BIOLOGICAL ELEMENTS OF THE ENVIRONMENT

AN OVERVIEW OF BIOLOGICAL DIVERSITY

This overview discusses and compares the elements of vegetation composition, pattern, structure, disturbances, processes and functions on a broad scale or "coarse-filter context" across the ARNF-PNG. Species and habitats that are more rare, unique and localized are discussed on a finer scale in relation to their habitats. Comparisons to situations beyond the Forests and Grassland are made to the extent possible. Biological diversity is best comprehended first on a large-scale perspective, and then in its finer details within the Forests and Grassland. The importance of biological diversity is stressed as a major *revision topic* for the *Forest Plan*. The topic addresses concerns about loss, fragmentation, connectivity, restoration and preservation of biological elements; spatial reference and different scales; constraints on resource use; and variety of successional stages, especially old-growth forests.

PRINCIPLES OF BIOLOGICAL DIVERSITY

Biological diversity (biodiversity) refers to "the full variety of life in an area, including the ecosystem, plant and animal communities, species and genes, and the processes through which individual organisms interact with one another and with their environment" (USDA Forest Service 1991). "Biodiversity at larger geographic scales, such as watersheds, landscapes, and beyond, includes the diversity of human cultures and lifestyles" (Salwasser et al. 1993). Biodiversity occurs at many levels from the molecular to complete ecosystems and is a measure of the relative abundance of genes, species, and ecosystems (OTA 1987).

LEGAL AND ADMINISTRATIVE FRAMEWORK

Management Requirements set down in *36 CFR 219.27* ...(a) for resource protection specify that all management prescriptions shall ...(5) "provide for and maintain diversity of plant and animal communities to meet overall multiple use objectives, as provided in paragraph (g) of this section." That paragraph specifies that:

> *diversity management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal species, so that it is at least as great as that which would be expected in a natural forest and the diversity of tree species similar to that in the planning area. Reductions in diversity of plant and animal communities and tree species from that which would be expected in a natural forest or from that similar to the existing diversity in the planning area may be prescribed only where needed to meet overall multiple use objectives. Planned type conversion shall be justified by an analysis showing biological, economic, social, and environmental design consequences, and the relations of such conversions to natural change.*

HIERARCHY OF ECOLOGICAL UNITS

Central to biodiversity and ecosystem management is the study of the spatial and temporal patterns of landscapes. The hierarchical structure of ecological systems allows characterization of ecosystems and identification of their patterns and processes at different scales. Composition, structure, pattern, and function determine an ecosystem's diversity patterns across a range of spatial and temporal scales.

The following levels of hierarchical scale used for management purposes are identified below. The scales of ecosystems are described in terms of vegetation patterns, biotic processes, environmental constraints, and disturbances. Table 3.46 presents the National Hierarchy of Ecological Units (ECOMAP 1993).

Table 3.46 National Hierarchy of Ecological Units

Planning and Analysis Scale	Ecological Units	Purpose, Objectives, and General Use	General Size Range
Ecoregions •Global •Continental •Regional	Domain Division Province	Broad applicability for modeling and sampling RPA assessment. International planning.	1,000,000s to 10,000s of square miles
Subregions	Sections Subsections	RPA planning multi-forest, statewide and multi-agency analysis and assessment	1,000s to 10,000s of square miles
Landscape	Landtype Association	Forest- or area-wide planning, and watershed analysis	1,000s to 100s of acres
Land Unit	Landtype Landtype Phase	Project and management area planning and analysis.	100s to less than 10 acres

Ecological units (column 2 of the table) define a very broad ecological spatial context. Information pertaining to the domain and division spatial scales of the National Hierarchy of Ecological Units is described in very general terms. The document provides increasing detail in discussing province, section, and forest and grassland.

DOMAINS

Domains are subcontinental areas of broad climate similarity. The Arapaho and Roosevelt National Forests and Pawnee National Grassland are within the *dry domain.* This domain is

characterized by a relatively dry climate where annual losses of water through evaporation at the earth's surface exceed annual water gains from precipitation (Bailey 1980).

DIVISIONS

Domains are further partitioned into divisions. Divisions are determined by isolating areas of differing vegetation, broad soil categories, and regional climates. The Forests and Grassland are within the *temperate steppe division*, which is characterized by a semiarid continental climatic regime (Bailey 1980).

PROVINCES

Divisions are further subdivided into provinces. Provinces are determined by broad vegetation regions which are primarily controlled by length and timing of dry seasons and the duration of cold temperatures. Provinces are also characterized by similar soil orders and by similar potential natural communities as mapped by Kuchler (1964). The Arapaho and Roosevelt National Forests are within the *southern Rocky Mountain steppe - open woodland - coniferous forest - alpine meadow province* (M331). The Grassland is within the *Great Plains-Palouse dry steppe province* (331).

M331 Southern Rocky Mountain Steppe—Open Woodland—Coniferous Forest—Alpine Meadow Province

The mountainous portions of the Rocky Mountain Region are included in province M331 (USDA Forest Service 1994). The area of this province covers about 102,300 square miles or 2.8 percent of the United States, and includes portions of Montana, Idaho, Wyoming, Utah, Colorado and New Mexico.

Land-surface form: The Rocky Mountains are rugged glaciated mountains as high as 14,000 feet (4,300 meters). Local relief is between 3,000 feet (900 meters) and 7,000 feet (2,100 meters). Several sections have intermontane depressions, or "parks," that have floors less than 6,000 feet (1,800 meters) in altitude. Many high-elevation plateaus composed of dissected, horizontally layered rocks occur in Wyoming and Utah.

Vegetation: Well-marked vegetational zones are a striking feature. Their distribution is controlled most by a combination of altitude, latitude, direction of prevailing winds, and slope exposure. The zones show a general gradation toward higher altitudes from the southern part of the province to the northern. They also extend downslope on east-facing and north-facing slopes and in narrow ravines and valleys subject to cold air drainage. The uppermost zone, the alpine, is characterized by alpine tundra and the absence of trees. Next below is the subalpine zone, dominated in most places by Engelmann spruce and subalpine fir. The montane zone, immediately below the subalpine, is characterized by the dominance of ponderosa pine and Douglas-fir; ponderosa pine tends to dominate on the lower, drier, more exposed slopes, and Douglas-fir to dominate on the higher, moister, and more sheltered slopes.

Fauna: Common large mammals include elk, deer, bighorn sheep, mountain lion, bobcat, beaver, porcupine, and black bear. Grizzly bear and moose are in the northern portions. Small mammals include mice, squirrels, martens, chipmunks, mountain cottontails, and bushytail woodrats. Hawks and owls inhabit most of the region. The numerous, more common birds are the mountain bluebird, chestnut-backed chickadee, red-breasted nuthatch, ruby-crowned kinglet, pygmy nuthatch, gray jay, Steller's jay, and Clark's nutcracker. Rosy finches are found around the high snowfields. Blue and ruffed grouse are the most common upland game birds.

Cover Types: The USDA Forest Service mapped the forested land as a part of the Resources Planning Act (RPA) 1993 assessment update (Powell et al. 1993). The broad cover types and acreages for the province are shown in Table 3.47. Most of the province is forested. The major forested cover types are lodgepole pine, spruce/fir and pinyon/juniper. Forested cover types comprise about 65 percent of the land area.

Table 3.47 Province Cover Types

Cover Type	Acres (approximate)	Percent of Total
Nonforested	23,317,000	35
Lodgepole pine	9,782,000	15
Spruce-fir (Engelmann spruce, subalpine fir, Colorado blue spruce)	8,776,000	13
Pinyon/juniper	8,116,000	12
Ponderosa pine	5,269,000	8
Douglas-fir	3,702,000	6
Western hardwoods (predominantly aspen and alder)	2,956,000	4
Aspen/birch (predominantly aspen)	2,080,000	3
Oakbrush (chaparral) (predominantly Gambel oak)	1,602,000	2
Water	242,000	0.4
Elm/ash/cottonwood (predominantly cottonwood)	9,000	>.1
TOTALS	65,851,000	≈100

Age of Forested Cover Types: Data are not specifically available for the province, but information is available for the Rocky Mountain Region (Colorado, most of Wyoming, and small portions of South Dakota, Nebraska, and Kansas). According to the Biological Diversity Assessment done for this Region, the major forested communities are lodgepole pine, ponderosa pine, Douglas-fir, spruce/fir, aspen, and pinyon/juniper. The majority of these forests are older than 100 years (USDA Forest Service 1992). Age classes for each dominant forested cover type are presented in Figures 3.5 through 3.9.

Province Cover Types and Acreages

Approximately 70 percent of the lodgepole pine cover type is between 80 and 180 years old. Stands of lodgepole pine at lower elevations start becoming high risk for bark beetles between the ages of 120 and 140 years. The younger stands have resulted from past timber harvests and fires. Figure 3.5 shows the lodgepole pine cover type age-class distribution.

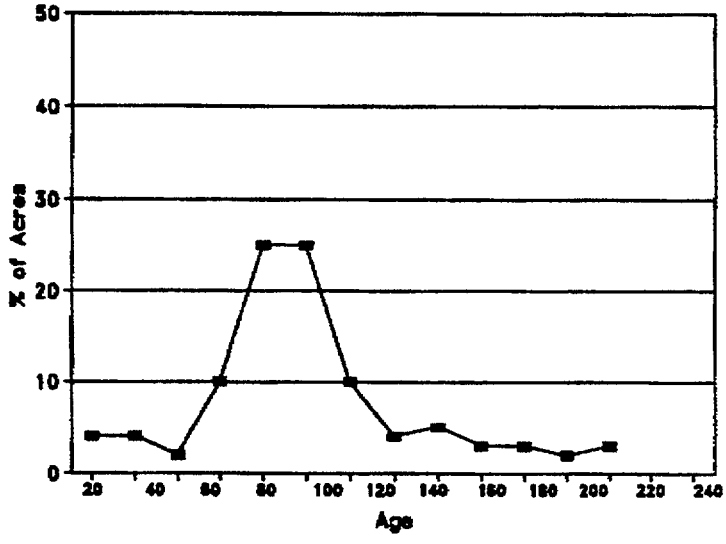

Figure 3.5. Lodgepole Pine Cover Type by Age Class

Approximately 70 percent of the ponderosa pine cover type is between 60 and 140 years old. Ponderosa pine can live to be 600 years old and usually does not slow down in growth until 150 to 225 years of age. About 10 percent is considered to be mature or older. Like lodgepole pine, the younger stands of ponderosa pine are a result of past timber harvests and fires. The open stands of ponderosa pine provide an understory of vegetation that is used by livestock and wildlife. Figure 3.6 shows the ponderosa pine cover type age-class distribution.

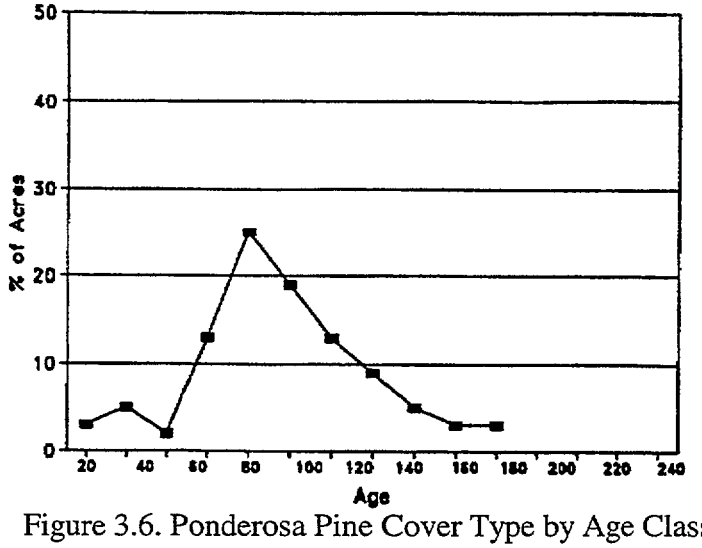

Figure 3.6. Ponderosa Pine Cover Type by Age Class

Approximately 75 percent of the Douglas-fir stands are between the ages of 80 and 180 years. In the northern and central Rockies, this community normally stops growing at about 200 years. Only a small percent lives beyond 200 to 220 years. Figure 3.7 shows the Douglas-fir cover type age-class distribution.

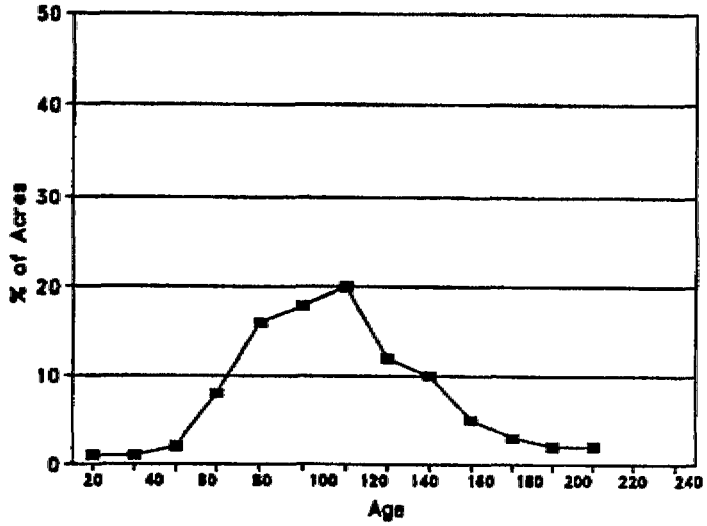

Figure 3.7. Douglas-fir Cover Type by Age Class

Aspen normally lives only 80 to 90 years before pathogens start causing death. Seventy-eight percent of the aspen stands are between 60 and 120 years old. About 44 percent are beyond 80 years. The amount of aspen is expected to decline as disease-causing organisms, insects, and the invasion of conifer trees affect the older stands. The aspen communities produce high yields of shrubs, forbs, and grasses available to livestock and wildlife. Figure 3.8 shows the aspen cover type age-class distribution.

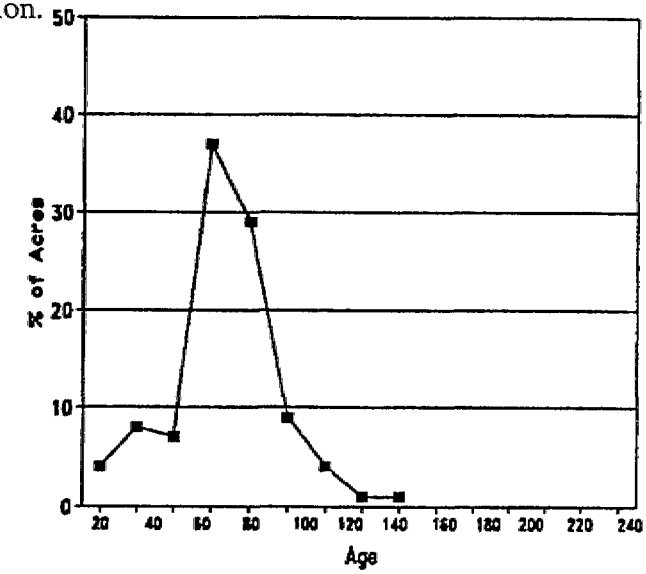

Figure 3.8. Aspen Cover Type by Age Class

Roughly 77 percent of the spruce/fir in the Region is between the ages of 80 and 220 years. Some spruce forests can reach an age of 500 years. The spruce/fir community is the most diverse of the cover types in terms of different ages represented. The younger forests are primarily a result of past timber harvesting. Figure 3.9 shows the spruce/fir cover type age-class distribution.

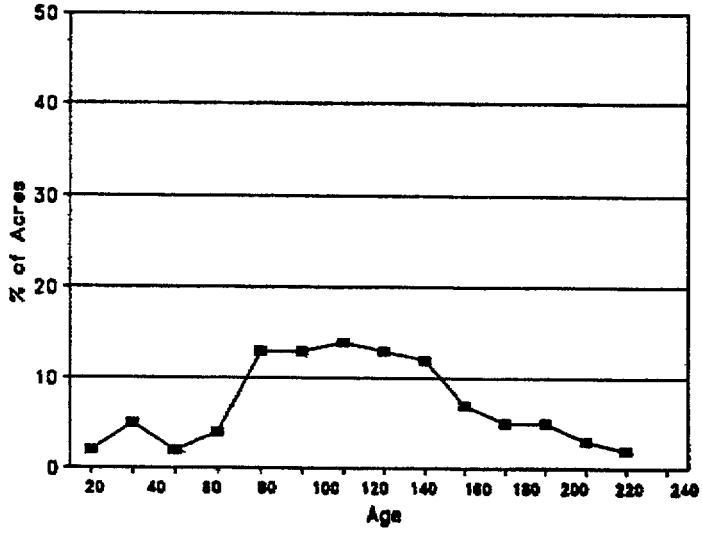

Figure 3.9. Spruce/fir Cover Type by Age Class

There is not as much information available for pinyon/juniper communities, but they are also composed primarily of older trees.

Insects and Disease: According to the Biological Diversity Assessment done for this Region (USDA Forest Service 1992), the region as a whole is at moderate to high risk of insect epidemics because of the large number of older trees. Insect epidemics are currently occurring in two places in the Region: the Uncompahgre Plateau in Colorado, and the Laramie Peak area in Wyoming. Insect and disease outbreaks have occurred in the past in the Wind River mountains in Wyoming, the Black Hills in South Dakota (outside the province), in Colorado along the Front Range and in central Colorado. In areas suffering from drought conditions, outbreaks can be expected in the near future, since trees are stressed and more susceptible to attack.

Timber Resource: Of the cover types listed above, Douglas-fir, ponderosa pine, lodgepole pine, and spruce/fir currently have the highest value for wood products. Totals for these cover types are shown below (Table 3.48). Not all of these forested lands are available for timber harvest, however. Timber harvest, as used here, means cutting and thinning trees. According to Forest Service plans, Bureau of Land Management programs, state programs and activities on private land, approximately 6.1 million acres (22 percent) of the province's 27.5 million forested acres currently valued for wood products are available for harvest, or 9 percent of the province's total of 65.8 million acres.

Table 3.48 Selected Province Cover Types

Cover Type	Acres	Percent of Total
Lodgepole pine	9,782,000	36
Spruce/fir	8,776,000	32
Ponderosa pine	5,269,000	19
Douglas/fir	3,702,000	13
TOTAL	27,529,000	100

Not all lands identified as available for timber harvest are treated in any year or even within a decade. It is estimated that 2 to 5 percent of the forested lands could be affected by some kind of timber harvest in any one decade. This means that over the long term approximately 22 percent of the forested lands could be altered by timber harvest. The other 78 percent would change through natural processes of fire, insects, diseases, other natural disturbances, and growth and death.

The forest cover types provide habitat for many species of wildlife associated with older forests. While it cannot be said that all of this habitat is suitable and occupied, older forests do contribute a significant amount of wildlife habitat. The likelihood of this older-forest component being altered through timber harvest is low. However, there are localized exceptions where the combination of timber harvest and fires has greatly reduced the abundance of older-forest habitats.

Of the major forested cover types in the province, ponderosa pine has probably been altered the most by human activities such as logging, residential and recreational development, and fire suppression. Preliminary work on the range of natural variability for Rocky Mountain ecosystems indicates that older ponderosa pine forests were not widespread or abundant. They were also more of an open forest, rather than a dense, multilayered forest that people tend to describe when discussing old-growth forests in general.

Livestock Grazing: Information is not yet available on how much of the province supports domestic livestock grazing. For the Rocky Mountain Region of the Forest Service, based on the Biological Diversity Assessment done for the Regional Guide, approximately 40 percent of the National Forest System land base supports livestock grazing (USDA Forest Service 1992). However, this includes the National Grasslands, which are not within the province proper. Thus, the 40 percent figure would actually be somewhat lower.

Rare Species: Nationwide, the Threatened and Endangered Species list contains 944 species — 433 animals and 511 plants (USDI Fish and Wildlife Service 1995). Flather et al. (1994) compiled a summary of threatened and endangered species for the entire United States by county. Threatened and endangered species are not evenly distributed across the country but tend to be localized in distinct areas of abundance relative to the size of the land area. Florida, southern

Appalachia and the arid Southwest, for example, support an especially high number of threatened and endangered species. Province M331, relative to the rest of the US, ranks low to moderate for the occurrence of threatened and endangered species.

331 Great Plains—Palouse Dry Steppe Province

The plains portions of the Rocky Mountain Region are included in Province 331 (UDSA Forest Service 1994). This area covers about 290,700 square miles or 8.1 percent of the United States.

Land-surface form: This province is characterized by rolling plains and tablelands of moderate relief. They are in a broad belt that slopes gradually eastward from an attitude of 5,500 feet (1,520 meters) near the foot of the Rocky Mountains to 2,500 feet (760 meters) in the Central States. The plains are notably flat but there are occasional valleys, canyons, and buttes. In the northern section, badlands and isolated mountains break the continuity of the plains. The Palouse region occupies a series of loess-covered basalt tablelands that have moderate to high relief. They range in altitude from 1,200 to 6,000 feet (370 to 1,800 meters).

Vegetation: Steppe, sometimes called shortgrass prairie, is a formation class of short grasses usually bunched and sparsely distributed, and is characteristic of this province. This is a dry steppe with six to seven arid months each year. Scattered trees and shrubs such as sagebrush and rabbitbrush occasionally appear in the steppe, and exist at all gradations of cover into semidesert and woodland formations. Since ground cover is scarce, much soil is exposed. Many species of grasses and herbs nevertheless grow in this province. Typical grasses are buffalo-grass, grama, wheatgrass and needlegrass. Sunflower and loco week are typical herbs. Many wildflower species bloom in spring and summer. The blazingstar and white prickly poppy are usually abundant. The alien Russian-thistle, also known as tumbleweed, is sometimes abundant. Except for its absence of shrubs, the Palouse Prairie resembles the central grasslands. The dominant species, however, are distinctive. They include bluebunch wheatgrass, fescue, and bluegrass.

Fauna: Large herds of buffalo once migrated with the seasons across the steppe. Now the pronghorn antelope is probably the most abundant large mammal, but mule deer and whitetail deer are often abundant where brush cover is available along stream courses. The whitetail jackrabbit occupies the northern part of the province and the blacktail jackrabbit the part south of Nebraska. The desert cottontail is widespread. The lagomorphs, the prairie dogs, and several other small rodents are preyed upon by the coyote and several other mammalian and avian predators; one of these predators, the blackfooted ferret, is classed as an endangered species. The thirteen-lined ground squirrel is common here, and both prairie dogs and ground squirrels are preyed upon by badgers. The Washington and Columbia ground squirrels inhabit large areas of the Palouse Prairie.

The lesser prairie chicken, formerly abundant, is now classed as threatened. Sage grouse, greater prairie chickens, and sharp-tailed grouse are present in the area. Among the many smaller birds are the horned lark, lark bunting, and western meadowlark. Two bird species are unique to the shortgrass prairies east of the Rockies: the mountain plover and McCown's longspur. Mountain plovers, which resemble killdeer, live in small flocks and are often seen feeding in freshly

plowed fields. Construction of stock ponds has created an important "duck factory" in the northern Great Plains.

SECTIONS

Provinces are further subdivided into sections. Sections are broad areas of similar geologic origin, geomorphic process, stratigraphy, drainage networks, topography, and regional climate. Sections are typically inferred by relating geologic maps to potential natural vegetation "series" groupings as mapped by Kuchler (1964).