Vegetation Condition Update The discussion about current vegetation conditions on the Malheur National Forest has been updated Tree information (including old growth), range, and other nonforested vegetation types are described using current information (1989).

Diversity Discussion Added: A section about "Diversity of Plant and Animal Communities" has been included in Chapter III. This summary describes current diversity concepts at the landscape ecology level and how natural and human-caused activities may influence those patterns.

B Physical and Biological Setting

1 The Malheur National Forest

The Forest is one of 19 National Forests that make up the Pacific Northwest Region, Region 6, of the National Forest System Region 6 includes lands within Oregon and Washington and is headquartered in Portland, Oregon

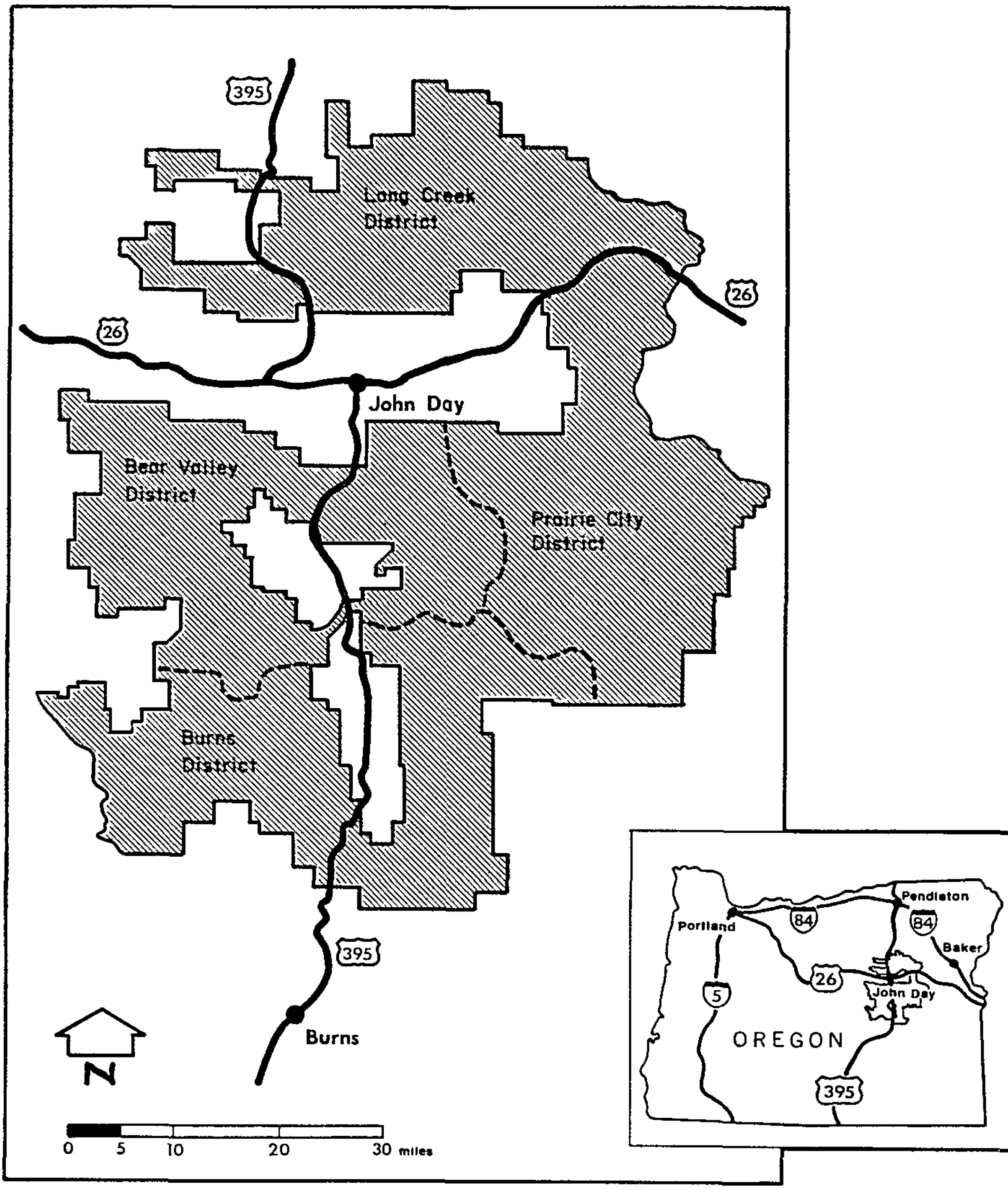
The Forest's 1,459,422 acres are located in eastern Oregon, approximately equidistant from the borders of Washington, Idaho, and Nevada (see Figure III-1.) The Strawberry Mountain Range, part of the Blue Mountains, extends east to west through the center of the Forest The Forest spans an elevational range of 3,300 to 9,038 feet, which results in a diverse and productive landscape of grasslands, sage, and juniper, forests of pine, fir, and other tree species, and mountain lakes and meadows

The northern part of the Forest is drained by the John Day River System into the Columbia River Basin. The southern part of the Forest is drained principally by the Silvies River system into the Great Basin, and by the Malheur River system into the Snake River

Malheur NF lands are in Grant (1,119,161 acres), Harney (293,876 acres), Baker (45,786 acres), and Malheur (599 acres) counties. The Forest is within a day's drive of Portland, Oregon Principal access routes are U S. 26 and U S 395, which are winding, two-lane, rural roads. There are two main population centers the John Day Valley from Dayville to Prairie City, and a 5-mile radius around Burns

The administrative breakdown of the Forest consists of four Ranger Districts Prairie City, with offices in Prairie City, Long Creek, with offices in John Day, Bear Valley, also headquartered in John Day; and Burns, with offices in Hines. The Forest Supervisor's Office is located in John Day. The ties between the Forest and the local communities are described in more detail in Section C, Social and Economic Setting

FIGURE III-1: Malheur National Forest



2. Geology and Topography

To understand the landscape seen across the Forest today, we must look back to the complex geological history of the area

The present Forest landscape is the result of a long and complex geologic history dating back to the Paleozoic Era (over 250 million years ago) At that time, northeastern Oregon was off the coast of the North American continent Over the next 100 million years, the continent grew through the accretion of marine sediments and volcanics, and buckled sections of oceanic crustal rocks carried in by plate tectonic processes During the Mesozoic Era, these units were uplifted, intruded by masses of granitic rocks, and erosion processes began carving a rugged landscape Early in the Tertiary Period of the Cenozoic Era, volcanic activity increased, and much of the old topography was covered by layers of volcanic ash and lava flows During the Miocene Epoch, extremely fluid basalts flowed from large fissures in the ground, covering much of the land area in eastern Washington, western Idaho, and northeastern Oregon Continued volcanic activity through the Miocene and Pliocene Epochs produced additional flows and extensive ash and tuff deposits. Regional stresses continued through the Tertiary Period and essentially up to the present, producing folding and faulting and eventually mountains and valleys. Erosional processes, greatly enhanced by Pleistocene glaciation and subsequent meltwater runoff, carved the rugged topography of the Aldrich, Strawberry, and Greenhorn Mountain Ranges. Erosion is continuing, and landslides are common in steep areas where hard, resistant rocks cap soft volcanic ash/tuff units typically having a high clay content

The Strawberry-Aldrich Mountain Ranges split the Forest into two physiographic divisions: the Blue Mountains to the north and the High Lava Plains to the south. Elevations on the Forest range from 3,300 feet along the Middle Fork of the John Day River to 9,038 feet on top of Strawberry Mountain.

Natural erosion and landslides have also affected the current landscape. Hard, resistant basalts erode slowly Ash deposits have already eroded from low, south- facing slopes, although upper elevations and west- and north-facing slopes still retain 8- to 24-inch deposits. Naturally occurring landslides are common "where steep cliffs form in soft rocks capped by hard resistant rocks" (Carlson, 1974)

3. Soils

Productive soils are a basic resource on which people depend for continued existence. The Malheur National Forest intends to maintain, enhance, and, where necessary, restore the long-term productivity of its soils.

The Forest's soils are typically not in a pristine condition They have been affected by more than a hundred years of mining and grazing activity, and more than 60 years of timber harvesting. Many of the adverse mining and grazing impacts occurred before the Malheur became a National Forest. Early sheep and cattle grazing was particularly damaging to meadows and upland range sites, many of which were compacted and eroded. Before the mid 1970's, logging was often indiscriminate and contributed to excessive compaction Many standards and guidelines in the Forest Plan were designed to address past soil problems

Existing problem areas were inventoried (Watershed Improvement Needs - WIN Inventory) and are being systematically corrected as funding permits

The Forest's soils were inventoried in the early 1970's; results were published in 1974 as the Soil Resource Inventory (SRI) There were 90 different mapping units, each with similar soils, landform, and vegetation The SRI has interpretative tables which present hazard ratings for each soil type, including ratings for surface erosion and compaction.

Forest soils originate from basically two sources underlying bedrock material and volcanic depositions Volcanic soils originated from Mt. Mazama, which is known today as Crater Lake Residual soils originate from bedrock and can be highly varied, while volcanic ash is a uniform, silt-loam soil with typically less than five percent coarse fragments.

The SRI classifies soils into one of four general categories loamy and clayey, nonforest soils; loamy, forested soils, clayey, forested soils, and volcanic-ash soils

a. Loamy and Clayey, Nonforest Soils - These are shallow (less than 15 inches deep), residual soils found on upland slopes and around meadows. They often show evidence of surface erosion resulting from overgrazing in the early part of this century. An erosion "pavement" has developed where soil material has been eroded away, leaving a layer of coarse rock on top of the ground Most of these sites are now in a stable condition because overgrazing has been curtailed

b Loamy, Forested Soils - These are residual soils that generally support ponderosa pine stands on southerly aspects Soil depth is typically greater than 12 inches Erosion is a concern on slopes greater than 30 percent, and compaction on slopes less than 30 percent Some of these sites have been eroded by past grazing activities Management practices are routinely mitigated for erosion and compaction on these sites

c Clayey, Forested Soils - These soils support a variety of forest types on a range of slopes and aspects Compaction and puddling are major concerns on these soils. They tend to resist erosion but, when it does occur, clayey, forested soils tend to produce turbidity in downstream water These soils are routinely mitigated for compaction and erosion after implementation of management activities

d Volcanic-Ash Soils - These soils are the most productive on the Forest. They have high water-holding capacity and, when dry, are easily displaced by a disturbance. Erosion is seldom a problem on these soils because of their high infiltration rates and water-holding capacity Depth of the ash layer ranges from 6 to about 24 inches

The Malheur NF has been intensively monitoring the soil impacts of tractor logging since 1981 Monitoring results have identified some instances where excessive compaction has occurred, those situations are being corrected Dedicated skid trails, directional falling, and winching are being used to keep skidding equipment on skid trails and thereby prevent excessive compaction. Soil ripping has been used to alleviate excessive compaction when it occurs The Forest is currently monitoring the effectiveness of soil ripping to assure that mitigation objectives are being met

4 Climate

The Malheur National Forest's climate is influenced by 2 major mountain ranges: the Cascade Mountains about 150 miles to the west, and the Rocky Mountains about 370 miles to the east The result is a high-desert climate with low precipitation and high summer temperatures

Much of the Malheur National Forest receives from 20 to 40 inches of annual precipitation, most of which falls as snow between November and May Dry periods occur annually and vary from one to three months in length

Average daily temperature during the year ranges from 27° Fahrenheit to 50° Fahrenheit Extreme annual temperatures could vary from -56° F to +108° F No month averages over 70° F and freezing conditions can occur in any month Prevailing westerly winds are generally of low velocity

5 Flora and Fauna

A variety of elevations, landforms, and climate results in a diversity of plants and animals. The ecological habitats supporting the Forest's flora and fauna can be divided into five broad life zones (see Figure III-2).

The alpine zone occurs above tree line at the highest elevations on the Forest Where vegetation grows in this zone, it consists primarily of alpine fleeceflower, alpine Idaho fescue, alpine big sagebrush, and alpine sedges This zone provides wildlife habitat for heather voles, water pipits, white-crowned sparrows and pika

The hudsonian (subalpine) zone occurs at high elevations across the Forest Characteristic vegetation consists of subalpine fir and Engelmann spruce stands growing in association with big huckleberry or grouse huckleberry. This life zone provides habitat for pine marten, Clark's nutcracker, and Lincoln's sparrow

The canadian (upper montane) zone occurs on mid- to high-elevation sites across the Forest. Characteristic vegetation consists of true fir stands, and ponderosa pine or lodgepole pine stands on areas with a fire history. Three-toed woodpeckers, snowshoe hares, and golden-crowned kinglets find feeding and breeding habitat in this life zone.

Mixed-conifer stands, consisting primarily of white firs and Douglas-fir, occupy moist, high-elevation sites on the Forest and cover more acreage than pine stands. These tree stands are denser and darker than typical pine stands and usually occur on cool, north- or east-facing slopes.

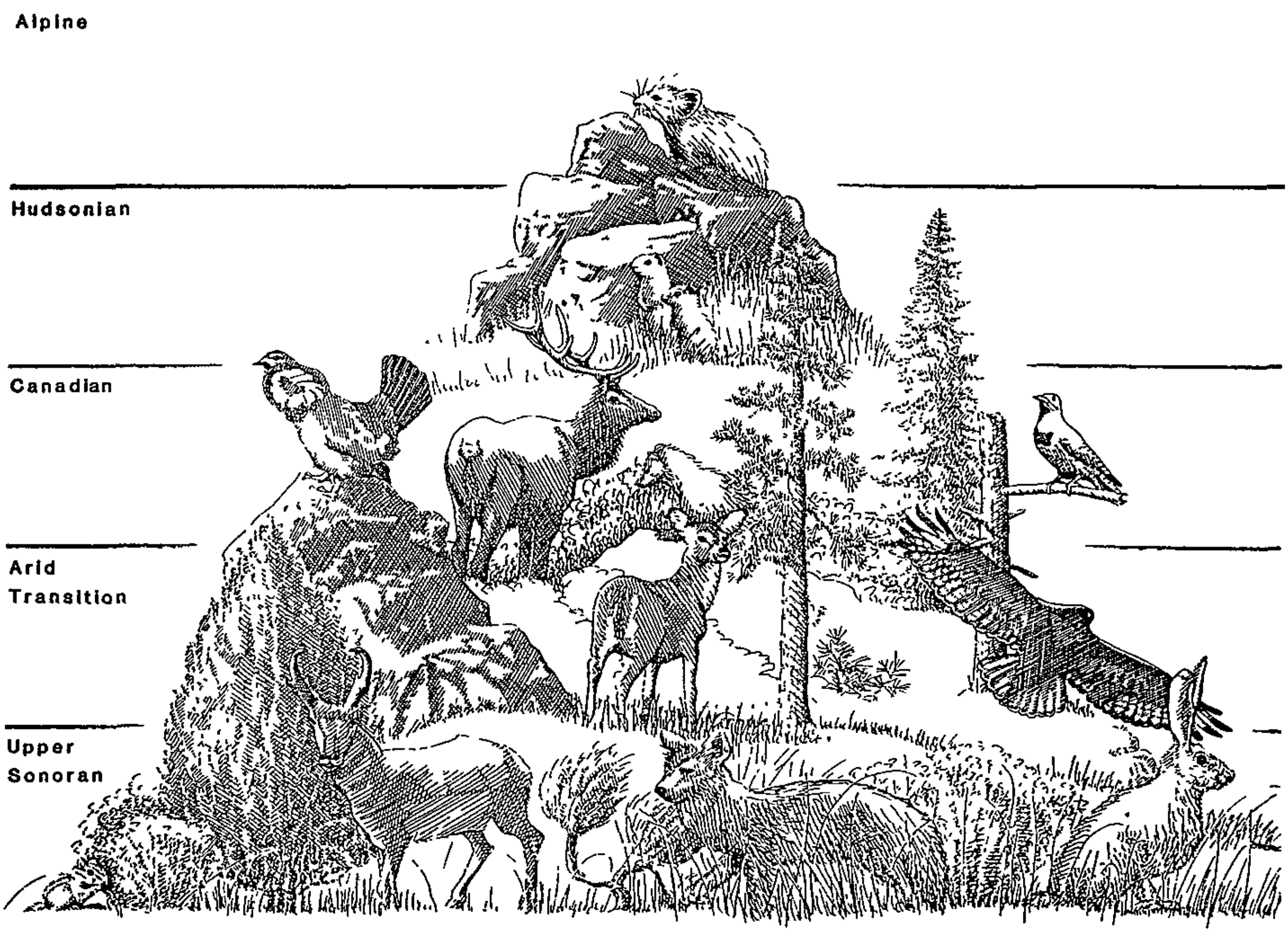
The lodgepole pine type underwent a transformation in the late 1970's due to a mountain pine beetle epidemic Few stands of mature lodgepole pine survive intact today and salvage of the dead material contributed to the Forest's supply of sawlogs, poles, posts, and fuelwood

The arid transition (lower montane) zone includes much of the pure ponderosa pine type on the Forest Common plant communities include ponderosa pine/bitterbrush and ponderosa pine/bunchgrass types Habitat for white-headed woodpeckers, mule deer, and pygmy nuthatch is plentiful in this life zone

Mature ponderosa pine trees are large and have a distinctive, orange-red, plate-like bark. Stands of mature ponderosa pine provide an attractive, open, park-like setting enjoyed by many recreationists Those same stands may also be the preferred raw material for local lumber mills Many pine stands are two- storied, with an overstory of mature trees and an understory of younger regeneration.

The upper sonoran (foothills) zone is characterized by juniper, sage and grassland ecosystems The Great Basin pocket mouse, Ord kangaroo rat, and vesper sparrow find habitat in these plant communities.

FIGURE III-2: Representative Species of Life Zones on the Malheur National Forest



Meadows, mountain grasslands, and scablands are interspersed throughout these five life zones in response to local changes in topography, soils and aspect. These open areas provide habitat for sandhill crane, upland sandpiper, and pronghorn

Hardwood species consist mainly of willow, quaking aspen, black cottonwood, and alder. These species have little commercial value but provide needed shade and wildlife habitat in riparian zones, which are among the most productive and sensitive ecosystems of the Malheur National Forest.

The variety of landforms and vegetation on the Malheur National Forest supports over 365 wildlife species, including 22 fish, 9 amphibians, 14 reptiles, 235 birds, and 85 mammals.

6. Diversity of Plant and Animal Communities

Diversity involves the distribution and abundance of different plant communities and their associated plant and animal species Wildlife species are adapted to these plant communities (or habitats) for feeding, reproduction, or both (Thomas, 1979). In general, potential diversity of wildlife species is greater whenever the diversity of habitats increases.

Figure III-3 depicts successional stages, the number of acres currently in each stage on the Forest (1980 conditions), and the percentage of the Forest for each successional stage The successional stages add up to 98 percent of the Forest The remaining two percent consists of roads, administrative sites, and water

Plant community diversity on the Malheur National Forest is provided by a complex vegetation mosaic resulting from variations in land form, elevation, aspect, climate, substrate (geology) and soils Natural diversity has been modified by the influence of fire, insects, disease, mining, grazing, logging, and the introduction of non-native plants The capability of various sites to sustain long-term productivity is determined by the extent, severity, and periodicity of site modification, whether human-caused or naturally occurring

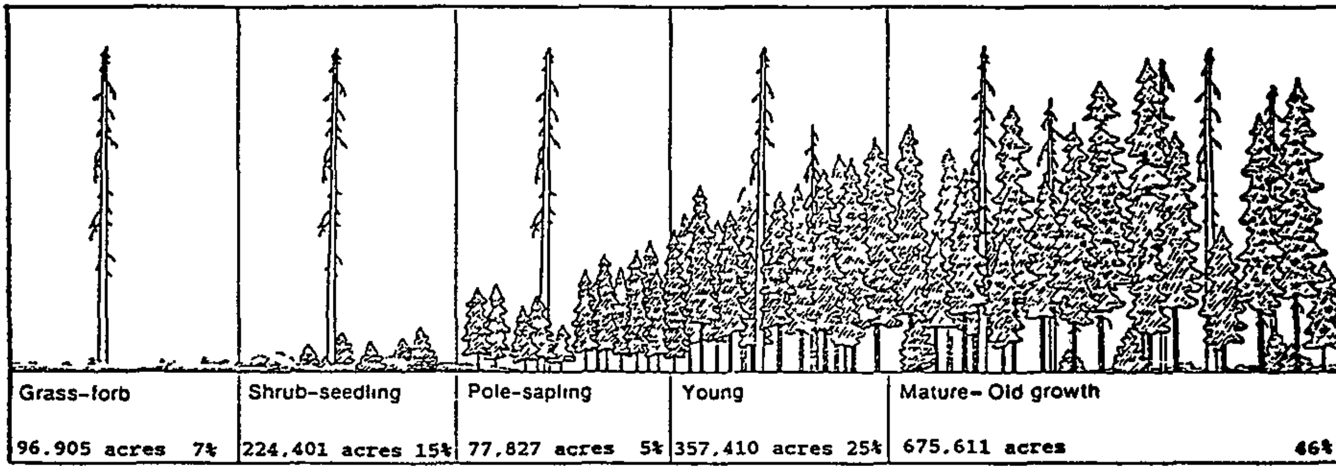
Over time, vegetation patterns may change dramatically, but changes usually result from gradual, long-term events like natural succession Conversely, vegetation changes resulting from human activities may appear quite suddenly Some natural changes may also occur suddenly, such as catastrophic events like wildfires and windstorms. Natural, catastrophic events may create landscape patterns similar to those resulting from timber harvest

Timber harvests, destructive fires, and severe windstorms generally decrease diversity within a stand, but will typically increase diversity between stands. This is often in response to changes in structural composition over time Harvests of large, old trees, thinnings, and establishment of certain species will create landscape patterns that are different than natural conditions As these timber harvests, thinnings, and plantings continue, there is an associated increase in diversity between stands.

Animal communities, both in terms of edge and habitat richness, will change as a result of management activities and natural processes As habitat conditions are modified, the opportunity exists to both positively and negatively affect certain ecosystems and their corresponding value to wildlife Increasing regeneration harvest in mature stands (clearcutting and shelterwood cuts) with an abundance of vegetative cover can increase the amount of edge contrast In areas with little vegetative cover, those same treatments may effectively reduce habitat conditions Recognizing the interactions of management activities is important for understanding their effects on plant and animal diversity Little is currently known about many of these interactions

Maintenance of special habitat conditions, such as unusual vegetation types, Research Natural Areas (RNAs) and sensitive species concentrations, will help perpetuate natural diversity found on the Forest

FIGURE III-3: Forest Successional Stages



The relationship between wildlife and habitat is not solely based on successional stages. Stand size and configuration, edge amounts, and type of plant communities are important as well (see discussion in Section D, "Wildlife") There are also specific habitats which are currently decreasing on the Forest

Aspen habitat is decreasing because of grazing by livestock, elk, and mule deer, conifer encroachment, poor regeneration, and fire suppression Fire suppression and management have also affected the availability and vigor of mountain-mahogany stands, mature sagebrush, bitterbrush, and ponderosa pine stands (see Section A-9 for discussion of the relationship between fire management and vegetation) Forage seeding (primarily grasses) has also affected the habitat provided by native grass-forb communities, yet the extent of that effect is unknown

Snags (standing dead trees) and downed logs are other important habitat components. Timber management and fuelwood harvest activities are reducing the availability of snags and defective trees (see discussion of snag habitat in Section D of this chapter). Downed logs are used for hiding cover and as sites for feeding and reproduction.

7. Old Growth

The most stable forested ecosystem is the successional stage referred to as old growth. Old growth is a vegetation condition characterized by a high number of old trees with structural damage and decay, large and numerous snags, and significant amounts of downed, woody material Production of organic matter is relatively high, and tree mortality is nearly equal to growth rates This favors high levels of nutrient retention and promotes nitrogen-fixing organisms in organic materials accumulating on the forest floor.

The large, old trees found in old-growth stands may offer spiritual and aesthetic values to humans

Mixed-conifer, old-growth stands are multistoried with large-diameter trees commonly older than 230 years The understory trees are usually shade-tolerant species like white fir, uneven in size and age, and range from saplings to large sawtimber. Although density and closure of individual canopy layers varies considerably, the overall closure is generally high (70-80 percent) because of the layered structure

Old-growth ponderosa pine stands generally have a more open, parklike appearance with overstory trees exceeding 250 years Lodgepole pine stands are characterized by dense stands of even-aged trees with canopy closures exceeding 70 percent and trees generally 70 to 80 years old

Numerous invertebrate and vertebrate species, as well as many plant species, find optimum habitat in old growth. Old growth or late-successional forests are decreasing and species using these areas are threatened by a loss of habitat At least 25 bird and 10 mammal species use large trees, cavities, or cracks in the bark for cover, feeding, or reproduction In addition to wildlife habitat, old growth provides ecosystem diversity and aesthetic values

In 1990, there are approximately 312,000 acres of old growth within the mature/ old growth successional stage on the Forest (see fig III-3) which met the Pacific Northwest Region's criteria for old growth. In 1980, there were approximately 409,000 acres which met the Regional criteria for old growth, since 1980, it is estimated that 97,000 acres of old growth have been harvested Of the three major forest types present on the Forest, old growth is found predominantly in the mixed-conifer type (88 percent), followed by ponderosa pine forests (4 percent) and the lodgepole pine type (8 percent)

8. Research Natural Areas (RNAs)

Parts of the Forest still retain natural, Blue-Mountain ecosystems which are essentially unmodified by human use Some areas contain unique features, but most are simply representative samples of specific plant associations in an untreated condition These areas could be managed as Research Natural Areas (RNAs), a classification used to allocate lands for purposes of research and education. Such management sets them apart from other land classifications having recreational, wilderness, and similar objectives

The Malheur National Forest is committed to continuation and improvement of the Research Natural Area system The Forest currently contains one designated RNA, the Canyon Creek Research Natural Area In addition, several other candidate research natural areas have been identified on the Forest Of these, six were identified as best suited for complementing the range of ecosystems included within the RNA system (Dyrness, et al , 1975)

The six candidate research natural areas are McClellan Mountain, Baldy Mountain, Antelope Valley, Dugout Creek, Shaketable Mountain, and Dixie Butte. These areas are compatible with RNA recommendations for other Forests in northeastern Oregon Descriptions of each candidate RNA follow

Baldy Mountain, located between Pine and Indian Creeks in the Strawberry Mountain Wilderness, displays a good example of forested communities on serpentine soils. It also contains a reproducing stand of limber pine and a type of fern listed as sensitive by the Pacific Northwest Region.

McClellan Mountain RNA has stiff sagebrush communities in good condition. Also present on McClellan Mountain are subalpine big sagebrush, mountain mahogany, and western juniper The north slope contains spruce-fir communities and some whitebark pine stands.

Antelope Valley is a low-elevation, valley meadow with good examples of native sedge-grassland communities Meadow plant communities are well represented, as are the silver sage and mountain big sage types Antelope Valley has high suitability as a research natural area, although much of the valley is in private ownership

Shaketable Mountain is a broad, gentle plateau with abundant acreage of low sage/bunchgrass and stiff sage/bunchgrass communities Additionally, juniper and bitterbrush savannahs are present in the area

Dugout Creek, near the North Fork Malheur River, includes mixed conifer/pinegrass communities on moderate slopes with ash soils. Forested sites feature old-growth ponderosa pine in the overstory, with ponderosa pine, Douglas-fir, and white fir in the understories Ground vegetation is dominated by pinegrass and elk sedge.

Dixie Butte represents an alpine sedge community, with examples of subalpine sage, subalpine Idaho fescue, and alpine fleeceflower This candidate RNA is at the top of Dixie Butte cone, where it provides good examples of vegetational differences caused by aspect changes

No aquatic or "rare and endangered" animal communities are located in these areas.

9 Natural Changes

The ecosystems of the Forest are constantly changing When one plant community is replaced by another one and the change wasn't caused by a catastrophic disturbance, it is called succession In temperate, coniferous ecosystems, succession often begins with pioneer species like aspen or ceanothus, which in turn are replaced with various conifer species, primarily Douglas-fir and white fir An intermediate species in this successional sequence is ponderosa pine

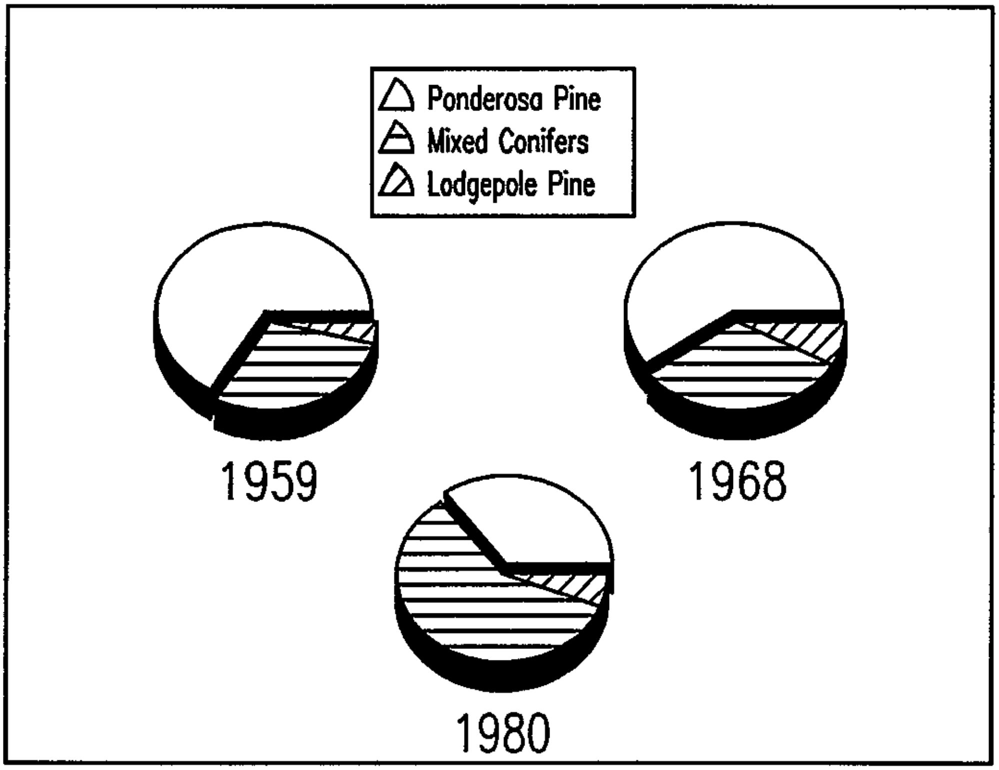
Prior to initiation of fire control in the western United States, fire played an important role in ecosystem development These natural fires occurred as one of two types high-intensity, conflagration fires, or low-intensity, ground fires

High-intensity fire areas are now dominated by plant communities of western larch, lodgepole pine, or a western larch/fir mixture These fires tended to occur on northerly or easterly slopes because they are cool and moist These slopes were not very susceptible to low-intensity, ground fires and seldom burned Fuels built up until a drought year occurred, when they were then dry enough to be ignited. High-intensity fires probably did not occur more than once every 15 to 25 years, but were devastating to large acreages of forest and range

Low-intensity, ground fires had a totally different effect on the forest environment. Ground fires often burned across ponderosa pine/pinegrass sites, where fire scars indicate that they occurred on an average of every 10 years These fires resulted in nonselective thinning of young ponderosa pine, selective elimination of white fir and Douglas-fir, and rather open stocking on the site

By suppressing natural ground fires since about 1900, land managers in the western United States have inadvertently been exchanging ponderosa pine type for mixed- conifer stands Figure III-4 shows how the area of each forest type has changed since 1959. Obviously, ponderosa pine's share of the Forest's landbase has declined steadily over the last 30 years Drops in ponderosa pine type have occurred not only because of fire suppression, but also as a result of the Forest's timber harvest program Figure III-5 shows that ponderosa pine has provided a disproportionate share of the Forest's harvest volume since 1970

FIGURE III-4: Historical Forest Type Changes, Malheur National Forest
(Data from previous 3 timber inventories)

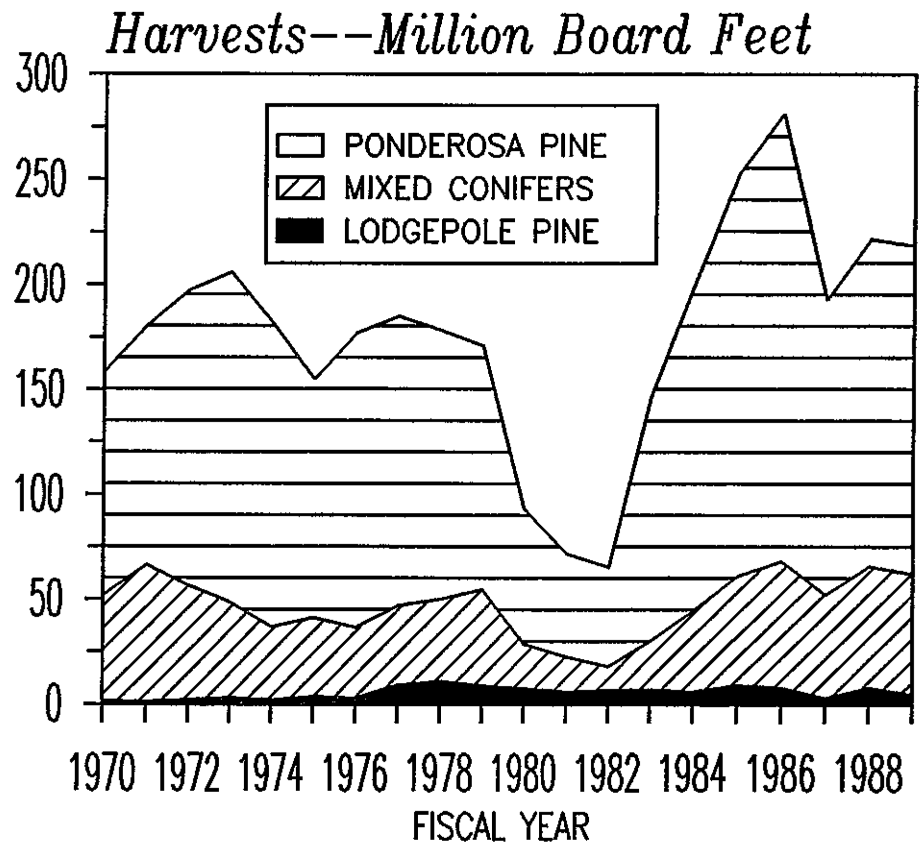


10. Prehistoric Human Activity

Human activity on the Forest has occurred in three chronological eras: prehistoric, historic, and current. Evidence indicates that hunter-gatherer peoples occupied the Forest and used its resources for the past 10,000 to 12,000 years. The Northern Paiute are more recent occupants of the area. Archaeological and other evidence indicates that these people migrated into the northern great basin over the centuries The principal residents of the area at the time of contact were the Northern Paiutes, a cohesive society integrated by kinship, warfare, and other factors Small groups were distributed widely and often shifted from band to band.

These fluid populations often became affiliated with neighboring groups. Territorial overlapping of both group and tribal boundaries occurred during seasonal migrations following food sources. The Umatilla, Cayuse, Tenino, Nez Perce, and Walla Walla tribes ranged southward from their Columbia River and Grande Ronde camps to the Paiute's northern boundary (approximately the John Day River) Evidence of prehistoric and protohistoric human activity remains on the Forest today and is managed as a cultural resource (see discussion of cultural resource management in Section D of this chapter).

FIGURE III-5: Historical Harvest (Cut) Volumes, Malheur National Forest



There was little human influence on the natural ecosystems of the Forest Vegetation and wildlife were largely governed by the occurrence and distribution of fire, as well as the climatic and physical characteristics discussed earlier

11. Historic Activity

Initial European contact with the area and the Indians living here was a result of the expanding fur trade in the early 1800's. The trails left by the trappers and explorers soon opened the country to immigrants.

The first large influx of prospectors and settlers coincided with the discovery of gold in Canyon Creek in 1862 Within 10 days, over 1,000 miners had arrived and that number soon swelled to 5,000 The town of Canyon City was laid out in July 1862.

Settlement of the area and development of the Forest's resources occurred at a time when National Forests in the West were being created to prevent abuse of the nation's natural resources The Blue Mountain Forest Reserve was established in 1907 amid a longstanding debate about the proper amount of public land to be preserved, and appropriate use of natural resources A year later, the Blue Mountain Reserve was divided and a Malheur National Forest created in June 1908

Timber played an important role in the development of early settlements by supplying building materials, fuel, fence posts, and mine timbers The first commercial sawmill in the area was the Oregon Lumber Company mill, built at Bates, Oregon, in 1917 With the development of this mill, the annual timber cut reached 2 8 million board feet. The annual timber cut increased again in the 1930's to 64 million board feet after construction of a sawmill at Hines, Oregon. Both annual timber harvest and local mill capacity have continued to increase since that time

Along with logging activity came the beginning of the Forest's transportation system Railroad lines were laid and haul roads built to move timber from the forest to the mills In later years, railroad lines were abandoned and, in many instances, the railroad grades became roads.

Although gold mining was the major factor in settling the area, grazing and farming began to increase as the population grew and the agricultural potential of the area was recognized. The number of livestock on Forest ranges increased from 1906 to 1921, primarily for the following reasons (1) homesteading eliminated much of the previously open range, and (2) World War I created high beef prices and an increased demand for range. In 1921, there were 35,168 cattle and horses and 90,245 sheep and goats grazing on the Forest. From 1921 to the late 1940's, the number of grazing animals gradually declined, mostly because of economic crises after World War I. Sheep have not grazed on the Forest since the 1960's Early grazing was uncontrolled and unrestricted, resulting in some detrimental soil impacts Heavily-damaged sites are still recovering from severe erosion.

Social and recreational uses of the Forest developed in association with settlement of the area Improved access into the Forest through mining, lumbering, and grazing also provided an opportunity for people to explore and enjoy the area The potential for the Forest to provide a unique, high-quality recreational experience was recognized as early as 1922 when a Forest Service report recommended the preservation of Strawberry Lake for recreational use.

In 1931, there were five improved campgrounds on the Forest. During the 1930's, with the help of the Civilian Conservation Corps (CCC), improved campgrounds were increased to a total of 24, and other improvements were made for increasing numbers of recreationists Much of the increase in recreational use was due to an influx of deer hunters from other parts of the State

Natural fire frequencies of 5-15 years in ponderosa pine and 25-70 years in mixed conifer stands were once prevalent Pine stands typically received low intensity fires due to light fuel accumulations through frequent underburning. Heavier fuel accumulations in mixed conifer stands accounted for more intense fires, often resulting in total stand destruction Due to fire suppression during the past 80 years, the natural ecological cycles involving nutrients, energy, and vegetation dynamics have been altered As a result, formerly open pine stands are being replaced by a mosaic of closed canopy, multistoried stands These stands are highly flammable and are more susceptible to destruction by wildfire than the natural fire-maintained open stands that existed previously

Human uses of the Forest continue to affect its resources, altering and shaping the forest we see today The following section describes those resources as they currently exist, their importance to human use, and the ways in which management of natural resources are interrelated Social and economic ties of the local area to the Forest are examined in detail in Section C (Social and Economic Setting)