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Finding the Best Remaining Black Hills Montane Grasslands, the First Step in Conservation

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FINDING THE BEST REMAINING BLACK HILLS MONTANE GRASSLANDS, THE FIRST STEP IN CONSERVATION—Black Hills Montane Grassland is a rare and endangered plant community endemic to the Black Hills of western South Dakota and northeastern Wyoming. It is restricted to higher elevations on the Limestone Plateau in the western part of the uplift (Fig. 1). Early visitors to the Black Hills wrote glowing reports of flower-filled grasslands on the Limestone Plateau. Lieutenant Colonel G.A. Custer and his soldiers reveled in lush grass, and decorated the headgear of their horses with flowers (Custer 1875). Expedition botanist A.B. Donaldson "estimated the number of flowers in bloom in Floral Valley at 50, while an equal number of varieties had bloomed, or were yet to bloom" (Ludlow 1875). Donaldson's Black Hills plant collection was sent to J.M. Coulter, who compiled a species list for the expedition's final report (Ludlow 1875). However there is no indication which species were collected from the flower-filled grasslands. In 1892, botanist P.A. Rydberg found the grasslands of the "Limestone District" reminiscent of Sweden, his homeland: "meadows with the knee-deep grass, and the flowers were in greater profusion and greater variety of color than I have seen elsewhere in America." He listed trees, shrubs, and notable forbs of the Limestone District, but no species specific to the meadows (Rydberg 1896). Thus, the original composition of these grasslands is unknown, though by the time of the first species lists, non-native plants were abundant.

In his Black Hills vegetation classification, Hayward (1928) described an "upland meadow stage" from the northwest Limestone Plateau dominated by grasses and sedges, including northern sweetgrass (*Anthoxanthum hirtum*), Richardson's needlegrass (*Achnatherum richardsonii*), timber oatgrass (*Danthonia intermedia*), and the non-natives timothy (*Phleum pratense*) and quackgrass (*Elymus repens*). McIntosh (1930, 1931) recognized a similar "mountain meadow stage" which he expanded to include two subtypes. Lower meadows were similar to Hayward's upland meadow stage, with timothy "commonly the most abundant grass." In contrast, "well-drained slopes" were dominated by native "speargrasses and dropseed" (today's *Achnatherum, Hesperostipa* and *Nassella*, and *Sporobolus heterolepis*).

In 1990 and 1991, a study of riparian vegetation of the Black Hills National Forest, which included mesic meadows on the Limestone Plateau, documented no stands of the

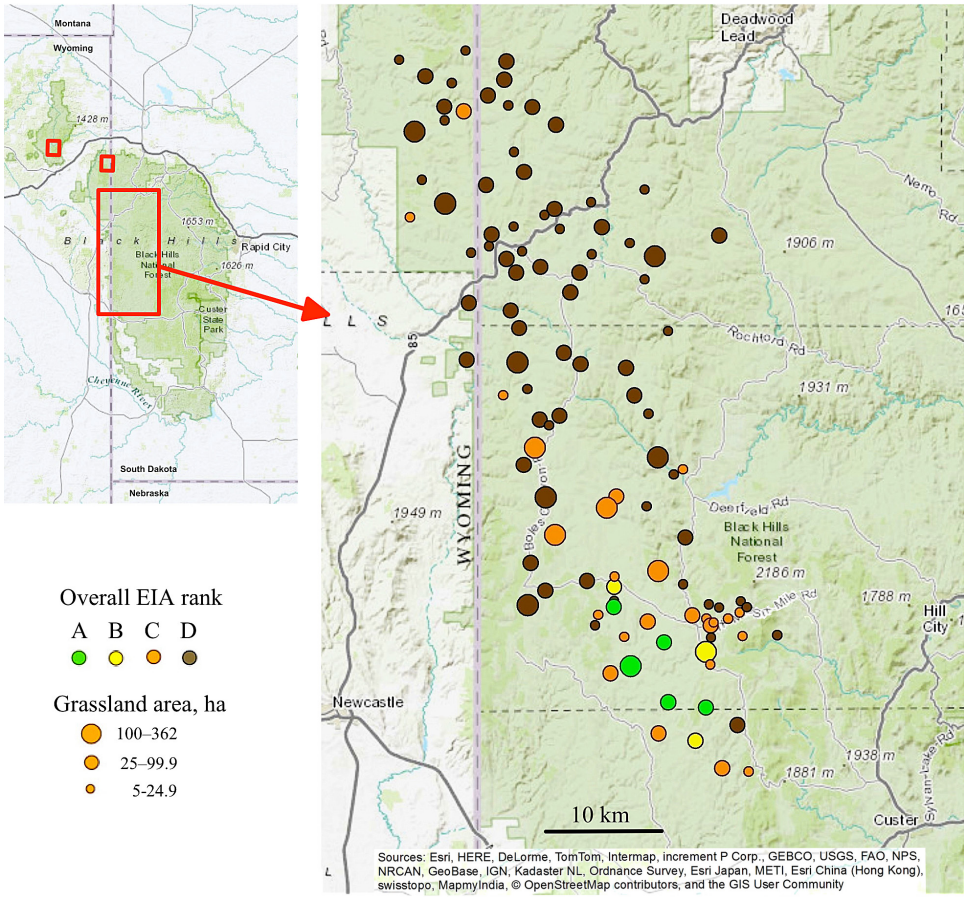

Figure 1. Black Hills Montane Grasslands locations with overall Ecological Integrity Assessment (EIA) rank and area indicated by circle color and size, respectively. Context map indicates main study area outlined in red.

meadow types of Hayward and McIntosh (M. Girard, Black Hills National Forest, unpublished data and report). In 1995, a preliminary classification was compiled for the three-year Black Hills Community Inventory (Marriott et al., The Nature Conservancy–Midwest Field Office, unpublished report). It included a high-elevation grassland type called Black Hills Montane Grassland (BHMG), or Prairie Dropseed – Richardson's Needlegrass – Timber Oatgrass Grassland (*Sporobolus heterolepis – Achnatherum richardsonii – Danthonia intermedia* Grassland), based on the well-drained slope subtype of McIntosh. However no candidate sites were identified. Reconnaissance in 1998 documented several small stands similar to McIntosh's drier subtype, but with non-native grasses common. In 1999, a survey focused on BHMGs showed the type to be more widespread than previously thought, but with non-native species common in most stands. (H. Marriott, South Dakota Game, Fish and Parks–Wildlife Division, unpublished report).

Recognizing the need to identify and conserve remaining native BHMG sites, South Dakota Game, Fish and Parks, Black Hills National Forest, and the Wyoming Natural Diversity Database funded comprehensive surveys in 2011 and 2012. Our objectives were to find and describe new occurrences of the type, evaluate the quality of BHMG occurrences identified in all projects, determine conservation status of the type, and recommend conservation sites.

Our study area included the Limestone Plateau in the western Black Hills, generally above 1800 m but occasionally as low as 1700 m in the northern part. We also surveyed large high-elevation grasslands off the Limestone Plateau in the vicinity of Deerfield Reservoir; at Warren Peaks in the Bear Lodge Mountains; and at Cement Ridge south of Beulah, Wyoming (Fig. 1). We surveyed grasslands identified in earlier work with native cover greater than 50%, as well as grasslands not previously visited. Grasslands <5 ha were considered too small to be viable as conservation sites and thus excluded from field surveys.

We conducted field surveys from late July through early September, 2011 and 2012, when indicator and dominant species are identifiable. Only stands with native cover greater than 50% were further characterized; others were assigned an overall rank of D (explained below). We covered most potential habitat, with the exception of some on private land. Privately owned grasslands were observed from roadsides and adjacent public land. We found none of sufficient quality to request permission for survey.

Survey methods were similar to earlier projects. Using an expanded version of the Community Ranking and General Description form of the Natural Heritage Network, we described each site, surrounding landscape, grassland, land use, disturbance, and threats. In largely native stands, we further characterized the grassland using 100 m^2 plots at representative locations to collect cover-class data for species and strata. We mapped all grasslands surveyed in all projects using a Geographic Information System, and provided GIS shape files and survey data to funding agencies.

To evaluate grassland quality consistently and explicitly, we developed a five-metric protocol specific to the BHMG type (Table 1) following the Ecological Integrity Assessment (EIA) method of NatureServe (2016*a*). We assessed the global conservation status of the type based on global range, rarity, past loss, continued threats, and level of protection (NatureServe 2016*b*).

A total of 120 sites were visited in all projects (1998–2012); BHMGs were found at 91 (other types described below) in broad drainage bottoms on the Limestone Plateau. We found two BHMG subtypes, corresponding to the "lower meadows" and "well-drained slopes" of McIntosh (1930). More mesic lower meadows in the the central and northern part of the study area were dominated by timothy and smooth brome (*Bromus inermis*). Stands similar to McIntosh's well-drained slopes often occurred nearby on drier slopes and rocky areas. In the southern part of the study area, the drier subtype predominated, both in drainage bottoms and

Table 1. Metrics and criteria for ranking Black Hills Montane Grasslands, following the Ecological Integrity Assessment (EIA) framework of NatureServe (2016*a*). Ranks for the five metrics were combined to produce an overall EIA rank for each grassland surveyed.

Metric	Definition	Criteria for ranks			
		A	B	C	D
Absolute size	grassland area, ha	> 100	25–100	5–24	< 5
Landscape connectivity	% unaltered habitat in surrounding 1000 ha	> 90	60–90	20–59	< 20
Native cover	% overall cover contributed by native species	95–100	85–94	50–84	<50
Native increaser species	% grassland area with concentrations of unpalatable native species	<10	10–25	25–50	>50
Soil surface condition	% grassland area with bare soil or old disturbances due to human activity, including livestock	<1	1–10	10–25	>25

on adjacent slopes. Consistent species include prairie dropseed, timber oatgrass, Richardson's needlegrass, and slender wheatgrass (*Elymus trachycaulus* ssp. *subsecundus*). Though grasses dominated, forbs contributed significant diversity, often > 30 species in a stand.

Additional high-elevation grasslands occurred within the study area off the Limestone Plateau. We found large grasslands near Deerfield Lake to be mosaics of lower-elevation types, consistent with early descriptions (Hayward 1928). During reconnaissance in 1998, the large grasslands on Warren Peaks and Cement Ridge in the northwest part of the study area were described as similar to the BHMG type, but we found that they differed in dominant grasses.

We assigned an overall EIA rank of A or B to eight BHMG sites, representing 10.5% by area of potential habitat surveyed. The most significant down-ranking factor was non-native species cover. North of Castle Creek, timothy and smooth brome often dominated potential habitat, sometimes forming pure stands over large areas. From Castle Creek south to the Sixmile Road, native species were progressively more common. All largely native BHMGs occurred south of the Sixmile Road (Fig. 1, Table 2).

Native increaser species (i.e., those that increase in number or cover with heavy grazing) did not contribute significantly to down-ranking except in the southern part of the study area. Soil surface disturbance by human activity was located in all grasslands surveyed—most commonly active and abandoned roads. Grassland size was a minor factor in ranking, outweighed by condition rank in all cases. Landscape connectivity was the least variable metric, as all but one grassland occurred in landscapes that were 60–90% unaltered (B-ranked). The highest-ranking grasslands occurred at sites without water, either naturally occurring or developed for livestock. Based on rarity, past and continued threats, and absence of direct protection, we assigned the BHMG type a conservation status of G1, critically imperiled on a global basis. Only eight A- or B-ranked occurrences are known, all on the southern Limestone Plateau. Hay farming, over-grazing, subdivision and increasing off-road recreation threaten remaining stands. The eight high quality grasslands (A- or B-ranked) are on public land managed for multiple use.

We recommend eight conservation sites, all with A- or B-ranked BHMG (Table 2) and managed by the Black Hills National Forest. Forest Service officials are directed to maintain or restore rare aquatic and terrestrial plant and animal communities in planning (U.S. Forest Service 2012). Given the globally endangered status of the BHMG plant community type, protective designations should be considered, such as Research Natural Area or Special Botanical Area.

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Table 2. Recommended Black Hills Montane Grassland conservation sites. These contain the only grasslands ranked A or B overall in Ecological Integrity Assessment, 2011–2012.

Site name	Location (decimal degrees)	Overall EIA rank
Upper Gillette Canyon	43.8906, −103.8924	A
Smith Draw South	43.8895, −103.8613	A
Upper Lemming Draw	43.8351, −103.8287	A
Redbird Canyon South	43.9234, −103.9195	A
Upper West Hell Canyon	43.8617, −103.8551	A
Gillette Canyon Headwaters	43.9119, −103.8259	B
Redbird Canyon at Sixmile	43.9509, −103.9211	B
Lower Lemming Draw	43.8349, −103.8295	B

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