CHAPTER 3: THE AFFECTED ENVIRONMENT AND CONSEQUENCES

3-1. PURPOSE AND ORGANIZATION OF THIS CHAPTER

This chapter provides information about the environmental resources of the Black Hills National Forest (Forest), and about the potential consequences of Phase II Amendment alternatives on those resources. The information presented builds upon that previously provided in the 1996 Final Environmental Impact Statement (Final EIS).

Chapter 3 includes eight resource areas.

3-2 Ecosystems of the Black Hills National Forest
3-3 Emphasis Species
3-4 Migratory Birds
3-5 Demand Species
3-6 Emphasis Areas
3-7 Natural Disturbance Processes
3-8 Use of the Forest
3-9 Social Environment
3-10 Heritage Resources
3-11 Economic Environment
3-12 Financial and Economic Efficiency
3-13 Physical Elements of the Environment

Certain resources considered in the 1996 Final EIS (i.e., Paleontology, Hazardous Materials, and Wild and Scenic Rivers) would be unaffected by the alternatives considered in this document. As a result, these resources are not included in this chapter.

Each of the resource areas included in this chapter provides a discussion of existing conditions and an effects analysis of the Phase II Amendment alternatives.

In addition, this chapter presents information concerning:

3-14 Energy Requirements
3-15 Unavoidable Adverse Effects
3-16 Short-term Resources Versus Long-term Productivity
3-17 Irreversible and Irretrievable Commitment of Resources
3-18 Summary Of Cumulative Effects

Alternative cumulative effects considered in the Phase II Amendment are bounded in time and space. Bounding in time considered the 10- to 15-year planning timeframe for forest plans for relatively short duration effects (economic, social, air quality, etc.) and a 50-year planning timeframe for longer duration effects.

The longer temporal scale corresponds to the time it takes natural systems to change. The cumulative effects analysis for wildlife and fish species viability is bounded in time as the next 50 years. This temporal scale is based on: a) the planning horizon (usually 50 years for a forest plan); b) the biology of the species (e.g., generation time, response time to changed conditions, recolonization capability); and c) the time needed for the overall ecosystem to respond to proposed management (Liggett et al. 2003).

The spatial scale for cumulative effects analysis of Phase II Amendment alternatives generally encompasses the Black Hills Ecosystem as defined by Bailey (1995) for ecosystem effects and the seven counties affected by activities on the Forest for social and economic effects. The cumulative effects analysis for fish is bounded in space as the fourth-order watersheds that encompass the Forest. This equates to the headwaters of the Belle Fourche and Cheyenne Rivers, and their associated tributaries, downstream to the Belle Fourche/Cheyenne River confluence. This bounding was determined because effects to water quality and/or quantity from Forest Service activities may extend downstream of the Forest boundary but become negligible at a downstream point due to the underlying Black Hills geology and the overriding effects of other non-Forest activities at an ever-increasing watershed/geographic scale.

Throughout this EIS, reference is made to goals, objectives, standards, and guidelines (see Appendix D) that constitute guidance for management direction on the Forest. Goals, objectives, standards, and guidelines are defined in the glossary (see Appendix E). In general, goals describe the desired end result and are expressed in broad general terms. Objectives are concise statements of measurable desired results intended to promote achievement of goals. Standards limit management activities and are mandatory requirements to be followed during plan implementation unless the Forest Plan is amended in a project NEPA document. Guidelines are preferred or advisable course of action to be followed during plan implementation unless not following a particular guideline is justified in a project NEPA document.

The cumulative effects analysis area is generally bounded in time as the next 10 to 15 years. This temporal scale corresponds to projections for the desired future condition described for each alternative (Chapter 2). The spatial scale for the cumulative effects analysis generally encompasses the Black Hills Ecoregion as defined by Bailey (1995). Other bounding parameters are used as appropriate in the effects analysis for specific effects.

The effects analysis, including alternative comparison, is conducted as if the goals, objectives, standards and guidelines are fully implemented for each of the alternatives. Some resource analyses use the anticipated level (acres) of on-the-ground treatments to implement the objectives. The estimated treatment acres are included in Appendix B and the text will cite the specific table when needed. Actual treatment levels done during Plan implementation will vary depending on budgets, personnel, environmental review, and administrative or resource policy. As budgets or these other items vary, the length of time to meet the objectives may vary somewhat from the 10- to 15-year period noted above.

3-2. Ecosystems of the Black Hills National Forest

The Black Hills is an isolated, unglaciated, and distinctive group of rugged mountains rising above the surrounding plains. It is variously described as an "island on the plains," and species from diverse environments, including the Rocky Mountains, northern coniferous forests, eastern hardwoods, and the surrounding Great Plains, have populated the "island." As such the area forms an "ecological crossroads" and has been described as one of the nation's greatest national treasures (USDA Forest Service 1996a). While ponderosa pine dominates the Black Hills, areas exist where white spruce, aspen, and other hardwoods prevail. Disturbance processes such as fire and insect infestations affect many of the area species. Ponderosa pine, for example, is adapted to frequent fire-return intervals. Changes in fire regime can influence the success of this species; because of its dominance, such changes can have a significant effect on the Forest's structure and composition as a whole.

The 1996 EIS for the 1997 Revised Land and Resource Management Plan (LRMP) discusses the Forest ecosystems in detail. This Phase II Amendment EIS focuses on the following ecosystems that the Phase II Amendment alternatives would potentially affect:

- Forested Ecosystems
- Grassland/Shrubland Ecosystems
- Riparian and Wetland Ecosystems
- Aquatic Ecosystems
- Cave Ecosystems

Overall, forested areas comprise about 89 percent of the Forest, with grasslands and shrublands comprising most of the remaining area. Riparian, wetland, aquatic, and cave ecosystems occupy relatively minor areas of the Forest but are nonetheless of considerable importance with regard to the function of the Forest ecosystem as a whole.

The following sections focus on these ecosystems as well as the potential effects that alternative implementation might cause.

3-2.1. Forested Ecosystems

Forested areas make up about 89 percent of the Forest. Three primary forest ecosystems, characterized by their dominant vegetation, are recognized within the Forest:

- Ponderosa Pine Ecosystems
- White Spruce Ecosystems
- Hardwood Forest Ecosystems

Overall, the ponderosa pine ecosystem is the most characteristic of the Forest, with about 92 percent of the forested area dominated by ponderosa pine. Hardwood communities (predominately aspen and bur oak) comprise about 6 percent of the forested area while white spruce communities cover about 2 percent of the area.

These ecosystems are detailed in the following sections, with emphasis placed on identification of the Affected Environment, Resource Conservation Measures, and Direct and Indirect Effects. Direct and indirect effects are discussed as they relate to the three key decision areas of this EIS: species-viability management, research natural areas (RNAs), and fire-hazard and insect-risk management. Cumulative effects are discussed for each resource.

A related issue on how fast does the Black Hills forest grow can be found in Section 3.8.3 – Timber Production. See also *A History of Black Hills Forestry* by Carl Newport (1954).

The cumulative effects analysis area is bounded in time as the next 10 to 15 years. This temporal scale corresponds to projections for the desired future condition described for each alternative (Chapter 2). The spatial scale for the cumulative effects analysis generally encompasses the Black Hills Ecoregion as defined by Bailey (1995).

3-2.1.1. Ponderosa Pine Ecosystems

3-2.1.1.1. Affected Environment

The Final EIS for the Forest LRMP (USDA Forest Service 1996a) presents information on ponderosa pine ecosystems on pages III-129 to III-150. Recent publications (Brown 2001, 2003; Shepperd and Battaglia 2002; Marriott et al. 1999; Marriott and Faber-Langendoen 2000a; and others) have increased the knowledge base of ponderosa pine communities on the Forest since the publication of the 1996 Final EIS. For example, today much more vegetative information is known as referenced in Marriott and Faber-Langendoen 2000a, which basically replaces *Forest Vegetation of the Black Hills National Forest* by Hoffman and Alexander RM-276 (1987).

Ponderosa pine is the dominant tree of the Forest and occurs from low to high elevations on all soil types and aspects (Shepperd and Battaglia 2002; USDA Forest Service 1996a p. III-134). Ponderosa pine forests occupy approximately 1,037,000 acres of the Forest (see **Table 2-5)**. In 1996, ponderosa pine forest acreage was estimated to be 1,042,000 (USDA Forest Service 1996a p. III-130), which was 5,000 acres more than 2003 estimates. This decrease from 1997 in the estimate of ponderosa pine acreage is due mostly to refinements in data and data analysis since 1997.

The composition, structure, and pattern of ponderosa pine forests have changed since Euro-American settlement, and these historical modifications are discussed at length in other documents (USDA Forest Service 1996a, Parrish et al. 1996, Shepperd and Battaglia 2002), the *Graves Report* (1899) and *Exploring with Custer* by Grafe and Horsted (2002) as well as the Natural Disturbance Processes in Chapter 3 of the Affected Environment and Consequences. Ponderosa pine forests of the western United States were historically open stands with high understory biomass and diversity (Brown 2003). These conditions were typically maintained by frequent fires, which limited stand density and the presence of pine in the understory (Brown 2003). Shinneman and Baker (1997) state it is likely that both low-intensity surface fires and large catastrophic wildfires occurred prior to Euro-American settlement in the Black Hills. Shinneman and Baker (1997) cite descriptions from early expeditions in the Black Hills (Custer Expedition 1874 and Dodge Expedition 1875), forest inventories conducted by Graves from 1891 to 1897, and sizeable areas of even-aged forest on the limestone plateau as evidence of large, stand-replacing fires occurring prior to settlement.

However, recent dendrochronological work by Brown (2001, 2003) provides an alternative hypothesis for the assertion that large, stand-replacing fires were part of the ponderosa pine ecosystem prior to settlement. Brown (2001, 2003) sampled trees (including stumps, logs, snags, and living trees) from three areas of the limestone plateau in an effort to reconstruct pre-settlement patterns of forest age structure and determine the probable role of surface fires, crown fires, and climate variability in driving current ponderosa pine structure in the Black Hills. Brown's work confirms that episodic surface fires were a major form of disturbance prior to Euro-American settlement but suggests that large patches of even-aged forest structure seen at settlement may have been the result of an extended wet period during the late 1700s and early 1800s seen over much of the northern Plains rather than the result of large crown fires during this period. These data do not rule out stand opening by more severe fires but suggest that mosaics of age and stand structure were created by a combination of both surface and patchy crown fires, climate variations, and other disturbances.

Additional dendrochronological work completed in Upper Pine Creek Research National Area (RNA) of the Black Hills confirms the importance of frequent surface fires on historical structure of ponderosa pine stands and notes that pine forest conditions have changed in Upper Pine Creek RNA due to disruption of the historical surface fire patterns (Brown 2003). These changes likely include loss of understory species and biomass, reduction in nutrient cycling, reduction in hydrological flows, and an increase in forest density and fuel loading leading to increased likelihood of large-scale crown fires (Brown et al. 2000) similar to changes seen in ponderosa pine forests throughout the western US (Friederici 2003).

The *Graves Report* (1899)presented evidence of dense uniform forests existing in pre-settlement forests and a forest condition of a scattered overstory of large trees existing over the denser smaller trees. Although Brown's work presents clear evidence that periodic surface fires did occur in the Black Hills, the Grafe and Horsted (2002) repeat photos and documented large fires early in the 20th century (Lentile et al. 2000) also document that large areas burned severely, but have since regenerated. Tree seedling establishment patterns after the Jasper Fire clearly show that although large openings will persist, smaller openings or openings with a sparse overstory are capable of being naturally reforested by pine (Bonnet et al. 2005). Lentile (in press) also shows that a high percentage of scarred trees exist within the perimeter of the Jasper Fire, indicating that future dendrochronologists will find ample tree-ring evidence of that fire throughout its perimeter, in spite of the areas within it that burned completely. Therefore, differences of historic range of variation views among scientists may be reconciled under a mixed-mode fire-disturbance regime where both crown fires and surface fires were simultaneously active in the Black Hills. (See 'deis_science_consistency_consultation' in Wayne Shepperd's comments in the Administrative Record.) An example of a mixed-mode fire disturbance may be viewed as the mixed fire severity of the Jasper Fire of 2000.

Photo 1. An Oblique Picture Of The Jasper Fire Area Mixed Fire Severity

Black Hills Community Types

Marriott and Faber-Langendoen (2000a) identified 13 ponderosa pine community types that occur in upland forests/woodlands of the Black Hills and two community types that occur as sparse vegetation. Most pine forests at lower elevations of the black hills are classified within the dry coniferous forest and woodlands ecological group. Pine forests occurring in moist habitat of lower elevations and at higher elevations are considered within the mesic coniferous forest and woodlands ecological group (Marriott and Faber-Langendoen 2000a). Pine communities that exist in association with limestone outcrops and scree slopes are classified within the Black Hills sparse vegetation ecological group (Marriott and Faber-

Langendoen 2000a). Ponderosa pine community types, grouped by ecological group, are listed on the Forest, other agency-administered lands, and private ownership in **Table 3-1**.

Table 3-1. Ponderosa Pine Ecological Groups And Plant Associations

Ecological Group	Plant Associations
Dry Coniferous Forests and Woodlands	Ponderosa Pine/Bearberry Woodland
	Ponderosa Pine/Sedge Woodland
	Ponderosa Pine/Rocky Mountain Juniper Woodland
	Ponderosa Pine/Oregon Grape Forest
	Ponderosa Pine/Western Wheat Grass Woodland
	Ponderosa Pine/Bluebunch Wheat Grass Woodland
	Ponderosa Pine/Little Bluestem Woodland
Mesic Coniferous Forests and Woodlands	Ponderosa Pine/Common Juniper Woodland
	Ponderosa Pine/Rough-leaf Rice Grass Woodland
	Ponderosa Pine/Mountain Ninebark Forest
	Ponderosa Pine/Chokecherry Forest
	Ponderosa Pine/Bur Oak Woodland
	Ponderosa Pine/Snowberry Forest
Black Hills Sparse Vegetation	Ponderosa Pine Limestone Cliff
	Ponderosa Pine Scree Slope

Sources: Marriott et al. 1999, Marriott and Faber-Langendoen 2000a

Dry Coniferous Forests And Woodlands

Dry coniferous forests and woodlands are relatively open forests with less than 50-percent canopy cover. This ecological group dominates in the Black Hills (Marriott and Faber-Langendoen 2000a). Ponderosa pine/bearberry, ponderosa pine/sedge, and ponderosa pine/little bluestem comprise most of the dry coniferous forest cover at higher elevations. Ponderosa pine/sedge, ponderosa pine/little bluestem, and ponderosa pine/western wheat grass communities are the most extensive types at lower elevations. Three other ponderosa pine types—ponderosa pine/Rocky mountain juniper, ponderosa pine/bluebunch wheat grass, and ponderosa pine/Oregon grape—are locally significant at lower elevations of the Black Hills; much of it occurs on private lands not administered by the Forest (Marriott and Faber-Langendoen 2000a). Detailed environmental and vegetation descriptions of plant associations are provided in Marriott and Faber-Langendoen (2000a).

Mesic Coniferous Forests And Woodlands

Mesic coniferous forests dominate at higher elevations of the Black Hills. These forests typically have canopy cover greater than 60 percent. The most extensive high-elevation associations are ponderosa pine/bearberry, ponderosa pine/common juniper, and ponderosa pine/rough-leaf rice grass. Ponderosa pine/mountain ninebark and ponderosa pine/chokecherry associations occur in scattered locations in the southern and central Black Hills, and ponderosa pine/bur oak is relatively common at middle and lower elevations of the northern and eastern Black Hills (Marriott and Faber-Langendoen 2000a).

Black Hills Sparse Vegetation

Marriott and Faber-Langendoen classify sparse vegetation in the Black Hills based on vegetation and rock substrate. Two ponderosa pine types are categorized within this ecological group: ponderosa pine/limestone cliff and ponderosa pine/scree slope. Ponderosa pine/limestone cliff association occurs in scattered patches on the limestone plateau and the Minnekahta Hills, and the ponderosa pine/scree slope association exists in limited locations off National Forest System (NFS) land in the central-core area (Marriott and Faber-Langendoen 2002a).

Panjabi (2001) categorizes Black Hills ponderosa pine habitats as northern hills, southern hills, and late successional. Ponderosa pine-northern hills habitat is generally moist with a diverse understory of shrubs and small trees while ponderosa pine-southern hills habitat is dry, having a grass understory with few woody components. Late-successional pine forests are stands characterized by large-diameter trees and snags and coarse woody debris on the forest floor (Panjabi 2001). The northern hills habitat had high bird species richness, probably due to the deciduous understory present in these stands. Species commonly associated with aspen stands such as warbling vireo, dusky flycatcher, yellow-rumped warbler, and ovenbird occurred in relatively high densities in northern hills habitat (Panjabi 2001). Plumbeous vireo and western tanager were detected in southern hills habitat at higher densities than other Black Hills habitats. Western tanagers may prefer dense conifer stands with a dense conifer understory and sparse grass coverage (Yanishevsky and Petring-Rupp 1998), which is characteristic of southern hills habitat. Brown creeper (a Forest emphasis species) was detected at highest densities in late-successional pine habitat. Although this species was also detected in both northern hills and southern hills habitat, numbers were not sufficient to estimate density (Panjabi 2001), likely indicating a preference for late-successional pine habitat parameters.

Most other emphasis species that occur in Forest ponderosa pine are primarily associated with either conditions favoring a deciduous understory (e.g., broad-winged hawk, Lewis' woodpecker, frigid ambersnail, and Black Hills mountainsnail) or late-successional conditions (e.g., northern flying squirrel, American marten, three-toed woodpecker, black-backed woodpecker, pygmy nuthatch, and pahasapa mountainsnail) (Anderson 2003, Buskirk 2002, Frest and Johannes 2002). However, some species such as Cooper's and sharp-shinned hawks utilize dense coniferous stands that have relatively open understories (Stephens and Anderson 2002). Northern goshawk and white-tailed deer are examples of emphasis species that benefit from a variety of forest conditions (Kennedy 2003, Uresk and Severson 1998).

Snags

Snag availability and recruitment in the ponderosa pine ecosystem is a key element of ecological sustainability relative to historical conditions on the Forest. It is also an important element for species-specific management of many emphasis species that depend on snags in the ponderosa pine ecosystem for foraging and nesting/roosting cavities.

Study Of Snag Densities On Unmanaged Stands

A study of snag densities in unmanaged forests (primarily ponderosa pine) on the Forest was completed in September 2000 (Lentile et al. 2000). Study areas with large-diameter trees without evidence of management activities in the past 20 to 30 years were chosen as a baseline for determining the density and type of snags necessary to provide wildlife habitat in managed stands (Lentile et al. 2000). Snag density by diameter class (greater than 3 inches in diameter at breast height [dbh], greater than 10-inch dbh, and greater than 20-inch dbh) was determined for three regions of the Forest (south, central, and north). Lentile et al. (2000) found no significant differences among snag densities measured in the three regions surveyed. Natural, near-equilibrium snags on the Forest have mean snag densities (all regions) of 17.15 per acre for dbh greater than 3 inches, 3.63 snags per acre for dbh greater than 10 inches, and 0.33

snags per acre for dbh greater than 20 inches (Lentile et al. 2000). Lentile et al. (2000) also learned the following:

- Snags less than 8-inch dbh dominated the snag population.
- Forage and cavity use by wildlife increases with snag size although small- diameter snags are used to some degree.
- Some wildlife species may depend on large snags.
- Snag distribution (per acre) is relatively even.
- Snag recruitment is uniform through time.
- Median snag persistence is 15 years.

Study Of Snag Densities On Managed Stands

Spiering and Knight (2004) examined whether cavity-nesting bird occurrence was related to the density of snags and whether snag variables were related to wildlife use of snags as nest sites and for foraging in managed stands of ponderosa pine on the Black Hills National Forest.

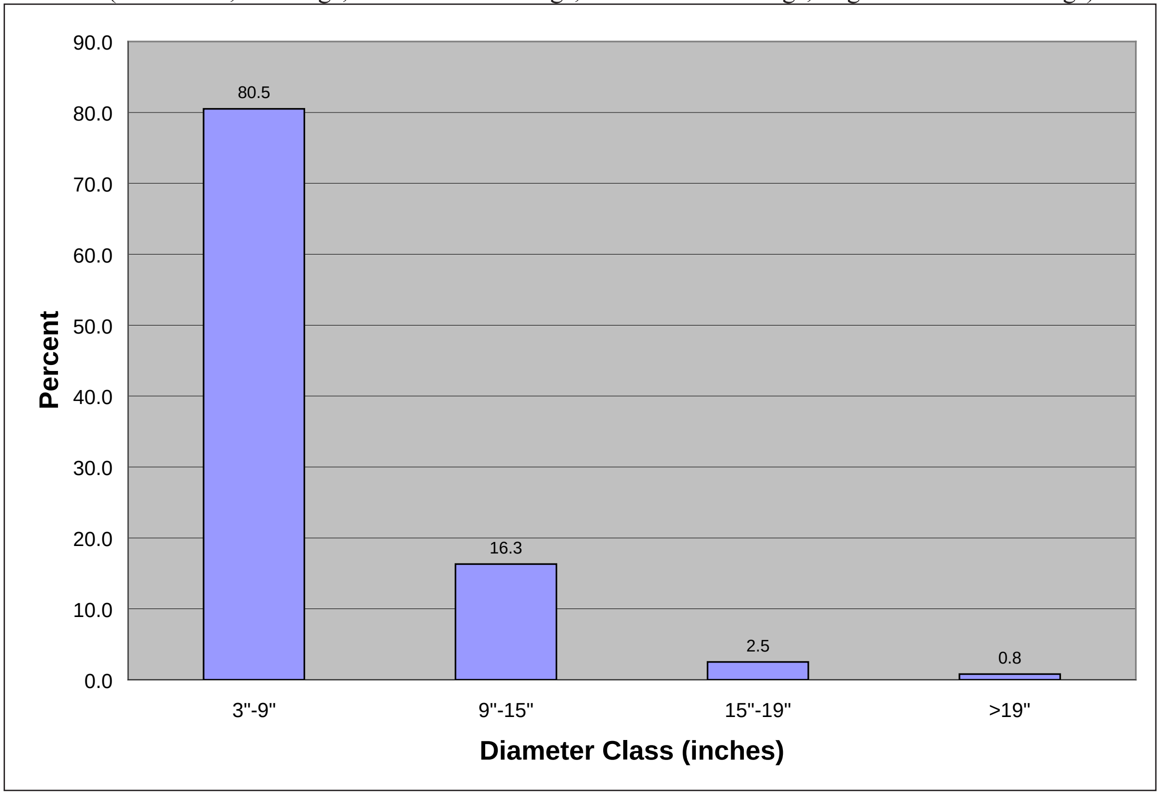
The study found that the presence of a cavity-nesting bird at a plot was independent of snag density. Larger dbh, greater height, and early stages of decay were positively associated with the presence of a cavity while the presence of a broken top was negatively associated. While the study found little relationship between the presence of a cavity-nesting bird and snag density across the range of snag densities, sizes, and conditions measured, the densities of high-quality snags, particularly large snags, were low and may have been too low to affect the presence of birds and the ability to detect such an effect.

Table 3-2 displays the findings for snag data by ranger district. **Figure 3-1** displays the percent of snags by diameter class.

Table 3-2. Plot And Snag Data For The Black Hills National Forest

Ranger District And Forest-wide	Plots	Snags	Density Range (Snags/Acre)	Median Snag Density (Snags/Acre)
Bearlodge	7	176	1-125	10
Hell Canyon	48	827	0-121	9.5
Mystic	44	1,011	0-81	19
Northern	45	923	0-93	16
Forest-wide	144	2,937	0-125	14

Figure 3-1. Percentage Of 2,937 Snags By Diameter Class Across The Black Hills National Forest; (3” to 9”=2,363 snags, 9” to 15”=478 snags, 15” to 19”=73 snags, larger than 19”=23 snags).



Spiering and Knight (2004)

Heights of snags sampled ranged from 6.6 feet to 91.2 feet with a mean height of 19.4 feet (standard deviation or SD=11.9) forest-wide. Snags in the Bearlodge Ranger District had a mean height of 22.3 feet (SD=13.9); snags in the Hell Canyon Ranger District had a mean height of 17.1 feet (SD=10.4); snags in the Mystic Ranger District had a mean height of 18.7 feet (SD=11.1); and snags in the Northern Hills Ranger District had a mean height of 21.7 feet (SD=11.9).

Snag Densities From Forest Inventory Analysis

In 1999 the Black Hills National Forest was part of the nationwide Forest Inventory Analysis (FIA). FIA collects vegetation data across all ownerships. FIA data were used in the growth and yield volume determinations. (Forest Analysis Process, Appendix B). The Presuppose software was used to query the FIA data specific to snag densities based upon various parameters. **Table 3-3** displays the snag densities by ranger district.

Table 3-3. Snag Density From Forest Inventory Analysis Data

Black Hills National Forest 1999 FIA – Mortality Trees per Acre Period: 1989-1999						
	Diameter/Class	All Species				
Ranger District	Aspect	0-5	5-9	9-15	15+	Total
Bearlodge	North	66.7	7.33	9.33	2.00	85.33
	East	105.00	19.80	6.60	3.00	134.40
	South	0.00	14.40	3.60	1.20	19.20
	West	67.50	13.80	3.60	2.40	87.30
	Average	68.38	13.94	6.00	2.29	90.62
Hell Canyon	North	27.78	11.11	4.44	1.11	44.44
	East	27.63	11.68	6.00	1.26	46.58
	South	29.17	9.67	1.33	1.67	41.83
	West	8.82	15.88	6.71	1.06	32.47
	Average	24.07	11.93	4.59	1.26	41.85
Mystic	North	42.19	14.62	6.00	0.75	63.56
	East	37.50	17.40	6.60	0.60	62.10
	South	100.00	12.50	3.50	1.00	117.00
	West	162.50	23.00	7.33	2.33	195.17
	Average	92.41	17.36	6.00	1.29	117.05
Northern Hills	North	32.81	25.50	15.37	3.38	77.06
	East	103.85	21.23	3.23	0.92	129.23
	South	80.77	10.15	5.08	2.31	98.31
	West	27.27	15.82	7.09	1.64	51.82
	Average	60.85	18.68	8.15	2.15	89.63
Grand Total	Average	56.58	15.19	6.00	1.63	79.41

DeBlander (2002) states an estimated 2.7 snags per acre greater than 11.0 inches in diameter are on the Black Hills NF. Large snags 19.0 inches in diameter or larger are estimated at 0.3 per acre.

An increase in insect-and-fire activity since 2000 (see Section 3-7. Natural Disturbance Processes and Insects) has placed more snags on the landscape than is represented in the above information. The FIA data was field collected in 1999. Snag study on unmanaged stands by Lentile et al. (2000) was completed in 2000. Snag study on unmanaged stands by Spiering and Knight (2004) was field completed in 2003.

From the 2004 Rocky Mountain Resource Information System (RMRIS) database, live and dead trees per acre by structural stage are displayed in **Table 3-4a**.

Table 3-4a. 2004 RMRIS Database Live And Dead Trees Per Acre By Structural Stage

Live Trees Per Acre					
Vegetation Structural Stage	Diameter Groups				
	0-8.9	9-14.9	15-19.9	20+	Average Total
1	792.4	39.7	3.5	0.4	836.1
2	2155.9	8.2	1.8	0.3	2166.4
3A	1236.3	23.8	1.5	0.3	1262.0
3B	1166.5	46.2	2.6	0.4	1216.0
3C	1434.5	56.6	3.5	0.5	1495.3
4A	1377.9	41.3	7.4	1.2	1428.6
4B	1518.3	70.4	10.7	1.7	1602.1
4C	1565.1	96.4	13.4	2.3	1678.4
5	1965.9	75.2	14.6	3.6	2060.9
Average	1397.0	55.9	7.9	1.3	1462.8
Dead Trees Per Acre					
Vegetation Structural Stage	Diameter Groups				
	0-8.9	9-14.9	15-19.9	20+	Average Total
1	51.5	3.3	0.7	0.1	55.7
2	120.8	4.2	0.6	0.1	125.7
3A	78.6	3.0	0.6	0.1	82.4
3B	82.1	2.9	0.6	0.1	85.7
3C	141.5	3.9	0.8	0.1	146.4
4A	61.6	3.8	0.8	0.1	66.4
4B	82.1	4.4	0.9	0.2	87.6
4C	107.5	5.9	1.2	0.2	114.8
5	9.0	2.8	1.3	0.7	13.8
Average	79.7	4.1	0.8	0.2	84.8

Continued on next page

Continued- Table 3-4. 2004 RMRIS Database Live And Dead Trees Per Acre By Structural Stage

Vegetation Structural Stage	All Trees Per Acre			
	Live	Dead	All trees	Percent Dead
4A	1428.6	66.4	1495.0	0.044
4B	1602.1	87.6	1689.7	0.052
4C	1678.4	114.8	1793.2	0.064
5	2060.9	13.8	2074.7	0.007
Vegetation Structural Stage	All Trees 9”+ Per Acre			
	9”+ Live	9”+ Dead	9”+ Total	Percent Dead
4A	49.9	4.7	54.6	0.086
4B	82.8	5.5	88.3	0.062
4C	112.1	7.3	119.4	0.061
5	93.4	4.8	98.2	0.049

The structural stage scheme:

Table 3-4b. Region 2, RMRIS Database - Habitat Structural Stage Codes

Code	**Structural Stage**	Tree Size Class	Diameter Range	Crown Cover %
1	Grass-forb	Nonstocked		0-10
2	Shrub/seedling	Established	Less than 1 inch	11-100
3A	Sapling-pole	Small, medium	Trees mostly 1-9	11-40
3B				41-70
3C				71-100
4A	Mature	Large, very large	Trees mostly 9 inches and larger	11-40
4B				41-70
4C				71-100
5	Old growth	Large, very large	Varies	

RMRIS Database, page 103 of 329

For structural stage 5, standard attributes are displayed in Mehl (1992). Also, for illustrations of the physical characteristics of old ponderosa pine trees reference RMRS-GTR-109 Huckaby et al. (2003) and RMRS-GTR-110 Huckaby et al. (2003). General physical characteristics of front range old ponderosa pine can be considered similar to Black Hills old ponderosa pine.

Table 3-5. Summary: Snags Per Acre

Source	DBH 9-15	DBH 15+	Total DBH 9+
Forest Inventory Analysis (FIA)	6.0	1.63	7.63
Rocky Mountain Resource Information System	4.1	1.0	5.1
Objective 211	2.25	0.75	3.0

From Forest Vegetation Simulator (FVS) growth and yield files, snags per acre by structural stage (SS) produced the following estimates: SS 4A, 5 snags per acre; SS 4B, 9 snags per acre; and SS 4C/5, 16 snags per acre from natural growth runs, which are untreated stands. The shelterwood treatment regime within the first period after overstory removal has an average of 1 snag per acre for SS 4A, SS 4B, and SS 4C/5. (See Appendix B – reference to Construction of Vegetative Yield Profiles by Washington Office February 2004.)

Snag Effects

Snag densities for Alternatives 3, 4, and 6 are analyzed on a management-area basis. Forest RIS and FIA data show an average snag height of 48 and 57 feet, respectively. Hence, the average snag height of 25-foot in Objective 211 will be achievable.

The three-snags-per-acre objective (211) will be achieved. Due to the recent disturbances of wildfire and insects, the number of snags on the forest as a whole has significantly increased. In some of the disturbed areas, only snags exist. The forest vegetation database (Table 3-4) shows more than 3 dead trees per acre that are greater than 9 inches in diameter in each structural stage. Therefore, snag recruitment (future snags) will be provided by the diversity of structural stages in the structural stage objectives (Objectives 4.1-203, 5.1-204, 5.4-206, 5.43-204, and 5.6-204). The number of snags-per-acre across the landscape is presently being met and is likely to be met in the future with all alternatives.

Structural Stages

The amount of ponderosa pine by structural stage is presented in Table III-15 in the 1996 Final EIS (USDA Forest Service 1996a p. III-134). A complete description of structural stages appears in the 1996 Final EIS (pages III-133 to III-134) and in Appendix B of the 1996 Final EIS. **Table 3-6** compares the 1996 values with the 2004-acreage values for the structural stages. Structural stages are for forested stands of ponderosa pine and spruce.

Table 3-6. Acreage Values For Ponderosa Pine Structural Stages

Structural Stage	Acres 1996	Acres 2004	Net Change Since 1996
1	23,502	119,566	+ 96,064
2	10,689	20,433	+ 9,744
3A	97,511	54,890	- 42,621
3B	134,949	70,978	- 63,971
3C	46,767	42,140	- 4,627
4A	332,392	289,824	-42,568
4B	258,784	302,676	+ 43,892
4C	114,798	133,754	+ 18,956
5	22,409	2646	- 19,763

Source: USDA Forest Service

The greatest amount of pine in 1996 was in structural stages 4A and 4B. In 2004, it remains in structural stages 4A and 4B. The most significant change in structural stage acreage from 1996 to 2004 is in structural stage 1, which increased (primarily from wildfire) by 96,064 acres. The data for 2004 are significantly more complete than in 1996. All forested polygons have cover type and structural stage. Since 1996 the Forest data have been updated and field verified to produce more database accuracy. Structural stage 5 is often called old growth and is sometimes referred to as late successional. On the Black Hills, there are two types of structural stage 5: the savannah and multi-storied (Mehl 1992).

Table 3-7. Historical Tree Size – Estimated Percent Across The Forest

Year	Sawtimber	Pole Timber	Sap/Seed	Nonstocked and Meadow
1875	20.0%	40.0%	0.0%	40.0%
1953	48.9%	19.7%	17.9%	13.5%
1963	62.1%	33.2%	3.3%	1.5%
1973	63.8%	22.0%	13.9%	0.3%
1976	66.2%	22.2%	11.4%	0.2%

The 1875 data are from the Dodge Expedition (Dodge 1875). The 1953, 1963, 1973, and 1976 data are from the 1976 Timber Management Plan (USDA Forest Service, 1976).

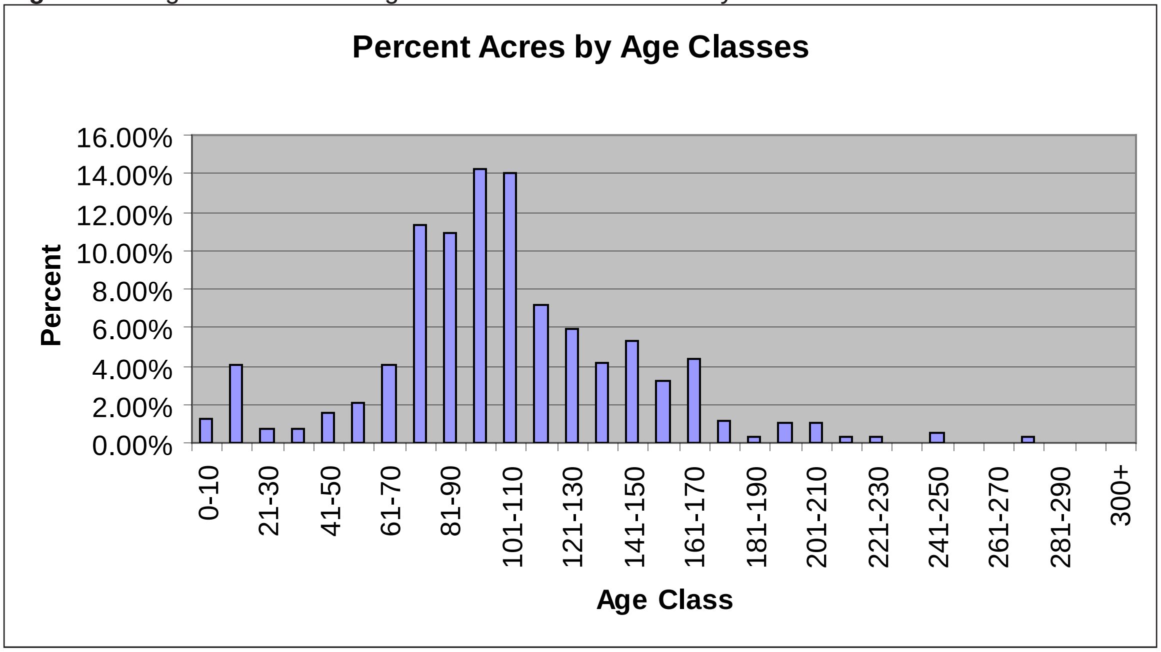
The Forest inventory has changed through time. **Table 3-8a** displays the estimated Forest inventory.

Table 3-8a. Timber Inventory And Harvest

Source	Year	Inventory Billion Bd.Ft.	Harvest Billion Bd.Ft.	Remarks
Black Hills NF 50th Anniversary	1897	1.5		Saw lumber
Black Hills NF 50th Anniversary	1947		1	
Black Hillls NF 50th Anniversary	1948	2.3		Trees 10" and larger
1977 Timber Plan	1963	2.9		Growing Stock Volume
1977 Timber Plan	1969		2	
1977 Timber Plan	1977	4.5		Growing Stock Volume
Black Hills NF Records	1979		3	
1996 Black Hills NF Final EIS, Appendix G	1987	5.1	4	Trees greater than 8"dbh
Black Hills NF Records	1997		5	
1999 FIA Report	1999	6.1		Trees greater than 9" dbh

The Black Hills Forest was growing and harvesting trees as **Table 3-8** displays. Tree seedlings established during the Custer Expedition of 1874 and thinned during the Civilian Conservation Corps (CCC) days were some of the trees being harvested later in the 20th century. The trees of the forest are a range of age classes. **Figure 3-2** displays the age class percentages from the 1986 inventory, and **Figure 3-3** displays age class percentages from the 1999 FIA inventory

Figure 3-2. Age-Class Percentages From The 1986 Inventory



From Inventory of the Black Hills National Forest, Book 1, Forest Service (1988).

Figure 3-3. Age Class Percents From the 1999 FIA Inventory

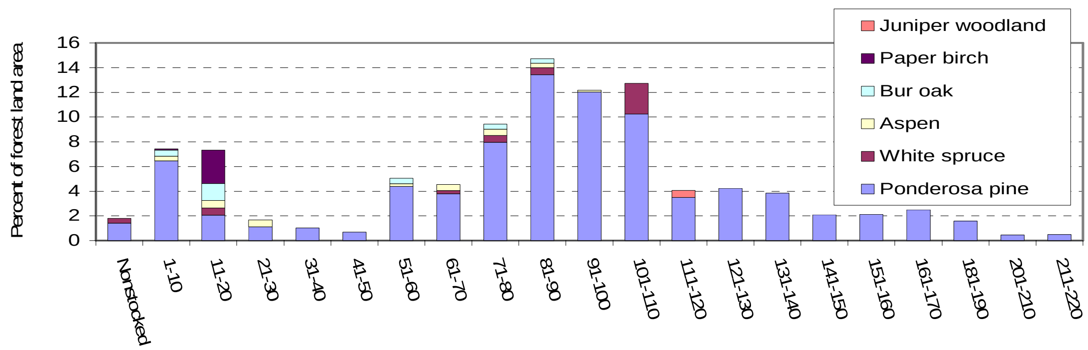


Figure 10--Percent of forest land area by forest type and stand-age class, Black Hills National Forest, 1999.

Figure 3-4. Number Of Live Trees By Diameter Class From the 1999 FIA Inventory

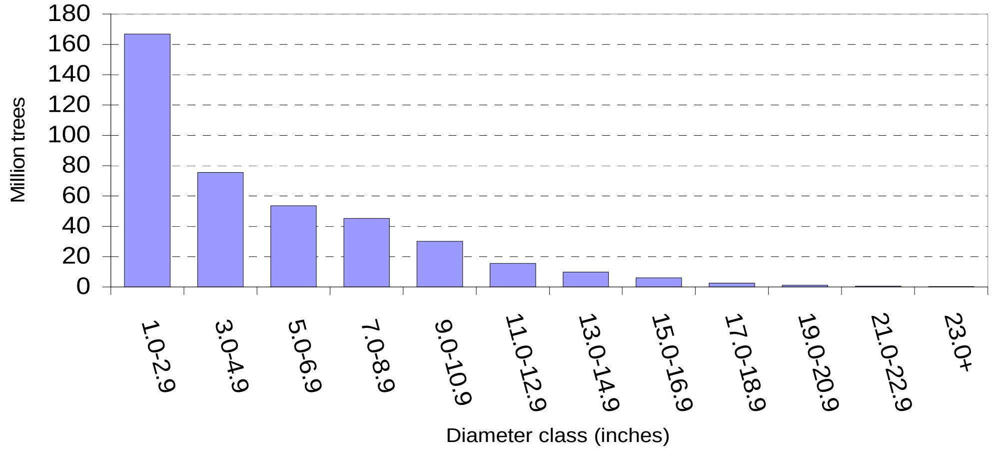


Figure 3--Number of live trees on forest land by diameter class, Black Hills National Forest, 1999.

The 1999 FIA data are forest information prior to the large wildfires of 2000 to 2003 and the increasing tree mortality from insects.

Diseases, insects, fire, storms, and other disturbance agents interact to alter the structure and function of forest ecosystems. Logging, cattle grazing, recreation, fire suppression, and other management practices can contribute, even exacerbate, the activities and interactions of disturbance agents. Fire suppression in the Black Hills has markedly increased stand density throughout forest stands (Progulske 1974, Grafe and Horsted 2002) with a corresponding increase in susceptibility to mountain pine beetle infestation (Sartwell and Stevens 1975, Schmid and Mata 1992, Lundquist 1995).

During the more than a century of timber harvesting in the Black Hills, the silvicultural systems applied on Federal lands have covered the spectrum from clearcutting (1876 to 1896), to seed-tree cutting (1897 to 1907), to shelterwood cutting (1908 to 1925), to individual tree selection (1926 to 1955), and then returned to shelterwood cutting (since 1956). Virtually every operable acre has been cutover at least once; the majority have received repeated partial cuts of one kind or another (Boldt et al. 1983, Black Hills NF 1997 Forest Plan).

Average annual timber sale levels were estimated for each of the Phase II Amendment alternatives (see **Table 3-8b**). Estimates were based on assumed full funding of Forest Plan timber objectives (see 1997 Forest Plan), the goals and objectives of each of the Phase II alternatives, and the limitations imposed by the standards and guidelines of each of the Phase II alternatives. Key standards and guidelines in several alternatives are expected to reduce timber sale levels (see Appendix B for further discussion).

Table 3-8b. Timber Sale Volume Estimate

Sale Volume	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 6
Sawtimber MMCF*	18.1	10.9	18.1	14.3	18.1
Products Other Than Logs (POL) MMCF	2.1	1.3	2.1	1.7	2.1

* MMCF – Million Cubic Feet

3-2.1.1.2. Resource Conservation Measures

Goals, objectives, standards, and guidelines have been developed for the Forest as a whole and for specific mangement areas (MAs) and are used to manage ponderosa pine ecosystems on the Forest. The following captures the differences in ponderosa pine ecosystem management in the LRMP that are being considered under the Phase II Amendment alternatives.

Under Alternatives 3 and 6, several Forest-wide objectives have been deleted in regard to ponderosa pine ecosystems (206, 207, 207.a, 207.b, 208, and 209). New ponderosa pine structural-stage objectives in MAs 4.1, 5.1, 5.4, 5.43, and 5.6 have replaced these Forest-wide objectives. The structural-stage objectives are designed as a broad scale approach to provide a diversity of habitat components in ponderosa pine. These habitat components include the following ranges: early-to-late succession; open-to-closed canopy; and small-to-large diameter trees. MA Objective 5.4A-207 is deleted in Alternatives 3, 4, and 6 since it is covered in the Forest-wide snag Objective 211. Under Alternatives 3 and 6, the number of snags maintained in ponderosa pine forested portions of a watershed has changed to the number of snags provided in conifer-forested portions of the Forest within management area(s) (Objective 211). Snags must be of a certain dbh and height and well-dispersed throughout the forest. Under Alternative 1, Standard 2301 and Objective 211 state 1.08 hard snags per acre in conifer forest habitat, at least 10-inch dbh, and 15-feet tall. Alternatives 2 and 4 Standard 2301 and Objective 211 provide 2 to 4 snags per acre (depending on aspect) in ponderosa pine stands, averaged across a watershed, with 20 percent of the snags 20-inch dbh or the largest diameter available. Standard 2301A and 2301B and Objective 211, under Alternatives 3 and 6, state to retain all large (greater than 20-inch dbh unless a safety hazard) snags, 3 conifer snags per acre, and at least 6 hardwood snags per acre in hardwood stands.

Forest-wide Objective 207 under Alternative 4 conserves late-successional stands. Guideline 2305 that calls for retaining soft (rotten) snags has been changed to a standard under Alternatives 2, 3, 4, and 6. Standards 2308A and 2308B have been combined into one standard (2308A) under Alternatives 3 and 6 to retain some coarse, woody debris for ponderosa pine forested sites during vegetation management activities.

3-2.1.1.3. Direct And Indirect Effects

The distribution, age, and physical characteristics of the ponderosa pine forests in the Black Hills are affected by natural factors such as fire, insects, wind, precipitation, soils, slope, aspect, and elevation. Management activities also affect ponderosa pine. The most significant of these activities are timber harvests; fire suppression and fire-hazard management; insect-risk management, and treatments designed to favor other cover types such as hardwoods, grasslands, spruce, riparian areas, or shrublands. Some management activities may be designed to favor or manage certain physical characteristics within the stand such as snags or late-successional conditions. Location of management activities affecting ponderosa pine differ among alternatives, and the resulting effects are discussed in this section.

Implementation of actions under each alternative affects ponderosa pine by changing the ponderosa pine acreage on the Forest, ponderosa pine age and density (structural stage), and ponderosa pine stand locations. **Table 3-6** shows current (2004 RIS) ponderosa pine structural stages.

Effects on ponderosa pine resulting from management activities related to decision areas are discussed under the relevant subheadings later in this section.

The structural stage variable is a management indicator of the forest structure. For the Phase II Forest Plan Amendment, the amount of structural stages is displayed with the following assumptions:

1) Structural stage and late successional objectives are met for each alternative.
2) In Alternatives 1, 2, and 4, Objective 207 will be attained in ponderosa pine, of which 5 percent of the ponderosa pine will be in late successional structural stage 5.
3) In Alternatives 3 and 6, management areas without structural stage objectives will remain similar to existing conditions.
4) The tree size of ‘very large’ within structural stage 4 is a subset of structural stages 4A, 4B, and 4C in management areas 4.1, 5.1, 5.4, 5.43, and 5.6. The tree size of ‘very large’ is defined in the Forest vegetation database as a stand where the majority of tree stocking based on basal area is in live trees 9.0 inches in diameter and larger, and within that group, the majority of the basal area is in live trees 16.0 inches in diameter and larger. The tree size (16-inch diameter) was used because it is an attribute that can be queried from the vegetation database and may not represent a significant ecological classification.
5) The time needed to reach the above objectives are dependent on funding and forest growth rates. This is not included in **Table 3-9**. As a result, it may take two or more decades to achieve the structural stage objectives.

Table 3-9. Acres Of Ponderosa Pine Structural Stage By Alternative

	Ponderosa Pine Acres					
Structural Stage	Existing	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 6
1	119,546	N/A	N/A	58,580	N/A	58,580
2	20,440	N/A	N/A	45,590	N/A	45,590
3A	54,879	N/A	N/A	99,649	N/A	99,649
3B	70,963	N/A	N/A	103,112	N/A	147,472
3C	42,058	N/A	N/A	49,427	N/A	49,427
4A	289,649	N/A	N/A	241,004	N/A	248,431
4B	302,164	N/A	N/A	274,980	N/A	267,553
4C	133,255	N/A	N/A	117,939	133,255	73,579
5	2,635	51,779	51,779	45,308	51,779	45,308
Total Acres	1,035,589			1,035,589		1,035,589
4 (tree size=very large)	72,275	N/A	N/A	N/A	N/A	55,366
Total Acres w/ Large Trees	75,378	51,779	51,779	51,878	51,779	100,674

Source: Black Hills National Forest RIS (Resource Information System) database

Items to note for **Table 3-9:**

1. N/A indicates there is no objective for that respective alternative for displayed structural stage.
2. All acreage figures are for ponderosa pine only.
3. The total of large trees is the sum of structural stage 4 (tree size is very large) and structural stage 5.

The most late-successional structural stage acres are from the 4C and 5 structural stages in Alternative 4. Alternative 4 retains the existing structural stage 4C and assumes attainment of 5 percent of the total ponderosa pine acres in structural stage 5. The difference of late successional structural stages 4C and 5 acres is attributable to the desired structural stage 4C at 10 percent in Alternative 3 as compared to the 5 percent in Alternative 6.

Reference Appendix B for further documentation on analysis.

Effects Of Species-viability Management On Ponderosa Pine

Most emphasis species that occur on the Forest are primarily associated with conditions favoring a deciduous understory (early-successional conditions or open stands) or late-successional stands. Management for the viability of emphasis species will affect ponderosa pine by treatments designed to convert pine to a different cover type or to achieve a certain physical characteristic within pine stands. Physical characteristics of focus may include structural stage, snags, or understory components or condition.

While ponderosa pine distribution would not change significantly among alternatives, there would be some differences. New Objective 10-01 emphasizes to manage for a low-to-moderate level of fire hazard in Alternatives 3, 4, and 6 in the wildland-urban interface (WUI). In Alternatives 3 and 4, the WUI includes all At-risk Communities (ARCs). Alternative 4 does not address fire hazard in the interior of the Forest. Alternative 3 adresses interior Forest fire hazard as needed to conserve species viability and adjacent to RNAs. In Alternative 6, the WUI includes all ARCs and NFS lands adjacent to non-NFS lands. Alternative 6 is the most aggressive management emphasizing 50 to 75 percent low-to-moderate fire hazard in the WUI and a 50 percent low-to-moderate fire hazard across the Forest with several exceptions. This objective will influence the structural stage distribution across the forest landscapes.

The 1997 Black Hills National Forest LRMP Record of Decision Addendum March 1997 displayed the acceptable silvicultural systems and harvest methods. These harvest methods are the silvicultural tools to implement management activities. The following is from the 1997 Forest Plan:

Standard 2408. The scientifically defined silviculture systems, shown by forest cover type, which meet the management objectives for the landscape or individual stands of trees within a landscape setting, are acceptable.

Table 3-10. Acceptable Silvicultural Systems

Forest Cover Type	Even-aged Systems	Two-aged Systems	Uneven-aged Systems
Ponderosa Pine	Shelterwood, Clear-cut and Seed Tree	Irregular Shelterwood	Group Selection and Single-Tree Selection
Aspen/Birch (see below)	Coppice	Coppice with Standards	Group Selection
White Spruce	Shelterwood and Clear-cut	Irregular Shelterwood	Group Selection and Single-Tree Selection
Lodgepole Pine Douglas-fir	Shelterwood, Clear-Cut and Seed Tree	Irregular Shelterwood	Group Selection

a. Both even-aged and uneven-aged management systems can be used and applied at scales ranging from a few acres to many hundreds of acres.

b. These silvicultural systems are to be applied in a manner that will promote natural regeneration.

c. Tree stand vegetation management treatments are to be approved by certified silviculturists.

d. The silvicultural systems identified can be used to convert uneven-aged stands to even-aged management and even-aged stands to uneven-aged management.

e. The preferred silvicultural system used for treating ponderosa pine on suitable lands will be shelterwood. Other systems may be used to meet specific resource objectives.

f. For Two-step shelterwood system: Residual stocking levels for seed cuts range from 20-50 basal area.

(From March 1997 Record of Decision - 1997 Black Hills National Forest LRMP)

The implementation of silvicultural prescriptions at various scales from a single tree to landscapes will influence the achievement of ecosystem goals. Growth and yield projections through FVS display different outputs based upon forest structure and prescription. This analysis remains valid from the Appendix B of the 1997 Forest Plan (chapter 1, Washington Office Appeal Decision on the 1997 Forest Plan).

Even-aged silviculture is eminently suited to Black Hills ponderosa pine (Boldt et al. 1983). The shelterwood method capitalizes on the species' natural tendency to form even-aged stands. Furthermore, it combines the advantages of continuous vegetative protection of the site; absence of obvious openings; assurance of an adequate, well-dispersed seed supply; fair control over development of competitive ground cover; good control over accumulations of hazardous and unsightly logging residue; and an esthetically acceptable appearance, provided the harvest job is skillfully planned and executed. An important disadvantage is that the parent overwood will hamper development of the replacement stand if it is too dense or left in place too long. Another disadvantage is that even a light shelterwood is likely to supply more seed than is needed, thus aggravating the problem of excess reproduction. The grass-forb seral stage which is desirable for wildlife and livestock forage does not develop fully nor persist for long under a shelterwood (Boldt et al. 1983).

For regeneration, the uneven-aged system is out of place in the naturally even-aged pine forest of the Black Hills. Light selection cuts which remove only a few individual trees or small groups, ordinarily do not lead to satisfactory establishment and development of replacement growing stock. Stands of uneven- or all-aged structure can only be produced and maintained at spacings wide enough to make all stand components essentially free growing. For purposes other than regeneration, individual tree selection can be a very useful harvest practice. It is particularly applicable in the management of remnant old-growth stands being perpetuated for esthetic reasons; for manipulation of stands on or adjacent to riparian zones or other sensitive sites; and for management of unusually large trees for high-quality wood, specialized habitats, or visual appeal. However, the selection method is difficult to prescribe and costly to apply (Boldt et al. 1983).

Silvicultural considerations on applying uneven-aged management versus even-aged management are found in many forest management textbooks, Forest Service manuals and handbooks.

Uneven-aged management creates a diverse canopy structure that may be uniformly stocked, or contain numerous gaps and clumps of trees. While even-aged silviculture is designed to raise a crop of trees to maturity and then harvest and replace them with a new forest, uneven-aged silviculture is designed to create a desired condition in the forest landscape and then maintain that condition through time by periodic entries to remove trees of various sizes and in various patterns. The goal is to eventually attain a forest comprised of trees of all ages and sizes. While this diverse structure is probably not achievable initially in any major area in the Black Hills, existing conditions are such that many areas can be moved toward an uneven-aged structure with one or two entries, or cutting cycles. (Shepperd and Battaglia 2002).

Not all resource needs can be met on a given site, nor is any one cutting method compatible with all uses. Land managers must recognize the potential multiple-use values of each area, determine the primary and secondary uses, and then select the management alternative that is most likely to enhance or protect these values within the limits imposed by stand conditions, damaging agents, and financial resources. On an individual site, some uses probably must be sacrificed or diminished to maintain the quantity and quality of others (Alexander 1987).

Species viability effect on ponderosa pine structural stages relates to management for all structural stage conditions. Some species desire a dense tree canopy while other species like a more open tree canopy. A landscape mosaic mix of tree sizes and tree canopy may best address all species habitat. All alternatives will have from 7 to 13 percent of its ponderosa pine in structural stage 4C. These stands will have less cubic-foot tree growth compared to structural stage 4B. Structural stage 4C stands are more susceptible to insects and fire. A lower stocking level of structural stage 4B has higher tree vigor and cubic-foot tree growth and lower probability of insect attack and lower probability of fire than structural stage 4C and 5. Structural stage 4A has a slightly reduced cubic-foot tree growth but lower probability of insect attack and fire.

Management recommendations designed to improve goshawk habitat is referenced in Reynolds et.al. (1992). Also reference the goshawk species assessment of the Biological Evaluation and Biological Assessment (Appendix C). These recommendations recognize that maintaining the desired mix of structural stages across landscapes will require “some form of stand replacement and density control,” but do not specify specific silvicultural methodology to achieve it. Establishing and maintaining the desired mix of structural stages across a landscape as each grows into a more mature class while at the same time regenerating areas to structural stage 1 is no small task. It is further complicated by the necessity to maintain high canopy cover percentages (less than 60 percent) within clumps in portions of the mature structural stage classes (Shepperd and Asherin and Edminster PNW-GTR-546).

Effects Of Research Natural Area Management On Ponderosa Pine

New RNAs could be established with the implementation of Alternatives 3, 4, and 6 and would at most cover less than 1 percent of the ponderosa pine on the Forest. There are ponderosa pine community types in all candidate RNAs with the exception of Lemming Draw. RNA establishment would preclude harvest within the RNA boundary. Ponderosa pine communities within the RNA would be allowed to go through natural succession, and in the absence of natural disturbance events such as fire or insect infestations would eventually approach latesuccessional conditions.

Refer to the Section 3.6.2 - Research Natural Areas for candidate RNA locations and additional information on the size and composition of each.

Effects Of Fire-hazard And Insect-risk Management On Ponderosa Pine

All alternatives would achieve some measure of fire-hazard reduction by altering ponderosa pine structural stages. In Alternative 6, hazard reduction through fuel-management/fuel-reduction/treatment is focused towards ARC and the WUI and also on the rest of the Forest. Results would be treatment of pine stands to a lower fire hazard and a lower insect hazard. Prescribed fire would also be used to reduce fire hazard.

Refer to Chapter 2 for fire-hazard percentage by alternative. Thinning has a significant effect on lowering fire hazard in Alternative 6.

The effects from estimated treatment acres displays that Alternative 6 has the lowest amount of very high and high fire-hazard acres, which reflects the higher number of thinning acres treated than in the other alternatives. All alternatives have reduced the high fire hazard. Prescribed burning, mechanical thinning and slash piling are important activities for reducing fuel conditions. Prescribed fire is expected to create some tree injury or mortality, thus influencing stand growth. Reducing fire hazard is expected to reduce wood fiber growth in the short term but may not significantly affect loss of wood fiber in the long term. The lower fire-hazard acres are reflective of the various levels of prescribed fire in each alternative.

3-2.1.1.4. Alternatives In Brief

All alternatives have the same level of commercial harvest acres. This level is the same as the 1997 Forest Plan, 24,000 acres annually. Estimated non-commercial treatments do vary by alternative. Estimated treatment acres are found in **Table B-1** in Appendix B. As ponderosa pine is the predomiant vegetation type on the Forest (1 million acres of pine on a 1.2 million-acre forest, see Appendix B) all non-commercial treatments will affect ponderosa pine.

Alternative 1 is the 1997 Forest Plan's selected Alternative G. It contains an estimated 15,400 of small diameter ponderosa pine treatments and 1,600 acres of restoration treatments annually. Alternative 2 is based upon the Phase I Forest Plan Amendment. It contains an estimated 15,400 acres of small diameter ponderosa pine treatments and 1,600 acres of restoration treatments annually.

Alternative 3 uses a range of structural stages to achieve desired forest conditions for all species, has WUI fire-hazard reduction objectives similar to Alternative 4, but also addresses fire-hazard reduction for species viability and for RNA management on the interior of the Forest. It contains an estimated 20,000 acres of small diameter ponderosa pine treatments and 6,540 acres of restoration treatments annually and has the second highest estimated treatment acres of the alternatives.

Alternative 4 would call for the least amount of fire-hazard reduction and retains all structural stage 4C stands. It contains an estimated 12,500 of small diameter ponderosa pine treatments and 2,100 acres of restoration treatments annually. The highest number of RNA candidates and the fewest estimated annual treatment acres are included in this alternative.

Alternative 6 has structural stage and fire-hazard objectives targeted to reduce fire hazard and insect risk across the Forest while maintaining species viability. It contains an estimated 46,000 acres of small diameter ponderosa pine treatments and 6,490 acres of restoration treatments annually. This alternative has the highest estimated non-commercial treatment acres.

The ponderosa pine ecosystem will continue to be the dominant feature of the Black Hills. Various levels of disturbances will affect the pine forest structure. Pine stands will experience natural disturbances and management treatments thereby influencing the forest structure. Forest management will capture some commodity production. Through time, fire and insects will continue to be a cyclical part of the Black Hills ponderosa pine ecosystem.

3-2.1.1.5. Cumulative Effects

Due to the programmatic nature of LRMP decisions and the lack of any site-specific proposed actions associated with the Phase II Amendment, no critical environmental threshold values will be exceeded and no quantifiable adverse cumulative effects on ponderosa pine were identified as a result of the alternatives analyzed in this section. Identified conservation measures are intended to reduce the risks to long-term persistence for individual species and ecosystems within the Forest. Implementation of these conservation measures combined with best management practices (BMPs), ongoing inventory of resources, monitoring, structural stage and fire-hazard objectives and adaptive management when necessary are intended to minimize the potential cumulative effects and promote sustainability of the natural, social, and economic Forest environment.

The Black Hills ponderosa pine forest has prolific natural regeneration. As evidence documented in this chapter the Forest is growing. Natural disturbances on the Black Hills ecosystem will always be present. The ponderosa pine forest will remain a pine forest for all the alternatives. Not including changes in the forest stand structure from natural disturbances, Alternative 6 would have the most change from management treatments followed by 1, 3, 2, and then 4.

3-2.1.2. White Spruce Ecosystems

3-2.1.2.1. Affected Environment

Background information regarding white spruce (*Picea glauca var. densata*) on the Forest is presented in the Forested Ecosystems section of the 1996 Final EIS on pages III-138 to III-139.

The Black Hills has one of the southern-most populations of white spruce in the United States; it is disjuncted from its primary range in the northern forests by several hundred miles (Burns and Honkala 1990, USDA Forest Service 1996a). It is found on the limestone plateau and in the central core but is absent from the Bear Lodge Mountains (Marriott et al. 1999). White spruce occurs at high elevations, on north aspects, and in cool canyon bottoms of the Forest.

Accounts from the late 19th century give estimates of white spruce on approximately 15,000 acres in the Black Hills, typically in densely stocked stands of 12- to 18-inch dbh trees (USDA Forest Service 1996a). This species' thin bark and persistent lower limbs make it especially susceptible to fire mortality, which was a limiting factor to its historic extent within the Black Hills. According to Parrish et al. (1996 p. 11), fire suppression during the last century has allowed spruce to increase in abundance and density in the Black Hills. The white spruce cover type now occurs on 25,000 acres on the Forest.

White spruce is the most shade tolerant of the Black Hills tree species, enabling regeneration and growth under closed forest canopies. It is the climax species on cool mesic sites such as north-facing slopes, at high elevations, and in cool canyon bottoms (USDA Forest Service 1996a). White spruce is found in locally dense stands on the limestone plateau, Black Fox Canyon, and Spearfish Canyon. Extensive stands occur as far south as the Harney Range and Custer State Park (USDA Forest Service 1996a). Seral associates in white spruce communities include ponderosa pine, aspen, and paper birch (Shepperd and Battaglia 2002).

White spruce is not as economically on important timber species on the Forest as is pine. Spruce forests naturally have a longer fire-return interval than pine. Due to its fire intolerance, a high proportion of fires in spruce forests are stand-replacing (USDA Forest Service 1996a). However, fire-suppression efforts over the last century have promoted climax spruce forests (Parrish et al. 1996, USDA Forest Service 1996a). These factors account for the presence of more white spruce on the landscape than occurred in recent history and likely varied over time. (USDA Forest Service 1996a).

There are two white spruce upland community types recognized in the Black Hills: white spruce/twinflower (*Picea glauca/Linnaea borealis*) and white spruce/grouseberry (*Picea glauca/Vaccinium scoparium*) (Marriott and Faber-Langendoen 2000a, Shepperd and Battaglia 2002). Marriott et al. (1999) and Marriott and Faber-Langendoen (2000b) also recognized a riparian-type, white spruce alluvial Black Hills forest as a third community.

The white spruce/twinflower community type is generally found at elevations of 5,800 to 6,400 feet within high, wet habitats on northwest to northeast aspects. Important understory shrubs in this community type include common juniper (*Juniperus communis*); prickly rose (*Rosa acicularis*); russet buffaloberry (*Shepherdia canadensis*); and white coralberry (*Symphoricarpos albus*). Grasses and forbs include Kentucky bluegrass (*Poa pratensis*); rough-leaved rice grass (*Oryzopsis asperifolia*); wild strawberry (*Fragaria virginiana*); sweet-scented bedstraw (*Galium triflorum*); American sweetvetch (*Hedysarum alpinum*); and longspur violet (*Viola adunca*). Mosses and lichens are common (Shepperd and Battaglia 2002, Marriott and Faber-Langendoen 2000a). Grouseberry is absent from this community type (Shepperd and Battaglia 2002).

The white spruce/grouseberry community typically occurs at elevations ranging from 5,700 to 6,700 feet in cooler, moist habitats on loamy, calcareous soils (Shepperd and Battaglia 2002). Besides grouseberry, other understory shrubs in this community type include bearberry; Oregon grape (*Mahonia repens*); common juniper; prickly rose; wild spiraea (*Spiraea betulifolia*); and white coralberry. Common grasses and forbs include rough-leaved ricegrass, Kentucky bluegrass, yarrow (*Achillea millefolium*), and pussytoes (*Antennaria* spp.) (Marriott and Faber-Langendoen 2000a, Shepperd and Battaglia 2002).

Marriott et al. (1999) gathered information on eight occurrences of the white spruce alluvial Black Hills forest community type. This type occurs in very mesic drainages at high elevations on the limestone plateau and the central core and at lower elevations in wetter portions of the northern Black Hills (Marriott et al. 1999, Marriott and Faber-Langendoen 2000b). The understory is highly variable. Small spruce, aspen, ponderosa pine, boxelder (*Acer negundo*), and paper birch (*Betula papyrifera*) often form a sub-canopy (Marriott and Faber-Langendoen 2000b). Some sites have an understory of riparian shrubland and wet meadow types with species such as beaked (Bebb's) willow (*Salix bebbiana*), water birch (*Betula occidentalis*), Canadian reed grass (*Calamagrostis canadensis*) and Nebraska sedge (*Carex nebrascensis*) (Marriott and Faber-Langendoen 2000b). Other common understory species include Wood's rose (*Rosa woodsii*), baneberry (*Actaea rubra*), red-osier dogwood (*Cornus sericea*), wild sarsaparilla (*Aralia nudicaulis*), fringed loosestrife (*Lysimachia ciliata*), several species of violets (*Viola* spp.), and horsetails (*Equisetum* spp.) (Marriott and Faber-Langendoen 2000b).

The cool, moist environments of white spruce stands provide habitat diversity in a ponderosa pine dominated landscape. Panjabi (2001) found that Swainson's thrush, golden-crowned kinglet, and ruby-crowned kinglet were almost exclusively associated with white spruce forest in the Black Hills. Many more bird species were detected at higher densities in spruce stands than in all other habitats surveyed. These species include northern flicker, gray jay, red-breasted nuthatch, American robin, and red crossbill. Elk use spruce for summer-fall range as thermal and hiding cover (Shepperd and Battaglia 2002).

Late-successional white spruce with its associated structural complexity (i.e., increased understory vegetation, downed woody debris, and snags), provides habitat for several Forest species. See emphasis species effects analysis in Chapter 3 and Appendix C as well as species assessments on the Black Hills National Forest website.

3-2.1.2.2. Resource Conservation Measures

In Alternatives 1, 2, and 4, existing Forest-wide Objective 204 calls for managing and conserving white spruce as well as lodgepole pine, limber pine, and Douglas fir. In Alternatives 3 and 6, conservation for white spruce is moved to Objective 200-01.

Objective 200-01 was established for Alternatives 3 and 6 to provide management of spruce across the forest except within 300 feet of buildings in Alternative 3 and within 200 feet of buildings in Alternative 6. The objective favors hardwood restoration where spruce has encroached upon hardwoods, and favors spruce where it is encroaching into pine stands, especially where it improves connectivity between spruce stands. Alternative 3 calls for maintaining or restoring mature and late-successional (structural stage 4 and 5) spruce and Alternative 6 calls for maintaining 20,000 acres of spruce across the Forest.

Guideline 4204 emphasizes that consideration should be given to the potential spread of insect pests at spruce sites when designing and developing new recreation, parking, or other high-use areas. This guideline is the same for all alternatives and would benefit spruce conservation.

Within MA 5.4a, Objective 206 calls for retaining or restoring acres of bur oak and white spruce within the Norbeck Wildlife Preserve (the Preserve) for all alternatives, which is compatible with Forest-wide white spruce objectives.

3-2.1.2.3. Direct And Indirect Effects

White spruce is a late-successional species that regenerates in a shaded environment (Parrish et al. 1996 p. 11, 17). The effects of natural processes or management activities on spruce then are related to changes in succession. Fire or timber harvest would influence a spruce stand in natural succession. Spruce with its thin bark and dense lower limbs is particularly susceptible to fire. A stand-replacing fire would result in the land area being converted to earlier-successional species, likely aspen or ponderosa pine, depending on location. Management activities that open up the forest canopy would also result in a shift towards early-successional species. Selection is the preferred silvicultural treatment for spruce. White spruce theoretically can be managed under both even-aged and uneven-aged silvicultural systems (Shepperd and Battaglia 2002).

Effects Of Species-viability Management On White Spruce Ecosystems

Management for habitat and structural diversity would affect the distribution and abundance of spruce on the Forest. Objective 201 would have the largest impact on spruce. This objective targets hardwood conservation and restoration, which in many areas would require the removal of spruce to benefit aspen. For Alternatives 1, 2, and 4, the objective is to conserve or restore hardwood communities by 10 percent over 1995 conditions. For Alternatives 3 and 6, this amount is approximately doubled: 46,000 acres of aspen and 4,000 acres of bur oak are targeted for restoration during the life of the Plan. For Alternative 3, priority areas are those where conifers including spruce have outcompeted aspen adjacent to riparian areas that once supported beaver. For Alternative 6, priority areas would be adjacent to ARCs and WUIs where treatments to lower fire hazard are emphasized, particularly 300 feet from structures. Thus, under Alternatives 1, 2, and 4, there is likelihood that some spruce would be removed but not in stands that are primarily spruce. Under Alternatives 3 and 6, a greater amount would likely be removed, but the removal would probably not affect the overall amount of spruce on the Forest.

Guideline 2205 specifically addresses treatment requirements for Objective 201 discussed in the previous paragraph. For Alternatives 1, 2, and 4, no more than 10 overstory conifers per acre are to be left on site following treatment. Under Alternatives 3 and 6, all conifers would be removed, and this guideline would be made a standard.

Objective 201 is balanced with Objectives 204 and 200-3, which are discussed above as resource conservation measures for spruce. To meet forest structure diversity goals under species-viability management, new Objective 200-3 (Alternatives 3 and 6) calls for a mix of seral stages in spruce forests.

Riparian restoration Objectives 200-10, 214, and 215 also may affect spruce. Objective 200-10 is a new objective and was created to benefit autumn willow (*Salix serrisima*) and hoary willow (*S. candida*). These special-status plants are found in the McIntosh Fen Botanical Area (the Fen). To maintain habitat suitable for these willows, Alternatives 3 and 6 specify habitat restoration for beaver, particularly the removal of spruce to aid aspen regeneration. Riparian restoration Objectives 214 and 215 do not specifically address white spruce; however, spruce may be removed in some areas to benefit riparian areas. Alternative 3 calls to restore 1,000 acres of riparian shrub during the planning period, while Alternatives 1, 2, 4, and 6 call for only 500 acres. Objective 215 targets five stream reaches for restoration in Alternatives 3 and 6; three reaches are targeted in Alternatives 1, 2, and 4.

Alternatives 3 and 6 would have the largest impact, as more spruce would be removed under the more aggressive approaches to hardwood restoration and fire-hazard reduction. Fuel reduction within the WUI is anticipated to be within 300 feet of structures. These changes would result from management to benefit hardwoods or reduce fire hazard around ARCs and WUIs or from the natural encroachment of spruce in pine and aspen stands.

Effects of Research Natural Area Management on White Spruce Ecosystems

White spruce communities are present on the existing Upper Pine Creek RNA. This RNA will continue to exist under all alternatives. Two candidate RNAs also contain spruce communities, Canyon City and North Fork Castle Creek. The majority of the Canyon City candidate RNA site is ponderosa pine forest with white spruce communities occurring along Rapid Creek and on the lower slopes of east aspects. North Fork Castle Creek candidate RNA has white spruce found at the toe of slopes, along drainages, and on north aspects.

Because management activities such as hardwood restoration would not occur on RNAs, these spruce stands would be protected from management activities. The direct effect of the establishment of an RNA on spruce would be conservation. However, RNAs would continue to be influenced by natural processes such as fire, insects, and disease. In the absence of management activities for fire, spruce may increase in density and canopy cover in these RNAs. Correspondingly, the likelihood of a stand-replacing fire in white spruce stands would increase. Likewise, some areas may succeed to white spruce in the absence of fire or management activities. Impacted areas would be current aspen stands or ponderosa pine sites favorable to spruce regeneration (e.g., higher elevations, north aspects, and canyon bottoms). In particular, spruce could encroach into aspen stands in the candidate North Fork Castle Creek RNA.

Refer to the research natural areas section for candidate RNA locations and additional information on the size and composition of each.

Effects Of Fire-hazard And Insect-risk Management On White Spruce Ecosystems

Alternatives 1 and 2 call for conserving spruce wherever it is found on the Forest. In Alternatives 3, 4, and 6 spruce management is defined in Objectives 200-01 and 204. Although fire-hazard goals and objectives (Goal 10 and Objectives 10-01 to 10-06) do not specifically address white spruce, it is expected that white spruce communities would be affected by fire-hazard treatments. In Alternative 3 and in Alternative 6, Objective 200-01 sets a 20,000-acre objective for spruce on the Forest, which is 5,000 acres less than the current level and 5,000 acres more than historic levels. Spruce would be treated as any other conifer when reducing fire hazard in the WUI and especially adjacent to structures because of its low branches that easily catch fire and a tendency to send fire brands out for a distance when burning. Because spruce represents a small portion of the forested landscape at 5 percent (DeBlander 2002), the direct effects of fire-hazard management on spruce are expected to be minimal. As discussed, overall losses of spruce to hardwood conversion and fuel reduction around ARCs and WUIs are expected to be balanced by gains due to succession elsewhere. Spruce stands in the interior of the Forest and in deep canyons are unlikely to be treated for fuel reduction. Such stands would continue to encroach into aspen and pine. Spruce timber harvests are unlikely as the wood is not as desirable as ponderosa pine.

3-2.1.2.4. Cumulative Effects

There are no known direct or cumulative effects that would adversely impact the long-term persistence of white spruce ecosystems of the Forest. Generally, white spruce is likely to continue to occupy a small, but possibly increasing, share of the coniferous forests in the region. The amount of white spruce within the Black Hills is relatively low in proportion to the total forested land. Development on private land may result in some loss of spruce. Management of spruce on federal lands is with the effects disclosed in the 1996 Final EIS on pages III-167 to 171.

Spruce in the Black Hills will exist with all the alternatives. Alternative 6 has an objective of slightly less acres (20,000) than the other alternatives (25,000). Alternatives 3 and 6 state that spruce can be cut within WUI areas.

3-2.1.3. Hardwood Ecosystems

3-2.1.3.1. Affected Environment

Background information regarding hardwoods on the Forest is presented in the Forested Ecosystems section of the 1996 Final EIS on pages III-129 to III-146. Quaking aspen (*Populus tremuloides*) and bur oak (*Quercus macrocarpa*) are the principle upland hardwoods (i.e., broad-leaved deciduous trees) on the Forest (USDA Forest Service 1996a). Other hardwood trees in the Black Hills include narrowleaf cottonwood (*Populus angustifolia*), plains cottonwood (*Populus deltoides*), paper birch, American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), and boxelder (*Acer negundo*). Since human settlement, fire suppression has generally favored ponderosa pine reproduction and reduced acreage of aspen and other hardwoods (Parrish et al. 1996). Therefore, it is reasonable to assume that the acreage of upland hardwoods was more extensive prior to 1874 than it is today (Parrish et al. 1996). Aspen currently occupies about 47,000 acres on the Forest and bur oak occupies about 12,000 acres (see **Table B-1)**.

Aspen

On dry sites, forest management practices that traditionally have favored pine regeneration over aspen and fire suppression have all contributed to the decline of aspen from pre-settlement conditions on the Forest (USDA Forest Service 1996a p. III-145). Aspen has also been negatively affected by grazing from livestock and wild ungulates. Aspen shoots are palatable, and overgrazing can result in the complete loss of an aspen clone (Parrish et al. 1996 p. 12).

In the *Assessment of Aspen Clonal Conditions on the Black Hills National Forest* by Shepperd and Asherin (2004), the data indicate that aspen is not in severe decline in the Black Hills.

Marriott et al. (1999) recognized four aspen community types in the Black Hills: aspen/beaked hazel, aspen/bracken fern, aspen/spiraea, and aspen/chokecherry. The aspen/chokecherry type is discussed in the dry riparian forest section of this document. The other community types are found in uplands at higher elevations and are best developed in the Central Core, Limestone Plateau, higher Minnekahta Foothills, and Bear Lodge Mountains (Marriott et al. 1999). Aspen also occurs in association with white spruce, ponderosa pine, and ironwood, although these are not distinct community types (Marriott et al. 1999). Common understory species in aspen stands include: beaked hazel, paper birch, bur oak, western serviceberry, Oregon grape, wild honeysuckle, chokecherry, pink shinleaf, prickly rose, red raspberry, wild spirea, white coralberry, wild sarsaparilla, Lindly's aster, wild strawberry, sweet-scented bedstraw, and wild lily-of-the-valley (Marriott et al. 1999).

Aspen stands on the Forest are generally open with approximately 24-percent tree cover, 12-percent shrub cover, 10-percent forb cover, and 16-percent graminoid cover (DeBlander 2002 p. 10). Forage production in aspen and other hardwood communities is three to six times higher than typical conifer stands and is comparable to some grasslands (Burns and Honkala 1990). Hardwood stands also have higher diversity of understory species than do pine stands (USDA Forest Service 1996a). Hardwood forests, with their associated understory shrub components, are an important source of forage for all browsing ungulates, especially white-tailed deer. White-tailed deer, particularly does with fawns, select deciduous habitats in summer because they provide high quality forage in combination with horizontal hiding cover (DePerno 1998, Uresk et al. 1999). Hardwood forests also provide food and cover for wintering deer (Sieg and Severson 1996). Aspen stands often support an abundance and diversity of bird species. Panjabi (2001) detected high densities of 23 bird species in Black Hills aspen stands. Aspen stands were important for red-naped sapsucker, warbling vireo, ovenbird, and dark-eyed junco (Panjabi 2001). Several Forest emphasis species are dependent on aspen for forage, including ruffed grouse and beaver (Shepperd and Battaglia 2002). Other species, such as Black Hill's redbelly snake and northern leopard frog, capitalize on the moist site conditions where aspen is found (SAIC 2003b).

Aspen can host a wide variety of insects including defoliators, borers, and suckers (Burns and Honkala 1990). Some insect species in the Black Hills that target aspen include: tent caterpillar, large aspen trorix, and aspen leaf beetle (USDA Forest Service 1996a). In most cases, native insects are a natural part of the ecosystem and diverse, vigorous forests inhibit serious infestations (USDA Forest Service 1996a). Insect monitoring conducted on the Forest from 1998 to 2001 does not note specific damage to hardwoods from insect infestations (USDA Forest Service 1999b, 2000a, 2002e). However, significant hail damage to aspen was noted on Kirk Hill within the Spearfish/Nemo District (Northern Hills Ranger District) in spring 1999 (USDA Forest Service 2000a) and along Sheridan Lake Road in summer 2000 (USDA Forest Service 2001a). These sites are being monitored to detect insect problems subsequent to hail damage.

The non-native gypsy moth could be particularly damaging to aspen and riparian communities if it becomes established in the Black Hills. It has been inadvertently introduced several times in the last two decades, but as yet is not known to have established a breeding population (USDA Forest Service 1996a). This pest is transported from other regions by vehicles, interstate nursery trade, and even in camping gear or other personal belongings (USDA Forest Service 1996a).

Bur Oak

In the Black Hills, bur oak is at the western most extent of its range (Burns and Honkala 1990; Shepperd and Battaglia 2002). Bur oak, often in association with ponderosa pine, can be found in large stands in the northern and eastern parts of the Black Hills (Marriot et al. 1999). Along the edges of the Black Hills, relatively large bur oak trees are found in ravines and in riparian areas (USDA Forest Service 1996a). Bur oak can regenerate by seed or by root sprouting, and fire is an important factor in oak establishment (USDA Forest Service 1996a). According to Shepperd and Battaglia (2002), "Fire exclusion, livestock grazing, invading exotic competitors, and increasing deer and elk populations all have probably influenced the distribution and abundance of bur oak in the Black Hills." Forest-wide insect monitoring did not identify damage to bur oaks (USDA Forest Service 1998, 1999b, 2000a, 2001a).

Marriott and Faber-Langendoen (2000a) recognized two upland community types for bur oak in the Black Hills: bur oak/chokecherry - western snowberry woodlands and bur oak/sedge woodlands. Bur oak/chokecherry - western snowberry occurs along the northern periphery of the Black Hills (Marriott and Faber-Langendoen 2000a). Other tree species such as green ash, American elm, ponderosa pine, and paper birch often occur in the understory of this community type along with several shrub and forb species that include Oregon grape, chokecherry, red raspberry, poison ivy, dryspike sedge, Kentucky bluegrass, and bedstraw (Marriott and Faber-Langendoen 2000a). The bur oak/sedge community is found on the outermost hogback in the northern and northeastern Black Hills, primarily on private lands (Marriott and Faber-Langendoen 2000a). Bloodroot, a Forest emphasis plant species, is frequently associated with moist hardwood forests, including bur oak stands (Hornbeck et al. 2003c).

Bur oak provides quality habitat and forage for several wildlife species. Bur oak acorns are highly nutritious and digestible. Merriam's turkey feed on bur oak acorns during September and October (Shepperd and Battaglia 2002). White-tailed deer use both bur oak and ponderosa pine/bur oak habitats as transitional and winter range (Sieg and Severson 1996). White-tailed deer browse on oak twigs during severe winters with deep snow, even though bur oak buds and twigs have little nutritional value (Severson and Kranz 1978). The Wyoming Game and Fish Department has documented significant browsing of bur oak by white-tailed deer in the Bearlodge Ranger District. Established monitoring transects have revealed about 60 percent of available new leaders by browsing animals during the past 2 years. Bur oak may also be an important habitat element for red-eyed vireo (Panjabi 2001).

Dry Riparian Forests And Woodlands

Montane dry riparian forests at upper elevations include paper birch/beaked hazel forest and aspen/chokecherry forest. These associations differ from other riparian plant associations because they typically occur in moist areas on the lowermost slopes and bottoms of drainages and may not be associated with open water or a stream (Marriott and Faber-Langendoen 2000b). Paper birch/beaked hazel forests tend to have dense canopies dominated by paper birch. They occur in drainage bottoms (with or without streams) and on slopes with northern aspects (Marriott and Faber-Langendoen 2000b). Emergent white spruce and ponderosa pine may be present in these areas. Shrub diversity can be high, but beaked hazel often dominates the shrub layer. Common herbaceous species include wild sarsaparilla, Lindley's aster, mayflower, fairy bells, and baneberry (Marriott and Faber-Langendoen 2000b). Currently over 50,000 acres of paper birch and aspen are estimated to occur on the Forest. The paper birch/beaked hazel community type has been found to be a habitat component at some emphasis plant species occurrence sites, including bristle-stalk sedge and large round-leaf orchid (SAIC 2003b).

Aspen/chokecherry forests may be uncommon in the Black Hills and data have been gathered from two locations (Marriott and Faber-Langendoen 2000b). This community type has a dense canopy with 60 to 100-percent cover, with aspen tree cover greater than 50 percent. Paper birch may be co-dominant in some instances. Common shrub species include chokecherry, serviceberry and western snowberry (Marriott and Faber-Langendoen 2000b).

Two plant associations form the low-elevation dry riparian forests and woodlands type: the bur oak/ironwood forest and plains hawthorne shrubland. As with their counterparts at higher elevations, these dry riparian plant associations occur in moist conditions that may or may not be associated with a stream or open water.

Bur oak/ironwood forest replaces paper birch/beaked hazel forest at lower elevations (3,550 to 4,750 feet). Bur oak/ironwood forests occur in mesic drainage bottoms, with or without flowing streams, and usually do not occur immediately adjacent to streams (Marriott and Faber-Langendoen 2000b, Marriott et al. 1999). The overstory canopy tends to be open (25- to 60-percent cover), with the sub-canopy often closed (60- to 100-percent cover). The understory is variable; the most common shrub species are western snowberry and chokecherry (Marriott and Faber-Langendoen 2000b).

Plains hawthorne shrublands also occur at lower elevations (4,000 to 5,700 feet) in drainage bottoms and on the lowermost portions of slopes with stands dominated by fineberry hawthorne (Marriott and Faber-Langendoen 2000b). This type has not been well characterized, but stands have been provisionally classified as black hawthorne shrubland because of structure and habitat similarities. Tree species may include bur oak, green ash, ponderosa pine, and aspen (Marriott and Faber-Langendoen 2000b).

3-2.1.3.2. Resource Conservation Measures – For Hardwood Ecosystems

- Forest-wide Objective 201 is the primary conservation measure for hardwoods. Acreage targeted for conservation and restoration varies among alternatives. Alternatives 1 and 2 call for conserving existing hardwood communities and restoring historic communities by 10 percent over 1995 conditions on sites capable of supporting them; Alternative 4 changes 10 to 20 percent. Alternative 3 calls for increasing the aspen acreage by 46,000 acres (approximately doubling the current aspen acreage) and increasing bur oak acres by 4,000 acres (an approximate 33-percent increase) during the life of the plan. Alternative 6 manages for a minimum of 92,000 acres of aspen (double the current acreage) and 16,000 acres of bur oak a 33-percent increase.

Other objectives, standards, and guidelines that provide goals for restoration and conservation follow:

- Objective 203 calls for managing 30 to 50 percent of each bur oak stand for 100-year old and older trees in all alternatives.
- Guideline 2201 would disperse hardwood treatments across the Forest under Alternatives 1, 2, and 4. Under Alternatives 3 and 6, Guideline 2201 would be deleted.
- Guideline 2202 calls for a mix of structural stage in landscapes with multiple aspen clones under all alternatives. • Under Guideline 2203, successful aspen regeneration is defined for Alternatives 1, 2, and 4 as several thousand 6-foot tall stems per acre, with at least one unbrowsed terminal leader within 3 to 5 years. For Alternatives 3 and 6, this guideline specifically defines the regeneration requirement as 2,000 6-foot tall stems per acre with unbrowsed terminal leaders.
- Guideline 2205 could leave up to 10 overstory conifers in hardwood treatment areas under Alternatives 1, 2, and 4. Under Alternatives 3 and 6, all conifers would be removed.
- Guidelines 2206 and 2207 provide protection to hardwood stands. Guideline 2206 does not allow the development of new recreation sites in aspen/birch stands. Improvements to existing sites would consider the health of the aspen stands and aesthetics. This guideline exists for Alternatives 1 and 2, but it is strengthened to a standard for Alternatives 3, 4, and 6. Guideline 2207 calls for locating livestock/wildlife watering sites or drinking structures outside of hardwood communities when feasible (Alternative 1). Alternative 2 adds “new” livestock water and deletes “when feasible.” Alternatives 3, 4, and 6 adds “new” and replaces “when feasible” with “except when no other option is available” and changes the guideline to a standard. Because livestock and wildlife tend to concentrate at watering sites, this guideline/standard would minimize damage to hardwoods.

Several MA objectives address hardwood conservation and restoration. These objectives do not change among alternatives. Within MA 5.1, Objective 203 maintains or enhances hardwood shrub communities where biologically feasible and within management objectives. Within MA 5.1a, Objective 201 maintains or enhances hardwood trees, shrub inclusions, and other beneficial plant communities and openings. In MA 5.4a, Objective 205 retains or restores acres of aspen and birch. Objective 206 retains or restores acres of oak and white spruce in MA 5.4a. MA 8.2, Objective 203 maintains existing stands and acres of hardwoods.

Two MA guidelines change among alternatives. Guideline 2101 in MA 5.6 calls for maintaining existing stands and acres of hardwoods for Alternatives 1, 2, and 4. For Alternatives 3 and 6, the expansion of hardwoods is encouraged, in addition to maintaining existing stands. Within MA 5.4a, Guideline 2102 (Alternatives 1, 2, and 4) recommends treating entire clones when an aspen stand is regenerated, leaving one birch stem uncut in each treated clump and preventing damage to new sprouts from grazing. This guideline is not included in Alternatives 3 and 6.

3-2.1.3.3. Direct and Indirect Effects

Management for vegetative diversity across the Forest would likely improve aspen abundance and distribution across the Forest under each of the Phase II Amendment alternatives. All alternatives manage for vegetative diversity, but do so by utilizing different approaches and with slightly different goals. Quaking aspen and bur oak are early successional species and therefore are susceptible to encroachment from white spruce and ponderosa pine. Historically, hardwood stands were maintained by fire. Conversely, fire suppression has favored conifers over hardwoods. Factors that could affect the continued existence of aspen in the Black Hills include: fire exclusion during most of the 20th century, competition from more shade-tolerant conifers, lack of younger age classes in existing clones, browsing and barking by animals, susceptibility to diseases, and global climate change. These factors, along with the lack of extensive mixed conifer/aspen forests indicate that growing conditions for aspen in the Black Hills are marginal, at best. Therefore, special actions may be necessary to expand and conserve existing aspen clones (Shepperd and Battaglia 2002). Recommended techniques for regenerating or expanding existing clones include removal of competing conifers, protection of existing new suckers, and stimulation of new suckers. Removing conifers growing in and around an aspen clone can reduce competition for moisture and light, which will favor the aspen. Aspen roots extend a considerable distance away from existing stems. Clearing surrounding conifer forest back 1 to 1.5 tree heights away from a declining aspen clone will allow new suckers to establish and expand the area occupied by the clone (Shepperd 2001) (Shepperd and Battaglia 2002) (Shepperd and Asherin 2004) (USDA Forest Service 1996 p. III-151). Prescribed fire could also be used as a tool (Shepperd and Asherin 2004). Further support of treatments to enhance aspen regeneration lists fire, removal of invading pine from within and surrounding the aspen clone, and possible exclosures for protection from herbivores (Keyser 2005).

Effects Of Species-viability Management On Hardwood Ecosystems

Managing for species viability encourages the development of habitat and structural diversity across the Forest. Therefore, hardwoods would benefit by, and be an intrinsic part of, species-viability management. However, the amount and distribution of benefits to hardwoods would vary among alternatives.

Objective 201 targets hardwood conservation and restoration. For Alternatives 1, and 2, the objective is to conserve or restore hardwood communities by 10 percent over 1995 conditions, on sites capable of supporting these communities, Alternative 4 changes that percentage to 20 percent. For Alternatives 3, this amount is approximately doubled; 46,000 acres of aspen and 4,000 acres of bur oak are targeted for restoration during the life of the planning period. Alternative 6 manages for a minimum of 92,000 acres of aspen (double the current acreage) and 16,000 acres of bur oak for a 33-percent increase.

For Alternatives 3 and 6, priority areas are those where conifers have outcompeted aspen adjacent to riparian areas that once supported beaver. In addition Alternative 6 prioritizes bur oak restoration away from the Bear Lodge Mountains where bur oak is plentiful.

Guideline 2201 would disperse hardwood treatments across the Forest under Alternatives 1, 2, and 4. Under Alternatives 3 and 6, Guideline 2201 is deleted, the priority is set by Objective 201.

During hardwood restoration, Guideline 2205 calls for leaving no more than 10 overstory conifers per acre and treating the conifer understory and hardwood component in order to shift the dominance of basal area from conifer to hardwood (Alternatives 1, 2, and 4). In Alternatives 3 and 6, all overstory conifers would be removed from hardwood restoration sites and this guideline would be upgraded to a standard. Because Alternatives 1, 2, and 4 would leave conifers on site, these seed sources may result in a quicker reversion back to a conifer-dominated stand.

In Alternatives 1, 2, and 4, Objective 204 calls for managing and conserving white spruce and other species. Because spruce encroaches on aspen stands and both are an important component of habitat diversity, Objective 200-01 was created for Alternatives 3 and 6. This new objective would favor hardwoods where spruce has encroached on hardwoods and favors spruce where spruce is encroaching on pine in Alternative 3. In Alternative 6, Objective 200-01 would manage for 20,000 acres of spruce and treating spruce within 200 feet of buildings, where spruce has encroached into hardwoods, and for emphasis species management.

In summary, aspen would benefit from species-viability management under any alternative, although the amount and distribution would vary. Aspen is predicted to increase over the life of the planning period from current acreages. At a Forest scale, bur oak acreage would not change considerably in the future under any alternative, but net bur oak acres do increase by 33 percent for Alternatives 3 and 6, by 20 percent if Alternative 4, and by 10 percent in Alternatives 1 and 2. Hardwood stands would likely be evenly distributed across the Forest under all alternatives. Finally, because of stricter restoration guidelines (e.g., Guidelines 2203 and 2205) under Alternatives 3 and 6, those hardwood stands receiving treatments would have a higher probability of success and longevity. See Appendix B.

Effects Of Research Natural Area Management On Hardwood Ecosystems

Hardwoods are represented in each candidate RNA, with the exception of Fanny/Boles. Aspen, bur oak, and other hardwoods are found through out these different candidate RNAs and in varying amounts. Hardwoods would be represented in eight of the candidate RNAs under Alternative 4. Under Alternative 6, three candidate RNAs would have representation of hardwood species. Four RNAs would be established under Alternative 3 with three containing hardwoods.

Although there are a number of restrictions on the use of RNAs (e.g., timber harvest, mineral entry, motorized travel), there would be no expected gains in hardwoods in these areas.

Effects Of Fire-hazard And Insect-risk Management On Hardwood Ecosystems

Although the greatest change in hardwood distribution and abundance on the Forest would be derived from species viability management, hardwoods could benefit from fire-hazard management on the Forest. Hardwoods are less flammable than conifers, and fire-hazard treatments would generally remove conifers in favor of hardwoods. Guideline 2201 would disperse restoration treatments across the Forest under Alternatives 1, 2, and 4. For Alternatives 3 and 6, Objective 201 would treat in areas where conifers have encroached on hardwoods and will also disperse restoration treatments across the Forest.

Hardwoods could benefit from management for insect risk. Insects are most abundant in dense conifer stands. Therefore, opening up the forest canopy to minimize risk of insects may benefit hardwoods in some areas.

3-2.1.3.4. Cumulative Effects

The analysis did not identify effects that would adversely impact the long-term persistence of hardwoods on the Forest. Outside the Forest, expanding hardwood ecosystems is also being accomplished. Private forested lands have potential for hardwood management. Much private timberland around the Hills is in ownerships of 50 acres or less in size (Leatherberry et al. 2000). According to Sampson and DeCoster (1997), various surveys of private landowners indicate that most people own forested land to protect the natural beauty and wildlife. The value of hardwoods to wildlife, diversity, and aesthetics complements these ownership objectives. Indeed, hardwood restoration and management is often completed on private lands in the Black Hills area (Josten 2004). Custer State Park is managing to achieve a 10-percent net increase in hardwoods over the life of their resource management plan (Custer State Park 1995). These activities complement efforts to expand hardwoods on the Forest.

The hardwoods contribute to the forest diversity. All alternatives address hardwood treatments. Hardwood treatment acres are the most in Alternative 6 followed by 3, 4, 1, and then 2 (see Final EIS Appendix B **Table B-1**).

3-2.2. Grassland / Shrubland Ecosystems

3-2.2.1. Affected Environment

Grassland and shrubland ecosystems were not addressed as distinct sections of the 1996 Final EIS but were addressed as portions of several discussions (USDA Forest Service 1996a p. III-146-150). They are discussed as distinct ecosystems in the Phase II Amendment to highlight their importance to the overall biological diversity of the Black Hills. Because grasslands and shrublands are typically managed in a similar manner, on the Forest, they are discussed together in this section.

Grassland and shrubland ecosystems are defined as upland plant communities dominated by herbaceous and/or shrubby vegetation with less than 10-percent tree cover and are often referred to as rangelands. In general, grassland ecosystems occur in the Black Hills as prairie grasslands or as interior grasslands. Shrublands discussed in this section typically occupy transitional zones between forested and grassland ecosystems. Vegetation in these ecosystems consists primarily of low-growing plants such as grasses, grass-like plants, forbs, and shrubs. Various types of wildlife depend on grassland and shrubland ecosystems for forage and cover throughout the year (USDA Forest Service 1996a p. III-173).

The same types of grassland and shrubland ecosystems that existed in the Black Hills prior to Euro-American settlement can still be found today. However, the specific character or quality of these modern-day grasslands and shrublands in the Black Hills compared to historic conditions is difficult to gauge. One aspect that has been ascertained with some certainty is that the historical forest/prairie interface of the Forest was higher in elevation due in part to a higher frequency of low-intensity fires (Brown and Sieg 1999; USDA Forest Service 1996a p. III-148) that had the effect of reducing pine encroachment into adjacent prairie grasslands. After a century of fire suppression and forest management, ponderosa pine is denser and more extensive with diminished understory productivity, acreage of interior prairies and meadows is reduced, and community diversity is simplified (Parrish et al. 1996). Similarly it is likely that shrublands were more widely distributed and abundant during pre-settlement times (USDA Forest Service 1996a p. III-149).

Continuity of Black Hills grasslands and shrublands has been disturbed since Euro-American settlement of the area primarily due to changes in land use associated with cultivation, residential housing, commercial development, roads, fire control localized non-native plant species invasion, and large wild ungulate-and-livestock grazing (USDA Forest Service 1996a p. III-247, III-273). One consequence of settlement and development of the Black Hills has been relatively high densities of roads (USDA Forest Service 1996a p. III-247, Parrish et al. 1996).

3-2.2.1.1. Grassland Ecosystems

Large numbers of wild ungulates such as bison, pronghorn antelope, and elk lived in and around the prairies of the Black Hills prior to Euro-American settlement (Parrish et al. 1996; Froiland 1990). Prairie dogs, another herbivore, were historically important to grassland ecosystems of the Northern Great Plains and the outer flanks of the Black Hills. Bison, natural wet and drought cycles, and fire created a dynamic mosaic of grassland habitat composed of a variety of plant associations and communities in varying seral stages. This historical habitat mosaic supported a diverse array of plant and animal species, several of which no longer occur as permanent residents in the Black Hills (e.g., grizzly bears, wolves). Early accounts of bison suggest that they had localized adverse effects on woody vegetation growth and regeneration (England and DeVos 1969). Other differences in character of historical grasslands from modern-day conditions include the replacement of shrubs and tall grasses of the prairie (and other grasslands and shrublands) by shorter exotics such as Kentucky bluegrass (USDA Forest Service 1996a p. III-149).

The most recent estimate of area covered by grasslands on the Black Hills is approximately 110,000 acres (See **Table B-4** Forest Vegetation Types). Grasslands on the Black Hills can be distinguished into two primary groups: prairie grasslands and interior grasslands. Prairie grasslands refer to those grasslands that generally occur on the outer perimeter of the Black Hills as a transition between the true prairie ecosystems and the forested ecosystems of the foothills and mountains. Interior grasslands occur within the forested perimeter of the Black Hills and can include large areas dominated by plant species typically associated with prairie systems (e.g., Reynolds and Gillette Prairies).

Emphasis species that occur in prairie ecosystems include the regal fritillary butterfly, northern harrier, ferruginous hawk, mountain plover, burrowing owl, loggerhead shrike, Cassin’s sparrow, Brewer’s sparrow, grasshopper sparrow, black tailed prairie dogs, and the black-footed ferret (SAIC 2003b). Recent bird monitoring by Panjabi (2003) found that species such as mountain bluebird, chipping sparrow, and vesper sparrow were generally more abundant in grasslands located near forests (e.g., interior grasslands), whereas species such as the upland sandpiper and grasshopper sparrow were more abundant in grasslands isolated from forests. Estimated relative density was greatest for the chipping sparrow; however, it occurs only in grasslands with available trees. The vesper sparrow, grasshopper sparrow, and western meadowlark densities were greater in mixed grass prairie habitats than in other surveyed habitat types (Panjabi 2003). Other bird species, such as the sharp-tailed grouse, upland sandpiper, and horned lark were only detected in mixed grass prairies (Panjabi 2003).

Prairie Grasslands

In the Black Hills prairie grasslands generally occur at lower elevations, typically below 5,500 feet in the south and 4,500 feet in the north (Hall et al. 2002). Based on species composition, it is believed that larger stands of prairie on the Forest are similar to the historical condition. In general, historic livestock grazing has not significantly or adversely affected these plant communities. (Hall et al. 2002). The introduction of non-native plant species and fragmentation by roads are typically the main causes of change from historical conditions (Hall et al. 2002).

Marriott and Faber-Langendoen (2000a) describe four primary types of prairie ecosystems in the Black Hills: mesic tall grass prairie, dry mixed grass prairie, mesic mixed grass prairie, and prairie dog grassland.

Mesic tall grass prairie is dominated by big and little bluestem. It occurs in the eastern foothills and may also occur in the northwestern and southwestern foothills (Hall et al. 2002). Cover in these grasslands ranges from 60 to 100 percent and is dominated by graminoids between 1.6 feet and 3.2 feet in height. Forb cover is light (Marriott and Faber-Langendoen 2000a).

Two types of dry mixed grass prairie occur on the Black Hills in limited quantities: northern great plains little bluestem prairie and needle and thread-blue grama mixed grass prairie. The northern great plains little bluestem prairie is best developed at lower elevations outside of the central core and limestone plateau. It is commonly found in mosaics with ponderosa pine woodlands and other grassland types. It typically occurs on slopes and rocky areas with coarse soils. The vegetation is composed primarily of graminoids less than 3.3-feet tall, and there is usually greater than 50-percent vegetative cover (Marriott and Faber-Langendoen 2000a). The needle and thread-blue grama mixed grass prairie is restricted to lower elevations of the Hogback Rim and the Red Valley and generally occurs on flat to rolling topography (Marriott and Faber-Langendoen 2000a). Canopy cover ranges from 25 to 60 percent and is dominated by graminoids 1.6 feet to 3.3 feet in height. Threadleaf sedge is often co-dominant with blue grama. Forbs and short shrubs occur but are sparse (Marriott and Faber-Langendoen 2000a).

Mesic mixed grass prairie is most extensive in the Red Valley and the Hogback Rim (Marriott and Faber-Langendoen 2000a). Western wheat grass-green needle grass and western wheat grass-needle and thread mixed grass prairies are the two specific plant associations that comprise the mesic mixed grass prairie type. The western wheat grass-green needle grass mixed grass prairie is dominated by midgrasses, generally between two and 3.3 feet in height. Stands occur in drainage bottoms, floodplain terraces, and rolling hills. Canopy cover ranges from 60 to 100 percent. Scattered ponderosa pine may occur, but forbs are sparse or absent in many stands (Marriott and Faber-Langendoen 2000a). Western wheat grass-needle and thread mixed grass prairies have similar characteristics to the western wheat grass-green needle grass association.

Black-tailed prairie dog town grassland complexes are found at lower elevations in areas of extensive mixed grass and short grass prairie habitat (Marriott and Faber-Langendoen 2000a). Total vegetative cover typically ranges from 25 to 60 percent, and the average canopy height ranges from 2 to 4 inches (Marriott and Faber-Langendoen 2000a). Species diversity is generally higher in the prairie dog towns than the surrounding grasslands; short grass prairie species and annual forbs are abundant. Common native dominants include buffalo grass, purple three-awn, bracted vervain, and fetid marigold. Common non-natives include Canada thistle, cheat grass, common mullein, and hornseed buttercup (Marriott and Faber-Langendoen 2000a).

Interior Grasslands

Interior grasslands are characteristic of the Black Hills. They typically occur at higher elevations and are open, park-like valleys, prairies, and grasslands of varying size (Froiland 1990). These grasslands can be grouped into two main forms: prairie and montane grasslands. Interior prairie grasslands are characteristically found on hillsides where the landscape is convex in shape (i.e., hillsides) and tends to shed water. These areas are typically dry and have thin, rocky soils. Examples of interior prairies found on the Forest are Reynolds Prairie and Gillette Prairie. In contrast, montane grasslands occur in valley bottoms where water tends to drain, creating more mesic conditions than the interior prairies. Additionally, the soils in these drainages are typically deeper and more fertile than grasslands found on hillsides. See section 3-14.2 Soils for more soils information.

The acreage of interior prairies such as Reynolds Prairie has declined from historic conditions due in large part to encroachment of ponderosa pine. The exclusion of fire along with historic heavy livestock grazing has allowed unpalatable shrubs such as snowberry to become dominant over grasses and forbs. Native grasses are often replaced by shorter exotic grasses, such as Kentucky bluegrass, which are better able to handle the impacts from increased conifer canopy cover and/or heavier grazing pressure (USDA Forest Service 1996a p. III-148 and 149).

Black Hills Montane Grasslands is a grassland type endemic to the Black Hills. This type occurs at higher elevations on the limestone plateau and the central core (Marriott and Faber-Langendoen 2000a). Herbaceous cover ranges from 60 to 100 percent, with the graminoid species dominant: prairie dropseed, Richardson’s needle grass, and timber oat grass (Marriott and Faber-Langendoen 2000a). The ratio of graminoid to forb cover ranges from 3:1 to 2:1 (Marriott and Faber-Langendoen 2000a). Common forbs include prairie smoke, threenerve fleabane, sticky geranium, purple meadow rue, and several cinquefoils (Marriott and Faber-Langendoen 2000a).

Though timothy often occurs in montane grassland habitat, grasslands dominated by timothy are not included in the Black Hills Montane Grassland type because the original composition from early studies is unclear. Timothy-dominated grasslands are fairly common throughout the Black Hills but are less common in the area between Custer, South Dakota and Newcastle, Wyoming (Marriott and Faber-Langendoen 2000a).

3-2.2.1.2. Shrubland Ecosystems

Shrublands are areas dominated (greater than 40-percent crown canopy) by shrubs, often with an understory of herbaceous vegetation that contains less than 10 percent of tree crown cover. Note that riparian shrublands are discussed separately in the Riparian and Wetlands Ecosystem.

Shrublands typically occupy transitional zones between forested and grassland ecosystems. In the Black Hills six types of upland shrublands were identified by Marriott et al. (1999) including big sagebrush; silver sagebrush; mountain mahogany; creeping juniper; three-leaved sumac; and chokecherry shrublands.

Over the last century, the current distribution and abundance of shrublands have been affected by factors including historic fire exclusion, recent large wildfires (e.g., Jasper Fire), livestock and wildlife-caused herbivory and structural changes, the introduction of exotic plants, and insect and disease suppression (USDA Forest Service 1996a p. III-148).

Marriott et al. (1999) determined that the majority of existing potential shrubland habitat occurs on private land in the Black Hills; consequently, shrublands have not been surveyed as comprehensively as other habitat types found on public lands. In general, big sagebrush shrublands are uncommon in the Black Hills and are restricted to the lower elevations of the western and southern flanks of the Hogback Rim (Marriott et al. 1999). Western wheat grass, blue grama, needle grasses, and prairie junegrass are graminoids associated with big sagebrush shrublands (Marriott and Faber-Langendoen 2000a), which could exist in small amounts in the Black Hills. The silver sagebrush shrubland type occurs in the floodplain of the Belle Fourche River (Marriott et al. 1999) and has not been documented on the Forest. Western snowberry is common with total herbaceous cover ranging from 50 to 75 percent. The herbaceous understory in silver sagebrush shrublands is characterized by Kentucky bluegrass, needle and thread grass, cudweed sagewort, with some western wheat grass (Marriott and Faber-Langendoen 2000a) also present.

Mountain-mahogany shrublands are the most extensive shrubland type on the Black Hills and are most common in the west-central portion (east of Newcastle, Wyoming) of the Black Hills on low-elevation limestone (Marriott et al. 1999). These shrublands are patchy and have a relatively sparse herbaceous understory dominated by side-oats grama (Marriott and Faber-Langendoen 2000a). Three-leaved sumac is usually present in mountain-mahogany shrublands, and Rocky Mountain juniper and ponderosa pine occur as scattered individuals (Marriott and Faber-Langendoen 2000a).

Creeping juniper shrublands are found only occasionally in the Black Hills; they have been documented in the eastern foothills and may also occur in the southwestern foothills (Hall et al. 2002; Marriott et al. 1999). Other shrubs that generally occur with creeping juniper include three-leaved sumac, chokecherry, and leadplant (Marriott and Faber-Langendoen 2000a). Three-leaved sumac shrublands have only been documented in the Devils Tower National Park (Marriott et al. 1999) but potentially could exist in the Black Hills. Total vegetative cover ranges between 10 and 25 percent and generally includes three-leaved sumac, fringed sagewort, big sagebrush, bluebunch wheat grass, poison ivy, blue grama, junegrass, and needle and thread grass (Marriott and Faber-Langendoen 2000a). Chokecherry shrublands are found in a variety of habitats such as dry draws, scree/talus slopes, and at rock outcrops primarily in the north central core, southwestern foothills, and eastern foothills (Marriott and Faber-Langendoen 2000a; Hall et al. 2002). In these shrublands, chokecherry is often co-dominant with three-leaved sumac, American plum, and/or western snowberry (Marriott and Faber-Langendoen 2000a).

Despite the relatively small acreage of shrublands in the Black Hills, important habitat is provided for shrubland specialists and ecotonal species that are transitional between low-elevation habitats and montane forests and seasonal migrants. Emphasis species that utilize shrublands include loggerhead shrike, Brewer’s sparrow, and white-tailed deer.