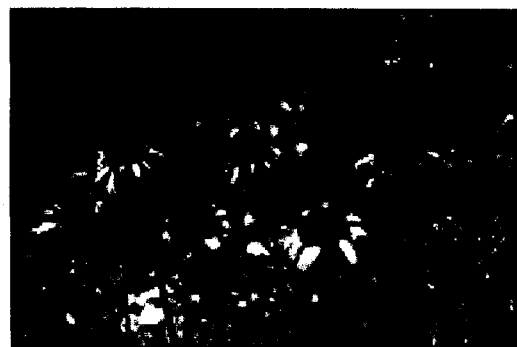
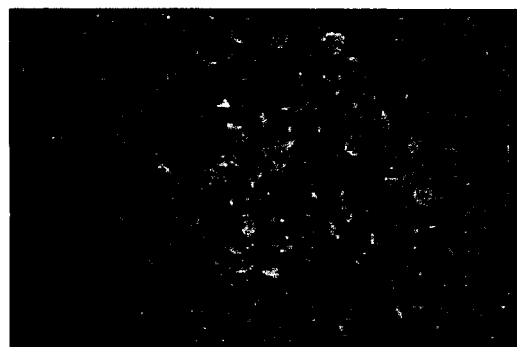
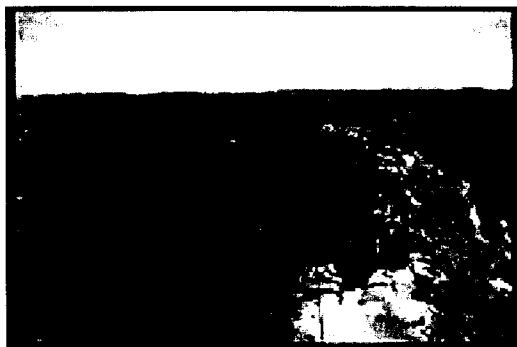




Black Hills Community Inventory

final report

Hollis Marriott
Don Faber-Langendoen
Amanda McAdams
Diane Stutzman
Beth Burkhart

December 1999

The
Nature
Conservancy
Saving the Last Great Places

THE BLACK HILLS COMMUNITY INVENTORY *final report*

Hollis Marriott, Don Faber-Langendoen, Amanda McAdams,
Diane Stutzman, and Beth Burkhart



The Nature Conservancy
Midwest Conservation Science Center
Midwestern Resource Office (MRO)
1313 Fifth Street SE, Suite 314
Minneapolis, Minnesota 55414

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EXECUTIVE SUMMARY

INTRODUCTION

The Black Hills Community Inventory (BHCI) was launched in 1995 to systematically classify and describe the vegetation of the Black Hills, and to identify high-quality examples of the various vegetation (plant community) types. The goals of the project are to contribute to a comprehensive description of the vegetation of the Black Hills, utilizing a standardized national vegetation classification system; to identify high quality occurrences of each community type throughout the study area; and to identify biologically significant sites where these types occur.

STUDY AREA

The Black Hills are an isolated mountain range in the Great Plains of western South Dakota and northeastern Wyoming. Trending roughly northwest-southeast, the uplift is approximately 200 km long and 100 km wide, with an area of more than 2 million acres. Elevations range from the about 900 m (or 3000 ft) in the surrounding plains to 2200 m (7242 ft) at Harney Peak.

Much of the uplift is covered with ponderosa pine forests, particularly at higher elevations. These pine forests intergrade with ponderosa pine woodlands on warmer, drier sites at high elevations. Pine woodlands are extensive at lower elevations, often with a strong grassland layer. A variety of hardwood types occur in the Hills, including both drier riparian stands of aspen, bur oak, and paper birch forests and wetter riparian stands of cottonwood, green ash, american elm, and boxelder forests. Shrublands occupy a variety of habitats, from high-elevation streams to drier non-riparian sites at lower elevations. Grasslands are most extensive at lower elevations, and include mixed- and tall-grass prairie types. High elevation grasslands include the Black Hills montane grassland, a type endemic to the Black Hills. Graminoid-dominated wet meadows and streambanks are common throughout the area. Saline and alkaline wetlands are found at lower elevations.

Human settlement and activity in the Black Hills have been widespread since the turn of the century. Interaction between natural large-scale ecological processes and human-caused processes has altered the Black Hills landscape in many ways. Fire, insect epidemics, wildlife and flooding, as well as related impacts from human activities, all have played a role in shaping current vegetation patterns.

Most of the public land within the Black Hills is managed by Black Hills National Forest, with State and National Park Service lands scattered throughout. The two largest parks are Custer State Park and Wind Cave National Park, located in the southeastern part of the range. The largest blocks in private ownership are at lower elevations where ranches are common, in areas of historical and current mining, and in many of the high elevation meadows. Timber, mining, agriculture and recreation are the most important land uses.

METHODS

Classification of Black Hills vegetation follows the US National Vegetation Classification System (USNVC). This system is vegetation-based, emphasizes existing natural vegetation, and uses a combined physiognomic-floristic approach to classification. The finest classification level is the (plant) association, and it was to this level that Black Hills vegetation was classified.

The BHCI project included three field seasons, May–September of 1996–1998. The focus of field survey during the BHCI was characterization and documentation of high-quality examples of community types. As a general guideline, at least three documented examples were sought for each association, with sites distributed throughout the range of the type in the Black Hills. Survey sites chosen included management areas likely to contain large, high-quality examples of natural vegetation, such as NPS units, Wilderness Areas, Research Natural Areas, Botanical Areas and the Late Succession Landscapes identified in the recent Forest Plan of the Black Hills National Forest. Late Succession Landscapes are a relatively new type of management unit characterized by large expanses of relatively high-quality vegetation with old, large trees and related structural features.

Prior to field survey, managed area maps, aerial photos and 7.5' topographic maps were used to delineate preliminary site boundaries. Where possible, preliminary plant community boundaries were delineated on aerial photos. In the field, vegetation was classified, mapped and evaluated as to quality. Data were collected using standard site and vegetation survey methodology of The Nature Conservancy.

Descriptions of plant community types of the Black Hills were prepared in the form of Community Characterization Abstracts (CCAs). The CCA is a standardized report developed by The Nature Conservancy for community characterization, and includes information on structure, floristic composition, habitat characteristics, successional patterns, natural processes, stand variation, global range and management concerns.

Site and occurrence data collected during the BHCI were sent to state Natural Heritage Programs. Plot data were visually scanned and compared against literature descriptions as a first iteration of community type review. As part of a second iteration, earlier and newly-collected plot data were analyzed using statistical methods.

Each of the community occurrences surveyed as part of the BHCI was ranked as to quality, using the EORANK (element occurrence rank) system of The Nature Conservancy and the Natural Heritage Program network. The three major factors (subranks) on which overall rank is based are condition of the vegetation occurrence, occurrence size (i.e. including all sufficiently-close stands) and landscape context. Each of the three subranks, as well as the overall rank, range from A (high) to D (low).

Sites within the Black Hills were classified as to their management goals using a four-class system. Level 1 includes areas maintained in a natural state through natural processes or mimicking of natural processes. Level 2 areas are generally managed for natural values but may receive use that degrades the quality of natural communities that are present. Level 3 areas are generally managed for consumptive or recreational values, but

may also maintain some natural value. The lowest level, 4, applies to lands with no easement or management agreement that maintains native species and natural communities. All sites ranked level 1 or 2 that were known or suspected to contain sufficiently high-ranking community occurrences were surveyed.

After field survey was completed, sites were evaluated based on size, landscape fragmentation, landscape context, communities types present and occurrence quality to produce a list of exemplary sites.

RESULTS

The Black Hills Community Inventory produced a comprehensive vegetation classification for the Black Hills. The classification includes 68 plant associations with detailed descriptions for each. A total of 178 plots were available for upland types, and a total of 120 plots were available for riparian types. The plant associations in the Black Hills classification were also assigned to ecological groups to highlight their ecological relationships, e.g. High Elevation Riparian Forests and Shrublands, and Dry Coniferous Forests and Woodlands.

Few of the surveyed occurrences received the highest overall rank of A. The most common factors behind downranking of *condition* were lack of old-growth conditions (forest and woodland types), presence of unnatural disturbances, and presence of exotics. *Size* rank for occurrences was highly variable, ranging from A (very large) to D (very small). *Landscape context* rank was the same for most occurrences surveyed in the Black Hills, as most were surrounded by moderately intact natural vegetation in an area of about 2500-10,000 acres with 50-80% natural vegetation.

Of the 16 occurrences with the highest overall rank of A, most (ten) are located in Wind Cave NP, where large stands are situated in a largely intact area with natural processes in place (e.g. bison, prescribed burns). Other A-ranking occurrences were scattered among types and management units.

Five sites managed at management level 1 and 1 site managed at management level 2 were surveyed during the course of the BHCI. Dry and mesic coniferous forests and woodlands are the types best represented at sites under level 1 or 2 management. Black Hills sparse vegetation types are common in the level 1 sites surveyed. Higher elevation riparian and wetland types are well-represented at level 2 sites. All told, about 75% of the Black Hills types were represented by higher-ranking occurrences (A or B) at sites under level 1 or 2 management.

Of 68 plant associations in the Black Hills classification, 28 are considered globally rare (G1-G3). The global status of five types is not known (G?). Of the globally rare types, at least ten are endemic or mostly limited to the Black Hills.

Eight of the sites surveyed are considered exemplary; that is, these sites are large and contain high-ranking occurrences of multiple community types in landscapes that are relatively intact over large areas. Exemplary sites include Black Elk/Upper Pine Creek,

Black Fox, Canyon City, Cranberry Springs, Elk Mountain, McIntosh Fen, Upper Grace Coolidge Creek, and Wind Cave NP. Several other sites surveyed are potential exemplary sites. Some are relatively small; others were not extensively covered and additional information is needed. These include Devils Tower National Monument, Hell Canyon North/Jewel Cave National Monument, Little Spearfish Creek, Vanocker Creek, Beaver Park, Cox Lake, Little Elk Creek and Lower French Creek, Eagle Cliffs and Hardy.

DISCUSSION

Through reconciliation of existing vegetation classifications and new field survey, a comprehensive vegetation classification has been developed for the Black Hills. This classification is fully integrated into the USNVC. The 68 types currently recognized range from high elevation white spruce forests and montane grasslands to low elevation mixed-grass prairies and saline meadows.

Developing quality standards and ranking stands of vegetation as to "naturalness" can be quite challenging. The range of natural variability of vegetation in the Black Hills is represented by only limited presettlement documentation, and is surrounded in controversy. In addition, the BHCI used old growth features as only one of multiple criteria for ranking occurrence quality in forest and woodland types. This was done partly because old growth criteria were available at only a general level, and partly because the presence of old growth alone does not ensure that a full complement of native species and ecological processes are present. In spite of these difficulties, there is clearly a need to assess vegetation and site quality in a consistent fashion for land management and conservation decisions, and the criteria provided here provide a first approximation to measuring that quality.

The BHCI has contributed towards the understanding of the status of plant associations in the Black Hills in two ways. Through survey, a list of types that are represented with exemplary stands and high-quality sites has been produced. Second, through management status analysis, we now know which types currently are receiving some level of biodiversity management, and which are not. However, the BHCI was *not* designed to determine and document the overall status of community types in the Black Hills. In general, coniferous forests and woodlands (both dry and mesic) are best represented with exemplary stands in large, relatively intact sites. Many other types have some level of protection, but not all are in good quality.

ADDITIONAL RESEARCH NEEDS

Several community types are high priority for additional survey. The Black Hills montane grasslands are globally rare, endemic to the Black Hills, and have been extensively altered or converted during the last century. The BHCI 1998 field season included the first in-depth survey of montane meadows since the time of McIntosh (1931). During the 1999 field season, additional A and B ranked montane grassland occurrences were found during

a survey funded by the SD Dept. of Game, Fish and Parks (Marriott in prep.). Another type(s) that may be globally rare and endemic to the Black Hills are the bur oak stands found on the northern and northeastern flanks where there are extensive exposures of Mowry shale. This community has been tentatively classified as the bur oak / sunsedge association, but probably includes other types. Very little information is available, as most occurrences are on private lands.

Riparian types play important roles in ecosystems, an importance that is disproportionate to their relatively small size. For this reason, these types need to be well-characterized and documented. The BHCI included many riparian site surveys during the second and third field seasons. However, there remain areas of the Black Hills (mostly at lower elevations) that need additional work.

Further studies could address landscape-scale issues in the management of Black Hills systems, particularly with respect to issues of old growth. It is conceivable that large natural landscapes are needed to maintain the viability of some Black Hills forest and woodland types and the ecological processes on which they depend, given the historic role of large-scale natural fires. Issues of old growth may benefit from a consideration of the natural processes that give rise to a diversity of stand structures on the landscape. Finally, this inventory has not addressed the more intensively managed landscape areas of the Black Hills to determine how well the natural community types are retaining their structure and diversity.

FINAL REPORT

INTRODUCTION

The Black Hills Community Inventory (BHCI) was launched in 1995 to systematically classify and describe the vegetation of the Black Hills, and to identify high-quality examples of the various vegetation (plant community) types. Interest in natural features of the Black Hills has increased as the landscape continues to be impacted by resource management, population growth, and associated development and land use. Many interest groups have acknowledged the need to identify significant biological sites as a first step towards understanding how to use and conserve the natural heritage of the Black Hills.

The BHCI was supported through a diverse group of funding sources, all of which shared an interest in better understanding the vegetation of the area: Black Hills National Forest (BHNF), the National Park Service (NPS), The Nature Conservancy (TNC) and the natural resources industries of the Black Hills. The project was overseen by a Science Committee composed of representatives from those groups as well as the academic community (see Appendix 1).

The goals of the project are to contribute to a comprehensive description of the vegetation of the Black Hills, utilizing a standardized national vegetation classification system; to identify high quality occurrences of each community type throughout the study area; and to identify biologically significant sites where these types occur. For Federal land management agencies and natural resource industries, this information will aid in determining appropriate land use. It can be used in prioritizing conservation targets for the Conservancy, federal agencies and other interested groups.

Previous Inventories and Surveys

The earliest systematic surveys of Black Hills vegetation were the forest timber inventories of Graves (1899), conducted for the purpose of assessing timber resources. Graves described forest conditions, and classified stands by age-class. The report includes maps showing merchantable timber volumes, and locations of extensive timber harvests of the late 19th century.

McIntosh (1930, 1931) was the first investigator to characterize the full range of vegetation in the Black Hills, emphasizing species composition. McIntosh classified vegetation types based on successional status. He gave brief habitat descriptions for each type, as well as lists of plant species found in those types. McIntosh's works remain good sources for overviews and context-based descriptions of Black Hills vegetation types. Many of his insights into the vegetation ecology of the area are as relevant today as they were 70 years ago.

Thilenius (1972) sampled and classified Black Hills vegetation in deer habitat, working in a subset of forest and woodland types. Hoffman and Alexander (1987) developed a more extensive classification of habitat types for the Black Hills, focusing primarily on timber-producing stands. This classification provided a useful beginning for a

comprehensive list of community types, especially those dominated by ponderosa pine. Severson and Thilenius (1976) sampled and classified aspen stands in the Black Hills.

The Black Hills National Forest, in compiling a Resource Inventory System database, has collected comprehensive quantitative data in the Black Hills for forest and woodland types, but these data are limited to tree species. In the 1980s, the Forest carried out quantitative surveys of riparian vegetation in the Black Hills (Girard *et al.*, unpubl. data). Data were collected in high quality riparian stands, and thus were useful for identifying candidate survey sites for the BHCI. The results of analysis of these data by the Rocky Mountain Forest Experiment Station were incorporated into the classification produced in this report.

The South Dakota Natural Heritage Program and the Wyoming Natural Diversity Database have been gathering data in the Black Hills since the early 1980s, focussing on both species and sites of special concern. Assessments of potential conservation sites have provided high quality examples and quantitative descriptions for some Black Hills community types.

Carried out concurrently with the BHCI, the US Geologic Survey–National Park Service Vegetation Mapping Project has provided detailed qualitative and quantitative information about community types found in NPS units in area. In addition, several outstanding examples of Black Hills community types were identified and described. The vegetation of Devils Tower National Monument, Jewel Cave National Monument and Mt. Rushmore National Memorial was sampled and mapped in 1996–1997. Field work at Wind Cave National Park was done in 1997–1998, with the map and final report completed in April 1999.

The BHCI was designed to compile, organize and build on the results of prior vegetation work in the Black Hills. Although extensive work had been done, there were significant gaps in vegetation description and classification prior to the project, and only limited information was available concerning stand quality and potential conservation sites. Moreover, there has not been available a consistent vegetation classification system that could be utilized by all agencies and land users. Recently, the Conservancy, in conjunction with the nationwide network of state natural heritage programs, undertook development of a scientifically-sound, consistent and flexible vegetation classification system, now called the US National Vegetation Classification (USNVC) (Grossman *et al.* 1998). The availability of a standardized classification has attracted a broad range of users, and the Federal Geographic Data Committee has accepted this framework as a standard to be used by all Federal agencies (FGDC 1997). The Black Hills classification that resulted from this project is based on the USNVC. The USNVC is described in detail in Appendix 2.

Project Goals and Outline

The BHCI goals were prepared jointly by the Conservancy and the Black Hills National Forest, with review by the Inventory Science Committee, and were designed to meet the needs of all partners in the project. In brief, the goals included classification and

description of the community types of the Black Hills, assessment of quality and status, and identification of sites with exemplary stands of Black Hills types. The following steps were implemented to meet project goals.

GOAL 1: Classify and describe plant community types of the Black Hills.

1.1 Compile a preliminary classification based on prior vegetation studies, utilizing the US National Vegetation Classification.

1.2 Add types where appropriate, through literature survey, consultation with knowledgeable individuals, and field survey.

1.3 Survey exemplary occurrences throughout the range of each of the identified community types in the Black Hills.

1.4 Collect quantitative data for those plant community types not adequately sampled in prior studies. Analyze newly-collected and existing quantitative data.

1.5 From qualitative and quantitative data, describe the plant community types of the Black Hills, addressing species composition, structure, habitat, successional patterns, natural processes, variation and distribution.

GOAL 2: Identify high-quality occurrences of Black Hills community types.

2.1 For each community type or ecological group, develop specifications for ranking occurrence quality, incorporating old-growth criteria where appropriate.

2.2 Assess status of community types in the Black Hills, using factors such as occurrence quality, management level and potential threats.

2.3 Where appropriate, recommend modifications to global and state natural heritage ranks for Black Hills community types.

GOAL 3: Identify sites with high-quality examples of Black Hills community types.

3.1 Identify survey sites thought to include exemplary stands of Black Hills community types.

3.2 Perform site surveys to classify vegetation, assess quality, map stands, and describe other site characteristics.

3.3 Before the final field season, review progress to identify survey sites for community types not found in previous surveys.

3.4 Produce a list of high-quality sites, with descriptions including community types and quality, other relevant site characteristics, and management needs where appropriate.

While the above outline is presented in rough order of execution, it should be noted that the entire process was iterative to a large extent. For example, survey of high-quality stands contributed to classification and characterization of community types, and was critical in developing criteria for quality, which could then be used in further survey.

STUDY AREA

The Black Hills are an isolated mountain range in the Great Plains of western South Dakota and northeastern Wyoming (Figure 1). Trending roughly northwest-southeast, the uplift is approximately 200 km long and 100 km wide, with an area of more than 2 million acres. The highest peak in the Black Hills is Harney Peak (elevation 2200 meters or 7242 feet above sea level) while the plains surrounding the range are about 900 meters or 3000 feet in elevation. The name "Black Hills" comes from the dark covering of ponderosa pine that contrasts with the surrounding prairie. The map of the Black Hills in Figure 2 shows the larger towns, roads, drainages and other important features that are frequently used as location references in this report.

Geology and Geomorphology

The Black Hills uplift is Laramide in age and style, a product of the Laramide mountain-building episodes that produced most of the ranges in the Rocky Mountains. Uplift began near the end of the Cretaceous period, 65 million years b.p. (before present), and ended by 35 million years b.p. (Froiland 1990). The result was a broad-backed

anticline, which subsequent erosion shaped into a rounded mountain range, with concentric exposures of progressively younger rocks moving from the center of the range outwards (Figure 3).

Darton and Paige (1925) described four geomorphic regions of the Black Hills (Figure 3). The Central Core consists of the oldest exposed rock—ancient Precambrian granitic and metamorphic rocks more than 1.6 billion years in age. Elevations are relatively high, and this region includes Harney Peak, the high point of the uplift (7,242 ft). Mt. Rushmore and the Black Hills Needles are other famous outcrops of the Central Core. The Limestone Plateau surrounds the Central Core. It is underlain by the Paleozoic Pahasapa Limestone, which has resisted erosion to produce a high broad surface west of the Central Core. Surrounding the higher elevations of the Central Core and Limestone Plateau is the Red Valley or Racetrack (derived from the Mesozoic Spearfish Formation), a collection of red sandstones and siltstones with occasional gypsum outcrops. The outermost geomorphic region of the Black Hills is the Hogback Rim, composed of sandstones, siltstones and shales of late Mesozoic age. On the southern and eastern flanks, these sandstones form prominent hogbacks—steeply tilted exposures. In the northwestern Black Hills, the strata dip much more gently, and underlie broad sandstone-capped ridges and divides, with sandstone-rimmed canyons. Elevations in the Hogback Rim vary from 3100 ft near Colony in northeast WY, to 4900 ft in the Elk Mountains south of Newcastle.

Froiland (1990) recognized a fifth geomorphic subdivision, the Minnekahta Foothills and Plains, to cover the area between the high Limestone Plateau and the Red Valley. This zone is made up of broad, rolling landscapes in the southern and western Black Hills, where the underlying strata are not steeply tilted. In the northern and eastern parts, the Minnekahta region is more foothills-like.

Also of geomorphological significance is a zone of Tertiary igneous intrusive and volcanic features found in the northern part of the uplift (Figure 3). This was an area of igneous activity late in the episode of mountain-building that produced the Black Hills (Lisenbee *et al.* 1981). The most famous of these features are Devils Tower (5117 ft) and Bear Butte (4422 ft), but there are many others, including Inyan Kara Mountain, Sundance Mountain and the Bear Lodge Mountains.

The Bear Lodge Mountains, or simply Bear Lodge, are a small uplift superimposed on the Black Hills uplift during the time of Tertiary igneous activity in the northern part (Figure 3). The highest elevations in the Bear Lodge are at Warren Peaks near the southern end (6650 ft). Technically a part of the Black Hills range, the Bear Lodge is sometimes considered distinct from the “Black Hills proper,” the two being separated by the Red Valley in the vicinity of Sundance, WY. For the purposes of this study, the Bear Lodge Range and surrounding Hogback Plateau are considered part of the Black Hills.

Climate

Within the Black Hills, precipitation is greater, variations in air temperature more moderate, and wind velocities lower than on the surrounding Great Plains (Froiland 1990).

Mean annual precipitation ranges from 14 inches near the perimeter to 29 inches at stations in the north-central part (Martner 1986), and probably exceeds 30 inches at high elevations in the northwestern Limestone Plateau, the northern central area and at Warren Peaks in the Bear Lodge Mountains (no data available).

The northern Black Hills receive significantly more precipitation than the southern, the boundary between the two regions running roughly west from Rapid City through Deerfield. Throughout the uplift, 65 to 75 percent of the year's moisture falls as rain, or occasionally snow, from April through September (Froiland 1990). Storms are typically frontal prior to mid-June, and convective the remainder of the summer. Intense thundershowers are common. Monthly precipitation increases through mid-July, then drops off sharply, while mean daily air temperatures continue to rise into mid-August. Late July through early September is referred to as the dry season. Snow has been recorded for every month of the year, but commonly falls from October through April.

Average annual air temperature decreases with increased elevation, ranging from 47° F on the outer Hogback Rim to 36° F on the Limestone Plateau. As with precipitation, air temperature exhibits a north-south pattern (Froiland 1990); stations in the northern half of the Black Hills are cooler than those at similar elevations further south. Annual ranges in air temperature are fairly large, with highs above 100° F common at low elevations in July and August, and lows below -15° F occurring periodically throughout the area from December through February (Martner 1986).

Strong winds, including tornadoes, occasionally extend into the Black Hills from the Great Plains, but winds generally are moderated by the uplift. Velocities are greatest during spring and early fall (Froiland 1990).

Flora and Vegetation

The Black Hills have strong floristic ties to four of the North American biomes: Cordilleran Forest, Grassland, Eastern Deciduous Forest and Northern Coniferous Forest. The Cordilleran biome to the west is best represented; roughly 30% of the plant taxa of the Black Hills have their main ranges to the west. Midwestern, eastern and northern influences are also significant (McIntosh 1931).

This botanical melting pot is reflected also in the mix of vegetation types found in the Black Hills. The varied topography, geology and climate result in a corresponding variety in plant communities, including such diverse elements as western ponderosa pine forests, grasslands of the Great Plains, and northern white spruce forests. Midwest hardwood types are well-represented by stands dominated by oak, ash and elm.

Much of the uplift is covered with ponderosa pine forest. It is the most extensive vegetation type over much of the higher elevation regions, in the Central Core, Limestone Plateau, higher Minnekahta Foothills and Bear Lodge Mountains. More mesic sites at higher elevations support stands of white spruce forest. Pine forest intergrades with ponderosa pine woodland, which is more common at lower elevations, in the lower Minnekahta Foothills, Red Valley, and Hogback Rim, and on warmer, drier sites at higher

elevations. Pine woodland includes somewhat closed to open, savanna-like stands of ponderosa pine, often in association with graminoids.

Stands dominated by hardwoods occur in both upland and riparian sites. Upland types include aspen forest, which occurs extensively in the Central Core, Limestone Plateau, higher Minnekahta Foothills and Bear Lodge Mountains, and as occasional small stands at lower elevations. At lower elevations, bur oak, often mixed with ponderosa pine, can form large stands, especially in the northern and eastern parts of the Black Hills. On the northeastern perimeter, bur oak savanna with very little understory covers broad exposures of Mowry shale.

Riparian hardwood vegetation includes paper birch forest, which is common in both wet and dry drainages at higher elevations (Central Core, Limestone Plateau, higher Minnekahta Foothills and Bear Lodge Mountains). At lower elevations, this type gives way to stands of bur oak with ironwood. Other riparian woodland types include cottonwood stands on low elevation floodplains, and a mix of hardwoods species such as oak, ash, boxelder, elm and hawthorne in lower elevation draws and drainages.

Riparian shrublands at lower elevations are typically composed of a mix of shrubs such as western snowberry, gooseberries, currants and roses. Silver sagebrush occasionally forms large stands on floodplains. Thickets of western snowberry are common in draws and on floodplains. High-elevation streams support several shrub types, including willows and water birch.

Non-riparian shrubland types are best developed at lower elevations. Stands of big sagebrush are found in the outer part of the Hogback Rim. Mountain mahogany shrubland is represented by extensive stands on steeply-dipping outcrops of Minnekahta limestone east of Newcastle.

Mixed-grass prairie grasslands are most extensive at lower elevations, in the Minnekahta Foothills, Red Valley and Hogback Rim. Dominant species include representatives of short-, mixed- and tall-grass prairies. High-elevation grasslands include the Black Hills montane grasslands, found in broad drainage bottoms on the Limestone Plateau and adjacent Central Core. The thin rocky soils on the summit of the Bear Lodge Mountains at Warren Peaks and on Cement Ridge south of Sundance, support a similar grassland type.

Graminoid-dominated wet meadows and streambanks are common throughout the Black Hills. Saline and alkaline wetlands are found in the Red Valley and some areas of the Hogback Rim.

Barren substrate communities are found on most of the rock types in the Black Hills. Extensive areas of igneous and metamorphic rocks occur in the Central Core, and in the zone of Tertiary igneous intrusions in the northern part of the range. Limestone outcrops are common on both the Limestone Plateau and in the Minnekahta Foothills, and sandstone is often exposed in the Minnekahta Foothills and Hogback Rim. Redbeds—badlands underlain by the red Spearfish Formation—occur in the Red Valley and along the Belle Fourche River in the northwest part of the uplift.

Landscape-scale Ecological Processes

Landscape-scale ecologic processes are those processes that occur at the scales of hundreds to many thousands of acres, and cover not just a single community type, but mosaics of types across these scales. Fire, insect epidemics, wildlife, and flooding are examples of natural types of landscape processes. Euro-American settlement and activity in the Black Hills have been widespread since the 1880s, and are equally influential at the landscape scale. Interaction between natural landscape-scale ecological processes and human-caused processes has altered the Black Hills landscape in many ways. The roles of fire, insect epidemics, wildlife and flooding, as well as related impacts from human settlement, are discussed below.

Fire

The role of fire in shaping Black Hills vegetation and landscapes has been the subject of much discussion recently (McAdams 1995, Brown and Sieg 1996, Parrish *et al.* 1996, Shinneman and Baker 1997). At question is the role of ecological processes in shaping presettlement vegetation, for which only limited documentation is available. Deriving historical conditions from existing conditions is difficult due to the extensive impact of human settlement in the Black Hills. Only limited success can be achieved in modeling vegetation structure, composition and distribution because of the stochastic, unpredictable nature of vegetation establishment and succession. Finally, the time scale at which vegetation responds to natural large-scale disturbance is great enough to be influenced by long-term trends such as climatic change.

In spite of the controversy associated with Black Hills ponderosa pine ecology, there is general agreement that since the time of Euro-American settlement, human impact has occurred at landscape scales. Little, if any, of the pine vegetation has not been subjected to fire suppression and at least one episode of logging or timber harvest since the late 19th century. In some cases, fuel loads may have increased since settlement. Other activities such as road-building and grazing may have altered natural fire regimes by reducing fuel loads, as well as creating fire breaks (Shinneman and Baker 1997). The widespread impact of human settlement in the Black Hills has produced a complex interaction of landscape-scale processes that is difficult to disentangle.

The earliest systematic survey of Black Hills forest vegetation was the forest inventory of Graves (1899). The inventory was conducted in 1891-1897, by which time substantial logging and timber harvest had already occurred in many parts of the area. Graves sampled, characterized and documented forest stands, producing maps of merchantable timber. Graves's report has been cited as evidence for conflicting views of fire ecology in the Black Hills. The USFS (1994) concluded that there was widespread maintenance of relatively-open forests with frequent fire, producing a relatively-stable condition. Shinneman and Baker (1997) cited Graves's descriptions of extensive denser pine stands as evidence that in much of the Black Hills, infrequent catastrophic fires resulted in a landscape governed by nonequilibrium dynamics. They also catalogue

historical reports of large, catastrophic fires in the Black Hills ranging from 7,500 to 22,000 acres (3000 to 9,000 ha), with a possible extremely large burn of 50,000 acres (20,000 ha). These values may apply to both dry conifer types and mesic conifer types.

Duthie (1930), a Forest Supervisor in the Black Hills, described forest conditions and the prevalence of fire in the area in an effort to promote fire prevention. He considered stand-replacing fires to be common in the Black Hills, as evidenced by frequent even-aged stands, and historical accounts of large stands of fire-killed trees (e.g. in the area of Deadwood). He described the ponderosa pine forests of the Black Hills as differing from those in other parts of the Rocky Mountains in terms of post-fire development:

The western yellow pine of the Black Hills has the peculiar habit, when the old forest has been killed or cleared away, of reproducing in dense thickets. I say this is a peculiar habit because it is unlike the behavior of the same pine in forests farther west where the seedlings will not stand crowding, and come up sparsely. But in the Black Hills the western yellow pine has acquired a characteristic of the lodgepole pine in that the seedlings come up in dense stands crowding each other, yet clinging tenaciously to life until growth practically reaches a stalemate. ... Some of these dense stands may be found where the trees are two hundred years old and the deadlock still persists.

Covington *et al.* (1994) describe ponderosa pine vegetation as being naturally park-like, with relatively few trees that are large and old. This condition would be maintained by frequent, low-intensity fires that cause only young-tree mortality. Covington considers open stands maintained by these frequent fires as the predominant natural condition for interior ponderosa pine vegetation in western North America. McAdams (1995) reached similar conclusions for the southern Black Hills. Other work suggests that this scenario describes only a portion of the range of natural variability of ponderosa pine in the area (Parrish *et al.* 1996, Shinneman and Baker 1997). While fire probably maintained relatively open stands in areas such as drier lower elevations, denser stands produced by longer fire frequencies may have been characteristic of more mesic sites.

Less frequent stand-replacing fires are inherently more difficult to document than frequent low intensity fires. With longer time intervals between burns, evidence is destroyed. Intense fire and the passage of time leave few intact tree ring records. Some fire ecologists consider even-aged stands as indicative of stand-replacing burns (e.g. McAdams 1997, comments to USFS), citing the general absence of such conditions in the Black Hills. However, widespread harvest of ponderosa pine has most likely altered stands from what would have developed post-burn. Even so, Graves (1899), Duthie (1930) and the US Forest Service (USFS 1948) have described large even-aged (or even-sized) stands in the Black Hills.

Progulske and Sowell (1974) concluded that forest cover has increased greatly in the Black Hills since the time of Euro-American settlement based on comparison of pine cover in photos taken during the Custer expedition in 1874, and in photos taken from the same vantage points in 1974. Their study is often cited as evidence of pine expansion with fire

suppression. However, Shinneman and Baker (1997) and Mehl (1992) point out that increased pine cover has resulted also from timber harvest and management.

In defining old growth, Mehl (1992) described the role of fire in ponderosa pine ecology. He recognized two presettlement conditions for ponderosa pine vegetation in the Black Hills. Mehl concluded that areas of periodic low intensity fires were characterized by relatively-small even-aged pine stands separated by grassy open areas. This scenario has been documented for several areas at lower elevations (Fisher *et al.* 1987, Brown and Sieg 1994), and is similar to that of ponderosa pine in other parts of the Rocky Mountain region. In more mesic areas in the Black Hills, where frequent low-intensity fires were not part of the ecosystem, ponderosa pine stands were multi-storied and denser, with standing dead and down trees. Since the end of the 19th century, the drier open pine vegetation has been converted through fire exclusion, harvesting and intensive management to stands with an older overstory and a younger understory. Little remains of the older multi-storied more-dense stands (Mehl 1992).

Increased pine cover during the past century has been attributed to fire suppression, timber harvest and other human activity, but it may also represent a longer-term trend, or events independent of human activity. Soils studies near the southwest edge of the Limestone Plateau suggest that ponderosa pine forest replaced grassland prior to Euro-American settlement of the Black Hills (Bennett 1984; Darwin Hoeft, BHNF Soils Scientist, pers. comm. to H. Marriott in 1984). Both open and closed stands of pine, often with many trees well over 100 years old, have been found on soils typical of grasslands (where soils have no E horizon). In the same area, heavily forested north- and east-facing slopes exhibit only weak E horizons, again indicating that forest development is relatively recent, but that it predates Euro-American settlement based on tree age. Reasons for these changes are unclear, but investigations into the factors that affect changes in fire frequencies or climatic changes over many centuries may provide some insight.

Insect Epidemics

The mountain pine beetle (*Dendroctonus ponderosae*) also contributes to natural disturbances in Black Hills pine stands (Lessard 1986, Schmid *et al.* 1994). Small infestations are common, but larger epidemics are restricted to areas of denser, relatively-young trees (7-13 inches dbh). Large areas of high tree mortality increase the likelihood of large intense burns, at least during the first few years while trees still have dead needles in place (Parrish *et al.* 1996). Some authors have concluded that the influence of the mountain pine beetle has increased in the Black Hills, following fire exclusion and associated increase in tree density. However, silvicultural practices include thinning stands to reduce beetle impacts; this likely has more than compensated for any changes due to fire suppression. Parrish *et al.* (1996) suggest that contemporary epidemics and ensuing fires may be less common because of widespread timber harvest.

Wildlife

Reduction of wildlife populations in the Black Hills has had major impacts on vegetation in some cases. Parrish *et al.* (1996) describe the loss of riparian and wetland habitat related to shrinking beaver populations. Through dam construction and impoundment, beaver expand the width of riparian zones and capture sediments, increasing valley bottom alluvium. Historical trapping and destruction of riparian vegetation (sources of food and building material) are the two major factors behind beaver decline.

At lower elevations in the Black Hills, bison and prairie dogs once played important roles in grassland ecology. Small bison herds currently are managed at Custer State Park and Wind Cave National Park. Both parks also contain prairie dog towns, as does Devils Tower National Monument. Prairie dogs are found elsewhere at lower elevations in the Black Hills, but are often subjected to eradication efforts outside of protected areas.

Hydrological Processes

The natural unpredictable variation in annual precipitation since the time of human settlement in the Black Hills makes assessment of human impact on ground and surface water difficult. Loss of surface water and lowering of water tables was observed in the 1980s, a decade which was relatively dry. However, with several wet years in the 1990s, water levels have increased. Given the natural variation in annual precipitation, and the expected continued population growth, water shortages will continue to be a periodic concern in parts of the Black Hills, especially at lower elevations.

Water diversion, for example for mining and hydroelectric power, has had major impacts on streams in some parts of the Black Hills. Other modifications of stream dynamics have significantly altered riparian vegetation. Two rivers cross the uplift at lower elevations: the Belle Fourche River in the northwest, and the Cheyenne River at the southern end (Figure 2). The Belle Fourche is dammed where it enters the Black Hills at Keyhole Reservoir. As a result, the river downstream is now in an entrenched channel, and floodplain vegetation is not being maintained (H. Marriott, pers. observations compared with old photographs, and conversations with long-time residents). In contrast, the Cheyenne River flows unaltered until it reaches Angostura Reservoir. Floodplain vegetation is well-developed along some stretches of the Cheyenne.

Land Ownership and Management

Most of the public land within the Black Hills is managed by Black Hills National Forest (BHNF), with State and National Park Service (NPS) lands scattered throughout. Custer State Park and Wind Cave National Park occupy large areas in the southeastern Black Hills. Both parks have bison herds that graze the prairies. The NPS manages three

other, small parks within the Black Hills: Mount Rushmore National Memorial is in the Central Core region, Jewel Cave National Monument is located on the edge of the Limestone Plateau in the southwest Black Hills, and Devils Tower National Monument is in the northwest part of the uplift, on the Hogback Rim.

Private land occurs throughout the Black Hills. The largest blocks in private ownership are at lower elevations in the Red Valley and Hogback Rim regions, where ranches are common. There are also concentrations of private land in areas of historical and present-day mining, such as the Lead-Deadwood area. Many of the high elevation meadows of the Central Core and Limestone Plateau are privately-owned, as they were logical homestead sites with more potential for grazing and cultivation.

Land Uses

The Black Hills are dotted with towns and criss-crossed with roads, and there are no large blocks of little-used land. Nine towns with populations of one thousand or greater are located within the uplift, and Rapid City (55,000) is situated on the eastern flank.

Timber, mining, agriculture, recreation and tourism are the most important land uses. The Black Hills are considered the most productive timber source in the region because of the longer, warmer growing season and comparatively high annual precipitation (Knight 1994). Timber harvest occurs throughout the area, on both public and private lands. Gold mining has been an important industry in the high northern Black Hills since the late 1800s. Agriculture, predominantly cattle ranching, is most extensive at lower elevations, but grazing and cultivation occur throughout the Black Hills on both public and private lands. Recreational uses are many, including hunting, fishing, camping, sightseeing, hiking, rock-climbing, mountain biking, snowmobiling and skiing. Recreational use is heavy, by both the local population and the influx of visitors during the summer season.

METHODS

Vegetation classification and description, assessment of vegetation quality and status, and identification of exemplary sites were the three major parts of the BHCI. Information was collected from both secondary sources and field survey over the course of the three-year project.

Vegetation Classification and Description

Classification of Black Hills vegetation follows the US National Vegetation Classification System (USNVC). This system is vegetation-based, emphasizes existing

natural vegetation, and uses a combined physiognomic-floristic approach to classification (Grossman *et al.* 1998). The finest classification level is the (plant) association, and it was to this level that Black Hills vegetation was classified. An association is a vegetation type of definite floristic composition, uniform habitat conditions and uniform physiognomy. Associations are named for dominant or diagnostic species and physiognomy, as illustrated by the following examples from the Black Hills:

ponderosa pine/little bluestem woodland;
boxelder/chokecherry forest;
mountain mahogany/side-oats grama shrubland;
western wheatgrass - green needlegrass herbaceous vegetation.

In general, where the term “community type” or simply “type” is used in this report, it is meant to be a synonymous, non-technical, term for “association.” The USNVC is explained in more detail in Appendix 2.

Preliminary Classification

The first step in the classification of Black Hills vegetation was the compilation of a preliminary classification based on prior work—published literature, data collected by the Forest Service, and information gathered previously by natural heritage programs in SD and WY. It was necessary (but not difficult) to reconcile the various existing classifications with the USNVC. The nature of prior work was such that the classification was best developed and best represented by data for forest, woodland and higher-elevation riparian types. Information gaps were largest for non-forested upland vegetation, and low-elevation types in general.

During the course of the BHCI, the classification was expanded and refined through literature survey, consultation with knowledgeable individuals and field survey. Some types were deleted or reclassified, types newly-reported for the Black Hills were added, and several new types were created.

Field Survey

The BHCI project included three field seasons: May–September of 1996–1998. The work schedule was designed to survey community types when the constituent species were identifiable. Survey targets were prioritized based on information needs and status. Common types for which extensive qualitative and quantitative data had been collected were not surveyed as intensively as were those for which little information was available, or that were considered rare (or for which good examples are rare). As a general guideline, at least three documented examples were sought for each association, with sites distributed

throughout the range of the type in the Black Hills, particularly across geomorphic regions. During the first two field seasons, forest and woodland types were the focus of survey. The final field season was spent filling in the few remaining gaps in forest and woodland survey, with the main areas of emphasis being riparian and non-forested upland types.

The focus of field survey during the BHCI was characterization and documentation of high-quality examples of community types. High quality examples are those sites where native species composition and structure are relatively intact, and where natural processes, such as fire and flooding, occur. Towards that end, a list of potential survey sites was compiled at the beginning of the project, and modified as additional information on sites and community types was gathered. Potential survey sites chosen included management areas likely to contain large, high-quality examples of natural vegetation, such as NPS units, Wilderness Areas, Research Natural Areas, Botanical Areas and the Late Succession Landscapes identified in the recent Forest Plan and EIS (USDA 1997). Late Succession Landscapes are a relatively new type of management unit characterized by large expanses of high-quality vegetation with old, large trees and related structural features. Management emphasizes late successional forest structure, and areas to be treated may be within the same scale as natural stand-replacement events. Prescribed fires and other treatments that mimic natural processes may be utilized, and natural processes may be allowed to operate (USDA 1997). All of these sites tend to emphasize management for the natural biological diversity of the site (see Level 1 definition below in Quality and Status section).

The preliminary survey site list was refined and expanded through consultation with knowledgeable individuals. The riparian study of Girard *et al.* (unpubl.) was helpful in identifying high-quality riparian sites for survey. Other sites were discovered in passing during fieldwork. Prior to the final field season, information gaps were identified, and another round of survey site analysis was made to locate needed vegetation types. BHCI survey site locations are shown in Figures 4a-c.

Prior to field survey, managed area maps, aerial photos and 7.5' topographic maps were used to delineate preliminary site boundaries. Where possible, preliminary plant community boundaries were delineated. These photos and topographic maps were the primary source of reference during field surveys. In the field, vegetation was classified, mapped and evaluated as described above.

Qualitative and quantitative data were collected using standard site and vegetation survey forms of The Nature Conservancy and the Natural Heritage Program Network (Appendix 3). Field survey typically began with reconnaissance of the site to assess suitability. Site Survey Summary forms were used to record site location, site characteristics and survey methodology. Qualitative data on stand composition and condition were collected for each type from multiple observation points (Polygon Characterization form, Appendix 3). If stand size and condition were adequate, more detailed qualitative data were collected to document size, landscape context, and condition (species structure and composition) (Community Ranking and General Description form, Appendix 3). Surveyed stands were combined into element occurrences where appropriate, and mapped on 7.5' USGS topographic maps.

A brief explanation of stand and occurrence definition is useful at this point; detailed accounts are presented in TNC's draft element occurrence data standards (The Nature Conservancy 1998). Stands, also called polygons, are defined as continuous, homogeneous units of a community type. An element occurrence of a community type may be composed of multiple stands of that type when the stands are separated by less than some specified distance. Separation distance is dependent on the type of intervening vegetation or barrier. For example, stands of ponderosa pine/little bluestem that are separated by a substantial barrier (e.g. a paved road or open body of water) are treated as separate element occurrences. Stands separated by some other natural vegetation type(s) less than two km in extent are combined into a single element occurrence.

Decisions as to what size of area qualified as a stand or occurrence varied by community type. In upland forest, woodland, prairie, and shrubland communities, stands were not mapped if they were less than 10 acres (4 ha) in size, and occurrences usually were not mapped or recorded if the total area was less than 40 acres (16 ha). Sites where these upland communities occurred often were greater than 1000 acres (400 ha), and so occurrences of less than 40 acres were considered inclusions within the surrounding vegetation. Exceptions were occasionally made, usually in cases of rare vegetation types or riparian types, for which large examples are rare or absent.

For some community types, it was necessary to map occurrences as complexes of types. This situation was encountered most frequently in riparian and wetland habitat, where vegetation often consists of small patches of multiple plant community types. Prairie dog towns also contain a patchwork of different herbaceous types and these were all treated together as a Prairie Dog Town Grassland Complex. Where possible, descriptions of complexes include the relationship of the various types to habitat characteristics within the complex.

For those plant associations not adequately sampled or described in prior studies, quantitative data were collected from plots (Quantitative Community Characterization form, Appendix 3). At least three plots per type were sought. Plots were placed at representative points within stands, and away from stand boundaries. Habitat data were collected, including slope, aspect and soils information. Cover class was estimated for strata and all species. Diameter at breast height (dbh) measurements were made for trees greater than 10 cm dbh. A variety of plot techniques were used by the various studies, but all forest and woodland types used approximately a 400 square meter area. Shrubland and herbaceous communities were sampled with 100 square meter plots (Appendix 3).

Information Management

Descriptions of plant community types of the Black Hills were prepared in the form of Community Characterization Abstracts (CCAs). The CCA is a standardized report developed by The Nature Conservancy for community characterization, and includes information on structure, floristic composition, habitat characteristics, successional patterns, natural processes, stand variation, global range and management

concerns. CCAs for all Black Hills plant associations are contained in a separate report (see Marriott and Faber-Langendoen 2000).

Site and occurrence data collected during the BHCI were sent to state Natural Heritage Programs. The South Dakota Heritage Program (SDHP) was responsible for entering and storing all data located in the South Dakota portion of the Black Hills. The Wyoming Natural Diversity Database (WYNDD) received all information and data entry responsibility for the Wyoming portion of the Black Hills. In cases where sites and occurrences crossed the state line, data were sent to both the SDHP and the WYNDD, with one of the two programs designated as responsible for database entry.

Plot data from previous studies were visually scanned and compared against literature descriptions as a first iteration of community type review. As part of a second iteration, earlier and newly-collected plot data were analyzed using statistical methods (Marriott and Faber-Langendoen 2000). Data from riparian plots were analyzed by the Rocky Mountain Research Station (Dan Uresk and others). Their analyses produced a list of types that was used to refine the list used in this study.

Quality and Status

Each of the community occurrences surveyed as part of the BHCI was ranked as to quality, using the EORANK (element occurrence rank) system of The Nature Conservancy and the Natural Heritage Program network. Specifications used in element occurrence ranking are presented in Appendix 4. The three major factors (subranks) on which overall rank is based are condition of the vegetation occurrence, occurrence size (i.e. including all sufficiently-close stands) and landscape context. Each of the three subranks range from A (high) to D (low). Overall rank also varies from A to D, but generally occurrences with less than a B overall rank were not documented for the BHCI. Generic specifications for size, condition and landscape context form part of the basis for ranking. In general, large stands with appropriate species composition and lack of unnatural disturbance are ranked higher.

Ranking specifications are relative to some degree, reflecting the range of quality observed in the study area. Developing these standards can be quite challenging in a region such as the Black Hills, where human activity has interacted extensively with natural processes. The process of assessing quality is iterative and underwent refinement as this study proceeded. By maintaining a set of criteria that were related to conditions in the Black Hills, all natural communities can be addressed, even those that may be generally poor in quality. For example, a community type for which there are no large high-quality examples may never receive the highest overall rank of A, but the better occurrences will be ranked sufficiently high to allow them to be tracked.

Condition rank for Black Hills types was based in part on community-specific requirements concerning structure, floristic composition and process. The old-growth criteria of Mehl (1992) for interior ponderosa pine had to be met for old-growth classification of occurrences. Dominant and/or diagnostic species had to be well-

represented and/or present for the higher condition ranks. Evidence of natural processes, such as fire in some ponderosa pine types and flooding in some riparian communities, also resulted in higher ranking. These condition criteria were partly determined by the ecological group in which a type was placed (see Table 1). Thus ponderosa pine types in the Dry Coniferous Forests and Woodlands ecological group had different structural and ecological processes associated with A quality than did ponderosa pine types in the Mesic Coniferous Forest and Woodland group.

The condition criteria may be difficult to apply where natural disturbances are absent, but where some forms of human activity, such as selective or shelterwood timber harvesting, may mimic to a certain degree these natural disturbances. For example, selective timber harvest may retain some of the old growth features of a stand, but may not promote the understory development that occurs after ground fires.

Size ranks were based on groups of community types, relating to the spatial pattern at which communities occurred, whether matrix, large patch or small patch, and to similar ecological processes. For example, those ponderosa pine types that dominate the landscape (matrix types), such as ponderosa pine/common juniper, had larger size requirements than ponderosa pine types that were restricted to large patch habitats, such as ponderosa pine/chokecherry, and small patch types, such as Bebb's Willow Black Hills Fen Shrubland.

The ranking process was continually refined as sites and stands were surveyed. For some community types, little information was available at the beginning of the project. With the discovery and survey of exemplary sites came increased understanding of both structure and composition, as well as appropriate ranking criteria.

Sites surveyed during the course of the BHCI are under a variety of management practices. In considering the management status of a site, the BHCI emphasized those practices that maintain the natural or biodiversity value of a site. For this reason, lands within the Black Hills were classified as to their management goals using a four-class system modified from Caicco *et al.* (1995; Table 2). Level 1 includes areas intended to be maintained in a natural state through natural processes or mimicking of natural processes. Level 2 areas are generally managed for natural values but may receive use that degrades the quality of natural communities that are present. Level 3 areas are generally managed for consumptive or recreational values, but may also maintain some natural value. The lowest level, 4, applies to lands with no easement or management agreement that maintains native species and natural communities.

All sites ranked level 1 or 2 that were known or suspected to contain sufficiently high-ranking community occurrences were surveyed during the BHCI. Several Botanical Areas designated for protection of rare plants (management level 2) were not surveyed during this project, either because previous vegetation surveys had been done, or because the sites and community occurrences were too small. Of the managed areas that were visited during the BHCI, most received extensive survey with all community types documented. The one exception was the Black Elk Wilderness, where several community types were documented in the Pine Creek Research Natural Area and along Grizzly Creek, but the rest of the area was not covered.

Global rarity

One method of prioritizing communities that are in need of protection is to assess those that are relatively rare and imperiled. To address this issue, the Natural Heritage Network and the Conservancy developed a method for evaluating community types and assigning appropriate conservation status ranks (Appendix 5). These ranks are typically applied to the association level. Ranks indicating the rangewide (global) conservation status have been developed for nearly all of the identified associations occurring in the United States, and are available for types in the Black Hills.

Community types are ranked on a global (G) scale of 1 to 5, with 1 indicating critical imperilment due to rarity, endemism, and/or threats, and 5 indicating little or no risk of extirpation or elimination. For example, a rank of G1 indicates critical imperilment on a rangewide basis, i.e., a great risk of "extinction" of the type worldwide. These ranks were used to evaluate which types in the Black Hills are currently most at risk of being eliminated, and to determine whether further field surveys may be needed for these rare types.

Identification of Exemplary Sites

After field survey was completed, sites were evaluated based on size, landscape context (including landscape fragmentation), occurrence quality, and number of community types present. Sites were compared to determine which ones provided the best occurrences. Other biological features, such as rare plants and wildlife habitat, were taken into account where appropriate. Ownership, current management, and existing and potential threats were considered for each site. Sites chosen as exemplary were those that were both relatively large in comparison to other Black Hills sites and contained high-quality examples of plant communities in a landscape sufficiently intact that long-term viability is likely. Exemplary sites were selected to represent as many of the Black Hills community types as possible.

RESULTS

The BHCI has produced a comprehensive vegetation classification for the Black Hills, based on existing classifications and data, as well as new field survey and analysis. This classification is consistent with the National Vegetation Classification System. Many of the community types in the Black Hills are now well-documented in terms of composition, structure, habitat and status. Sites with exemplary high-quality vegetation have been identified and described.

Classification and Description

The vegetation classification produced by the BHCI includes 68 plant associations as shown in Table 1. These types have been standardized to the United States National Vegetation Classification (Grossman *et al.* 1998). The preliminary classification compiled at the beginning of the project included 40 types (Appendix 6). Two of these have since been combined into other types. In addition, three types included on the preliminary list as possibly occurring in the Black Hills were not found during the BHCI, and were dropped from the classification after consultation with local experts (see Acknowledgements). Types considered for the Black Hills, but dropped from the final classification are listed in Appendix 7.

Thirty-three types were added to the preliminary classification during the course of the BHCI. Many of these were wetland types, or types found at lower elevations in the study area. Most were either existing types found elsewhere and now also reported for the Black Hills, or types previously reported for the Black Hills found through literature survey and consultation with local experts. Four types were newly created as a result of this project: Prairie Dog Town Grassland Complex, Redbeds Sparse Vegetation, Black Hills Streamside Vegetation and Western Great Plains Streamside Vegetation. Several existing community types were renamed or reclassified based on the better information available at the end of the project.

Decisions about community classification in the Black Hills were made through a combination of expert review and preliminary quantitative data analysis. A total of 178 plots were available for upland types, either collected as part of this survey (including National Park Service surveys) or by Hoffman and Alexander (1987). A total of 120 plots were available for riparian types, including plots collected either as part of this survey or by the Forest Service riparian survey (M. Girard, B. Parrish and others). Data from the upland plots were visually scanned and compared against literature descriptions as a first iteration of community type review. As part of a second iteration, plot data were analyzed using statistical methods (Marriott and Faber-Langendoen 2000). Data from riparian plots were analyzed by the Rocky Mountain Research Station (Dan Uresk and others). Their analyses produced a list of types that was used to refine the list used in this study.

The plant associations in the Black Hills classification were assigned to ecological groups (Table 1). These groups contain types that occur at similar scales in broadly similar habitats and are subject to similar ecological processes. The ecological groups are not rigorously defined, but are used as a simple ecological ordering of the types. Brief synopses of Black Hills associations are presented by ecological group in the following sections. A detailed description of each plant association in the classification will be contained in the Community Characterization Abstracts (CCAs) to be presented in Marriott and Faber-Langendoen (1999). Included is information on structure, composition, variability, habitat characteristics, ecological processes and distribution.

Dry Coniferous Forests and Woodlands

Much of the Black Hills is vegetated with dry coniferous woodlands. Canopies typically are relatively-open, with less than 50% cover. Four pine types contribute most of the dry coniferous cover: ponderosa pine/bearberry, ponderosa pine/sunsedge, ponderosa pine/little bluestem and ponderosa pine/western wheatgrass. At higher elevations where dry conifer stands are restricted to the more xeric sites, ponderosa pine/bearberry woodland is the most extensive of the dry coniferous communities. It is best developed in the Central Core region in areas of granite outcrops. The ponderosa pine/sunsedge and ponderosa pine/little bluestem associations also are common at higher elevations, but both are widespread in the Black Hills. Ponderosa pine/little bluestem occurrences are most extensive at lower elevations.

Dry coniferous woodlands are more dominant at lower elevations in the Black Hills, especially in the Minnekahta Foothills and Hogback Rim. Ponderosa pine/sunsedge, ponderosa pine/western wheatgrass and ponderosa pine/little bluestem are the most extensive types. Five other dry coniferous woodland associations are locally significant at lower elevations. Ponderosa pine/Rocky Mountain juniper and Rocky Mountain juniper/little-seed ricegrass are important components of the vegetation in the outer Hogback Rim. Ponderosa pine/bluebunch wheatgrass woodland has been documented in the northwest part of the Hogback Rim. The ponderosa pine/Oregon grape association has also been reported from that area, and from the Limestone Plateau (Larson and Johnson 1999). Ponderosa pine scree woodland occurs at Bear Butte, on the eastern flank of the Black Hills.

During the course of the BHCI, representative examples of all dry coniferous forest and woodland associations were surveyed (Table 3). At least six occurrences were documented for each of the four major types except one, the ponderosa pine/western wheatgrass community (two occurrences documented). That type occurs at lower elevations and is predominantly under private ownership. One to three occurrences each were surveyed for the five less frequent types.

Survey of dry coniferous woodlands in the Black Hills confirmed that habitat differences among many of those communities can be difficult to recognize. Previous workers have described the difficulties in segregating ponderosa pine types, and modeling distribution based on habitat (Thilenius 1972, Hoffman and Alexander 1987). Certainly stochastic events have played an important role in vegetation establishment and succession, among these being human activity, which has been an important factor for over a hundred years. In general, the most xerophytic and mesophytic of the ponderosa pine types in the Black Hills are the easiest to circumscribe in terms of composition and habitat.

Mesic Coniferous Forests and Woodlands

Mesic coniferous forests and woodlands contribute much of the vegetative cover in the Black Hills at higher elevations, and are found at lower elevations on more mesic sites. Canopy cover is typically greater than 60%. The most extensive associations are ponderosa

pine/common juniper, ponderosa pine/snowberry and ponderosa pine/rough-leaved ricegrass. Several other mesic coniferous types can occur as large stands, but are less common or more localized in distribution. White spruce/twinflower and white spruce/grouseberry forests are found in more mesic habitat on the Limestone Plateau and in the Central Core. They are absent from the Bear Lodge Mountains, even though comparable elevations occur there. Ponderosa pine/mountain ninebark and ponderosa pine/chokecherry occurrences have been documented at locations scattered throughout the central and southern Black Hills. Ponderosa pine/bur oak is more common at mid- to low elevations in the eastern and northern parts.

At least four occurrences were documented for all but one of the mesic coniferous types in the Black Hills (Table 3). Two occurrences were documented for the white spruce/grouseberry association, which is the least common of these types.

Like dry coniferous woodlands, stands of mesic coniferous pine types can be difficult to classify due to variable species composition and intergradation among types.

Upland Hardwood Forests and Woodlands

Upland hardwood forests and woodlands occur as smaller patches within the coniferous vegetative cover of the Black Hills. Four upland hardwood types were recognized as a result of the BHCI. Probably the most distinctive is the bur oak woodland that occurs on exposures of Mowry shale in the outermost Hogback Rim in the northern and northeastern Black Hills. This type was not surveyed during the BHCI as ownership is private. This community has been tentatively classified as the bur oak/sunsedge association, but probably includes other types. Very little information is available. Three upland aspen types were recognized: aspen/beaked hazel, aspen/bracken fern and aspen/spiraea. All are found at higher elevations, and are best developed on the northern Limestone Plateau and in the Bear Lodge Mountains. Several occurrences for each of these associations were documented from those areas (Table 3). The final upland hardwood type included in the classification is the bur oak/western snowberry association. Other oak types may occur in the northern Black Hills; additional survey is needed.

Two mixed conifer-hardwood types with aspen as a component were dropped from the final classification: white spruce-aspen and ponderosa pine-aspen. It was decided that these situations were not floristically distinct, and are better treated as aspen patches within spruce or pine types.

Aspen stands were sometimes difficult to classify. Aspen can occur with highly variable understory in the Black Hills, which is not inconsistent with the concept of aspen types as early successional. Severson and Thilenius (1976) recognized nine aspen groups based on a similarity index of 60; four of these were based on only one stand each. Several of the groups shared herbaceous dominants with at least one other group. In BHCI surveys, stands of aspen/beaked hazel and aspen/bracken fern were fairly consistent in composition and easily classified. Both types show good correspondence to groups recognized by Severson and Thilenius. The aspen/spiraea type of the Black Hills classification is the most variable in terms of species composition. It includes six of the

groups recognized by Severson and Thilenius; most of which are based on only one stand each. The most mesic

aspen group of those authors was dominated by aspen and ironwood. This is not a common combination of dominants in the Black Hills, and probably represents a transition between types.

Dry Plains Shrublands

Dry plains shrublands are found at lower elevations in the Black Hills, in the Minnekahta Foothills, Red Valley and Hogback Rim. Four associations are currently recognized: big sagebrush/western wheatgrass shrubland, mountain mahogany/side-oats grama shrubland, creeping juniper/little bluestem dwarf-shrubland, and three-leaved sumac/bluebunch wheatgrass shrubland. The big sagebrush type is uncommon in the Black Hills, being restricted to the lowest elevations of the western and southern Hogback Rim. It is found in areas of private ownership, and no occurrences were surveyed for the BHCI. The mountain mahogany type is the most extensive of the dry plains shrublands in the study area, but also is restricted in distribution. It is best developed on low-elevation limestone east of Newcastle, WY. The type was also documented on limestone at Wind Cave NP (Table 4). Creeping juniper dwarf-shrubland is found only occasionally in the Black Hills. Two occurrences were documented: one on the eastern flank near Sturgis, and one at Wind Cave NP. A single occurrence of three-leaved sumac/bluebunch wheatgrass shrubland was found, on the summit of Devils Tower (Table 4).

Dry plains shrublands probably are not as uncommon as current documentation indicates (Table 3). Much of the potential habitat is under private ownership, and has not been surveyed.

Mesic Plains Shrublands

Two mesic plains shrubland types were recognized and documented for the Black Hills (Table 3). Silver sagebrush/western wheatgrass shrubland is known from the floodplain of the Belle Fourche River in the northwestern part of the range. Chokecherry shrubland, often with three-leaved sumac co-dominant, was found in dry draws in parts of Wind Cave NP (Table 4).

As for dry plains shrublands, the mesic plains shrubland types have been poorly surveyed due to ownership patterns.

Dry Mixedgrass Prairies

The most common dry mixedgrass prairie type in the Black Hills is the Northern Great Plains little bluestem prairie, dominated by little bluestem, blue and side-oats grama and often thread-leafed sedge. It occurs throughout the study area, but stands at higher

elevations tend to be small. It is best developed in the Red Valley and Hogback Rim. Eight occurrences of the little bluestem type were documented in the course of the BHCI (Table 3).

The other dry mixedgrass prairie type, needle-and-thread - blue grama mixedgrass prairie, is restricted to the lower elevations of the Hogback Rim and Red Valley. Occurrences were documented at Wind Cave NP, Elk Mountain in the southwestern part of the study area and in the northern Red Valley (Table 4).

Mesic Mixedgrass Prairies

Mesic mixedgrass prairies are most extensive in the Red Valley and much of the Hogback Rim. Two associations are currently recognized for the Black Hills: western wheatgrass - green needlegrass and western wheatgrass - needle-and-thread mixedgrass prairies. Mesic mixedgrass prairies were surveyed extensively during vegetation mapping at Devils Tower NM and Wind Cave NP (Table 4). Stands can be difficult to classify due to shared dominants among both mesic and dry mixedgrass types. Species distribution often is patchy, with local dominance variable. Additional survey of lower elevation areas under private ownership is needed to refine the grassland classification for the Black Hills, as well as to document distribution and habitat.

Black Hills Montane Grasslands

Black Hills montane grasslands are endemic to the Black Hills (i.e. this plant association does not occur anywhere else outside of the area), and are found at higher elevations on the Limestone Plateau and adjacent Central Core. They are typically forb-rich, and are known among locals for spectacular seasonal wildflower displays.

The montane grassland type was described by McIntosh (1930, 1931), who provided general habitat descriptions with lists of species encountered. He considered the "mountain meadow stage" a preclimax or development stage in succession from wetland to climax forest. He described two phases, one with timothy (*Phleum pratense*), an exotic, dominating lower meadows, and the second with prairie dropseed (*Sporobolus heterolepis*) and needlegrass (*Stipa* spp.) common on well-drained slopes. McIntosh's work remains the most oft-cited reference for the montane grassland type.

Limited survey has been done since McIntosh's time, including non-forested upland sampling by the Forest Service in the 1980s at sites that were thought to possibly include montane grasslands. Surveys have been hampered by the lack of clear definition and circumscription of the type. There is also widespread concern that little or no native montane meadow vegetation remains in the Black Hills. Many of the montane grasslands have been significantly altered or converted, through hydrological modification, grazing, cultivation, and invasion of exotics.

During the 1998 field season, Black Hills montane grasslands were the focus of approximately one-week of reconnaissance and sampling. The objectives were to better

define the type(s), and to identify exemplary sites. Many candidate meadows, especially in the northern Black Hills, were found to be overwhelmingly dominated by timothy, and were probably cultivated or seeded in the past. Many others were dominated by timothy and red clover, often with stands of noxious weeds and other invaders.

Thirteen sites were found with recognizable examples of montane grassland, i.e. with the native species reported by McIntosh present and at least as prevalent as non-natives (Table 3). All were on BHNF lands. Most were small, and all of the higher-quality examples fit the description for the well-drained slope phase described by McIntosh. Five stands were considered large enough for sampling, and nine plots were done for the type. Several stands from Warren Peaks and Cement Ridge are included in this type because they occur at high elevations, and are similar in floristic composition. All stands surveyed during the BHCI would require some level of restoration management to produce worthy conservation sites. During the 1999 field season, additional A and B ranked montane grassland occurrences were found during a survey funded by the SD Dept. of Game, Fish and Parks (Marriott in prep.).

Prairie Dog Town Grassland Complex

Prairie dog towns were surveyed during vegetation mapping projects at Devils Tower NM and Wind Cave NP (Table 4). Towns also occur on private lands at lower elevations in the Black Hills, but location, extent and vegetation characteristics have not been documented outside of the NPS units. Dog towns are naturally disturbed sites, with sparse-to-dense herbaceous cover of variable species composition. The towns surveyed during the BHCI were dominated most frequently by purple three-awn and fetid marigold, with a wide range of species locally dominant.

Plains Riparian Forests and Shrublands

The riparian forests and shrublands of lower elevations in the Black Hills were poorly surveyed during the BHCI due to ownership status (an estimated 50% of all riparian systems in the study area are privately owned). However, at least one occurrence of most types was documented (Table 3). Sandbar willow stands (an early successional type) were documented throughout the study area, and appear to be equally common at lower and higher elevations. However the most extensive stands occur at lower elevations, for example along the Cheyenne River above Angostura Reservoir, where the hydrology is still largely natural. Wolfberry (western snowberry) shrubland was found to be widespread in drainage bottoms and draws at lower elevations.

The narrowleaf cottonwood/red-osier dogwood type was found in the lower canyons of Spearfish and Little Elk Creeks, typically on recently formed alluvial bars. Most of the documented occurrences of other plains riparian types were located within NPS units. Devils Tower NM includes small examples of two floodplain types along the Belle Fourche River, the plains cottonwood/sandbar willow and green ash - elm/western

snowberry associations. Boxelder/chokecherry occurrences were well-documented at Wind Cave NP and Jewel Cave NM (Table 4).

High Elevation Riparian Forests and Shrublands

Three community types were recognized within this ecological group. All have been well documented, either by previous workers or with survey during the course of the BHCI. Beaked (or Bebb's) willow scrub is by far the most common riparian shrubland type at higher elevations throughout the Black Hills. Thirteen occurrences were documented during the BHCI (Table 3). Sandbar willow shrubland, though more common as a *Plains Riparian Forests and Shrublands* type, is also common along streams at higher elevations, often found mixed with beaked willow scrub. Water birch shrubland is uncommon and restricted to higher elevations of the Central Core in the central Black Hills. Two occurrences were documented. The third high elevation riparian type is white spruce alluvial Black Hills forest. It usually is found in very mesic drainages at high elevations on the Limestone Plateau and Central Core. In the wetter northern Black Hills, the type extends to lower elevations. Eight occurrences were documented as part of this project.

Dry Riparian Forests and Woodlands

Four dry riparian community types are recognized for the Black Hills. These types typically occur on the lowermost slopes and bottoms of drainages with or without streams. Paper birch/beaked hazel forest is the most extensive type at higher elevations, especially in the northern part of the study area. Eight occurrences were surveyed and documented during the BHCI (Table 3). At lower elevations in the eastern and northern parts of the Black Hills, this type is replaced by bur oak/ironwood forests; stands in transition zones include dominant species from both types. Five occurrences of the bur oak/ironwood type were surveyed.

Aspen/chokecherry forest was documented at two locations: in the Central Core northwest of Hill City, and in Hell Canyon just north of Jewel Cave NM (Table 4). This type may represent a short-lived phase successional to ponderosa pine/chokecherry, which is more common.

Three occurrences of Plains Hawthorn Shrubland were found in the northern Black Hills. This is a newly-reported community type for the area, and needs additional survey for adequate characterization and quality assessment. It is probably more common at lower elevations, where much of the land is under private ownership.

Riparian/Wet Meadows

Classification and delineation of riparian and wet meadow types has long been challenging, as these types often occur in mosaics of small patches. For the BHCI, riparian/wet meadow vegetation was often treated as mapping complexes for the purpose of defining occurrences. At higher elevations, these complexes often contained stands of high elevation riparian forests and shrublands, especially beaked willow scrub and white spruce alluvial Black Hills forest. The common riparian/wet meadow types found in these complexes include Canada bluejoint meadow, Nebraska sedge wet meadow, prairie cordgrass-sedge wet prairie, and Black Hills streamside vegetation. Six riparian/wetland complexes were documented at higher elevations (Table 3). A baltic rush type also is present, but further documentation is needed.

At lower elevations, Nebraska sedge wet meadow, prairie cordgrass-sedge wet prairie, creeping spikerush wet meadow, northern Great Plains cattail community and western Great Plains streamside vegetation are the most common components of riparian/wet meadow mosaics. Three lower-elevation riparian/wet meadow complexes were documented.

Inland saltgrass - alkali-sacaton saline prairie has been reported from saline riparian habitat at low elevations in the Black Hills (Marriott 1985), but the type was not surveyed during the BHCI.

Fens

A single fen type is known from the Black Hills, at McIntosh Fen northwest of Deerfield Lake. The wetland was drained earlier this century while under private ownership, and much of the unusual species assemblage reported by McIntosh (1931) has been lost. The fen is now a relatively small wetland, but is located in unique habitat for the Black Hills. Three community types occur in the riparian/wet meadow complex at McIntosh Fen: sage willow fen, Nebraska sedge wet meadow, and baltic rush wet meadow. Two of the willows found at McIntosh Fen, *Salix candida* and *S. serissima*, are rare or found nowhere else in the Black Hills. These small stands may be the last relics of a once-more-extensive type.

Marshes

The single marsh type known from the Black Hills is the Great Plains cattail - bulrush marsh. A single occurrence was documented at Cox Lake in the Red Valley.

Black Hills Sparse Vegetation

Sparse vegetation types in the Black Hills have been classified based on substrate type. The Black Hills rock outcrop type occurs on the granitic and metamorphic rocks of the Central Core and on igneous rocks exposed in the northern part of the study area. The ponderosa pine limestone cliff type occurs as occasional small patches on the Limestone Plateau and in the Minnekahta Foothills. Redbeds rock outcrop sparse vegetation develops on the badlands underlain by the Spearfish Formation in the Red Valley. Sandstone Great Plains rock outcrops are found in the Minnekahta Foothills and Hogback Rim, both as hogbacks and extensive exposures rimrock along drainages. Two scree/talus types, a sparsely vegetated type, and a wooded type dominated by ponderosa pine, are found in restricted localities in the Central Core region and on Bear Butte. Shale barrens slopes, though not documented, are expected to be common at lower elevations on the outer Hogback Rim, perhaps in conjunction with the bur oak/sun sedge woodland.

Status and Quality

As explained in the METHODS section, each of the community occurrences surveyed was ranked as to natural quality. Occurrence ranks range from A (high) through D (low). The three major factors or subranks on which overall occurrence rank is based are condition (e.g. old-growth, burden of exotics), landscape context, and occurrence size (based on the combined acreage of all stands of a type that are not separated by a substantial barrier within the site— see METHODS: Field Survey section). The focus of the BHCI was higher-quality vegetation, and so occurrences with less than a B overall rank usually were not surveyed and documented in detail. The one exception was Black Hills montane grassland communities, for which very few high-ranking occurrences were found.

Few occurrences of any community type received the highest overall rank of A. The most common factors behind downranking of condition were lack of old-growth conditions for some forest types[HM1], presence of unnatural disturbances (e.g. roads and associated exotics, doghair (dense understory of ponderosa pine seedlings and saplings), and presence of exotics. Size rank was highly variable, ranging from A (very large) to D (very small). Landscape context rank was the same for most occurrences surveyed in the Black Hills, as most were "... surrounded by moderately intact natural vegetation, with species interactions and natural processes occurring across many communities ... area is 2500-10,000 acres with 50-80% natural vegetation" (The Nature Conservancy 1998). Occurrences at Wind Cave NP were given slightly higher landscape context rank (usually AB, which is intermediate between A and B) because of the large size of that natural area, and the extent of natural processes such as burning and bison grazing.

Quality ranks for occurrences surveyed in the BHCI are summarized by community type in Table 3, and survey site locations are shown in Figures 4a-c. The BHCI focussed on high-quality sites and vegetation; high-ranking examples (A-B) were found and documented for most of the community types in the Black Hills. Even the lowest-ranking occurrences surveyed are ranked B in most cases.

At many of the sites surveyed, all community types were documented in order to provide a comprehensive list of types for the site, even those occurring only as smaller stands (though still meeting the minimum mapping unit requirements – see METHODS). Thus for some types, in addition to the three or so high quality occurrences that were explicitly sought out to fulfill the goals of the inventory, several occurrences of relatively poor quality were recorded simply because they were present at sites where other types were being documented. For example, ponderosa pine/little bluestem woodland is widespread in the Black Hills, occurring as small stands at higher elevations, and as extensive stands at lower elevations. Fourteen occurrences were documented (Tables 3 and 4). Most are ranked B, due to size subranks of C or D, and occurred on sites where other types were being documented. The large number of B ranks should not be construed to mean that many more A quality examples were not available.

Of the 16 occurrences with the highest overall rank of A, most (ten) are located in Wind Cave NP, where large stands are situated in a largely intact area with natural processes in place (e.g. bison, prescribed burns) (Table 5). Other A-ranking occurrences were scattered among types and management units. Types with the highest percentage of occurrences ranked A were the Black Hills sparse vegetation types.

The only community type surveyed for which criteria for high-quality had to be adjusted downward because of the generally low quality of existing occurrences was the Black Hills montane grassland (Tables 3 and 4). The ranking scale this community type was adjusted to accommodate its relatively-poor overall condition. Even so, of the thirteen occurrences documented, only one large occurrence, at Warren Peaks in the Bear Lodge Mountains, received a rank higher than B (AB). This is not the typical montane grassland of the Limestone Plateau, but has been provisionally included in the type due to floristic similarity (see DISCUSSION; Additional Research Needs). During the 1999 field season, additional A and B ranked montane grassland occurrences were found during a survey funded by the SD Dept. of Game, Fish and Parks (Marriott in prep.).

Management Status

Five sites managed at management level 1, and 15 sites managed at management level 2, were surveyed during the course of the BHCI (Table 2, Figures 4a–c). Black Hills community types under different levels of management are shown in Table 6, with a summary of A and B ranked occurrences found under levels 1 and 2 management. Few strong patterns emerged as to which types are managed for natural values and which are not. In general, types found most commonly in areas with significant private ownership, such as montane grasslands and low elevation types, were less well represented in level 1 or 2 sites. However, Devils Tower NM and Wind Cave NP provided multiple high-ranking occurrences of lower elevation community types under level 1 management.

Dry and mesic coniferous forests and woodlands are the types best represented at sites under level 1 or 2 management (Table 6). Black Hills sparse vegetation types are common in the level 1 sites surveyed. Higher elevation riparian and wetland types are well-represented at level 2 sites.

When all Black Hills community types represented by higher-ranking occurrences (A, AB and B) at sites under level 1 or 2 management are totaled it can be seen that 75% percent of the Black Hills types, and 49% of the occurrences documented during the BHCI, meet these criteria (Table 6).

Global Status

Of 68 plant associations in the Black Hills classification, 28 are considered globally-rare (G1-G3, Table 7). The global status of five types is not known (G?). Of the globally rare types, at least ten are either endemic or mostly limited to the Black Hills. The rangewide distribution of some types is not currently known. The 28 rare types fall in to three categories. Fourteen are riparian types (including three High Elevation Riparian Forests and Shrublands, three Dry Riparian Forests and Shrublands, five Plains Riparian Forests and Shrublands and three Riparian/Wet Meadows), three are upland high elevation types, and eleven are endemic or limited upland types (including the three upland high elevation types).

Sites

One of the more important contributions of the BHCI has been the identification and description of sites with high quality occurrences of Black Hills community types. In addition to their value as natural areas, such sites serve as examples against which to compare other areas and stands, for example in assessing management impacts.

Sites chosen for survey were suspected to include good examples of community types. As a result, of 62 sites visited, only two were considered inadequate for survey, due to poor vegetation condition and small stand size. Almost all of the remainder included occurrences ranked B or higher (with the exception of six montane grassland sites with occurrences ranked BC or C). Some sites were surveyed for only one or two communities, for the purpose of characterizing those types. However, at most of the large sites, all stands were classified and ranked. Survey site locations are shown in Figures 4a-c.

Eight of the sites surveyed are considered exemplary sites (Table 8). These sites typically are large relative to other Black Hills sites, and contain high-ranking occurrences (A, AB or B) of multiple community types in landscapes that are relatively intact over large areas. To be considered exemplary, a site did not necessarily rank high for all criteria. Sites chosen as exemplary are Black Elk/Upper Pine Creek, Black Fox, Canyon City, Cranberry Springs, Elk Mountain, McIntosh Fen, Upper Grace Coolidge Creek, and Wind Cave NP. Together, these sites represent each geomorphic region in the Black Hills (Table 9). Table 5 lists each site surveyed, but more comprehensive descriptions and justification for exemplary sites are provided below. Community types found at all survey sites of the BHCI, with occurrence ranks, are shown in Table 5. Community types found in exemplary sites and other possible exemplary sites, with occurrence ranks, are shown in Table 8.

Black Elk/Upper Pine Creek

Black Elk Wilderness (Site #55), which includes the Upper Pine Creek Research Natural Area (RNA), is located in the southern part of the Central Core region, southwest of Rapid City. It includes the highest point in the Black Hills, Harney Peak. Community types found in this area are shown in Table 8. Mesic coniferous forests and woodlands (including old growth), the ponderosa pine/bearberry type (dry coniferous forests and woodlands), and high elevation riparian types are well-represented with high-ranking occurrences. This is a large area in a landscape managed largely for natural values. The site is under level 2 management. Much of the region from Black Elk/Pine Creek, through the Norbeck Wildlife Preserve and Custer State Park to Wind Cave NP is under level 1 or 2 management, with portions of Custer State Park managed at level 3.

Black Fox

Black Fox (Site #27) is located in the northwest part of the Central Core region, north of Deerfield Lake. Community types found in this area are shown in Table 8. Mesic coniferous forests and woodlands (including old growth), and high elevation riparian types are well-represented. There is a large complex of riparian forest, shrubland and herbaceous types that is one of the best examples found during the course of the BHCI. The area includes significant recreational use. The site is under level 2 management.

Canyon City

The Canyon City site (Site #34) is located in the central part of the Central Core, along Rapid Creek west of Pactola Reservoir. It is a large site, with a high diversity of types; occurrences are generally high-quality. Community types found in this area are shown in Table 8. Mesic coniferous forests and woodlands (including old growth), dry riparian types and high elevation riparian types are well-represented. The best example of water birch shrubland, a type that is relatively uncommon and restricted in the Black Hills, was found at this site. Several dry coniferous types occur as well. The site is under level 2 management.

Cranberry Springs

Cranberry Springs (Site #11) is located on the northwest edge of the Limestone Plateau east of Sundance. It is a designated Late Succession Landscape, and is adjacent to the Upper Sand Creek Botanical Area. Community types found in this area are shown in Table 8. Mesic coniferous forests and woodlands (including old growth), dry riparian types

and upland hardwoods are well-represented. Small occurrences of dry conifer types are present. The site is under level 2 management.

Elk Mountain

Elk Mountain (Site #41) is located in the southwest Hogback Rim, south of Newcastle. Community types found in this area are shown in Table 8. The site is large, with a diverse mix of the more xerophytic types of the Black Hills. Dry coniferous forests and woodlands (including old growth), and dry and mesic mixedgrass prairies are the types best represented. The site is under level 3 management.

McIntosh Fen

McIntosh Fen (Site #38) is a relatively small site, but is located within a unique habitat in the Black Hills. Only four community types were identified at McIntosh Fen (Table 8), but the small pockets of willow shrublands (*Salix candida*, *Salix serissima*) are rare or found nowhere else in the study area, and may be the last relics of a once-more-extensive type. Black Hills National Forest is currently managing this site as a Botanical Area, and restoration of the natural water regime is underway in hopes of reinvigorating the native plant communities. The site is under level 2 management.

Upper Grace Coolidge Creek

Upper Grace Coolidge Creek (Site #58) is located in the southern Central Core southeast of Custer. It was surveyed during the BHCI only for riparian and wetland types (Table 8), but includes upland types as well, predominantly mesic coniferous forests and woodlands. It includes a large complex of high elevation riparian and wet meadow types, including forests, shrublands and herbaceous communities. Occurrences surveyed are high ranking. The Upper Grace Coolidge Creek site is located a short distance south of the Black Elk Wilderness, and is within a relatively large region under level 1 or 2 management (from Black Elk/Pine Creek through the Norbeck Wildlife Preserve and Custer State Park to Wind Cave NP, although much of Custer State Park is managed at level 3). The site itself is under level 2 management.

Wind Cave National Park

Wind Cave National Park (Site #62) is located in the southeast Black Hills, north of Hot Springs. It contains some of the highest quality community occurrences in the Black Hills and is the largest unit under level 1 management. The park spans most of the geomorphic subdivisions, but the Minnekahta Foothills, Red Valley and Hogback Rim are

best represented. It supports one of two bison herds in the Black Hills (the other is in Custer SP).

Community types found in this area are shown in Table 8. Included are dry and mesic coniferous forest and woodland communities, plains shrubland types, dry and mesic mixedgrass prairies, tallgrass prairie (big bluestem - little bluestem), and relatively-small stands of riparian and wetland types. Perhaps one third of the park is vegetated with forest or woodland; the remainder is largely grassland with smaller stands of shrubs and hardwoods.

Exotics are locally common at scattered locations, but the overall condition of vegetation in the park is high. The NPS has been actively managing the park with prescribed burns, returning the natural element of fire to the system. The site is under level 1 management.

Other Possible Exemplary Sites

Several other sites surveyed are potential exemplary sites. Some are relatively small; others were not extensively surveyed during the BHCI, and additional information is needed. Included are the following (the community types found in each of these sites are given in Table 8).

Devils Tower National Monument (Site #1), on the northwest Hogback Rim, includes high ranking occurrences of a diversity of low elevation types. However, most occurrences are relatively small, and the riparian types are in poor condition. The site is under level 1 management.

Hell Canyon North (Site #43)/Jewel Cave National Monument (Site #42), on the southwest edge of the Limestone Plateau west of Custer, is a large area with a mix of coniferous types, including old growth stands. The two individual sites did not rank out as high as other sites with similar vegetation, but if managed together might qualify as exemplary. The site is under both level 1 (Jewel Cave) and level 2 (the rest) management.

Little Spearfish Creek (Site #16) on the northern Limestone Plateau includes a diversity of high ranking riparian and wet meadow types. Recreational use is high. The site is under level 3 management.

The Cox Lake site (Site #6) is located in the Red Valley west of Spearfish, in a public access fishing area approximately one mile north of the McNenney State Fish Hatchery. It includes wetlands and small ponds or lakes, including one sinkhole lake. At least three community types are represented by good-condition stands within the wetland mosaic found. These are lower elevation types not well represented in sites chosen as exemplary.

Beaver Park (also known as Forbes Gulch/Beaver Park) was not surveyed as part of the Black Hills Community Inventory, but data from the site have been included in the project (from a draft report by Dave Ode, SDNHP). Landscape context for the site ranks relatively high due to the roadless nature of the area. Several occurrences received overall ranks of AB based on information from Ode. However, because ranking was based on

secondary sources, and because no survey was done to define the extent of community types and compare quality to other occurrences, it was not possible to confidently determine exemplary status.

Vanöcker Creek (Site #17), Little Elk Creek (Site #30) and Lower French Creek (Site #61) on the east flank of the Black Hills all contain at least one high quality example of plains riparian forests and shrublands. Additional research is needed, including survey of Little Elk Creek and Upper French Creek. The sites are under level 3 management.

During the survey of Black Hills montane grasslands, several occurrences were clearly of better quality: Eagle Cliffs (Site #20) and Hardy (Site #22), both near O'Neill Pass southwest of Spearfish. These occurrences may form the basis for exemplary sites for that type. During the 1999 field season, additional A and B ranked montane grassland occurrences were found during a survey funded by the SD Dept. of Game, Fish and Parks (Marriott in prep.).

DISCUSSION

Classification and Description

Through reconciliation of existing vegetation classifications and new field survey, a comprehensive vegetation classification has been developed for the Black Hills. This classification is fully integrated into the USNVC (Grossman *et al.* 1998). The 68 types currently recognized range from high elevation white spruce forests and montane grasslands to low elevation mixed-grass prairies and saline meadows. Existing classifications and descriptions for higher-elevation coniferous and upland hardwood types were modified only slightly. Most of the new information and changes (deletions, additions, combinations and new types) applied to areas where less work has been done, such as lower elevations where private ownership is significant, and smaller or unusual habitats including riparian zones and rock outcrops.

As is often the case in vegetation inventories, not all community types surveyed in the course of the BHCI were easily segregated. Two especially problematic groups were ponderosa pine and aspen communities. While the most xerophytic and mesic of the pine types generally are easy to classify, the intermediate types do not segregate as well, as was clearly shown in vegetation mapping projects at the NPS units in the Black Hills. Stands of pine with understory dominants from several different "types" were not uncommon. Aspen also occurs with highly variable understory in the Black Hills, which is consistent with the concept of aspen types as early successional. Problems in classification are further addressed in the CCAs for Black Hills associations (Marriott and Faber-Langendoen 2000).

Additional classification challenges are presented by transition zones between types. A good example from the Black Hills is that of paper birch/beaked hazel and bur oak/ironwood associations. Both are major dry riparian types, with the birch type occurring at higher elevations than the oak type. In both the BHCI and in previous studies, some stands of paper birch/ironwood and bur oak/beaked hazel were described.

These are considered transition phases, and are classified by canopy dominant into one of the two overlapping types.

The uses of ecological groups to organize the types, though simple and not based on any rigorous classification criteria, has helped present the types in a meaningful ecological order. Major environmental gradients suggested by this ordering include elevation (as it affects precipitation and temperature), moisture, and soil thickness. Fire interacts with these gradients in the dry uplands group, increasing at lower elevations and drier soil conditions. These inter-relationships are presented in schematic fashion in Figure 5.

Though comprehensive, the Black Hills classification will continue to be modified as additional work is done. Some of the community types are restricted to lower elevations in areas of private ownership, where survey has been limited. For example there is little information available for several of the Dry Plains Shrubland and Dry Mixedgrass Prairie community types, which are found predominantly on private lands. Types not yet reported for the Black Hills may be found in these areas also. Several Black Hills plant associations that are known to be high-priority for additional survey are discussed under Additional Research Needs below.

Quality and Status

Assessment of Community Quality

Developing quality standards and ranking stands of vegetation as to "naturalness" can be quite challenging. The range of natural variability of vegetation in the Black Hills is represented by only limited presettlement documentation, and the concept is surrounded in controversy. In addition, it is difficult to assess "naturalness" of individual stands in an ecosystem characterized by processes that operate at large temporal and spatial scales. For example, prior to settlement the extent and locations of dense "second growth" ponderosa pine most likely varied significantly over time, depending on when and where fires started, what the climatic and fuel conditions were at the time, and what subsequent years provided in terms of conditions for establishment and growth. Thus a single stand or occurrence of dense ponderosa pine may in itself represent natural conditions. But if all pine stands in the Black Hills were dense, an important component of the range of natural variability would be missing.

In spite of these difficulties, there is clearly a need to assess vegetation and site quality. For example, evaluation of land management practices requires definition of acceptable results. Identification of important natural areas requires knowledge of what constitutes high-quality and representative examples of plant communities.

During the BHCI, community occurrence ranking was done using both generic guidelines and specifications developed for Black Hills types. Generic criteria (Appendix 4) include size specifications, certain condition criteria such as presence of exotics and unnatural disturbances, and landscape context categories. Specifications developed for Black Hills types are based on Mehl's (1992) definitions of old growth for interior

ponderosa pine, definitions of community structure and composition based on prior work and BHCI surveys, and relative scales based on the range of quality observed in the study area. Thus the overall ranks are not absolute, but represent to some degree the range of quality in the Black Hills, from high to low. In this way, occurrences of all natural communities can be prioritized, even those that may be generally poor in quality.

Good examples of the need for relative ranking are the Black Hills montane grasslands found at higher elevations in the Central Core and Limestone Plateau regions, which were surveyed during the 1998 field season. Only small occurrences were found where native species were well represented. All had some burden of exotics. The ranking specifications that were developed (Appendix 4) reflect the range of quality of montane grasslands surveyed. Stands with native species well-represented can be ranked relative to other much poorer quality occurrences as high as B, even though exotics are present and perhaps locally abundant, features that in other types would lead to a rank of C.

There remain several significant information gaps related to ranking specifications. For those types that are relatively poorly known, mainly those restricted to or occurring predominantly at lower elevations in areas of largely private ownership, only generic specifications were available, as few occurrences were documented. The controversy surrounding the role of fire in Black Hills pine communities and the need for consideration over a broader context (i.e. at larger spatial and temporal scales) forced conservatism in ranking structural conditions. For example, occurrences with significant doghair stands were downranked, but not heavily (e.g. to AB from A, or to B from AB).

Old Growth and Occurrence Quality

In evaluating forest and woodland occurrences, old growth conditions were not necessarily requisite for, nor indicative of, high occurrence quality. For example, some stands with old-growth structure may be small and have an understory dominated by exotics. For the purposes of the BHCI, old growth features were only one of multiple criteria for ranking occurrence quality (see Appendix 4). This was done partly because old growth criteria were available only at a general level from Mehl's (1992) work, and were not available for specific types. Thus limited information was collected directly on the location of old-growth stands in the Black Hills and their extent. However, because A-ranked criteria for the condition subrank explicitly used presence of old growth features as defined by Mehl (1992), we are confident that most A and B ranked occurrences would fit under an old growth definition. Surveys were made of most areas designated Late Succession Landscapes in the latest Black Hills Land Resource Management Plan (1997), and extensive old growth stands were documented. That said, we recommend in future studies that field forms explicitly include an old growth checkoff feature, separate from condition ranking criteria.

What are currently lacking in the Black Hills are good successional models of ponderosa pine forest and woodland development. In many places in the Black Hills, it appears that as young pine stands mature and close in during the pole timber stage (30-50 yrs), the understory changes and may become very sparse. Duthie (1930) described ponderosa pine establishment in open habitat in the Black Hills as producing dense stands

of small trees that might persist in that state for hundreds of years. In the absence of fire or selective logging, it is not clear how stands will further develop under natural conditions. Would they begin to open up, as natural stand thinning occurs, leading to a rejuvenation of the understory? Would ground fires during this transition phase hasten a more open condition? Or is catastrophic fire or disease more likely to be the next step for the stand? Exploration of these patterns in the Late Succession Landscapes is critical to understanding the development of old growth features in the Black Hills.

Status of Black Hills Plant Associations

The BHCI has contributed towards the understanding of the status of plant associations in the Black Hills in two ways. Through survey, a list of types that are well-represented with exemplary stands and high-quality sites has been produced. Second, through management status analysis, we now know which types currently are receiving some level of biodiversity management, and which are not. However, the BHCI was *not* designed to determine and document the overall status of community types in the Black Hills with respect to management levels. Analysis of the full range of sites and their contribution to the protection of natural features is a separate study. Our study does provide the tools to conduct such a study, and, for that matter, to assess the relative need for more or less protection of various community types.

In general, coniferous forests and woodlands (both dry and mesic) are best represented with exemplary stands in large, relatively intact sites (Table 5). This is not to say that few or no exemplary stands exist elsewhere, nor that exemplary stands of other types do not exist. For example, most of the aspen stands documented from key sites are relatively small. Much larger stands are known from both the northern Limestone Plateau and the Bear Lodge Mountains, but were not surveyed during this inventory.

Most of the managed areas that emphasize natural features (Level 1 and Level 2 management) in the Black Hills were surveyed as part of the BHCI. The one exception was the Black Elk Wilderness, where several specific community types were surveyed, but much of the area was not covered. Table 5 shows community types included in areas managed at the two highest management levels (1 and 2, managed for natural values), and the summary of patterns in Table 6 indicated that a substantial number of types (75%) are already being managed for biodiversity values.

Exemplary Sites

The exemplary sites identified through the BHCI are large relatively-intact landscapes with large high-quality examples of multiple Black Hills community types. In an ecosystem such as the Black Hills, where human activity plays such important and widespread roles, identification of high-ranking natural areas is critical for future development. Such information can be used in planning and management by a variety of users: federal land managers, conservation organizations and private industry.

The list of exemplary sites should not be interpreted as including the only important natural areas in the Black Hills, as was mentioned above. They were exemplary among the ones we visited. These are sites where the best occurrences of many Black Hills communities were found, sites that are clearly biologically significant. A review is still needed as to the degree of representation of all community types in the selected exemplary and potential exemplary sites.

Additional Research Needs

In addition to the information gaps described in previous sections of the DISCUSSION, several Black Hills communities have been identified as high-priority for additional survey and study, based on rarity, impacts and/or ecological importance.

The Black Hills montane grasslands are globally rare and endemic to the area (this is an endemic community type – a rare and endemic association of mainly non-rare species, not to be confused with endemic species). Many of these grasslands have been extensively altered or converted with settlement of the Black Hills. The BHCI 1998 field season included the first in-depth survey of montane meadows since the time of McIntosh (1931). Rare status was confirmed in that most meadows surveyed had been converted to other types; furthermore, only the more xeric phase of montane grasslands was documented. No mesic phase sites with native vegetation were found. High-elevation grasslands on Warren Peaks and Cement Ridge were provisionally classified as montane grassland due to floristic similarity, but the habitat is somewhat different, and these stands may represent a different type. During the 1999 field season, additional A and B ranked montane grassland occurrences were found during a survey funded by the SD Dept. of Game, Fish and Parks (Marriott in prep.).

Another type that may be globally-rare and endemic to the Black Hills is the bur oak type(s) found on the northern and northeastern flanks where there are extensive exposures of Mowry shale. Most of the ownership is private, and very little work has been done in this area; it was not surveyed during the BHCI. Little is known about the composition and status of this type. There may be additional community types in that area that are new or not currently included in the Black Hills classification.

Riparian types play important roles in ecosystems, an importance that is disproportionate to their relatively small size. For this reason, these types need to be well-characterized and documented. The BHCI included many riparian site surveys during the second and third field seasons. However, there remain areas of the Black Hills that need additional work. Several drainages on public lands at higher elevations in the Bear Lodge Mountains may include large high elevation riparian forest and shrubland communities. Survey of plains riparian forests and woodlands at lower elevations is needed; little was done in the BHCI due to lack of public lands in those areas.

Further studies could address landscape-scale issues in the management of Black Hills systems, particularly with respect to issues of old growth and natural processes. It is conceivable that large natural landscapes, on the order of 15,000 acres or more, are needed

to maintain the viability of the matrix set of community type diversity and the ecological processes that they depend on. This can be inferred from proposed definitions for minimum dynamic area, the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires. Shugart (1984) proposed that the minimum dynamic area could be fifty times the average disturbance size. Johnson and Van Wagner (1985) suggested two times the maximum disturbance size (see also Frelich 1995). There is little information on what the average disturbance size in the Hills might be, but, as noted above, Shinneman and Baker (1997) cite historical reports of large, catastrophic fires in the Black Hills ranging from 7,500 to 22,000 acres (3000 to 9,000 ha). These values suggest that landscape size for a minimum dynamic area could be in the order of 15,000 to 44,000 acres (6,000 ha to 18,000 ha). This is a very preliminary figure, subject to considerations on how prescribed fire management and other such tools could alleviate the need for such large, natural landscapes. But few, if any, such sites exist currently.

Given the potential for large-scale fires in the Black Hills, few management level 1 or 2 areas are large enough to allow for large-scale fires. Unless such areas are big enough, fire management risks burning the entire area, thereby jeopardizing recovery of both plants and animals. Large-scale fires can be patchy, mitigating this concern to some degree. Consideration could be given to using management techniques that emphasize natural values in management units adjacent to these areas. For example, are there ways of harvesting timber that would retain some of the old growth characteristics in stands surrounding natural areas? Could prescribed fire be used in conjunction with such timber management to promote understory species diversity?

Issues of old growth may benefit from a consideration of the natural processes that give rise to a diversity of stand structures. Some Late Succession Landscapes may be dominated by Dry Coniferous Forest and Woodland types; others may be dominated by more Mesic Coniferous Forest and Woodland types. The natural processes introduced into these environments may need to be different. It is not yet known what the effect of management proposals for Late Succession Landscapes will be on the structure and diversity of those sites. Some type of monitoring protocol could be considered to determine how effective the management is in producing different kinds of old growth structure and diversity in these areas.

Finally, this inventory has not addressed the more intensively managed areas of the Black Hills to determine how well the natural community types are retaining their structure and diversity. Given the baseline criteria developed in this inventory for high quality stands, studies could be conducted in these areas to determine the relative effects of different management techniques on stand structure, species diversity, spread of exotics, etc., in addition to the concerns of silvicultural management of these stands (Boldt and Van Deusen 1974, Alexander 1988). This would add to our understanding of the kinds of management that would be appropriate at some level in or near more highly protected areas.

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FIGURES

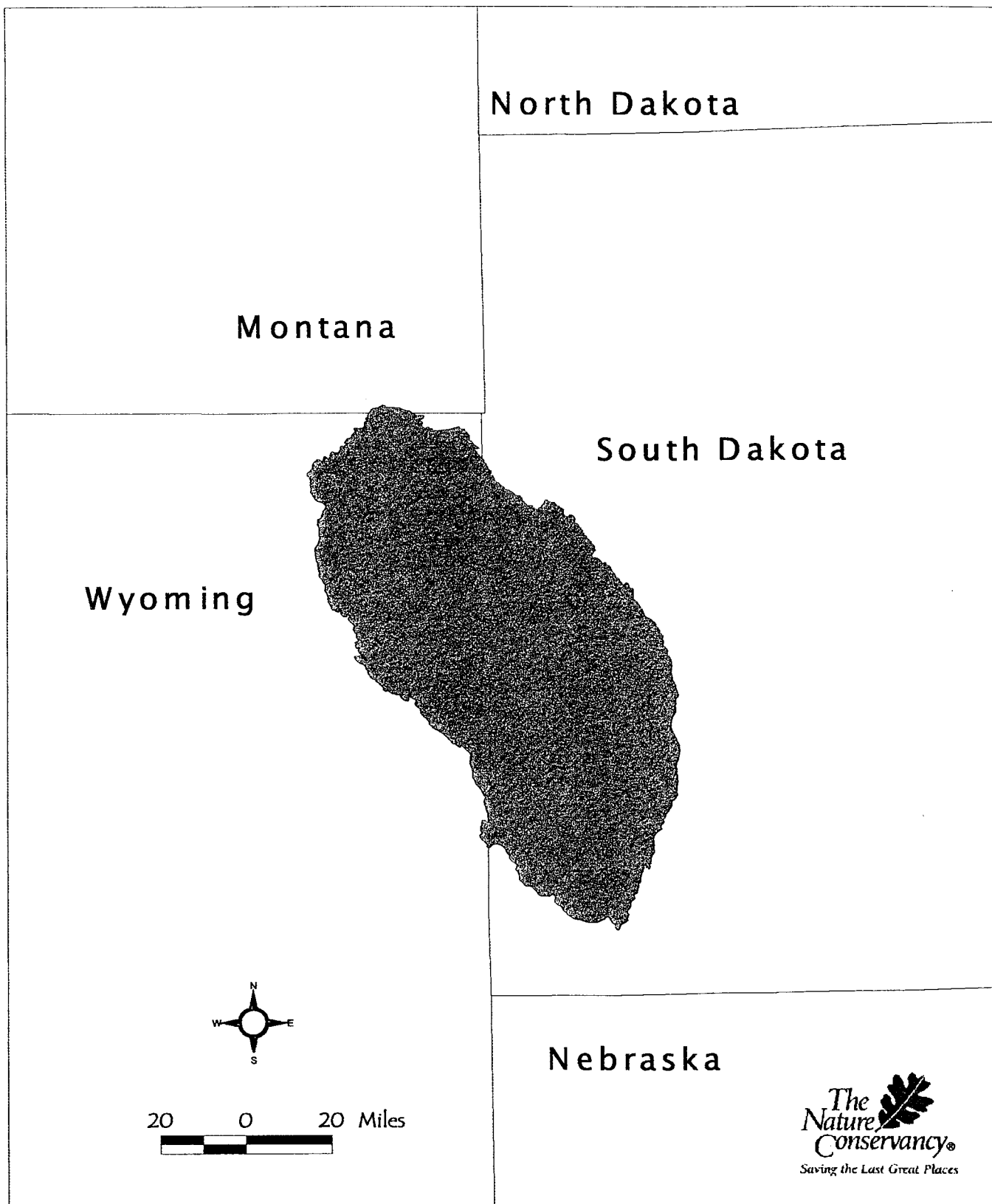


Figure 1. Location of the Black Hills. The Cretaceous Mowry Formation marks the outer boundary of the study area (after DeWitt et al. 1989).

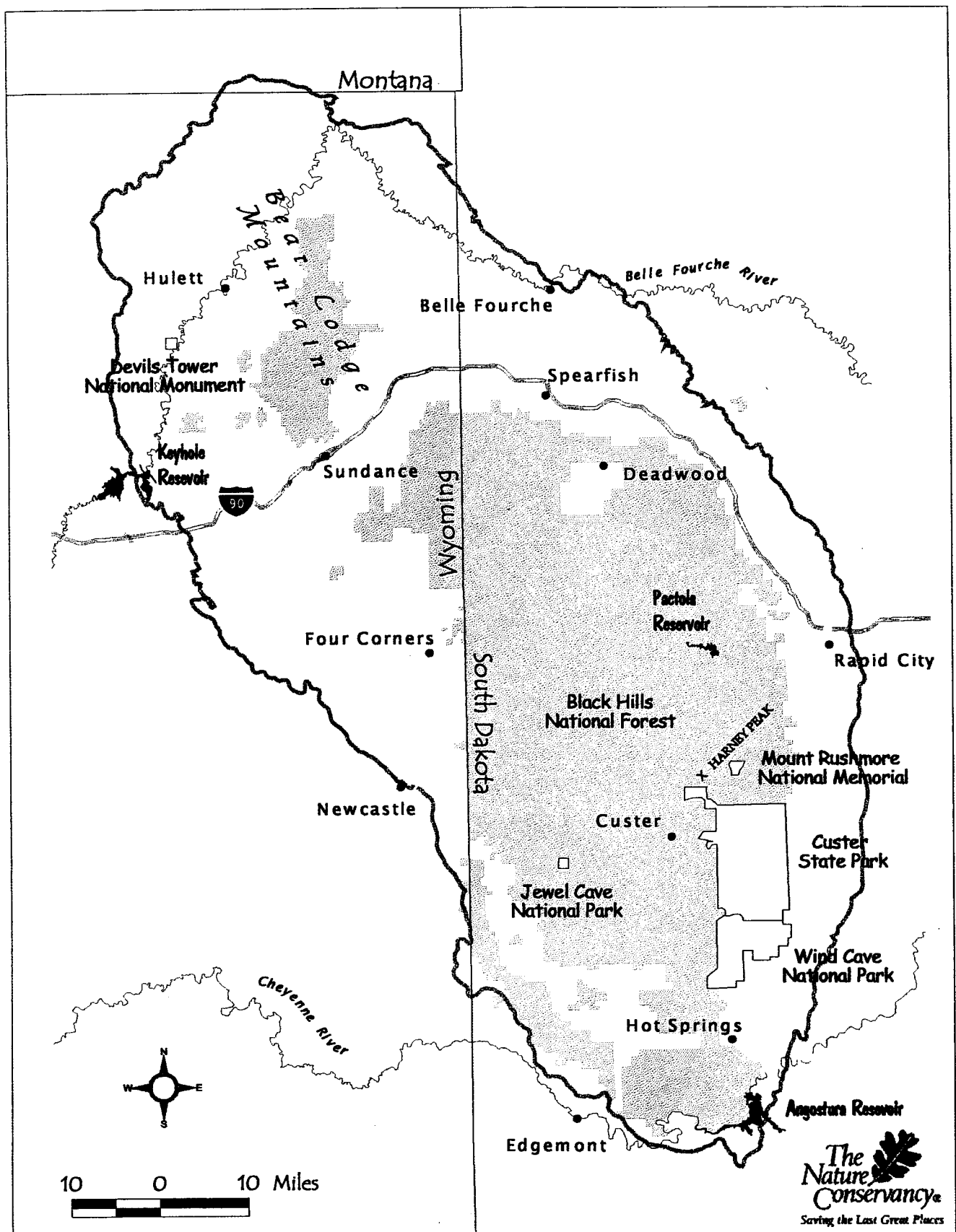


Figure 2. Political features and landmarks in the Black Hills.

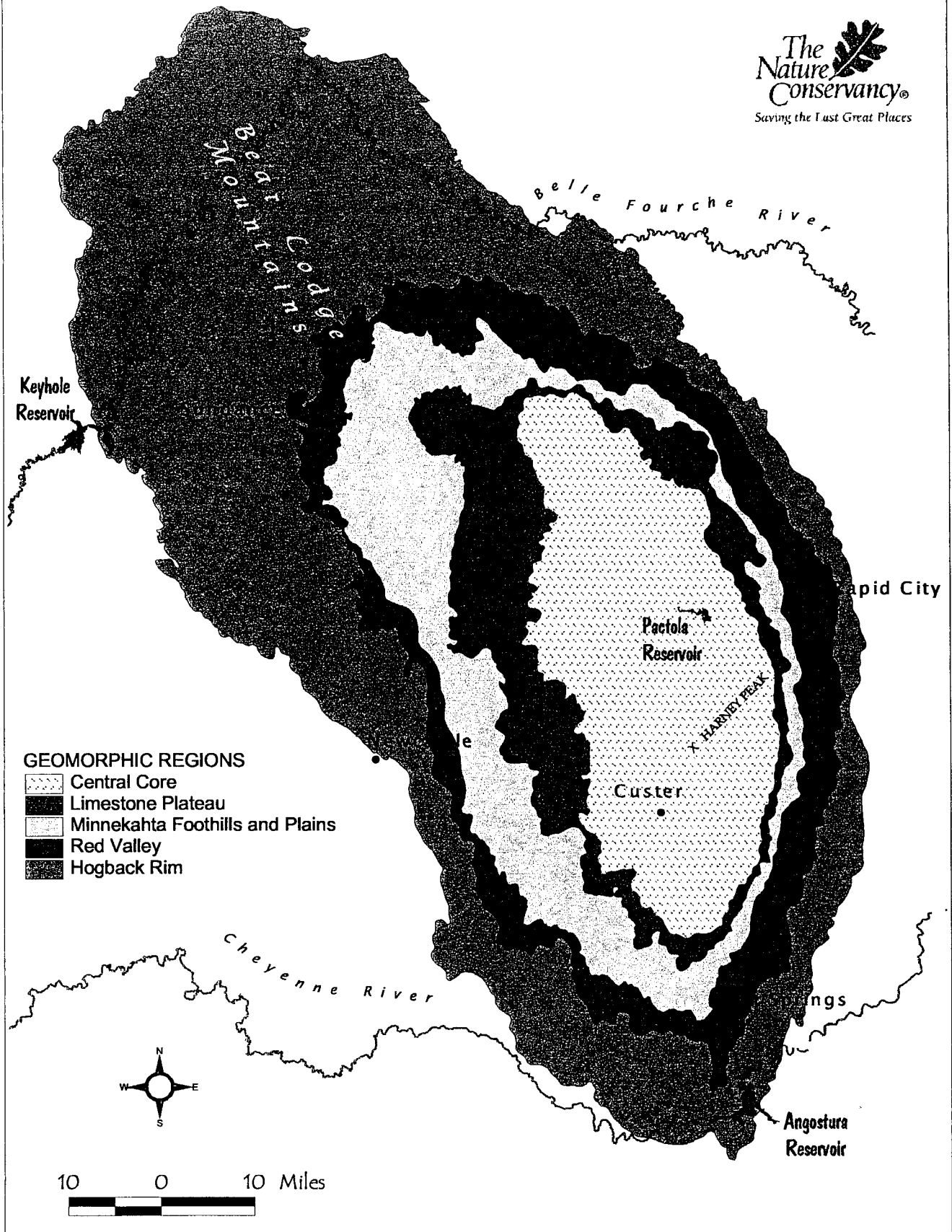
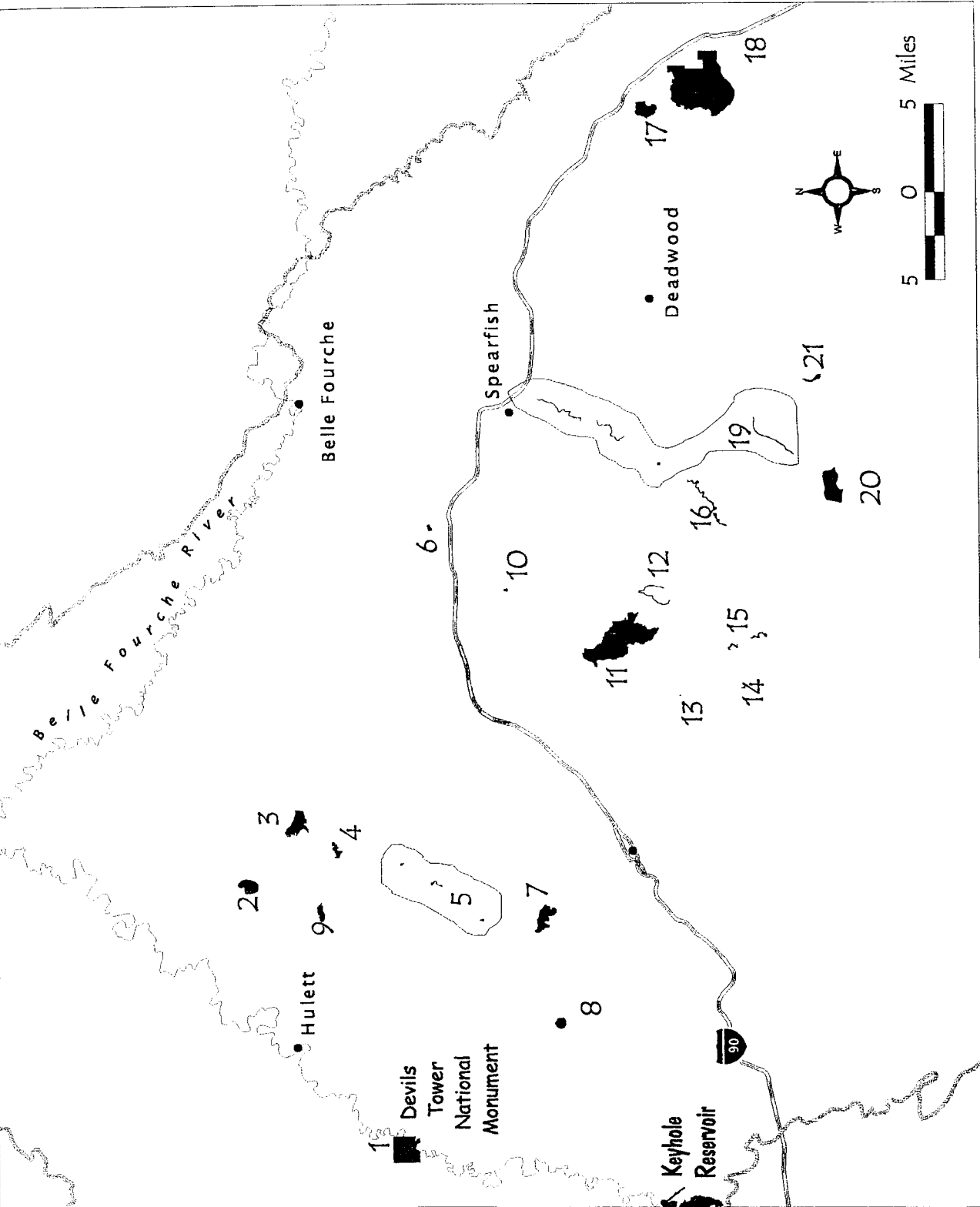


Figure 3. Geomorphic regions of the Black Hills (after Froiland 1990; DeWitt et al. 1989).



SURVEY SITES

- 1 Devils Tower NM
- 2 Lone Tree Hill
- 3 Geis Spring
- 4 Gordon Ranch
- 5 Cook Lake Vicinity
- 6 Cox Lake
- 7 Warren Peaks
- 8 Miller Creek
- 9 Snyder Spring
- 10 Shephard Canyon
- 11 Cranberry Springs
- 12 Sand Creek Headwaters
- 13 Grand Canyon North
- 14 Moskee
- 15 Grand Canyon South
- 16 Little Spearfish Creek
- 17 Vanocker Creek
- 18 Beaver Park
- 19 Spearfish Creek
- 20 Eagle Cliffs
- 21 Keough Draw

Geomorphic Boundary of
the Black Hills

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Figure 4a. Location of survey sites 1-21.

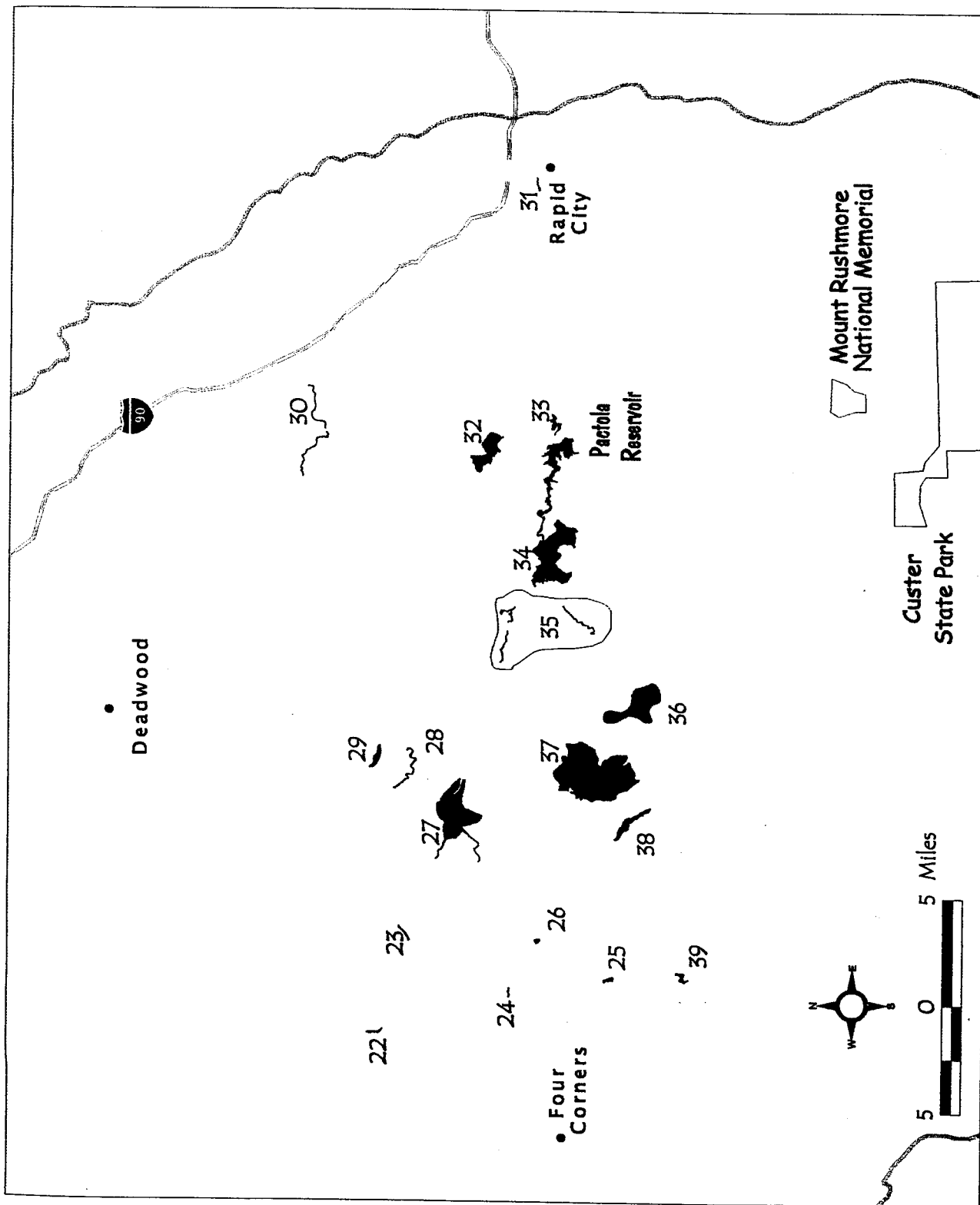


Figure 4b. Location of survey sites 22-39.

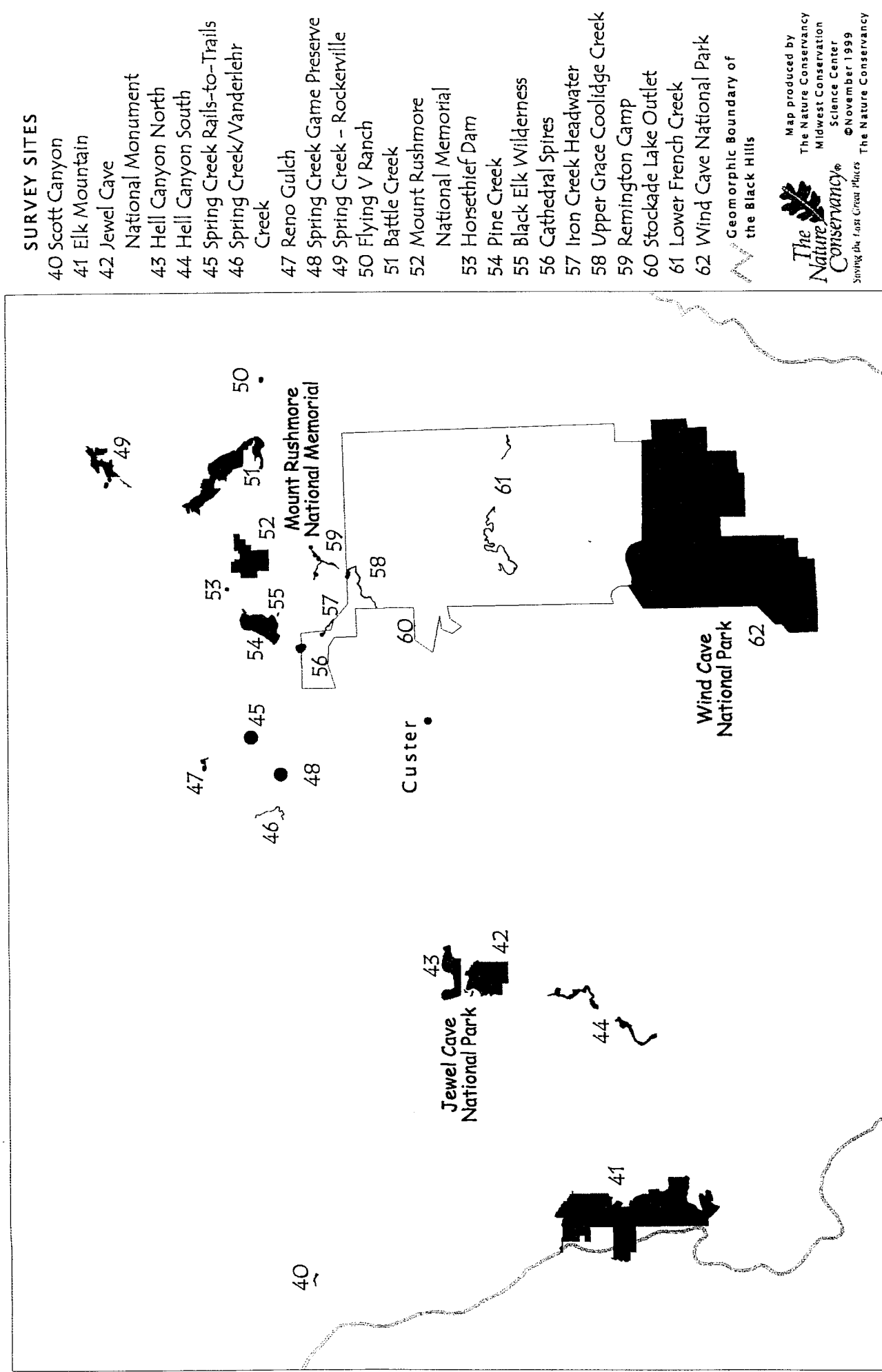


Figure 4c. Location of survey sites 40-62.

HIGH > increasing > decreasing ELEVATION Precipitation Temperature LOW decreasing increasing	Fen	Montane Grasslands Upland Hardwood F & W Mesic Coniferous F&W High Elevation Riparian Forests & Shrublands Riparian/Wet Meadow Dry Coniferous F&W			Granitic/ Metamorphic Rock Outcrops, Scree/Talus
	Marsh	Plains Riparian Forests and Shrublands Mesic Tallgrass Prairie Mesic Plains Shrublands Mesic Mixedgrass Prairie Dry Mixedgrass Prairie Dry Plains Shrublands			Low Elevation Rock Outcrops
	Fens Marshes	Riparian/Meadow	Uplands		Rock Outcrops
	WET	MOIST	DRY		XERIC

Figure 5. Distribution of Black Hills Ecological Groups.

TABLES

Table 1. Black Hills vegetation classification developed for the Black Hills Community Inventory. A total of 68 community types are listed. This classification is consistent with the US National Vegetation Classification (Grossman et al. 1998). Columns labeled Global Name and Global Common Name give the scientific and common names, respectively, for each type. The Global Code is the type code used in the Biological and Conservation Database maintained by the Conservancy and its Natural Heritage Program Partners.

Each type has also been assigned a Pattern (P) and Distribution (D) category. Matrix (M) pattern forest (F) and wetland (W) types form extensive cover, are the most widespread landform types, have broad ecological amplitude, and are driven by regional-scale processes; large patch (LP) communities may form extensive cover over some of the area, but usually their boundaries correlate with a single dominant process such as hydrology or soils; and small patch (SP) communities rarely form extensive cover, they have very specific ecological amplitudes and occur where a number of local conditions come together in a very precise way. Communities with Endemic/Restricted (E) distribution occur primarily or entirely within the Black Hills area; limited (L) community types occur within the area, but also within a few adjacent areas; and peripheral (P) communities occur rarely in the Black Hills area, with the core of their distribution in a different area. The ecological groups are used as adhoc categories to group types that share similar habitats and ecological processes. Upland groups are listed first, followed by wetland groups.

UPLAND FORESTS & WOODLANDS

Dry Coniferous Forests & Woodlands

Global Name	Global Common Name	Global Code	P	D
Juniperus scopulorum / Oryzopsis micrantha Woodland	Rocky Mountain Juniper / Little-seed Ricegrass Woodland	CEGL000747	LP	P
Pinus ponderosa / Arctostaphylos uva-ursi Woodland	Ponderosa Pine / Bearberry Woodland	CEGL000844	MX-F	W
Pinus ponderosa / Carex inops ssp. heliophila Woodland	Ponderosa Pine / Sedge Woodland	CEGL000849	MX-F	L
Pinus ponderosa / Juniperus scopulorum Woodland	Ponderosa Pine / Rocky Mountain Juniper Woodland	CEGL000861	MX-F	L
Pinus ponderosa / Mahonia repens Forest	Ponderosa Pine / Oregon Grape Forest	CEGL000187	LP	L
Pinus ponderosa / Pseudotsuga smithii Woodland	Ponderosa Pine / Western Wheatgrass Woodland	CEGL000188	MX-F	L
Pinus ponderosa / Pseudotsuga spicata Woodland	Ponderosa Pine / Bluebunch Wheatgrass Woodland	CEGL000865	LP?	P
Pinus ponderosa / Schizachyrium scoparium Woodland	Ponderosa Pine / Little Bluestem Woodland	CEGL000201	MX-F	W?

Mesic Coniferous Forests & Woodlands

Global Name	Global Common Name	Global Code	P	D
<i>Picea glauca</i> / <i>Linnaea borealis</i> Forest	White Spruce/Twinflower Forest	CEGL000382	LP	E
<i>Picea glauca</i> / <i>Vaccinium scoparium</i> Forest	White Spruce/Grouseberry Forest	CEGL000383	SP	E
<i>Pinus ponderosa</i> / <i>Juniperus communis</i> Woodland	Ponderosa Pine/Common Juniper Woodland	CEGL000859	MX-F	L
<i>Pinus ponderosa</i> / <i>Oryzopsis asperifolia</i> Woodland	Ponderosa Pine / Rough-leaf Ricegrass Woodland	CEGL002123	MX-F	E
<i>Pinus ponderosa</i> / <i>Physocarpus monogynus</i> Forest	Ponderosa Pine / Mountain Ninebark Forest	CEGL000190	MX-F	L
<i>Pinus ponderosa</i> / <i>Prunus virginiana</i> Forest	Ponderosa Pine / Chokecherry Forest	CEGL000192	LP	L
<i>Pinus ponderosa</i> / <i>Quercus macrocarpa</i> Woodland	Ponderosa Pine / Bur Oak Woodland	CEGL000873	LP	E
<i>Pinus ponderosa</i> / <i>Symphoricarpos albus</i> Forest	Ponderosa Pine / Snowberry Forest	CEGL000203	MX-F	W?

Upland Hardwood Forests & Woodlands

Global Name	Global Common Name	Global Code	P	D
<i>Populus tremuloides</i> / <i>Corylus cornuta</i> Forest	Aspen / Beaked Hazel Forest	CEGL000583	LP	L
<i>Populus tremuloides</i> / <i>Pteridium aquilinum</i> Forest	Aspen / Bracken Fern Forest	CEGL000597	LP	L
<i>Populus tremuloides</i> / <i>Spiraea betulifolia</i> Forest	Aspen / Shiny-leaf Spiraea Forest	CEGL000607	LP	L
<i>Quercus macrocarpa</i> / <i>Carex inops</i> ssp. <i>heliophila</i> Woodland	Bur Oak / Sedge Woodland	CEGL000554	LP?	L
<i>Quercus macrocarpa</i> / <i>Prunus virginiana</i> - <i>Symphoricarpos occidentalis</i> Woodland	Bur Oak / Chokecherry - Western Snowberry Woodland	CEGL002138		

UPLAND SHRUBLANDS

Dry Plains Shrublands

Global Name	Global Common Name	Global Code	P	D
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Pascopyrum smithii</i> Shrub Herbaceous Vegetation	Big Sagebrush / Western Wheatgrass Shrub Grassland	CEGL001047	LP	L?
<i>Cercocarpus montanus</i> / <i>Bouteloua curtipendula</i> Shrubland	Mountain Mahogany / Side-oats Grama Shrubland	CEGL001086	LP	P?
<i>Juniperus horizontalis</i> / <i>Schizachyrium scoparium</i> Dwarf-shrubland	Creeping Juniper / Little Bluestem Dwarf-shrubland	CEGL001394	SP	P
<i>Rhus trilobata</i> / <i>Pseudoroegneria spicata</i> Shrub Herbaceous Vegetation	Ill-scented Sumac / Bluebunch Wheatgrass Shrub Prairie	CEGL001120	SP	P?

Mesic Plains Shrublands

Global Name	Global Common Name	Global Code	P	D
<i>Artemisia cana</i> / <i>Pascopyrum smithii</i> Shrubland	Silver Sagebrush / Western Wheatgrass Shrub Prairie	CEGL001072	SP	L?
<i>Prunus virginiana</i> Shrubland	Chokecherry Shrubland	CEGL001108	SP	P?

UPLAND GRASSLANDS

Dry Mixedgrass Prairies

Global Name	Global Common Name	LP	P	D
Pascopyrum smithii - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	Western Wheatgrass - Blue Grama - Threadleaf Sedge Prairie	CEGL001579	LP	W
Schizachyrium scoparium - Bouteloua (curtipendula, gracilis) / Carex filifolia Herbaceous Vegetation	Northern Great Plains Little Bluestem Prairie	CEGL001681	MX-G	W
Stipa comata - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	Needle-and-Thread - Blue Grama Mixedgrass Prairie	CEGL002037	LP	W

Mesic Mixedgrass Prairies

Global Name	Global Common Name	LP	P	D
Pascopyrum smithii - Nassella viridula Herbaceous Vegetation	Western Wheatgrass - Green Needlegrass Mixedgrass Prairie	CEGL001583	MX-G	W
Pascopyrum smithii - Stipa comata Central Mixedgrass Herbaceous Vegetation	Wheatgrass - Needle-and-Thread Mixedgrass Prairie	CEGL002034	MX-G	W

Prairie Dog Grassland Complex

Global Name	Global Common Name	LP	P	D
Prairie Dog Town Grassland Complex	Prairie Dog Town Grassland Complex	CECX002003	LP	W

Mesic Tallgrass Prairies

Global Name	Global Common Name	LP	P	D
Andropogon gerardii - Schizachyrium scoparium Northern Plains Herbaceous Vegetation	Northern Plains Big Bluestem Prairie	CEGL002205	LP	P?

Black Hills Montane Grasslands

Global Name	Global Common Name	LP	P	D
Sporobolus heterolepis - Stipa richardsonii - Danthonia intermedia Herbaceous Vegetation	Black Hills Montane Grassland	CEGL002240	LP	E

SPARSE VEGETATION

Black Hills Sparse Vegetation

Global Name	Global Common Name	LP	P	D
Black Hills Granite/Metamorphic Rock Outcrop Sparse Vegetation	Black Hills Granite/Metamorphic Rock Outcrop	CEGL002295	SP	E

Cirsium arvense - Weedy Forb Great Plains Herbaceous Vegetation [Provisional]	Great Plains Weedy Meadows	CEGL005260	SP
Pinus ponderosa Limestone Cliff Sparse Vegetation	Ponderosa Pine Limestone Cliff	CEGL002055	SP L
Pinus ponderosa Scree Woodland	Ponderosa Pine Scree Slope	CEGL000878	SP W?
Redbeds (Siltstone, Sandstone, Gypsum) Sparse Vegetation	Redbeds (Siltstone) Rock Outcrop	CEGL005261	SP W?
Scree/Talus Black Hills Sparse Vegetation	Black Hills Talus	CEGL002307	SP E
Shale Barren Slopes Sparse Vegetation	Shale Barren Slopes	CEGL002294	SP W?

RIPARIAN/WETLANDS

Plains Riparian Forests & Shrublands

Global Name	Global Common Name	Global Code	P	D
Acer negundo / Prunus virginiana Forest	Box Elder / Chokecherry Forest	CEGL000628	LI	W?
Fraxinus pennsylvanica - Ulmus americana / Symphoricarpos occidentalis Forest	Ash - Elm / Wolfberry Forest	CEGL002082	LI	W
Populus angustifolia / Cornus sericea Woodland	Narrowleaf Cottonwood / Red-osier Dogwood Forest	CEGL002664	LI	P
Populus deltoides - (Salix amygdaloides) / Salix exigua Woodland	Cottonwood - Peach-Leaf Willow Floodplain Woodland	CEGL000659	LI	W
Populus deltoides / Symphoricarpos occidentalis Woodland	Cottonwood / Wolfberry Floodplain Woodland	CEGL000660	LI	L?
Salix amygdaloides Woodland	Peach-leaf Willow Woodland	CEGL000947	LI?	P?
Salix exigua Temporarily Flooded Shrubland	Sandbar Willow Shrubland	CEGL001197	LI	W?
Symphoricarpos occidentalis Shrubland [Provisional]	Western Snowberry Shrubland	CEGL001131	SP	W

Dry Riparian Forests & Shrublands

Global Name	Global Common Name	Global Code	P	D
Betula papyrifera / Corylus cornuta Forest	Paper Birch / Hazel Forest	CEGL002079	SP	W
Crataegus douglasii - (Crataegus chrysocarpa) Shrubland	Black Hawthorne Shrubland	CEGL001093	LI	L?
Populus tremuloides / Prunus virginiana Forest	Aspen/Chokecherry Forest	CEGL000596	LI	L
Quercus macrocarpa / Ostrya virginiana Forest	Bur Oak-Ironwood Forest	CEGL000555	LI	E

High Elevation Riparian Forests & Shrublands

Global Name	Global Common Name	Global Code	P	D
Betula occidentalis / Cornus sericea Shrubland	Water Birch / Red-osier Dogwood Shrubland	CEGL001161	LI	W
Picea glauca Alluvial Black Hills Forest	White Spruce Alluvial Black Hills Forest	CEGL002057	LI	E
Salix bebbiana Shrubland	Beaked Willow Scrub	CEGL001173	LI	W?

Riparian/Wet Meadows

Global Name	Global Common Name	Global Code	P	D
Calamagrostis canadensis Western Herbaceous Vegetation	Canadian Reedgrass Wet Meadow	CEGL001559	SP	W
Carex nebrascensis Herbaceous Vegetation	Nebraska Sedge Wet Meadow	CEGL001813	SP	W
Eleocharis palustris Herbaceous Vegetation	Creeping Spikerush Wet Meadow	CEGL001833	SP	W
Glyceria grandis - Poa palustris - Mixed Herbaceous Black Hills Herbaceous Vegetation [Provisional]	Black Hills Streamside Vegetation	CEGL005262	LI	E?
Juncus balticus Herbaceous Vegetation	Baltic Rush Wet Meadow	CEGL001838	SP	P?
Scirpus spp. - Poa palustris - Mixed Herbaceous Great Plains Streamside Herbaceous Vegetation [Provisional]	Western Great Plains Streamside Vegetation	CEGL005263	LI	W?
Spartina pectinata - Carex spp. Herbaceous Vegetation	Prairie Cordgrass - Sedge Wet Meadow	CEGL001477	SP	P
Typha spp. - Scirpus spp. - Mixed Herbs Great Plains Herbaceous Vegetation	Great Plains Cattail - Bulrush Marsh	CEGL002228	P	P

Saline Meadows

Global Name	Global Common Name	Global Code	P	D
Distichlis spicata - Hordeum jubatum - Sporobolus airoides Herbaceous Vegetation Alkali Sacaton Saline Prairie		CEGL002274	LI	P?

Marshes

Global Name	Global Common Name	Global Code	P	D
Typha spp. Great Plains Herbaceous Vegetation	Northern Great Plains Cattail Marsh	CEGL002389	SP	W

Fens

Global Name	Global Common Name	Global Code	P	D
Salix candida / Carex rostrata Shrubland	Sage Willow Fen	CEGL001188	L	

Table 2. Managed areas classification (modified from Caicco *et al.* 1995). The classification categorizes sites by the degree of emphasis on management for natural values.

LEVEL 1 "Highly Protected Managed Area"	An area "maintained in its natural state with an active management which allows for mimicking of natural processes or allows natural disturbance events to proceed without interference."	Examples: National Park units, Research Natural Areas
LEVEL 2 Moderately Protected Managed Areas	An area that is generally managed for its natural values but may receive use that degrades the quality of natural communities that are present..	Examples: Late Succession Landscapes, Wilderness Areas, Botanical Areas
LEVEL 3 Managed Areas of Low Protection	An area that is generally managed for consumptive or recreational values, but which also may maintain some natural value.	Examples: All other National Forest lands, State Parks and other State lands
LEVEL 4 Areas with No Protection	All land in public or private ownership without an existing easement or management agreement that maintains native species and natural communities.	Example: Private

Table 3. Number of element occurrences found for each community type in the Black Hills Community Inventory. Types are organized by ecological group (see Table 1). Occurrences are listed both separately by their element occurrence rank (EORANK), which indicates the overall quality of the occurrence on a scale from A (excellent) to OTH (poor or unranked occurrences), and combined into a total.

Dry Coniferous Forests & Woodlands

Global / Subtype / Name / Federal Code	A	AB	B	BC	OTH	Total
Ponderosa Pine / Bearberry Woodland (CEGL000844)	0	2	6	0	1	9
Ponderosa Pine / Bluebunch Wheatgrass Woodland (CEGL000865)	0	1	0	0	0	1
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	1	1	8	3	1	14
Ponderosa Pine / Oregon Grape Forest (CEGL000187)	0	1	0	0	0	1
Ponderosa Pine / Rocky Mountain Juniper Woodland (CEGL000861)	0	0	3	0	0	3
Ponderosa Pine / Sedge Woodland (CEGL000849)	1	2	2	0	0	5
Ponderosa Pine / Western Wheatgrass Woodland (CEGL000188)	1	0	0	0	0	2
Rocky Mountain Juniper / Little-seed Ricegrass Woodland (CEGL000747)	0	0	1	0	0	1

Mesic Coniferous Forests & Woodlands

Global / Subtype / Name / Federal Code	A	AB	B	BC	OTH	Total
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	0	3	1	0	1	5
Ponderosa Pine / Chokecherry Forest (CEGL000192)	0	0	3	0	1	5
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	0	0	3	1	0	4
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	0	0	2	1	1	5
Ponderosa Pine / Snowberry Forest (CEGL000203)	0	1	2	1	0	4
Ponderosa Pine / Common Juniper Woodland (CEGL000859)	0	3	7	0	0	10
White Spruce / Grouseberry Forest (CEGL000383)	0	1	1	0	0	2
White Spruce / Twinflower Forest (CEGL000382)	0	0	2	0	1	4

Upland Hardwood Forests & Woodlands

Global / Subtype / Name / Federal Code	A	AB	B	BC	OTH	Total
Aspen / Beaked Hazel Forest (CEGL000583)	0	1	2	0	0	3
Aspen / Bracken Fern Forest (CEGL000597)	0	0	1	0	0	1
Aspen / Shiny-leaf Spiraea Forest (CEGL000607)	0	0	2	0	0	2
Bur Oak / Chokecherry - Western Snowberry Woodland (CEGL002138)	0	0	2	0	0	2
Bur Oak / Sedge Woodland (CEGL000554)	0	0	0	0	0	0

Dry Plains Shrublands

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Big Sagebrush / Western Wheatgrass Shrub Grassland (CEGL001047)	0	0	0	0	0	0	0	0
Creeping Juniper / Little Bluestem Dwarf-shrubland (CEGL001394)	0	1	1	0	0	0	2	2
Ill-scented Sumac / Bluebunch Wheatgrass Shrub Prairie (CEGL001120)	0	1	0	0	0	0	1	1
Mountain Mahogany / Side-oats Grama Shrubland (CEGL001086)	2	0	1	0	0	0	3	3

Mesic Plains Shrublands

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Chokecherry Shrubland (CEGL001108)	0	1	0	0	0	0	1	1
Silver Sagebrush / Western Wheatgrass Shrub Prairie (CEGL001072)	0	0	1	0	0	0	1	1

Dry Mixedgrass Prairies

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	0	1	1	1	1	0	4	2
Northern Great Plains Little Bluestem Prairie (CEGL001681)	1	1	4	2	2	0	9	6

Mesic Mixedgrass Prairies

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Western Wheatgrass - Green Needlegrass Mixedgrass Prairie (CEGL001583)	0	1	1	0	1	1	3	2
Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)	0	1	1	0	0	0	3	2

Prairie Dog Grassland Complex

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Prairie Dog Town Grassland Complex (CECX002003)	0	1	0	1	1	0	2	1

Mesic Tallgrass Prairies

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Northern Plains Big Bluestem Prairie (CEGL002205)	0	0	1	0	0	1	2	1

Black Hills Montane Grasslands

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Black Hills Montane Grassland (CEGL002240)	0	1	6	6	6	0	13	7

Black Hills Sparse Vegetation

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	3	0	2	0	0	0	5	5
Black Hills Talus (CEGL002307)	0	0	0	0	0	0	0	0

Great Plains Weedy Meadows (CEGL005260)	0	0	0	0	0	0	0
Ponderosa Pine Limestone Cliff (CEGL002055)	1	0	0	0	0	0	0
Ponderosa Pine Scree Slope (CEGL000878)	1	1	0	0	0	0	0
Redbeds (Siltstone) Rock Outcrop (CEGL005261)	1	1	0	0	0	0	0
Shale Barren Slopes (CEGL002294)	0	0	0	0	0	0	0

Plains Riparian Forests & Shrublands

Ash - Elm / Wolfberry Forest (CEGL002082)	0	0	1	1	0	2	1
Box Elder / Chokecherry Forest (CEGL000628)	0	1	1	0	0	2	2
Cottonwood - Peach-Leaf Willow Floodplain Woodland (CEGL000659)	0	0	1	1	0	2	1
Cottonwood / Wolfberry Floodplain Woodland (CEGL000660)	0	0	1	0	0	1	1
Narrowleaf Cottonwood / Red-osier Dogwood Forest (CEGL002664)	0	0	2	0	0	2	2
Peach-leaf Willow Woodland (CEGL000947)	0	0	0	1	0	1	0
Sandbar Willow Shrubland (CEGL001197)	0	2	3	0	0	6	5
Western Snowberry Shrubland (CEGL001131)	0	2	2	1	0	5	4

Dry Riparian Forests & Shrublands

Aspen/Chokecherry Forest (CEGL000596)	0	1	2	0	0	3	3
Black Hawthorne Shrubland (CEGL001093)	0	0	4	0	0	5	4
Bur Oak-Ironwood Forest (CEGL000555)	0	4	1	0	1	6	5
Paper Birch / Hazel Forest (CEGL002079)	0	5	2	0	1	8	7

High Elevation Riparian Forests & Shrublands

Beaked Willow Scrub (CEGL001173)	0	6	2	2	0	10	8
Water Birch / Red-osier Dogwood Shrubland (CEGL001161)	0	2	0	0	0	3	2
White Spruce Alluvial Black Hills Forest (CEGL002057)	0	4	5	0	1	10	9

Riparian/Wet Meadows

Baltic Rush Wet Meadow (CEGL001838)	0	0	1	0	0	1	1
Black Hills Streamside Vegetation (CEGL005262)	1	5	2	0	1	9	8
Canadian Reedgrass Wet Meadow (CEGL001559)	0	1	2	1	0	4	3
Creeping Spikerush Wet Meadow (CEGL001833)	0	0	1	0	0	1	1
Great Plains Cattail - Bulrush Marsh (CEGL002228)	0	0	1	0	0	1	1
Nebraska Sedge Wet Meadow (CEGL001813)	0	3	3	1	3	10	6
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	0	1	3	1	0	5	4
Western Great Plains Streamside Vegetation (CEGL005263)	1	2	0	0	0	3	3

Saline Meadows

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Alkali Sacaton Saline Prairie (CEGL002274)	0	0	0	0	0	0	0	0

Marsbes

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Northern Great Plains Cartail Marsh (CEGL002389)	0	1	4	0	0	0	6	5

Fens

Global Common Name (Global Code)	A	AB	B	BC	C	OTH	TOTAL	TOTAL A-B
Sage Willow Fen (CEGL001188)	0	0	1	0	0	0	1	1

Table 4. Community occurrences surveyed for the Black Hills Community Inventory. Types are organized by ecological group (see Table 1). For each, survey sites where the type was found are listed, along with site management level (see Table 2) and occurrence rank (from A, excellent, to D, poor). Where multiple occurrences of a type were found at one site, each occurrence was assigned its own rank.

Dry Coniferous Forests & Woodlands

Ponderosa Pine / Bearberry Woodland (CEGL000844)

Site	Site Name	Management Level	Rank
11	Cranberry Springs	2	B
18	Beaver Park	3	BC
27	Black Fox	2	B
32	Bogus Jim Creek	2	B
34	Canyon City	2	B
43	Hell Canyon North	3	B
51	Battle Creek	2	B
52	Mount Rushmore National Memorial	1	AB
54	Pine Creek	1	AB

Ponderosa Pine / Bluebunch Wheatgrass Woodland (CEGL000865)

Site	Site Name	Management Level	Rank
1	Devils Tower NM	1	AB

Ponderosa Pine / Little Bluestem Woodland (CEGL000201)

Site	Site Name	Management Level	Rank
1	Devils Tower NM	1	AB
11	Cranberry Springs	2	B
17	Vanocker Creek	3	B
18	Beaver Park	3	AB
27	Black Fox	2	C
32	Bogus Jim Creek	2	B
34	Canyon City	2	BC
41	Elk Mountain	3	B
42	Jewel Cave National Monument	1	B
43	Hell Canyon North	3	B
49	Spring Creek - Rockerville	3	B
51	Battle Creek	2	BC
52	Mount Rushmore National Memorial	1	B
62	Wind Cave National Park	1	A

Ponderosa Pine / Oregon Grape Forest (CEGL000187)

Site	Site Name	Management Level	Rank
1	Devils Tower NM	1	AB

Ponderosa Pine / Rocky Mountain Juniper Woodland (CEGL000861)

Site	Site Name	Management Level	Rank
41	Elk Mountain	3	B

43	Hell Canyon North	3	B
44	Hell Canyon South	2	B

Ponderosa Pine / Sedge Woodland (CEGL000849)

Site#	Survey Site Name	Management Level	FORank
1	Devils Tower NM	1	AB
33	Placerville	2	B
41	Elk Mountain	3	AB
42	Jewel Cave National Monument	1	B
62	Wind Cave National Park	1	A

Ponderosa Pine / Western Wheatgrass Woodland (CEGL000188)

Site#	Survey Site Name	Management Level	FORank
1	Devils Tower NM	1	AB
62	Wind Cave National Park	1	A

Rocky Mountain Juniper / Little-seed Ricegrass Woodland (CEGL000747)

Site#	Survey Site Name	Management Level	FORank
40	Scott Canyon	3	B

Mesic Coniferous Forests & Woodlands

Ponderosa Pine / Bur Oak Woodland (CEGL000873)

Site#	Survey Site Name	Management Level	FORank
3	Geis Spring	2	AB
11	Cranberry Springs	2	AB
17	Vanocker Creek	3	AB
51	Battle Creek	2	B,U

Ponderosa Pine / Chokecherry Forest (CEGL000192)

Site#	Survey Site Name	Management Level	FORank
11	Cranberry Springs	2	B
18	Beaver Park	3	BC
27	Black Fox	2	B
51	Battle Creek	2	B
62	Wind Cave National Park	1	A

Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)

Site#	Survey Site Name	Management Level	FORank
34	Canyon City	2	B
41	Elk Mountain	3	BC
42	Jewel Cave National Monument	1	B
43	Hell Canyon North	3	B

Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)

Site#	Survey Site Name	Management Level	FORank
3	Geis Spring	2	BC
18	Beaver Park	3	AB
32	Bogus Jim Creek	2	B
52	Mount Rushmore National Memorial	1	B
54	Pine Creek	1	U

Ponderosa Pine / Snowberry Forest (CEGL000203)

Site #	Site Name	Management Level	EC Rank
11	Cranberry Springs	2	B,BC
27	Black Fox	2	B
42	Jewel Cave National Monument	1	AB

Ponderosa Pine/Common Juniper Woodland (CEGL000859)

Site #	Site Name	Management Level	EC Rank
27	Black Fox	2	B
32	Bogus Jim Creek	2	B
34	Canyon City	2	AB
41	Elk Mountain	3	B
42	Jewel Cave National Monument	1	B
43	Hell Canyon North	3	B
51	Battle Creek	2	B
52	Mount Rushmore National Memorial	1	B
54	Pine Creek	1	AB
62	Wind Cave National Park	1	AB

White Spruce/Grouseberry Forest (CEGL000383)

Site #	Site Name	Management Level	EC Rank
21	Keough Draw	3	B
29	Buskala Creek	3	AB

White Spruce/Twinflower Forest (CEGL000382)

Site #	Site Name	Management Level	EC Rank
27	Black Fox	2	B
34	Canyon City	2	B
54	Pine Creek	1	U
57	Iron Creek Headwater	2	AB

Upland Hardwood Forests & Woodlands

Aspen / Beaked Hazel Forest (CEGL000583)

Site #	Site Name	Management Level	EC Rank
5	Cook Lake Vicinity	3	B
11	Cranberry Springs	2	AB
51	Battle Creek	2	B

Aspen / Bracken Fern Forest (CEGL000597)

Site #	Site Name	Management Level	EC Rank
5	Cook Lake Vicinity	3	B

Aspen / Shiny-leaf Spiraea Forest (CEGL000607)

Site #	Site Name	Management Level	EC Rank
5	Cook Lake Vicinity	3	B
7	Warren Peaks	3	B

Bur Oak / Chokecherry - Western Snowberry Woodland (CEGL002138)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	B
10	Shephard Canyon	4	B

Bur Oak / Sedge Woodland (CEGL000554)

Site#	Survey Site Name	Management Level	EORank
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Dry Plains Shrublands

Big Sagebrush / Western Wheatgrass Shrub Grassland (CEGL001047)

Site#	Survey Site Name	Management Level	EORank
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Creeping Juniper / Little Bluestem Dwarf-shrubland (CEGL001394)

Site#	Survey Site Name	Management Level	EORank
17	Vanocker Creek	3	B
62	Wind Cave National Park	1	AB

Ill-scented Sumac / Bluebunch Wheatgrass Shrub Prairie (CEGL001120)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	AB

Mountain Mahogany / Side-oats Grama Shrubland (CEGL001086)

Site#	Survey Site Name	Management Level	EORank
40	Scott Canyon	3	A
44	Hell Canyon South	2	B
62	Wind Cave National Park	1	A

Mesic Plains Shrublands

Chokecherry Shrubland (CEGL001108)

Site#	Survey Site Name	Management Level	EORank
62	Wind Cave National Park	1	AB

Silver Sagebrush / Western Wheatgrass Shrub Prairie (CEGL001072)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	B

Dry Mixedgrass Prairies

Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	AB
6	Cox Lake	3	BC
41	Elk Mountain	3	B
62	Wind Cave National Park	1	AB

Northern Great Plains Little Bluestem Prairie (CEGL001681)

Site	Survey Site Name	Management Level	EO Rank
1	Devils Tower NM	1	AB
2	Lone Tree Hill	3	B
6	Cox Lake	3	BC
10	Shepherd Canyon	4	B
17	Vanocker Creek	3	B
41	Elk Mountain	3	BC
42	Jewel Cave National Monument	1	B
50	Flying V Ranch	4	B
62	Wind Cave National Park	1	A

Mesic Mixedgrass Prairies

Western Wheatgrass - Green Needlegrass Mixedgrass Prairie (CEGL001583)

Site	Survey Site Name	Management Level	EO Rank
36	Slate Prairie	3	B
44	Hell Canyon South	2	B
62	Wind Cave National Park	1	AB

Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)

Site	Survey Site Name	Management Level	EO Rank
1	Devils Tower NM	1	AB
42	Jewel Cave National Monument	1	B
62	Wind Cave National Park	1	A

Prairie Dog Grassland Complex

Prairie Dog Town Grassland Complex (CECX002003)

Site	Survey Site Name	Management Level	EO Rank
1	Devils Tower NM	1	BC
62	Wind Cave National Park	1	AB

Mesic Tallgrass Prairies

Northern Plains Big Bluestem Prairie (CEGL002205)

Site	Survey Site Name	Management Level	EO Rank
6	Cox Lake	3	B
50	Flying V Ranch	4	B

Black Hills Montane Grasslands

Black Hills Montane Grassland (CEGL002240)

Site	Survey Site Name	Management Level	EO Rank
7	Warren Peaks	3	AB
12	Sand Creek Headwaters	3	B
14	Moskee	4	BC
20	Eagle Cliffs	3	B,BC
22	Hardy	3	B
23	Powerline Draw	3	BC
24	Upper Dry Beaver Creek	3	BC

25	Upper Beaver Creek	3	B
26	Upper Castle Creek	3	BC
36	Slate Prairie	3	B
37	Reynolds Prairie	3	BC
39	Redbird Draw	3	B

Black Hills Sparse Vegetation

Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	A
52	Mount Rushmore National Memorial	1	B
54	Pine Creek	1	A
56	Cathedral Spires	2	A
62	Wind Cave National Park	1	B

Black Hills Talus (CEGL002307)

Site#	Survey Site Name	Management Level	EORank
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Great Plains Weedy Meadows (CEGL005260)

Site#	Survey Site Name	Management Level	EORank
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Ponderosa Pine Limestone Cliff (CEGL002055)

Site#	Survey Site Name	Management Level	EORank
62	Wind Cave National Park	1	A

Ponderosa Pine Scree Slope (CEGL000878)

Site#	Survey Site Name	Management Level	EORank
32	Bogus Jim Creek	2	AB
34	Canyon City	2	A

Redbeds (Siltstone) Rock Outcrop (CEGL005261)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	AB
62	Wind Cave National Park	1	A

Shale Barren Slopes (CEGL002294)

Site#	Survey Site Name	Management Level	EORank
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Plains Riparian Forests & Shrublands

Ash - Elm / Wolfberry Forest (CEGL002082)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	BC
61	Lower French Creek	2	B

Box Elder / Chokecherry Forest (CEGL000628)

Site #	Survey Site Name	Management Level	ECORank
42	Jewel Cave National Monument	1	B
62	Wind Cave National Park	1	AB

Cottonwood - Peach-Leaf Willow Floodplain Woodland (CEGL000659)

Site #	Survey Site Name	Management Level	ECORank
1	Devils Tower NM	1	C
31	Rapid City Bike Path	3	B

Cottonwood / Wolfberry Floodplain Woodland (CEGL000660)

Site #	Survey Site Name	Management Level	ECORank
62	Wind Cave National Park	1	B

Narrowleaf Cottonwood / Red-osier Dogwood Forest (CEGL002664)

Site #	Survey Site Name	Management Level	ECORank
19	Spearfish Creek	3	B
30	Little Elk Creek	3	B

Peach-leaf Willow Woodland (CEGL000947)

Site #	Survey Site Name	Management Level	ECORank
19	Spearfish Creek	3	BC

Sandbar Willow Shrubland (CEGL001197)

Site #	Survey Site Name	Management Level	ECORank
31	Rapid City Bike Path	3	B
34	Canyon City	2	AB
35	Mystic Rapid	3	B
49	Spring Creek - Rockerville	3	AB
51	Battle Creek	2	B
60	Stockade Lake Outlet	3	BC

Western Snowberry Shrubland (CEGL001131)

Site #	Survey Site Name	Management Level	ECORank
17	Vanocker Creek	3	AB
34	Canyon City	2	B
42	Jewel Cave National Monument	1	B
47	Reno Gulch	3	BC
62	Wind Cave National Park	1	AB

Dry Riparian Forests & Shrublands

Aspen/Chokecherry Forest (CEGL000596)

Site #	Survey Site Name	Management Level	ECORank
35	Mystic Rapid	3	AB,B
43	Hell Canyon North	3	B

Black Hawthorne Shrubland (CEGL001093)

Site#	Survey Site Name	Management Level	EORank
2	Lone Tree Hill	3	B
4	Gordon Ranch	3	B
9	Snyder Spring	3	B
12	Sand Creek Headwaters	3	B
13	Grand Canyon North	3	B

Bur Oak-Ironwood Forest (CEGL000555)

Site#	Survey Site Name	Management Level	EORank
3	Geis Spring	2	AB
17	Vanocker Creek	3	AB
18	Beaver Park	3	B
49	Spring Creek - Rockerville	3	AB
51	Battle Creek	2	AB
52	Mount Rushmore National Memorial	1	B

Paper Birch / Hazel Forest (CEGL002079)

Site#	Survey Site Name	Management Level	EORank
3	Geis Spring	2	AB
11	Cranberry Springs	2	AB
16	Little Spearfish Creek	3	AB
18	Beaver Park	3	AB
34	Canyon City	2	AB
49	Spring Creek - Rockerville	3	B
51	Battle Creek	2	B
52	Mount Rushmore National Memorial	1	AB

High Elevation Riparian Forests & Shrublands

Beaked Willow Scrub (CEGL001173)

Site#	Survey Site Name	Management Level	EORank
12	Sand Creek Headwaters	3	B
16	Little Spearfish Creek	3	AB
19	Spearfish Creek	3	AB
27	Black Fox	2	AB
28	Tillson Creek/Swede Gulch	3	B
30	Little Elk Creek	3	AB
47	Reno Gulch	3	BC
55	Black Elk Wilderness	2	AB
58	Upper Grace Coolidge Creek	2	AB
60	Stockade Lake Outlet	3	BC

Water Birch / Red-osier Dogwood Shrubland (CEGL001161)

Site#	Survey Site Name	Management Level	EORank
33	Placerville	2	AB
34	Canyon City	2	AB
60	Stockade Lake Outlet	3	BC

White Spruce Alluvial Black Hills Forest (CEGL002057)

Site	Survey Site Name	Management Level	EC Rank
16	Little Spearfish Creek	3	B
19	Spearfish Creek	3	AB
27	Black Fox	2	B
34	Canyon City	2	AB
35	Mystic Rapid	3	AB
46	Spring Creek/Vanderlehr Creek	3	B
53	Horsethief Dam	3	B
57	Iron Creek Headwater	2	AB
58	Upper Grace Coolidge Creek	2	B
59	Remington Camp	3	B

Riparian/Wet Meadows

Baltic Rush Wet Meadow (CEGL001838)

Site	Survey Site Name	Management Level	EC Rank
38	McIntosh Fen	2	B

Black Hills Streamside Vegetation (CEGL005262)

Site	Survey Site Name	Management Level	EC Rank
16	Little Spearfish Creek	3	A
27	Black Fox	2	AB
28	Tillson Creek/Swede Gulch	3	AB
34	Canyon City	2	B
51	Battle Creek	2	AB
52	Mount Rushmore National Memorial	1	B
55	Black Elk Wilderness	2	AB
58	Upper Grace Coolidge Creek	2	AB
59	Remington Camp	3	B

Canadian Reedgrass Wet Meadow (CEGL001559)

Site	Survey Site Name	Management Level	EC Rank
48	Spring Creek Game Preserve	3	BC
49	Spring Creek - Rockerville	3	B
58	Upper Grace Coolidge Creek	2	AB
59	Remington Camp	3	B

Creeping Spikerush Wet Meadow (CEGL001833)

Site	Survey Site Name	Management Level	EC Rank
62	Wind Cave National Park	1	B

Great Plains Cattail - Bulrush Marsh (CEGL002228)

Site	Survey Site Name	Management Level	EC Rank
6	Cox Lake	3	B

Nebraska Sedge Wet Meadow (CEGL001813)

Site	Survey Site Name	Management Level	EC Rank
12	Sand Creek Headwaters	3	B
16	Little Spearfish Creek	3	B

19	Spearfish Creek	3	B
27	Black Fox	2	AB
34	Canyon City	2	BC?
38	McIntosh Fen	2	AB
46	Spring Creek/Vanderlehr Creek	3	B
47	Reno Gulch	3	BC
58	Upper Grace Coolidge Creek	2	AB
59	Remington Camp	3	B

Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)

Site#	Survey Site Name	Management Level	EORank
1	Devils Tower NM	1	BC
6	Cox Lake	3	B
58	Upper Grace Coolidge Creek	2	AB
59	Remington Camp	3	B
62	Wind Cave National Park	1	B

Western Great Plains Streamside Vegetation (CEGL005263)

Site#	Survey Site Name	Management Level	EORank
30	Little Elk Creek	3	AB
61	Lower French Creek	2	AB
62	Wind Cave National Park	1	A

Saline Meadows

Alkali Sacaton Saline Prairie (CEGL002274)

Site#	Survey Site Name	Management Level	EORank
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Marshes

Northern Great Plains Cattail Marsh (CEGL002389)

Site#	Survey Site Name	Management Level	EORank
12	Sand Creek Headwaters	3	B
30	Little Elk Creek	3	B
35	Mystic Rapid	3	B
58	Upper Grace Coolidge Creek	2	B
60	Stockade Lake Outlet	3	BC
61	Lower French Creek	2	AB

Fens

Sage Willow Fen (CEGL001188)

Site#	Survey Site Name	Management Level	EORank
38	McIntosh Fen	2	B

Table 5. Sites surveyed for the Black Hills Community Inventory. Survey sites are presented in alphabetical order, with site number, management unit and management level (see Table 2) for each. Survey site locations are shown in Figures 4a-c. Management area abbreviations are: BHNF - Black Hills National Forest; CSP - Custer State Park; NPS - National Park Service; PRV - private; STATE-SD or STATE-WY - state; RAPID CITY - Rapid City. For each survey site, community types found are listed, along with element occurrence ranks for each (from A, excellent, to D, poor). Where multiple occurrences were found at one site, each occurrence was assigned its own rank.

Battle Creek (Site #51, BHNF, 2)

Community Types Present	EO Rank
Aspen / Beaked Hazel Forest (CEGL000583)	
Black Hills Streamside Vegetation (CEGL005262)	B
Bur Oak-Ironwood Forest (CEGL000555)	AB
Paper Birch / Hazel Forest (CEGL002079)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	B
Ponderosa Pine / Chokecherry Forest (CEGL000192)	B,U
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	BC
Sandbar Willow Shrubland (CEGL001197)	B
	B

Beaver Park (Site #18, BHNF, 3)

Community Types Present	EO Rank
Bur Oak-Ironwood Forest (CEGL000555)	
Paper Birch / Hazel Forest (CEGL002079)	B
Ponderosa Pine / Bearberry Woodland (CEGL000844)	AB
Ponderosa Pine / Chokecherry Forest (CEGL000192)	BC
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	BC
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	AB
	AB

Black Elk Wilderness (Site #55, BHNF, 2)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	
Black Hills Streamside Vegetation (CEGL005262)	AB
	AB

Black Fox (Site #27, BHNF, 2)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	
Black Hills Streamside Vegetation (CEGL005262)	AB
Nebraska Sedge Wet Meadow (CEGL001813)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	AB
Ponderosa Pine / Chokecherry Forest (CEGL000192)	B
	B

Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	C
Ponderosa Pine / Snowberry Forest (CEGL000203)	B
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B
White Spruce Alluvial Black Hills Forest (CEGL002057)	B
White Spruce/Twinflower Forest (CEGL000382)	B

Bogus Jim Creek (Site #32, BHNF, 2)

Community Types Present	EO Rank
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	B
Ponderosa Pine Scree Slope (CEGL000878)	AB
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B

Buskala Creek (Site #29, BHNF, 3)

Community Types Present	EO Rank
White Spruce/Grouseberry Forest (CEGL000383)	AB

Canyon City (Site #34, BHNF, 2)

Community Types Present	EO Rank
Black Hills Streamside Vegetation (CEGL005262)	B
Nebraska Sedge Wet Meadow (CEGL001813)	BC?
Paper Birch / Hazel Forest (CEGL002079)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	BC
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	B
Ponderosa Pine Scree Slope (CEGL000878)	A
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	AB
Sandbar Willow Shrubland (CEGL001197)	AB
Water Birch / Red-osier Dogwood Shrubland (CEGL001161)	AB
Western Snowberry Shrubland (CEGL001131)	B
White Spruce Alluvial Black Hills Forest (CEGL002057)	AB
White Spruce/Twinflower Forest (CEGL000382)	B

Cathedral Spires (Site #56, CSP, 2)

Community Types Present	EO Rank
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	A

Cook Lake Vicinity (Site #5, BHNF, 3)

Community Types Present	EO Rank
Aspen / Beaked Hazel Forest (CEGL000583)	B
Aspen / Bracken Fern Forest (CEGL000597)	B
Aspen / Shiny-leaf Spiraea Forest (CEGL000607)	B

Cox Lake (Site #6, STATE-SD, 3)

Community Types Present	EO Rank
Great Plains Cattail - Bulrush Marsh (CEGL002228)	B
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	BC

Northern Great Plains Little Bluestem Prairie (CEGL001681)	BC
Northern Plains Big Bluestem Prairie (CEGL002205)	B
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	B

Cranberry Springs (Site #11, BHNF, 2)

Community Types Present	EC Rank
Aspen / Beaked Hazel Forest (CEGL000583)	AB
Paper Birch / Hazel Forest (CEGL002079)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	AB
Ponderosa Pine / Chokecherry Forest (CEGL000192)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Snowberry Forest (CEGL000203)	B,BC

Devils Tower NM (Site #1, NPS, 1)

Community Types Present	EC Rank
Ash - Elm / Wolfberry Forest (CEGL002082)	BC
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	A
Bur Oak / Chokecherry - Western Snowberry Woodland (CEGL002138)	B
Cottonwood - Peach-Leaf Willow Floodplain Woodland (CEGL000659)	C
Ill-scented Sumac / Bluebunch Wheatgrass Shrub Prairie (CEGL001120)	AB
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	AB
Northern Great Plains Little Bluestem Prairie (CEGL001681)	AB
Ponderosa Pine / Bluebunch Wheatgrass Woodland (CEGL000865)	AB
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	AB
Ponderosa Pine / Oregon Grape Forest (CEGL000187)	AB
Ponderosa Pine / Sedge Woodland (CEGL000849)	AB
Ponderosa Pine / Western Wheatgrass Woodland (CEGL000188)	AB
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	BC
Prairie Dog Town Grassland Complex (CECX002003)	BC
Redbeds (Siltstone) Rock Outcrop (CEGL005261)	AB
Silver Sagebrush / Western Wheatgrass Shrub Prairie (CEGL001072)	B
Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)	AB

Eagle Cliffs (Site #20, BHNF, 3)

Community Types Present	EC Rank
Black Hills Montane Grassland (CEGL002240)	B,BC

Elk Mountain (Site #41, BHNF, 3)

Community Types Present	EC Rank
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	BC
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	BC
Ponderosa Pine / Rocky Mountain Juniper Woodland (CEGL000861)	B
Ponderosa Pine / Sedge Woodland (CEGL000849)	AB
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B

Flying V Ranch (Site #50, PRV, 4)

Community Types Present	EO Rank
Northern Great Plains Little Bluestem Prairie (CEGL001681)	B
Northern Plains Big Bluestem Prairie (CEGL002205)	B

Geis Spring (Site #3, BHNF, 2)

Community Types Present	EO Rank
Bur Oak-Ironwood Forest (CEGL000555)	AB
Paper Birch / Hazel Forest (CEGL002079)	AB
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	AB
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	BC

Gordon Ranch (Site #4, BHNF, 3)

Community Types Present	EO Rank
Black Hawthorne Shrubland (CEGL001093)	B

Grand Canyon North (Site #13, BHNF/PRV, 3)

Community Types Present	EO Rank
Black Hawthorne Shrubland (CEGL001093)	B

Hardy (Site #22, BHNF, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	B

Hell Canyon North (Site #43, BHNF, 3)

Community Types Present	EO Rank
Aspen/Chokecherry Forest (CEGL000596)	B
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	B
Ponderosa Pine / Rocky Mountain Juniper Woodland (CEGL000861)	B
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B

Hell Canyon South (Site #44, BHNF, 2)

Community Types Present	EO Rank
Mountain Mahogany / Side-oats Grama Shrubland (CEGL001086)	B
Ponderosa Pine / Rocky Mountain Juniper Woodland (CEGL000861)	B
Western Wheatgrass - Green Needlegrass Mixedgrass Prairie (CEGL001583)	B

Horsethief Dam (Site #53, BHNF, 3)

Community Types Present	EO Rank
White Spruce Alluvial Black Hills Forest (CEGL002057)	B

Iron Creek Headwater (Site #57, CSP, 2)

Community Types Present	EO Rank
White Spruce Alluvial Black Hills Forest (CEGL002057)	AB
White Spruce/Twinflower Forest (CEGL000382)	AB

Jewel Cave National Monument (Site #42, NPS, 1)

Community Types Present	EO Rank
Box Elder / Chokecherry Forest (CEGL000628)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	B
Ponderosa Pine / Sedge Woodland (CEGL000849)	B
Ponderosa Pine / Snowberry Forest (CEGL000203)	AB
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B
Western Snowberry Shrubland (CEGL001131)	B
Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)	B

Keough Draw (Site #21, BHNF, 3)

Community Types Present	EO Rank
White Spruce/Grouseberry Forest (CEGL000383)	B

Little Elk Creek (Site #30, BHNF, 3)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Narrowleaf Cottonwood / Red-osier Dogwood Forest (CEGL002664)	B
Northern Great Plains Cattail Marsh (CEGL002389)	B
Western Great Plains Streamside Vegetation (CEGL005263)	AB

Little Spearfish Creek (Site #16, BHNF, 3)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Black Hills Streamside Vegetation (CEGL005262)	A
Nebraska Sedge Wet Meadow (CEGL001813)	B
Paper Birch / Hazel Forest (CEGL002079)	AB
White Spruce Alluvial Black Hills Forest (CEGL002057)	B

Lone Tree Hill (Site #2, BHNF, 3)

Community Types Present	EO Rank
Black Hawthorne Shrubland (CEGL001093)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	B

Lower French Creek (Site #61, CSP, 2)

Community Types Present	EO Rank
Ash - Elm / Wolfberry Forest (CEGL002082)	B
Northern Great Plains Cattail Marsh (CEGL002389)	AB
Western Great Plains Streamside Vegetation (CEGL005263)	AB

McIntosh Fen (Site #38, BHNF, 2)

Community Types Present	EO Rank
Baltic Rush Wet Meadow (CEGL001838)	B
Nebraska Sedge Wet Meadow (CEGL001813)	AB
Sage Willow Fen (CEGL001188)	B

Moskee (Site #14, BHNF/PRV, 4)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	BC

Mount Rushmore National Memorial (Site #52, NPS, 1)

Community Types Present	EO Rank
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295) ✓	B
Black Hills Streamside Vegetation (CEGL005262) ✓	B
Bur Oak-Ironwood Forest (CEGL000555) ✓	B
Paper Birch / Hazel Forest (CEGL002079) ✓	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844) ✓	AB
Ponderosa Pine / Little Bluestem Woodland (CEGL000201) ✓	B
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123) ✓	B
Ponderosa Pine/Common Juniper Woodland (CEGL000859) ✓	B

Mystic Rapid (Site #35, BHNF, 3)

Community Types Present	EO Rank
Aspen/Chokecherry Forest (CEGL000596)	AB,B
Northern Great Plains Cattail Marsh (CEGL002389)	B
Sandbar Willow Shrubland (CEGL001197)	B
White Spruce Alluvial Black Hills Forest (CEGL002057)	AB

Pine Creek (Site #54, BHNF, 1)

Community Types Present	EO Rank
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	A
Ponderosa Pine / Bearberry Woodland (CEGL000844)	AB
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	U
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	AB
White Spruce/Twinflower Forest (CEGL000382)	U

Placerville (Site #33, BHNF, 2)

Community Types Present	EO Rank
Ponderosa Pine / Sedge Woodland (CEGL000849)	B
Water Birch / Red-osier Dogwood Shrubland (CEGL001161)	AB

Powerline Draw (Site #23, BHNF, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	BC

Rapid City Bike Path (Site #31, RAPID CITY, 3)

Community Types Present	EO Rank
Cottonwood - Peach-Leaf Willow Floodplain Woodland (CEGL000659)	B
Sandbar Willow Shrubland (CEGL001197)	B

Redbird Draw (Site #39, BHNF/PRV, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	B

Remington Camp (Site #59, BHNF, 3)

Community Types Present	EO Rank
Black Hills Streamside Vegetation (CEGL005262)	B
Canadian Reedgrass Wet Meadow (CEGL001559)	B
Nebraska Sedge Wet Meadow (CEGL001813)	B
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	B
White Spruce Alluvial Black Hills Forest (CEGL002057)	B

Reno Gulch (Site #47, BHNF, 3)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	BC
Nebraska Sedge Wet Meadow (CEGL001813)	BC
Western Snowberry Shrubland (CEGL001131)	BC

Reynolds Prairie (Site #37, BHNF/PRV, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	BC

Sand Creek Headwaters (Site #12, BHNF, 3)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	B
Black Hawthorne Shrubland (CEGL001093)	B
Black Hills Montane Grassland (CEGL002240)	B
Nebraska Sedge Wet Meadow (CEGL001813)	B
Northern Great Plains Cattail Marsh (CEGL002389)	B

Scott Canyon (Site #40, PRV, 3)

Community Types Present	EO Rank
Mountain Mahogany / Side-oats Grama Shrubland (CEGL001086)	A
Rocky Mountain Juniper / Little-seed Ricegrass Woodland (CEGL000747)	B

Shephard Canyon (Site #10, STATE-WY, 4)

Community Types Present	EO Rank
Bur Oak / Chokecherry - Western Snowberry Woodland (CEGL002138)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	B

Slate Prairie (Site #36, BHNF/PRV, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	B
Western Wheatgrass - Green Needlegrass Mixedgrass Prairie (CEGL001583)	B

Snyder Spring (Site #9, BHNF, 3)

Community Types Present	EO Rank
Black Hawthorne Shrubland (CEGL001093)	B

Spearfish Creek (Site #19, BHNF, 3)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Narrowleaf Cottonwood / Red-osier Dogwood Forest (CEGL002664)	B
Nebraska Sedge Wet Meadow (CEGL001813)	B
Peach-leaf Willow Woodland (CEGL000947)	BC
White Spruce Alluvial Black Hills Forest (CEGL002057)	AB

Spring Creek - Rockerville (Site #49, BHNF, 3)

Community Types Present	EO Rank
Bur Oak-Ironwood Forest (CEGL000555)	AB
Canadian Reedgrass Wet Meadow (CEGL001559)	B
Paper Birch / Hazel Forest (CEGL002079)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Sandbar Willow Shrubland (CEGL001197)	AB

Spring Creek Game Preserve (Site #48, BHNF, 3)

Community Types Present	EO Rank
Canadian Reedgrass Wet Meadow (CEGL001559)	BC

Spring Creek/Vanderlehr Creek (Site #46, BHNF, 3)

Community Types Present	EO Rank
Nebraska Sedge Wet Meadow (CEGL001813)	B
White Spruce Alluvial Black Hills Forest (CEGL002057)	B

Stockade Lake Outlet (Site #60, CSP, 3)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	BC
Northern Great Plains Cattail Marsh (CEGL002389)	BC
Sandbar Willow Shrubland (CEGL001197)	BC
Water Birch / Red-osier Dogwood Shrubland (CEGL001161)	BC

Tillson Creek/Swede Gulch (Site #28, BHNF, 3)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	B
Black Hills Streamside Vegetation (CEGL005262)	AB

Upper Beaver Creek (Site #25, BHNF/PRV, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	B

Upper Castle Creek (Site #26, BHNF/PRV, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	BC

Upper Dry Beaver Creek (Site #24, BHNF/PRV?, 3)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	BC

Upper Grace Coolidge Creek (Site #58, CSP, 2)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Black Hills Streamside Vegetation (CEGL005262)	AB
Canadian Reedgrass Wet Meadow (CEGL001559)	AB
Nebraska Sedge Wet Meadow (CEGL001813)	AB
Northern Great Plains Cattail Marsh (CEGL002389)	B
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	AB
White Spruce Alluvial Black Hills Forest (CEGL002057)	B

Vanocker Creek (Site #17, BHNF, 3)

Community Types Present	EO Rank
Bur Oak-Ironwood Forest (CEGL000555)	AB
Creeping Juniper / Little Bluestem Dwarf-shrubland (CEGL001394)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	B
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	AB
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Western Snowberry Shrubland (CEGL001131)	AB

Warren Peaks (Site #7, BHNF/PRV, 3)

Community Types Present	EO Rank
Aspen / Shiny-leaf Spiraea Forest (CEGL000607)	B
Black Hills Montane Grassland (CEGL002240)	AB

Wind Cave National Park (Site #62, NPS, 1)

Community Types Present	EO Rank
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	B
Box Elder / Chokecherry Forest (CEGL000628)	AB
Chokecherry Shrubland (CEGL001108)	AB
Cottonwood / Wolfberry Floodplain Woodland (CEGL000660)	B
Creeping Juniper / Little Bluestem Dwarf-shrubland (CEGL001394)	AB
Creeping Spikerush Wet Meadow (CEGL001833)	B
Mountain Mahogany / Side-oats Grama Shrubland (CEGL001086)	A
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	AB

Northern Great Plains Little Bluestem Prairie (CEGL001681)	A
Ponderosa Pine / Chokecherry Forest (CEGL000192)	A
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	A
Ponderosa Pine / Sedge Woodland (CEGL000849)	A
Ponderosa Pine / Western Wheatgrass Woodland (CEGL000188)	A
Ponderosa Pine Limestone Cliff (CEGL002055)	A
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	AB
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	B
Prairie Dog Town Grassland Complex (CECX002003)	AB
Redbeds (Siltstone) Rock Outcrop (CEGL005261)	A
Western Great Plains Streamside Vegetation (CEGL005263)	A
Western Snowberry Shrubland (CEGL001131)	AB
Western Wheatgrass - Green Needlegrass Mixedgrass Prairie (CEGL001583)	AB
Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)	A

Table 6. Surveyed occurrences of community type. Occurrences are summarized by both element occurrence rank and by management level. Types are presented in ecological group order.

Dry Coniferous Forests & Woodlands

Global Community Name (Global Code)	Survey 1			Survey 2			Survey 3			Survey 4			Survey 5			Survey 6			Survey 7			Survey 8			Survey 9			Survey 10			Survey 11			Survey 12			Survey 13			Survey 14			Survey 15			Survey 16			Survey 17			Survey 18			Survey 19			Survey 20			Survey 21			Survey 22			Survey 23			Survey 24			Survey 25			Survey 26			Survey 27			Survey 28			Survey 29			Survey 30			Survey 31			Survey 32			Survey 33			Survey 34			Survey 35			Survey 36			Survey 37			Survey 38			Survey 39			Survey 40			Survey 41			Survey 42			Survey 43			Survey 44			Survey 45			Survey 46			Survey 47			Survey 48			Survey 49			Survey 50			Survey 51			Survey 52			Survey 53			Survey 54			Survey 55			Survey 56			Survey 57			Survey 58			Survey 59			Survey 60			Survey 61			Survey 62			Survey 63			Survey 64			Survey 65			Survey 66			Survey 67			Survey 68			Survey 69			Survey 70			Survey 71			Survey 72			Survey 73			Survey 74			Survey 75			Survey 76			Survey 77			Survey 78			Survey 79			Survey 80			Survey 81			Survey 82			Survey 83			Survey 84			Survey 85			Survey 86			Survey 87			Survey 88			Survey 89			Survey 90			Survey 91			Survey 92			Survey 93			Survey 94			Survey 95			Survey 96			Survey 97			Survey 98			Survey 99			Survey 100			Survey 101			Survey 102			Survey 103			Survey 104			Survey 105			Survey 106			Survey 107			Survey 108			Survey 109			Survey 110			Survey 111			Survey 112			Survey 113			Survey 114			Survey 115			Survey 116			Survey 117			Survey 118			Survey 119			Survey 120			Survey 121			Survey 122			Survey 123			Survey 124			Survey 125			Survey 126			Survey 127			Survey 128			Survey 129			Survey 130			Survey 131			Survey 132			Survey 133			Survey 134			Survey 135			Survey 136			Survey 137			Survey 138			Survey 139			Survey 140			Survey 141			Survey 142			Survey 143			Survey 144			Survey 145			Survey 146			Survey 147			Survey 148			Survey 149			Survey 150			Survey 151			Survey 152			Survey 153			Survey 154			Survey 155			Survey 156			Survey 157			Survey 158			Survey 159			Survey 160			Survey 161			Survey 162			Survey 163			Survey 164			Survey 165			Survey 166			Survey 167			Survey 168			Survey 169			Survey 170			Survey 171			Survey 172			Survey 173			Survey 174			Survey 175			Survey 176			Survey 177			Survey 178			Survey 179			Survey 180			Survey 181			Survey 182			Survey 183			Survey 184			Survey 185			Survey 186			Survey 187			Survey 188			Survey 189			Survey 190			Survey 191			Survey 192			Survey 193			Survey 194			Survey 195			Survey 196			Survey 197			Survey 198			Survey 199			Survey 200			Survey 201			Survey 202			Survey 203			Survey 204			Survey 205			Survey 206			Survey 207			Survey 208			Survey 209			Survey 210			Survey 211			Survey 212			Survey 213			Survey 214			Survey 215			Survey 216			Survey 217			Survey 218			Survey 219			Survey 220			Survey 221			Survey 222			Survey 223			Survey 224			Survey 225			Survey 226			Survey 227			Survey 228			Survey 229			Survey 230			Survey 231			Survey 232			Survey 233			Survey 234			Survey 235			Survey 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929			Survey 930			Survey 931			Survey 932			Survey 933			Survey 934			Survey 935			Survey 936			Survey 937			Survey 938			Survey 939			Survey 940			Survey 941			Survey 942			Survey 943			Survey 944			Survey 945			Survey 946			Survey 947			Survey 948			Survey 949			Survey 950			Survey 951			Survey 952			Survey 953			Survey 954			Survey 955			Survey 956			Survey 957			Survey 958			Survey 959			Survey		
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Upland Hardwood Forests & Woodlands

Global Common Name (Global Code)	LEVEL 1		LEVEL 2		LEVEL 3		LEVEL 4		Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOs in level 1 and 2
	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B		
Aspen / Beaked Hazel Forest (CEGL000583)	0	0	2	2	1	1	0	0	3	2 (67%)
Aspen / Bracken Fern Forest (CEGL000597)	0	0	0	0	1	1	0	0	1	0 (%)
Aspen / Shiny-leaf Spiraea Forest (CEGL000607)	0	0	0	0	2	2	0	0	2	0 (%)
Bur Oak / Chokecherry - Western Snowberry Woodland (CEGL002138)	1	1	0	0	0	0	1	1	2	1 (50%)
Bur Oak / Sedge Woodland (CEGL000554)	0	0	0	0	0	0	0	0	0	0 (0%)
TOTAL	1	1	2	2	4	4	1	1	8	3 (38%)

Dry Plains Shrublands

Global Common Name (Global Code)	LEVEL 1		LEVEL 2		LEVEL 3		LEVEL 4		Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOs in level 1 and 2
	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B		
Big Sagebrush / Western Wheatgrass Shrub Grassland (CEGL001047)	0	0	0	0	0	0	0	0	0	0 (0%)
Creeping Juniper / Little Bluestem Dwarf-shrubland (CEGL001394)	1	1	0	0	1	1	0	0	2	1 (50%)
Ill-scented Sumac / Bluebunch Wheatgrass Shrub Prairie (CEGL001120)	1	1	0	0	0	0	0	0	1	1 (100%)
Mountain Mahogany / Side-oats Grama Shrubland (CEGL001086)	1	1	1	1	1	1	0	0	3	2 (67%)
TOTAL	3	3	1	1	2	2	0	0	6	4 (67%)

Mesic Plains Shrublands

Global Common Name (Global Code)	LEVEL 1		LEVEL 2		LEVEL 3		LEVEL 4		Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOs in level 1 and 2
	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B		
Chokecherry Shrubland (CEGL001108)	1	1	0	0	0	0	0	0	1	1 (100%)
Silver Sagebrush / Western Wheatgrass Shrub Prairie (CEGL001072)	1	1	0	0	0	0	0	0	1	1 (100%)
TOTAL	2	2	0	0	0	0	0	0	2	2 (100%)

Dry Mixedgrass Prairies

Global Common Name (Global Code)	LEVEL 1		LEVEL 2		LEVEL 3		LEVEL 4		Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOs in level 1 and 2
	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B		
Needle-and-thread - Blue Grama Mixedgrass Prairie (CEGL002037)	2	1	0	0	2	1	0	0	4	1 (25%)
Northern Great Plains Little Bluestem Prairie (CEGL001681)	3	3	0	0	4	2	2	1	9	3 (33%)
Western Wheatgrass - Blue Grama - Threadleaf Sedge Prairie (CEGL001579)	0	0	0	0	0	0	0	0	0	0 (0%)
TOTAL	5	4	0	0	6	3	2	1	13	4 (31%)

Black Hills Sparse Vegetation

Global Common Name (Global Code)	LEVEL 1				LEVEL 2				LEVEL 3				LEVEL 4				Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOs in level 1 and 2
	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B		
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	4	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	5	5 (100%)
Black Hills Talus (CEGL002307)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (0%)
Great Plains Weedy Meadows (CEGL005260)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (0%)
Ponderosa Pine Limestone Cliff (CEGL002055)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1 (100%)
Ponderosa Pine Scree Slope (CEGL000878)	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	2	2 (100%)
Redbeds (Siltstone) Rock Outcrop (CEGL005261)	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2 (100%)
Shale Barren Slopes (CEGL002294)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (0%)
TOTAL	7	7	3	3	0	0	0	0	0	0	0	0	0	0	0	10	10	10 (100%)

Plains Riparian Forests & Shrublands

Global Common Name (Global Code)	LEVEL 1				LEVEL 2				LEVEL 3				LEVEL 4				Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOs in level 1 and 2
	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B		
Ash - Elm / Wolfberry Forest (CEGL002082)	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	2	1 (50%)
Box Elder / Chokecherry Forest (CEGL000628)	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2 (100%)
Cottonwood - Peach-Leaf Willow Floodplain Woodland (CEGL000659)	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2	2	0 (%)
Cottonwood / Wolfberry Floodplain Woodland (CEGL000660)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1 (100%)
Narrowleaf Cottonwood / Red-osier Dogwood Forest (CEGL002664)	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	2	2	0 (%)
Peach-leaf Willow Woodland (CEGL000947)	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0 (%)
Sandbar Willow Shrubland (CEGL001197)	0	0	2	2	2	4	3	3	0	0	0	0	0	0	0	6	6	2 (33%)
Western Snowberry Shrubland (CEGL001131)	2	2	1	1	2	4	10	7	0	0	0	0	0	0	0	5	5	3 (60%)
TOTAL	7	5	4	4	10	7	0	0	0	0	0	0	0	0	0	21	21	9 (43%)

Dry Riparian Forests & Shrublands

Global Common Name (Global Code)	LEVEL 1				LEVEL 2				LEVEL 3				LEVEL 4				Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOs in level 1 and 2
	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B	TOTAL	A-B		
Aspen/Chokecherry Forest (CEGL000596)	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	3	3	0 (%)
Black Hawthorne Shrubland (CEGL001093)	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	5	5	0 (%)
Bur Oak-Ironwood Forest (CEGL000555)	1	1	2	2	3	2	0	0	0	0	0	0	0	0	0	6	6	3 (50%)
Paper Birch / Hazel Forest (CEGL002079)	1	1	4	4	3	2	0	0	0	0	0	0	0	0	0	8	8	5 (63%)
TOTAL	2	2	6	6	14	11	0	0	0	0	0	0	0	0	0	22	22	8 (36%)

High Elevation Riparian Forests & Shrublands

Global Conservation Planning (GCP) Code	Habitat I										Habitat II		TOTAL No. (3)A
	CEGL0001173	CEGL0001161	CEGL0002057	CEGL0001173	CEGL0001161	CEGL0002057	CEGL0001173	CEGL0001161	CEGL0002057	CEGL0001173	CEGL0001161	CEGL0002057	
Beaked Willow Scrub (CEGL001173)	0	0	3	3	7	5	0	0	0	10			3 (30%)
Water Birch / Red-osier Dogwood Shrubland (CEGL001161)	0	0	2	2	1	0	0	0	0	3			2 (67%)
White Spruce Alluvial Black Hills Forest (CEGL002057)	0	0	4	4	6	5	0	0	0	10			4 (40%)
TOTAL	0	0	9	9	14	10	0	0	0	23			9 (39%)

Riparian/Wet Meadows

Global Conservation Planning (GCP) Code	Habitat I										Habitat II		TOTAL No. (3)A
	CEGL001838	CEGL005262	CEGL001559	CEGL001833	CEGL002228	CEGL001813	CEGL001477	CEGL005263	CEGL001838	CEGL005262	CEGL001559	CEGL001833	
Baltic Rush Wet Meadow (CEGL001838)	0	0	1	1	0	0	0	0	0	1			1 (100%)
Black Hills Streamside Vegetation (CEGL005262)	1	1	5	5	3	2	0	0	0	9			6 (67%)
Canadian Reedgrass Wet Meadow (CEGL001559)	0	0	1	1	3	2	0	0	0	4			1 (25%)
Creeping Spikerush Wet Meadow (CEGL001833)	1	1	0	0	0	0	0	0	0	1			1 (100%)
Great Plains Cattail - Bulrush Marsh (CEGL002228)	0	0	0	0	1	1	0	0	0	1			0 (0%)
Nebraska Sedge Wet Meadow (CEGL001813)	0	0	4	3	6	3	0	0	0	10			3 (30%)
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	2	1	1	1	2	2	0	0	0	5			2 (40%)
Western Great Plains Streamside Vegetation (CEGL005263)	1	1	1	1	1	1	0	0	0	3			2 (67%)
TOTAL	5	4	13	12	16	11	0	0	0	34			16 (47%)

Saline Meadows

Global Conservation Planning (GCP) Code	Habitat I										Habitat II		TOTAL No. (3)A
	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	CEGL002274	
Alkali Sacaton Saline Prairie (CEGL002274)	0	0	0	0	0	0	0	0	0	0			0 (0%)
TOTAL	0	0	0	0	0	0	0	0	0	0			0 (0%)

Marshes

Global Conservation Planning (GCP) Code	Habitat I										Habitat II		TOTAL No. (3)A
	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	CEGL002389	
Northern Great Plains Cattail Marsh (CEGL002389)	0	0	2	2	4	3	0	0	0	6			2 (33%)
TOTAL	0	0	2	2	4	3	0	0	0	6			2 (33%)

Fens

Global Common Name (Global Code)	LEVEL 1		LEVEL 2		LEVEL 3		LEVEL 4		Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOS in level 1 and 2
	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B		
Sage Willow Fen (CEGL001188)	0	0	1	1	0	0	0	0	1	1 (100%)
TOTAL	0	0	1	1	0	0	0	0	1	1 (100%)

TOTAL ACROSS ALL ECOLOGICAL GROUPS

Global Common Name (Global Code)	LEVEL 1		LEVEL 2		LEVEL 3		LEVEL 4		Total no. of occurrences surveyed	TOTAL NO. (%) A-B EOS in level 1 and 2
	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B	TOTAL A-B		
GRAND TOTALS	61	51	74	65	104	74	5	3	244	116 (48%)

Table 7. Rare community types found in the Black Hills. Rare types include all G1-G3 ranks, where G1=Critically Imperilled, G2=Imperilled, G3=Vulnerable. A "Q" after the rank means there are taxonomic difficulties in classifying the type, which, if resolved could lower the rank; a "?" means there is some uncertainty about the rank value, a range (e.g. G2G3) means there is greater uncertainty about the rank. See Appendix 5 for further details of the rank criteria. Distribution category (see Table 1) and number of occurrences surveyed are provided for each type.

Global Common Name (Global Code)	Distribution	No. of EO's	RANK
Black Hills Montane Grassland (CEGL002240)	E	13	G1G2
White Spruce/Grouseberry Forest (CEGL000383)	E	2	G1G2
Black Hawthorne Shrubland (CEGL001093)	L?	5	G2Q
Black Hills Streamside Vegetation (CEGL005262)	E?	9	G2G4
Bur Oak-Ironwood Forest (CEGL000555)	E	6	G2G3
Cottonwood / Wolfberry Floodplain Woodland (CEGL000660)	L?	1	G2G3
Paper Birch / Hazel Forest (CEGL002079)	W	8	G2G3
Western Great Plains Streamside Vegetation (CEGL005263)	W?	3	G2G4
White Spruce Alluvial Black Hills Forest (CEGL002057)	E	10	G2G3
White Spruce/Twinflower Forest (CEGL000382)	E	4	G2G3
Aspen / Beaked Hazel Forest (CEGL000583)	L	3	G3
Beaked Willow Scrub (CEGL001173)	W?	10	G3?
Box Elder / Chokecherry Forest (CEGL000628)	W?	2	G3
Cottonwood - Peach-Leaf Willow Floodplain Woodland (CEGL000659)	W	2	G3G4
Northern Great Plains Little Bluestem Prairie (CEGL001681)	W	9	G3G4
Peach-leaf Willow Woodland (CEGL000947)	P?	1	G3
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	E	5	G3
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	W?	14	G3G4
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	L	4	G3
Ponderosa Pine / Oregon Grape Forest (CEGL000187)	L	1	G3
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	E	5	G3G4Q
Ponderosa Pine / Sedge Woodland (CEGL000849)	L	5	G3
Ponderosa Pine / Western Wheatgrass Woodland (CEGL000188)	L	2	G3G4
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	P	5	G3?
Rocky Mountain Juniper / Little-seed Ricegrass Woodland (CEGL000747)	P	1	G3
Sage Willow Fen (CEGL001188)	L	1	G3
Water Birch / Red-osier Dogwood Shrubland (CEGL001161)	W	3	G3?
Western Wheatgrass - Green Needlegrass Mixedgrass Prairie (CEGL001583)	W	3	G3G4

Table 8. Exemplary sites and possible exemplary sites identified in the Black Hills Community Inventory. Exemplary sites are those that have outstanding size, landscape context (including little landscape fragmentation), a diverse or unusual set of community types present, and high quality occurrence ranks for those types. Possible exemplary sites are known to include one or more high-ranked occurrences, but there is insufficient information currently available to justify exemplary status. For each site listed below, site number, management unit, management level (see Table 2) and geomorphic region (see Figure 3) are provided. Survey site locations are shown in Figures 4a-c.

EXEMPLARY SITES

Black Elk Wilderness

(Site #55, BHNF, 2, Central Core)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Black Hills Streamside Vegetation (CEGL005262)	AB

Black Fox

(Site #27, BHNF, 2, Central Core)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Black Hills Streamside Vegetation (CEGL005262)	AB
Nebraska Sedge Wet Meadow (CEGL001813)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Chokecherry Forest (CEGL000192)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	C
Ponderosa Pine / Snowberry Forest (CEGL000203)	B
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B
White Spruce Alluvial Black Hills Forest (CEGL002057)	B
White Spruce/Twinflower Forest (CEGL000382)	B

Canyon City

(Site #34, BHNF, 2, Central Core)

Community Types Present	EO Rank
Black Hills Streamside Vegetation (CEGL005262)	B
Nebraska Sedge Wet Meadow (CEGL001813)	BC?
Paper Birch / Hazel Forest (CEGL002079)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	BC
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	B
Ponderosa Pine Scree Slope (CEGL000878)	A
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	AB
Sandbar Willow Shrubland (CEGL001197)	AB
Water Birch / Red-osier Dogwood Shrubland (CEGL001161)	AB

Western Snowberry Shrubland (CEGL001131)	B
White Spruce Alluvial Black Hills Forest (CEGL002057)	AB
White Spruce/Twinflower Forest (CEGL000382)	B

Cranberry Springs

(Site #11, BHNF, 2, Limestone Plateau)

Community Types Present	EO Rank
Aspen / Beaked Hazel Forest (CEGL000583)	AB
Paper Birch / Hazel Forest (CEGL002079)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	AB
Ponderosa Pine / Chokecherry Forest (CEGL000192)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Snowberry Forest (CEGL000203)	B,BC

Elk Mountain

(Site #41, BHNF, 3, Hogback Rim)

Community Types Present	EO Rank
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	BC
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	BC
Ponderosa Pine / Rocky Mountain Juniper Woodland (CEGL000861)	B
Ponderosa Pine / Sedge Woodland (CEGL000849)	AB
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B

McIntosh Fen

(Site #38, BHNF, 2, Limestone Plateau)

Community Types Present	EO Rank
Baltic Rush Wet Meadow (CEGL001838)	B
Nebraska Sedge Wet Meadow (CEGL001813)	AB
Sage Willow Fen (CEGL001188)	B

Pine Creek

(Site #54, BHNF, 1, Central Core)

Community Types Present	EO Rank
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	A
Ponderosa Pine / Bearberry Woodland (CEGL000844)	AB
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	U
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	AB
White Spruce/Twinflower Forest (CEGL000382)	U

Upper Grace Coolidge Creek

(Site #58, CSP, 2, Central Core)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Black Hills Streamside Vegetation (CEGL005262)	AB
Canadian Reedgrass Wet Meadow (CEGL001559)	AB
Nebraska Sedge Wet Meadow (CEGL001813)	AB
Northern Great Plains Cattail Marsh (CEGL002389)	B

Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	AB
White Spruce Alluvial Black Hills Forest (CEGL002057)	B

Wind Cave National Park

(Site #62, NPS, 1, Minnelusa Foothills, Red Valley, Hogback Rim)

Community Types Present	EO Rank
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	B
Box Elder / Chokecherry Forest (CEGL000628)	AB
Chokecherry Shrubland (CEGL001108)	AB
Cottonwood / Wolfberry Floodplain Woodland (CEGL000660)	B
Creeping Juniper / Little Bluestem Dwarf-shrubland (CEGL001394)	AB
Creeping Spikerush Wet Meadow (CEGL001833)	B
Mountain Mahogany / Side-oats Grama Shrubland (CEGL001086)	A
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	AB
Northern Great Plains Little Bluestem Prairie (CEGL001681)	A
Ponderosa Pine / Chokecherry Forest (CEGL000192)	A
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	A
Ponderosa Pine / Sedge Woodland (CEGL000849)	A
Ponderosa Pine / Western Wheatgrass Woodland (CEGL000188)	A
Ponderosa Pine Limestone Cliff (CEGL002055)	A
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	AB
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	B
Prairie Dog Town Grassland Complex (CECX002003)	AB
Redbeds (Siltstone) Rock Outcrop (CEGL005261)	A
Western Great Plains Streamside Vegetation (CEGL005263)	A
Western Snowberry Shrubland (CEGL001131)	AB
Western Wheatgrass - Green Needlegrass Mixedgrass Prairie (CEGL001583)	AB
Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)	A

OTHER POSSIBLE EXEMPLARY SITES

Beaver Park

(Site #18, BHNF, 3, Minnelusa Foothills)

Community Types Present	EO Rank
Bur Oak-Ironwood Forest (CEGL000555)	B
Paper Birch / Hazel Forest (CEGL002079)	AB
Ponderosa Pine / Bearberry Woodland (CEGL000844)	BC
Ponderosa Pine / Chokecherry Forest (CEGL000192)	BC
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	AB
Ponderosa Pine / Rough-leaf Ricegrass Woodland (CEGL002123)	AB

Cox Lake

(Site #6, STATE-SD, 3, Red Valley)

Community Types Present	EO Rank
Great Plains Cattail - Bulrush Marsh (CEGL002228)	B
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	BC
Northern Great Plains Little Bluestem Prairie (CEGL001681)	BC
Northern Plains Big Bluestem Prairie (CEGL002205)	B
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	B

Devils Tower NM

(Site #1, NPS, 1, Hogback Rim)

Community Types Present	EO Rank
Ash - Elm / Wolfberry Forest (CEGL002082)	BC
Black Hills Granite/Metamorphic Rock Outcrop (CEGL002295)	A
Bur Oak / Chokecherry - Western Snowberry Woodland (CEGL002138)	B
Cottonwood - Peach-Leaf Willow Floodplain Woodland (CEGL000659)	C
Ill-scented Sumac / Bluebunch Wheatgrass Shrub Prairie (CEGL001120)	AB
Needle-and-Thread - Blue Grama Mixedgrass Prairie (CEGL002037)	AB
Northern Great Plains Little Bluestem Prairie (CEGL001681)	AB
Ponderosa Pine / Bluebunch Wheatgrass Woodland (CEGL000865)	AB
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	AB
Ponderosa Pine / Oregon Grape Forest (CEGL000187)	AB
Ponderosa Pine / Sedge Woodland (CEGL000849)	AB
Ponderosa Pine / Western Wheatgrass Woodland (CEGL000188)	AB
Prairie Cordgrass - Sedge Wet Meadow (CEGL001477)	BC
Prairie Dog Town Grassland Complex (CECX002003)	BC
Redbeds (Siltstone) Rock Outcrop (CEGL005261)	AB
Silver Sagebrush / Western Wheatgrass Shrub Prairie (CEGL001072)	B
Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)	AB

Eagle Cliffs

(Site #20, BHNF, 3, Limestone Plateau)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	B,BC

Hardy

(Site #22, BHNF, 3, Limestone Plateau)

Community Types Present	EO Rank
Black Hills Montane Grassland (CEGL002240)	B

Hell Canyon North

(Site #43, BHNF, 3, Minnelusa Foothills)

Community Types Present	EO Rank
Aspen/Chokecherry Forest (CEGL000596)	B
Ponderosa Pine / Bearberry Woodland (CEGL000844)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	B
Ponderosa Pine / Rocky Mountain Juniper Woodland (CEGL000861)	B
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B

Jewel Cave National Monument

(Site #42, NPS, 1, Minnelusa Foothills)

Community Types Present	EO Rank
Box Elder / Chokecherry Forest (CEGL000628)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	B
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Ponderosa Pine / Mountain Ninebark Forest (CEGL000190)	B
Ponderosa Pine / Sedge Woodland (CEGL000849)	B

Ponderosa Pine / Snowberry Forest (CEGL000203)	AB
Ponderosa Pine/Common Juniper Woodland (CEGL000859)	B
Western Snowberry Shrubland (CEGL001131)	B
Wheatgrass - Needle-and-Thread Mixedgrass Prairie (CEGL002034)	B

Little Elk Creek

(Site #30, BHNF, 3, Minnelusa Foothills)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Narrowleaf Cottonwood / Red-osier Dogwood Forest (CEGL002664)	B
Northern Great Plains Cattail Marsh (CEGL002389)	B
Western Great Plains Streamside Vegetation (CEGL005263)	AB

Little Spearfish Creek

(Site #16, BHNF, 3, Limestone Plateau)

Community Types Present	EO Rank
Beaked Willow Scrub (CEGL001173)	AB
Black Hills Streamside Vegetation (CEGL005262)	A
Nebraska Sedge Wet Meadow (CEGL001813)	B
Paper Birch / Hazel Forest (CEGL002079)	AB
White Spruce Alluvial Black Hills Forest (CEGL002057)	B

Lower French Creek

(Site #61, CSP, 2, Minnelusa Foothills)

Community Types Present	EO Rank
Ash - Elm / Wolfberry Forest (CEGL002082)	B
Northern Great Plains Cattail Marsh (CEGL002389)	AB
Western Great Plains Streamside Vegetation (CEGL005263)	AB

Vanocker Creek

(Site #17, BHNF, 3, Minnelusa Foothills)

Community Types Present	EO Rank
Bur Oak-Ironwood Forest (CEGL000555)	AB
Creeping Juniper / Little Bluestem Dwarf-shrubland (CEGL001394)	B
Northern Great Plains Little Bluestem Prairie (CEGL001681)	B
Ponderosa Pine / Bur Oak Woodland (CEGL000873)	AB
Ponderosa Pine / Little Bluestem Woodland (CEGL000201)	B
Western Snowberry Shrubland (CEGL001131)	AB

Warren Peaks

(Site #7, BHNF/PRV, 3, Central Core)

Community Types Present	EO Rank
Aspen / Shiny-leaf Spiraea Forest (CEGL000607)	B
Black Hills Montane Grassland (CEGL002240)	AB

Table 9. Number of survey sites by management level and geomorphic region in the Black Hills. Management level is based on Caicco et al. (1995) (see Table 2). Geomorphic regions are shown in Figure 3 (after Froiland 1990, Dewitt et al. 1989).

Protection Level	General Code	Geomorphic Region				TOTAL SITES IN EACH MANAGEMENT LEVEL
		Upland Plateau	Montane Piedmont	Riparian Valley	High Plains	
1	2	0	2	0	1	5
2	11	2	2	0	0	15
3	18	12	5	1	2	38
4	0	1	1	0	1	3
TOTAL SITES IN EACH GEOMORPHIC REGION		15	10	1	4	61

APPENDICES

Appendix 1. Black Hills Community Inventory Science Committee.

Phil Barnes	Homestake Mining Company
Steve Chaplin	The Nature Conservancy
Bill Coburn	Pope & Talbot, Inc.
Don Faber-Langendoen	The Nature Conservancy
Mark Gable	Black Hills State University
George Jones	Wyoming Natural Diversity Database
Hollis Marriott	The Nature Conservancy
Dave Ode	South Dakota Natural Heritage Program
Deanna Reyher	Black Hills National Forest
Ross Rice (1996)	Wind Cave National Park
Dan Roddy (1997-99)	Wind Cave National Park
George San Miguel (1996-97)	Devils Tower National Monument
Carolyn Sieg	US Forest Service
Tom Troxel	Black Hills Forest Resource Association

Appendix 2. Summary of the United States National Vegetation Classification Systems (from Maybury 1999).

Four key attributes characterize the United States National Vegetation Classification (USNVC) system:

1. It is based on vegetation.

Classifications of ecological systems can be based on a variety of factors, such as vegetation, soils, and landforms, that can be used either singly or in combination. Conservancy ecologists, however, made a pivotal decision to develop a terrestrial classification system that is based primarily on vegetation. Several factors led to this decision. First, the mission of the Conservancy is to protect biodiversity; a classification that emphasizes the biotic component of ecological systems was seen as being most directly relevant to this mission. Second, vegetation is an easily measured component of an ecological system. Indeed, it is often chosen as the most useful single factor for classifying terrestrial ecological systems because it integrates more measurably than any other factor or set of factors the environmental conditions, ecological processes, and biogeographical dynamics that operate on a site or landscape. (10,11) Third, vegetation can serve to describe many facets of biological and ecological patterns across the landscape. Plants provide the habitat and structure for many other organisms in an ecological community, and vegetation is often used to infer soil and climate patterns. Fourth, building a single-factor system was simply more practical than building a more complex, multifactor system.

2. It has been applied to natural vegetation.

The USNVC framework may be used to classify all vegetation, from the extremes of natural (those that appear to be unmodified by human activities) to cultural (planted and maintained types, such as annual croplands, tree plantations, orchards, and vineyards), but, because the Conservancy's focus is on the protection of natural vegetation, only the more natural types are being classified and described by the Conservancy and the Natural Heritage network. These include types that occur spontaneously without regular management, maintenance, or planting, and that generally have a strong component of native species.

3. It is based on existing vegetation.

Vegetation classifications are based on either existing or potential natural vegetation (PNV). PNV types represent the projected mature or stable end points of vegetation development over time (late seral types). These are vegetation types projected to occur and persist on a site in the absence of disturbance, whether human-caused or natural. PNV classifications offer insight into

vegetation-site relationships and can be helpful in projecting the type of vegetation expected under a certain set of ecological factors. However, disturbances have a profound influence on the structure and composition of vegetation, and each major successional stage following a natural disturbance (or a human-caused disturbance that closely mimics a natural one) is biologically and ecologically distinct and of inherent worth. Indeed, important habitat is provided by many communities that are not at mature or stable end points of vegetation development. For this reason, the Conservancy believes the conservation of all existing natural community types will ensure the survival of the greatest possible number of species, both plant and animal.

In addition to its usefulness for conservation purposes, a classification of existing, rather than potential, vegetation makes fewer assumptions about natural processes or vegetation dynamics and allows the classification to be grounded in what is directly observable and measurable. Finally, the focus on existing vegetation can support a wide number of uses, including inventorying and monitoring the current status of vegetation. Thus, while the USNVC framework is comprehensive with regard to existing vegetation—encompassing the spectrum from natural to cultivated—the Conservancy's efforts have focused on the best existing occurrences of natural types, both naturally disturbed (early and mid-seral) and naturally undisturbed (late-seral).

4. It is a hierarchical system, defined by physiognomy and floristics.

The USNVC has a hierarchical taxonomic structure with physiognomic criteria used at the coarsest levels of the hierarchy and floristic criteria used at the finest. Physiognomy refers to the structure (height and spacing) and overall shape of plants, and to leaf characteristics, such as seasonality, shape, duration, size, and texture. These features provide a fast, efficient way to categorize vegetation on broad geographic scales. Physiognomic features can often be linked to remote sensing signatures, are easily recognized in the field, and can be applied even in places where very little information about the flora exists. Floristics refers to species composition. Using species composition or species groups to characterize vegetation reveals finer-scale local and regional patterns than are likely to be perceived using physiognomic characters.

A combined physiognomic-floristic system allows for most of the advantages of both approaches and provides a unifying framework within which to relate typically coarse-scale physiognomic systems to more local and regional floristic systems. Additionally, structuring the USNVC in a hierarchical fashion allows it to be used at different taxonomic scales, depending on the amount of information available and the resolution needed.

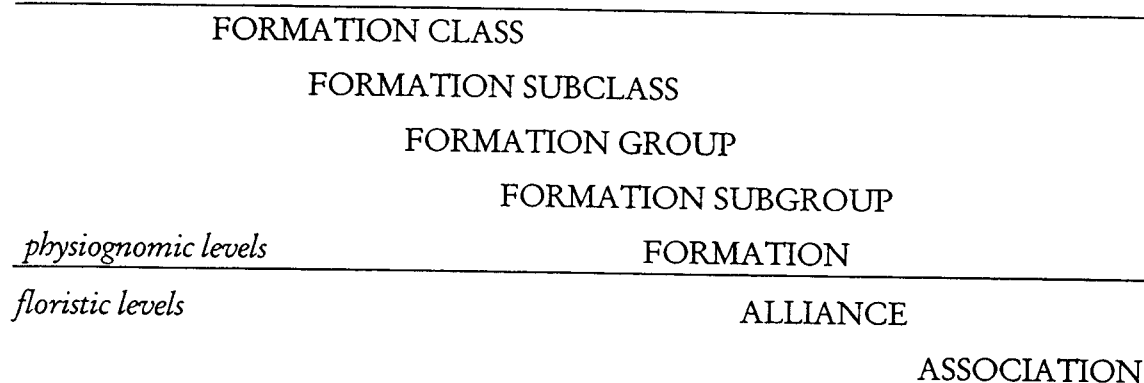
Structure and Type Definition

Structure

The USNVC terrestrial¹ classification system consists of a seven-level hierarchy. Five levels (class, subclass, group, subgroup, and formation) are based on physiognomic characteristics, and two levels (alliance and association) are based on species composition or floristics.

Hierarchical Vegetation Classification System for the Terrestrial Ecological Communities

SYSTEM: TERRESTRIAL



Physiognomic Levels

The physiognomic levels of the USNVC are a modification of the UNESCO world physiognomic classification of vegetation (9).

Class

The formation class (or "class") is based on the structure of the vegetation: Classes are determined by the type, height, and relative percentage of cover of the dominant, uppermost life-forms. There are seven classes:

Forest: Trees with their crowns overlapping (generally forming 60 percent to 100 percent cover).

¹ The terrestrial system is defined to include all wetland and shallow-water vegetation with rooted vascular plants.

- Woodland: Open stands of trees with crowns not usually touching (generally forming 25 percent to 60 percent cover).
- Shrubland: Shrubs generally greater than 0.5 meter tall with individuals or clumps overlapping to not touching (generally forming greater than 25 percent cover, with trees generally less than 25 percent cover). Vegetation dominated by woody vines is generally treated in this class.
- Dwarf-shrubland: Low-growing shrubs, usually less than 0.5 meter tall. Individuals or clumps overlapping to not touching (generally forming greater than 25 percent cover; with trees and tall shrubs generally less than 25 percent cover).
- Herbaceous: Herbaceous plants dominant (generally forming at least 25 percent cover, with trees, shrubs, and dwarf-shrubs generally with less than 25 percent cover).
- Nonvascular: Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 25 percent cover).
- Sparse Vegetation: Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25 percent).

Subclass

The Forest, Woodland, Shrubland, and Dwarf-Shrubland Classes each include three formation subclasses (or "subclasses") based on leaf character: evergreen, deciduous, or mixed evergreen-deciduous. The Herbaceous Class comprises four subclasses based on a combination of persistence and growth-form characteristics: perennial grasslands, perennial forb vegetation, annual grasslands or forb vegetation, and hydromorphic vegetation. The relative dominance of either lichens, mosses, or algae divides the Nonvascular Class into three subclasses. Lastly, the three subclasses of the Sparse Vegetation Class are defined primarily by the particle sizes of the substrate features: consolidated rock; boulder, gravel, cobble, or talus; and unconsolidated material (soil, sand, or ash).

Group

The subclasses of the Forest, Woodland, and Shrubland, and Dwarf-shrubland Classes are further divided into formation groups (or "groups") based on leaf characteristics, such as broad-leaved or needle-leaved. These units are defined and named in conjunction with broad climatic types. For example, the Evergreen Woodland Subclass includes the Tropical or Subtropical Broad-Leaved Evergreen Woodland Group, the Tropical or Subtropical Needle-Leaved Evergreen Woodland Group, the Temperate Broad-Leaved Evergreen Woodland Group, and the Temperate or Subpolar Needle-Leaved Evergreen Woodland Group.

Both climate and the presence and character of woody strata are used to separate subclasses into groups in the Herbaceous and Nonvascular Classes. For example, in the Perennial Graminoid (grassland) Subclass, the Tropical or Subtropical Grassland Group is separated from Temperate

or Subpolar Grasslands, as well as from Tropical or Subtropical Grasslands with a Sparse Tree Layer.

Sparse Vegetation subclasses are separated into groups based on major topographic position types or landforms (for example, cliffs versus flat to gently sloping bedrock).

Subgroup

Each group is divided into either a Natural/Semi-natural Formation Subgroup or a Cultural Formation Subgroup, providing a consistent dichotomy between vegetation actively planted or maintained by humans and all other types of vegetation. This distinction is useful for mapping vegetation types across the natural and cultural landscape. Its placement at the subgroup level allows for the development of culturally distinct formations (for example, orchards and annual croplands) within the overall USNVC hierarchy.

Formation

The formation level represents vegetation types that share a definite physiognomy or structure within broadly defined environmental factors, landscape position, or hydrologic regime. Structural factors such as crown shape and lifeform of the dominant stratum are used in addition to the physiognomic characters already specified at the higher levels. Hydrologic modifiers, adapted from Cowardin and others (22), are used for wetlands. Examples include the Rounded-Crowned Temperate or Subpolar Needle-Leaved Evergreen Forest Formation, the Semipermanently Flooded Tropical or Subtropical Broad-Leaved Evergreen Shrubland Formation, and the Short Alpine or Subalpine Sod Grassland Formation.

Floristic Levels

The lower two levels of the hierarchy—the alliance and the association—are based on species composition. Both are primarily defined by their dominant species (those that are most abundant or prevalent). Diagnostic species (those found consistently in some vegetation types but not in others) are considered as well.

Alliance

Within a formation, the alliance is a group of plant associations (see “Association” below) sharing one or more dominant or diagnostic species, usually found in the uppermost or dominant stratum of the vegetation.

Association

An association is defined as a plant community with a definite floristic composition, uniform habitat conditions, and uniform physiognomy. With the exception of a few associations that are restricted to specific and unusual environmental conditions, associations repeat across the landscape. They occur at variable spatial scales depending on the steepness of environmental gradients and the patterns of disturbances. The association is the lowest level of the USNVC

hierarchy, as well as the basic unit for vegetation classification in the USNVC in North America.

How Types Are Defined

A wide variety of methods is used to define USNVC alliances and associations. These range from directly adopting types from compatible state or local classification systems, especially Heritage program classifications, to conducting field studies in which new vegetation information is collected and analyzed. The great majority of existing associations has been defined with a mixture of quantitative analysis of available vegetation data and a review of more qualitative, descriptive types of information about vegetation patterns. About 80 percent of the associations have been defined with the benefit of quantitative analyses of plot data, analyses either published in the scientific literature or, less commonly, conducted by Conservancy or Heritage ecologists expressly to define USNVC types. Regardless of the specific approach used, the cornerstone of type definition is structured peer review by experienced local, state Heritage program, and regional ecologists.

Citation

Maybury, K.P. 1999. *Seeing the Forest and the Trees: Ecological classification for Conservation*. The Nature Conservancy, Arlington, Virginia. 37 p.

Appendix 3. Sample Forms.

Form 2: Community Ranking and General Description Draft: Spring, 1997

A. Identifiers / Location (general EOR information)

1. SNAME: _____	
2. GNAME: _____	
3. GNAME.TRANS: _____	
4. Site name: _____	4a. Sitecode: _____
5. Survey site name: _____	
6. Quad name/scale(s): _____	
6a. Quad code(s): _____	7. County name(s): _____
8. County code(s): _____	
9. Town (LOCALJURIS): _____	9a. T/R/S: _____
10. Lat/Long: _____	
11. Photos: _____	
12. Directions: _____	
13. Sourcecode: _____	
14. Survey date: _____	
15. Last obs: _____	
16. First obs: _____	
17. State: _____	
18. Surveyors: _____	

B. General Community Description (General EOR information)

19. Transect: _____	20. Observation point number: _____	21. Size: _____
22. Community Description (HETEROGENEITY): (brief word picture of community; include characteristic spp., inclusion of other communities. If community occurs as mosaic, depict spatial distribution and associated community types)		
23. Fauna note: _____		
24. Evidence of community processes: _____		
25. General description (Describe landscape context of EO (GEN DESC)):		
26. Management comments and monitoring needs (MGMTCOM):		
27. Maintenance comments (PROTCOM):		
28. Owner(s): _____		
29. Owner comments (OWNERCOM): _____		
30. Comments: _____		

C. Specific community description (EOR-C information)

31. Minimum elevation: ____ ft. 32. Maximum elevation: ____ ft. 33. Topo. position: ____ 34. Slope: ____ 35. Aspect: ____
 36. Survey type: ____ 37. Landform: ____ 38. Geology comments: ____
 39. Soil type: ____ 40. Soil, moisture: ____
 41. Hydrological influence: ____ 42. Cow. System: ____ Terrestrial ____ Palustrine ____ Estuarine
 43. Physiognomic class: ____ 44. Leaf phenology: ____

45: Strata/life form:	height	% cover	most abundant species	diagnostic species	other species
Emergent tree					
Tree Canopy					
Tree sub-canopy					
Tall shrub					
Short shrub					
Herbaceous					
Non-vascular					
Epiphyte / liana					
Unvegetated surf.					

D. Element occurrence ranking information

46. Succession.com : Age, successional stage: ____
 47. Disturbance.com / Condition.com: a. Known land use history: ____
 b. Inferred land use history: ____
 c. Other anthropogenic or unnatural disturbance: ____
 d. Pesticides (known or suspected): ____
 e. Presence of invasives: ____
 f. Alterations in natural processes: ____
 g. Other factors: ____
 h. Integrity / fragmentation of community: ____
 48. Landscape context rating: ____
 49. Size rating: (indicate size relative to other occurrences and whether full extent of occurrence is known): ____
 50. Potential Impacts (on-site): ____
 51. Potential impacts (off-site): ____ 52.
 EO Rank comments: ____
 53. (Overall) Element Occurrence Rank: ____ 54. EORANKDATE: ____

SITE SURVEY SUMMARY

SURVEY SITE VISIT CHRONOLOGY:

_____ - _____ - _____	to _____	_____	F _____
_____ - _____ - _____	to _____	_____	F _____
_____ - _____ - _____	to _____	_____	F _____
_____ - _____ - _____	to _____	_____	F _____
_____ - _____ - _____	to _____	_____	F _____

Precise location:
(distance and direction from a prominent feature shown on the topographic map, or some other map)

Road Directions to Site:

Location of Site Access Point:
(where to park, location of important trail)

Imagery/scale:

ELEMENT OCCURRENCES:
EO PRESENT? ☐ YES ☐ NO
Comments:

Under "Element Name" list all elements sought, reported, or confirmed from the site. If known, record the Occurrence Numbers for each. Generate simple letter or number codes which identify each element occurrence on the base map; these codes help keep the base map uncluttered. Indicate whether the element was found (Y, N, N/A) on the date of the site visit, and whether a return visit is needed.

[illegible]

SITE DESCRIPTION:

page 2

MAINTENANCE URGENCY:

(circle one)

- U1 Immediately Threatened
- U2 threat expected within 5 years
- U3 threatened, but not in the next 5 years
- U4 no threats imminent
- U5 land protection complete

(circle one)

MANAGEMENT URGENCY:

- M1 management needed this year
- M2 management needed within 5 years to prevent loss of EOs
- M3 management needed within 5 years to maintain current EO quality
- M4 management may be needed in future
- M5 no management needed

Maintenance Urgency Comments (&date):

Management Urgency Comments (&date):

TOPOGRAPHIC BASE MAP:

Attach a photocopy of the topographic map and/or aerial photographs showing the site. complete steps 1 to 3 below.

Completed?

____ yes ____ no 1. Indicate precise element locations and/or boundaries (use solid lines). Identify each element with the codes you used on page 1.

____ yes ____ no 2. If knowledge of the site permits, draw primary (---|---|---) and secondary (---||---||---) ecological site boundaries. Within the primary site boundary, include all known element occurrences and lands necessary for the immediate maintenance of the Eos. The secondary boundary (or buffer) includes lands intended to mitigate further unforeseen negative impacts to the Eos (e.g., to control erosion, trespass related damage, natural succession, exotic species, urban sprawl). Use (---|---||---|---|---) where primary and secondary boundaries coincide. Below, provide a brief written justification of the boundary locations.

BOUNDARY JUSTIFICATION:

____ yes ____ no 3. If known, indicate tract ownership boundaries using dashed (-----) lines.

Tract ownership or Managed Area Name (names, addresses, phone #'s):

STEWARDSHIP:

page 3

Land Use Comments:

Describe current and past land use, improvements, and structures, and possible stewardship implications.

Potential Hazards:

Describe any potential hazards, both natural (e.g., cliffs, caves, venomous snakes, etc.), and of human origin (e.g., mine shafts, old wells, dangerous structures). Prescribe appropriate precautions.

Exotic Flora/Fauna Comments:

List problem exotic species, describe their effects on the EOs, and, if possible, prescribe control methods.

Off-site Considerations:

Describe off-site land uses (e.g., farming, grazing, mining, urban development, stream perturbations) and how these uses might affect the EOs on the site and their future management.

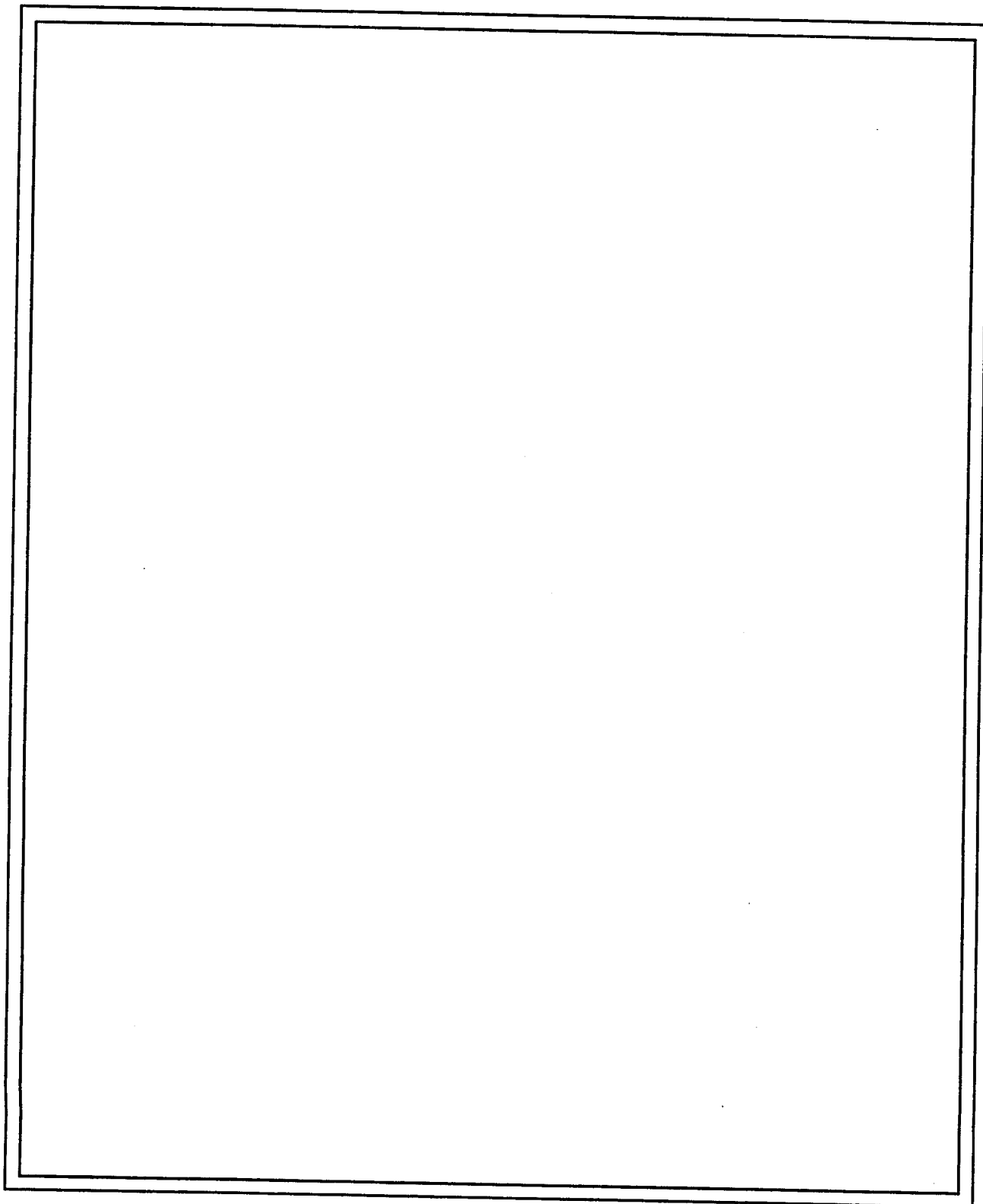
Site and Element Management Needs:

summarize the expected management needs for the site and its Eos.

DETAILED SKETCH MAP:

page 4

The purpose of this map is to show fine details of the site which are not shown on the topographic base map. this map can be used to show: (1) EO locations, (2) study plots or marked individuals, (3) natural landmarks, and (4) disturbance features, such as structures, dumps, trails, etc. Include scale and indicate north.



Polygon characterization Form

Survey Site Name		Quad Name		Quad Code
Survey Date		Surveyors		
1.	Polygon Code	Community Name	EO Code	Plot Code (x if no plot)
	Lat/Long		Polygon Size (ac)	
	Environmental Description			
	Vegetation Description			
	Canopy Spp. ht, cover: (note emergents)		Subcanopy spp, ht, cover:	
	Shrub spp,(T-all, S-hort, D-warf) ht, cover:			
	Herbaceous spp, ht, cover			
	Non-vasc/Epiphytes (E) ht, cover:		Unveg. cover:(Describe, Cover)	
	Disturbances		Condition. Rank	
	Other			
2.	Polygon Code	Community Name	EO Code	Plot Code (x if no plot)
	Lat/Long		Polygon Size (ac)	
	Environmental Description			
	Vegetation Description			
	Canopy Spp. ht, cover: (note emergents)		Subcanopy spp, ht, cover:	
	Shrub spp,(T-all, S-hort, D-warf) ht, cover:			
	Herbaceous spp, ht, cover			
	Non-vasc/Epiphytes (E) ht, cover:		Unveg. cover:(Describe, Cover)	
	Disturbances		Condition. Rank	
	Other			

Plot Survey Form

A. IDENTIFIERS/LOCATORS

Sci. name:	1.SNAME:		
	2.GNAME:		
3.Site name:			3a. Site #:
4.Survey site name:			
5.Quad name(s):			6.Quad code/scale(s):
7.County name(s):			8.County code(s):
9.Town (LOCALJURIS):			
10.Lat: _____ N	11. Long: 0 _____ W	12. Directions: _____	
13.Sourcecode:	14.Survey date:	_____	
15.Last obs: - -	16. First obs: - -	17.State: _____	
18.Surveyors:	_____		

B. ENVIRONMENTAL DESCRIPTION

19. Transect/Obs point #	20. Image annotation #	21. Elevation:
22. Topographic position: ☐ Interfluvial ☐ Backslope ☐ High slope ☐ Step in slope ☐ High level ☐ Lowslope ☐ Midslope ☐ Toeslope ☐ Low level ☐ Channel wall ☐ Channel bed ☐ Basin ☐ Other	23. Topographic sketch	24. Slope degrees: _____ 25. Slope aspect: _____ 26. Parent material: _____ 26a. Landform: _____
27. Soil profile description: note depth, texture, and color of each horizon. Note significant changes such as depth to mottling, depth to water table, root penetration depth (SOILCOM)	31. Soil moisture regime: ☐ Extremely dry ☐ Somewhat dry ☐ Very dry ☐ Wet ☐ Dry ☐ Very wet ☐ Somewhat moist ☐ Permanently inundated ☐ Moist ☐ Periodically inundated	32. Stoniness: ☐ Stone free <0.18 ☐ Moderately stone 0.1-1% ☐ Stony 3-15% ☐ Very stony 15-50% ☐ Exceedingly stony 50-90% ☐ Stone piles >90%
28. Organic horizon depth: _____	33. Soil drainage: ☐ Excessively drained ☐ Somewhat poorly drained ☐ Well drained ☐ Very wet ☐ Moderately well drained ☐ Poorly drained ☐ Very poorly drained	34. Average texture: ☐ sand ☐ clay loam ☐ sandy loam ☐ clay ☐ loam ☐ peat ☐ silt loam ☐ muck ☐ other _____
29. Organic horizon type: _____	34a. Inundation: ☐ Never inundated ☐ Periodic inundation, frequency unknown ☐ Infrequently inundated ☐ Always submerged by shallow water < 30cm ☐ Regularly inundated ☐ Always submerged by deep water >30cm ☐ Frequently inundated for periods greater than 6 mo.	
30. Ave pH of mineral soil: _____	35. Unvegetated surface: ☐ %Bedrock ☐ %Litter, duff ☐ %Large rocks (cobbles, boulders >10cm) ☐ %Wood (>1cm) ☐ %Small rocks (gravel, 0.2-10cm) ☐ %Water ☐ %Sand (0.1-2mm) ☐ %Other: _____ ☐ %Bare soil	
36. Environmental Comments: Note homogeneity of vegetation, erosion/sedimentation, inundate, etc.		
37. Plot representativeness:		

Appendix 4. Element occurrence ranking specifications.

Element Occurrence ranking specs are presented for the following groups:

- A. DRY CONIFEROUS FORESTS AND WOODLANDS - PONDEROSA PINE MATRIX
- B. DRY CONIFEROUS FORESTS AND WOODLANDS - PONDEROSA PINE LARGE PATCH
- C. MESIC CONIFEROUS FORESTS AND WOODLANDS - PONDEROSA PINE MATRIX
- D. MESIC CONIFEROUS FORESTS AND WOODLANDS - PONDEROSA PINE LARGE PATCH
- E. MESIC CONIFEROUS FORESTS AND WOODLANDS - WHITE SPRUCE
- F. BLACK HILLS MONTANE GRASSLANDS

A table giving size ranking specifications for all groups is presented after these group specific types.

A. DRY CONIFEROUS FORESTS AND WOODLANDS - PONDEROSA PINE MATRIX

Matrix group: *Pinus ponderosa* / *Arctostaphylos uva-ursi* Woodland, *Pinus ponderosa* / *Carex inops* ssp. *heliophila* Woodland, *Pinus ponderosa* / *Juniperus scopulorum* Woodland, *Pinus ponderosa* / *Pascopyrum smithii* Woodland, *Pinus ponderosa* / *Schizachyrium scoparium* Woodland

EOSPECS

The minimum size recommended is 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects.

EOs are separated by either:

- a substantial barrier between patches (e.g., a major two-lane paved highway, urban development, open body of water); or,
- an area of Cultural vegetation (including ruderal vegetation, such as old-fields) greater than 0.5 km; or,
- a different intervening natural or semi-natural open (grassland, shrubland, clearcut) community type greater than 2 km [needs review].

Justification: The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on ponderosa pine or shrub and herb seed dispersal. Seeds of ponderosa pine are reported to travel as far as 120 m from the parent tree (Barret 1978, in Oliver and Fiyker 1990). The separation distance for intervening natural or semi-natural open (grassland, shrubland, clearcut) communities seemed to be a pragmatically useful distance].

Faber-Langendoen, D / McAdams, A.

TNCMCS

1999-02-06

RANK.PROCEDURE

Use standard ranking procedures to determine a summary EO rank.

CONDITION.SPECS

"A"-rated condition;

- a) overstory canopy is open (often 25-60% canopy cover) and structure is intact, *i.e.*, for *Pinus ponderosa* types an average of 10 trees per acre greater than 40 cm dbh and/or more than 160 years old are present (Mehl 1992). Density may be low (less than 100 trees/acre > 10 cm dbh). Crown shape is mature, flattened, bark yellowish in color, and old trees have broken branches;
- b) understory vegetation composed of native species, particularly native graminoids (except for scree type dominated by bare rock);
- c) shrub layer may or may not be present;
- d) there is evidence of frequent fire as a natural process, including potentially long intervals without fire. Such evidence might include fire scars and scorching, as well as little evidence of dead down material or small trees. Evidence of lack of natural fire patterns might include increased densities of small diameter trees, increased litter depth, and/or decreased herbaceous production; and
- e) stands may have been thinned with minimal disruption of understory (> 20 years ago), but little or no exotics are present.

"B"-rated condition:

- a) for *Pinus ponderosa* types, old-growth trees and associated crown structure present over greater than 75% of occurrence *i.e.*, average of 10 trees per acre greater than 40 cm dbh and/or more than 160 years old are present over most of area (Mehl 1992);

- b) if thinning of small diameter trees has occurred, there is evidence of minimal disruption of understory vegetation;
- c) some light grazing by livestock may have occurred; and
- d) exotic species may be present at low densities.

"C"-rated condition:

- a) Heavily logged with only small diameter trees remaining and disturbance to understory vegetation (due to logging activities or grazing);
- b) heavy grazing by livestock has severely altered ground layer composition; and
- c) some exotic species present (including such species as *Cirsium arvense* [Canada thistle] and/or *Euphorbia esula* [Leafy spurge]).

"D"-rated condition:

- a) Heavily logged and thinned, perhaps to the point of a clear-cut;
- b) ground very disturbed with major disruptions to vegetation; and
- c) large proportion of exotic species, including *Cirsium arvense* (Canada thistle) and/or *Euphorbia esula* (Leafy spurge).

Justification for "A"-rated criteria: Dry ponderosa pine and Rocky Mountain Juniper forest systems generally depend on some form of fire to maintain overstory and understory composition and structure (Mehl 1992, Shinneman and Baker 1997). Studies in the northern (Fisher et al. 1987) and southern Hills (Brown and Sieg 1996) indicate that dry conifer types may have mean fire-return intervals ranging from 10 to 30 yrs (Shinneman and Baker 1997). These fires were likely low intensity, surface fires, and not likely to kill mature trees, suggesting that these stands may also contain very old trees (> 160 yr old). Some stands had intervals as long as 45 years. Lack of fire within this time frame leads to structural changes in these types, and alters ground layer composition and diversity.

Justification for "C"/"D" threshold: Native ground layer composition is severely altered and unlikely to replace exotics. Recovery of ponderosa pine and juniper old-growth structure would take greater than 100 years.

SIZE.SPECS

"A"-rated size: Very Large: (> 2,500 ac)

"B"-rated size: Large (500-2,500 ac)

"C"-rated size: Moderate (100-500 ac)

"D"-rated size: Small (2-100 ac)

Justification for "A"-rated criteria: Stands this size would be able to support natural disturbance processes such as fire, and would contain sufficient internal variability to represent variability within the type.

Justification for "C"/"D" threshold: Stands lack variability, and often are confined to specific aspects or slopes.

LANDSCAPE.CONTEXT-SPECS

"A" rated landscape: Intact: landscape has been little altered, completely surrounded by other EO quality communities, including forests, woodlands, prairies, or wetlands (> 10,000 ha) (25,000 acres)

"B" rated landscape: Managed: surrounded by partially disturbed natural or semi-natural communities, some of it not EO quality, .e.g. due to heavy grazing and recent clearcut logging (> 10,000 ha) (25,000 acres)

"C" rated landscape: Fragmented: surrounded by a mix of intensive agriculture and adjacent forest lots (total natural community area at least ten times the minimum EO size).

"D" rated landscape: Agricultural or Urban: surrounding landscape primarily intensive agriculture or suburban development.

Justification for "A" rank criteria: Landscapes could sustain natural disturbance regimes. . Definitions for minimum dynamic area (the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) have been proposed by Shugart (1984) as - fifty times the average disturbance size, and by Johnson and Van Wagner (1985) as - two times the maximum disturbance size (see also Frelich 1995). These can be used as a rough guide to landscape size where the disturbance size is known. Shinneman and Baker (1997) catalogue historical reports of large, catastrophic fires in the Black Hills ranging from 7,500 to 22,000 acres (3000 to 9,000 ha), with a possible extremely large burn of 50,000 acres (20,000 ha). These values may apply to both dry conifer types and mesic conifer types. These values suggest that landscape size for a minimum dynamic area would be in the order of 15,000 to 44,000 acres (6,000 ha to 18,000 ha). If

disturbance regimes are virtually unknown, or the maximum sizes are considered unreliable, the minimum viable EO size for matrix types, set above at 100-500 acres (40-200 ha), can be used as a starting point and multiplied by fifty. Using those figures, the "A" rated matrix ponderosa pine landscapes may need to be between 5,000 and 25,000 acres (2,000 and 10,000 ha) in size, a value on the same order of magnitude as the previous estimate.

Justification for "C"/"D" threshold: Processes such as natural disturbances are essentially irretrievable.

LITERATURE CITED

See Literature Cited section of main report.

B. DRY CONIFEROUS FORESTS AND WOODLANDS - PONDEROSA PINE LARGE PATCH

Large patch group: *Juniperus scopulorum* / *Oryzopsis micrantha* Woodland, *Pinus ponderosa* / *Mahonia repens* Forest, *Pinus ponderosa* / *Pseudoroegneria spicata* Woodland

EOSPECS

The minimum size recommended is 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects.

EOs are separated by either:

- a substantial barrier between patches (e.g., a major two-lane paved highway, urban development, open body of water); or,
- an area of Cultural vegetation (including ruderal vegetation, such as old-fields) greater than 0.5 km; or,
- a different intervening natural or semi-natural open (grassland, shrubland, clearcut) community type greater than 2 km [needs review].

Justification: The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on ponderosa pine or shrub and herb seed dispersal. Seeds of ponderosa pine are reported to travel as far as 120 m from the parent tree (Barret 1978, in Oliver and Fiyker 1990). The separation distance for intervening natural or semi-natural open (grassland, shrubland, clearcut) communities seemed to be a pragmatically useful distance].

Faber-Langendoen, D / McAdams, A.

TNCMCS

1999-02-06

RANK.PROCEDURE

Use standard ranking procedures to determine a summary EO rank.

CONDITION.SPECS

"A"-rated condition;

- a) overstory canopy is open (often 25-60% canopy cover) and structure is intact, i.e., for *Pinus ponderosa* types an average of 10 trees per acre greater than 40 cm dbh and/or more than 160 years old are present (Mehl 1992). Density may be low (less

than 100 trees/acre > 10 cm dbh). Crown shape is mature, flattened, bark yellowish in color, and old trees have broken branches;

- b) understory vegetation composed of native species, particularly native graminoids (except for scree type dominated by bare rock);
- c) shrub layer may or may not be present;
- d) there is evidence of frequent fire as a natural process, including potentially long intervals without fire. Such evidence might include fire scars and scorching, as well as little evidence of dead down material or small trees. Evidence of lack of natural fire patterns might include increased densities of small diameter trees, increased litter depth, and/or decreased herbaceous production; and
- e) stands may have been thinned with minimal disruption of understory (> 20 years ago), but little or no exotics are present.

"B"-rated condition:

- a) for *Pinus ponderosa* types, old-growth trees and associated crown structure present over greater than 75% of occurrence *i.e.*, average of 10 trees per acre greater than 40 cm dbh and/or more than 160 years old are present over most of area (Mehl 1992);
- b) if thinning of small diameter trees has occurred, there is evidence of minimal disruption of understory vegetation;
- c) some light grazing by livestock may have occurred; and
- d) exotic species may be present at low densities.

"C"-rated condition:

- a) Heavily logged with only small diameter trees remaining and disturbance to understory vegetation (due to logging activities or grazing);
- b) heavy grazing by livestock has severely altered ground layer composition; and
- c) some exotic species present (including such species as *Cirsium arvense* [Canada thistle] and/or *Euphorbia esula* [Leafy spurge]).

"D"-rated condition:

- a) Heavily logged and thinned, perhaps to the point of a clear-cut;
- b) ground very disturbed with major disruptions to vegetation; and
- c) large proportion of exotic species, including *Cirsium arvense* (Canada thistle) and/or *Euphorbia esula* (Leafy spurge).

Justification for "A"-rated criteria: Dry ponderosa pine and Rocky Mountain Juniper forest systems generally depend on some form of fire to maintain overstory and understory composition and structure (Mehl 1992, Shinneman and Baker 1997). Studies in the northern (Fisher et al. 1987) and southern Hills (Brown and Sieg 1996) indicate that dry conifer types may have mean fire-return intervals ranging from 10 to 30 yrs (Shinneman and Baker 1997). These fires were likely low intensity, surface fires, and not likely to kill mature trees, suggesting that these stands may also contain very old trees (> 160 yr old). Some stands had intervals as long as 45 years. Lack of fire within this time frame leads to structural changes in these types, and alters ground layer composition and diversity.

Justification for "C"/"D" threshold: Native ground layer composition is severely altered and unlikely to replace exotics. Recovery of ponderosa pine and juniper old-growth structure would take greater than 100 years.

SIZE.SPECS

- "A"-rated size: Very Large: (> 2,500 ac)
- "B"-rated size: Large (500-2,5000 ac)
- "C"-rated size: Moderate (100-500 ac)
- "D"-rated size: Small (2-100 ac)

Justification for "A"-rated criteria: Stands this size would be able to support natural disturbance processes such as fire, and would contain sufficient internal variability to represent variability within the type.

Justification for "C"/"D" threshold: Stands lack variability, and often are confined to specific aspects or slopes.

LANDSCAPE.CONTEXT-SPECS

"A" rated landscape: Intact: landscape has been little altered, completely surrounded by other EO quality communities, including forests, woodlands, prairies, or wetlands (> 10,000 ha) (25,000 acres)

"B" rated landscape: Managed: surrounded by partially disturbed natural or semi-natural communities, some of it not EO quality, .e.g.due to heavy grazing and recent clearcut logging (> 10,000 ha) (25,000 acres)

"C" rated landscape: Fragmented: surrounded by a mix of intensive agriculture and adjacent forest lots (total natural community area at least ten times the minimum EO size).

"D" rated landscape: Agricultural or Urban: surrounding landscape primarily intensive agriculture or suburban development.

Justification for "A" rank criteria: Landscapes could sustain natural disturbance regimes. . Definitions for minimum dynamic area (the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) have been proposed by Shugart (1984) as - fifty times the average disturbance size, and by Johnson and Van Wagner (1985) as - two times the maximum disturbance size (see also Frelich 1995). These can be used as a rough guide to landscape size where the disturbance size is known. Shinneman and Baker (1997) catalogue historical reports of large, catastrophic fires in the Black Hills ranging from 7,500 to 22,000 acres (3000 to 9,000 ha), with a possible extremely large burn of 50,000 acres (20,000 ha). These values may apply to both dry conifer types and mesic conifer types. These values suggest that landscape size for a minimum dynamic area would be in the order of 15,000 to 44,000 acres (6,000 ha to 18,000 ha). If disturbance regimes are virtually unknown, or the maximum sizes are considered unreliable, the minimum viable EO size for matrix types, set above at 100-500 acres (40- 200 ha), can be used as a starting point and multiplied by fifty. Using those figures, the "A" rated matrix ponderosa pine landscapes may need to be between 5,000 and 25,000 acres (2,000 and 10,000 ha) in size, a value on the same order of magnitude as the previous estimate.

Justification for "C"/"D" threshold: Processes such as natural disturbances are essentially irretrievable.

LITERATURE CITED

See Literature Cited section of main report.

C. MESIC CONIFEROUS FORESTS AND WOODLANDS - PONDEROSA PINE MATRIX

Matrix group: *Pinus ponderosa* / *Juniperus communis* Woodland, *Pinus ponderosa* / *Oryzopsis asperifolia* Woodland, *Pinus ponderosa* / *Symphoricarpos albus* Forest, *Pinus ponderosa* / *Physocarpus monogynus* Forest

EOSPECS

The minimum size recommended is 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects.

EOs are separated by either:

- a substantial barrier between patches (e.g., a major two-lane paved highway, urban development, open body of water); or,
- an area of Cultural vegetation (including ruderal vegetation, such as old-fields) greater than 0.5 km; or,
- a different intervening natural or semi-natural open (grassland, shrubland, clearcut) community type greater than 2 km [needs review].

Justification: The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on ponderosa pine or shrub and herb seed dispersal. Seeds of ponderosa pine are reported to travel as far as 120 m from the parent tree (Barret 1978, in Oliver and Fiyker 1990). The separation distance for intervening natural or semi-natural (grassland, shrubland, clearcut) communities seemed to be a pragmatically useful distance.

Faber-Langendoen, D / McAdams, A.

TNCMCS

1999-02-06

RANK.PROCEDURE

Use standard ranking procedures to determine a summary EO rank.

CONDITION.SPECS

"A"-rated condition;

- a) overstory canopy is closed (often > 60% canopy) and structure intact, i.e., for *Pinus ponderosa* types an average of 10 trees per acre greater than 40 cm dbh and/or more than 160 years old are present (Mehl 1992). Density often exceeds 100 trees/acre over 10 cm dbh. Crown shape is mature, flattened, bark yellowish in color, standing dead and down trees, and multiple canopy layers may be present;
- b) understory vegetation composed of native species, particularly native graminoids (except for scree type dominated by bare rock);
- c) shrub layer may or may not be present;
- d) there is evidence of fire as a natural process, including potentially long intervals without fire. Such evidence might include fire scars and scorching. Evidence of lack of natural fire patterns might include increased densities of small diameter trees, increased litter depth, and/or decreased herbaceous production; and
- e) stands may have been thinned with minimal disruption of understory (> 20 years ago), but little or no exotics are present.

"B"-rated condition:

- a) for *Pinus ponderosa* types, old-growth trees present over greater than 75% of occurrence, i.e., average of 10 trees per acre greater than 40 cm dbh and/or more than 160 years old are present over most of area (Mehl 1992);
- b) if thinning of small diameter trees has occurred, there is evidence of minimal disruption of understory vegetation;
- c) some light grazing by livestock may have occurred; and
- d) exotic species may be present at low densities.

"C"-rated condition:

- a) Heavily logged with only small diameter trees remaining and disturbance to understory vegetation (due to logging activities or grazing);
- b) heavy grazing by livestock has severely altered ground layer composition; and
- c) some exotic species present (including such species as *Cirsium arvense* [Canada thistle] and/or *Euphorbia esula* [Leafy spurge]).

"D"-rated condition:

- a) Heavily logged and thinned, perhaps to the point of a clear-cut;
- b) ground very disturbed with major disruptions to vegetation; and

- c) large proportion of exotic species, including *Cirsium arvense* (Canada thistle) and/or *Euphorbia esula* (Leafy spurge).

Justification for "A"-rated criteria: Mesic ponderosa pine and white spruce forest systems generally depend on a longer intervals without fire (greater than 100 yrs), leading to more dense stands with young or old trees, and the possibility of catastrophic fires (Shinneman and Baker 1997). Shinneman and Baker (1997) report that older stands may have trees as old as 250-300 yrs of age.

Justification for "C"/"D" threshold: Native ground layer composition is severely altered and unlikely to replace exotics. Recovery of ponderosa pine old-growth structure would take greater than 100 years.

SIZE.SPECS

"A"-rated size: Very Large: (> 2,500 ac)

"B"-rated size: Large (500-2,5000 ac)

"C"-rated size: Moderate (100-500 ac)

"D"-rated size: Small (2-100 ac)

Justification for "A"-rated criteria: Stands this size would be able to support natural disturbance processes such as fire, and would contain sufficient internal variability to represent variability within the type.

Justification for "C"/"D" threshold: Stands lack variability, and often are confined to specific aspects or slopes.

LANDSCAPE.CONTEXT-SPECS

"A" rated landscape: Intact: landscape has been little altered, completely surrounded by other EO quality communities, including forests, woodlands, prairies, or wetlands (> 10,000 ha) (25,000 acres)

"B"-rated landscape: Managed: surrounded by partially disturbed natural or semi-natural communities, some of it not EO quality, e.g. due to heavy grazing and recent logging (> 10,000 ha) (25,000 acres)

"C" rated landscape: Fragmented: surrounded by a mix of intensive agriculture and adjacent forest lots (total natural community area at least ten times the minimum EO size).

"D" rated landscape: Agricultural or Urban: surrounding landscape primarily intensive agriculture or suburban development.

Justification for "A" rank criteria: Justification for "A" rank criteria: Landscapes could sustain natural disturbance regimes. Definitions for minimum dynamic area (the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) have been proposed by Shugart (1984) as - fifty times the average disturbance size, and by Johnson and Van Wagner (1985) as - two times the maximum disturbance size (see also Frelich 1995). These can be used as a rough guide to landscape size where the disturbance size is known. Shinneman and Baker (1997) catalogue historical reports of large, catastrophic fires in the Black Hills ranging from 7,500 to 22,000 acres (3000 to 9,000 ha), with a possible extremely large burn of 50,000 acres (20,000 ha). These values may apply to both dry conifer types and mesic conifer types. These values suggest that landscape size for a minimum dynamic area would be in the order of 15,000 to 44,000 acres (6,000 ha to 18,000 ha). If disturbance regimes are virtually unknown, or the maximum sizes are considered unreliable, the minimum viable EO size for matrix types, set above at 100-500 acres (40- 200 ha), can be used as a starting point and multiplied by fifty. Using those figures, the "A" rated matrix ponderosa pine landscapes may need to be between 5,000 and 25,000 acres (2,000 and 10,000 ha) in size, a value on the same order of magnitude as the previous estimate.

Justification for "C"/"D" threshold: Processes such as natural fire disturbances are essentially irretrievable.

LITERATURE CITED

See Literature Cited section of main report.

D. MESIC CONIFEROUS FORESTS AND WOODLANDS – PONDEROSA PINE LARGE PATCH

Large patch group: *Pinus ponderosa* / *Prunus virginiana* Forest, *Pinus ponderosa* / *Quercus macrocarpa* Woodland

EOSPECS

The minimum size recommended is 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects.

EOs are separated by either:

- a substantial barrier between patches (e.g., a major two-lane paved highway, urban development, open body of water); or,
- an area of Cultural vegetation (including ruderal vegetation, such as old-fields) greater than 0.5 km; or,
- a different intervening natural or semi-natural open (grassland, shrubland, clearcut) community type greater than 2 km [needs review].

Justification: The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on ponderosa pine or shrub and herb seed dispersal. Seeds of ponderosa pine are reported to travel as far as 120 m from the parent tree (Barret 1978, in Oliver and Fiyker 1990). The separation distance for intervening natural or semi-natural (grassland, shrubland, clearcut) communities seemed to be a pragmatically useful distance.

Faber-Langendoen, D / McAdams, A.

TNCMCS

1999-02-06

RANK.PROCEDURE

Use standard ranking procedures to determine a summary EO rank.

CONDITION.SPECS

“A”-rated condition;

- a) overstory canopy is closed (often > 60% canopy) and structure intact, *i.e.*, for *Pinus ponderosa* types an average of 10 trees per acre greater than 40 cm dbh and/or

more than 160 years old are present (Mehl 1992). Density often exceeds 100 trees/acre over 10 cm dbh. Crown shape is mature, flattened, bark yellowish in color, standing dead and down trees, and multiple canopy layers may be present;

- b) understory vegetation composed of native species, particularly native graminoids (except for scree type dominated by bare rock);
- c) shrub layer may or may not be present;
- d) there is evidence of fire as a natural process, including potentially long intervals without fire. Such evidence might include fire scars and scorching. Evidence of lack of natural fire patterns might include increased densities of small diameter trees, increased litter depth, and/or decreased herbaceous production; and
- e) stands may have been thinned with minimal disruption of understory (> 20 years ago), but little or no exotics are present.

"B"-rated condition:

- a) for *Pinus ponderosa* types, old-growth trees present over greater than 75% of occurrence, i.e., average of 10 trees per acre greater than 40 cm dbh and/or more than 160 years old are present over most of area (Mehl 1992);
- b) if thinning of small diameter trees has occurred, there is evidence of minimal disruption of understory vegetation;
- c) some light grazing by livestock may have occurred; and
- d) exotic species may be present at low densities.

"C"-rated condition:

- a) Heavily logged with only small diameter trees remaining and disturbance to understory vegetation (due to logging activities or grazing);
- b) heavy grazing by livestock has severely altered ground layer composition; and
- c) some exotic species present (including such species as *Cirsium arvense* [Canada thistle] and/or *Euphorbia esula* [Leafy spurge]).

"D"-rated condition:

- a) Heavily logged and thinned, perhaps to the point of a clear-cut;
- b) ground very disturbed with major disruptions to vegetation; and
- c) large proportion of exotic species, including *Cirsium arvense* (Canada thistle) and/or *Euphorbia esula* (Leafy spurge).

Justification for "A"-rated criteria: Mesic ponderosa pine and white spruce forest systems generally depend on a longer intervals without fire (greater than 100 yrs), leading to more dense stands with young or old trees, and the possibility of catastrophic fires (Shinneman and Baker 1997). Shinneman and Baker (1997) report that older stands may have trees as old as 250-300 yrs of age.

Justification for "C"/"D" threshold: Native ground layer composition is severely altered and unlikely to replace exotics. Recovery of ponderosa pine old-growth structure would take greater than 100 years.

SIZE.SPECS

"A"-rated size: Very Large: (> 2,500 ac)
"B"-rated size: Large (500-2,5000 ac)
"C"-rated size: Moderate (100-500 ac)
"D"-rated size: Small (2-100 ac)

Justification for "A"-rated criteria: Stands this size would be able to support natural disturbance processes such as fire, and would contain sufficient internal variability to represent variability within the type.

Justification for "C"/"D" threshold: Stands lack variability, and often are confined to specific aspects or slopes.

LANDSCAPE.CONTEXT-SPECS

"A" rated landscape: Intact: landscape has been little altered, completely surrounded by other EO quality communities, including forests, woodlands, prairies, or wetlands (> 10,000 ha) (25,000 acres)

"B" rated landscape: Managed: surrounded by partially disturbed natural or semi-natural communities, some of it not EO quality, e.g. due to heavy grazing and recent logging (> 10,000 ha) (25,000 acres)

"C" rated landscape: Fragmented: surrounded by a mix of intensive agriculture and adjacent forest lots (total natural community area at least ten times the minimum EO size).

"D" rated landscape: Agricultural or Urban: surrounding landscape primarily intensive agriculture or suburban development.

Justification for "A" rank criteria: Justification for "A" rank criteria: Landscapes could sustain natural disturbance regimes. Definitions for minimum dynamic area (the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) have been proposed by Shugart (1984) as - fifty times the average disturbance size, and by Johnson and Van Wagner (1985) as - two times the maximum disturbance size (see also Frelich 1995). These can be used as a rough guide to landscape size where the disturbance size is known. Shinneman and Baker (1997) catalogue historical reports of large, catastrophic fires in the Black Hills ranging from 7,500 to 22,000 acres (3000 to 9,000 ha), with a possible extremely large burn of 50,000 acres (20,000 ha). These values may apply to both dry conifer types and mesic conifer types. These values suggest that landscape size for a minimum dynamic area would be in the order of 15,000 to 44,000 acres (6,000 ha to 18,000 ha). If disturbance regimes are virtually unknown, or the maximum sizes are considered unreliable, the minimum viable EO size for matrix types, set above at 100-500 acres (40- 200 ha), can be used as a starting point and multiplied by fifty. Using those figures, the "A" rated matrix ponderosa pine landscapes may need to be between 5,000 and 25,000 acres (2,000 and 10,000 ha) in size, a value on the same order of magnitude as the previous estimate.

Justification for "C"/"D" threshold: Processes such as natural fire disturbances are essentially irretrievable.

LITERATURE CITED

See Literature Cited section of main report.

E. MESIC CONIFEROUS FORESTS AND WOODLANDS- WHITE SPRUCE FORESTS

Picea glauca/ *Linnea borealis* Forest (large patch type), *Picea glauca*/ *Vaccinium scoparium* Forest (small patch type?)

EOSPECS

The minimum size recommended is 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects.

EOs are separated by either:

- a substantial barrier between patches (e.g., a major two lane paved highway, urban development, open body of water); or,
- an area of Cultural vegetation (including ruderal vegetation, such as old-fields) greater than 0.5 km; or,
- a different intervening natural or semi-natural community greater than 2 km; or,

Justification: The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on seed dispersal or other ecological processes affected by these barriers. The separation distance for intervening natural or semi-natural communities seemed to be a pragmatically useful distance.

McAdams, A. / Faber-Langendoen, D. TNCMCS
1999-02-09

RANK.PROCEDURE

Use standard ranking procedures to determine a summary EO rank.

CONDITION.SPECS

"A"-rated condition: For types that attain old-growth status;

- a) overstory structure intact, *i.e.*, an average of 10 trees per acre greater than 30 cm dbh and/or more than 120 years old have not been cut (Frelich 1995, Buell and Niering 1957);
- b) understory vegetation composed of native species;

- c) shrub layer may or may not be present;
- d) stands may have been thinned with minimal disruption of understory (> 20 years ago), but little or no exotics are present.

"B"-rated condition:

- a) Overstory structure intact over greater than 75% of the occurrence, i.e., an average of 10 trees per acre greater than 30 cm dbh and/or more than 120 years old have not been cut (Frelich 1995, Buell and Niering 1957);
- b) there may be evidence of minimal disruption of understory vegetation;
- c) some light grazing by livestock may have occurred; and
- d) exotic species may be present at low densities.

"C"-rated condition:

- a) Heavily logged with only small diameter trees remaining or heavily impacted by grazing with disturbance to understory vegetation;
- b) some exotic species present (including such species as *Cirsium arvense* [Canada thistle] and/or *Euphorbia esula* [leafy spurge]).

"D"-rated condition:

- a) Heavily logged and thinned, perhaps to the point of a clear-cut;
- b) ground very disturbed due to grazing with major disruptions to vegetation; and
- c) large proportion of exotic species, including *Cirsium arvense* (Canada thistle) and/or *Euphorbia esula* (leafy spurge).

Justification for "A"-rated criteria: White spruce forest systems may be subject to logging and heavy grazing which disrupts native vegetation.

Justification for "C"/"D" threshold: Native ground layer composition is severely altered and unlikely to replace exotics.

SIZE.SPECS

"A"-rated size: Very large (> 50 ha).

"B"-rated size: Large (20-50 ha).

"C"-rated size: Moderate (10-20 ha).

"D"-rated size: Small (1-10 ha).

Justification for "A"-rated criteria: Stands this size would be able to support natural disturbance processes, such as flooding and fire, and would contain sufficient internal variability to represent variability within the type.

Justification for "C"/"D" threshold: Stands lack variability, and often are confined to specific aspects or slopes.

LANDSCAPE.CONTEXT-SPECS

"A" rated landscape: Intact: landscape has been little altered, completely surrounded by other EO quality communities, including forests, woodlands, prairies, or wetlands (> 500 ha) (1250 acres)

"B" rated landscape: Managed: surrounded by partially disturbed natural or semi-natural communities, some of it not EO quality, due to overgrazing and recent logging (> 500 ha) (1250 acres)

"C" rated landscape: Fragmented: surrounded by a mix of intensive agriculture and adjacent forest lots (total natural community area at least ten times the minimum viable EO size (10 -20 ha) (100-500 ha)

"D" rated landscape: Agricultural or Urban: surrounding landscape primarily intensive agriculture or suburban development.

Justification for "A" rank criteria: Landscapes could sustain natural disturbance regimes. Definitions for minimum dynamic area (the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) proposed by Shugart (1984) - fifty times the average disturbance size, or Johnson and Van Wagner (1985) - two times the maximum disturbance size (see also Frelich 1995) can be used as a rough guide to landscape size. If disturbance regimes are virtually unknown the minimum

viable EO size (10-20 ha) can be used as a starting point and multiplied by fifty. Thus "A" rated landscapes may need to be 500-1000 ha in size.

Justification for "C"/"D" threshold: Processes such as natural disturbances are essentially irretrievable.

LITERATURE CITED

See Literature Cited section of main report.

F. BLACK HILLS MONTANE GRASSLANDS

Sporobolus heterolepis – *Stipa richardsonii* – *Danthonia intermedia* Herbaceous
Vegetation (small patch type)

EOSPECS

The minimum size recommended is 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and may be heavily influenced by edge effects.

EOs are separated by either:

- a substantial barrier between patches (e.g., a major two-lane paved highway, urban development, open body of water); or,
- an area of Cultural vegetation (including ruderal vegetation, such as old-fields) greater than 0.5 km; or,
- a different intervening natural or semi-natural community type greater than 2 km.

Justification: The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on seed dispersal for Black Hills Montane Grassland species. The separation distance for intervening natural or semi-natural open (grassland, shrubland, clearcut) communities seemed to be a pragmatically useful distance, but needs review.

Faber-Langendoen, D / Marriott, H.

TNCMCS

1999-06-26

RANK.PROCEDURE

Use standard ranking procedures to determine a summary EO rank.

CONDITION.SPECS

“A”-rated condition:

- a) native indicator species present and contributing at least 10% cover (may be locally common or dominant), including some combination of the following

graminoids: *Sporobolus heterolepis*, *Agropyron subsecundum*, *Danthonia intermedia*; native forbs providing at least 20% of overall cover;

- b) *Phleum pratense* and *Trifolium* spp. (non-native) absent or contributing less than 10% of overall cover (either localized or widely scattered); natives strongly dominant (> 90% cover);
- c) other non-native invader species (e.g. *Carduus nutans*, *Cirsium arvense*, *Cynoglossum officinale*, *Verbascum thapsus*) absent, or uncommon and localized (less than 1% overall cover); and
- d) some light grazing by livestock may have occurred.

"B"-rated condition:

- a) native indicator species present and contributing at least 10% cover (may be locally common or dominant), including some combination of the following graminoids: *Sporobolus heterolepis*, *Agropyron subsecundum*, *Danthonia intermedia*; native forbs providing at least 20% of overall cover, and native species dominant (> 50% cover);
- b) *Phleum pratense* and *Trifolium* spp. (non-native) present but less common than native species (less than 50%), either scattered or locally abundant;
- c) other non-native invader species (e.g. *Carduus nutans*, *Cirsium arvense*, *Cynoglossum officinale*, *Verbascum thapsus*) absent, or uncommon and localized (less than 1% overall cover); and
- d) some grazing by livestock may have occurred, but herbaceous stratum is not closely-cropped.

"C"-rated condition:

- a) *Phleum pratense* and *Trifolium* spp. (non-native) dominant (> 50% cover); native indicator species common (greater than 20% cover, either widely-scattered or localized as small relic patches);
- b) non-native invader species (e.g. *Carduus nutans*, *Cirsium arvense*, *Cynoglossum officinale*, *Verbascum thapsus*) uncommon to common but localized, and with less than 10% cover overall;
- c) some grazing by livestock may have occurred; herbaceous stratum may be closely-cropped seasonally.

“D”-rated condition:

- a) native species uncommon to absent (less than 10% overall cover);
- b) *Phleum pratense* strongly dominant, or vegetation composed of a mix of *Phleum pratense*, *Trifolium* spp. (non-native) and some native species, but heavily-grazed with other non-native invaders often common (e.g. *Carduus nutans*, *Cirsium arvense*, *Cynoglossum officinale*, *Verbascum thapsus*).

Justification for “A”-rated criteria: Indicator species are taken from descriptions by McIntosh (1930, 1931), as well as from qualitative and quantitative data collected during the Black Hills Community Inventory (this report). Some level of cover from non-natives is acceptable. All known occurrences have some burden of exotics. It is thought that with native cover intact, cover from exotics would not increase in these situations.

Justification for “C”/“D” threshold: Native ground layer composition is severely altered and unlikely to replace exotics.

SIZE.SPECS

- “A”-rated size: Very Large: (> 500 ac)
- “B”-rated size: Large (50-500 ac)
- “C”-rated size: Moderate (10-50 ac)
- “D”-rated size: Small (2-10 ac)

Justification for “A”-rated criteria: Stands this size would be able to support natural disturbance processes such as fire, and would contain sufficient internal variability to represent variability within the type. An estimated 10% of known occurrences are in this size range (though not necessarily high ranking otherwise).

Justification for “C”/“D” threshold: Stands lack variability, and are subject to conversion to adjacent community types, and highly susceptible to invasion from non-native invaders from adjacent weedy edges.

LANDSCAPE.CONTEXT-SPECS

“A” rated landscape: Intact: landscape has been little altered, completely surrounded by other EO quality communities, including forests, woodlands, prairies, or wetlands (> 1000 ha) (2,500 acres)

"B" rated landscape: Managed: surrounded by partially disturbed natural or semi-natural communities, some of it not EO quality, .e.g., due to heavy grazing and recent clearcut logging (> 1000 ha) (2,500 acres)

"C" rated landscape: Fragmented: surrounded by a mix of intensive agriculture and adjacent forest lots (total natural community area at least ten times the minimum EO size).

"D" rated landscape: Agricultural or Urban: surrounding landscape primarily intensive agriculture or suburban development.

Justification for "A" rank criteria: Landscapes could sustain natural disturbance regimes. Definitions for minimum dynamic area (the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) have been proposed by Shugart (1984) as - fifty times the average disturbance size, and by Johnson and Van Wagner (1985) as - two times the maximum disturbance size (see also Frelich 1995). These can be used as a rough guide to landscape size where the disturbance size is known. Shinneman and Baker (1997) catalogue historical reports of large, catastrophic fires in the Black Hills ranging from 7,500 to 22,000 acres (3000 to 9,000 ha), with a possible extremely large burn of 50,000 acres (20,000 ha). These values may apply to both dry conifer types and mesic conifer types in the Hills, but whether they are applicable to montane grasslands is unclear. If disturbance regimes are virtually unknown, or the maximum sizes are considered unreliable, the minimum viable EO size for this large patch type, set above at 10-50 acres (4- 20 ha), can be used as a starting point and multiplied by fifty. Using those figures, the "A" rated large patch montane grassland landscapes may need to be between 500 and 2,500 acres (200 and 1000 ha) in size.

Justification for "C"/"D" threshold: Processes such as natural disturbances are essentially irretrievable.

LITERATURE CITED

See Literature Cited section of main report.

Not all ecological group EO ranking specifications have been developed. Generic Specs are used for now, except that Size specs have been worked out for all types. These specs follow Ecological Group Categories. Pattern codes are as follows P1 = matrix (F = forest matrix, G = grassland matrix), P2 = large patch, and P3 = small patch.

ELCode	Working Gname	EcoGroup	Patterns	Size Categories (Acres)		
CEGL000844	Pinus ponderosa / Arctostaphylos uva-ursi Woodland	Dry Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL000849	Pinus ponderosa / Carex inops ssp. heliophila Woodland	Dry Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL000861	Pinus ponderosa / Juniperus scopulorum Woodland	Dry Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL000188	Pinus ponderosa / Pascopyrum smithii Woodland	Dry Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL000201	Pinus ponderosa / Schizachyrium scoparium Woodland	Dry Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL000747	Juniperus scopulorum / Oryzopsis micrantha Woodland	Dry Coniferous Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000187	Pinus ponderosa / Mahonia repens Forest	Dry Coniferous Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000865	Pinus ponderosa / Pseudotsuga spicata Woodland	Dry Coniferous Forests & Woodlands	P2?	> 500	100-500	20-100
CEGL000859	Pinus ponderosa / Juniperus communis Woodland	Mesic Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL0002123	Pinus ponderosa / Oryzopsis asperifolia Woodland	Mesic Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL000203	Pinus ponderosa / Symphoricarpos albus Forest	Mesic Coniferous Forests & Woodlands	P1-F	> 2,500	500-2,500	100-500
CEGL000190	Pinus ponderosa / Physocarpus monogynus Forest	Mesic Coniferous Forests & Woodlands	P1-F?	> 2,500	500-2,500	100-500
CEGL000382	Picea glauca / Linnæa borealis Forest	Mesic Coniferous Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000192	Pinus ponderosa / Prunus virginiana Forest	Mesic Coniferous Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000873	Pinus ponderosa / Quercus macrocarpa Woodland	Mesic Coniferous Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000383	Picea glauca / Vaccinium scoparium Forest	Mesic Coniferous Forests & Woodlands	P3	> 25	10-25	2-10
CEGL000583	Populus tremuloides / Corylus cornuta Forest	Upland Hardwood Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000597	Populus tremuloides / Peridium aquilinum Forest	Upland Hardwood Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000607	Populus tremuloides / Spiraea betulifolia Forest	Upland Hardwood Forests & Woodlands	P2	> 500	100-500	20-100
CEGL000554	Quercus macrocarpa / Carex inops ssp. heliophila Woodland	Upland Hardwood Forests & Woodlands	P2?	> 500	100-500	20-100
CEGL002138	Quercus macrocarpa / Prunus virginiana Woodland	Upland Hardwood Forests & Woodlands	P2	> 500	100-500	20-100
CEGL001007	Artemisia tridentata / Pascopyrum smithii Shrub Herbaceous Vegetation	Dry Plains Shrublands	P2	> 500	100-500	20-100
CEGL001086	Cercocarpus montanus / Bouteloua curtipendula Shrubland	Dry Plains Shrublands	P2	> 500	100-500	20-100
CEGL001394	Juniperus horizontalis / Schizachyrium scoparium Dwarf-shrubland	Dry Plains Shrublands	P3	> 25	10-25	2-10
CEGL001120	Rhus trilobata / Pseudotsuga spicata Shrub Herbaceous Vegetation	Dry Plains Shrublands	P3	> 25	10-25	2-10
CEGL001072	Artemisia cana ssp. cana / Pascopyrum smithii	Mesic Plains Shrublands	P3	> 25	10-25	2-10

	Shrubland							
CEGL001108	Prunus virginiana Shrubland	Mesic Plains Shrublands	P3	> 25	10-25	2-10	< 2	
CEGL001681	"Schizachyrium scoparium - Bouteloua (curtipendula, gracilis) / Carex filifolia Herbaceous Vegetation"	Dry Mixedgrass Prairies	P1-G	> 2,500	500-2,500	100-500	2-100	
CEGL001579	Pascopyrum smithii - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	Dry Mixedgrass Prairies	P2	> 500	100-500	20-100	2-20	
CEGL002037	Stipa comata - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	Dry Mixedgrass Prairies	P2	> 500	100-500	20-100	2-20	
CEGL001583	Pascopyrum smithii - Nassella viridula Herbaceous Vegetation	Mesic Mixedgrass Prairies	P1-G	> 2,500	500-2,500	100-500	2-100	
CEGL002034	Pascopyrum smithii - Stipa comata Central Mixedgrass Herbaceous Vegetation	Mesic Mixedgrass Prairies	P1-G	> 2,500	500-2,500	100-500	2-100	
CEGL002205	Andropogon gerardii - Schizachyrium scoparium Northern Plains Hillslope Herbaceous Vegetation	Mesic Tallgrass Prairies	P2	> 500	100-500	20-100	2-20	
CEGL002240	Sporobolus heterolepis - Stipa richardsonii - Danthonia intermedia Herbaceous Vegetation	Black Hills Montane Grasslands	P2	> 100	20-100	5-20	< 5	
new	Prairie Dog Town Grassland Complex							
CEGL002055	Pinus ponderosa Limestone Cliff Sparse Vegetation	Prairie Dog Grassland Complex	P2	> 500	100-500	20-100	2-20	
CEGL002295	Black Hills Rock Outcrop Sparse Vegetation	Black Hills Sparse Vegetation	P3	> 25	10-25	2-10	< 2	
CEGL005260	Sandstone Plains Rock Outcrop Sparse Vegetation	Black Hills Sparse Vegetation	P3	> 25	10-25	2-10	< 2	
CEGL002294	Shale Barrens Slopes Sparse Vegetation	Black Hills Sparse Vegetation	P3	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL005261	Siltstone (Redbeds) Plains Sparse Vegetation	Black Hills Sparse Vegetation	P3	> 25	10-25	2-10	< 2	
CEGL002307	Scree/Talus Black Hills Sparse Vegetation	Black Hills Sparse Vegetation	P3	> 25	10-25	2-10	< 2	
CEGL000878	Pinus ponderosa Scree Woodland	Black Hills Sparse Vegetation	P3	> 25	10-25	2-10	< 2	
new	Recent Burn Sparse Vegetation	Black Hills Sparse Vegetation	P3	> 25	10-25	2-10	< 2	
CEGL000628	Acer negundo / Prunus virginiana Forest	Plains Riparian Forests/Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL002088	Fraxinus pennsylvanica - (Ulmus americana) - Acer negundo Forest	Plains Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL002082	Fraxinus pennsylvanica - Ulmus americana / Symphoricarpos occidentalis Forest	Plains Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL002664	Populus angustifolia Woodland	Plains Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL000659	Populus deltoides - (Salix amygdaloides) / Salix exigua Woodland	Plains Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL000658	Populus deltoides - Fraxinus pennsylvanica Forest [Provisional]	Plains Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL000660	Populus deltoides / Symphoricarpos occidentalis Woodland	Plains Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL000947	Salix amygdaloides Woodland	Plains Riparian Forests & Shrublands	P4?	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles	
CEGL001131	Symphoricarpos occidentalis Shrubland [Provisional]	Plains Riparian Forests & Shrublands	P3	> 25	10-25	2-10	< 2	

CEGL001197	Salix exigua Temporarily Flooded Shrubland [Provisional]	Plains Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL002057	Picea glauca Alluvial Black Hills Forest	High Elevation Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL001161	Betula occidentalis / Cornus sericea Shrubland	High Elevation Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL001173	Salix bebbiana Shrubland	High Elevation Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL002079	Betula papyrifera / Corylus cornuta Forest	Dry Riparian Forests and Shrublands	P3	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL000596	Populus tremuloides / Prunus virginiana Forest	Dry Riparian Forests and Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL000555	Quercus macrocarpa / Ostrya virginiana Forest	Dry Riparian Forests & Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL001093	Crataegus douglasii - (Crataegus chrysocarpa) Shrubland	Plains Riparian Forests and Shrublands	P4	> 5 miles	1-5 miles	0.2 - 1 miles	0.2 miles
CEGL001559	Calamagrostis canadensis Western Herbaceous Vegetation	Riparian/Wet Meadows	P3	> 25	10-25	2-10	< 2
CEGL001803	Carex aquatilis - Carex rostrata Herbaceous Vegetation	Riparian/Wet Meadows	P3	> 25	10-25	2-10	< 2
CEGL001813	Carex nebrascensis Herbaceous Vegetation	Riparian/Wet Meadows	P3	> 25	10-25	2-10	< 2
CEGL001833	Eleocharis palustris Herbaceous Vegetation	Riparian/Wet Meadows	P3	> 25	10-25	2-10	< 2
CEGL001838	Juncus balticus Herbaceous Vegetation	Riparian/Wet Meadows	P3	> 25	10-25	2-10	< 2
CEGL001477	Spartina pectinata - Carex spp. Herbaceous Vegetation	Riparian/Wet Meadows	P3	> 25	10-25	2-10	< 2
CEGL005262	Black Hills Streamside Vegetation	Riparian/Wet Meadows	P4	> 0.5 miles	0.25-0.5 miles	0.1 - 0.25 miles	< 0.1 miles
CEGL005263	Western Great Plains Streamside Vegetation	Riparian/Wet Meadows	P4	> 0.5 miles	0.25-0.5 miles	0.1 - 0.25 miles	< 0.1 miles
CEGL002274	Distichlis spicata - Hordeum jubatum - Sporobolus airoides Herbaceous Vegetation	Saline Meadows	P4	> 0.5 miles	0.25-0.5 miles	0.1 - 0.25 miles	< 0.1 miles
new?	Salix bebbiana Black Hills Fen Shrubland	Fens	P3	> 25	10-25	2-10	< 2
CEGL002389	Typha spp. Great Plains Herbaceous Vegetation	Marshes	P3	> 25	10-25	2-10	< 2

Appendix 5. Global rarity and conservation status ranking (from Grossman et al. 1998).

The USNVC was originally developed to provide a complete, standardized listing of all natural vegetation types that represent the variation in biological diversity at the community level and to identify those communities that require protection (Goodin and Grossman 1994). One method of prioritizing communities that are in need of protection is to assess those that are relatively rare and imperiled. To address this issue, the Natural Heritage Network and the Conservancy developed a method for evaluating community types and assigning appropriate conservation status ranks. These ranks are applied to the finest possible level of the hierarchy. Ranks indicating the rangewide (global) conservation status have been developed for nearly all of the identified associations occurring in the United States: these are presented in the Global Rank field.

Community types are ranked on a global (G), national (N), and subnational (S) scale of 1 to 5, with 1 indicating critical imperilment due to rarity, endemism, and/or threats¹, and 5 indicating little or no risk of extirpation or elimination. For example, a rank of G1 indicates critical imperilment on a rangewide basis, i.e., a great risk of "extinction" of the type worldwide; S1 indicates critical imperilment within a specific state, province, or other subnational jurisdiction, i.e., a great risk of extirpation of the type from the subnation.

Two primary ranking factors are used in assessing the appropriate conservation status rank for a community element: (1) the total number of occurrences and (2) the total area (acreage) of the element. Secondary ranking factors such as the geographic range over which the element occurs, the threats to the occurrences, and the viability² of the occurrences also affect the rank.

Although community ranking is best done when information on all the factors listed above is available, it is often necessary establish preliminary ranks when this information is lacking or incomplete. This is particularly true for communities that have not been well described. In practice, four main factors have been useful in arriving at a preliminary assessment of a community's rangewide (global) rank:

1 Associations may be ranked G1-G3 due exclusively to rarity, i.e., in the absence of imminent threats. Examples are rare types occurring in areas remote from human alteration or unsuitable to human use, those that are endemic to a well-protected national park, or those that exhibit an inherent resistance to alteration or degradation. Although the relationship between rarity and vulnerability is not well defined, the two concepts have often been confounded. This may be, in part, because rarity per se confers some degree of inherent threat in that very rare species and communities can be threatened rapidly (Master 1991).

2 Viability is assessed through element *occurrence* ranking on an excellent to poor scale based on degree of altered species composition and structure, condition, and inferred ecosystem processes. The Conservancy also uses these occurrence ranks to ensure the protection of the best examples of *all* associations, as well as occurrences of rare and imperiled ones.

1. The geographic range over which the type occurs.
2. The long term decline of the type across this range.
3. The degree of site specificity exhibited by the type.
4. The rarity across the range based on state ranks assigned by state Natural Heritage Programs.

Most of the ranks currently applied to USNVC types are based on such preliminary assessments of rarity.

The table on the following page presents definitions for all global ranks for community types. For further information on ranking see Master (1991). For information on specifications for "occurrences" of elements see TNC (1998).

Literature Cited

- Goodin, K. L., and D. H. Grossman. 1994. National overview. Pages 1-22 *in* Grossman, D. H., K. L. Goodin, and C. L. Reuss, editors. Rare plant communities of the conterminous United States: an initial survey. The Nature Conservancy, Arlington, Virginia, USA.
- Grossman, D.H., D. Faber-Langendoen, A.W. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Volume I: The National Vegetation Classification System: Development, Status, and Applications. The Nature Conservancy, Arlington, VA. 126 pp.
- Master, L. L. 1991. Assessing threats and setting priorities for conservation. *Conservation Biology* 5:559-563.
- The Nature Conservancy. 1998. Draft Element Occurrence Data Standard. Arlington, VA. 188 pp.

Global Rank Definitions

GX ELIMINATED throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

GH PRESUMED ELIMINATED (HISTORIC) throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration (e.g., *Castanea dentata* Forest).

G1 CRITICALLY IMPERILED

Generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G2 IMPERILED

Generally 6-20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G3 VULNERABLE

Generally 21-100 occurrences. Either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout its range due to specific factors.

G4 APPARENTLY SECURE

Uncommon, but not rare (although it may be quite rare in parts of its range, especially at the periphery). Apparently not vulnerable in most of its range.

G5 SECURE

Common, widespread, and abundant (though it may be quite rare in parts of its range, especially at the periphery). Not vulnerable in most of its range.

GU UNRANKABLE

Status cannot be determined at this time.

G? UNRANKED

Status has not yet been assessed.

Modifiers and Rank Ranges

? A question mark added to a rank expresses an uncertainty about the rank in the range of 1 either way on the 1-5 scale. For example a G2? rank indicates that the rank is thought to be a G2, but could be a G1 or a G3.

G#G# Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate. For example, a G1G3 rank indicates the rank could be a G1, G2, or a G3.

Q A “Q” added to a rank denotes questionable taxonomy. It modifies the degree of imperilment and is *only* used in cases where the type would have a *less imperiled* rank if it were not recognized as a valid type (i.e., if it were combined with a more common type). A GUQ rank often indicates that the type is unrankable *because of* daunting taxonomic/definitional questions.

Note: “G” refers to global (rangewide) status. National (N) and subnational (S) ranks can also be assessed.

Appendix 6. Preliminary Community List that formed the starting point for the vegetation classification of the Black Hills.

COMMUNITIES	SYNONYMS
Forests	
<i>Pinus ponderosa</i> / <i>Physocarpus monogynus</i> Forest	Ponderosa Pine/Mountain Ninebark Forest
<i>Pinus ponderosa</i> / <i>Prunus virginiana</i> Forest	Ponderosa Pine/Chokecherry Forest
<i>Pinus ponderosa</i> / <i>Symphoricarpos albus</i> Forest	Ponderosa Pine/Snowberry Forest
<i>Picea glauca</i> / <i>Linnaea borealis</i> Forest	White Spruce/Twinflower Forest
<i>Picea glauca</i> / <i>Vaccinium scoparium</i> Forest	White Spruce/Grouseberry Forest
<i>Picea glauca</i> Alluvial Black Hills Forest	White Spruce Alluvial Black Hills Forest
<i>Populus tremuloides</i> / <i>Corylus cornuta</i> Forest	Aspen/Beaked Hazel Forest
<i>Quercus macrocarpa</i> / <i>Ostrya virginiana</i> Forest	Bur Oak-Ironwood Forest
<i>Betula papyrifera</i> / <i>Corylus cornuta</i> Forest	Paper Birch/Hazel Forest
<i>Populus tremuloides</i> / <i>Picea glauca</i> Black Hills Forest	Black Hills Aspen/White Spruce Forest
<i>Populus tremuloides</i> / <i>Prunus virginiana</i> Forest	Aspen/Chokecherry Forest
<i>Fraxinus pennsylvanica</i> - <i>Ulmus americana</i> / <i>Symphoricarpos occidentalis</i>	Green Ash - Elm/Wolfberry Forest
<i>Populus deltoides</i> - <i>Fraxinus pennsylvanica</i> Forest	Cottonwood - Green Ash Floodplain Forest
<i>Populus tremuloides</i> / <i>Pinus ponderosa</i> Forest	Aspen - Ponderosa Pine Forest
Woodlands	
<i>Pinus ponderosa</i> / <i>Arctostaphylos uva-ursi</i> Woodland	Ponderosa Pine/Bearberry Woodland
<i>Pinus ponderosa</i> / <i>Juniperus communis</i> Woodland	Ponderosa Pine/Common Juniper Woodland
<i>Pinus ponderosa</i> / <i>Oryzopsis asperifolia</i> Woodland	Ponderosa Pine/Rough-leaved Ricegrass Woodland
<i>Pinus ponderosa</i> / <i>Pseudoroegneria</i> [<i>Agropyron</i>] <i>spicata</i> Woodland	Ponderosa Pine/Bluebunch Wheatgrass Woodland
<i>Pinus ponderosa</i> / <i>Quercus macrocarpa</i> Woodland	Ponderosa Pine/Bur Oak Woodland
<i>Pinus ponderosa</i> / <i>Schizachyrium</i> [<i>Andropogon</i>] <i>scoparium</i> Woodland	Ponderosa Pine/Little Bluestem Woodland
<i>Quercus macrocarpa</i> / <i>Corylus cornuta</i> Woodland	Northwestern Great Plains Bur Oak Woodland
<i>Populus deltoides</i> - (<i>Salix amygdaloides</i>)/ <i>S. exigua</i> Floodplain Woodland	Cottonwood - Peach-leaf Willow Floodplain Woodland
Shrublands and Dwarf-shrublands	
<i>Artemisia filifolia</i> / <i>Calamovilfa longifolia</i> Shrubland	Sand Sagebrush/Prairie Sand Reed Shrubland
<i>Cercocarpus montanus</i> / <i>Bouteloua curtipendula</i> Shrubland	Mountain Mahogany/Side-oats Grama Shrubland
<i>Symphoricarpos occidentalis</i> Shrubland	Wolfberry Shrubland
<i>Salix bebbiana</i> Shrubland	Beaked Willow Scrub
<i>Salix exigua</i> Shrubland	Sandbar Willow Shrubland
<i>Betula pumila</i> - <i>Salix</i> spp. Rich Prairie Fen Shrubland	Bog Birch - Willow Rich Prairie Fen
<i>Juniperus horizontalis</i> / <i>Schizachyrium</i> [<i>Andropogon</i>] <i>scoparium</i> Dwarf-	Creeping Juniper/Little Bluestem Dwarf- Shrubland
Pine and Shrub Savannas	
<i>Pinus ponderosa</i> / <i>Schizachyrium scoparium</i> Sparse Woodland	Ponderosa Pine/Little Bluestem Savanna
<i>Artemisia tridentata</i> / <i>Bouteloua gracilis</i> Sparse Shrubland	Big Sagebrush/Blue Grama Shrubland
<i>Artemisia tridentata</i> / <i>Pascopyrum</i> [<i>Agropyron</i>] <i>smithii</i> Sparse Shrubland	Big Sagebrush/Western Wheatgrass Shrubland
Prairies	
<i>Andropogon gerardii</i> - <i>Schizachyrium scoparium</i> Northern Plains Hillslope Herbaceous Vegetation	Northern Plains Big Bluestem Prairie
<i>Pascopyrum</i> [<i>Agropyron</i>] <i>smithii</i> - <i>Bouteloua gracilis</i> - <i>Carex filifolia</i> Herbaceous Vegetation	Western Wheatgrass - Blue Grama - Thread-leaved Sedge Mixedgrass Prairie
<i>Pascopyrum smithii</i> - <i>Nasella</i> [<i>Stipa</i>] <i>viridula</i> Herbaceous Vegetation	Western Wheatgrass - Green Needlegrass Mixedgrass Prairie
<i>Poa</i> spp. - <i>Sporobolus heterolepis</i> Montane Black Hills Herbaceous	Black Hills Montane Grassland
<i>Schizachyrium scoparium</i> - <i>Bouteloua</i> spp. (<i>curtipendula</i> , <i>gracilis</i>) - <i>Carex filifolia</i> Herb. Veg.	Northern Great Plains Little Bluestem Prairie
<i>Stipa comata</i> - <i>Bouteloua gracilis</i> - <i>Carex filifolia</i> Herbaceous Vegetation	Needle-and-thread - Blue Grama Mixedgrass Prairie
Wet Meadows and Marshes	
<i>Scirpus</i> spp. - <i>Typha</i> spp. Mixed Inland Great Plains Herbaceous Vegetation	Great Plains Bulrush - Cattail Marsh
<i>Calamagrostis stricta</i> - <i>Carex lanuginosa</i> Herbaceous Vegetation	Bluejoint - Woolly Sedge Wet Meadow

APPENDIX 7.

List of types considered for the Black Hills but dropped from the final classification

Global Name	Global Common Name
Artemisia cana ssp. cana / Pascopyrum smithii Shrub Herbaceous Vegetation	Silver Sagebrush / Western Wheatgrass Shrub Prairie
Artemisia filifolia / Calamovilfa longifolia Shrubland	Sand Sage / Prairie Sandreed Shrubland
Artemisia tridentata / Bouteloua gracilis Shrub Herbaceous Vegetation	Big Sagebrush / Blue Grama Shrub Prairie
Betula papyrifera - (Tilia americana, Quercus macrocarpa) Canyon Forest	Bur Oak - Basswood - Paper Birch Canyon Forest
Calamovilfa longifolia - Carex filifolia Herbaceous Vegetation	Prairie Sandreed Sand Prairie
Carex (rostrata, utriculata) - Carex lacustris - (Carex vesicaria) Herbaceous Vegetation	Northern Sedge Wet Meadow
Carex aquatilis - Carex rostrata Herbaceous Vegetation	Water Sedge-beaked Sedge Wet Meadow
Carex aquatilis - Carex spp. Herbaceous Vegetation	Water Sedge Wet Meadow
Carex aquatilis Herbaceous Vegetation	Water Sedge Wet Meadow
Carex lanuginosa - Calamagrostis stricta Herbaceous Vegetation	Bluejoint - Woolly Sedge Wet Meadow
Fraxinus pennsylvanica - (Ulmus americana) - Acer negundo Forest	Great Plains Ash - Elm - Boxelder Forest
Phragmites australis Temperate Herbaceous Vegetation	Reed Marsh
Pinus ponderosa - Populus tremuloides Black Hills Forest	Ponderosa Pine - Aspen Forest
Pinus ponderosa / Schizachyrium scoparium Wooded Herbaceous Vegetation	Ponderosa Pine / Little Bluestem Savanna
Populus deltoides - Fraxinus pennsylvanica Forest [Provisional]	Cottonwood - Green Ash Floodplain Forest
Populus tremuloides / Mahonia repens Forest	Aspen / Oregon Grape Forest
Populus tremuloides / Picea glauca Black Hills Forest	Black Hills Aspen / White Spruce Forest
Populus tremuloides / Rosa woodsii Forest	Aspen / Wood's Rose Forest
Populus tremuloides / Rubus parviflorus Forest	Aspen / Thimbleberry Forest
Quercus macrocarpa / Corylus cornuta Woodland	Northwestern Great Plains Bur Oak Woodland
Quercus macrocarpa / Mixedgrass Shale Wooded Herbaceous Vegetation	Bur Oak Shale Savanna
Salix exigua / Mesic Graminoids Shrubland	Sandbar Willow / Mesic Graminoid Shrubland
Spartina pectinata - Calamagrostis stricta - Carex spp. Herbaceous Vegetation	Northern Cordgrass Wet Prairie

