STATUS SURVEY FOR *ERIOGONUM VISHERI*
WALL RANGER DISTRICT
NEBRASKA NATIONAL FOREST
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[* Tables and slides are not included in this on-line version]

INTRODUCTION

Eriogonum visheri, or Dakota Wild Buckwheat, is a candidate for endangered or threatened status under the Endangered Species Act of 1973. This plant is listed as a Category 2 species under this act. Taxa in this category have indications that a listing as threatened or sensitive is in order, but lack sufficient data on biological vulnerability and threats to state this with a certainty. Such taxa require more research and study to determine their status.
To provide more data on *E. visheri*, surveys were conducted on known and undocumented populations of *E. visheri* on the Buffalo Gap National Grassland and intermingled private land in southwestern South Dakota. Surveys conducted in May of 1991 in the Wall Ranger District of BGNG encountered 14,050 individual plants of *E. visheri* on 23 sites. Word of mouth reports from Forest Service personnel described populations within the Wall Ranger District on four other sites. On July 6-20 and August 18, 1993 these known and undocumented populations and their surroundings were revisited and surveyed. Surveys were conducted with a view to 1) verify the presence of *E. visheri* on documented and undocumented sites, 2) to discover other populations of *E. visheri* not previously observed, 3) to delineate and measure the area of the populations, 4) to arrive at population densities and totals, 5) to determine the nature of the preferred habitat of the populations, and 6) to determine the amount of labor necessary to perform such a survey.

METHODS

General: Surveys were conducted in July and August of 1993 to coincide with known flowering times of *E. visheri*. Its yellow flowers distinguish it from *E. gordonii,* which has white flowers. Also, by mid-summer the flowering stems have reached their maximum height, whereby the plant is at it's most visible. Sites were accessed by means of pickup truck, All Terrain Vehicle (ATV), and on foot. Two persons were involved in gathering the information in this survey, and a third provided information about the location of an undocumented site. To locate the sightings of 1991, cartographic records of the 1991 survey were used. To locate the undocumented sites, directions were obtained from the personnel who discovered the populations. Surrounding areas with similar habitat were also inspected for *E. visheri*.
Mapping: The areas surveyed and the areas supporting populations of *E. visheri* were mapped. This was done by visually locating the boundaries of an area in the field, and representing this on a topographic map. Areas were then measured in terms of acres by means of a Numonics electronic planimeter and coordinate digitizer.
Population Densities: In typical or representative populations, population densities were estimated by replicated sampling of plot frames along a transect. The plot frame used in this survey measured 1 ft. by 2 ft or .1858 square meters. The transect would be established within the boundaries of an area containing *E. visheri*. At regularly spaced intervals along this transect, the number of individual plants of *E. visheri* that fell within the borders of the plot frame were counted. The densities of *E. visheri* along each transect and were then averaged. This was expressed in plants per frame, square meter, hectare and acre. The number of plants in other smaller populations was actually counted. The number of plants in other larger populations was estimated. All populations were delineated and measured in terms of square meters. For these populations not measured by plot frame, population densities were calculated as well, and expressed in plants per square meter, hectare, and acre. The average of all densities were then applied to other acreage possessing *E. visheri* not yet surveyed, or to acreage with the potential to harbor *E. visheri*.
Documentation: At sites bearing clues as to the nature of the species, photographs were taken. These included photographs of habitat, associated vegetation, and close-ups of *E. visheri* and associated species. A photographic directory was produced and is presented in ***Table 6****, "Directory and Contents of *Eriogonum visheri* Photographs."
Survey Form: For each site surveyed, whether *E. visheri* was found or not, a form entitled "Plant Species of Special Concern Survey Form" was completed. This form recorded the vital habitat characteristics of the areas with and without *E. visheri*, as well as details concerning population size, biology, location and documentation.

RESULTS AND DISCUSSION

1) Verification of 1991 Sites and Undocumented Sites: In 1991 *E. visheri* plants were discovered on 23 sites. Seventeen of those sites were revisited in this survey. Five of the sites surveyed in 1991 did not present any *E. visheri* in this survey. It is likely that at least one of the 1991 sites was mismapped, the population being found at a nearby location. However, this is hard to imagine, for the formations on which the plants were purportedly found are distinct badland outcrops, easily located on a map. It may be possible that misidentification of the plant is responsible for the inclusion of these areas in the 1991 survey. Or, the smallness of the populations found at these sites in 1991

may account for the failure to discover them in this survey. For example, site Fortune-125W had 10 plants in 1991, and site Weta South-55W had 30 plants in 1991. No plants were found at either of these sites in this survey. Hence, *E. visheri* was found at twelve of the seventeen 1991 sites. There were four areas where *E. visheri* was observed but never documented. These areas were surveyed, and within these areas twelve sites were found to have *E. visheri*. In all, 29 documented and undocumented sites were surveyed.

2) Discovery of New Populations: A total of nine new sites for *E. visheri* were encountered on this survey. These were found coincident with the search for known and undocumented sites. Often habitat that appeared suitable for *E. visheri* would present itself along the route to a known or undocumented site. Closer inspection would occasionally yield specimens. Other times the plant would arise without expectation, such as when coming upon a cliff or ledge. The potential for additional sites yet to be discovered is high. There remained numerous locations not surveyed that exhibited the habitat on which *E. visheri* thrived. Also, due to time constraints, some areas possessing *E. visheri* were not surveyed in their entirety. For example, site Conata West-I, an undocumented site, was measured only in part. The creek bed, which the plants paralleled, carries on for about 2000 meters before joining another drainage Good habitat appears to lie along this entire stretch. Yet, only 475 meters of the drainage way was surveyed. This surveyed area supported an estimated 7,100 plants.

Most noteworthy was the discovery of *E. visheri* in Steer Pasture and North Whitewater. Although these were undocumented sites, not entirely new, the verification of these sites gives certitude to the presence of *E. visheri* above the formation known as The Badlands Wall, in the Bad River watershed. Previous documented sightings of this plant on this District were restricted to locations below the Wall, in the White River watershed.

Perhaps the discovery of these new populations could be attributed to the extent of this surveys. It involved more hours of labor, covered more ground in less time by means of an ATV, and toured through areas untouched by the survey of 1991. However, it might be said that the strongest reason for the discovery of new populations is near ideal growing conditions. Rain was above average for the past three years, and was consistent throughout the entire growing season. Also, temperatures were moderate for the past two growing seasons. See ***Table 1****, "Weather Data from Cottonwood Research Station." This provided temperature and precipitation data for the region for the years 1990 through 1993, and compares this to the 30 year average.

3) Delineation and Area of Populations: Numbers of *E. visheri* plants within a colony were always relatively small, numbering a few dozen to a few thousand. This made it possible to delineate the colony and measure the area of the populations with fair accuracy and little difficulty

The area covered by individual colonies was consistently small. The largest area encountered was 2700 square meters. The average area of a population was 560.40 square meters. This too made for ease and fair accuracy of delineation and area measurement.

Populations were usually defined well enough to be delineated. All plants but one were a member of a distinct colony. Apparent erratics were traced to colonies within a few meters. In the occasion of the one isolated plant, found at site Beckwith-2B, it appeared to be a member of another large colony 15 meters away. It's presence on a cattle trail that passed through the large colony suggested that it had been transported from the larger colony by cattle hoof

Total area of *E. visheri* colonies surveyed in this study was 19,614 square meters or 1.96 hectares. For more details on areas of individual sites and colonies of *E. visheri*, see ***Table 2****, "Population Counts for *Eriogonum visheri*."

Total area surveyed for *E. visheri* in this study was 960.91 acres or 2,374.38 hectares. For more details on total area surveyed on individual allotments and sites, see ***Table 3****, "Acreage of All Areas Surveyed for *Eriogonum visheri*."

Thus, in a total of 2,374.38 hectares surveyed, 1.96 hectares of *E. visheri* were found. This translates into .00083 hectares of *E. visheri* for every hectare of land surveyed.

4) Population Densities and Totals: Density of the species would vary widely within the boundaries of the population. Densities ranged from a low of 0.118 plants per square meter to a high of 300.00 plants per square meter with an average of 15.74 plants per square meter. In terms of hectares this is a range of 1176.47 to 3,000,000.00 plants per hectare. The average is 158,693.87. In terms of acres this is a range of 476.12 to 1,214,100 with an average of 64,223.41.

Total population was 1,650 plants by actual count and an additional 69,374 plants by estimate, bringing a total of 71,024 plants. Comparing population totals on sites that were surveyed in both 1991 and 1993, there was an increase from 10,326 plants in 1991 to 29,392 plants in 1993, an increase of 186.8%.

For more information on population counts of individual sites and colonies see ***Table 2****, "Population Counts for *Eriogonum visheri*."

This increase may be explained by the intensity of this survey in comparison to the survey of 1991. More time and attention to detail was given to the plant in the survey of 1993. This could have resulted in the discovery of plants overlooked in 1991. Or, it could be explained by the near ideal growing conditions cited earlier. This may account for the reports that the annual crops in western South Dakota had an increase in yield in comparison to last year, which could parallel the increase in *E. visheri*. Also, the abundance of rainfall this year may have actually released seeds locked in the soil, producing a second germination of *E. visheri* within one growing season.

5) Nature of Preferred Habitat: A number of patterns or tendencies appeared in the *E. visheri* habitat. These were in a) vegetation structure, b) associated vegetation, c) light exposure, d) parent material, e) soil type, and f) disturbance. Each of these characteristics serves as indicators of the presence of *E. visheri*. All habitat data is summarized in ***Table 4****, "Habitat Description for *Eriogonum visheri.*"

a) Vegetation Structure: The vegetation structure exhibited in *E. visheri* populations was consistently spare. An overstory was never present. Trees were absent. Additionally, forbs and grasses were uncommon. Of the 33 sites that bore *E. visheri*, 21 had bare ground percentages of 95 or above, 6 had percentages of 90. One site, Weta North-8B, had a bare ground percentage of 40, but the vegetation was composed almost entirely of *E. visheri* (see slides **22B, 23B, 24B**).
More than an indicator of the presence of *E. visheri*, this factor appears to determine suitability of the habitat for *E. visheri*.
b) Associated Vegetation: Associated vegetation, while rare, was consistent. When *E. visheri* appeared on lower, level slopes, as at the base of a badland, it was common to see *Salsola iberica, E. pauciflorum,* annual and perennial *Atriplex, Oryzopsis hymenoides, Gutierrezia sarothrae,* and *Agropyron trachycaulum.* Where *E. visheri* appeared on the upper slope of a shelf or eroded bank it was commonly in association with the above plants and *Dyssodia papposa, Artemesia cana, Solanum rostratum, Sphaeralcea coccinea, Helianthus annus*, and a variety of *Euphorbia.* Across all sites, the associated species were, in order of abundance, *E. pauciflorum, Salsola iberica, Gutierrezia sarothrae, Atriplex canescens, Agropyron trachycaulum, Atriplex argentea, Astragalus racemosus,* and *Oryzopsis hymenoides*. However, the consistency of these associates was not enough to predict the occurrence of *E. visheri*, as these communities of species would be present on the kind of slopes, vegetation structures, soils and parent materials that *E. visheri* would not. Also, where the associated plants were present on the kind of slopes, vegetation structures, soils and parent materials that *E. visheri* preferred, the majority of the areas did not exhibit *E. visheri*. These associates, at best, merely suggested the potential for *E. visheri* or indicated the presence of one or more other site factors favorable to *E. visheri*. For example, the presence of an abundance of annuals indicated the presence of the disturbed, exposed soil preferred by *E. visheri*. It was necessary to combine the associated vegetation with many other site factors to actually indicate the existence of *E. visheri*.
c) Light Exposure: Without exception, the plants grew in open light conditions. Apparently, their demand for open light conditions was so pronounced that the plants would grow nearer to a badland outcrop than any other, and often in association with no other plants than its kind, and often with a distance of .5 to 1.5 meters between individual plants in a community (see slides **3A**, **10A**, and **12A** of sites Beckwith-2 and IT-l). However, this placement in open light conditions may be more a function of competition for nutrients, water, and seedbeds than a demand for sunlight. It was observed at some sites that the plants experienced some shading from their own species and associated species (see slides **8A** and **37A** for sites IT-l and Steer Pasture-6), yet seemed to be thriving. On these sites, the soils were of a more productive series or *E. visheri* had germinated in a slightly wetter location. Or it is possible that the *E. visheri* plants had germinated and matured earlier than the other plants, and were overcome by the other plants as they germinated and reached maturity. This may have been the case at site Weta North-l. In 1991 six plants were found at this site. None were found in 1993. In the location where the *E. visheri* were once present there was an abundance of annual plants, especially *Atriplex argenta.* These were so thick that they may have concealed any *E. visheri* plants in the area. This may have occurred after the germination and maturation of *E. visheri* on the site.
Hence, this factor seemed to be more than an indicator of the presence of *E. visheri*, going so far as to determine the suitability of the habitat for *E. visheri*.
d) Parent Material: At every site where *E. visheri* was found on the Wall Ranger District the parent material was some variation of the Chadron or Brule claystones which compose most of the badlands formations in this district. The Chadron claystone includes occasional channel sandstone, limestone, and abundant calcium carbonates. The Brule claystone is the layer which overlays the Chadron and is composed of claystone, sandstone, volcanic ash, and calcareous cement. On 18 out of the 33 sites bearing *E. visheri* the parent material included pediment deposits derived from the original Chadron and Brule claystones. On 10 of the 33 sites the Chadron and Brule materials were also in the form of erosional outwash from the original Chadron and Brule claystones, but differed from the former in the absence of significant soil development, proximity to the badland formation from which they originated, and absence of pediment architecture. These differences are reflected in the different soil series assigned to the pediment deposits and the erosional outwash. On 13 out of the 33 sites the Chadron and Brule materials were in their original, unaltered state (see slides **28A-31A** for site Steer Pasture-3 and slide **29B** for Agate-2B). In no instance was *E. visheri* found on Pierre Shale, a formation of plastic clays containing calcareous concretions which underlays the Chadron. At times *E. visheri* was to be found in the sandstone or limestone component of the Chadron or Brule material (as in slides **28A** and **30A** for site Steer Pasture-3), but in most instances the plants were found in the clayey component.
Seeing that these parent materials make up the vast majority of the surface material in the area surveyed, and that only 1.96 hectares, of *E. visheri* habitat were found within an area of 2374.38 hectares, parent material was not a strong indicator of the existence of *E. visheri*. Yet, seeing that *E. visheri* appeared on no other material, it is evident that this factor was a critical determinant of the suitability of the habitat for *E. visheri*.
e) Soil Type: Without exception, *E. visheri* appeared on Badland, Interior, or Cedarpass soil types. The Badland soil type refers to the exposures of original Brule or Chadron parent material or alluvium that lack any significant soil development. The Interior soils are the sodium rich, highly stratified, silty and loamy alluvium found on fans at the base of the badlands outcrops or in flood plains that lead away from the badlands outcrops. Cedarpass soils are

sodium rich, silty soils found on small mesas and pediment slopes that radiate away from badlands outcrops. They are on higher parts of the landscape and are more stratified than the Interior soils.
Twenty-one of the 33 sites that supported *E. visheri*, or 64%, had Interior soil, 55% had Cedarpass soil, and 36% had Badlands soil. Seventeen of the 33 sites had more than one soil type supporting *E. visheri*. The existence of two or three soil types at a site bearing *E. visheri* was due to the fact that Interior and Cedarpass soils have the Badlands soil as a common origin. Furthermore, Cedarpass soils were often positioned directly above the Interior soils. In these situations, colonies of *E. visheri* in the Cedarpass soil appear to have seeded colonies in the Interior soil below.
The physical and chemical characteristics of Interior and Cedarpass soils may correlate with the presence of *E. visheri*. These characteristics are: Moderate permeability's, .6 to 2.0 in/hr. Available Water Capacities that are very low, .13 to .19 in/in. Soil pH is 7.4 to 9.0 for Interior soil - moderately alkaline - and 6.1 to 7.8 for Cedarpass soil - slightly acidic - in the upper 3 inches of soil. Below that the pH rises to 7.9 to 9.0 for Interior soil and 7.4 to 9.0 for Cedarpass soil. Salinity is <2 to <4 mmhos/cm for Interior soil, and <4 to <8 mmhos/cm for Cedarpass soil. Shrink swell potential is low for Interior soil and low to moderate for Cedarpass soil. Erosion factors are moderate for both soils .32 to .43. Organic matter is very low in Interior soil, <1%. Cedarpass soils are not as low, 1-3%.
Soil texture was not a major indicator of *E. visheri*. The Interior and Cedarpass soils have textures that range from sandy loam to clay to silt loam. Although certain textures tend to be found at certain depths only, often the deeper horizons were exposed by erosion. *Eriogonum visheri* was found on these deeper, exposed horizons of a differing texture as well. For example, it was found growing on unusually sandy soil of what appears to be the exposed C horizon of a Cedarpass soil at Steer Pasture-4 (see slide **32A**).
Those plants that appeared on the Cedarpass were with few exceptions, of a larger and more robust stature. Some plants on the Cedarpass were 40cm in height, while it was rare to find any over 25cm on the Interior soils. The greater fertility, higher organic matter, lower pH in the upper horizons, and lower salinity of the Cedarpass soil in comparison to the Interior and Badlands soils can explain this. In fact, where the Cedarpass soils lay above the Interior soils, and where the outwash from the Cedarpass soils onto the Interior soils was brown or gray, indicating organic matter, the plants on the Interior soil would rival those found on the Cedarpass soils in height and vigor. This was the case at site Agate-l.
The plants that appeared on the Interior soils would be at a maximum vigor and height in a narrow band that paralleled the badland formation. As the distance from the badland formation increased, the plants would decrease in vigor and height. As the distance toward the badland formation decreased the vigor and height would decrease as well. This could be explained by the slight accumulation of plant litter in the interior of the population, which would provide greater nutrition and water retention. The higher erosion process on the margins of a population also could explain it. In some instances channel erosion was of a degree sufficient to expose most of the roots of the plants. These plants were usually toppled, uprooted, or dead (see slide **11A**). At times deposition was higher at these margins, often resulting in the burial of nearly the entire plant. These plants were commonly stunted or dead (see slides **15B**, **16B**).
Discoloration of *E. visheri* was observed, especially on plants growing in Interior and Badlands soils. Many plants that dwelled on the margins of populations were not only of lower vigor and height, but they were chlorotic and necrotic, exhibiting rust coloration, yellow spotting, or drying, especially on the lower leaves (see slides **2B**, **3B**, **4B**, **14B**). This too, could be a result of the greater erosion process on the margins. Again, channel erosion often exposed most of the roots of the plants. These plants were consistently chlorotic, and necrotic (see slide **11A**). Plants that suffered from severe deposition were almost always discolored (see slides **15B**, **16B**). Low soil organic matter could have accounted for the discoloration as well. As noted, the Interior soils are very low in organic matter, and plant litter was seen in small amounts in the inner regions of a population. The Badlands soils are almost devoid of organic matter. Organic matter is the source of most of the nitrogen supplied by a soil. The symptoms displayed match those of Nitrogen deficiency, which typically attacks the lower, oldest leaves with a yellowing at the tip which progresses down the midrib of the leaf. As newer leaves are attacked, the older leaves die and turn completely brown.
Thus, it appears that this factor is another critical determinant of the suitability of the habitat for *E. visheri*.
f) Disturbance: All 33 sites bearing *E. visheri* were highly disturbed sites. This height of disturbance was indicated by the lack of cover, bare ground being mainly in the range of 90-99%. It was also indicated by the abundance of erosional and depositional features. These included rivulets, miniature sandbars and deltas, and large fans of alluvium.
While disturbance was primarily as a result of water erosion and deposition, two sites, Beckwith-2 and Fifteen Creek-2, appeared to be disturbed as a result of cattle trampling. On another site, Weta North-3, the disturbance was in the form of ditching for a pasture road.
Whether by trampling, road construction, or by water, the disturbance produced appeared to favor the *E. visheri* by reducing competition from other plants and by dispersal of seeds.
Within the disturbed area *E. visheri* tended toward certain locations. It extended out into the disturbed area farther than any other plant. It was closest to the Badlands formation when in the Interior soils and farthest out on the ledge when in Cedarpass soils. It was uncommon to find the plant in the rivulets formed by water erosion. It would tend to appear on the small sandbar-like formations between the rivu1ets. And it would tend to take root in the large cracks found on steep slopes, up to 40 degrees, of exposed Cedarpass soils. Hence, the locations of *E. visheri* within a disturbed area were where erosion gradients were just beyond the tolerance of most other plants, yet were where it

afforded a small measure of protection, as in a crack in the soil or a small sandbar. Where these gradients became severe, as in rivulets, fans of high deposition, or slopes above 40 degrees, the *E. visheri* were not in evidence. For example, at site IT-6, fans were observed that had 5-15cm of material that had been deposited during this growing season (see slides **15B**, **16B**). On this relatively severe deposit there were but a few *E. visheri* plants to be seen, and these were partly buried in sediment, toppled, chlorotic, and necrotic. Also, at site IT-l (slide **11A**), *E. visheri* plants were observed in a rivulet who's roots had been exposed by channel erosion. These plants were chlorotic and necrotic as well.

Wind may have played a part in the distribution of plants within the sites. At some sites the plants appeared with regularity on the south facing exposures. As the exposures turned to the north the plants decreased in number, becoming absent at northwest exposures. This was the case at site Steer Pasture-S. It is possible that the strong northerly winds that prevail after seed dispersal in the fall will sweep any seeds from north exposures into the dense cover beyond the bare soil or onto the southern exposure sheltered from these winds.

In view of the above, it is believed that in addition to being an indicator of the presence of *E. visheri*, this is another characteristic of the habitat necessary for the species.

g) Exceptions: While *E. visheri* grew in what appeared to be a discreet habitat, it was not found in all areas that bore the indicators of its presence. Three conclusions arise: First, it is possible that the absence of *E. visheri* may be due to a lack of a seed source. Perhaps there were populations at this site in the past. If this is the case, there is the possibility that *E. visheri* may be reintroduced onto the site. Second, the absence may be due to some difference in habitat not recognized, such as chemistry, farming, fire, or grazing. Third, the failure to find *E. visheri* at these sites where all indications were that it should be there underscores the fact that these habitat factors simply suggest the presence of *E. visheri*, and in no way imply it's presence.

6) Hours of Labor Required: Two persons were involved in this survey. A total of 178 hours of labor were required to prepare, perform and summarize the survey. Thus, the total of 960.91 acres surveyed required .19 hours of labor per acre surveyed. The total *E. visheri* habitat of 4.84 acres required 36.78 hours of labor for each acre surveyed. The hours of labor required to perform this survey are presented in detail in ***Table 5****, "Hours of Labor Invested in *Eriogonum visheri* Survey."

SUMMARY AND MANAGEMENT RECOMMENDATIONS

This survey provided data that may be useful in determining whether *Eriogonum visheri* should receive a threatened or endangered status under the Endangered Species Act. It has given estimates of the area inhabited by the species on the Buffalo Gap National Grassland: 4.84 acres. It has given population estimates for the species on the Grassland: 71,024 plants.

This survey has also given information about the preferred habitat of *E. visheri*. Four factors that suggest the presence of *E. visheri* were uncovered. These are, in order of importance, 1) Parent material consisting of Brule or Chadron formation badlands or alluvial deposits derived from these formations. 2) Badland, Interior, or Cedarpass soil series. 3) Highly disturbed sites, with exposed soil produced by erosion or deposition. 4) Vegetation structure with 90% or more of the ground being bare. 5) Open light conditions. 6) Associated vegetation that could include annual and perennial *Atriplex, Eriogonum pauciflorum, Salsola iberica*, or *Gutierrezia sarothrae*.

These indicators of the presence of *E. visheri* provide a useful tool for the location of new populations the plant. It is suggested that, while searching for new populations of *E. visheri*, these steps be followed: First, locate all exposures of Brule or Chadron parent material in the area to be surveyed. Alluvial deposits derived from these materials should be included. Second, limit the survey to Badland, Interior, or Cedarpass soil series that are found on the Brule or Chadron parent material. Third, seek highly disturbed sites within these soil types. These sites may exhibit disturbance as a result of erosion or deposition. Fourth, limit the survey to areas of disturbance with 90% bare ground or more. Fifth, limit the survey to bare ground that is in open light conditions. Sixth, seek out areas within these open light conditions that have annual and perennial *Atriplex, Eriogonum pauciflorum, Salsola iberica,* or *Gutierrezia sarothrae.* This will direct the survey to the area that is most likely to support *E. visheri*.

The absence of *E. visheri* in preferred habitats may be due to the lack of a seed source or some unseen difference in habitat. The possibility exists that *E. visheri* may be introduced into these areas with success.

The absence of *E. visheri* in preferred habitats emphasizes the fact that these factors suggest the presence of *E. visheri*, and do not imply it. However, many of the factors determine the suitability of the habitat for the species.

At least four points for further research remain: 1) the potential for other *E. visheri* sites is strong. Some populations, such as that found at Conata West-l, were not surveyed in their entirety due to time constraints. This fact, along with the pace of discovery and the anecdotal remarks of a rancher about the extent of this plant indicate that there may very well be many other populations of *E. visheri* on the Wall Ranger District. Also, the habitat that indicates the presence of *E. visheri* is very extensive. The Brule and Chadron badlands extend from the North Platte River in Wyoming and Nebraska to the White River in South Dakota. Are there other populations of *E. visheri* on these badlands outside of this district? 2) There may be significant correlations between the sites in this survey and other sites in North and South Dakota in terms of parent material, soil, disturbance, vegetation structure, light exposure, and associated vegetation. What correlations are there between these sites? 3) It is evident that *E. visheri* does not grow on other sites that appear to have the characteristics that would support populations of *E. visheri*. What

differences are there between these sites that may account for this? 4) It may be possible to propagate *E. visheri* on sites with suitable characteristics where it does not presently exist. Can this be done?

The original report is housed at Wall Ranger District, Buffalo Gap National Grassland, Nebraska National Forest in Wall, South Dakota.

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