Status Report on

Desert Glandular Phacelia

(*Phacelia glandulosa* var. *deserta*)

in Southwest Wyoming

Prepared for the Bureau of Land Management
Wyoming State Office

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Abstract

Desert glandular phacelia (*Phacelia glandulosa* var. *deserta*) was first described as a distinct species by Aven Nelson in 1898, but was subsequently synonymized under its more widespread relative, *P. glandulosa*. The two taxa differ primarily in their relative proportions of long, non-glandular to short, gland-tipped hairs on the stems. All known occurrences of var. *deserta* are restricted to the Green River and Washakie basins and foothills of the Overthrust Belt in southwestern Wyoming. Eight populations of var. *deserta* are currently recognized, although several of these may actually represent populations of var. *glandulosa*, or a mixture of both taxa. Surveys in 1997-98 documented 6900-9500 individuals, mostly in the Green River/Rock Springs area, Opal, Ross Butte, and one site in the Washakie Basin. Var. *deserta* is found primarily in cushion plant/bunchgrass communities on sparsely vegetated slopes of whitish clay covered by bleached fragments of limey-slate of the Green River Formation or conglomerate derived from the Bridger Formation. Individual colonies are often small and consist of clumped or widely scattered plants. All known occurrences are on public lands managed for multiple use by the BLM or Flaming Gorge National Recreation Area. Populations are potentially threatened by compaction and soil loss from high off-road vehicle use and surface disturbances associated with mineral development. Implementation of management strategies for this plant should be contingent on biosystematic studies that confirm or reject the validity of "var. *deserta*" as a distinct taxon.

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I. INTRODUCTION

Desert glandular phacelia (*Phacelia deserta*) was discovered on barren shale bluffs near Green River, Wyoming, by Aven Nelson in 1897, and described as a new species the following year (Nelson 1898). The species was later reduced to a variety of the more widespread *P. glandulosa* in 1913, and ultimately placed in synonymy under *P. glandulosa* in 1975 (Atwood 1975; Brand 1913). More recently, Dr. Duane Atwood of Brigham Young University has been reevaluating species within the *Phacelia* Crenulatae group and has suggested that *deserta* may warrant taxonomic resurrection (D. Atwood, personal communication). If var. *deserta* is a legitimate taxon, it may be restricted to southwestern Wyoming and could be a strong candidate for conservation attention.

In 1998, the Bureau of Land Management (BLM) Wyoming State Office contracted with the Wyoming Natural Diversity Database (WYNDD) on a cost-share basis to conduct field surveys and evaluate the taxonomic and conservation status of *Phacelia glandulosa* var. *deserta* on BLM lands in Wyoming. The objective of this report is to summarize existing data on the biology, distribution, habitat, population size, and potential threats of this taxon to be used in determining its status and management needs in Wyoming.

II. METHODS

Information on the habitat and distribution of *Phacelia glandulosa* var. *deserta* was obtained from secondary sources, including WYNDD files and computer databases, specimens from the Rocky Mountain (RM) herbarium, scientific literature, and knowledgeable individuals. USGS topographic maps, geologic maps (Love and Christiansen 1985), and BLM land status maps were used to identify areas of potential habitat for ground survey.

Field surveys were conducted from mid June to early July 1998 (survey routes and collection sites are indicated in Appendix B). Data on the biology, habitat, population size, and management needs of this species were collected using WYNDD plant survey forms. Locations of occurrences were mapped on 7.5 minute USGS topographic maps. If populations were sufficiently large, voucher specimens were collected for deposit at the RM. Color photographs were taken of plants and their habitat at each site. Information gathered in the field was entered into the computerized Element Occurrence database at WYNDD.

III. SPECIES INFORMATION

A. CLASSIFICATION

1. SCIENTIFIC NAME: *Phacelia glandulosa* Nutt. var. *deserta* (A. Nelson) Brand. Type specimen: USA: Wyoming: Sweetwater County: Green River, [ca T18N R107W], 31 May 1897, Nelson 3050 (RM) (Brand 1913; Nelson 1898).
2. SYNONYMS: Atwood (1975) treated *Phacelia glandulosa* var. *deserta* and *P. deserta* as synonyms of *P. glandulosa*.

3. COMMON NAMES: Desert glandular phacelia.

4. FAMILY: Hydrophyllaceae (waterleaf family).

5. SIZE OF GENUS: The genus *Phacelia* contains approximately 150 species restricted to the New World, but best developed in the western United States and northern Mexico (Cronquist *et al.* 1984). Dorn (1992) recognizes 15 species in Wyoming.

6. PHYLOGENETIC RELATIONSHIPS: *Phacelia glandulosa* var. *deserta* is closely related to typical var. *glandulosa*, differing primarily in the lower density of gland-tipped hairs on the herbage. Both taxa fall within Atwood's "*Phacelia neomexicana* complex" a group that is characterized by non-corrugated seeds, glandular pubescence, compound leaves, and a branched growth form (Atwood 1975). Within this group, *P. glandulosa* is most closely allied with *P. bakeri* (a regional endemic of southern Colorado and northern New Mexico), *P. argillacea* (endemic to Utah County, Utah and federally listed as Endangered), and *P. formosula* (endemic to Jackson County, Colorado and federally listed as Endangered). Of these species, *P. glandulosa* is the most widely distributed and the most morphologically diverse (Atwood 1975).

7. TAXONOMIC CONSIDERATIONS: In the field, specimens of "var. *deserta*" can be recognized by their mix of long, non-glandular hairs and shorter gland-tipped hairs along the main stem below the inflorescence. Typical *glandulosa*, by contrast, has a dense pubescence of short, gland-tipped hairs and relatively few non-glandular hairs. These differences break down when specimens are dried in the herbarium, with both varieties appearing to have a similar mixture of long and short, non-glandular and glandular hairs. The two taxa appear to differ more in their relative percentage of glandular to non-glandular hairs, rather than in the type of pubescence. No other obvious morphological differences have been detected, although var. *deserta* tends to have grayer stems and is often more robust in stature. It seems probable that populations of "var. *deserta*" in the Green River/Flaming Gorge area are genetically differentiated from other populations of *P. glandulosa*, but whether these differences are sufficient to warrant taxonomic recognition requires more sophisticated systematic research.

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. NATIONAL

a. LEGAL STATUS: Neither *Phacelia glandulosa* nor *P. glandulosa* var. *deserta* have any federal status or formal legal protection.

b. HERITAGE RANK: *Phacelia glandulosa* is ranked G4 in The Nature Conservancy's Natural Heritage network system, indicating that the full species is "apparently secure, although [it] may be quite rare in parts of its range, especially the periphery" (Fertig 1997). Var. *deserta* is ranked T1T2Q, indicating that its global abundance is intermediate between T1 (critically imperiled with 5 or fewer extant occurrences) and T2 (imperiled, with 6-20 extant occurrences). The rank is modified by "Q" to indicate that there are questions about the validity of the taxon (Fertig 1997).

2. STATE

a. LEGAL STATUS: None.

b. HERITAGE RANK: *Phacelia glandulosa var. deserta* is ranked S1, indicating that the taxon is "critically imperiled" because of extreme rarity and is known from 5 or fewer extant occurrences in the state (Fertig 1997).

C. DESCRIPTION

1. GENERAL NON-TECHNICAL DESCRIPTION: Desert glandular phacelia is an annual or biennial herb with erect, branched or unbranched stems 0.6-20 cm tall (Figures 1-2). The stems are densely pubescent with short grayish hairs and occasional glands. Leaves are lanceolate to oblong and pinnately divided into 5-9 round-toothed segments. The inflorescence is a dense panicle of coiled cymes that elongates to 6.5 cm in fruit. Flowers have a bright blue, pinkish, or purple, open, bell-shaped corolla consisting of 5 rounded lobes, conspicuously exserted stamens, and deeply cleft styles. Fruits are oval, pubescent capsules bearing elliptic to oblong, pitted seeds (Atwood 1975; Coulter and Nelson 1909; Fertig 1998; Nelson 1898).

2. TECHNICAL DESCRIPTION: Stem erect, simple or branched from the base, 10-20 cm high, densely leafy at base, sparsely so upward, the whole plant canescent with a short close pubescence, obscurely glandular; leaves petioled, narrowly oblong in outline, pinnate, the pinnae nearly oval and

Figure 1. Line drawing of *Phacelia glandulosa var. deserta* from Atwood (1975).

crenately toothed, 5-9 pairs which are nearly equal in size; inflorescence dense, paniculate, of scorpioid cymes; sepals equal, lanceolate-oblong; corolla bright blue, turbinate-campanulate, 7 mm long, lobes equalling or surpassing the tube, rounded, entire; the obliquely vertical lamellae broad and conspicuous, loosely united over the filament; filaments and style conspicuously exserted; style cleft below the middle; ovary oval, pubescent, cells two-ovuled; ovules oblong; mature seeds elliptic to oblong, reddish-brown, 2.4-3.3 mm long, pitted, the ventral surface excavated on both sides of the ridge (Atwood 1975; Coulter and Nelson 1909; Nelson 1898).

3. LOCAL FIELD CHARACTERISTICS: *Phacelia glandulosa* "var. *deserta*" can be recognized by its dense, multi-branched, glandular inflorescence of bluish-purple bell-shaped flowers with conspicuously exserted stamens and styles, grayish pubescent (largely non-glandular) lower stems and herbage and pinnately compound leaves with rounded lobes (Fertig 1998).

4. SIMILAR SPECIES: *Phacelia glandulosa* var. *glandulosa* has densely glandular pubescent stems and inflorescences. *P. sericea* is a perennial from a branched, woody rootstalk (Coulter and Nelson 1909; Dorn 1992; Fertig 1998).

D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: *Phacelia glandulosa* var. *deserta* is apparently endemic to the Green River Basin and the desert foothills of the Overthrust Belt in southwestern Wyoming in Lincoln, Sweetwater, and Sublette counties (Fertig 1998) (Figure 3). The full species ranges from central Idaho and southwestern Montana to western Wyoming, northeast Utah, and northwest Colorado (Atwood 1975; Cronquist *et al.* 1984; Welsh *et al.* 1993).

2. EXTANT SITES: *P. deserta* was originally described from a single specimen collected on "high, white, dry and barren bluffs [of] the Green River shales" near Green River, Wyoming (Nelson 1898). Three populations that may represent var. *deserta* were found in the vicinity of Green River and Rock Springs in 1998 (at the south end of White Mountain, Wilkins Peak, and the vicinity of Logan Draw). Populations that may represent *deserta* have also recently been documented along Flaming Gorge Reservoir (Refsdal 1996), the north end of White Mountain and Windmill Draw (Ward *et al.* 1998), Ross Butte (Cramer and Hartman 1996; Fertig 1998), and near Opal. If these populations are all legitimate, var. *deserta* is currently known from 8 extant locations in the state.

Exact locations of populations are listed in Table 1. More detailed

information is provided in the Element Occurrence Records and maps in Appendix A.

3. HISTORICAL SITES: In addition to Nelson's type location, five other populations of "var. *deserta*" have been reported in southwest Wyoming. Collections at the RM by Ownbey ("hills east of Superior), Goodding ("Henry's Fork"), Lang ("top of bluff 6 miles south of Red Desert"), and Payson and Payson (near Rock Springs") have not been relocated in the last 63-98 years and may no longer be extant, or may actually represent var. *glandulosa*. One historical occurrence reported by Payson and Armstrong "between Opal and Kemmerer" may have been relocated in 1998 (Occurrence # 004) (Table 1).

4. SITES WHERE PRESENT STATUS NOT KNOWN: The exact location of Nelson's 1897 "Green River" collection is not precisely known, but is probably in the vicinity of Occurrences 005 and 006 in the Green River/Rock Springs area.

5. UNVERIFIED/UNDOCUMENTED REPORTS: None.

6. AREAS SURVEYED BUT SPECIES NOT LOCATED: Surveys in 1998 focused on potential habitat in the northern Green River Basin (near Ross Butte and Big Piney), the Little Colorado Desert east of La Barge, Fontenelle Reservoir, White Mountain, and the lower Green River Basin on the east side of Flaming Gorge Reservoir. No confirmed populations of var. *deserta* were documented in these areas, although at least five new occurrences of typical *P. glandulosa* were discovered at Ross Butte and in the Little Colorado Desert. 1998 survey routes are depicted in Appendix B.

7. AREAS OF UNSURVEYED POTENTIAL HABITAT: Additional potential habitat may occur in the uplifts east of Flaming Gorge (on BLM lands and Ashley National Forest/Flaming Gorge National Recreation area), private lands in the Wilkins Peak and White Mountain areas near Rock Springs and Green River, and in the Washakie Basin.

Figure 2 (page 11). Photograph of *Phacelia glandulosa* "var. *deserta*" from a shale ridge northeast of Whalen Butte (near the type locality in Green River, Wyoming). WYNDD photograph by W. Fertig, 27 June 1998.

Figure 3. Wyoming distribution of *Phacelia glandulosa var. deserta*.

Table 1. Location Information for Populations of *Phacelia glandulosa var. deserta* in Southwest Wyoming.

I. Green River Basin

Occurrence # 001 (8 subpopulations).
County: Sublette.
Legal Description: **T30N R110W S13** (SE4), **14** (W4), **19** (NE4 of SW4 of NW4), **23** (SE4SE4).
Latitude: 42° 33' 50" N (centrum).
North: 42° 33' 50" N.
South: 42° 33' 23" N.
Longitude: 109° 53' 11" W (centrum).
East: 109° 53' 11" W.
West: 109° 54' 39" W.
Elevation: 6800-7480 ft (2070-2390 m).
USGS 7.5' Quad: Ross Butte.
Location: North slope and south arm of Ross Butte and north and west end of Ross Ridge, 0.5-1.5 miles south of the New Fork River.
Comments: This population was originally reported by Cramer and Hartman (1996) and resurveyed in 1997-98 (Fertig 1998). Specimens observed and collected by Fertig and Steve Laster in June 1998 from the north and south side of Ross Butte and west end of Ross Ridge were extremely glandular in the field, suggesting that the population may represent var. *glandulosa*. Once dried, these specimens are far less glandular and resemble var. *deserta* (Laster *s.n.*, Fertig 18278, 18282, [RM]). Populations at Ross Butte and Ross Ridge are found on gray clay-shale slopes with minimal rock cover, a habitat typical of var. *glandulosa* in the Little Colorado Desert area.

Occurrence # 002.
County: Sweetwater.
Legal Description: **T15N R108W S13** (SE4).
Latitude: 41° 16' 37" N.
Longitude: 109° 31' 28" W.
Elevation: 6040-6290 ft (1840-1915 m).
USGS 7.5' Quad: Halfway Hollow East.
Location: Small cove on the east side of Flaming Gorge Reservoir, ca 1.5 miles below Blacks Fork River, ca 4 air miles
northeast of Buckboard Crossing, ca 17.5 air miles south of Green River.
Comments: This population was discovered by B.E. Nelson in 1995 (Refsdal 1996).

Occurrence # 005.
County: Sweetwater.
Legal Description: **T18N R106W S10** (W4 of NE4 of SW4 & SW4 of SE4 of NW4).
Latitude: 41° 33' 10" N (centrum).
North: 41° 33' 16" N.
South: 41° 33' 02" N.
Longitude: 109° 21' 40" W (centrum).
East: 109° 21' 35" W.
West: 109° 21' 45" W.
Elevation: 6700-7000 ft (2040-2135 m).
USGS 7.5' Quad: Kanda.
Location: South slope of White Mountain, ca 1.4 miles northwest of Kanda siding on the north side of Interstate 80, ca 5 air miles northeast of the city of Green River.
Comments: Most plants at this site are sparsely glandular. This population may be very close to Nelson's type locality.

Occurrence # 006 (14 subpopulations).
County: Sweetwater.
Legal Description: **T18N R106W S26** (E4 of SW4 & SE4 of NW4), **S32** (S4

of SE4 of NW4, N4 of NW4, SW4 of NE4, & N4 of NE4), **T17N R106W S2** (SE4 of NW4),
Latitude: 41° 30' 27" N (centrum).
North: 41° 30' 50" N.
South: 41° 28' 59" N.
Longitude: 109° 20' 27" W (centrum).
East: 109° 20' 18" W.
West: 109° 24' 10" W.
Elevation: 6500-7285 ft (1980-2220 m).
USGS 7.5' Quads: Wilkins Peak, Kanda,
Green River, and Whalen Butte.
Location: north and south slopes of Wilkins Peak and east-west trending ridge system extending ca 3.5 miles to the west. Includes 3 main subpopulations: (1) Sec 32: ridge system ca 1-1.3 miles NE of Whalen Bottom and the Green River, ca 2.5-3 miles E of the city of Green River and ca 2.6 miles W of the Wilkins Peak radio tower; (2) Sec 2: ridge ca 0.8 miles SSE of Wilkins Peak radio tower,
ca 7.5 miles SW of Rock Springs; (3) Sec 26: N-S trending ridge on N side of Wilkins Peak, ca 0.5-1 mile N of Wilkins Peak radio tower and ca 1.8-2.3 miles S of Interstate 80 and Kanda.
Comments: Populations mostly contain plants with sparse (but evident) glandular pubescence that is more readily apparent in the field than in dried herbarium specimens.

Occurrence # 007.
County: Sweetwater.
Legal Description: **T17N R107W S12** (SE4 of NE4 & N4 of NE4 of SE4).
Latitude: 41° 28' 03" N (centrum).
North: 41° 28' 05" N.
South: 41° 28' 00" N.
Longitude: 109° 25' 40" W (centrum).
East: 109° 25' 36" W.
West: 109° 25' 42" W.
Elevation: 6400-6480 ft (1950-1975 m).
USGS 7.5' Quad: Whalen Butte.
Location: Ridge on south side of Logan Draw, ca 0.9 miles southeast of Whalen Butte, ca 0.9 miles southwest of Cordwood Bottom and the Green River, ca 2.2 air miles south of the city of Green River.
Comments: Population consists of sparsely glandular plants that are intermediate between typical *glandulosa* and var. *deserta.* Older collections from the vicinity have been identified as var. *glandulosa* (Fertig 14942 [RM]).

Occurrence # 008 (2 subpopulations).
County: Sweetwater.
Legal Description: **T20N R105W S7**, **S18** (NE4), **T20N R106W S2** (NW4 of NE4).
Latitude: 41° 44' 30" N (centrum).
North: 41° 44' 30" N.
South: 41° 43' 15" N.
Longitude: 109° 20' 06" W (centrum).
East: 109° 18' 37" W.
West: 109° 20' 06" W.
Elevation: 6660-7500 ft (2030-2285 m).
USGS 7.5' Quad: Pilot Butte.
Location: Slopes of White Mountain on the east and west sides of US Highway 191 near state rest area, ca 9.5 miles northwest of Rock Springs.
Comments: Several specimens have been
collected from this area, representing both var. *deserta* and var. *glandulosa*. Most plants have a mix of glandular and non-glandular hairs.

II. Washakie Basin

Occurrence # 003.
County: Sweetwater.

Legal Description: **T15N R94W S4** (S4 of NE4).
Latitude: 41° 18' 17" N.
Longitude: 107° 58' 40" W.
Elevation: 6780-6860 ft (2065-2090 m).
USGS 7.5' Quad: South Barrel Spring.
Location: Bluffs above Windmill Draw ca 4 air miles north of Courthouse Butte, ca 24.5 miles south of Wamsutter, ca 24 air miles northwest of Baggs [ca 3.25 miles west of the Carbon County line].
Comments: This is the only population known from the Washakie Basin and was first discovered by B.E. Nelson in 1996 (Ward *et al.* 1998). The specimen has been sent to Duane Atwood for verification.

III. Overthrust Belt

Occurrence # 004 (2 subpopulations?).
County: Lincoln.
Legal Description: **T21N R114W S26** (N2 of NE4 of NW4).
Latitude: 41° 46' 35" N.
Longitude: 110° 18' 53" W.
Elevation: 6900 ft. (2100 m).
USGS 7.5' Quad: Opal.
Location: Ridge due north of Opal, ca 0.3 miles north of US Highway 30 and ca 0.5 miles east of WY Highway 240.
Comments: Population contains robust, gray-cinereous plants corresponding with "var. *deserta*" and gland-rich, green plants fitting var. *glandulosa*. This occurrence includes Payson and Armstrong's vague 1923 collection from "between Opal and Kemmerer".

IV. Ambiguous, Historical Reports

A. Sweetwater County: Green River Basin: "Green River".
Comments: Based on Aven Nelson's vague type locality (# 3050) which is distinctly non-glandular.

B. Sweetwater County: Rock Springs Uplift: "hills east of Superior" [northeast of Rock Springs].
Comments: Based on an August 1936 collection by Marion Ownbey (# 1108) which may actually represent var. *glandulosa*.

C. Sweetwater County: Rock Springs Uplift: "near Rock Springs".
Comments: Based on ambiguous July 1925 collection by Edwin and Lois Payson (# 4311).

D. Sweetwater County: Green River Basin: "Henry's Fork".
Comments: Ambiguous June 1901 collection by Leslie Goodding (# 1191) which may represent var. *glandulosa*.

E. Sweetwater County: Red Desert Basin: "top of bluff 6 miles south of Red Desert" [probably Delaney Rim south of town of Red Desert, south of Interstate 80].
Comments: Based on a July 1936 collection by R. Lang (# 11), which may represent var. *glandulosa*.

E. HABITAT

1. ASSOCIATED VEGETATION: *Phacelia glandulosa* "var. *deserta*" is found primarily on semi-barren south or west-facing upper slopes of gray clay shale covered by fragments of bleached slate in cushion plant and bunchgrass communities dominated by turpentine spring-parsley (*Cymopterus terebinthinus*), Hooker's sandwort (*Arenaria hookeri*), thrift goldenweed (*Haplopappus armerioides*), bearded wheatgrass (*Elymus trachycaulus*), and Indian ricegrass (*Oryzopsis hymenoides*) (Figure 4).
Less frequently, desert glandular phacelia may occur on whitish, chalky-limey slate openings locally dominated by moss phlox (*Phlox muscoides*), tufted cryptantha (*Cryptantha caespitosa*), and Hooker's sandwort, or within small stands of shadscale (*Atriplex confertifolia*). Total vegetative cover in these communities ranges from 5-30%.

   Small populations of *P. glandulosa* var. *deserta* are occasionally found in semi-barren openings within a matrix of shadscale, green rabbitbrush (*Chrysothamnus viscidiflorus*), and greasewood (*Sarcobatus vermiculatus*) with low cover of cushion species. One occurrence is also found in a mixed mountain mahogany (*Cercocarpus montanus*)-shadscale community on limey clay shale soils with an understory of moss phlox and false sagebrush (*Sphaeromeria capitata*). Otherwise, desert glandular phacelia is mostly absent from shrub dominated sites, including sagebrush grasslands, Gardner's saltbush (*Atriplex gardneri*) clay barrens, and Utah juniper (*Juniperus osteosperma*) woodlands. Occasionally, plants can be found along abandoned two-tracks composed of reddish or gray slate fragments.

   An unusual population of *P. glandulosa* from just north of Opal occurs on conglomerate covering a bench of dark gray clay-shale dominated by low cushion plants and scattered *Atriplex*. This occurrence appears to contain both var. *deserta* and var. *glandulosa*. Other populations of typical *glandulosa* in southwestern Wyoming are found on sparsely vegetated brown sandy clay slopes covered by brown sandstone flakes, gray clay badland ridges, or white chalky knolls.

2. FREQUENTLY ASSOCIATED SPECIES:

   Arenaria hookeri (Hooker's sandwort)
   Astragalus jejunus var. *jejunus* (Starveling milkvetch)

Figure 4 (page 17). Habitat of *Phacelia glandulosa* "var. *deserta*" on barren slopes of whitish bleached shale and slate fragments of the Green River Formation (center of photo) on the south slope of White Mountain north of Interstate 80 near "Kanda" (Sweetwater County, Wyoming). WYNDD photograph by W. Fertig, 18 June 1998.

Astragalus spatulatus (Spoonleaf milkvetch)
Atriplex confertifolia (Shadscale)
Chrysothamnus viscidiflorus (Green rabbitbrush)
Cryptantha caespitosa (Tufted cryptantha)
Cryptantha sericea (Silky cryptantha)
Cymopterus terebinthinus (Turpentine spring-parsley)
Elymus trachycaulus (Bearded wheatgrass)
Eriogonum brevicaule (Shortstem wildbuckwheat)
Haplopappus armerioides (Thrift goldenweed)
Haplopappus nuttallii (Nuttall's goldenweed)
Ipomopsis congesta (Ballhead gilia)
Linum lewisii (Blue flax)
Oryzopsis hymenoides (Indian ricegrass)
Phlox muscoides (Moss phlox)
Physaria acutifolia (Sharp-leaved twinpod)
Senecio canus (Woolly groundsel)
Stanleya viridiflora (Desert plume)
Thelypodiopsis elegans (Elegant thelypody)

In addition to these common species, *Phacelia glandulosa* "var. *deserta*" may also occur with several rare species, including *Thelesperma caespitosum* (Green River greenthread, G1/S1), *Lesquerella macrocarpa* (Large-fruited bladderpod, G2/S2), and Payson's beardtongue (*Penstemon paysoniorum,* G3/S3) (Fertig 1998).

3. TOPOGRAPHY: *Phacelia glandulosa* var. *deserta* typically occurs on upper slopes of barren clay-shale ridges (Figure 5). Plants may occur on all aspects, but are most commonly associated with south and west-facing slopes. This taxon is usually found on concave slopes of 10-20%, but occasionally may also occur on flat-topped ridgecrests. Known occurrences range in elevation from 6040-7500 ft (1840-2285 m).

4. SOIL RELATIONSHIPS: Desert glandular phacelia is found primarily on grayish shale clay soils covered by bleached, grayish white to brownish limey slate fragments derived from the Eocene Green River Formation (Love and Christiansen 1985). Bare soil and rock typically account for 60-95% of the total cover at these sites. Most of these soils are entisols or weakly developed aridisols. The population near Opal occurs on conglomerates and gray claystones of the Bridger Formation. The purported Ross Butte populations are found mostly on loose, gray clay-shale with sparse or no surface rock cover derived from Eocene age river deposits.

Figure 5. Topographic position of *Phacelia glandulosa var. deserta* on the landscape. Illustration by W. Fertig from Occurrence # 005 at the south end of White Mountain 1.4 miles northwest of Kanda.

5. REGIONAL CLIMATE: In Wyoming, the average annual precipitation within the range of *Phacelia glandulosa* var. *deserta* varies from 8-10 inches (20-25 cm). Average annual temperature ranges from 40-42º F (4.4-5.5º C). Mean minimum and maximum temperatures in January are 4-6º F (-15.5 to -14.4º C) and 28-32º (-2.2 to 0º C), while in July mean minimum and maximum temperatures are 48-50º F (8.9 to 10º C) and 84-86º F (28.9 to 30º C) (Martner 1986).

6. LOCAL MICROCLIMATE: Desert glandular phacelia typically grows on light-colored, sparsely vegetated substrates that may be hotter and drier than the regional climate would suggest.

F. POPULATION BIOLOGY AND DEMOGRAPHY

1. PHENOLOGY: Flowering and fruiting occurs from mid June to late August (Atwood 1975).

2. POPULATION SIZE AND CONDITION: Eight extant occurrences of "var. *deserta*" are currently recognized in southwest Wyoming, consisting of about 30 subpopulations. Nearly all of these colonies contain mixed populations of glandular and non-glandular plants. Six of the extant occurrences were surveyed in 1997 and 1998 (the remaining two occurrences were discovered between 1995-96, but have not been formally censused). The total population at these six sites is estimated at 6900-9500 individuals in a total area of at least 53 acres (Table 2). These figures are probably conservative, given the amount of additional potential habitat on unsurveyed private lands and landlocked BLM lands in the Green River area.

   Individual colonies of *P. glandulosa* var. *deserta* range in size from 10 to 500 individuals in patches of 0.5 to 3 acres. Populations consist primarily of small clumps or widely scattered individuals restricted to somewhat patchy microsites. Density may be as high as 8-12 plants per square meter in favorable sites, but is more typically 1-3 plants per square meter. Populations observed in 1998 usually consisted of a mix of size and age classes, including large flowering or fruiting plants, smaller vegetative individuals and first-year seedlings.

   Long-term trend data are not available for most populations of desert glandular phacelia, although populations have been known from the Green River and Opal areas since the 1890s and 1920s. Due to uncertainties in the taxonomic status of surveyed populations, no permanent demographic monitoring plots were established in 1998. Suitable sites for monitoring include the south end of White Mountain (Occurrence # 005) and slopes along Wilkins Peak (Occurrence # 006).

Table 2. Demographic information for Wyoming populations of *Phacelia glandulosa var. deserta*

Occurrence # 001
Area: ca 5 acres.
Number of Plants: Population estimated at 500-1000 plants in 1998, although most of these may represent var. *glandulosa*. Individual colonies range in size from 10 to 400 plants.
Density: Patchy, occurring in widely scattered clumps.
Evidence of Reproduction: Observed in flower in 1994 and 1998.
Evidence of Expansion/Contraction: *P. glandulosa* was first documented at this site by Tom Cramer in 1994. Additional colonies have been observed by Steve Laster and W. Fertig in 1997 and 1998. Field observations in 1998 suggest that these populations represent var. *glandulosa*. Populations are probably stable at present.

Occurrence # 002
Area: Not known.
Number of Plants: Not reported.
Density: Not known.
Evidence of Reproduction: Observed in flower in 1995.
Evidence of Expansion/Contraction: Population was first discovered by B.E. Nelson in 1995 (Refsdal 1996).

Occurrence # 003
Area: Not known.
Number of Plants: Not known.
Density: Not known.
Evidence of Reproduction: Observed in flower and fruit in 1996.
Evidence of Expansion/Contraction: Population discovered in 1996 (Ward *et al.* 1998).

Occurrence # 004
Area: 3 acres.
Number of Plants: Population estimated at 250-500 and observed to be "locally abundant" in 1998.
Density: Plants clustered.
Evidence of Reproduction: Observed in flower in 1987 and 1998.
Evidence of Expansion/Contraction: Population has been known since at least 1987 and possibly since 1923 (if Payson and Armstrong's specimen from "between Opal and Kemmerer" is from this site.

Occurrence # 005
Area: 10 acres.
Number of Plants: 600-800 plants observed in 1998.
Density: Scattered to clustered, with densities as high as 7-15 plants in favorable microsites (usually lower).
Evidence of Reproduction: Observed in flower in June 1998.
Evidence of Expansion/Contraction: This occurrence may represent Nelson's 1897 type locality. It was last surveyed in 1998.

Occurrence # 006
Area: 30 acres.
Number of Plants: Total population estimated at 5050-6550 plants in 14 small to medium-sized colonies in 3 main locations in 1998.
Density: Sparse to locally clustered, with densities of 5-12 plants per square meter in favorable microsites (1-3 plants per square meter in less suitable areas).

Evidence of Reproduction: Observed in flower and vegetative condition in 1998.
Evidence of Expansion/Contraction: Population was discovered in 1998.

Occurrence # 007
Area: 3 acres.
Number of Plants: 500-600 plants estimated in 1998 survey.
Density: Clumped.
Evidence of Reproduction: Observed in flower and fruit in July 1998.
Evidence of Expansion/Contraction: Population discovered in 1998, although specimens from the same general area were found in 1994 and attributed to var. *glandulosa*.
Occurrence # 008
Area: ca 2 acres.
Number of Plants: 10 plants observed at one of two colonies in 1997.
Density: Widely scattered.
Evidence of Reproduction: Observed in flower and vegetative condition in August 1997.
Evidence of Expansion/Contraction: Populations discovered in 1997, although specimens from the same general area were found in 1994 and attributed to var. *glandulosa*.

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3. REPRODUCTIVE BIOLOGY:

a. TYPE OF REPRODUCTION: *Phacelia glandulosa* var. *deserta* reproduces entirely by seed. Although plants may have multiple branches, it is not known to spread vegetatively.

b. POLLINATION BIOLOGY: This species is pollinated by a variety of small to mid-sized bees and flies that are attracted by the plant's colorful flowers, glandular hairs, or strong odor. At least four different types of pollinators were observed in 1998, including a large bumblebee with an orange abdomen, wasp-like flies, mid-sized bees with numerous black and white stripes on the abdomen, and green glossy bees. Pollinators were most numerous from late morning to early afternoon (11 AM to 2 PM).

c. SEED DISPERSAL AND BIOLOGY: The seeds of *Phacelia glandulosa* have a rough surface of reticulated pits which may facilitate dispersal by wind or animals. No data are available on the biology of seedlings, or the longevity of seeds in the seed bank.

G. POPULATION ECOLOGY

1. GENERAL SUMMARY: *Phacelia glandulosa* var. *deserta* occurs primarily on semi-barren upper slopes of whitish shale-clay covered by bleached slate fragments derived from the Green River Formation. Most populations occur in sparsely vegetated cushion plant-bunchgrass communities

or with scattered shadscale, green rabbitbrush, and mountain mahogany in openings within denser shrub vegetation. Populations consist of small patches or widely scattered clumps, with densities ranging from 1-3 in marginal habitat to 7-15 in favorable microsites. Populations studied in 1998 consisted of a mix of size and age classes, suggesting that adequate reproduction is occurring.

2. COMPETITION: This taxon is mostly restricted to sparsely vegetated openings with low cover, suggesting that it is intolerant of shading or does not compete well with other species.

3. HERBIVORY: Little evidence of herbivory by livestock or native grazers was observed on stems and foliage of desert glandular phacelia during 1998 surveys. The sticky pubescence and strong aroma of this species probably makes it of low palatability to most herbivores. Seeds and fruits may suffer some herbivory by insects and rodents.

4. HYBRIDIZATION: Numerous plants with pubescence characteristics intermediate between typical var. *glandulosa* and var. *deserta* were observed during 1998 surveys. Such individuals may reflect hybridization or introgression between sympatric populations of these two varieties, or reflect incomplete genetic and morphologic differentiation. No evidence of hybridization between *P. glandulosa* and other *Phacelia* species has been observed.

H. LAND OWNERSHIP

1. BLM: Six occurrences of "var. *deserta*" are found on lands managed by the BLM Rock Springs District (Pinedale, Kemmerer, and Green River resource areas) and one population is found in the Rawlins District (Great Divide Resource Area). All of these populations are on lands managed for multiple use, although the Ross Butte population is within the potential Ross Butte Special Management Area (Fertig 1998; Fertig *et al.* 1998).

2. US FOREST SERVICE: One occurrence (# 002) is found in Flaming Gorge National Recreation Area, managed by Ashley National Forest.

3. STATE: Occurrence # 008 may extend onto state lands on the east side of US Highway 191 (near the rest area).

IV. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

A. POTENTIAL THREATS TO CURRENTLY KNOWN POPULATIONS: A small geographic range and high habitat specificity makes this taxon potentially vulnerable to extirpation. The following potential threats were observed in 1998 field surveys:

1. RECREATION: Much of the habitat of "var. *deserta*" is readily accessible or already used for off-road vehicle (ORV) recreation. Intensive use can result in direct mortality to plants through physical damage or indirect mortality through enhanced soil erosion and increased spread of exotics into disturbed sites. All populations on BLM lands are in areas open to off-road vehicle recreation, although this use technically is confined to existing roads and trails.

2. EXOTIC PLANTS/WEED CONTROL: Competition from exotic plants may be a threat at some sites, especially near two-tracks or pipeline routes. This species could be sensitive to broad-leaf herbicides used for weed control.

3. GRAZING: Most of the habitat of desert glandular phacelia is within active cattle grazing allotments. Although evidence of dried dung was commonly found, no plants were observed with grazing or trampling damage from livestock in 1998. *P. glandulosa* var. *deserta* habitat appears to receive minimal use due to the lack of surface water, minimal forage, and rugged conditions.

4. MINERAL DEVELOPMENT: The entire range of var. *deserta* on BLM lands is open to mineral exploration and development. Populations at Ross Butte and in the Green River area occur within crucial big game winter range where mineral development may be constrained by seasonal use stipulations (USDI Bureau of Land Management 1987, 1997). Parts of the range of this species may also contain trona and coal deposits. The Opal population (Occurrence # 004) is in the vicinity of a major pipeline corridor (USDI Bureau of Land Management 1986).

B. MANAGEMENT PRACTICES AND RESPONSE: No experimental data exist on the response of this taxon to management actions.

C. CONSERVATION RECOMMENDATIONS

1. RECOMMENDATIONS REGARDING PRESENT OR ANTICIPATED ACTIVITIES: The development of additional and unplanned two-tracks and roads should be discouraged within the range of *Phacelia glandulosa* var. *deserta* to protect populations from physical damage and soil loss. The location of access roads and drill pads for mineral development should avoid steep slopes and rim areas occupied by this species. Water tanks and salt blocks should not be located in areas of occupied habitat.

2. AREAS RECOMMENDED FOR PROTECTION: Populations at Ross Butte, Logan Draw, and along Flaming Gorge Reservoir (Blacks Fork area) have been recommended for consideration as special management areas due to the

presence of this and other rare plant and animal species (Fertig 1998; Fertig *et al.* 1998).

D. STATUS RECOMMENDATIONS: The uncertain taxonomic status of *Phacelia glandulosa* var. *deserta* makes concrete status recommendations premature. Evidence from field and herbarium studies strongly suggests that this taxon may not be completely distinct from the more widespread and common var. *glandulosa*. More thorough systematic studies employing modern genetic and molecular techniques could shed valuable light on this taxonomic problem. If var. *deserta* should prove to be sufficiently distinct, it would warrant listing as Sensitive by the BLM state office and could be a candidate for protection under the Endangered Species Act. Additional surveys in the Green River area and intensive monitoring of known sites would then be justified, as well as other proactive conservation measures, such as development of an off-site seedbank and greater protection from surface disturbing activities. If, however, this taxon were shown to be only a minor variant of var. *glandulosa*, no special conservation efforts would need to be undertaken and var. *deserta* would not warrant Sensitive status.

V. SUMMARY: Desert glandular phacelia (*Phacelia glandulosa* var. *deserta*) is either a sparsely pubescent variant of the more widespread *P. glandulosa*, or a locally endemic taxon restricted to southwestern Wyoming. Eight populations of "var. *deserta*" are currently recognized, although several of these may actually represent populations of var. *glandulosa*, or a mixture of both taxa. Surveys in 1997-98 documented 6900-9500 individuals, mostly in the Green River/Rock Springs area, Opal, Ross Butte, and one site in the Washakie Basin. Var. *deserta* is found primarily in cushion plant/bunchgrass communities on sparsely vegetated slopes of whitish clay covered by bleached fragments of limey-slate of the Green River Formation or conglomerate derived from the Bridger Formation. Individual colonies are often small and consist of clumped or widely scattered plants. All known occurrences are on public lands managed for multiple use by the BLM or Flaming Gorge National Recreation Area. Populations are potentially threatened by compaction and soil loss from heavy off-road vehicle use and surface disturbances associated with mineral development. Implementation of management strategies for this plant should be contingent on biosystematic studies that confirm or reject the validity of "var. *deserta*" as a distinct taxon.

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Appendix A.

Element Occurrence Records and Population Maps

for *Phacelia glandulosa var. deserta*

Appendix B.

1998 Survey Routes

Appendix C.

Slides