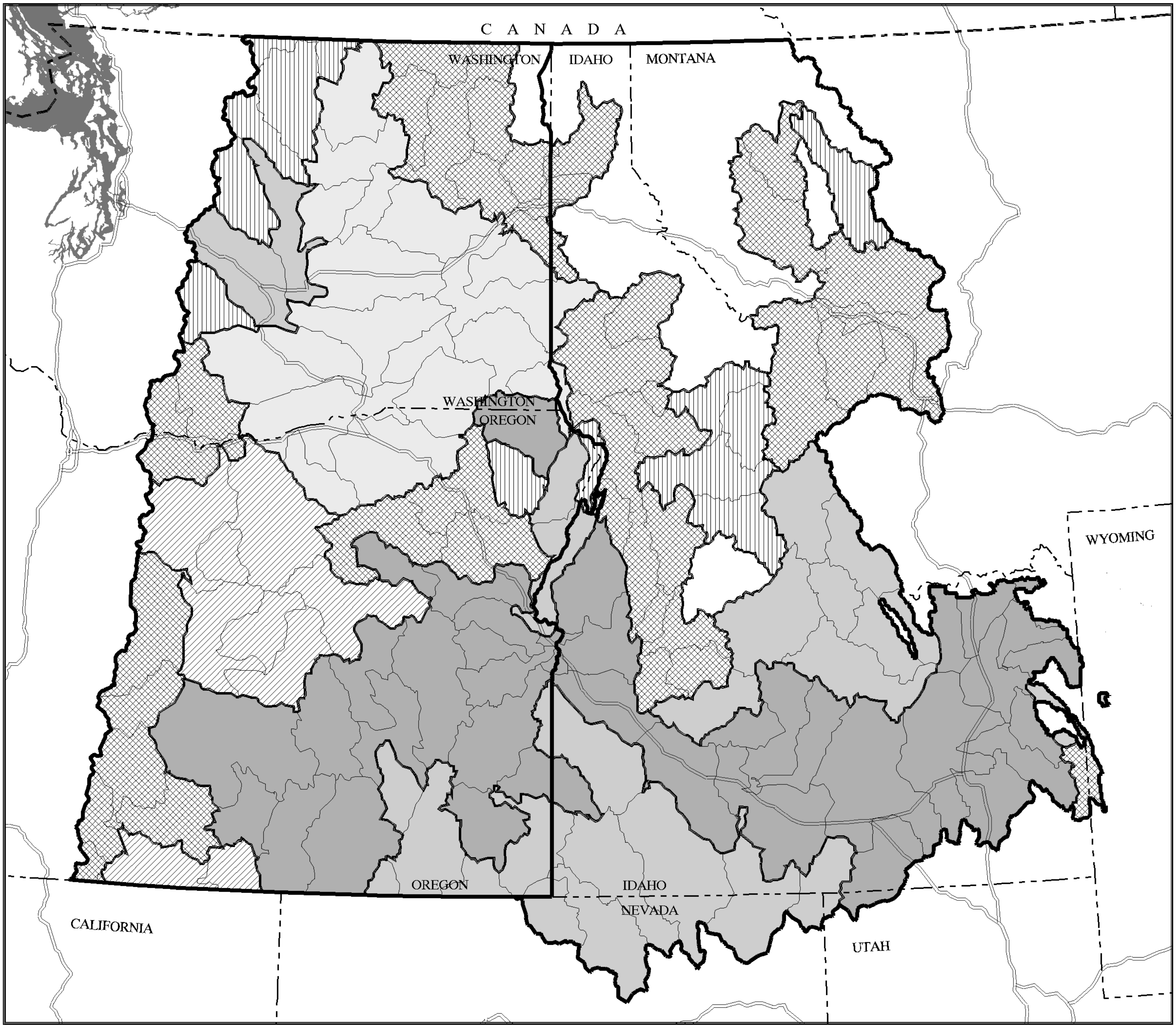
Map 2-47.
Forest Clusters

BLM and Forest Service Administered Lands Only

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS



Map 2-48.
Range Clusters

BLM and Forest Service Administered Lands Only

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

For the cluster analysis, conditions within forest clusters and range clusters are summarized for the entire landscape, including both terrestrial and aquatic components. Within any cluster, the predominant conditions are an average ~ some locations within the cluster may have specific conditions that are better or worse than what is indicated.

Forest Clusters

Sub-basins with at least 20 percent of their area comprised of dry forest, moist forest, or cold forest potential vegetation groups were classified as forest clusters. Relationships among variables reflecting vegetative conditions, hydrologic sensitivity, and human-caused disturbance of native forests were studied to identify dominant patterns and differences. What emerged were six forest "clusters" of sub-basins with similar conditions. Differences among clusters were summarized in terms of forest conditions, departures in terrestrial communities, implications for terrestrial vertebrate species, hydrologic conditions, aquatic community status, and opportunities for management. Abbreviated forest cluster descriptions follow.

Forest Cluster 1

Sub-basins in Forest Cluster 1 represent those that are most intact ecologically, with the least loss of integrity in both forest and aquatic ecosystems. They are predominantly high elevation and tend to be dominated by wilderness or roadless areas, and by cold, or moist and cold forests.

Forest ecosystems in this cluster are the least altered, although forest structure and composition have been simplified primarily by fire exclusion. These sub-basins have the lowest mean changes in fire frequency and severity.

Forest habitats in this cluster provide a relatively high degree of security for a variety of species vulnerable to human exploitation and/or disturbance. The decline of late-seral forest structures within moist and cold forests in Forest Cluster 1 has likely had detrimental effects on available habitats for species associated with those structures. Conversely, an increased area in early-seral structures has likely increased the abundance of primarily summer foraging habitat for many forest ungulates (big game species).

This cluster has the highest hydrologic integrity of any forestlands in the project area. All sub-basins have high or moderate aquatic integrity, with the best overall fish conditions and the best watershed conditions. They support some of the largest blocks of watersheds supporting strong salmonid populations and high measures of fish community condition. Although introduced fishes are often present, they rarely dominate communities. Connectivity among watersheds supporting native fish strongholds is good, and strongholds for multiple species often exist in subwatersheds throughout these sub-basins.

Forest Cluster 2

These sub-basins tend to have a mix of areas of moderate-to-high forest and aquatic integrity. Moderate to large blocks of wilderness or roadless areas and cold or moist forests are associated with the best conditions. Whereas, roaded non-wilderness areas and dry and moist forests often coincide with more altered vegetation conditions.

Forests in these sub-basins tend to be moderately to highly productive. The headwater areas are likely to be primarily moist and cold forests with the least altered structure and composition. Changes have been more substantial at mid- and lower-elevation, dry and moist forests where road densities are moderate to high and fire regimes have changed from non-lethal to mixed and lethal.

Forests in this cluster provide relatively secure habitats for those species vulnerable to exploitation and/or human disturbance. Risks to species persistence likely have increased for terrestrial vertebrates that rely heavily on early- or late-seral structures, or for species that prefer small openings of non-forest, canopy gaps, or open understories. The overall decline of early-seral forest structures has probably reduced habitat availability for dry, moist, and cold forest species.

Hydrologic integrity of the forests within these sub-basins is relatively high. Sub-basins have high or moderate aquatic integrity, with both strong and unproductive watersheds present. Blocks of strong and high integrity watersheds are associated with the wilderness and roadless areas. Fish populations show relatively little influence from introduced species and thus have good potential for long-term persistence.

Forest Cluster 3

Sub-basins in Forest Cluster 3 are represented by aquatic ecosystems that are in relatively good condition, but forests that are in highly altered and poor condition. Wilderness or roadless areas play a relatively insignificant role, and roading is moderate to extensive. Forests in this cluster are dominated by moist and dry forest potential vegetation groups.

The moderately to highly productive forests in this cluster appear to have substantially changed structure, composition, and fire regime.

Terrestrial species vulnerable to human disturbance and/or exploitation have a relatively limited amount of secure habitat. Risks to species persistence have likely increased for terrestrial vertebrates that rely heavily on early- or late-seral structures, and for species that prefer small openings of non-forests, canopy gaps, or open forests. The overall decline of early-seral forest structures in dry and moist forest probably has reduced habitat availabilities for species associated with those structures.

Hydrologic integrity of these sub-basins is low to moderate. Most sub-basins in Forest Cluster 3 have moderate aquatic integrity, but roading densities present an uncertain influence on watershed conditions. There are pockets of high integrity fish communities and relatively large numbers of strongholds, and most communities are still dominated by native species. Current conditions may indicate highly productive and resilient aquatic ecosystems; however, their association with low-integrity forest landscapes may indicate that cumulative effects of disturbance in streams may not have been expressed yet.

Forest Cluster 4

Sub-basins in Forest Cluster 4 have relatively low forest integrity and low or moderate aquatic integrity. The highly altered forests are mostly comprised of the productive moist forest potential vegetation group. They tend to have the highest road densities in the project area, with few wildernesses or roadless areas.

Forest structures and composition have been altered. These forests generally show moderate to strong change in fire severity, but less change in fire frequency.

Terrestrial species vulnerable to human disturbance and/or exploitation have a relatively low amount of secure habitat presently available. Risks to species persistence have likely increased substantially for terrestrial vertebrates that rely heavily on early- or late-seral structures, and for species that prefer small openings. The overall decline of early-seral forest structures in moist forests has probably reduced habitat availabilities for moist forest species associated with those structures.

Hydrologic integrity of these sub-basins is moderate. Aquatic integrity is low or moderate. Although the aquatic systems often have some connectivity, the distribution of productive or strong watersheds is often fragmented.

Forest Cluster 5

Sub-basins in Forest Cluster 5 have low forest integrity and low or moderate aquatic integrity. Forest Cluster 5 is dominated by dry forests that are extensively roaded and have little, if any, wilderness.

Forest structure and composition have been substantially altered from historical conditions. These sub-basins show large changes in fire frequency but less change in fire severity.

Relatively low amounts of secure isolated blocks of habitat persist for species vulnerable to human exploitation and/or disturbance. The substantial increase of late-seral forest structures has likely benefitted species preferring more densely stocked forests with a greater composition of shade-tolerant conifers; these same changes have likely reduced the habitat available for species preferring more open, park-like structures.

Hydrologic integrity of these sub-basins is low to moderate. Productive watersheds are often patchy in distribution. Native fish strongholds are poorly distributed, and the likelihood of widely distributed fish strongholds in the future is low.

Forest Cluster 6

Sub-basins in Forest Cluster 6 are in relatively poor condition from both a forest and an aquatic perspective, with especially fragmented aquatic systems. Forests in this cluster are comprised of a variety of dry, moist, and cold

TABLE OF CONTENTS

forest potential vegetation groups. Sub-basins are heavily roaded with little, if any, wilderness or roadless areas.

Forests are similar in composition and condition to those in Forest Cluster 5, but in Forest Cluster 6 there are more sub-basins with moderate and high forest integrity. There is also a greater mix of dry and moist forests, and the change in fire frequency is not as dramatic.

Terrestrial wildlife species vulnerable to human disturbance and/or exploitation have a relatively low amount of secure habitat presently available. The risks to species persistence have likely increased for terrestrial vertebrates that rely heavily on early- or late-seral forest structures, and for species that prefer small openings. The overall decline of early-seral forest structures has probably reduced habitat availability for forest species that are associated with these structures.

Hydrologic integrity is the lowest of any Forest Clusters. Aquatic systems are especially fragmented, with few, widely scattered native fish strongholds, and the poorest overall conditions for fish communities. For the most part, remaining native fishes exist in remnant and isolated populations scattered throughout the sub-basins. Many of the watersheds have been heavily influenced by non-native fish species. Some watersheds do support remnant strongholds and isolated populations of listed or sensitive fish species, or narrow endemic species.

Table 2-31 summarizes conditions in the six forest clusters.

Range Clusters

Selected sub-basins that historically had at least 20 percent of their area comprised of dry grass, dry or cool shrub, and woodland potential vegetation groups were classified as range clusters. Relationships among variables reflecting vegetative conditions, hydrologic sensitivity, and human-caused disturbance were also used in a similar, but not identical, way as forest clusters. Range Cluster analysis identified dominant patterns and differences between subsets of these variables. What emerged were six range clusters, where sub-basins within clusters were more like each other than sub-basins in other clusters. Differences among clusters were summarized in terms of range conditions, departures in terrestrial communities, implications for rangeland vertebrate species, aquatic community status, and opportunities for management. Abbreviated range cluster descriptions follow.

Range Cluster 1 ~ Juniper Woodlands

Rangeland and aquatic integrity are low to moderate in Range Cluster 1, which is distinguished by having large areas of western juniper woodland. These sub-basins support the highest average road densities. Very little is managed as wilderness or roadless, and over half the area is managed in range allotments.

There has been a substantial reduction in areal extent of herblands and shrublands, and large increases in woodland area. The average area in cropland and pasture is low. Fire frequency has declined in at least half of the sub-basins, while fire severity has increased in 20 to 50 percent of the area.

Decline of herbland and shrubland types within this cluster suggests that persistence of terrestrial vertebrates such as the western sage grouse, pygmy rabbit, Brewer's sparrow, and loggerhead shrike is currently at risk. Conversely, increases in western juniper woodlands suggest that species such as the plain titmouse and the Townsend's solitaire would be favored.

Hydrologic integrity of these sub-basins ranges from low to moderate, and the riparian environment integrity commonly is low. A few areas support above average numbers of fish species or important salmonid stocks and habitats that could be connected to larger functional networks, but overall aquatic integrity is low to moderate, with watersheds in Categories 2 or 3.

Range Cluster 2 ~ High Integrity Dry Forest Ranges

Rangeland and aquatic integrity are high in Range Cluster 2. There are large blocks of wilderness and minimally roaded areas. These dry, forested ranges are generally in the lower elevations and have little area managed as range allotments.

TABLE OF CONTENTS

Table 2-31. Summary of Forest Clusters (all lands).

Variable	Forest Cluster 1	2	3	4	5	6
	percent					
BLM/FS-administered Land	80	86	40	58	50	35
Potential Vegetation Groups						
Dry Forest	13	26	22	14	43	23
Moist Forest	23	25	33	67	6	16
Cold Forest	47	30	15	7	4	9
Dry Grass/Shrub	7	11	6	3	24	15
Cool Shrub	3	3	1	1	8	11
Other	8	5	24	8	15	26
Road Density Classes						
Low or none	85	62	32	20	22	36
Moderate or higher	15	38	68	80	78	64
<12" annual precipitation	1	4	2	3	14	14
Fire frequency change	37	60	66	51	60	60
Fire severity increase	36	50	57	47	35	36
High wildland/urban fire interface risk	0	17	6	1	29	10
Moderate wildland/urban fire interface risk	29	61	36	13	30	23
Forest Integrity						
Low	0	10	67	86	79	59
Moderate	0	43	33	10	21	17
High	100	47	0	4	0	24
Range Integrity						
Low	0	29	100	57	100	66
Moderate	61	48	0	43	0	35
High	40	23	0	0	0	0
Aquatic Integrity						
Low	5	0	8	54	52	87
Moderate	38	59	85	46	44	13
High	58	41	7	0	4	0
Hydrologic Integrity						
Low	0	4	47	12	39	76
Moderate	4	30	49	54	41	17
High	96	66	4	34	20	7
Composite Ecological Integrity						
Low	0	0	4	83	96	100
Moderate	0	3	96	17	4	0
High	100	97	0	0	0	0

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

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

Herblands, shrublands, and woodlands (mixed conifer and juniper) declined significantly in this cluster. In some areas conifers have invaded historical meadows, grasslands, shrublands, and savannah woodlands, creating high fire fuel conditions.

The decline of shrubland and herbland community types suggests that wildlife species relying on the boundaries between shrubland or herbland habitats and dry forests would be most affected by the vegetation changes in this cluster. The progression of mixed-conifer woodlands to dry forest types would affect species that prefer habitats comprised of sparse trees.

Hydrologic and riparian integrity of these sub-basins are high. Measures of fish community integrity and numbers of fish strongholds are among the highest in the project area, with most watersheds in Category 1 and most sub-basins having two or more sensitive fish species. Connectivity of subwatersheds that function as native fish strongholds is good. Fish populations and communities associated with these sub-basins are among the most resilient in the project area and represent core distributions for many of the sensitive salmonids.

Range Cluster 3 ~ Moderate Integrity Dry Forest Ranges

Dry, forested ranges in Range Cluster 3 have moderate rangeland integrity and mixed aquatic integrity. These sub-basins contain little or no wildernesses or roadless areas. Less than half of the sub-basins are managed as public land range allotments.

These sub-basins are among the most altered forested rangelands of the project area. Dry forest areas have experienced changes in structure and composition. Meadows, grasslands, shrublands, and savannah woodlands have been invaded by conifers, creating elevated fuel conditions for fires. Some areas are improving, but are still challenged by expansion of introduced exotic grasses and herbs. Average sub-basin cropland area is low to moderate.

Terrestrial wildlife changes are estimated to be similar to Range Cluster 2.

Hydrologic and riparian environment integrity of sub-basins within this cluster is low. For the most part, fish populations are fragmented and represented by remnant and isolated populations scattered throughout the sub-basins. Some subwatersheds support remnant native fish strongholds, isolated populations of listed or sensitive species, or narrowly endemic species. Many areas are influenced by non-native fish species. Sub-basins that straddle the Columbia River at the base of the Cascade Mountains represent the migration corridor for all anadromous fishes entering the Columbia River Basin, and contain the highest number of sensitive species in the project area. Other areas have low to moderate watershed integrity and contain important populations of key salmonids.

Range Cluster 4 ~ Columbia Shrub Steppe/Croplands

Range Cluster 4 is composed of 33 percent rangelands and 56 percent croplands. The landscape pattern is islands of native habitat surrounded by agricultural lands. The BLM and Forest Service manage only five percent of this cluster.

Sub-basins in Range Cluster 4 have the lowest rangeland and aquatic integrity of all rangelands in the project area. One wilderness lies within this cluster. Range allotments on public lands are minimal. Sub-basins in this cluster are distinguished from other clusters by being comprised primarily of cropland and pasture.

Herblands and shrublands decreased significantly in these sub-basins. Of the grassland and shrubland areas that have not been converted to cropland or pasture, most have been overgrazed and invaded by exotic grass and forbs.

Conversion of native herblands and shrublands to agricultural types has diminished habitat for a large number of wildlife species. Species associated with mixed-conifer woodlands have likely increased as a whole across the cluster.

Hydrologic and riparian integrity of these sub-basins is low. Some sub-basins in Range Cluster 4 contain major stretches of the mainstem Columbia and Snake Rivers, and contain the highest values for numbers of fish species in the cluster. Other aquatic systems have been radically altered, and most native fishes in the sub-basin currently exist as very isolated populations, with some scattered salmonid strongholds.

TABLE OF CONTENTS

Range Cluster 5 ~ Moderate Integrity Upland Shrublands

Sub-basins in Range Cluster 5 are comprised of upland shrublands with moderate integrity and mixed aquatic integrity. These sub-basins represent the bulk of the high elevation ranges. They are less developed, less roaded, more remote, and tend to be less disturbed by agricultural conversion or grazing than cropland-dominated sub-basins.

Large areas are in the cool shrubland potential vegetation group, with the lowest area in cropland of the range clusters. Herbland habitats have decreased significantly.

Declines in herbland and shrubland habitats in this cluster have contributed to observed declines in populations of several species of upland game birds, songbirds, raptors, ungulates, and small mammals. An increased area in exotic grasses and herbs and croplands has likely benefitted some non-native vertebrates.

Hydrologic and riparian integrity of these sub-basins is high and moderate, respectively. Among rangeland clusters, these sub-basins support the highest diversity of salmonids and a relatively higher proportion of population strongholds. Introduced species have played an important role, but overall aquatic integrity remains moderate in some places, and good to excellent in others. Several sub-basins still have relatively high quality river corridors designated under the National Wild and Scenic Rivers Act. Moderate or better water quality suggests that the potential for connection among some subwatersheds is still good.

Range Cluster 6 ~ Low Integrity Upland Shrublands

Both rangeland and aquatic integrity in these sub-basins are low. The dry shrubland potential vegetation group dominates upland shrublands. Road densities are relatively high. Most rangelands on public lands in this cluster are managed as range allotments.

Sub-basins in this cluster are highly altered and have been invaded by exotic species, or converted to crested wheatgrass and other desirable exotic grasses. Herblands and shrublands decreased significantly. The amount of croplands varies.

Declines in herbland and shrubland habitats have contributed to declines in populations of several wildlife species. The overall increase of mixed-conifer woodland area across the cluster has likely increased habitats for other species.

Hydrologic integrity of these sub-basins ranges from low to moderate, and riparian integrity is commonly low. Sub-basins in this cluster represent some of the most strongly altered aquatic systems in the project area. Aquatic communities vary greatly, with a few salmonid strongholds, but with overall highly fragmented habitat and isolated fish populations. Introduced warm water fishes have influenced many lakes, and recreational fisheries throughout much of the area currently focus on introduced races.

Table 2-32 summarizes conditions in the six range clusters.

Composite Ecological Integrity

The SIT recognized that there are no direct measures of ecological integrity and that assessing integrity requires comparisons against a set of ecological conditions and against a set of clearly stated management goals and objectives as described in the alternatives. The SIT also recognized that this process is not a strictly scientific endeavor (Wickium and Davis 1995), because to provide meaning, ecological integrity must be grounded in desired outcomes. The initial estimates were based on current understanding and information, and are not presumed to be absolute.

Current composite ecological integrity was based on the analysis of the 164 sub-basins within the project area. Relative integrity ratings (high, moderate, low) were assigned by sub-basins for forestlands, rangelands, forestland and rangeland hydrology, and aquatic systems. The analysis was based on information from the *Scientific Assessment* (Quigley et al. 1996a, b) and understandings of conditions and trends. At present, 26 percent of the BLM- or Forest Service-administered lands is in high, 28 percent is in moderate, and 46 percent is in low ecological integrity.

Map 2-49 displays this information.

TABLE OF CONTENTS

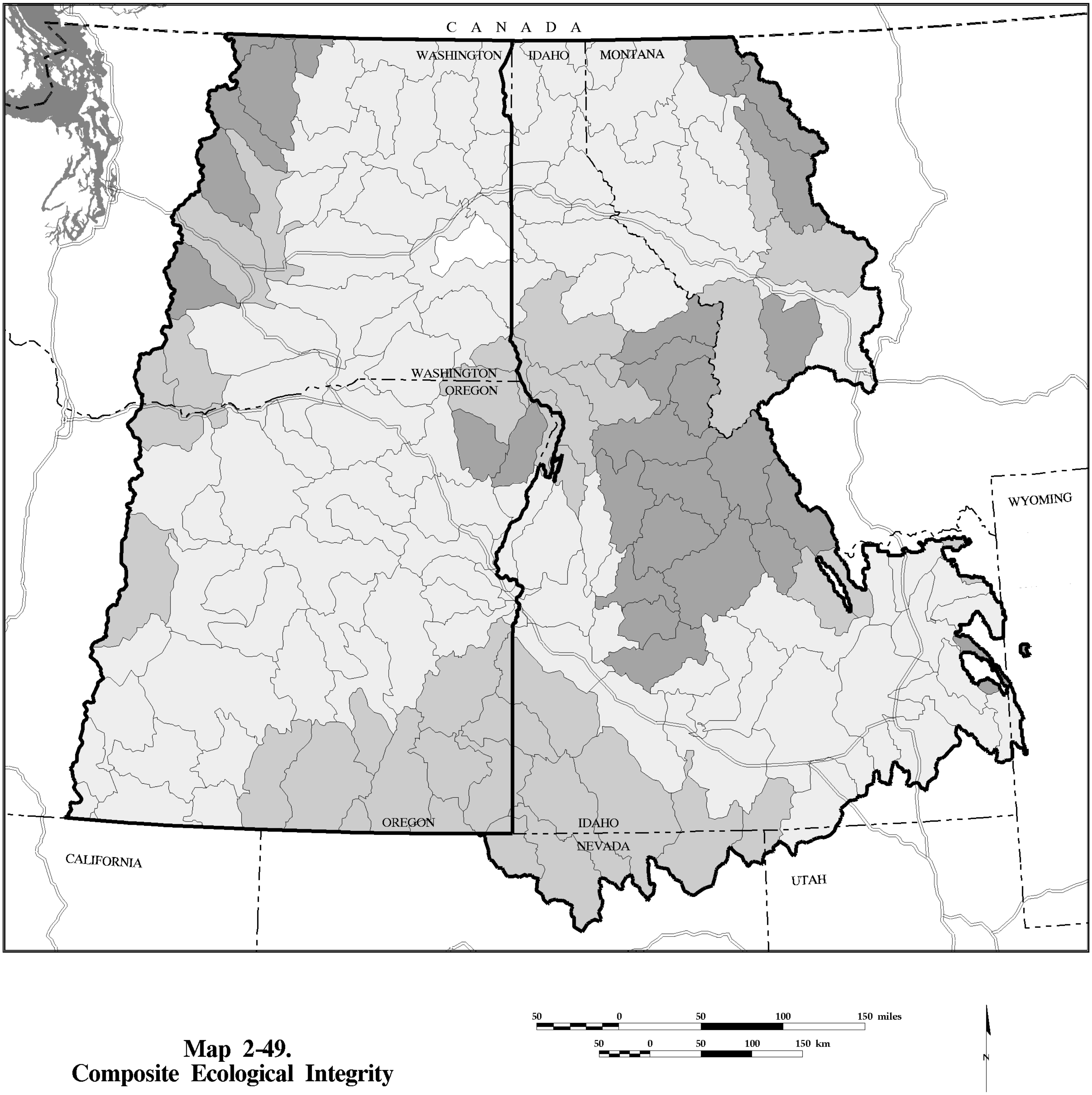
Table 2-32. Summary of Range Clusters (all lands).

Variable	Range Cluster 1	2	3	4	5	6
	percent					
BLM/FS-administered Land	36	81	44	5	75	55
Potential Vegetation Groups						
Dry Forest	29	21	34	8	10	12
Moist Forest	5	33	28	4	5	2
Cold Forest	1	34	14	0	11	4
Dry Grass/Shrub	32	4	4	26	45	50
Cool Shrub	22	1	2	3	20	9
Other	11	7	18	59	9	23
Rangeland Vegetation Groups						
Dry Rangeland (dry forest/dry grass/dry shrub)	49	34	17	30	61	61
Cool Rangeland	34	8	8	3	27	11
Other	17	58	75	67	12	28
Road Density Classes						
Low or none	20	71	30	62	64	30
Moderate or higher	80	29	70	38	36	70
Cropland/pasture	9	3	14	56	5	17
<12" annual precipitation	23	1	2	51	33	38
Fire frequency change	37	51	67	17	24	17
Fire severity increase	18	47	49	13	16	9
High wildland/urban fire risk interface	32	7	12	0	6	8
Moderate wildland/urban fire risk interface	10	59	33	4	58	39
Change in juniper woodland	+ 12	0	0	0	0	0
Forest Integrity						
Low	100	6	76	79	12	37
Moderate	0	37	15	21	27	43
High	0	57	9	0	61	20
Range Integrity						
Low	100	6	76	100	26	79
Moderate	0	37	15	0	50	21
High	0	57	9	0	24	0
Aquatic Integrity						
Low	39	4	43	84	37	79
Moderate	61	24	50	16	57	18
High	0	72	7	0	6	3
Hydrologic Integrity						
Low	34	6	49	100	7	44
Moderate	66	16	35	0	35	34
High	0	78	16	0	58	22
Composite Ecological Integrity						
Low	100	0	58	97	8	80
Moderate	0	3	32	3	63	20
High	0	97	10	0	29	0

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

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

Table of Contents



Map 2-49.
Composite Ecological Integrity

INTERIOR COLUMBIA
BASIN ECOSYSTEM
MANAGEMENT PROJECT

Project Area
1996

TABLE OF CONTENTS

GO TO CHAPTER 1

GO TO CHAPTER 3