grand river ranger district, dakota prairie grasslands

dakota buckwheat survey 2004

report to darla lenz, botanist, dakota prairie grasslands

DAKOTA BUCKWHEAT SURVEY 2004
GRAND RIVER RANGER DISTRICT
DAKOTA PRAIRIE GRASSLANDS

ABSTRACT

Rare plant surveys were conducted in August 2004 on 14,880 acres of the Grand River Ranger District of the Dakota Prairie Grasslands in Corson and Perkins Counties, South Dakota. These surveys described 1281 populations of Dakota buckwheat, or *Eriogonum visheri*. Of the 52 historic populations of *E. visheri,* 41 were accounted for, resulting in 1240 new populations of the species. Habitat requirements included Hell Creek or Ludlow formation geology, high erosion rates, clayey soil with high shrink-swell capacity, and open vegetation structure such as that found on the outwash at the base of badland buttes, on clayey slickspots, on the popcorn-weathered clay sideslopes of badland buttes. While it is believed that the vast majority of the populations were accounted for in this survey, the fractured terrain made it likely that some smaller populations escaped detection. Most populations were thriving, robust, and in flower, despite a protracted drought. No significant adverse impacts from human activity, cattle grazing, or noxious weeds were observed. Moisture stress appeared to be the greatest threat to population viability.

Other significant findings included six populations of *Talinum parviflorum*, four populations of the noxious tree *Eleangus angustifolium*, two populations of the noxious weed *Euphorbia esula*, one colony of *Populus tremuloides*, many springs, and one apparent buffalo wallow.

No alterations in the current grasslands management program were recommended, but rare plant monitoring and proactive surveys were advised.

PROJECT INFORMATION

Dakota buckwheat (*Eriogonum visheri*) is a rare, summer annual plant. It is a regional, edaphic endemic, restricted to dry, open outcrops and outwashes within badlands topography in western South Dakota, western North Dakota, and eastern Montana. Currently, the species has a global ranking of G3. It is a Federal Species of Management Concern and the Rocky Mountain Region of the U.S. Forest Service lists it as a Forest Service Sensitive Species in North and South Dakota. It is ranked S3 in South Dakota, S2-S3/E in North Dakota, and S1 in Montana.

The species has a presence on the Dakota Prairie Grasslands (DPG) in the western Dakotas. Dozens of historic populations are scattered across the Grand River Ranger District (GRRD) in Corson and Perkins Counties in western South Dakota. Seventy-one historic populations were concentrated within eight allotments on the GRRD: Texley, Petik, Miller, Hofer, Shambo, Pasture 8, Pasture 9, and Waldecker. The historic distribution of these populations is presented in **Table 1***, Historc* Eriogonum visheri *populations* and the map, *Overview Map with New and Historic Populations*, found in **Appendix 1,** *Maps.*

Table 1. Historic *Eriogonum visheri* populations.

ALLOTMENT	# OF SITES	DATE	SURVEYOR	# PLANTS	NOTES
Hofer	2	9/25/2001		54	
Miller	4	7/30/1995			
Pasture 8	1	7/30/1995			
Pasture 9	51	7/30/1995			Three populations found 11/16/01
Petik	11	9/25/2001	K. Hansen		
Schopp	1	None			
Shambo	1	9/25/2001		70	

In the spring of 2004, the DPG proposed a rare plant inventory of the *E. visheri* populations on the eight allotments on the GRRD. The objective of the survey would be to locate and map *E. visheri* populations, collect population data, and obtain an overview of the status and condition of these populations on the GRRD. The proposed survey area amounted to approximately 31½ sections of land or 20,237 acres.

David and Amy Schmoller of Yellowfield Biological Surveys were contracted to perform the survey. A pre-work meeting was held with Darla Lenz on July 30, 2004. On August 4, 2004, the DPG provided project information such as topographic maps, aerial photographs, GPS standards, and the locations of historic *E. visheri* popula-

tions. The GRRD provided an Off Road Travel permit allowing for the use of an All Terrain Vehicle (ATV) or a four wheel drive pickup truck to access the survey area. The inventory and assessment for *E. visheri* was conducted during August 2004. DPG Forest Service Botanists Darla Lenz and Kurt Hansen supervised the project. The final report was composed between November 2004 and February 2005.

METHODS

The rare plant surveys were conducted according to the guidelines published in J. R. Nelson's publication, *Rare plant surveys: Techniques for impact assessment* (Nelson 1985). August surveys were arranged in order to coincide with known flowering times of *E. visheri*. All sites were accessed by a four-wheel-drive pickup, an ATV, or on foot. All sites were inspected on foot or, where no adverse impact would occur, by ATV. Surveys were conducted at an intuitive controlled survey intensity level. Two surveyors participated in the field surveys. Darla Lenz and Kurt Hansen assisted in the surveys for one day.

Within the first two days of the survey, it became apparent that the abundance of *E. visheri* was well beyond expectations. This would make it difficult to survey the entire 31½ sections of land within the available time. Hence, the survey scope was reduced to the federal lands within the Pasture 8, Pasture 9, and Waldecker allotments; this amounted to approximately 24¼ sections or 15,520 acres.

All 52 historic populations within Pasture 8, Pasture 9, and Waldecker allotments were revisited so as to confirm, describe, and map the populations. The survey extended beyond the boundaries of the known populations to embrace all suitable habitat within the eight allotments.

When *E. visheri* populations were encountered the general ecology was described. This site data was logged into the GPS unit. At a minimum, it included the following: location, population size, population distribution, estimated area covered by the population, geomorphology, and substrate. Any unusual or noteworthy features were described. This data was transcribed onto the table, *Site Data*, which is contained on the CD-ROM included with this report.

Plants were identified in the field based on the descriptions in the plant keys listed in the bibliography on page 10. Close-up photographs served to confirm the identity of the species. No voucher specimens were collected. Population densities were determined by visual estimate or actual count.

Detail and panoramic photographs were taken using a Kodak© DX6490 digital camera. Selected photographs are included in this report.

Eriogonum visheri population locations were identified using Garmin© 12XL and Trimble Geoexplorer© 3 GPS units. Larger populations were described by polygons and smaller populations were described by points. An explanation of terms used in identifying sites logged in the GPS units is listed in **Table 2**, *Waypoint Definitions*. Using Pathfinder Office 2.8, Trimble GPS data was differentially corrected over the internet using the base station at CORS, Medora 3, ND. The Trimble and Garmin waypoints are on the CD-ROM included with this report.

Table 2. Waypoint definitions

GARMIN 12XL DEFINITIONS

Example: "0001"
0001=*Eriogonum visheri* site number

Non-*E. visheri* sites will have some of the following information:
ELEANG=*Eleangus angustifolia*
POPTRE=*Populus tremuloides* grove
TALPAR=*Talinum parviflorum*
WALLOW=Apparent buffalo wallow
SPRING=A spring

TRIMBLE GEOEXPLORER 3 DEFINITIONS

Example: "448 300 5x4 ow "
448 = *Eriogonum visheri* site number
300 = number of plants
5x4 = area covered by plants
ow = geomorphic site description
- ow = generally flat outwash usually at badland base
- ss = population on sideslope
- gr = gravelly substrate, usually mixed with dense clay
- sd = sandy
- cl = dense clay
- riv = rivulet, usually in outwash at base of badland
- cr = crest of hill, mound, butte, etc.
- m = mound

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Using Maptech© software, population locations were displayed on topographic maps. These maps are displayed in **Appendix 1**.

All time and travel expended on the project were recorded. A summary is presented in the table, *Daily Log*, located in **Appendix 2**. Weekly reports were submitted to Darla Lenz. A report summarizing the survey findings was composed on a desktop PC.

RESULTS AND DISCUSSION

1) TABLE SUMMARIZING SIGNIFICANT FINDINGS

Table 3. ***Summary of significant findings***

FEATURE	SITES	COUNT	ACRES	NOTES
Eriogonum visheri	1281	2,788,102 plants	72.95	On nearly bare Hell Creek or Ludlow Formations. All historic sites relocated.
Talinum parviflorum	6	1850 plants	0.01	Scattered in dense slickspots with cactus in east 1/3 of area. 1 site not GPS'd.
Eleangus angustifolia	4	about 6 trees	0.10	A noxious tree species. Mostly solitary trees.
Populus tremuloides	1	one grove	0.25	About 1/4 acre in deep ravine. A known site.
Springs	dozens			Especially to the east, along badland base or ravines. Some are developed.
Buffalo wallow	1	1		Not certain if it is a wallow

2) GENERAL DESCRIPTION OF PROJECT AREA

The survey area falls within the Missouri Plateau physiographic region, in the Grand River watershed. It is mixed grass prairie or Northern Wheatgrass-Needlegrass Plains characterized by rolling, grassy uplands, badlands, and wooded riparian areas. The region has a semiarid continental climate. Temperatures are extreme, winds are relatively high, and annual precipitation is low. Most precipitation arrives as spring rain.

The geologic formations in the survey area are late Cretaceous Hell Creek formation or early Tertiary Ludlow formation ***(Figure 1)***. The Hell Creek formation is mostly bedded clays with lesser amounts of sand and lignite ***(Figure 2)***. It contains sedimentary features such as siderite nodules, mud cracks, raindrop impressions, ripple

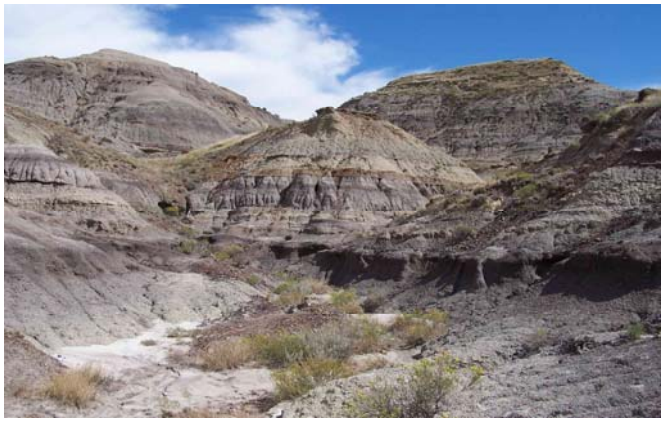

Figure 1. Hell Creek formation badlands.

Figure 2. Ludlow formation badlands.

marks, and bird and animal tracks. It has produced many excellent and renowned dinosaur skeletons, including *Triceratops* and *Tyrannosaurus rex.* Most of the badland topography in the survey area is Hell Creek formation. The Ludlow formation is of more recent origin and lies on top of the Hell Creek formation ***(Figure 3)***. It is composed of bedded clays and sandstones interlayered with lignite. This formation is predominant on the rolling, grassy terrain typical of the higher elevations of the survey area. The riparian areas along the Grand River contain modern and older alluvium and alluvial fans as well as slumps and cut banks ***(Figure 4)***.

The badlands lack soil development. They fall within the Rhoades-Rock outcrop complex (RnD), Rock outcrop-Cabba complex (RoE), or Cabba-Lantry loams (CaE). The vegetated landscape is composed of aridisols, mollisols and entisols. Soil map units in these areas include Morton-Rhoades loams (MeD), Rhoades-Daglum-Slickspots complex (RmC), Rhoades-Rock outcrop (RnD), and Vebar-Cohagen complex (VaC).

The survey area is currently used for cattle grazing and is divided into eight grazing allotments.

Figure 3. Hell Creek and Ludlow contact (red line).

Figure 4. Recent alluvial deposits along the Grand River.

3) ERIOGONUM VISHERI FINDINGS

POPULATIONS

Originally, it was anticipated that the total number of populations seen in this survey might double or triple the list of known *E. visheri* populations. This was a miscalculation. By the end of the first day of field surveys—August 4, 2004—24 new populations had been located on 900 acres of marginal habitat. These initial findings extrapolated to some 545 populations on 20,237 acres. The number of populations had been greatly underestimated. On August 12, 2004, Darla Lenz and Kurt Hanson assisted David Schmoller in the field surveys in Pasture 9, Section 14. Despite their determined efforts, the extreme density of populations and ruggedness of terrain limited the day's work to only 640 acres ***(Figure 5)***. A total of 175 populations were found. However, these figures may be misleading: about half of the populations and acreage had to be revisited two days later to log population location data. This extreme population density was the primary reason for reducing the survey scope to 15,520 acres. Even so, the multiplicity of populations made it impossible to the reduced acreage in its entirety. Section 13, a parcel of heavily populated and deeply eroded land, was not surveyed at all. Thus, the total land surveyed was 14,880 acres.

Figure 5. Dense lawn of Eriogonum visheri in Section 14.

Total population count: 1281 populations. Of these, 41 were historic, bringing the total new populations to 1240. The 11 unverified populations were on non-federal land, overlooked, extirpated, or mapped inexactly. The 1281 populations were scattered across 14880 acres, resulting in a density of 0.083 populations per acre or 1 population every 12 acres. However, many individual populations were so large that they were described by polygons up to 4.08 acres in size and contained plants that numbered up to one million.

Total plant tally: A better image of plant profusion is presented based on the total number of plants. There were an estimated 2,788,102 plants for all 1281 populations. This resulted in a density of 187.37 plants per acre or 1 plant every 0.0053 acres.

Total population area: This was an estimated 72.95 acres. Thus, 0.49% of the total acreage was occupied by *E. visheri*. The average population contained 2176 plants and covered 0.057 acres (230.45 m²).

HABITAT

Some patterns of habitat preferences and aversions were observed during the course of this survey, most of which are consistent with findings in other *E. visheri* surveys (Lenz, 1993; Ode, 1987; Peabody, 1995; Schmoller, 1993; Schmoller, 1995; Vanderhorst and Heidel, 1998; Vanderpool, 1993).

Geology: A primary determinant of suitable *E. visheri* habitat appears to be the parent material. All *E. visheri* populations found in this survey were situated on Hell Creek or Ludlow formations. More populations were found on the Hell Creek formation than Ludlow. The Hell Creek formation had more badland topography, bastion of the open vegetation structure that *E. visheri* prefers. No populations were found along the Grand River where more recent alluvial geology exists. Only one population was found on lignite.

Figure 6. E. visheri growing along rivulets on outwash below badland buttes.

Figure 7. E. visheri growing in outwash flats below badlands.

Erosion: After parent material, erosion seems to be the fundamental determinant of habitat suitability. The Hell Creek and Ludlow formations—composed of poorly consolidated mudstones, siltstones, and sandstones—are very prone to weathering and erosion. Intense precipitation episodes, common on the Great Plains, result in high erosion rates. Vegetation is often buried in sediment or uprooted by runoff. This creates the open site conditions, relatively free of competition and succession, in which *E. visheri* thrives. Thus, it was common to find *E. visheri* growing on the banks of rivulets or on the outwash of badlands buttes ***(Figures 6 and 7)***.

Soil: More often than not, this species grew on badland outcrops, that is, on the exposed, raw parent material or the primary erosional debris of the parent material. Actual soil development on these outcrops was negligible. The vast majority of these populations were on the miniature alluvial fans at the base of badlands buttes ***(Figure 8)***, sideslopes of badland outcrops ***(Figure 9)***, or slickspots on the prairie flats ***(Figure 10)***. Almost without exception it grew in dense gray to white clays. The clays occupied by *E. visheri* had high shrink-swell capacities. It has been surmised that these clays limit competition and succession, creating the thin vegetation structure that favors *E. visheri*. Clays with red to orange hues, likely due to oxides of iron, rarely supported a population of *E. visheri*. In those few locations where it grew in sand, the sand was shallow and underlain by clay. Often it was seen in association with gravel, but this was also a shallow deposit over clay. The stones may have served to create safe-sites for the germination of seed ***(Figure 11)***. The species tended to attain greater vigor and stature on darker clays, the darker chromas presumably an expression of a higher organic matter content. The species was rarely found in close association with selenium-, sodium-, or alkali-tolerant vegetation. The absence of populations on lignite suggests an aversion to sulfur or the lower pH that might accompany coal strata.

Figure 8. Miniature alluvial fans at base of badland butte.

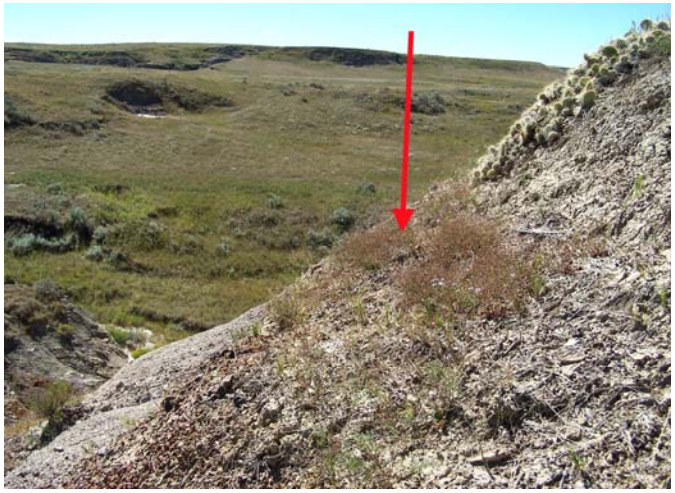

Figure 9. Gravelly sideslope of butte with reddish E. visheri.

Most of these badland outcrops were within the Rhoades-Rock outcrop complex (RnD), Rock outcrop-Cabba complex (RoE), or Cabba-Lantry loams (CaE).

Vegetation: Only a few plant species were seen in close association with *E. visheri*. In all likelihood, this was the result of the poor soil development and fertility at these locations. These associates were: *Artemisia cana, Chrysothamnus nauseosus, Gutierrezia sarothrae, Comandra umbellata,* and *Salsola iberica.*

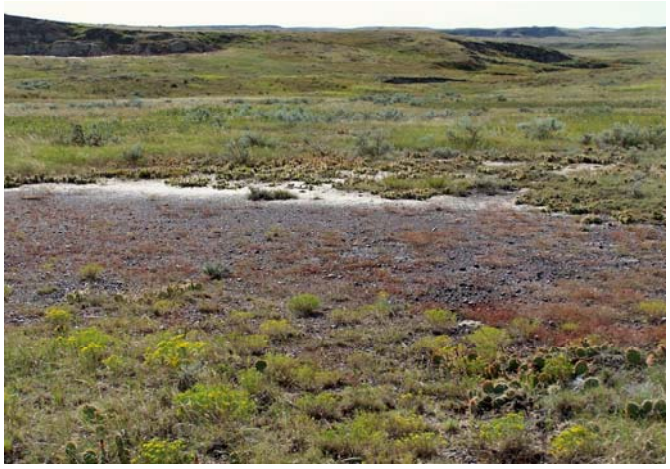

Figure 10. Slickspots on prairie flats with reddish E. visheri.

Figure 11. Flowering E. visheri growing in gravel-covered clay sideslope.

Figure 12. Very dense cover of reddish E. visheri growing on gravel-covered clay outwash.

Figure 13. Arrow shows E. visheri on SE face of slope only. Compass in foreground. Photo facing to SW.

Despite what appeared to be favorable soil and geology, it was uncommon to find *E. visheri* in close proximity to populations of *Astragalus racemosus, Atriplex nuttallii, Ceratoides lanata, Eriogonum pauciflorum, Opuntia polyacantha, Polygonum arenastrum. Melilotus officinalis, Schizachyrium scoparium,* the lichen *Hypogymnia psycodes,* or sandy soil indicators such as *Calamovilfa longifolia.* Some of these species are tolerant of selenium, sodium, or alkaline, suggesting that soil chemistry was a primary factor that excluded *E. visheri*.

Vegetation structure usually lacked shrub or tree cover. Bare soil ranged from 50% to 95%. In the unusual case where vegetation cover was high, the vegetation was often a dense colony of *E. visheri* ***(Figure 12)***. It is surmised that cattle maintain open vegetation structure and disperse *E. visheri* seeds.

Aspect: Most often the populations were found on the relatively level clay outwash at the base of badland buttes. Lesser numbers were on sideslopes. A minority of populations were on ridge tops. The sideslope populations tended to be on the southeast face. It was not unusual to find a population downslope and to the southeast of the ridge top populations. In both cases, it appeared that seeds produced on the upslope were carried to the southeast by the strong fall and winter winds to germinate downwind in a safe-site ***(Figure 13)***.

Exposure: Each population and almost every individual specimen were in open light conditions. The occasional plant was found in the shadow of a cutbank, a steep ravine, a boulder, or a shrub ***(Figure 14)***.

Figure 14. E. visheri growing in shadow of boulder.

Figure 15. Closeup of E. visheri growing in a crack in popcorn-weathered clay sideslope. Note apparent insect damage.

Figure 16. Chlorotic E. visheri in bloom, growing in outwash flats below badlands.

Slope: Most specimens grew on the flat outwash below badland buttes. When found on steeper slopes, they were usually in the midst of gravel, which stabilized the soil and created safe-sites for germination. In the rare instance that they grew on bare clay sideslopes, it was in the cracks within popcorn-weathered clay ***(Figure 15)***.

Elevation: Most populations resided between 675 and 725 meters in elevation.

VIGOR

Overall, vigor of the populations was excellent. Almost every population was in flower at the time of the survey. This is remarkable in view of the drought that has gripped Corson and Perkins counties for years.

No evidence of grazing or browsing was seen. Trampling was rare. The basal leaves of many did appear to have some insect damage ***(Figure 15)***. Many plants had lost all green coloration despite the fact that they were still in bloom ***(Figure 16)***. Some populations were stunted. A minority of the populations contained scattered plants that had died during the current growing season.

Figure 17. E. visheri growing in the middle of pasture road FS5747. Population number 1036.

THREATS

No significant anthropogenic threats were seen. Most *E. visheri* mortality seemed to be from moisture stress.

Development: The survey area has seen relatively little development over the years. There are a few pasture fences, about one-half dozen wells, and some pasture roads. There is an old homestead in Pasture 9, Section 35. But none of these appeared to impact the populations of *E. visheri.* In fact, some individual plants were growing in the center of pasture roads ***(Figure 17)***. During the month-long course of this survey, only four other vehicles were seen: two contained antelope hunters, one contained sightseers, and one contained ranch hands.

Figure 18. Cattle trampling on E. visheri population. Reddish foliage indicates damage.

Cattle: Cattle did not frequent the poorly vegetated and badly eroded terrain occupied by *E. visheri*, nor did they not show any taste for it as forage. Hence, cattle trampling of *E. visheri* was a rare sight. Any

Figure 19. Skeletons of E. visheri from previous season on exposed ridge. No live specimens were on this ridge.

Figure 20. Convex ridge top typical of sites where chlorotic, necrotic, and stunted E. visheri plants were found.

trampling likely occurred as cattle moved across the uninviting *E. visheri* habitat toward productive range ***(Figure 18)***.

Noxious Weeds: Noxious weeds did not have any noteworthy presence in the survey area. Two small patches of Leafy spurge *(Euphorbia esula)* were found a few hundred meters to the west of the stock dam in Pasture 9 Wildlife Area. One population was GPS'd. Four widely scattered Russian olive (*Eleangus angustifolia)* populations were discovered. They were essentially solitary trees. All four populations were GPS'd.

Soil Moisture: Moribund populations with skeletal plants from the previous growing season were scattered about the survey area. Quite often they were on ridge tops where there was greater exposure to wind and limited soil moisture ***(Figure 19)***. Living populations with generalized leaf chlorosis ordinarily displayed a stunted growth form and a larger proportion of dead plants. These specimens were usually situated on a dry, convex landform ***(Figure 20)***. Often, a more robust colony was growing nearby, downslope or in a concavity. This suggested that lack of soil moisture created stress on the plants situated on the elevated, convex landforms.

Insects: Where leaf chlorosis was spotty it was likely the result of insect damage. Most of these plants exhibited vigor in all other respects ***(Figure 13)***.

4) OTHER FINDINGS

TALINUM PARVIFLORUM

Six populations of *Talinum parviflorum*, or Fameflower, were found in the course of these surveys. It is listed in North Dakota as S2, in South Dakota as SNR, and is not listed with the GRRD. The plants were situated on slickspots on the prairie that were dominated by *Opuntia polyacantha, Artemisia cana,* and *Bouteloua gracilis* ***(Figures 21 and 22)***. Slopes and erosion were relatively low, resulting in more advanced soil development than the *E. visheri* sites. Parent material was likely Hell Creek formation. All six populations were in the eastern half of the survey area. GPS data was collected for five of the populations. No data was collected for the population in Pasture 9, Section 35.

Figure 21. Overview of Talinum parviflorum slickspot habitat.

Figure 22. Closeup of Talinum parviflorum.

Figure 23. Overview of Populus tremuloides grove in steep-sided canyon in Pasture 9, Section 10.

Figure 24. Tall sedges fill a series of springs seeps along valley floor at base of embankments.

Approximately 1850 plants were seen on about 255m² or 0.063 acre. The average population had 308 plants over 43m² or 0.01 acre. All populations were in flower, robust, and gave no evidence of injury, predation, parasitism, or grazing.

POPULUS TREMULOIDES

One grove of *Populus tremuloides*, or Quaking aspen, was found in Pasture 9, Section 10. This was a historic population. The site was GPS'd. Approximately 100 saplings made up the grove. It covered about 0.25 acre in a steep sided box canyon ***(Figure 23)***.

SPRINGS

Many springs dot the landscape. Some have been developed. Most lie at the base of a ridge or embankment ***(Figure 24)***.

BUFFALO WALLOW

What appeared to be a buffalo wallow was found in the northeast quarter of Section 3 West.

HARDING COUNTY *E. VISHERI*

It is of interest to note that during a recreational visit to Harding County by David Schmoller on November 19, 2004, a small population of *E. visheri* was discovered on private land (T18N, R6E, S11 NE of SE). This site lies at 910m in elevation and 93k at 255 degrees from the westernmost populations of Pasture 8. GPS coordinates were 13T/0629578/5043899.

Six plants were located in dense, white, clay outwash at the base of a 3m-high badlands outcrop in the Hell Creek formation ***(Figures 25 and 26)***. Ground cover was 3%, sunlight was full, slope was 3%, and aspect was NE. All specimens were about 6" tall and in fruit. The population covered an area 2m x 2m. Only two species were in association with this population: *Grindelia squarrosa* and *Eriogonum paucifloru*m.

Figure 25. E. visheri in outwash flats below Hell Creek formation badland. Harding County, SD.

Figure 26. Overview of E. visheri in Hell Creek formation habitat. Harding County, SD.

CONCLUSIONS AND RECOMMENDATIONS

Highlights: Without a doubt, the most outstanding result of this survey was the sheer abundance of *Eriogonum visheri* populations. It exceeded even the most exaggerated expectations. While it is believed that the vast majority of the populations were accounted for in this survey, the fractured terrain made it likely that some smaller populations escaped detection and may account for some of the unverified historic populations Others populations may have simply disappeared. Several historic populations that were not verified were on non-federal lands, which were not included in the survey area.

The discovery of six *Talinum parviflorum* populations was incidental to this survey. They existed in upland grassland habitat not likely to harbor *E. visheri.* The abundance of such habitat in the survey area makes the discovery of more *T. parviflorum* populations a probability.

Threats: It was evident that there were no significant threats to the populations. Most populations were thriving, robust, and in flower, despite the protracted drought. Cattle activity did not present a great threat to the populations; most populations were avoided by cattle due to the lack of forage or ruggedness of terrain. Noxious weeds have yet to make a strong presence in the survey area. Human activity is infrequent. The area has seen minimal development, most of which is limited to the scattered wells, fences, and pasture roads. This area sees little human visitation other than the occasional cattle rancher, hunter, or sightseer. Thus, anthropogenic threats should remain insignificant for years to come. Current management practices in the survey area appear to be compatible with the goal of maintaining a healthy *E. visheri* component.

Recommendations: No changes in management practices are recommended. It is recommended that surveys be conducted on the acreage deleted from the original survey plan. The casual discovery of a population in Harding County gives weight to the suggestion that surveys be extended to other badland outcrops within the GRRD and nearby federal lands. Populations observed in this survey should be revisited periodically to observe trends. The fact that the plants seen in Harding County were still readily identifiable at such a late hour indicates that fall surveys for *E. visheri* could be legitimate.

The *T. parviflorum* populations may require further attention to gather more site and population data. The *Euphorbia esula* and *Eleangua angustifolia* should be eradicated.

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