ES

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April 26, 2005

Matthew Hogan
Acting Director
U.S. Fish and Wildlife Service
U.S. Department of the Interior
1849 C Street, NW
Washington, DC 20240

And

Gale Norton
Secretary of the Interior
U.S. Department of the Interior
1849 C Street, NW
Washington, DC 20240

Dear Acting Director Hogan and Secretary Norton:

Enclosed please find a formal petition to list the DeBeque phacelia (*Phacelia submutica)* as threatened or endangered within its known historic range, pursuant to Section 4 of the Endangered Species Act (16 U.S.C. 1531 et seq.). This petition is being submitted by Center for Native Ecosystems, The Colorado Native Plant Society, and botanist Steve O'Kane. This petition is filed under 5 U.S.C. 553(e) and 50 C.F.R. 424.14 (1990).

We understand that this petition sets in motion a specific process, with specific time constraints, placing specific response requirements on the U.S. Fish and Wildlife Service, including a letter confirming receipt of the petition. Thank you for your consideration of this matter.

Sincerely,

Joshua Pollock
Policy Director

Cc: Ralph Morgenweck, Region Six Director, U.S. Fish and Wildlife Service


U.S. FISH & WILDLIFE SERVICE
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REGIONAL DIRECTOR
DENVER, COLO.

PETITION TO THE SECRETARY OF THE

UNITED STATES DEPARTMENT OF THE INTERIOR AND

THE DIRECTOR THE OF U.S. FISH AND WILDLIFE SERVICE

CENTER FOR NATIVE ECOSYSTEMS, COLORADO NATIVE PLANT SOCIETY, and STEVE L. O'KANE, Jr., Ph.D. Petitioners, and GALE NORTON, SECRETARY OF THE DEPARTMENT OF INTERIOR, Respondent, and MATTHEW HOGAN, ACTING DIRECTOR OF THE U.S. FISH AND WILDLIFE SERVICE, Respondent	PETITION TO LIST DEBEQUE PHACELIA (*PHACELIA SUBMUTICA*) AS THREATENED OR ENDANGERED AND DESIGNATE CRITICAL HABITAT UNDER THE ENDANGERED SPECIES ACT (16 U.S.C. § 1531, *ET SEQ.*)

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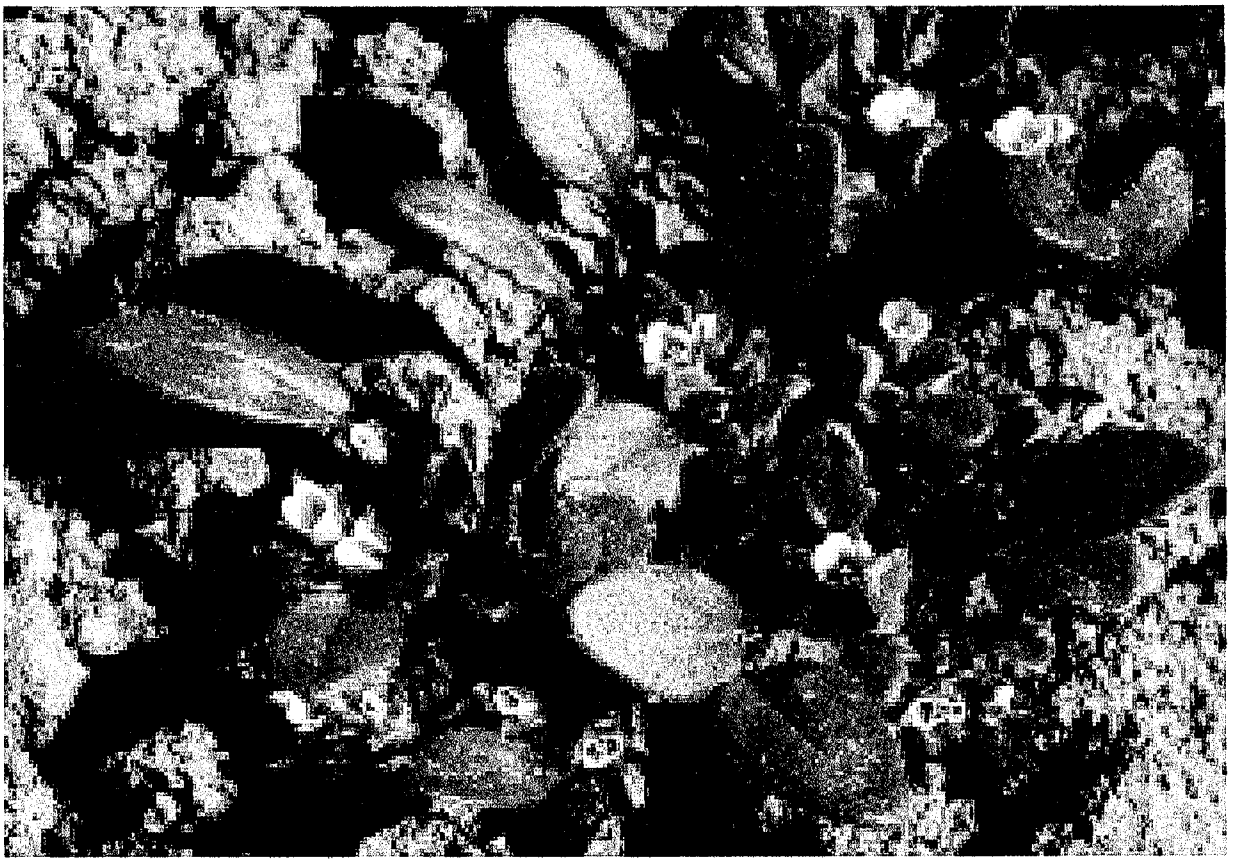
Figure 1: Photograph of DeBeque phacelia (*Phacelia submutica)*
--(courtesy of B. Jennings)



I. INTRODUCTION

DeBeque phacelia (*Phacelia submutica* Howell) is a narrowly distributed annual wildflower that shows dense clumps of cream and yellow tube-shaped flowers in the spring. Living in only a small portion of western Colorado, the plant's habitat is rapidly being degraded. Despite broad recognition that this species needs protection, especially given the rapid pace of oil and gas drilling and increasing off-road vehicle use throughout its habitat, the plants lack any security against extinction. This rare wildflower has yet to receive the protection necessary for its survival.

This petition and accompanying materials provide substantial scientific and commercial information establishing that DeBeque phacelia meets the requirements for listing under the Endangered Species Act (ESA), and requires ESA protection to prevent its extinction and ensure its persistence. We consider every document cited in this petition as well as those cited in the References section to be part of the petition, and copies are available on request.

Current threats from oil, gas, and mineral extraction, noxious weeds, roads, recreation, livestock, and climate change, combined with the rarity of the plant and its specific life history characteristics, point to a clear need to protect this plant under the ESA. All but a handful of the occurrences of the species occur wholly on Bureau of Land Management (BLM) lands already leased for oil and gas development; none of these leases contain strict protections for BLM Sensitive species such as this one. Of the remaining occurrences, most are on private land owned by oil and gas companies.

DeBeque phacelia has been listed by the U.S. Fish and Wildlife Service as a candidate for protection under the Endangered Species Act for twenty five years now, clearly indicating that sufficient information already exists to qualify the species for protection. In addition, DeBeque Phacelia has been given formal biological status review several times over the past twenty years (1987, 1995, 2003), and in each case researchers noted the extreme vulnerability of this species to disturbance, given its specific life cycle, as well as the presence of many imminent threats to its survival. Now, most if not all of those threats have become reality, and the plant faces a high likelihood of extinction in short order.

Petitioners thus submit this petition to the Secretary of the Interior (Secretary) and the Service pursuant to the ESA (16 U.S.C. § 1531, *et seq.*), its implementing regulations including those for listing (50 C.F.R. § 424), and the Administrative Procedures Act (5 U.S.C. § 553), requesting that Secretary take the two following actions: (1) list DeBeque phacelia as threatened or endangered, and (2) designate critical habitat concurrent with the listing. This petition is filed under 5 U.S.C. § 553(e), 16 U.S.C. § 1533(b)(3)(A) and 50 C.F.R. § 424.19 (1987) which gives interested persons the right to petition for issuance of a listing rule. Petitioners look forward to receiving a formal acknowledgment of the Secretary's receipt of the petition and, within 90 days, the Secretary's preliminary finding regarding this petition.

II. PETITIONERS

Center for Native Ecosystems (CNE) is a non-profit advocacy organization dedicated to conserving and recovering native and naturally functioning ecosystems in the Greater Southern Rockies. CNE values the clean water, fresh air, healthy communities, sources of food and medicine, and recreational opportunities provided by native biological diversity. CNE also passionately believes that all species and their natural communities have the right to exist and thrive. CNE uses the best available science to forward its mission through participation in policy, administrative processes, legal action, public outreach and organizing, and education. The sage-steppe ecosystems of northwestern Colorado, northeastern Utah, and southern Wyoming, sometimes known as the Great Divide Ecoregion, are a conservation priority for CNE and its members. The region is rich in biological diversity and is home to imperiled native species such as the white-tailed prairie dog and sage grouse. The area of the Colorado River Valley near the town of DeBeque and the Roan Plateau, where DeBeque phacelia is found, are both key components of the Great Divide Ecoregion. DeBeque phacelia is one of many native species in these areas facing severe threats from oil and gas drilling, inappropriate livestock grazing, off-road vehicle use and other activities. In fact, another narrowly endemic wildflower species whose range overlaps almost exactly with DeBeque Phacelia, is facing similar threats and has recently been proposed for listing.

The Colorado Native Plant Society (CoNPS) is dedicated to the appreciation and conservation of the Colorado native flora. *Phacelia submutica* is a regional endemic that CoNPS has long had significant concerns about due to its limited global range and very high level of threat. CoNPS members include botanists who have observed this plant in the wild numerous times, and who intend to observe it again in the future. The small area around the town of DeBeque and the base of the Roan Plateau which supports this regional endemic is threatened by oil, gas, and mineral extraction, and CoNPS believes it is imperative that *Phacelia submutica* receive federal protection so that the species and its habitat will be preserved for now and the future.

Steve O'Kane, Jr., Ph.D. wrote the original status review for *Phacelia submutica* in 1987 after completing survey work for the Colorado Natural Areas Program. Steve has been conducting field surveys in Colorado and the American West since 1978 and is currently working on the Flora of the Four Corners Region Project in collaboration with botanists from throughout the United States. As a professional botanist, Steve has a strong interest in rare flora, including *Phacelia submutica.* After earning a Master's degree in Botany from Colorado State University in 1984, he completed a Doctorate in Evolutionary and Population Biology from Washington University at St. Louis in 1993. Currently Steve is an Associate Professor at the University of Northern Iowa with primary research interests in Floristics and Plant Systematics and Evolution, and has published many botanical articles in periodicals such as Taxon, Systematic Botany, Annals of the Missouri Botanical Garden, Harvard Papers in Botany, and Novon. Steve believes it is critical that *Phacelia submutica* receive federal protection to ensure it will not be fully extirpated by the rapid expansion of oil and gas drilling in its habitat.

III. DEBEQUE PHACELIA ECOLOGY AND LIFE HISTORY

A. Taxonomy: DeBeque phacelia is a very narrowly endemic, monotypic species

DeBeque phacelia was described by John Thomas Howell in 1944 from a collection made by George Osterhout in 1911. Osterhout identified it as *Emmenanthe* scopulina A.Nels (Holotype and isotype specimens: No.4458 in Rocky Mountain Herbarium, University of Wyoming; isotype specimen No.4458 at the University of Colorado -Boulder Herbarium). Ladyman (2003) reports that

> Osterhout also collected a specimen (no.4726) identified as *E.scopulina* from the type locality, again just describing it as from DeBeque in Mesa County, on June 22, 1912 (specimen at University of Colorado –Boulder Herbarium). It was thus named Debeque phacelia because it was originally found near, or perhaps within, the town of DeBeque.

Rupert Barneby collected the species again in 1955, and William A. Weber collected it in 1965 (O'Kane 1987). It is in the Hydrophyllaceae (Waterleaf) family. The genus Phacelia contains approximately 150 species but is relatively limited geographically, with almost all Phacelia species found in western North America (Cronquist, et al. 1984, Burt and Spackman 1995).

In his initial description of the species, Howell (1944) recognized *P.submutica* as "undoubtedly closely related" to *P. scopulina* but listed 13 characteristics that clearly distinguish the two taxa. This first treatment of the plant's taxonomy has been upheld by most botanists who have written on the species subsequently (Harrington 1964, Weber 1987, and Weber and Wittman 1991, 1992). The few exceptions to this have been questioned by researchers more intimately familiar with the species in its habitat. Halse (1981) gave *P.submutica* varietal status (*Phacelia scopulina var. submutica*) that has been challenged as being incorrect (O 'Kane 1987). O'Kane points out that Halse's treatment was based on only two specimens and no first-hand field observations. Most significant, one of two specimens Halse used was almost surely incorrectly labeled (O'Kane 1987, Burt and Spackman 1995, Ladyman 2003). This specimen was collected over 100 years ago near Winslow, Arizona—well outside the known currently known range of the species—and the label on the specimen was too vague to allow it to be accurately located (O'Kane 1987). Cronquist et al. (1984) treated *P. scopulina* and *P. submutica* as two of seven varieties of *P.*lutea that they described as a "geographically significant but not wholly discrete species ". O'Kane (1987) again points out that this statement is based on "very little material and little or no first-hand experience with the taxon." He also notes, as others have since, that *P. submutica* is geographically isolated from both *P. scopulina* and *P. lutea.*

Though Natureserve tracks DeBeque phacelia as *Phacelia scopulina* var. *submutica* (Ladyman 2003), the U.S. Fish and Wildlife Service itself tracks the species as *Phacelia submutica* (U.S. Fish and Wildlife Service, 2002). So do the Bureau of Land Management (on whose land most of the occurrences of the species are found), the Colorado Natural Heritage Program, and the Colorado Natural Areas Program of Colorado State Parks. The Forest Service, which also manages a few critical occurrences, uses the name *P. submutica* in some cases but not

in all (see e.g. Ladyman 2003 and USDA Forest Service 2005). In several sources, *P. scopulina* var. *submutica* is listed as a synonym for *P. submutica* (Peterson 1982, O'Kane 1987, Burt and Spackman 1995).

There is currently no movement among botanists to change the taxonomic status of *P. submutica*; however, if a change in taxonomic status from species to variety were to be accepted by the wider scientific community, the need for this taxon's protection under the ESA and the procedure for securing this listing would remain the same, but the current consensus is that *P. submutica* is a valid monotypic species.

B. Description: DeBeque phacelia is distinct from other phacelia species

DeBeque phacelia is a small summer annual with often branching stems that lay flat on the ground surface in a disk-shaped clump (Ladyman 2003) (see Figure 1). The branches are 2-8 cm long and often a deep red color. The leaves are reddish-brown and are 5 to 15 mm long, egg-shaped or tending to be almost rectangular with rounded corners, with the bases abruptly tapering to a wedge-shaped point. The leaf margins are smooth or toothed. The stems and leaves are covered by variable numbers of straight, stiff hairs. The root is a tap-root. The very small, tube-shaped flowers are crowded and light-yellow or cream colored, often with a purple tinge (Harrington 1964). Unlike many *Phacelia* species, the stamens do not protrude beyond the petals. The elongated-egg shaped seeds are 1.5 to 2 mm long with 6 to 12 fine ridges, or corrugations. They are blackish brown and tend to be iridescent (Ladyman 2003, description after Howell 1944 and Halse 1981). Observers have noted that the "compact arrangement of stems forming a flat disk, reddish foliage, and small, densely arranged flowers" are the DeBeque phacelia's most easily identifiable characteristics in the field (Burt and Spackman 1995).

Technical descriptions of the plant are in Howell (1944), Harrington (1964), Halse (1981), Cronquist et al. (1984), and Weber and Wittman (2001). A description and photograph are published in Weber (1987) and in Colorado Native Plants Society compilation (1997). A description, photograph, and line drawing are published on the Colorado Natural Heritage Program Web site and in the Colorado Rare Plant Field Guide (Spackman et al.1997).

C. Habitat and Associated Species: DeBeque phacelia occupies clay soils of the Atwell Gulch and Shire Members of the Wasatch Formation that are relatively barren, varicolored, and saline, and it is not associated with many other species

DeBeque phacelia occupies a largely unique niche: it grows on mostly barren slopes of the clay soils of only two geologic formations, the Atwell Gulch and Shire members of the Eocene and Paleocene Wasatch Formation (Ladyman 2003, Burt and Spackman 1995, O'Kane 1987). The layer in between these two, the mostly sandstone Molina member of the Wasatch Formation, does not support the plant (Burt and Spackman 1995, O'Kane 1987), a fact which should further suggest its naturally limited range and its narrow soil type requirements (Ladyman 2003). In further limitation of its habitat, it appears that the plant avoids direct competition for light, water, and/or nutrients, so it tends to occupy only the more barren or less vegetated patches of potential habitat on the Atwell Gulch and Shire soils (Burt and Spackman 1995).

Though there are other regional endemics to the "Adobe badlands" of western Colorado and Eastern Utah, few are as specific in their habitat requirements as *Phacelia submutica*. For one thing, it only occupies slopes of soils from the Atwell Gulch and Shire members of the Wasatch Formation (see Figures 2 and 3, p. 14). The easiest way to identify these slopes is their color: they are dark charcoal gray or dark brown (Burt and Spackman 1995, Ladyman 2003). The gray soils generally do not support any other vegetation than *Phacelia submutica*, while the brown soils support a variety of native and introduced pioneer species, though *P. submutica* grows on barren patches of this soil type where other vegetation is generally lacking (Ladyman 2003, Burt and Spackman 1995). It seems to prefer moderately steep slopes and ridge tops to valley floors, though some observers have noted that individual plants seem to grow on small benches within the steeper slopes (O'Kane 1987).

These slopes are naturally highly erosive, and, due to their clay content, they have a large natural shrink-swell cycle (see Figure 3). In other words, the soil surface cracks in the sun, forming a distinct microhabitat that several observers have suggested *Phacelia submutica* may depend on (Ladyman 2003, Burt and Spackman 1995) for survival. While many individual plants of various species can actually be expelled by the shrinking and cracking of drying soils (Burt and Spackman 1995), and this does appear to occur with individuals of *Phacelia submutica*, this species is specifically adapted to this soil condition and may rely on it to allow wind-dispersed seeds to fall into the cracks and "self plant" by being buried when the cracks close up with new moisture (O'Kane 1988). In general, the brown soils of the species' habitat display smaller cracks and more vegetative cover, though *Phacelia submutica* occupies the more sparsely vegetated areas on this soil. The gray soils, with higher clay content, have very deep cracks (Burt and Spackman 1995).

Where observers reported aspect, plants have been most often observed on south, southwest, and west facing slopes, in that order. However, individuals with north, east, and northeast aspects have also been observed (Ladyman 2003). Elevational range is between 5060 and 6200 feet (Burt and Spackman 1995).

Like all of the endemics to its region, *Phacelia submutica* is adapted to withstand "wide temperature fluctuations, long dry periods, high incident light, saline and clayey soils, and soils which are extremely erosive" (Burt and Spackman 1995). Precipitation occurs evenly throughout the year with a small peak in May and October (Burt and Spackman 1995, Ladyman 2003). Cool season precipitation usually falls as snow, and thunderstorms likely account for most warm season precipitation. Because of the largely clay soils, sediment runoff from rainfall on slopes may be substantial (Ladyman 2003).

Figure 2: DeBeque phacelia habitat (slopes of barren clay are interspersed with more vegetated spots—DeBeque phacelia will grow on the more barren spots) *–(Photo courtesy of C.Scheck)*

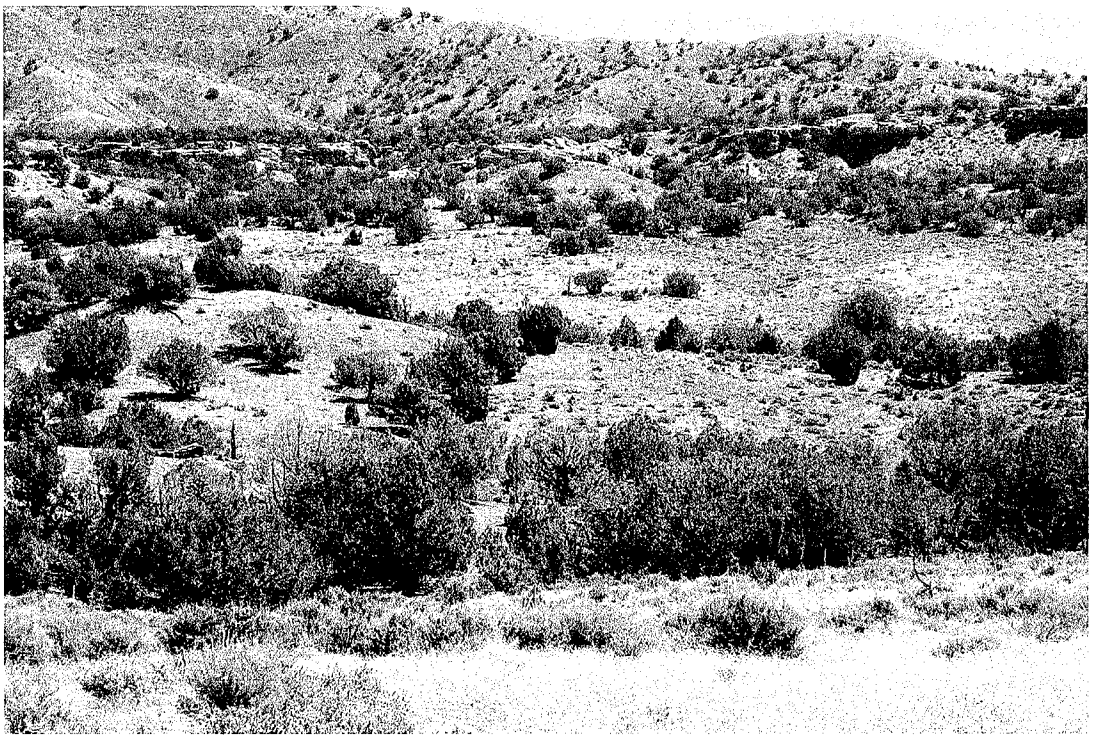


Figure 3: DeBeque phacelia habitat (within the Pyramid Rock ACEC; note the prominent shrink-swell cracks on the soil surface) *–(Photo courtesy of C.Scheck)*

Grindelia fastigiata (pointed gumweed) and *Eriogonum gordonii* (Gordon 's buckwheat) are the most frequently listed associates of *Phacelia submutica*. However, some botanists have specifically stated in occurrence records (Colorado Natural Heritage Program 2005) that *G. fastigiata* has not been observed with *P. submutica* in all locations, so reliance on associated species to identify potential habitat could be misleading (Ladyman 2003). Three other species of concern grow in *P. submutica* habitat: *Sclerocactus glaucus* (K. Schum.) Benson, listed as threatened by the U.S. Fish and Wildlife Service, *Astragalus debequaeus* Welsh, a federal candidate for listing, and *Lomatium eastwoodiae* (C.& R.) Fern (Eastwood 's desert parsley), a BLM sensitive species (Ladyman 2003).

Phacelia submutica has been described as occurring with the Rocky Mountain Forest and juniper-piñon regional vegetation types (Ladyman 2003, O'Kane 1987). Specifically, however, *Phacelia submutica* occurs only on the periphery of these needle-leaved woodland communities, where herbaceous and shrubby vegetation abuts. It is found most reliably as part of the episodical forb communities dominated by herbaceous annuals, where in general climatic conditions in any given year greatly influence the occurrence and frequency of the members of the community (O'Kane 1987, Ladyman 2003). As noted above, within these general community types, *Phacelia submutica* occupies only the particular patches of habitat where other plant species do not grow, which means its habitat is better described as barren or almost "pioneer-state" locations within these larger classifications.

Specifically, Burt and Spackman (1995) have used the terms "pioneer" and "early-successional" to describe the species, given the barren slopes it occupies. However, Ladyman (2003) points out that this description, while technically applicable, may be misleading for the layperson:

> [DeBeque phacelia] is found at sites characterized by sparse vegetative cover that likely represents a "climax "condition maintained by edaphic properties, harsh environmental factors, and occasional disturbance. Therefore, this taxon may not represent an early successional species in the classical sense but occupies a specialized ecological niche. This alternative view of the taxon may influence some human perception of its position within the community. "Early successional" suggests a taxon that is eventually replaced, whereas one that is "part of a climax community "suggests a permanence.

Regardless of the label given to DeBeque phacelia in this case, it is clear that it prefers habitat where it can avoid competition with other species by occupying locations that other plants cannot (Burt and Spackman 1995). Therefore, it "occurs in patches across the landscape" (Burt and Spackman 1995) that correspond with its narrow soil-type requirements. Burt and Spackman (1995) use the term "dynamic" to describe the changes to soil surface caused by erosion in *P. submutica* habitat. Ladyman (2003), while still noting the caveat above about the term "pioneer" to the species itself, says that "[b]ecause of the soil characteristics, susceptibility to erosion, and subsequent low vegetation cover, [*Phacelia submutica*] sites are always in a pioneer state of development." Clearly, one of the features of this species' habitat that makes it unsuitable for so many other plant species is the natural shrink-swell cycle of the clay soils.

Nearly every researcher who has studied this plant in its habitat has noted that it appears "well adapted to the shrink-swell feature of the soil that tends to expel plants that grow on them" (Ladyman 2003). Given the severity of the conditions on the sites this species occupies, O'Kane (1987) notes that "...endemic species, including *P. submutica*, add significantly to the biological diversity of the nearby barren substrates on which they are found."

Within the species' range and within the stretches of possible habitat found in that range, *Phacelia submutica* seems to be even patchier than its narrowly restricted soil requirements would suggest. Burt and Spackman (1995) note that areas of appropriate habitat are often small – "less than one acre" and within those areas occurrences of the plant are even smaller. Ladyman (2003, with internal citations) notes

> The individuals appear to have a spatially aggregated, or patchy, distribution even within suitable habitat. For example, ostensibly suitable habitat was estimated to be 40,000 sq. ft., but only four plants were found in one small (25 sq. ft.) area. At another occurrence only one plant was seen in a "large area of potential habitat." Potential habitat has not been critically defined and may be loosely described as that habitat, which from casual observation, appears to be suitable for the species but is not occupied by it. Areas occupied by contiguous occurrences tend to be small, less than 5 acres, except for the Pyramid Rock population that has been delineated to occupy approximately 160 acres (Burt and Spackman 1995). However, even within this area *P. scopulina* var. *submutica* occurs sporadically, only occupying small patches of habitat (O 'Kane 1987)... Even though interaction is expected between many occurrences, it is not known to what extent some patches are genetically isolated. Occurrence reports indicate that potential habitat is found within a patchwork of unsuitable habitat and individuals tend to be found in aggregated patterns within areas of potential habitat.

DeBeque phacelia's seeds are small and wind dispersed; therefore, they tend not to land more than a short distance away from their source. Given this, seeds are generally not widely distributed. Therefore, this species is unlikely to occupy new habitat very quickly, certainly not quickly enough to outrun the threats it faces on its currently occupied habitat. More importantly, potential habitat is already greatly limited by the plant's narrow geologic substrate requirements. In 1995, Burt and Spackman noted that although "[y]early seaches of potential habitat will probably turn up previously undocumented occurrences of *Phacelia submutica*... new reports will not likely extend this species' range because of geologic restriction." Indeed, reports of newly discovered occurrences since then have not extended the species' range.

D. Similar species and look alikes: no species are confused with DeBeque phacelia

None of its immediate neighbors look like DeBeque phacelia, and the closest phacelia species to it are geographically distinct and can be differentiated by a number of characteristics. Ladyman (2003) writes "it is very unlikely that any other sympatric species would be mistaken for *Phacelia scopulina* var. *submutica* when it is flowering. Early in the season, when the plant is a seedling, it may be confused with many different annual species" (citing Scheck personal communication 2002). In fact, one such misidentification shows up in the Colorado Natural

Heritage Program Element Occurrence Records (CNHP 2005), but the survey that led to this element occurrence being "discovered" happened early in the season and was well outside of the known range of the species. In general, species in the *Miltitzia* section, such as *P. submutica*, are distinguished from other members of the waterleaf (Hydrophyllaceae) family by their yellowish, persistent corolla (petals) and their transversely ribbed seeds (Halse 1981).

As for *Phacelia scopulina*, the one other phacelia that the DeBeque phacelia has been associated with by taxonomists, Ladyman (2003) and Burt and Spackman (1995) offer lists of features that distinguish the two species, as first delineated by Howell (1944) and Halse (1981). They both note that *P. subutica* has generally fewer leaves and more flowers than *P. scopulina*. In addition, both note that *P. submutica*'s flowers are yellowish while *P. scopulina*'s flowers show more lavender. The seeds of *P. submutica* tend to be larger than those of *P. scopulina*, with finer, less round, and deeper corrugations on the coat. The fruiting calyx of *P. sumbutica* is 6 to 10 mm long, while it is 5 to 7 mm long on *P. scopulina*. The capsules of *P. submutica* are not or only slightly tipped, while those of *P. scopulina* end in an abrupt, slender, somewhat flexible tip. Finally, the style of *P. submutica* is 1 to 1.5 mm long and essentially hairless, with hairs only at its base, while the style of *P. scopulina* is 1 to 2 mm long with hair up one-third of its length.

E. Reproduction: DeBeque phacelia relies on its seed bank for survival

Phacelia submutica relies on a healthy bank of seeds in the soil to survive the harsh and variable conditions of its habitat. Seeds are wind dispersed (Ladyman 2003), and possibly additionally dispersed by water in runnels on the soil surface (O'Kane 1987) and/or insects (Ladyman 2003). Because the plant grows close to the ground, and wind-dispersed seeds tend not to travel far anyway (Silvertown 1987), its seeds do not scatter far away from their sources. This helps to partly explain the patchy nature of its distribution over areas of possible habitat, as well as the high plant density that has been observed in some locations.

Several researchers have noted how "the seed bank appears to be critical to the survival of this species" (Ladyman 2003, see also Burt and Spackman 1995). For many species that live in harsh desert or semi-arid climates, seed banks in the soil are a valuable component of their overall survival strategy. Several factors can influence the dynamics of seed banking, and Ladyman (2003) notes:

> [*Phacelia submutica*] has a well-documented temporal variation in abundance, and it is likely that seeds have a moisture-controlled dormancy (O 'Kane 1987, Burt and Spackman 1995). Spring temperatures were noted as "cold " in some years when no plants were observed, and it is quite likely that seeds also have a temperature-controlled component to dormancy (Kemp 1989). Some species of desert annuals also have some type of innate dormancy, where a fraction of the seeds remain dormant in any one season even if growing conditions are optimal. This mechanism provides protection against depletion of the seed bank in the event that successful reproduction could not be accomplished in any given year (Freas and Kemp 1983, Silvertown 1987). Seeds within the seed bank may also have a light component to dormancy control (Baskin and Baskin 1989). One can

> speculate that seeds in the seed bank respond to light introduced by the shrink-swell cracking of the substrate. This localized, often subtle, disturbance regime may be important and contribute to the patch dynamics of the species. A persistent seed bank seems to be a requirement for continued survival of this species consistent with the model of a ruderal species (Grime et al.1988). Inference of a requirement for substantial seed longevity is also supported by observations of other annuals in deserts and semi-deserts where conditions are unstable, precipitation is variable, and relatively long droughts are frequent (Moseley 1989).

In desert environments like the one *Phacelia submutica* occupies, "seeds are generally distributed near the ground surface, and seeds below 7 cm of the surface are considered lost from the seed bank" (Ladyman 2003, referencing Kemp 1989). Therefore, for any desert species that relies on its seed bank for survival, activities that disturb the top few centimeters of soil can be devastating. This is certainly true for *Phacelia submutica*, as most biologists who have studied it have noted (Ladyman 2003, Burt and Spackman 1995, O'Kane 1987).

The spatial variability of *Phacelia submutica* populations and their density likely affects its reproduction as well. Ladyman (2003) notes

> There may be an individual-density dependent aspect to successful cross-pollination, because some pollinators, such as bees, are density-dependent foragers (Geer and Tepedino 1993). Small populations of *Phacelia scopulina* var. *submutica* with few flowers separated by relatively large distances that also have few flowering plants may be pollinator limited.

Thus, though some temporal variation in population size is natural for this species, there may be some minimal threshold of population size that cannot be crossed without negatively impacting its ability to interbreed. Such genetic isolation of individual populations would likely increase the threat of genetic and environmental stochasticity, especially for a species whose natural life cycle and reproductive strategy make it inherently vulnerable to such effects in the first place. In addition, "[o]ccurrences appear to be spatially dynamic, but seed dispersal appears limited and plants may only slowly move into unoccupied habitat" (Ladyman 2003).

F. Life span: DeBeque phacelia is a short-lived annual with a widely varying population size, making it especially susceptible to extinction

DeBeque phacelia flowers from late April through June and sets fruit from mid-May through late June. Its vegetative growth probably begins in early April, and its life cycle finishes by late June to early July, so individual plants may no longer be visible after this time (Burt and Spackman 1995). Occurrence data (Colorado Natural Heritage Program 2002, as cited in Ladyman 2003) suggest that all individuals within an occurrence are at about the same stage, such as vegetative, flowering, and/or fruiting, at the same time. The average size of individuals has been reported to differ between adjacent occurrences; for example, individuals on a

particular slope were all generally bigger than those on a nearby level area. It was not clear if density could simply explain the difference (Silvertown 1987, as cited in Ladyman 2003).

As described above, *Phacelia submutica* is an annual that survives in a harsh environment by employing several survival strategies that make it especially well adapted to its habitat but also make it especially susceptible to extinction due to external, unnatural disturbances. Its growing season is necessarily short, given its climate and range. It relies heavily on its seed bank to survive years when environmental conditions further curtail its chances to reproduce successfully. Imagine a year when, in response to unfavorable environmental conditions such as a later spring thaw or colder average temperatures throughout the spring, fewer individual plants sprout. This means fewer new seeds are produced and added to the seed bank in the soil that year. This lowers the future genetic diversity within the seed bank, which increases the species' overall vulnerability to genetic stochasticity (see discussion of this threat below in Section VI,D,1,a,iii below).

In addition, *any* widespread disturbance of the soil surface across *Phacelia submutica* habitat could prevent large numbers of seeds from germinating in a future year, which could lead to dramatic and irreversible declines. If oil and gas drilling or recreational vehicle riding or overgrazing or a combination of threats led to a substantial increase in soil disturbance and compaction across the species' range, the seed bank could never recover.

Finally, the large variation in the number of individuals represented in a population in any given year could also place this species at a higher risk of disturbance and ultimately extinction. If a varying number of plants sprout during any given year, then the one-time surveys typically conducted for projects on BLM land may not locate all plants at a given location during a drought or colder year. Consequently, gas drilling platforms, roads, pipelines, and other surface-disturbing infrastructure could be sited on top of DeBeque phacelia seeds that would have otherwise germinated in a future year.

G. Geographic distribution: DeBeque phacelia is narrowly distributed near the town of DeBeque in Mesa and Garfield Counties, west-central Colorado

Only three populations of DeBeque phacelia have been found in an area less than 17 miles by 17 miles around the town of DeBeque (see Figure 4, pg. 21). It is, of course, found only in locations within those boundaries where soils formed by the particular geologic layers it is associated with are exposed. Because of these restrictions, "the geographic range of this species is unlikely to extend substantially out of the currently known region" (Ladyman 2003). Two occurrences in Garfield County on the cliffs of the Roan Plateau near Anvil Points were reported in 2002, but these have been widely understood as a misidentification (Ladyman 2003, Scheck 2005, personal comm.).

Occurrences of DeBeque phacelia can generally be divided into three "meta-populations," each containing a number of separate but related occurrences. Though it is possible to delineate areas occupied by individual occurrences, there are several reasons to think of this species instead in terms of these meta-populations. For one thing, individual occurrence

size varies widely from year to year (i.e. "In a given year a single patch of appropriate habitat may produce no individuals or it may produce several hundreds or even thousands" –Burt and Spackman 1995). For another thing, the boundaries of individual occurrences are difficult to know for certain given the variability of the size of each occurrence. As Ladyman (2003, with internal citation) notes, *Phacelia submutica* populations "are understood to be spatially dynamic, and therefore occurrences may need to be extended beyond original boundaries in subsequent years, rather than the number of occurrences being increased (Burt and Spackman 1995)." For another thing, the reproductive and genetic relationships among adjacent populations are unknown. As Ladyman (2003) points out, "[p]opulations are difficult to delineate because information on seed dispersal and pollination biology, including pollinators, is lacking. Because many of the reported occurrences may interact at some level, occurrences should not be strictly equated with populations." Finally, the natural geographic concentration and clustering of individual occurrences—clustering based on topography and proximity of slopes of exposed soils of the right types—also suggests such grouping of occurrences anyway. Many researchers who have observed this species in the field have suggested this grouping by meta-populations as well (Ladyman 2003, Burt and Spackman 1995, O'Kane 1987).

The three meta-populations proposed by O'Kane (1987) and Burt and Spackman (1995) are 1) Coon Hollow and Sulphur Gulch, 2) the area near the confluence of Roan Creek and Dry Fork, and 3) the area around Horsethief Mountain south of the Colorado River (Ladyman [2003] proposes these same meta-populations but divides Coon Hollow and Sulphur Gulch into separate populations for a total of four). Ladyman (2003) goes on to define a meta-population:

> A meta-population is defined as being composed of populations that are likely to interact in some way, for example sharing pollinators. Although some populations do not fit precisely into the prescribed meta-population boundaries, it has been suggested that distances separating the satellite occurrences are sufficiently small to support this delineation (O 'Kane 1987).

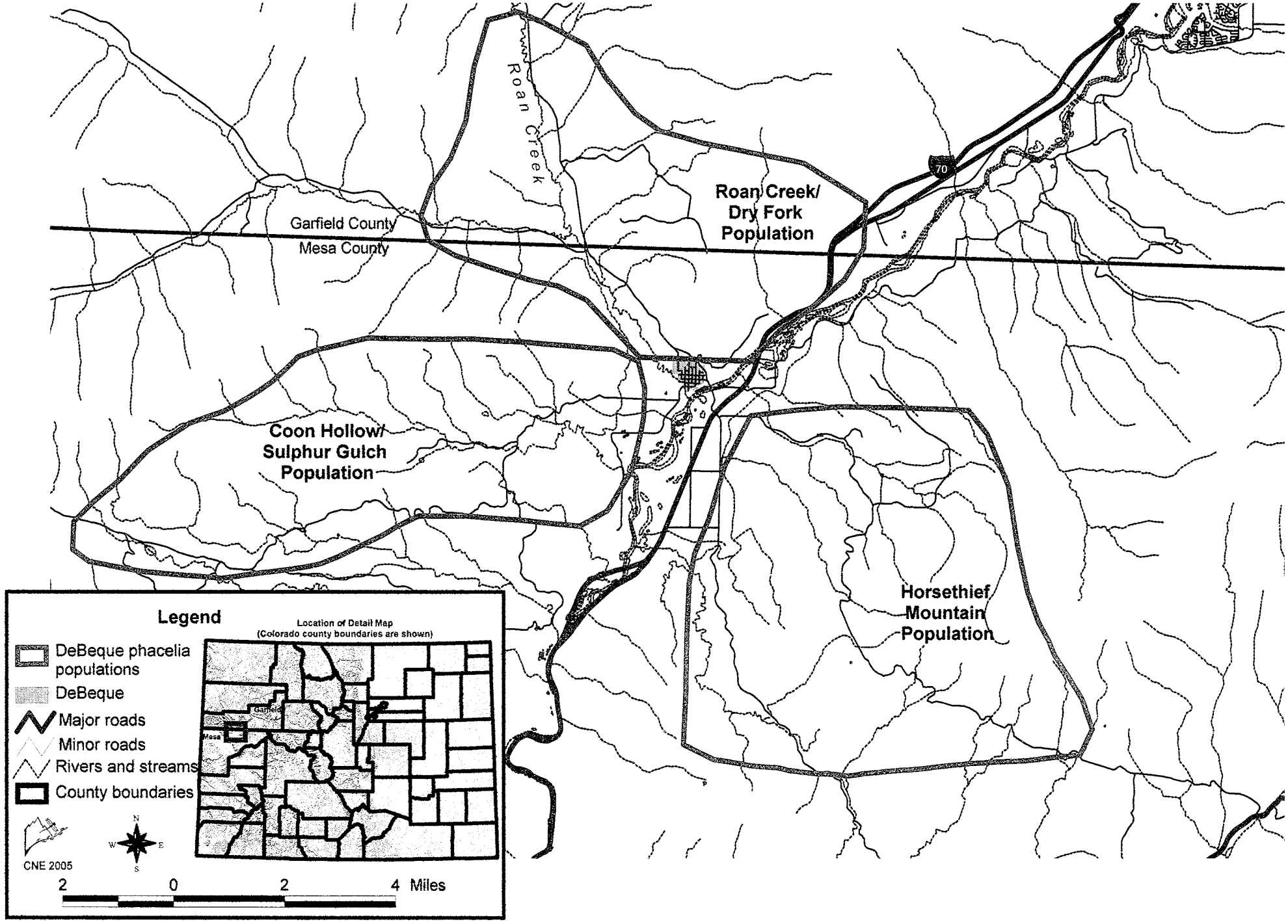
Burt and Spackman (1995) even suggest that, "[i]n terms of protection, the species should be considered to have three populations making up one meta-population."

The three populations of DeBeque phacelia are comprised of 39 specific occurrences. As described above, these occurrences are highly dynamic over both time and space. With regard to the variation from year to year, Ladyman (2003) has observed that the species:

> exhibits highly variable population sizes over time. This variability is likely due to environmental conditions that affect seed germination and seedling establishment, like precipitation. The contribution of the seed bank size and annual fecundity is unknown. In addition, the role of management practices in contributing to its variable population size has not been studied. Occurrence size varies in both number of individuals and density.

Figure 4. DeBeque Phacelia Distribution.

(Occurrences are much smaller than site locations, and are not presented here because of data sensitivity concerns.)



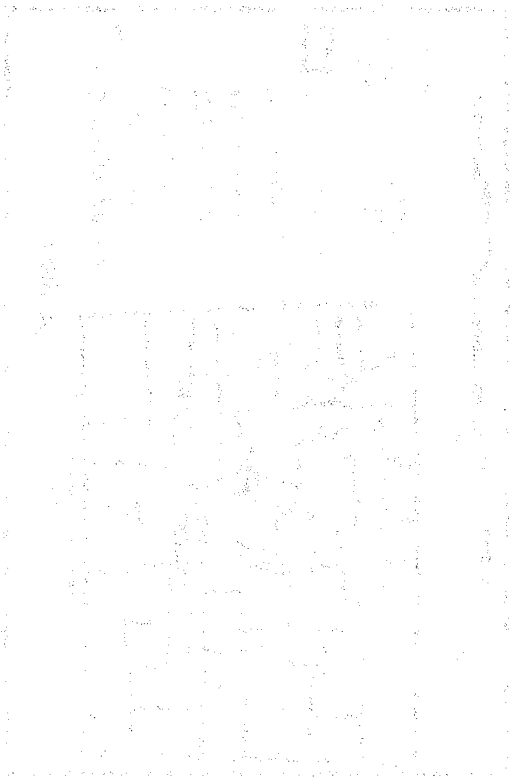
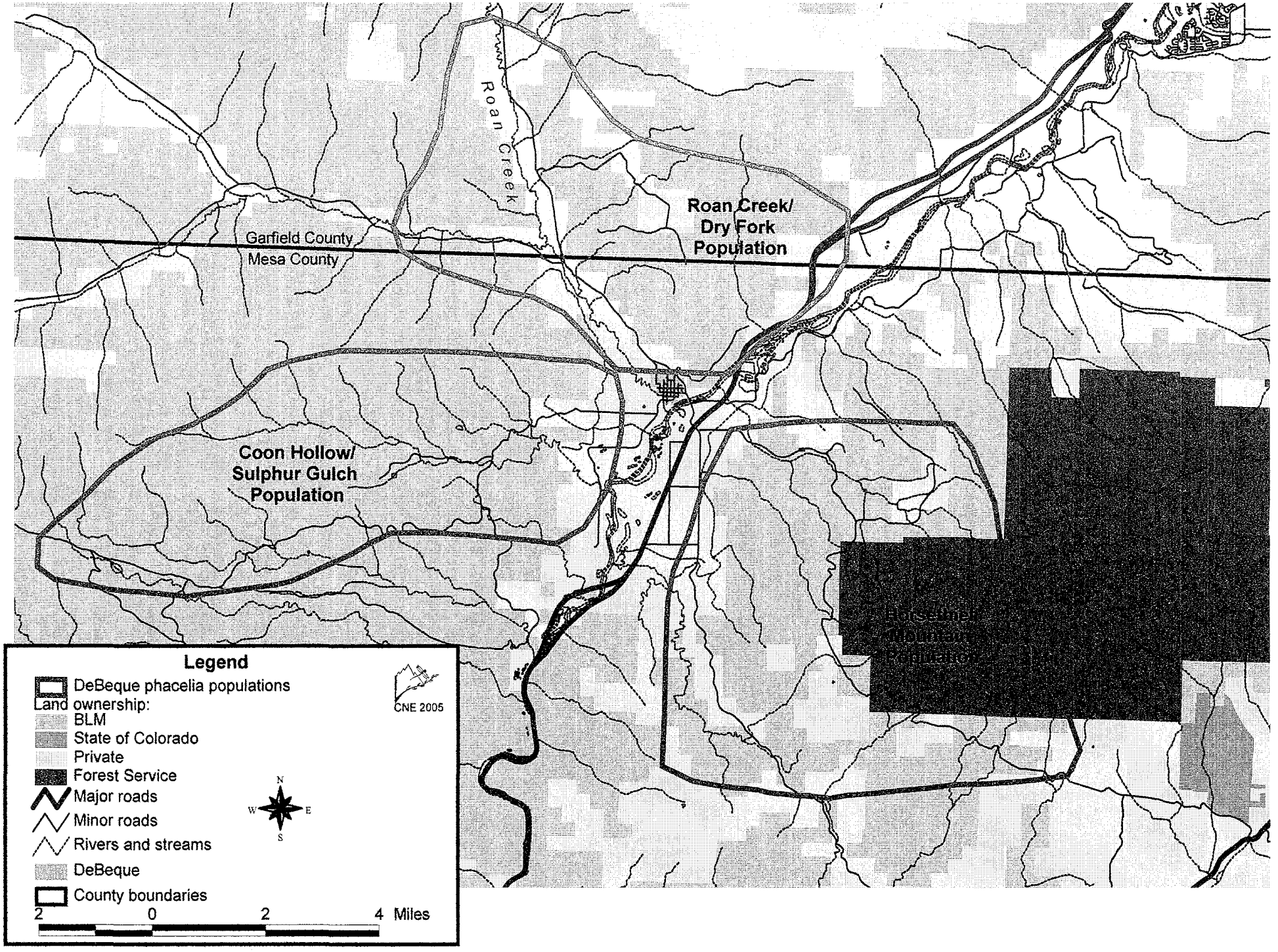


Figure 5. DeBeque Phacelia and Land Ownership.

(Occurrences are much smaller than site locations, and are not presented here because of data sensitivity concerns.)



With regard to the spatial variability of individual occurrences, two implications are pertinent. One, as noted above, is that observers and land managers may need to adjust the recognized boundaries of individual occurrences to include "newly discovered" plants, as opposed to delineating new occurrences and generating new, separate records. The second implication is that, with regard to conservation of the species, land managers must err on the side of protecting larger polygons of area around known occurrences so as to avoid unintentionally excluding suitable habitat that does in fact include a portion of the seed bank for this species.

The variation in occurrence size from year to year can indeed be large and shows up plainly in the data on specific occurrences. For example, one occurrence that has been visited multiple times exemplifies this dynamic particularly well. At this site, thirty individuals were observed in 1978, zero in 1980, 150 to 500 in 1982, and zero in both 1994 and 1995. The site was not visited from 1983 to 1993 (Ladyman 2003). Despite the potential confusion such variation could cause, the author of the most recent conservation assessment of DeBeque phacelia was unequivocal in her conclusion that the best available population data suggested a rangewide decline: "[o]bservations that have been made on several populations over the last two decades indicate a decline in abundance... Based on observations made periodically at the same sites over two or more years, the population size over its range appears to be generally in decline" (Ladyman 2003). In fact, at thirteen out of the nineteen occurrences of the species that have been visited multiple times over the years (and for which multiple years of population data therefore exists), population counts would suggest decline. Ladyman (2003, with internal citations, emphasis added) describes two locations where populations have declined:

> The population on the White River National Forest, which includes three occurrences, has been... variable, and observations also support *a characterization of general decline*. In 1986, O 'Kane reported two sites, each approximately 1 acre in size. He estimated 2,000 to 2,500 individuals occupied one of the sites in 1986. In 1991, 50 individuals and in 1992,100 individuals were observed in the same area (Colorado Natural Heritage Program 2002). However, no plants were observed in 1998 (Colorado Natural Heritage Program 2002). O 'Kane (1986) estimated 300 individuals at a second site. At this site approximately 50 individuals were observed in 1991 and only 12 in 1998 (Colorado Heritage Program records 2002)...
>
> The numbers of individuals at two populations on the BLM Glenwood Springs resource district appeared to be lower in 2003 than in the past (Scheck personal communication 2003).

The cause of this general decline can be traced to the variety of threats of soil surface disturbance that this species faces across the majority of its habitat. Ladyman (2003) notes that "[i]t is likely that some populations have been reduced in size or even extirpated where substantial disturbance and subsequent habitat modification have occurred within its restricted habitat." This habitat modification can come in almost any form that would compact, erode, or otherwise compromise the top few centimeters of soil that sustain the seed bed so critical to DeBeque phacelia's long term survival strategy. Though of course the observed downward trend

in population numbers may be influenced by the sporadic nature of the field observations made and the natural annual variation in numbers of individuals this species displays, there is still substantial cause for concern. Alteration of this species' habitat is clearly occurring—through oil and gas drilling, off-road vehicle recreation, and continued grazing—and some of its most substantial threats are growing exponentially larger right now (see section VI,A below). Given this, a species such as *Phacelia submutica* that occupies a limited range and exhibits high variability in annual population size would seem to need protection from the threats it faces. Imagine, for example, the fate of this species after a year in which few individual plants germinate, so there are fewer members of the species available to produce seeds for the future bank, and soil disturbance occurs across many or most population sites, thus compromising both the individuals that have germinated that year and the rest of the seed bank. Such a year could produce a massive decline in population sizes over the next several years, one from which the species could never recover.

Based on what is known about the narrow ecological and habitat requirements of this species, and in the absence of reliable evidence of species status from certain populations, we must look to the evidence of soil disturbance as the strongest indicator of population decline for those populations. In other words, where known populations are disturbed in certain ways that affect the viability of the seed bank, these populations *will* decline, in many cases irrevocably, and such disturbance is likely occurring at most sites where this species is found, due to a combination of oil and gas drilling, off-road vehicle riding, and livestock trampling.

Though many occurrences of DeBeque phacelia are small, all of its existing population should be preserved to the greatest extent possible. Each occurrence, regardless of its size, may be vital to the survival of a species with the particular characteristics that DeBeque phacelia possesses. In general, for rare and narrowly endemic species such as this one, with relatively small populations overall, preservation of small populations is vitally important. As Ladyman (2003, with internal citation) points out, "the value of small populations in maintaining genetic diversity should not be belittled. For example, alleles that were absent in larger populations were only found in a small population of a rare *Astragalus* (Karron et al.1988)."

DeBeque phacelia is found primarily on BLM land, though it also occurs within the White River and Grand Mesa National Forests and on a few private land holdings (see Figure 5, pg. 22). Of the eight occurrences found wholly or partly on private land, six are on land owned by the Getty Oil Exploration Company and Texaco Company (Burt and Spackman 1995). Most of this land is currently leased to ranchers. On the White River National Forest, the area occupied by DeBeque phacelia has been proposed as the Battlement Mesa Research Natural Area. On BLM land, the plant has been surveyed for and monitored sporadically at various points over the last few decades. BLM has also taken the role of steward of the species on occasion. In 1995, BLM representatives met with private landowners in the region that had *Phacelia submutica* and/or the other two associated rare plant species, *Astragalus debequaeus* and *Sclerocactus glaucus*, on their land to discuss land management practices that would minimize impacts on the species (Burt and Spackman 1995). The effects of those meetings on management practices and on the welfare of those plant species are unknown.

Surveys for DeBeque phacelia have occurred at various points over the past few decades, conducted mostly by the Colorado Natural Heritage Program in partnership with various land management agencies. The most recent substantial search for this species was in 1995, and since then only five new occurrences have been discovered, one on private land in 2002 and the rest in 2004 through surveying work done by a private contractor for a proposed Encana gas pipeline north of DeBeque and for seismic exploration south of DeBeque (Scheck personal communication, 2005). In addition to CNHP's efforts, BLM and U.S. Forest Service each have a duty to regularly survey for the plant during assessments for new projects, such as those that precipitated the discovery of the new occurrences mentioned above. Even though surveys have occurred for many projects on BLM land in the plant's range in recent years, only the five new occurrences have been discovered since the 1995 CNHP survey.

To summarize, DeBeque phacelia grows only in the area immediately surrounding the town of DeBeque, a range of less than 17 miles by 17 miles. Within this area, only three populations have been found, consisting of a total of 39 identified occurrences. The plant is patchily distributed even within the boundaries of each occurrence that has been mapped. Several experts have advocated that the plant be considered in terms of its three broader populations, for a variety of biological and conservation reasons. Experts have also noted a general decline in population sizes in recent years, and despite high natural variation in the size of each occurrence from year to year, soil surface disturbances are taking their toll in many places.

IV. SPECIFIC DEBEQUE PHACELIA SITES[1]

Most DeBeque phacelia occurrences are located in clusters where multiple occurrences are found in the same Section and/or in adjacent Sections. Throughout this petition, we follow the suggestion made by O'Kane (1987), Burt and Spackman (1995), and Ladyman (2003) that occurrences be grouped by the three broad populations.

Some problems with the occurrence data and population size estimates for *Phacelia submutica* are the age of some of the data and the infrequency with which some occurrences have been visited. According to CNHP element occurrence data, only half of the occurrences of the species have been visited more than once. More than 66 percent of them have not been relocated in ten years or more. Over half have not been visited in more than fifteen years. Just under one third of the occurrences have not been relocated in nineteen years or more, and fully fifteen percent of all occurrences have not been visited in more than twenty years.

The staleness of the surveys raises significant concerns regarding our knowledge about the status of these occurrences for a few reasons. Most importantly, this plant lives in the middle of an area that has seen a massive surge in oil and gas drilling recently. It is also in prime riding areas for the increasing numbers of off-road vehicle riders. The fact that the BLM is not monitoring annually how these occurrences are faring under these attacks in any place other than the Pyramid Rock ACEC is alarming. Additionally, given that the number of individuals found at any given location fluctuates widely over time, even in the absence of such threats the

[1] Unless otherwise noted, all information in this section is from CNHP 2005, the Colorado Natural Heritage Program's Element Occurrence Records for *Phacelia submutica*.

estimates in the Colorado Natural Heritage Program database would likely not present an accurate picture of current status. The general picture these data can give is of broad scale decline across many occurrences, and that should certainly warrant additional efforts to monitor and protect the species.

Population Descriptions

A. Coon Hollow and Sulphur Gulch

This meta-population includes the largest number of occurrences of DeBeque phacelia as well as the occurrences with the largest numbers of individuals observed, but it also already covered by oil and gas leases; crisscrossed with pipelines, roads, wellpads, and other infrastructure, and dirt bike and ATV terrain.

The Coon Hollow and Sulphur Gulch population includes the slopes and side drainages above the valley floors of Coon Hollow to the north and Sulphur Gulch to the south. Each of these valleys is located just to the west of the town of DeBeque. They run east-west and drain east into the flats at the confluence of Roan Creek and the Colorado River, where the town of DeBeque sits. Between them is an ill-defined spur of South Shale Ridge that terminates at its eastern end in the Pyramid Rock Area of Critical Environmental Concern (ACEC). Thus, this population includes the only area that has any sort of protective management status for *Phacelia submutica*[2].

All but one of the occurrences in this population are found entirely on BLM land (the one remaining occurrence is split between BLM and private land), and all are within existing oil and gas leases that were issued prior to 2001. Several leases in the area were issued prior to 1971 (U.S. DEP. OF INTERIOR, BLM, LR2000 database [LR2000]) before BLM added lease stipulations allowing it to protect biological resources including Sensitive plants from drilling activities (see discussion below in Section VI,A,1,c,ii). In addition, multiple pipelines, roads, and road right-of-ways crisscross the area and several occurrences are located near drilling facilities, especially those found in Coon Hollow and Sulphur Gulch and not on the ridge above. All occurrences except for those within the boundaries of the Pyramid Rock ACEC are found in places managed as "open" to off-road vehicle use. Finally, all occurrences are found within BLM grazing allotments, with the exception of the portion of the single occurrence partly on private land, though few of the permits for those grazing allotments even mention the presence of the plant, let alone account for any possible disturbance. Only one of the records for an occurrence in this population states that the plant is found in an area relatively inaccessible to cattle and off-road vehicles (CNHP 2005, EOR #11). For several others, the slopes and ridgetops they occupy have the potential to be highly attractive to dirt bike and other off-road vehicle riders.

The population found dispersed over Coon Hollow and Sulphur Gulch is the largest and most robust of the three. Altogether, it has included as many as a hundred thousand individuals in certain years, although numbers vary greatly from year to year, of course. In CNHP's records,

[2] If the Proposed Battlement Mesa RNA is accepted by the Forest Service, there will be a second location—see the description for the Horsethief Mountain population below.

there are eleven occurrences noted in this area, many of them consisting of several small patches found close together on slopes above Coon Hollow and Sulphur Gulch and on the ridge top between them. The Pyramid Rock site has alternately been mapped as one large occurrence or several smaller ones, and the ridge to the West of the ACEC has a string of small patches along it. In general, DeBeque phacelia has been found on the upper portion of the slopes coming off the ridge. The soil that supports DeBeque phacelia in this region has been described as dark chocolate brown.

DeBeque phacelia has been observed as far west as Winter Flats and as far east as the southern slopes of Mount Low, a mile and a half from the town of DeBeque. This means the entire Coon Hollow-Sulphur Gulch meta-population occupies an area no larger than three miles by nine miles. Within this area, most of the occurrences have been described as occupying less than one acre each of potential habitat, and many are much smaller than that. Most of the occurrences in this population are small; in 64 percent of the occurrence locations, more than 150 individuals have never been observed, even after multiple visits in some cases. More than half of the CNHP element occurrence records for this population specifically mention the presence of cheatgrass, and several other mention encroachment by invasive weeds of various kinds.

The Pyramid Rock ACEC was designated in 1987; a management plan for the area was adopted in 1992 and includes a restriction on motorized vehicle travel (Bureau of Land Management 1992). Ladyman (2003) explains further the land management dictates of the ACEC:

> Recreational off-road vehicles are prohibited in the area, and the area is signed to that effect. Livestock grazing continues according to the relevant BLM Allotment Management Plan. There is a No Surface Occupancy (NSO) leasing stipulation for all new oil and gas leases in the area. Existing oil and gas leases are pre-Federal Land Policy and Management Act of 1976 and therefore NSO cannot be required. However, the BLM can negotiate for a NSO stipulation on applications for any permits to drill existing leases (Bureau of Land Management/Colorado Natural Areas Program 1992,1996).

Despite the prohibition on off-road vehicle riding in the ACEC, in 1995 CNHP botanists visiting the site observed off-road vehicle tracks leading up the west slope of Pyramid Rock, within the boundaries of the ACEC (CNHP 2004, Astragalus debequaeus EOR #28). They specifically noted that no DeBeque phacelia was found growing in the tire tracks, though the area was otherwise described as "carpeted with *Phacelia submutica* (CNHP 2005). The ACEC is bound on its western edge by an established road, so it is likely that the illegal tracks were made by a vehicle or vehicles leaving the road and traveling overland through a previously untracked area. Grazing also occurs within the ACEC (Bureau of Land Management 1992, CNHP 2001 at 49), greatly reducing its ability to offer protection to the plants.

A large number of the most robust occurrences are found adjacent to the Pyramid Rock ACEC, in an area that does not share the same protections from off-road vehicles. The land immediately surrounding the ACEC is all designated as "open" to cross-country off-road vehicle travel, according to the 1987 Resource Management Plan for the Grand Junction area (Bureau of

Land Management 1987a). The only time this area is closed to off-road vehicles is during severe winters, based on the need to protect big game wintering range. In fact, the road on the western edge of the ACEC provides access to the ridge to the west, where the occurrences are found. One of several main roads that lead up Sulphur Gulch to Winter Flats runs below this same ridge. This means that the segment of the landscape in the Coon Hollow – Sulphur Gulch region that was most thoroughly covered with patches of healthy *Phacelia submutica* is also one of the segments most available to cross country travel by off-road vehicles.

In recognition of the quality of the DeBeque phacelia population in the area as well as other rare and endemic plant species, multiple parties have proposed preservation of the Coon Hollow and Sulphur Gulch region in addition to the existing Pyramid Rock ACEC. The first status report for DeBeque phacelia recommended that critical habitat be designated at both Coon Hollow and Horsethief Mountain (O'Kane 1987). This of course has not occurred yet. Later, Burt and Spackman (1995) recommended that Coon Hollow be designated as an ACEC, pointing out that it contains not only a healthy population of DeBeque phacelia but also *Sclerocactus glaucus*, a federally listed Threatened species, and *Astragalus debequaeus*, recently petitioned for ESA protection as well. Burt and Spackman also noted that Coon Hollow was less susceptible to off-road vehicle impacts because the road into Coon Hollow dead ends, whereas Pyramid Rock, they pointed out, was "vulnerable to OHV use."

In Sulphur Gulch, A four-inch gas pipeline installation project was initiated by BLM June 15, 2004, and in April 2004 a project was initiated to install two gas wells and an access road in the Gulch as well. The plants are within an area where "open" off-road vehicle use is allowed (Bureau of Land Management 1996, Grand Junction Resource Area map), and within the active Coon Hollow Com. 06712 grazing allotment.

B. Roan Creek and Dry Fork

This meta-population generally follows the two creek valleys and is perhaps the most threatened due to the likely future use of the area for a reservoir to feed oil shale mining operations. In the meantime, traditional oil and gas drilling is occurring, grazing happens on or near most occurrences, and off-road vehicle riders use the area.

The Roan Creek and Dry Fork population includes 8 different occurrences found along Roan Creek and Dry Fork. Several are found close to the confluence of those two creeks, and two are found just north of the town of DeBeque close to Highway 204. One of those two occurrences has not been observed since 1982 and could be extirpated[3]. In 2004, surveyors for a proposed Encana pipeline project across BLM and private land north of DeBeque found two new occurrences, below Mount Logan, though neither proved to be especially large. In general, the Roan Creek and Dry Fork occurrences are not especially large. Most are less than a few hundred plants, and only one, the occurrence farthest to north along Roan Creek, has been estimated at several thousand plants at one time.

[3] Ironically, this occurrence (CNHP 2005 EOR#002) was proposed as the "DeBeque phacelia Preserve" when it was first discovered (Baker 1981). When, in 1982, additional populations were discovered in the Pyramid Rock area, attention for preserving the species turned to that area instead (Ladyman 2003). Now this occurrence has not been visited in over 20 years.

Though surrounded by BLM lands, Roan Creek and Dry Fork each run within a corridor of private land and each shares this corridor with a road: Highway 204 runs north-south along the Roan Creek valley, while Dry Fork Road branches west to follow Dry Fork. Due to the access provided by these roads, the Roan Creek and Dry Fork drainages are home to many water ditches as well as spur roads accessing oil and gas wells. While many of the occurrences in this population are found on BLM land, some straddle property lines and are found partly on the private land in the valley bottoms, most of which is owned by Getty Oil Exploration Company and Texaco Company (Burt and Spackman 1995).

This private land is leased out to ranchers for the time being, which means livestock tramping is a concern in this area, but the largest threat to this population by far is the possible future construction of the Roan Creek Reservoir. This reservoir has been proposed by several oil companies at several points in the past as a way to supply water to possible oil shale operations in the future (see Section VI,A,2 for a discussion of oil shale impacts on DeBeque phacelia). Though the reservoir has not yet been constructed, as oil shale mining in the area has not commenced, the proposal could be revived at any time. In fact, in the mid 1990s proponents of the reservoir plan sought to build it in anticipation of the time when oil shale mining would become viable and sell the water for profit in the interim. Should a reservoir be constructed along Roan Creek at any time, at least three occurrences of DeBeque phacelia would be fully extirpated and several others negatively affected.

In addition to the large threat of possible reservoir construction, this population faces pressure from traditional oil and gas development, off-road vehicle travel, and various forms of disturbance by virtue of each occurrence's relative proximity to roads and developed infrastructure. A pipeline has already been constructed along South Dry Fork near the road, and the road itself will see increasing use under current projections for oil and gas development in the area. Grazing occurs on or adjacent to several occurrences, and one of the occurrences found near Highway 204 has been observed with vehicle tire tracks running off the road and through the DeBeque phacelia habitat. Half of all the occurrence records for this population include mention of weed encroachment, many specifically mentioning cheatgrass. One occurrence, a series of small patches along the south side of Dry Fork near the road, was given a condition rank of "D" based on the observations that it was "grazed"and "especially weedy" (CNHP 2005, EOR #10). Another occurrence only a mile north of DeBeque on Highway 204 was first observed in 1978 and received several subsequent visits. This location was found to also support *Sclerocactus glaucus*. In 1982, DeBeque phacelia in this location numbered 500 individuals, but when it was visited again in 1994 and 1995, zero plants were found. Weedy encroachment and off-road vehicle tire tracks were noted.

C. Horsethief Mountain

This population faces oil and gas drilling pressure similar to the other two, as well as livestock trampling and invasion by exotic weeds.

The meta-population found on the north and west lower slopes of Horsethief Mountain exists partially on White River and Grand Mesa National Forest lands, partially on BLM land,

and partially on the patches of private land interspersed with those federal lands. Most occurrences in this population are on the northwest slopes of Horsethief Mountain above Horsethief Creek and Little Horsethief Creek. Two occurrences on Horsethief Creek were discovered only last year during a survey for seismic exploration for oil and gas by Trace Energy (Scheck 2005, personal comm.). A few are farther west: one is in Ashmead Draw, one is in Sand Wash near DeBeque Road, and one is between Sand Wash and Kimbell Mesa. A final occurrence has been found south of Horsethief Mountain, off the Sunnyside Road northwest of the top of Jerry Gulch.

This population includes only a few large occurrences—most have been estimated at a few hundred plants at their largest. Several occurrences have only been estimated at 10 or 20 plants. In general, even within the largest occurrences, DeBeque phacelia has been found only in small patches scattered across larger areas of potential habitat, as seems to be typical for this species. Thus, several of the records of the largest occurrences in this population actually consist of lists of numbers found in smaller sub-occurrences, as many as ten with individual plant counts as low as 10 or 20. 60 percent of the occurrences in this population have been estimated to occupy less than one acre of space; two have been estimated to occupy only ten square feet each. The greatest concentration of occurrences is found at the head of Little Horsethief Creek, on a combination of Forest Service and BLM land.

The occurrences that are found on Forest Service land are generally at the westernmost edge of the White River and Grand Mesa National Forests, where they abut BLM lands. Some occurrences straddle the property line. Thus, while the occurrences found on Forest Service land generally receive more protection by virtue of the Forest Service's land management practices in the Horsethief Mountain – Battlement Mesa area, they are at the very edge of such protected land, and therefore if the adjacent BLM land does not have similar land use restrictions in place, trespass and degradation of natural values at the edge of the National Forests is always possible. In recognition of this gap in protection for the species, Burt and Spackman (1995) proposed that the BLM land adjacent to this Forest Service land be designated as an ACEC. This proposal has not been adopted.

The area on the National Forests where DeBeque phacelia is found is part of the proposed Lower Battlement Mesa Research Natural Area (RNA). This RNA, proposed in the 2002 revision of the White River National Forest Plan, has not yet been adopted, so the protections it offers to DeBeque phacelia are not yet fully realized. Ladyman (2003) explains:

> The management of the area has been designated as category 2.2 (RNA)with category 5.42 (Bighorn sheep habitat)in some areas. However, the more restrictive management guidelines associated with a 2.2 management area would be enforced throughout the region when the RNA is designated. This means that activities associated with timber harvest, motorized and mechanized recreation, developed recreation, livestock grazing, and locatable minerals will not be permitted. Until the RNA is designated, the area is managed to protect those qualities that qualify it for consideration as a RNA. This is not as restrictive as management of a formally designated RNA. There are currently several established two-track roads through the proposed RNA, linking adjacent BLM

land. Although the travel management status of this Forest Service land is "closed to all motor vehicles off established roads and trails," there is always the potential for trespass... During the RNA evaluation process and when the RNA is established, livestock grazing, mechanized recreation activities, and resource extraction would be restricted.

Currently, however, because the RNA has not yet been adopted, the DeBeque phacelia occurrences on the White River National Forest are within a grazing allotment. This allotment is vacant for the time being and not used for livestock grazing (Johnston 2002, personal comm., as cited in Ladyman 2003).

The Horsethief Mountain population contains one occurrence that aptly demonstrates the threat that livestock grazing can pose even to a plant that cattle do not appear to graze, such as DeBeque phacelia. One of the occurrences found right at the interface between BLM and Forest Service land has a fence running through its middle. Cattle walk the fence line regularly, and one observer noted a marked difference in the quality and vigor of the individual plants from the trampled side to the untrampled side (CNHP 2005, EOR# 20). One other occurrence record for this population mentions the presence of cattle, again noting it is their travel through the area, not their grazing, that is the problem for DeBeque phacelia (CNHP 2005, EOR# 38).

Almost half of the occurrence records for this population note the presence of invasive weeds, mostly cheatgrass. Even the one occurrence ranked "A+" for condition is pressured by some weed invasion.

D. Summary of Population Information

In general, the DeBeque phacelia needs to be understood as a species occurring in a very limited range and facing an overwhelming volume of threats to its future stability. Of the three known populations of the plant, only two contain occurrences of any substantial size—with numbers of individuals in the thousands. Most occurrences of the species are small—with individuals ranging from a few hundred observed to as low as ten. Almost one third of all occurrences have not been observed in nineteen years or more, which raises serious concerns about the current status of these occurrences. In fact, only half of all occurrences have been visited more than once. Thus, in the presence of substantial threats to it persistence, there is a chance that some of the occurrences of the species we are assuming are still extant are in fact extirpated already. Given the plant's extremely restricted habitat, there are a limited number of new sites, if any, that it could occupy, so it is unlikely that more than a handful of small new occurrences will be discovered in the future. Even the largest known occurrence are, in fact, a series of small patches, many as small as ten square feet, where plants are found.

Of the occurrences that have been visited more than once, more than half show signs of population decline. Although population numbers naturally vary for this species from year to year, these sites seem to suggest a downward trend over longer periods, despite the natural variation. This downward trend may be related to the forms of land use pressure and threat the species faces across most of its range. Only one occurrence, in the Pyramid Rock ACEC, is formally protected from such threats as surface occupancy for oil and gas drilling and off-road

vehicle use, but even this designation may be inadequate without more substantial enforcement. A few other occurrences are proposed to be protected in the Lower Battlement Mesa RNA, but this designation has not yet been officially adopted.

All other occurrences face extreme risk of harm or full extirpation: every occurrence on BLM land is leased for oil and gas, and every one is found within a grazing allotment. Most are in areas the BLM has designated "open" for cross-country off-road vehicle use. Most of the occurrences found partly on private land also face oil and gas drilling pressures, as the land owners in most cases are oil and gas corporations. In the Roan Creek area, these owners have proposed building a reservoir that would destroy many DeBeque phacelia plants and their habitat. As soon as oil shale mining become economically viable again, the impetus to build this reservoir and to mine much of DeBeque phacelia's habitat will grow rapidly. Thus, the magnitude of the threats the species faces in each of its three populations is large enough to warrant concern, and the likely addition of oil shale mining and reservoir development will be overwhelming.

V. THE CURRENT LEGAL STATUS AND OTHER DESIGNATIONS FOR DEBEQUE PHACELIA INDICATE THAT LISTING IS WARRANTED

Scientists who have studied DeBeque phacelia recognize that this species is at risk of extinction and in need of protections (Ladyman 2003, Burt and Spackman 1995, O'Kane 1987). It has been listed as a candidate species by the U.S. Fish and Wildlife Service since 1980. The U.S. Forest Service Region 2, which includes the White River National Forest, has designated *Phacelia submutica* as a Sensitive Species. BLM tracks the species on its list of "Plants in Colorado Federally listed as Threatened or Endangered and Candidates for Listing." The Colorado Natural Heritage Program ranks DeBeque phacelia as G2 S2, meaning they consider the species imperiled both globally and at the state level. Finally, several major studies of the species conducted by researchers for both state and federal agencies have warned that it faces multiple possible threats and that its status could rapidly decline if one or several of these threats were to grow in magnitude, which has now occurred. All of these considerations indicate a high level of concern for the species that lends support for listing under the ESA.

A. U.S. Fish and Wildlife Service Designation: the U.S. Fish and Wildlife Service has been concerned about the threat of extinction for this species for many years

Since 1980, the U.S. Fish and Wildlife Service has listed DeBeque phacelia as a candidate for listing under the Endangered Species Act. This listing is a significant recognition of the species' need for protection under the Endangered Species Act.

The U.S. Fish and Wildlife Service defines candidate species as "...those species for which the Service has on file sufficient information on biological vulnerability and threats to support proposals to list them as threatened or endangered species" (see Federal Register Volume 61, No. 49, page 7598, and 61 FR 64481). On their "Candidate Conservation Program" website, the Service translates this language into the following: "Candidate species are plants and animals for which the Service has sufficient information on their biological status and threats

to propose them as endangered or threatened under the Endangered Species Act, but for which development of a listing regulation is precluded by other higher priority listing activities" (U.S. Fish and Wildlife Service 2005).

In listing DeBeque phacelia as a candidate for ESA protection, the U.S. Fish and Wildlife Service specifically acknowledged some of the conditions that make this species particularly susceptible to extinction. In its periodic reviews of the candidate list and revision of the priority it assigns to different species, the Service described the specific environmental and reproductive requirements of the species that make it susceptible to dramatic and irreversible declines:

> The plant is a narrow endemic, with populations known only from suitable clay (adobe) soils in Mesa and Garfield Counties, Colorado...In a given year, a population may produce no individual plants, or it may produce thousands. Populations are small, and all known populations are less than 5 acres. (Ireland 2002)

In their analysis of threats to the species, the Service again highlights these biological facts about the plant as a source of threat: "This species is limited to a very small area and occurs on a specialized substrate" (Ireland 2002). They also go on to list livestock grazing, off-road vehicle use, weed invasion, and development of infrastructure to support oil and gas drilling (specifically reservoir development) as potential threats. This list and the language describing the species' throughout the Candidate Assessment and Listing Priority Assignment Form are a significant recognition back in 2002 by the U.S. Fish and Wildlife Service of the possibility that this species could easily fall into a dramatic and irreversible decline should its circumstance regarding any of these threats change. Since that time, circumstances have indeed changed regarding several of these threats (see Section VI below); therefore the Service should elevate the priority assigned to this species and list it as Threatened or Endangered immediately.

Species that are officially recognized as candidates for ESA listing by the U.S. Fish and Wildlife Service receive particular recognition and management considerations by other federal agencies, such as BLM and the Forest Service. Specifically, the Endangered Species Act dictates that no federal agency can contribute to the need to list as threatened or endangered any species that is listed as a candidate, and agency internal directives reflect this mandate. For example, the BLM Manual dictates that "*[c]onsistent with existing laws*, the BLM shall implement management plans that conserve candidate species and their habitats and shall ensure that actions authorized, funded, or carried out by BLM do not contribute to the need for the species to become listed" (BLM Manual § 6840.06(C) (emphasis added)). However, the current state of BLM compliance with the BLM Manual direction for candidate species, and the shortfalls of the direction itself, are ineffective to protect these species.

A key shortfall of this provision for DeBeque phacelia is the position of the Glenwood Springs Field Office (and the BLM generally) that it is "obligated by law and committed through previous land use planning decision to make public lands available for oil and gas development" and that "providing such opportunities is an important element of BLM's multiple-use mission" (Bureau of Land Management 1999c). Thus as the Glenwood Springs Field Office appears to be interpreting these BLM Manual provisions, it is only committed to protect candidate (and thus

also Sensitive) species if doing so does not interfere with the legal obligation that it believes it has to develop public lands for oil and gas extraction; obviously, this is an inadequate level of protection and much less protective than the ESA.

The BLM Manual also directs BLM to take certain specific actions with regards to candidate species (BLM Manual § 6840.06(C)), but it is not clear to what extent these actions have been or are being taken. For example, the BLM Manual directs BLM to conserve candidate species by "[d]eveloping, cooperating with, and implementing rangewide and or site-specific management plans, conservation strategies, and assessments for candidate species that include specific habitat and population management objectives designed for conservation, as well as management strategies necessary to meet those objectives." Id. However, BLM planning and protection efforts for this plant do not live up to this direction in the BLM Manual. For example, the BLM has not developed or adopted a rangewide conservation strategy for the DeBeque phacelia, and even obvious conservation measures, such as evaluating grazing impacts to the plants at the time of allotment renewals, have not been taken. Many occurrences have apparently not even been visited in ten or even nineteen years.

The agency directives regarding treatment of candidate species are important for the protection of these species, but in this case they clearly do not replace or obviate the need for full listing as Threatened or Endangered under the ESA.

B. U.S. Forest Service: DeBeque Phacelia is recognized as a Sensitive Species

The U.S. Forest Service recognizes DeBeque phacelia as a Sensitive Species in Region 2, the region that includes the White River National Forest land on which the plant is found. Within the National Forest System, a sensitive species is a plant or animal whose population viability is identified as a concern by a Regional Forester because of significant current or predicted downward trends in abundance or in habitat capability that would reduce its distribution (FSM 2670.5 (19)). The Forest Service recognizes that Sensitive Species may require special management to avoid declines. Unfortunately, Forest Service Sensitive Species status under the old Forest Service regulations does not confer any specific protection other than a general requirement that the Forest Service be attentive to its status and management needs, and this requirement is equally vague under the recently adopted revision of these regulations. Although the National Forest Management Act includes some general resource protection provisions, its most important protective mandate (to protect the viability of native and desired nonnative species) does not apply to plants. Therefore, to the extent the previous regulations apply, they are insufficient to protect this species, and the same is true under the new regulations.

Partly in recognition of DeBeque phacelia's Sensitive Species status, and partly to protect other natural values, the U.S. Forest Service has proposed the area of the White River National Forest where DeBeque phacelia is found as the Lower Battlement Mesa Research Natural Area (RNA). This area has not yet been designated, so in the interim it retains its status as a Proposed RNA and is managed so as to preserve its qualities that qualify it for consideration as an RNA in the future. This is, of course, an important added level of protective status beyond regular White River National Forest land, but it is less protective than RNA status. For example, several established two-track roads cut through the proposed RNA now, and though they are designated

as "closed" now that the area is a proposed RNA, they remain available to trespass for the time being (Ladyman 2003).

C. Colorado Natural Heritage Program: the ranking for DeBeque phacelia indicates a high level of concern about its continued existence

The Natural Heritage Program, through its affiliates such as the Colorado Natural Heritage Program, tracks imperiled species and assigns them non-regulatory ranks that reflect their perceived level of imperilment. On a five point scale, with "1" being the most imperiled, CNHP ranks DeBeque phacelia globally as a "G2" and at the sub-national (state or province) level as a "S2" (CNHP, 2005). These rankings mean that scientists believe the species is imperiled. CNHP rankings confer no legal status but are an important indicator of the scientific community's knowledge and assessment of the conservation status of a given species. The following definitions for the DeBeque phacelia rankings are from NatureServe (2003):

G2: A global rank of G2 is defined as:

> **Imperiled** - At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

S2: A sub-national (state or province) rank of S2 is defined as:

> **Imperiled** - Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

DeBeque phacelia's global and state ranks of Imperiled show that scientists believe the risk of extinction of this species is very high.

D. Colorado Natural Heritage Program and Forest Service Reports: Multiple researchers have warned of DeBeque phacelia's decline

The first major status report on DeBeque phacelia was written in 1987 by Steve O'Kane for the Colorado Natural Areas Program. Even as early as eighteen years ago, Dr. O'Kane (1987, emphasis added) was able to predict the population declines that later research has confirmed and some of the threats that are contributing to the declines:

> Present and potential threats *will* decrease suitable habitat and *will* impact a significant portion of the species known range. The species' 'status' is likely to deteriorate as its habitat is further developed both for oil and gas extraction and for Roan Creek Reservoir.

Eight years later, Julie Burt and Susan Spackman revisited many occurrences of DeBeque phacelia and updated O'Kane's status report. They agreed with O'Kane's prior assessment that "[o]verall the status [of this species] can be expected to deteriorate as oil and gas

exploration continues along with recreational vehicle use, and potentially Roan Creek Reservoir construction and oil shale development" (Burt and Spackman 1995). They went on to clarify the magnitude of the threat to the species and the necessity of federal action should evidence of population declines surface in the future:

> ...known possible and existing threats could bring about the extinction of this species within 25 years... *If threats... increase, this species should be immediately re-considered for listing under the Endangered Species Act.* Any downward trend noted by federal agencies with *Phacelia submutica* on their land under their jurisdiction (i.e. weed species taking over large areas of habitat) should also cause the species to be reconsidered for listing.... *Priority for listing would become high if any of the threats to the species became imminent.* (Burt and Spackman 1995, emphasis added)

Despite these clear warnings from the scientists most knowledgeable of the species, several of the primary threats this species faces, most notably oil and gas drilling and off-road vehicle recreation, have increased in magnitude and immediacy since 1995, yet the U.S. Fish and Wildlife Service has not elevated the priority assigned to this species on their candidate list.

In the meantime, the U.S. Forest Service has added the latest significant update to the body of scientific writing on the status of the species with a Technical Conservation Assessment of *Phacelia submutica* [which they track as *Phacelia scopulina* (A. Nels) J.T. Howell var. *submutica* (J.T. Howell) Halse] (see Ladyman 2003). This assessment echoes the earlier warnings that this species will be negatively impacted by the threats it faces:

> Current evidence suggests that this species is particularly vulnerable to habitat destruction and loss because of its restricted habitat requirements. Any elimination of potential habitat would likely have a negative long-term impact, because this species is restricted by geology and cannot extend beyond a limited habitat type. (Ladyman 2003)

Clearly, each new scientific study repeats a theme: DeBeque phacelia is at risk of extinction. These opinions represent the best assessments of the most authoritative experts on the species at the current time and therefore should not be ignored.

E. Summary: There is a high level of concern about the conservation status of DeBeque phacelia and its risk of extinction, and many indicators support Endangered Species Act listing

Clear concern for the persistence of this plant has been stated and reiterated by those who have studied it (CNHP 1997). Most significantly, the U.S. Fish and Wildlife Service already recognizes this species deserves protection under the Endangered Species Act. The extensive oil and gas drilling about which so many botanists expressed concern in the several status reports on the species is undeniably materializing now. We may well not get a second chance to conserve this narrowly distributed plant. Now is the time to recognize all of these designations and the

concerns that have been expressed, and afford the plant the protections it deserves under the ESA.

VI. THE SERVICE IS REQUIRED TO LIST DEBEQUE PHACELIA AS THREATENED OR ENDANGERED UNDER THE ESA

The ESA, along with its implementing regulations, requires the appropriate Secretary[4] to determine whether any species is an endangered species or a threatened species because of *any* of five listed factors. 16 U.S.C. 1533 § 4 (a)(1)(A-E); 50 C.F.R. § 424.11(c). In the case of DeBeque phacelia, three out the five factors are unequivocally met.

The ESA states that:

> The Secretary . . . shall determine whether any species is an endangered species or a threatened species because of *any* of the following factors:
>
> (A) The present or threatened destruction, modification, or curtailment of the species' habitat or range
> (B) Overutilization for commercial, recreational, scientific, or educational purposes
> (C) Disease or predation
> (D) Inadequacy of existing regulatory mechanisms
> (E) Other natural or man-made factors affecting the species' continued existence

16 U.S.C. 1533 § 4 (a)(1)(A-E) (emphasis added).

The ESA defines an "endangered species" as "any species which is in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. § 1532(6). A "threatened species" under the ESA is "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20).

This section contains an analysis of the listing factors applicable to the DeBeque phacelia, demonstrating that this wildflower meets at least three of the five criteria for listing under the ESA. As such, DeBeque phacelia clearly merits listing as threatened or endangered.

A. The present or threatened destruction, modification, or curtailment of the species' habitat or range

The clearest continuity among the various status reports and conservation assessments written on DeBeque phacelia over the past several decades has been the emphasis on the fragility of both the plant's habitat and its particular dependence on certain conditions within that habitat due to its strategy of seed banking. In every major report produced on the species, scientists

[4] The Service has responsibility for most terrestrial and inland aquatic species, while the National Marine Fisheries Service is responsible for most marine species.

have been at pains to emphasize that specific types of habitat disturbance or modification, regardless of the source of that disturbance, has particularly devastating effects on this species.

Since DeBeque phacelia avoids competition by occupying sites with a high natural degree of soil disturbance due to erosion, it necessarily faces a higher rate of individual plant mortality than if it grew on more stable slopes. It also favors sites where the clay soils crack as they dry and then swell closed again when wetted. This natural cycle actually expels individual plants from the soil, further contributing to natural plant mortality. In addition, it lives in a higher elevation, arid, semi-desert region which naturally experiences droughts and years of little precipitation or harsh weather and temperature conditions. Given all of this, this species has adopted a survival strategy that relies heavily on the presence of a healthy seed bank in the surface layer of soil to allow the species as a whole to survive harsh years or natural events that are catastrophic to individuals of the species. In fact, in dry years, no individuals may come up at all in some or many locations. The only way DeBeque phacelia is able to withstand such low-yield years is the bank of seeds in the soil that can germinate in a subsequent year.

However, seeds likely remain viable only in the top few centimeters of soil (Ladyman 2003), and researchers have suggested that the seeds of this species may in fact require some light penetrating the top layers of soil via soil surface cracking to germinate. Others have suggested the seeds could be moisture-triggered, but even then seeds would need to be close to the soil surface to germinate since the clay soils are relatively impermeable to water. Even earlier in the plant's life cycle, it may require the deep cracks in the soil surface to catch and later bury its wind-deposited seeds. Later, it may need the cracks as a natural point in which to take root and grow on a clay surface that would otherwise be hard to penetrate, especially for an annual. Given all these ways in which the natural shrink-swell cracking regime of the Atwell Gulch and Shire soils may be important to DeBeque phacelia's reproduction and life cycle, any disturbance that changes this dynamic of the soil surface could be devastating.

Several of the most imminently threatening forms of soil surface disturbance are very likely to change exactly this soil surface dynamic. Obviously, constructions such as access and maintenance roads, well pads, and stock ponds, if located directly on *Phacelia submutica* habitat, will completely replace the plant's required soil surface with uninhabitable surfaces. If oil shale development becomes viable in the near future, then mining of shale below the soil surface and reservoir construction must be added to this list of actions that could immediately eliminate habitat. But, even trampling by cattle, off-road vehicles, seismic surveyer ("thumper") trucks, and oil tankers making illegal U- and K-turns at the ends of access roads and next to well pads can destroy the shrink-swell action of the soil surface by compacting the soil and thus changing its hydrology. Soil compaction is especially dangerous for this species as it will not only alter the shrink-swell cycle of the soil surface but also prevent members of the seed bank below the soil surface from germinating in the next years. Thus, impacts allowed in DeBeque phacelia habitat now, even if those impacts appear temporary in their nature, could suppress the viability of the DeBeque phacelia population for years to come and potentially initiate an irreversible spiral into decline and extinction.

Similar warnings have been made by the leading scientists who have assessed the condition of this species and its habitat over the last decade. Ladyman (2003) notes that

> Activities that lead to significant soil disturbance, or progressive soil erosion, would likely eliminate or sharply reduce the seed bank, which appears to be the mechanism by which populations survive. Therefore, all actions that cause significant disturbances, including mechanized vehicle travel and intensive hoof action, are threats.

Burt and Spackman (1995) note that "surface disturbing activities that change soil structure negatively affect *Phacelia submutica*." Ladyman (2003) reinforces this message more strongly:

> In general, *all activities leading to substantial soil disturbance are potential threats* to [this species]. Disturbance alters soil structure, which is likely important to a species that has evolved to colonize a substrate with specific and unique properties... With this type of habitat specialist, any loss of soil structure and properties may be very detrimental to long-term sustainability... Intense disturbance that leads to soil removal, and thus seed bank removal or to seed predation can be predicted as being particularly devastating to local populations. (emphasis added)

More generally, Ladyman (2003) points out that DeBeque phacelia's "restricted habitat requirements make it vulnerable to habitat destruction:"

> Current evidence suggests that this species is particularly vulnerable to habitat destruction and loss because of its restricted habitat requirements. Any elimination of potential habitat would likely have a negative long-term impact, because this species is restricted by geology and cannot extend beyond a limited habitat type. (Ladyman 2003)

Specific sources of potential habitat loss are outlined below.

1. Traditional oil and gas drilling poses undeniable and substantial threats to DeBeque phacelia

For analytical clarity, we address extraction of oil and gas via traditional drilling methods (along with the necessary infrastructure) under this heading, and address oil shale mining and coalbed methane extraction separately below. However, it should be noted that any combination of these resource extraction activities during the same time period could represent, when taken in total, the single most devastating impact to *Phacelia submutica* because of its multifarious nature and its reach across almost the entire range of the species. The narrow geographic range of DeBeque phacelia, tied as it is to the Atwell Gulch and Shire Members of the Wasatch Formation in Mesa and Garfield Counties, places it at especially great risk of extirpation from the impacts of traditional oil and gas drilling. This is because these specific geological strata

overlay deposits of oil and natural gas that BLM has already largely leased for energy development.

(a) Traditional oil and gas resources and development are extensive within the range of DeBeque phacelia

All of the known DeBeque phacelia occurrences are located within the geologically defined Piceance Basin, which overlays large amounts of oil and natural gas. Recent calculations by the U.S. Geological Survey show the Uinta-Piceance Province containing 21 trillion cubic feet of natural gas (U.S. Geological Survey, 2003). Current federal policy for the Piceance Basin generally includes massively increased drilling for natural gas on public lands (see e.g. Prendergast 2004). Even in 1987, scientists writing on DeBeque phacelia were able to predict that "[o]il and gas activity in the DeBeque area is likely to increase in the future" (O'Kane 1987). This increase in energy development places plants such as DeBeque phacelia at increased risk from development impacts. As the BLM itself noted over ten years ago, "as oil and gas development continues and well density increases, the potential impacts are magnified" (Bureau of Land Management 1999a at 4-33, 34). More recently, BLM staff has concurred: "The increase in resource extraction activity is probably the most imminent threat to rare plant populations in the Piceance Basin" (Scheck personal communication 2002, as cited in Ladyman 2003). Throughout the Uinta and Piceance basins, 80 percent of federally managed land is open to resource development (Bureau of Land Management et al.2002, cited in Ladyman 2003) (see Figure 6, pg. 42).

The emphasis on the accelerated development of the oil and gas resources within the range of the DeBeque phacelia is typical of the patterns of extensive oil and gas extraction happening elsewhere across the state of Colorado, and specifically on other BLM lands. Garfield County, where seven of the known occurrences are located, including two discovered just last year during surveying for a gas pipeline, contains more than 1,400 wells "operating at a higher density than anywhere else in the country" (Id.). Four hundred new wells were permitted in Garfield County in 2003, twice the number permitted in 2001, and 500 are projected for 2004 (Id.). The county leads the nation in its growth of planned well numbers, with 10,000 planned in the next few decades. Personal communication, Pete Kolbenschlag, 2004b. Trends are similar in neighboring Mesa County. Statewide, the Colorado Oil and Gas Conservation Commission director says that there has been a "sustained drilling boom for three years in a row [in Colorado]" (Chakrabarty 2004).

The National Petroleum Council estimates that within the Rocky Mountain region industry will be able to access 91% of natural gas reserves found on federal lands (National Petroleum Council 2001). It should also be noted that there is a well-advertised effort by the BLM to better serve the oil and gas industry by processing well drilling permits faster. A BLM Instructional Memo posted on the agency's website outlines this effort as follows:

> Background: Task #8 of the National Energy Policy Implementation Plan includes the requirement that the Bureau of Land Management (BLM) identify ways to expedite the APD [application for permit to drill] approval process. A team was formed to study the APD process and identify improvements.

Bureau of Land Management EFOIA website (visited Feb. 22, 2004)

Especially given declining federal land management budgets, such fast-tracking of drilling permits is likely to result in extensive impacts to the plant populations that the BLM is charged with protecting.

In summary, all DeBeque phacelia occurrences overlay rich oil and gas resources in areas likely to see much development in the near future. The Service should list the DeBeque phacelia before it becomes extirpated through this activity.

(b) Mechanics of traditional oil and gas development impacts

Threats to plant persistence from traditional energy extraction arise primarily from the construction and use of extensive infrastructure networks (roads, pipelines, well pads, power lines, railroad tracks, waste pits and others) that accompany the development of oil and gas fields (Bureau of Land Management 1999a at 4-33, 34; The Wilderness Society 2002). In fact, Ladyman (2003) cites personal communication with BLM officials to assert that the infrastructure associated with oil and gas development is the "[t]he most significant foreseeable threat" to *Phacelia submutica.*

While the amount of road construction needed for each new well pad varies, depending in part on well density, road densities associated with oil and gas development are consistently very high. Recent government estimates from different areas suggest that approximately one new mile of road is needed for each oil well (U.S. Dep. of Agriculture, Forest Service, Bridger-Teton National Forest, 2000) and 0.4 new miles of road are needed per conventional natural gas well (Bureau of Land Management 2000). The Wilderness Society (2002) recently conducted a pilot analysis of the ecological footprint of oil and gas infrastructure in the Big-Piney-LaBarge oil and gas field, located in the Upper Green River Basin in Wyoming and managed primarily by the BLM. The study found, among other things, that the linear infrastructure (pipelines and roads) density was 8.43 miles per square mile.

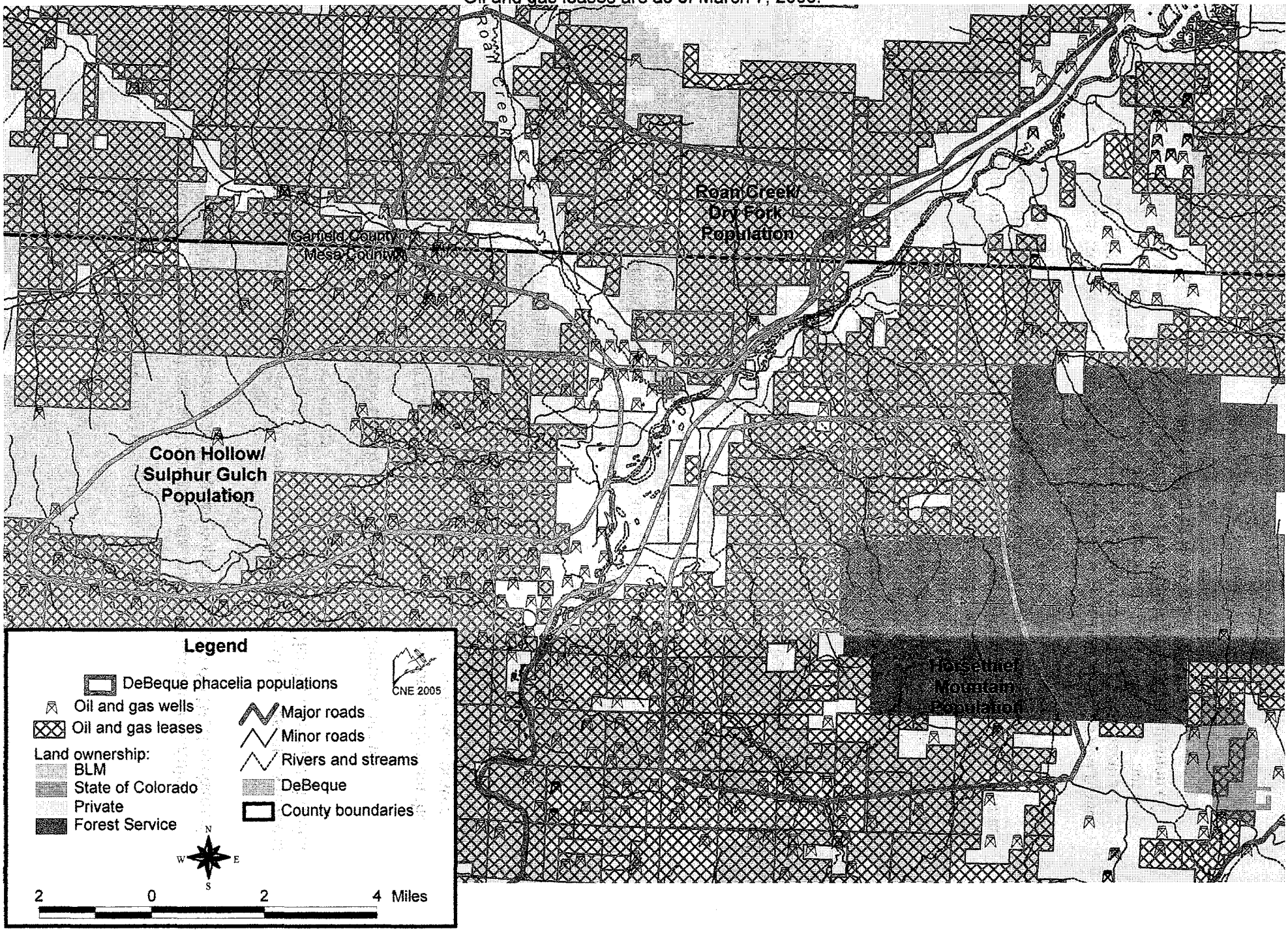
The Wilderness Society report notes that natural gas reserves that are "tight sands," also called "continuous-type," are classified by the U.S. Geological Survey as unconventional. They further cite the U.S. Geological Survey for the fact that "[e]xploitation of tight sands gas requires drilling a significant number of wells because the distribution of this gas type is not well known." Id. (internal citation omitted). This likely means that natural gas development in the DeBeque phacelia range will carry high environmental costs from drilling because in the Uinta-Piceance Basin "nearly all the undiscovered gas is unconventional (continuous)" (U.S. Geological Survey, 2003).

One clear threat from facility construction is the direct destruction of plants and plant habitat even when the BLM attempts to mitigate impacts (see Bureau of Land Management 1999a at 4-33, 34). For example, in one instance on land previously held by the DOE but now held by the BLM, "the DOE moved a well pad slightly to avoid the highest concentration of [Special Status] plants but did destroy a sizeable number of individuals" (Id).

Figure 6. DeBeque Phacelia and Oil and Gas Leases.

(Occurrences are much smaller than site locations, and are not presented here because of data sensitivity concerns.)

Oil and gas leases are as of March 7, 2005.



In another instance, the BLM found that a proposed well pad site would have destroyed "several dozen BLM Sensitive plants" (Id). However, alternative well pad sites would have required greater cuts and fills, creating more impacts to the drainage, so the well pad was moved only slightly resulting in "avoid[ance] of a clump" of the BLM Sensitive plants, while "a dozen or so were directly impacted by well construction" (Id). Ladyman (2003, with internal citation) notes that "[h]istorically, well sites have been placed on valley bottoms, and [DeBeque phacelia] is generally found on slopes (Burt and Spackman 1995), but new technology and more aggressive exploration could potentially change that situation." In addition, well pad density may increase as the current boom in energy exploration peaks. While a greater well pad density certainly increases the chance of direct extirpation of DeBeque phacelia, is also increases the density and magnitude of incidental impacts: "A denser well spacing also leads to an increase in incidental impacts, such as more informal vehicle turn-sites" (Ladyman 2003. More significantly for this species and its steeply sloped habitat, pipelines constructed to serve wells may directly cross such areas even when well pads are not built on top of the plants. Burt and Spackman (1995, with internal citation) note that

> while the actual well pads may not have had an impact on [much DeBeque phacelia] habitat, building new pipelines to serve well sites may impact the plant. These pipelines often cross relatively inaccessible areas where the plant may grow (pers. comm. Lambeth)... The most important aspect of this impact [from oil and gas drilling activity] is likely to come from pipelines built to service drill sites... Where a pipeline or an access road crosses PHSU habitat, the plants are not likely to survive.

The extensive ground disturbance caused by the construction and use of the facilities also results in a host of less direct but often devastating impacts. Ground disturbances may introduce noxious weeds (Shuman and Whicker 1986); eliminate mycorrhizal fungi (Knapp 1996), and disrupt or eliminate pollinator habitat (especially for ground nesters). Side cast from well pad construction can destroy or damage plant populations even when the well pad is not constructed directly on top of the plants. As the Glenwood Springs Field Office's 1999 Oil and Gas Leasing and Development FSEIS reports "[t]he total amount of surface disturbance associated with oil and gas development is a primary factor in determining impacts to soils . . . Construction of 1,200 additional wellpads may result in a large amount of soil being moved locally in the short-term, resulting in sedimentation of nearby streams and some loss of site productivity" (Bureau of Land Management 1999a at ES-8). Ladyman (2003) also notes that "[t]he impacts of oil and gas developments on the hydrology of *P. submutica* habitat have not been investigated," but any changes to surface hydrology from well pad placement or changes in run-off patterns from road or pipeline placement could have a large impact on a species that relies on particular soil surface conditions. Additionally, oil and gas facilities often badly fragment habitat (The Wilderness Society 2002). Researchers who have observed DeBeque phacelia and its habitat in the past have noted that "access roads [for well pads] may also impact habitat particularly by opening new areas to OHV [off-highway vehicle] use" (Burt and Spackman 1995). Aside from the ground disturbance, compressor stations and well pumps release pollutants into the air, waste products contaminate habitat, and dust from roads and surface disturbances can coat and bury plants (Clarren 1999, Clifford 2001).

Additionally, seismic exploration activities, which often precede drilling, may crush large swaths of vegetation, destroy biological soil crusts, compact soils, bury vegetation, decrease nitrogen fixation activity, introduce noxious weeds, increase soil erosion by wind and water, (Boyle and Connaughton 2002, Bureau of Land Management 2002), as well as fragment habitat. Even shot hole exploration requires the use of vehicles such as recording trucks (Evans 1997). The effects of seismic exploration are long lasting, and may persist for 50-300 years after activity ceases (Bureau of Land Management 2002, Belnap 2002). Routes used for seismic exploration often turn into established roads. McLellan and Shackleton, 1989; Crawford, 2001; Zimmermann, 2001; Belnap, 2002; U.S. Dep. of Interior, BLM, Moab Field Office, 2002; Conway, 2002. In fact, the BLM has acknowledged that tracks from seismic exploration conducted in the 1970's remained visible in 2002, and are often used as roads and trails by motorized vehicles (Bureau of Land Management 2002).

Some DeBeque phacelia populations are found on steep escarpments of the Roan Plateau area, including those of the former Naval Oil Shale Reserve. BLM classifies the steep southerly escarpments along the Naval Oil Shale Reserve as an area "with high to very high soil loss" (Bureau of Land Management 1983 at 83). These are areas that "generally have excessive rates of geologic erosion because parent materials are soft and easily erodible, slopes are steep, and vegetation cover is poor" (Id). BLM identifies "mineral exploration/development" as one of the "[p]rimary factors contributing to erosion, other than geologic erosion" (Id. at 83 – 84). The highly erosive land on which DeBeque phacelia lives will make these places very sensitive to drilling. Though DeBeque phacelia has evolved to tolerate a substrate that is subject to natural movement because of steep slopes, this does not suggest that it can tolerate the additive erosive effects of motor vehicles or heavy machinery.

(c) Status of threat from traditional oil and gas development on BLM lands

(i) The pertinent BLM plans lack adequate stipulations for protecting Sensitive plants

The Grand Junction Field Office does not operate under a Resource Management Plan (RMP) that prohibits surface occupancy at sites of Sensitive species, such as DeBeque phacelia.

The Grand Junction Record of Decision for its RMP states that "[s]ignificant known sites [of Sensitive or candidate plant species] will be protected from surface disturbance" (Bureau of Land Management, GJFO ROD 1987, at 2-16). However, it never defines "significant." Moreover, at the time BLM adopted the plan it had identified zero acres of Sensitive plant species locations (id.); thus it is not clear what was intended.

The provisions in the RMP relating to oil and gas drilling do not apply to any leases granted prior to completion of that plan. The "BLM Sensitive Species" controlled use stipulation in a similar RMP for the neighboring Resource Area (Glenwood Springs) states that:

> For those species listed as sensitive by BLM and for significant natural plant communities, special design, construction and implementation measures, including relocation of operations by more than 200 meters, may be required. For plants, habitat areas include occupied habitat and habitat necessary for the maintenance or recovery of the species or communities...

Bureau of Land Management 1999c at 2-12. This provision is strong in stating that relocation greater than 200 meters may be required, and in protecting habitat necessary for recovery. However, it never states that there is a no surface occupancy standard, so it is not clear when these measures would ever be applied.

Even if the Grand Junction RMP were to be amended to include No Surface Occupancy stipulations ("NSOs") for Sensitive and candidate species, BLM's habit of allowing broad exceptions to NSOs would likely render them ineffective. BLM's propensity to waive species protection stipulations is well documented. For example, despite the fact that the sage grouse is listed as a Sensitive Species by the Wyoming State Office of the BLM, the Pinedale Field Office in Wyoming made exceptions to stipulations designed to protect sage grouse winter and nesting habitat 30 times in the less than three months for which data are available on their web page (Bureau of Land Management 2004b). Additionally, the Pinedale Field Office made exceptions to raptor winter and nesting protections thirteen times in less than three weeks, and to winter range protections 51 times in less than three months (Bureau of Land Management 2004c,d). The BLM is just as likely to waive protective stipulation here.

Importantly, the Glenwood Springs Field Office's 1999 FSEIS describes instances where the field office attempted to mitigate the impacts of oil and gas development on sensitive plants, but failed to avoid significant damage. In one example, "a wellpad was relocated less than ten feet to avoid a population of BLM Sensitive plants. Subsequent visits to the site determined that the new road and pad had become a conduit for livestock travel and the rare plants had been "damaged by grazing and trampling" (Bureau of Land Management 1999d at 4-34). This example illustrates that even if a NSO stipulation is successful at preventing surface occupancy coincident with the plants, this does not always prevent harm to them from oil and gas development.

In another example, on land previously held by the DOE but now held by the BLM, "the DOE moved a well pad slightly to avoid the highest concentration of (Special Status) plants but did destroy a sizeable number of individuals" (Id.). Application of the NSO exception factors could easily lead to a decision like this regarding a DeBeque phacelia population; such treatment is unacceptable for this plant.

Similarly, in another instance also discussed above, the BLM found that a proposed well pad site would have destroyed "several dozen BLM Sensitive plants" (Id.). However, alternative well pad sites would have required greater cuts and fills, creating more impacts to the drainage, so the well pad was moved only slightly resulting in "avoid[ance] of a clump" of the BLM Sensitive plants, while "a dozen or so were directly impacted by well construction" (Id.). This is also a possible, and unacceptable, outcome of the application of the NSO exception factors.

Another shortfall of the NSO provision, even if it were applied without exception, is that it does not appear to prevent activities on the slopes above DeBeque phacelia plants or habitat. Disturbance in these areas could have devastating effects on the plants and/or habitat by altering runoff patterns, causing sedimentation, eroding the slopes below, or other physical destruction. Similarly, side cast from well pad construction can damage plants even if the BLM requires that the well pad not be constructed directly on top of them.

Lastly, no provision in either RMP does anything to protect the habitat of the plant's pollinators.

(ii) Lease term Section 6 is ineffective for protecting DeBeque phacelia

There is a standard lease provision added to all Colorado BLM leases that offers some limited protection from oil and gas development. This lease provision, Section 6, states in pertinent part:

> Conduct of operations – Lessee shall conduct operations in a manner that minimizes adverse impacts to the land, air, and water, to cultural, biological, visual, and other resources, and to other land uses or users. Lessee shall take reasonable measures deemed necessary by lessor to accomplish the intent of this section. To the extent consistent with lease rights granted, such measure may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specifications of interim and final reclamation measures.

Lease term Section 6 was added in the middle 1980s[5]; leases granted before this time do not include any lease term that specifically allows BLM to protect biological resources or the other resources listed in Section 6.

Measures "consistent with lease rights granted" is defined by regulation as follows:

> At a minimum, measures shall be deemed consistent with lease rights granted provided that they do not: require relocation of proposed operations by more than 200 meters; require that operations be sited off the leasehold; or prohibit new surface disturbing operations for a period in excess of 60 days in any lease year.

43 C.F.R. 1301.1-2.

Thus for leases granted after the change in the lease terms the agency may ask an oil company to move a proposed well pad, road, pipeline, or other oil and gas infrastructure location by up to 200 meters if biological resources of concern, such as Sensitive plants, are found at the proposed location.

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[5] Based on the lease document for C-38012 (now COC-038012) (on file with the author), one of the leases that contains DeBeque phacelia (EOR #18), we know that lease term Section 6 was not yet added in 1984. This 1984 lease document contains no provision similar to lease term Section 6 within its boundaries.

Several significant problems for Sensitive plants result from this system. First, there are many leases that were granted prior to the date when Section 6 provisions were added to the standard lease terms. Many DeBeque phacelia occurrences are found within areas leased on or before March 1, 1984. For these leases, BLM appears to have no legal right to require that a company relocate a surface disturbing activity planned to coincide with a Sensitive plant location.

Second, for leases with the Section 6 term, while BLM has reportedly been able to avoid most Sensitive plant locations by moving the surface disturbing activity up to 200 meters, it is not at all clear if this success will continue as energy development of these lands accelerates. In at least one situation already, a road right-of-way on Grand Junction Field Office lands was not relocated away from three *Astragalus debequaeus* plants (a BLM Sensitive species that lives along side DeBeque phacelia and one that has recently been proposed for ESA listing). A BLM employee transplanted the three individuals by hand, but none survived longer than 3 years after the move (Trappett 2004).

Third, even if surface disturbing activities can be moved 200 meters from the site of any Sensitive Species, this distance may be insufficient to adequately protect those species, especially when they are plants. As described above and in subsequent sections, construction of oil and gas drilling access roads, for example, can create points of entry to a new area for cattle and off road vehicles, thus exposing plants to trampling and herbivory.

Fourth, BLM does not apply this provision to suitable unoccupied habitat for Sensitive plants. Thus even if it were effective at protecting known sites, it would be unlikely to succeed at providing for the recovery of these species. Given the absence of any other provision in the Grand Junction Field Office RMP seeking to protect this habitat, the failure of this provision in this area is particularly critical. The Controlled Surface Use (CSU) provisions in the Glenwood Springs Field Office's 1999 RMPA could potentially allow the BLM to apply Section 6 not just to existing populations of rare or Sensitive species but to habitat necessary for maintenance or recovery of species as well. However, it appears that no actual instances of such an application of these CSU provisions exist.

Failing to protect suitable unoccupied habitat is especially important when dealing with arid land perennial plants. Many of these plants strategically persist underground, with no above ground growth, in years of drought or other unfavorable conditions. Without a provision that protects the habitat of these plants, it is likely that surface disturbing activity will be permitted directly above the plants such that they cannot survive.

(d) Status of threat from traditional oil and gas development to each site

Every known occurrence of DeBeque phacelia on BLM land—more than 85 percent of the total occurrences of the species—are leased for oil and gas drilling. Of the occurrences found on private land, most are owned by oil and gas companies. In total, more than 90 percent of the species exists in places vulnerable to disturbance by oil and gas drilling.

(e) Summary: threats from traditional oil and gas development are significant and demand immediate action

Traditional oil and gas development is clearly the threat of the greatest magnitude and immediacy this species faces. It actually constitutes a host of threats to native plants overall. Many of these threats stem from the massive infrastructure associated with extracting these resources, such as the 8.43 miles of linear infrastructure per square mile found in one recent study (The Wilderness Society 2002). Well pads and their reclamation, pipelines, roads and other facilities can all directly impact plants or their habitat, or indirectly damage these through the spread of noxious weeds, displacement of sediment, or the alteration of hydrologic flow.

All occurrences of DeBeque phacelia on BLM land are in areas already leased for oil and gas development by BLM, or in areas under consideration for leasing in the near future. None of these occurrences are adequately protected from the disturbance associated with energy development by existing BLM plans, lease stipulations, or regulations. DeBeque phacelia is facing quickly mounting threats due to changes in federal policy and economic conditions influencing energy development.

2. Oil shale mining continues to become a more concrete threat that would devastate DeBeque phacelia

One of the threats to this plant identified by several researchers over the past decade is oil shale mining. In fact, in 1995 Burt and Spackman noted that "[o]il shale development and concurrent changes in land use human populations pose the single most important threat to PHSU and other sensitive plant species. It threatens to directly impact many thousands of acres through secondary development, including water and human services." Although oil shale mining is not currently taking place on any large scale in the area, oil shale companies there continue to hold conditional water rights permits for oil shale mining in Garfield County, a significant amount of oil shale mining occurred twenty years ago, and Shell oil has a major experimental program in the area now (Chakrabarty 2004b). Feasibility of oil shale mining is likely just an economic turn away.

(a) Oil shale resources are extensive within the range of DeBeque phacelia and development is foreseeable

The oil shale resources of the Piceance Basin, where all DeBeque phacelia occurrences are located, are substantial. For example, 7.5 billion barrels of oil were estimated to underlie the 31,204 acre parcel for which the BLM Glenwood Springs Resource Area managed the oil shale reserves when it wrote its 1983 FSEIS (Bureau of Land Management 1983 at 88). Thirteen billion barrels are estimated to be contained in 50,000 acres of land owned by Getty Oil Exploration Company in Garfield and Mesa Counties. *Municipal Subdistrict, Northern Colorado Water Conservancy District v. Getty Oil Exploration Co.*, 997 P.2d 557, 560 (Colo. 2000) (*en banc*) (upholding water court's finding of Getty's reasonable diligence regarding its conditional oil shale water rights). On Raven Ridge, outcrop samples of the Parachute Creek Member of the Green River Formation have yielded up to 25 gallons of oil per ton of shale, and unweathered shale beneath the surface should produce even higher yields (Bureau of Land

Management 1987b). Though the DeBeque phacelia is restricted to the Wasatch formation, its proximity to areas identified as oil shale resources exposes it to potential risk from such activities (Burt and Spackman 1995). In 1995, Burt and Spackman pointed out that "oil companies own land and water rights in the DeBeque area and are moving ahead on plans to build a reservoir on Roan Creek that will eventually supply water for oil shale processing... this reservoir would flood two occurrences of *Phacelia submutica* and impact at least one more." Though there is currently no active pursuit of a Roan Creek Reservoir specifically used for oil shale development, the land and water rights continue to be held and plans for a reservoir continue to be revived periodically (Scheck, pers. Comm., 2005). It is clear that the oil companies still intend to use Roan Creek for a reservoir as soon as petroleum extraction from oil shale becomes economically and logistically feasible. While the boom in oil shale research over a decade ago died relatively quickly, it has always been understood that interest would return as soon as new technology made extraction more possible. There is increasing recent activity on the part of several oil companies that suggests that they either have already developed the necessary technology or are prepared to devote serious resources to do so.

The fact that oil shale mining remains a real possibility is evidenced by three recent *en banc* opinions of the Colorado Supreme Court. In 1999 and 2000, that court held in three separate cases that oil companies had exercised reasonable diligence and met the "can and will" test regarding their conditional water rights for oil shale development. *Municipal Subdistrict, Northern Colorado Water Conservancy District v. Chevron Shale Oil Co.*, 986 P.2d 918 (Colo. 1999) (*en banc*) (*Chevron*); *Municipal Subdistrict, Northern Colorado Water Conservancy District v. OXY USA, Inc.*, 990 P.2d 701 (Colo. 1999) (*en banc*) (*OXY*); *Getty*, 997 P.2d 557.

Under Colorado law, a party holding a conditional water right must apply every six years to the water court for a finding of reasonable diligence regarding its development of that conditional water right. Conditional water right holders must prove "reasonable diligence" by demonstrating "the steady application of effort to complete the appropriation in a reasonably expedient and efficient manner under all the facts and circumstances." § 37-92-301(4)(b), 10 C.R.S. (1999). During a reasonable diligence proceeding, the water right holder must also establish that it meets the "can and will" test found at § 37-92-305(9)(b). This provision states:

> No claim for a conditional water right may be recognized or a decree therefore granted except to the extent that it is established that the waters can be and will be diverted, stored, or otherwise captured, possessed, and controlled and will be beneficially used and the project *can and will be completed* with diligence and *within a reasonable amount of time.*

(emphasis added).

In each of the three recent cases, the court found reasonable diligence, citing numerous actions and expenditures that the company had undertaken towards the goal of developing its oil shale resources. The court also found that in each case the company "can" complete its oil shale development project, and that it "will" complete the project when economic conditions improve in the oil shale business. *OXY*, 990 P.2d at 708 (finding no error in the water court's ruling that "the oil shale project is technically feasible given current technology—or, in other words, that

OXY "can" complete the project" and that "OXY "will" complete the project when the current economic conditions facing the oil shale industry no longer exist."); *Getty*, 997 P.2d at 565 (concluding that the issue is governed by *OXY*, and upholding the water court's findings that "Getty "can" complete the project" and that "Getty "will " go forward with the project when it becomes economically feasible."); *Chevron*, 986 P.2d at 923 (finding that holder of conditional water right was not required to meet the "can and will" test on the facts there, *but see OXY*, 990 P.2d at 708 "conclusion of [Chevron] water court was sufficient to satisfy both the "can and will" standard and the reasonable diligence standard.") In an issue not addressed in the other two opinions, the OXY Court further found that the company met the requirements of the anti-speculation doctrine because it demonstrated intent to pursue the oil shale projects to completion in the future. *OXY* at 708-709. Based on this line of cases, it is clear that oil shale mining remains a clear risk for the plants.

In addition to the three companies involved in the Colorado Supreme Court cases discussed above, Shell Exploration and Production Co. has been conducting active experimentation in the Piceance Basin since 1996 that may have bearing on the economics of oil shale extraction. It is actively pursuing a new method of oil shale extraction (described in the Mechanics section below), with over ten people drilling at the experiment site and "with the oversight of a constant stream of additional consultants and Shell scientists" (Lofholm 2001 at 8A). Relatively low oil prices are not seen as a hindrance to this research, as "[p]art of Shell's mission is to devise a technology that will not be affected by fluctuating oil prices" (Id). In November of 2001, Rich Hansen of Shell stated, "We're pretty excited about this" (Id. at 1A).

The U.S. Fish and Wildlife Service has provided on-point analysis regarding the threat of oil shale mining in its 1990 Final Rule for the listing of the Dudley Bluffs Bladderpod (*Lesquerella congesta*) and Dudley Bluffs Twinpod (*Physaria obcordata*) as threatened species. 55 Fed. Reg. 4152, 4154 (Feb. 6, 1990). These species are very rare oil shale endemics found exclusively on the Green River Formation in the Piceance Basin, each being known at the time of the listings from only five populations. *Id.* at 4152 ("With the exception of the recently described *Penstemon debilis* (O'Kane and Anderson 1987), these two herbaceous perennials are the rarest of several oil shale plant species in the Piceance Basin.")

In the Summary of Comments and Recommendations section of this listing rule, the Service responds to a comment by oil shale companies (Issue 2) that "there are no current threats to these species because there is no current oil shale mining occurring in the Piceance Basin." *Id.* at 4154. The Service's response was that the proposed rule recognized oil shale development as being large scale but not imminent, but "because this development could potentially endanger these plants which were not protected under State or Federal law, the plants fit the definition of threatened species under the Act, i.e., species likely to become endangered within the foreseeable future throughout all or a portion of their range" (Id). Because in the instant case oil shale mining is foreseeable in proximity to much of the range of the DeBeque phacelia, and because DeBeque phacelia is not adequately protected by any State or Federal law, the Service must reach the same conclusion here.

Just recently, U.S. Senator Pete Domenici requested a $2 million appropriation from Congress to fund an oil shale leasing program under the Bureau of Land Management (Gallegos

2005). In doing so, the senator noted that rising gas prices could make oil shale mining more economically feasible. "We have vast shale oil reserves, much of it on federal land that could be tapped. Doing so would not only increase our own oil production, but increase royalty payments to the government," said the senator (Gallegos 2005). Clearly, as the pressure to use federal lands to meet the nation's demand for oil in the face of a rising global market price increases, more oil companies and even lawmakers will be tempted to look to oil shale mining as a possible solution.

In such an environment, whether the technology is successfully developed or simply tested on the ground and later abandoned, the impact on *Phacelia submutica* from renewed interest in oil shale mining will be serious indeed. Thus, the threat of oil shale mining impacts on DeBeque phacelia is real whether or not oil shale "booms" or "busts" in the future.

(b) Mechanics of oil shale mining impacts

Technically, Colorado oil shale does not contain oil, but rather an organic material called kerogen that can be converted into a liquid that can be further processed into oil (Youngquist, 1998). In order to convert kerogen into oil it must be heated to approximately 900 degrees F (some report the temperature to be 1000 degrees F.) (Id). The process of heating the oil shale this way is called retorting, and there are basically three processes that have been used: above-ground, modified *in situ*, and true *in situ* (Congress of the United States 1980, Appendix).

Above-ground retorting involves mining the oil shale and trucking it to a processing area where the retorting takes place (Id). This type of retorting would have obvious impacts on the landscape as it would leave behind huge open pit mines. Large-scale oil sand mining is currently occurring in Alberta, Canada with this effect (Suncor website 2004). Though oil sand is a different substance than oil shale, the processing is similar in that both substances must be superheated to get the end product of oil (Id., Congress of the United States 1980, Appendix).

In modified *in situ* retorting, "a portion of the shale is mined out, and the rest is fractured with explosives or by other means to create a highly permeable zone though which hot fluids can be circulated" (Congress of the United States 1980). Occidental Oil has tried a modified *in situ* process in the area where a series of small rooms were excavated, blasting filled these rooms with oil shale rubble, the area was set on fire with temperatures reaching 900 degrees F., and the oil was drained into a sump (Id.). Other reports of modified *in situ* retorting in western Colorado from the early 1980s include a party taking a one square mile area, grading it flat, dynamiting the area, and then setting it on fire to attempt oil recovery (CNE, *et al.* 2002). A likely impact from such practices would be the widespread damage to native vegetation across these areas, considerable indirect effects in adjacent areas, and all of the infrastructure impacts associated with traditional energy development.

Another experiment with modified *in situ* retorting took place near Rifle, Colorado in the 1960s using nuclear explosions to recover oil from oil shale slopes. The U.S. Atomic Energy Commission (a precursor to the DOE) conducted these nuclear tests as part of the Plowshare Program. In a summary of the objectives of the Plowshare Program, the DOE wrote,

"Underground nuclear explosion applications included...creation of underground zones of fractured oil shale for *in situ* retorting" (Department of Energy, undated at 1).

The method that Shell is experimenting with is an *in situ* process where superheated water is injected underground to melt the oil, which is then pumped aboveground (Alexander's Gas & Oil Connections website 2004). The ecological impacts of an *in situ* process like this will include all of the infrastructure impacts discussed with regards to traditional oil and gas development, and likely others.

Several experts on DeBeque phacelia have pointed out that an oil shale boom would not only directly affect many populations of the species, but it would also cause an explosion in a host of secondary effects that could further threaten it. Burt and Spackman (1995) have noted that "[s]hould oil shale development occur, the area's human population would likely rise exponentially. Increased demands for roads, housing, and recreational opportunities would potentially affect all occurrences of *Phacelia submutica*, even those legally protected."

Exacerbating the likely impacts of oil shale mining are the soil conditions found in the DeBeque phacelia's range. Many DeBeque phacelia populations are found on steep escarpments of the Roan Plateau, including those of the former Naval Oil Shale Reserve. BLM classifies the steep southerly escarpments along the Naval Oil Shale Reserve as an area "with high to very high soil loss" (Bureau of Land Management 1983 at 83). These are areas that "generally have excessive rates of geologic erosion because parent materials are soft and easily erodible, slopes are steep, and vegetation cover is poor" (Id.). This type of erosiveness makes a landscape very vulnerable to surface disturbance from development. BLM identifies "mineral exploration/development" as one of the "[p]rimary factors contributing to erosion, other than geologic erosion" (Id. at 83, 84). Though DeBeque phacelia has evolved to tolerate a substrate that is subject to natural movement because of steep slopes, this does not suggest that it can tolerate the additive erosive effects of motor vehicles or heavy machinery.

(c) Summary: oil shale mining impacts are foreseeable and would be devastating

While there is currently no oil shale mining occurring near or on DeBeque phacelia occurrences, research breakthroughs or market fluctuations could quickly result in an oil shale mining boom throughout the region. As Burt and Spackman (1995) point out, ""[s]hale oil development represents a serious threat and should be planned for now to avoid future, more controversial and more expensive conservation actions." The Colorado Supreme Court recently ruled that three separate oil companies, including Occidental Oil, had met the due diligence and the "can" and "will" test regarding their conditional water rights for oil shale development, indicating that oil shale mining remains a real threat.

DeBeque phacelia's already high risk of extinction will increase dramatically if oil shale mining becomes economically feasible in the United States, as oil sand mining has become in Canada.

3. Coalbed methane development and/or coal mining may constitute threats due to the resources present and the processes for extraction

Another threat from energy development comes from the area's potential for coal and coal-bed methane development. While the extent of this threat is difficult to estimate, it is significant due to the resources present.

(a) Coalbed methane and coal resources are present within the range of DeBeque phacelia and exploratory work is occurring

The Cameo Coal Zone underlies the Roan area, and EnCana is doing some exploratory work for coalbed methane development in this vicinity (Kolbenschlag 2004a, pers. Comm.). Some coalbed methane development is already occurring in the vicinity of DeBeque. To date, at least 30 wells specifically defined for coalbed methane extraction have been drilled on South Shale Ridge, which is in the vicinity of a DeBeque phacelia site, with at least ten more wells permitted but not yet drilled (Trappet 2004, pers. Comm.).

(b) Mechanics of impacts from coalbed methane development and coal mining

Impacts from coalbed methane (CBM) development include roads, pipelines, transmission lines and compressor stations. One study found that 0.3 miles of new road were needed for each coalbed methane well. (Bureau of Land Management 2002). A drilling company can use 2-10 acres of land, per drill site (Western Slope Environmental Resource Council website 2004). Surface damage from CBM development can be extensive. For example, in a recent Montana court case, a jury returned a verdict against Paxton Resources, Inc. for damaging a privately held ranch during its CBM development of the split estate. The Brannaman ranch was awarded over $800,000 in damages, and over $500,000 of those damages were for the replacement of topsoil to repair extensive damage including gouging out the land surface with heavy equipment that left massive ruts, eroded hillsides, and compacted soil at drill sites (see Save the Grand Mesa website 2004), Powder River Basin Resource Council website 2004).

In addition, methane gas is often held in the coal beds by water, in which case huge amounts of groundwater must be pumped from underground aquifers in order to release the methane. This water is often saline, contaminated with dissolved solids and minerals, or laced with carcinogens including benzene toluene, ethylbenzene and xylene (Western Slope Environmental Resource Council website 2004). This water must be disposed of either by placing it in evaporation ponds, allowing it to leave the site as runoff, or reinjecting it back into the underground aquifers (Id.). Due to the large amount of water that must be disposed of, if ponds are employed their construction causes extensive surface damage. Additionally, as the water levels in evaporation ponds drop, salt and other contaminants are exposed to wind erosion and can cause damage to downwind areas (see Powder River Basin Resource Council website, Dr. Munn, expert testimony (visited Feb. 9, 2004). Runoff can contaminate streams, and

reinjection can cause a suite of problems with the underground aquifers (see Powder River Basin Resource Council website 2004).

Impacts from coal mining are also often severe and can include massive surface disturbance. Whether coal is mined using surface mines, longwall mining, or traditional roof-and-pillar operations, disturbance levels are high. Surface mining involves disturbing large areas to create open pit mines. Longwall mining is an underground mining process in which a long underground room of coal is removed using a movable hydraulic roof support system to protect the work area. Wyoming Coal website, Glossary (visited March 3, 2004). Significant surface disturbance impacts often result when the roof is allowed to collapse after mining out the coal. All three mining techniques are accompanied by extensive road and facility infrastructure impacts.

(c) Summary: coalbed methane development and/or coal mining could be devastating to DeBeque phacelia

The imminence and extent of the threats to DeBeque phacelia from coalbed methane development and/or coal mining are difficult to estimate at this time, but remain a serious concern given the resources present. BLM employees confirm that there is "still some potential" for coalbed methane development within the range of the DeBeque phacelia (Trappet, personal communication 2004). The area where this species is found is underlain by coal beds, and certainly coal mining and coal bed methane mining activities are increasing throughout the region, so disturbance of the species from these activities in the near future is a real possibility.

4. Noxious weeds and seeding pose threats to DeBeque phacelia

Competition from invasive weed species is an especially acute threat for DeBeque phacelia given its particular ecological requirements:

> The barren, or nearly barren, habitat in which [DeBeque phacelia] has developed suggests that it has not evolved to be a competitor for water, light, and/or nutrients. Therefore, [DeBeque phacelia] may not be able to tolerate invasive and aggressive species that colonize areas of potential habitat. O 'Kane and Anderson (1986) observed that plants were small and of low vigor in a site that was especially weedy. (Ladyman 2003)

The spread of noxious weeds often occurs as a result of energy development, recreation, grazing and other activities. BLM recognizes this, as is apparent from the following excerpt from the Coon Hollow grazing allotment renewal EA that covers the Pyramid Rock site: "[t]he most likely areas to find weeds are ponds, roads, oil and gas pads, and high use areas (salting areas)" (Bureau of Land Management 2003). In general, noxious weeds are often able to colonize new locations because they can quickly take over in the aftermath of soil disturbances. Thus soil disturbance that does not immediately or directly extirpate *Phacelia submutica* could indirectly lead to negative impacts by introducing the conditions that favor invasive and exotic species that *P. submutica* can't compete with. In addition, Ladyman (2003) points out, "[h]abitat modification, rather than direct competition, is another concern associated with weed invasion.

Weeds such as Bromus tectorum can alter the frequency at which a site will experience fire. Other weed species exhibit allelopathy and essentially poison the soil to reduce competitors."

Well pads are often reclaimed with inappropriate plant mixes, even when regulations specify otherwise. DeBeque phacelia is adapted to sparsely vegetated areas and clayey, unstable soils. It deliberately avoids competition with other plant species and may not be able to compete with introduced vegetation. In the case of many arid land plants, including DeBeque phacelia, even the unnatural spread of native plants, for example through seeding of nearby well pads, could spell disaster.

Even in 1999, according to the BLM, "[s]ome populations of rare plants [in the area managed by the Glenwood Springs Field Office were] experiencing competition from noxious weeds and other invasive plants. These populations are close to roads and other disturbance, so it is likely the disturbance contributed to the establishment of the weeds" (Bureau of Land Management 1999c at 4-34). Additionally, as a recent grazing allotment Environmental Assessment Record prepared by the Glenwood Springs Field Office notes "[l]ivestock congregating along springs, seeps, reservoirs and drainages encourage noxious weed development and encroachment, while seeds are dispersed through livestock travel" (Bureau of Land Management 2003).

Ladyman (2003) lists some of the noxious weed and invasive species that affect DeBeque phacelia:

> Aggressive species of *Lepidium* (species unreported),annual *Chenopodium* ,and invasive non-native weeds such as *Lappula* species, *Bromus tectorum* (cheatgrass), and *Malcomia africana* (African mustard) have been observed in regions of potential habitat and may be a threat. It is likely that disturbance is necessary before such species can become established on the dark-gray soils, but they may be able to invade the more hospitable brown soils quite readily. Thistles have also been observed at some of the occurrences. The significance of the potential threat they pose is unclear because the specific species of thistle was not noted. The noxious weed,*Cirsium arvense* (Canada thistle), is common within the range of [DeBeque phacelia].

Cheatgrass (*Bromus tectorum*) in particular has been noted by multiple researchers in several locations where DeBeque phacelia grows. Physical disturbances accelerate nitrogen mineralization, and cheatgrass proliferates in areas that have experienced nitrogen enrichment (Young and Allen 1997). Cheatgrass can survive in areas where mycorrhizal fungi have been drastically reduced (Knapp 1996), which occurs when soils are disturbed. Cheatgrass is capable of increasing even in areas where livestock have been excluded (Goodrich *et al.* 1999), and can outcompete native plants because it produces massive numbers of seeds that accumulate in the seedbank (Young and Allen 1997). Cheatgrass germination success rates can reach 99.5% (Knapp 1996), and this weed often forms dense monocultures. It also may outcompete native plants by developing quickly. For example, Goodwin *et al.* (1999) found that cheatgrass roots grew 17 times faster than Idaho fescue (*Festuca idahoensis*) roots.

Cheatgrass is extremely susceptible to intense wildfires, and these wildfires actually lead to the spread of cheatgrass across the landscape. Physical disturbances and wildfires both accelerate nitrogen minearlization, and cheatgrass proliferates in areas that have experienced nitrogen enrichment (Young and Allen 1997). In stands of cheatgrass that lack woody fuel, even intense wildfires do not significantly decrease the number of cheatgrass seeds in the seedbank, which allows for quick reestablishment of this noxious weed (Young and Allen 1997). Cheatgrass germinates quickly after fire and outcompetes native plants as a colonizer of disturbed areas (Knapp 1996).

Cheatgrass changes fire regimes. Hull (1965, as cited in Knapp 1996) estimated that areas dominated by cheatgrass are ten to 500 times more likely to experience wildfire than areas dominated by native bunchgrasses, and he estimated that fire seasons are between one and three months longer in areas dominated by cheatgrass. Fire can then occur so frequently that native shrubs that do not resprout after fire cannot become established by seeds (Knapp 1996).

Noxious weeds invade an estimated 4600 acres of Western public lands every day (65 Fed. Reg. 54544 (Sept. 8, 2000)). In 1999, the BLM estimated that noxious weeds occupied 17 million acres of public land in the West (Bisson 1999).

Noxious weed control is expensive and may require years of work before results are noticeable. Moreover, control efforts are rarely very successful in the long-term. Noxious weeds threaten many native species and are an exploding problem throughout the West. Noxious weeds threaten half of the imperiled species in the U.S. (Wilcove *et al.* 1998), including DeBeque phacelia.

Overgrazing can result in the spread of noxious weeds. According to Ingelfinger (2001), 30% of sagebrush steppe "is heavily grazed and the native understory has been replaced by introduced annuals (West 1983, 1996)" at 8. Kitchen and Hall (1996) found that spring grazing by sheep resulted in higher percent cover of exotic annuals, and favored halogeton and cheatgrass expansion. Robertson and Kennedy (1954) also found that cheatgrass and halogeton abundance increased in the presence of grazing. Grazing can reduce leaf area to the point where native plants cannot complete photosynthesis, or can prevent native plants from reaching reproductive maturity (Knapp 1996). Noxious weeds that are annuals, like cheatgrass, may then outcompete native plants in overgrazed environments. Livestock also can transport noxious weed seeds on their hides or hooves (Knapp 1996), or by eating weed seeds that remain viable after being eliminated. Lacey (1987, as cited in Belsky and Gelbard 2000) found that 500 grams of sheep manure contained 14 viable halogeton seeds.

Noxious weeds that are less palatable to livestock may proliferate in overgrazed areas, where there is little competition from native plants. Individual cheatgrass and halogeton plants were found to be larger in areas that were heavily grazed in Utah compared to ungrazed areas (Harper *et al.* 1996). Livestock add nitrogen to the soil through urine and manure. Many noxious weeds, such as cheatgrass, thrive in high nitrogen environments. Kay and Evans (1965) found that nitrogen addition combined with livestock grazing favored cheatgrass while reducing

intermediate wheatgrass abundance. Wilson *et al.* (1966) also documented increased cheatgrass abundance and decreased bluebunch wheatgrass yields with the addition of nitrogen.

Livestock may trample and destroy biological soil crusts, resulting in the destabilization of soil and vegetation (Kaltenecker *et al.* 1999). Areas where soil crusts have been disturbed are ripe for noxious weed invasion, are easily eroded, and experience decreased nutrient cycling. In areas lacking biological soil crusts, Gelbard (1999, as cited in Belsky and Gelbard 2000) observed cheatgrass cover four times greater than that found on undisturbed sites. Nitrogen fixation may be suppressed long after disturbed soil crusts appear to have recovered (Belnap *et al.*, 1994, as cited in Kaltenecker *et al.*, 1999). Trampling during the summer when conditions are very dry, and during late spring when soils are very wet, is most detrimental (Kaltenecker *et al.*, 1999).

Goodrich *et al.* (1999) found that ground cover in areas with heavy spring cattle grazing was only 30%, compared to 55% ground cover in areas where livestock were excluded. Holecheck *et al.* (1998) reviewed the literature and concluded that this loss of litter contributes to soil erosion:

> various studies of grazing impacts on rangeland soils and watershed status are highly consistent in showing that vegetation residue is the primary factor determining degree of soil erosion and water infiltration into the soil. As residue is depleted by heavy grazing, soil erosion increases, water infilitration decreases, and water overland flow increases (as quoted in Goodrich *et al.* 1999, p. 166).

Bare ground may also be colonized by noxious weeds. Kaltenecker *et al.* (1999) also found that areas dominated by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and by mountain big sagebrush (*A. t.* ssp. *vaseyana*) that were excluded from livestock had higher ground cover ratios than areas that were grazed.

All of the DeBeque phacelia occurrences appear to be within active grazing allotments (due to a map quality issue, we are unable to establish whether one EOR falls between two allotments or is within one of them). Though the EORs note that some occurrences are inaccessible to cattle for various reasons, this extent of grazing throughout the plant's range has likely contributed and will continue to contribute to these noxious weed problems.

The effects on DeBeque phacelia from invasions of noxious weeds or other plants as a result of increased disturbance levels could be devastating. Control of noxious weeds and invasive plants through control of disturbance and other means is essential for the protection of DeBeque phacelia.

5. Roads can adversely impact DeBeque phacelia in a myriad of ways, and are likely already doing so

Most of the sites where DeBeque phacelia is found are near roads. Roads could impact DeBeque phacelia in a myriad of ways, and these impacts will become more severe if increased development occurs resulting in increased use of existing roads and construction of many new

miles of road. Past researchers on this plant species have specifically noted the potential threat posed by roads and have noted that other threats listed in this section, such as oil shale mining, could significantly increase the use of and building of roads in DeBeque phacelia's habitat. Burt and Spackman (1995) note that "[s]everal known *Phacelia submutica* occurrences are near maintained county roads... Garfield County does spray [for weeds] and mow county roads through private contractors. The contractors usually spray around May 1 using Torton."

Threats from existing roads have not been addressed, and projected new road miles under proposed development plans pose significant new threats.

(a) Mechanics of road impacts

Roads result in a myriad of ill ecological effects (Forman and Alexander, 1998) several of which are relevant to DeBeque phacelia. Roads change soil density, soil water content, dust movement, patterns of runoff and sedimentation, and can add heavy metals to roadside environments (Trombulak and Frissell 2000). Impacts of particular concern for DeBeque phacelia include soil compaction, fine particle deposition on the plants, alterations in hydrologic flow above the plants, spread of invasive plants, increased off-road vehicle use, and destabilization of the slopes where the plants are found.

A recent Forest Service General Technical Report explains that:

> Roads affect geomorphic processes by four primary mechanisms: Accelerating erosion from the road surface and prism itself by both mass and surface erosion processes; directly affecting channel structure and geometry; altering surface flowpaths, leading to diversion or extension of channels onto previously unchannelized portions of the landscape; and causing interactions among water, sediment, and woody debris at engineered road-stream crossings.
>
> (U.S. Dep. of Agriculture, Gucinski *et al.,* 2001 at 21)

Similarly, off-road vehicle trails in arid regions have been found to increase water runoff and erosion (Hinckley *et al.* 1983). The Forest Service General Technical Report points out that "[s]urface-erosion problems are worst in highly erodible terrain, particularly landscapes underlain by granite or highly fractured rocks (Megahan 1974b, Megahan and Ketcheson 1996)" (U.S. Dep. of Agriculture, Gucinski *et al.,* 2001 at 23). DeBeque phacelia inhabits highly erodible terrain. Surface-erosion from roads can harm plants, such as DeBeque phacelia, located on slopes below these roads. Thus surface-erosion problems should be considered a significant threat to these plants.

Construction of roads can provide access for off-road vehicles to cross country travel in previously untrammeled areas, whether or not such use is designated or legal. For example, in a BLM area near Brown's Park in the Little Snake Field Office in northwestern Colorado, a road was recently constructed to provide access to a cell phone tower site. The area around the site included an archaeological resource as well as an occurrence the rare Duchesne milkvetch. After the road was contructed, the area was driven through by off-road vehicle recreationists,

damaging both the archaeological site and the plant's highly erodible habitat (Gebhart 2004). This example demonstrates how constructing a road into a new area exposes plant species in that area to new harms, such as off-road vehicle disturbance. In the case of the Pyramid Rock ACEC, which covers one of the largest DeBeque phacelia populations, it appears that a nearby road may have provided access to the ACEC for off-road vehicles, though the ACEC is formally off limits to motorized travel (see Pyramid Rock site description, section IV,A,b for details).

Material from road slides, road repair and road maintenance activities could be deposited onto slopes that serve or could serve as habitat for DeBeque phacelia, destabilizing the slopes, damaging habitat, and/or damaging plants directly. While DeBeque phacelia is clearly adapted to some shifting of the slopes where it is found, the effects of disturbance above natural rates are unknown. The U.S. Forest Service's recent General Technical Report explains:

> Road-related mass failures result from various causes. Typical causes of failure include improper placement and construction of road fills and stream crossings; inadequate culvert sizes to pass water, sediment, and wood during floods; poor road siting; modification of surface or subsurface drainage by the road surface or prism; and diversion of water into unstable parts of the landscape (Burroughs and others 1976, Clayton 1983, Hammond and others 1988, Furniss and others 1991, Larsen and Parks 1997, Larsen and Simon 1993).

(U.S. Dep. of Agriculture, Gucinski *et al.* 2001 at 22)

Roads are also widely understood to promote the dispersal of exotic species (Trombulak and Frissell, 2000; U.S. Dep. of Agriculture, Gucinski *et al.,* 2001 at 32-33). Roads can be both the first point of entry for exotic species, and also a corridor along which the plants move farther into the landscape (U.S. Dep. of Agriculture, Gucinski *et al.* 2001, internal citations omitted). Invasive plants could cause problems for DeBeque phacelia through competition or through unnatural stabilization of its habitat. A recent field study of roadless habitats found that on both nonserpentine and serpentine grasslands, two exotic species (*Centaurea solstialis* and *Aegilops triuncialis*) were at their lowest frequencies, while a native bunchgrass (*Nassella pulchras*) was at its highest frequency greater than 1000 meters from roads. Gelbard and Harrison, 2003. One study showed that abandoned roads had lower numbers of exotics and a lower frequency of individuals than did roads that were in use. U.S. Dep. of Agriculture, Gucinski *et al.,* 2001.

Unpaved roads, such as those found near the DeBeque phacelia populations, are a well-recognized source of dust (see e.g. Grand Canyon Visibility Transport Commission 1999). A model that was developed and reviewed by the Department of Transportation and the Environmental Protection Agency estimates the amount of dust emitted into the atmosphere by a formula that considers the number and speed of vehicles traveling on a road in a given period, the relative humidity, and the composition of the road surface (U.S. Dep. of Agriculture, Gucinski *et al.,* 2001). Under this formula, the roads near the DeBeque phacelia would likely be found to have high levels of dust emissions. Such dust can harm plants by inhibiting transpiration.

Additionally, road maintenance activities involving roadside herbicide spraying could damage the plants, and its pollinators and/or the pollinators' habitats. Lastly, roads could limit recruitment and establishment of DeBeque phacelia individuals, or disrupt dispersal.

Road impacts are both short and long term (Schubert & Associates 1999) and need to be carefully evaluated and controlled near DeBeque phacelia and its suitable habitat. For all of the reasons discussed above, roads must be considered a significant threat to the persistence of DeBeque phacelia plants and habitat.

(b) Status of threat from existing and projected new roads

In addition to existing roads, proposed energy development of the Roan Plateau is predicted to bring with it an extensive new road network. An internal Colorado Division of Wildlife memorandum obtained by the newspaper Westword projects that the planned development could add up to 170 miles of new road on top of the Roan Plateau, a 70 percent increase in the current road miles (Prendergast 2004). New road construction is also occurring around the town of DeBeque. Obviously, this level of new road construction could pose significant problems for DeBeque phacelia given all the road impacts discussed above.

(c) Summary: existing and projected roads pose significant threats to the persistence of DeBeque phacelia

Roads clearly pose a number of threats to existing DeBeque phacelia plants and to the ability of the species to disperse and establish. Roads are a major vector for off-road vehicles, noxious weeds, and livestock. Additionally, road maintenance and road repair activities could damage the plants in a number of different ways, and roads themselves can limit plant dispersal and recruitment. Road closures should be considered a priority near all of the populations.

6. Livestock trampling poses a clear threat to DeBeque phacelia

Every DeBeque phacelia occurrence on BLM land is within one or more BLM grazing allotments. None of the allotment EAs provide an analysis of the effects of the grazing on DeBeque phacelia. Several permits for allotments containing DeBeque phacelia were renewed without even a mention that the plant was found in the allotment. Others simply mentioned the plant without assessing grazing impacts on it, as demonstrated by this excerpt from the Lyon/Anderson Allotment renewal EA:

> However, [sage grouse] along with the Townsend's big-eared Bat, northern goshawk, and Northern leopard frog, and the plants *Phacelia submutica, Astragalus naturitensis*, and *Astragalus debequaeus* are BLM sensitive species.

(Bureau of Land Management 2003a)

There is simply no analysis regarding grazing impacts on DeBeque phacelia, despite the assessment of several CNHP observers that trampling has impacted some occurrences.

(a) Mechanics of livestock impacts

Livestock pose threats to DeBeque phacelia through direct trampling of plants as well as by serving as a vector for noxious weeds and other invasive plants. Livestock can transport noxious weed seeds on their hides or hooves (Knapp 1996), or by eating weed seeds that remain viable after being eliminated (Belsky and Gelbard 2000). Burt and Spackman (1995) note that two occurrences of DeBeque phacelia found near a stock pond "both had a high cover of annual weeds." They also note that one occurrence was described in 1982 as "under severe grazing pressure;" at the time, only 300 individuals were observed. In 1995 it was visited again, and this time the area "still seemed heavily grazed" according to the observers, and only one plant was found. Impacts of noxious weeds have already been discussed in subsection 4 above.

While direct trampling of the plants has been noted by botanists, there seems to wide agreement that livestock do not directly graze DeBeque phacelia. Ladyman (2003) notes that "[r]uderal species [such as DeBeque phacelia] often have very high palatability to unspecialized herbivores (Grime et al.1988), but no herbivore activity or seed predation has been reported." This may due to one or both of the following factors: first, the plants are likely selenium rich and thus unpalatable; and second, the plants generally are not growing in associations with plants preferred by cattle and so the cattle are not grazing near them.

(b) Status of threat from livestock trampling

Every known occurrence of DeBeque phacelia on BLM land is found within a grazing allotment, several occurrences on private land are subject to livestock grazing, and direct damage from trampling was observed at two sites at least. In fact, many observers of the species have noted that trampling seems to be a threat to DeBeque phacelia, and several have made the connection between trampling and the soil compaction that this species cannot tolerate: "On livestock accessible sites, the most important effect of cattle may be heavy trampling that changes and compacts the soil" (Burt and Spackman 1995); "Livestock trample and compact soils, and the soils of [DeBeque phacelia] are highly erodible" (Ladyman 2003). Ladyman (2003) describes the effect of heavy livestock activity on one DeBequer phacelia occurrence:

> One population of [DeBeque phacelia] existed on a slope with a fence running down the middle. Soil, slope, exposure, and species composition were identical on either side of the fence, except for the presence of [DeBeque phacelia]. No plants were observed on the side that was used by livestock, while there were at least 2,500 individuals on the ungrazed side (O'Kane 1987). It can be speculated that direct soil disturbance, soil compaction, herbivory, or a change of soil properties such as increased nitrogen and other minerals may all have contributed to the difference.

Though DeBeque phacelia often grows on steep slopes that are generally unattractive to cattle, it does also grow on more level spots, and these may be more vulnerable to disturbance by cattle:

> "Sites particularly vulnerable to livestock trampling may include areas with less slope than the typical PHSU habitat, areas with very high animal density, and areas near fence lines "as cattle tend to walk along fence lines." (Burt and Spackman 1995)

(Ladyman 2003, with internal citation)

In addition, Burt and Spackman (1995) mention the infrastructure development and other land management activities, such as the building and maintenance of stock ponds and fences, that are concomitant with livestock grazing. They point out that most use of BLM grazing allotments occurs in the spring, shortly after DeBeque phacelia's peak flowering period. They go on to make recommendations about how to minimize impacts from livestock grazing:

> Cattle may threaten individual occurrences if a fence or stock trail crosses habitat, or if range improvements such as stock ponds concentrate cattle on or near habitat... Range improvements that would concentrate cattle on PHSU habitat should be avoided. When possible, grazing regimes should be changed from primarily spring, to fall or winter.

(Burt and Spackman 1995)

Finally, though some occurrences of *Phacelia submutica* are currently protected from livestock use, such as the occurrences found on Forest Service land, trespass by cattle is always possible, and in fact has been observed by some in the field (Burt and Spackman 1995).

(c) Summary: all occurrences are within grazing allotments, and livestock have been shown to damage DeBeque phacelia

In summary, all of the known occurrences of DeBeque phacelia on BLM land are found at least partially within BLM grazing allotments; therefore, the impacts of livestock grazing must be acknowledged and anticipated. In two cases, the negative effects of livestock grazing on plants in a particular occurrence have been noted.

In contrast, none of the Environmental Assessments or Categorical Exclusions completed for the renewal of grazing permits for allotments containing DeBeque phacelia do not adequately assess potential grazing impacts to the species, and many do not even mention the plant's presence.

7. Dirt Bikes and other ATVs threaten DeBeque phacelia

Off-road vehicle use either directly disturbs the plant through trampling or indirectly disturbs it through promotion of erosion. With every occurrence of the species except for those

found on Forest Service land in areas that are available to off-road vehicle use, this is a significant threat to the plant's persistence.

(a) Mechanics of dirt bike and ATV impacts

Off-road vehicles can damage and destroy DeBeque phacelia plants when driven over the plants, or near current or potential habitat, for example by driving on roads or trails located above such habitat. Driving above habitat can damage it by changing the physical aspects of the habitat-- for example, by changing the runoff pattern or causing dust to cover the plants.

In general, plants like DeBeque phacelia that rely on the persistence of a healthy seed bank in the top few centimeters of soil are particularly susceptible to damage from ORV use because of the soil compacting effects that vehicle tires have. The compaction, rutting, and increased erosion that ORV tires cause alters soil hydrology and surface runoff patterns, which could affect the shrink-swell cracking of the soil surface that DeBeque phacelia relies on. As Burt and Spackman (1995) note:

> where OHVs change soil structure, and/or disrupt the soil surface they will likely have a negative impact on PHSU. This impact may come from directly disrupting the seed bank, directly disrupting growth and reproduction of germinated seedlings or older plants, or by changing the habitat so it is no longer suitable for growth. In general occurrences near existing roads are most vulnerable to this type of disturbance.

(b) Status of threat from dirt bike and ATV use

As stated above, every occurrence of the species on BLM land but those found in the Pyramid Rock ACEC is in an area that allows off-road vehicle travel, and almost all are in areas that allow "open" or cross-country, off-route travel. . The few occurrences found inside the Pyramid Rock ACEC are still exposed to off-road vehicle disturbance despite the fact that the ACEC is closed to motorized travel (CNHP, 2004, *Astragalus debequaeus* EOR #28).

In general across DeBeque phacelia's range, "recreational use of off-highway vehicles has increased" (Burt and Spackman 1995). Multiple observers have noted negative impacts from off-road vehicles on several *Phacelia submutica* occurrences (CNHP 2005, Ladyman 2003, Burt and Spackman 1995, O'Kane 1987). As Burt and Spackman (1995) have summarized, "[m]otorized dirt bikes can travel across *Phacelia submutica* habitat, and tire tracks have been observed over known habitat."

In addition, observers have noted that off-road vehicles could become a greater threat should other human development in the area, such the current expansion in oil and gas drilling or a future oil shale boom, cause the local population to rise dramatically (Ladyman 2003, Burt and Spackman 1995). Burt and Spackman (1995) also point out that resource extraction development in particular could encourage increased off-road vehicle traffic: "[a]ccess roads for oil and gas drilling may open new areas to recreational vehicles that could in turn impact *Phacelia submutica*." They recommend the following measures to protect DeBeque phacelia

from this threat: "[r]ecreational vehicle use should be monitored and steps taken to reduce vehicle use on PHSU habitat. Specifically, OHV routes should be designated and well signed to route traffic away from sensitive areas. This will become a very high priority should OHV use increase."

(c) Summary: dirt bike and ATV use poses a significant threat and has been documented at a DeBeque phacelia site

Off-road vehicle use is allowed in almost every area where the DeBeque phacelia is found, and it has been documented at one site where it is not allowed. In general, it will continue to pose a threat to the welfare of the species until appropriate actions are taken to limit its potential harm.

8. Summary: DeBeque phacelia suffers from extensive present and threatened destruction, modification, and curtailment of its habitat and range

Substantial current threats to DeBeque phacelia habitat include energy development, off-road vehicle use, noxious weeds, livestock tramling, and road construction, repair and maintenance activities. In addition, with a slight change in economic conditions, any of these factors could quickly be eclipsed by the extreme surface disturbance of oil shale mining. These threats point to a strong need for listing.

As earlier observers of this species have pointed out:

> known possible and existing threats could bring about the extinction of this species within 25 years... If threats including OHV use, oil and gas drilling, reservoir development and oil shale development increase, this species should be immediately re-considered for listing under the Endangered Species Act.

(Burt and Spackman 1995)

In fact, many prognoses for this species have been grim, given the range of threats it faces. The following statements from each of the major status reviews and conservation assessments completed for the species over the last ten years indicate the kind of longstanding concern experts have had about DeBeque phacelia:

> Present and potential threats will decrease suitable habitat and will impact a significant portion of the species known range. The species' 'status' is likely to deteriorate as its habitat is further developed both for oil and gas extraction and for Roan Creek Reservoir.

(O'Kane 1987)

> Overall the status [of this species] can be expected to deteriorate as oil and gas exploration continues along with recreational vehicle use, and potentially Roan Creek Reservoir construction and oil shale development... Priority for [ESA] listing would become high if any of the threats to the species became imminent.

(Burt and Spackman 1995)

> [DeBeque phacelia] is inherently vulnerable to habitat loss by virtue of it being restricted to barren and semi-barren habitat on only specific members of the Wasatch geological formation that has a limited distribution within the Piceance Basin. This area has high amounts of gas reserves and has historically been impacted by activities associated with resource extraction. Current and future levels of resource extraction activity are likely to be substantial. Activities that lead to significant soil disturbance, or progressive soil erosion, would likely eliminate or sharply reduce the seed bank, which appears to be the mechanism by which populations survive. Therefore, all actions that cause significant disturbances, including mechanized vehicle travel and intensive hoof action, are threats.

(Ladyman 2003)

The threats this species faces need to be addressed immediately. Every known occurrence of the species on BLM land occurs within oil and gas lease boundaries, and most of the private land occurrences are owned by oil and gas companies in areas that have been slated for reservoir development as part of likely future oil shale production. Many sites are found in locations where oil and gas development infrastructure has already been built. In fact, the four most recently discovered occurrences of the species were found during surveys for oil and gas infrastructure and seismic operations. In addition, almost every occurrence on BLM land is found entirely within areas designated by the BLM for "open" use of off-road vehicles. This means that most of the locations where the plant occurs are unprotected from off-road vehicle disturbance. Every site on BLM land also occurs partly or wholly within BLM grazing allotments.

The dramatic acceleration of energy development that is happening in the region, and being proposed throughout the plant's limited range, brings urgency to the necessity for listing. And the recent revival of the possible threat of oil shale mining makes this threat, long held to be a theoretical of future problem, much more real and immediate.

B. Disease or predation—predation in the form of herbivory may threaten DeBeque phacelia

Though observers have generally thought that herbivory is not a substantial threat to DeBeque phacelia, no conclusive study has occurred. Given the small population, few occurrences, and limited geographic range of this species, the threat posed by predation in the form of herbivory---even natural herbivory—could be significant if it is found to be a factor in this species' welfare.

C. Inadequacy of existing regulatory mechanisms

1. Federal regulatory mechanisms are clearly inadequate to protect the DeBeque phacelia

Federal regulatory mechanisms are clearly inadequate to protect DeBeque phacelia. The DeBeque phacelia has been placed on the U.S. Forest Service's Sensitive Species list and the BLM's list of "Plants in Colorado Federally listed as Threatened or Endangered and Candidates for Listing," clearly demonstrating agency concern for the welfare of the species; however, in both cases agency policy for management of Sensitive and Candidate Species fails to back up this concern with adequate regulatory protections. Forest Service Sensitive Species status under the old Forest Service regulations does not confer any specific protection other than a general requirement that the Forest Service be attentive to its status and management needs, and this requirement is equally vague under the recently adopted revision of these regulations. Although the National Forest Management Act includes some general resource protection provisions, its most important protective mandate (to protect the viability of native and desired nonnative species) does not apply to plants. Therefore, to the extent the previous regulations apply, they are insufficient to protect this species, and the same is true under the new regulations.

As for the BLM, while it is required to monitor the status of its Sensitive Species, this monitoring often does not occur consistently, and if it does, it often does not translate into meaningful mitigation for species on this list. In fact, the BLM has failed to even monitor this species adequately. Several occurrences on BLM land haven't been revisited in over 19 years.

The Brown's Park Cellular Site EAs (EA 03-096 [formerly CO-100-LS-03-063 EA amendment]) (on file with the author) include information about a road that was constructed into a previously unroaded area which contains one of only six known occurrences in Colorado of another rare and endemic species, *Astragalus duchesnensis* (Duchesne milkvetch). BLM determined that the original route for the road, built to enable construction and power service for a cellular tower, would "lead to degradation or loss of the population . . ." EA at 12. BLM rerouted the road and then surveyed the new route on August 8, 2003, at a time when "Duchesne milkvetch had already gone to seed and died back, preventing an actual plant survey along this route." Id. Regarding the six areas of suitable habitat that the re-routed road traverses, the EA reports that "[i]t is likely [Duchesne milkvetch] occurs within at least some of these areas." Id. In addition to the unknown number of plants that BLM destroyed when building the road, BLM reported that the cellular tower and building site "would eliminate one population of approximately 30-40 plants." Id. This is not appropriate protection for a BLM Sensitive Species known from only six locations in Colorado.

In addition to failing to manage with Sensitive and Candidate Species in mind, the BLM has also failed to designate Areas of Critical Environmental Concern (ACECs). In the case of the DeBeque phacelia, only the Pyramid Rock ACEC contains an occurrence of the species. This ACEC has an illegal off-road vehicle track running through it and is within an existing grazing allotment (CNHP 2004, *Astragalus debequaeus* EOR #28). Thus, ACEC status for this area does not provide protection to DeBeque phacelia from several of its largest potential threats:

plant destruction and increased erosion from off-road vehicle recreation, introduction of invasive plants by livestock, and livestock trampling. In the past, Center for Native Ecosystems has nominated several places on Grand Junction and Glenwood Springs Field Offices land for ACEC designation, including an ACEC at Anvil Points in part to protect the DeBeque phacelia plants there. The BLM declined to designate any of these new ACECs, in part because each contained land that had already been leased for oil and gas drilling. This would not necessarily have precluded such designation; despite what the title would suggest, ACEC designation does not require any specific changes to existing management practices for each area. Therefore, in general, ACECs alone are and will be insufficient to protect this species—not because they couldn't be managed in ways that would protect imperiled species, but because the BLM fails to manage them adequately.

The BLM is also able to directly regulate activities such as oil and gas development, off-road vehicle use, and livestock grazing on lands it manages, but its execution of such regulation fails to adequately protect the DeBeque phacelia. For example, the BLM may stipulate alterations in a grazing permit at the time of its renewal. An environmental assessment (EA) is required for each such renewal, and since the DeBeque phacelia is on the BLM's Candidate Species list, BLM is required to consider grazing impacts to the plant in its renewal EAs. However, we reviewed several Grand Junction Field Office NEPA documents for renewals and transfers of allotments that include known occurrences of the species, and none included any specific measures to protect the plant. Some NEPA documents mention that the plant is present in the allotment but then contain no analysis regarding livestock impacts to it.

Similarly, the BLM's ability and willingness to protect DeBeque phacelia from oil and gas drilling are lacking. A central problem is that many of the occurrences were leased prior to the addition of lease term Section 6 to BLM's standard oil and gas leases. Section 6 allow BLM to relocate energy development activities such as well pad siting and road and pipeline construction if necessary to protect biological resources such as Sensitive Species. Without this provision, or a lease term added by a BLM RMP, the BLM has less authority to require a company to relocate its surface disturbing activities away from DeBeque phacelia locations.

The 1987 Grand Junction RMP does not adequately control energy development impacts on the plants either. First, the RMP is too recent to apply to the occurrences that lack the standard Section 6 lease term. Second, it does not require No Surface Occupancy at Sensitive plant sites. In fact, the Grand Junction RMP only contains a provision to protection "[s]ignificant known sites [of Sensitive plant species]" from surface disturbance, and never explains how this might be accomplished (Bureau of Land Mangement 1987a).

In summary, the few regulatory mechanisms that exist at the federal level that could provide some level of protection to the DeBeque phacelia are clearly inadequate.

2. Colorado has no state regulatory mechanisms for protecting rare plant species

No state laws or regulations exist that protect any of the DeBeque phacelia populations. Colorado does not have any laws or regulations intended to protect rare plants. The only plant

that receives protection from the state of Colorado is the state flower, the columbine (*Aquilegia coerulea*). The only state agency that has taken responsibility for protecting and monitoring rare plants (including DeBeque phacelia) is the Colorado Natural Areas Program; unfortunately this agency was gutted by the Colorado legislature in 2001 and funding for the program has not yet been restored. Although this program produces conservation benefits, on private lands and on federal lands such as BLM lands, it is limited to strictly voluntary agreements, which means that, even when fully funded, it is insufficient to protect and provide for recovery of the DeBeque phacelia.

3. Summary: existing regulatory mechanisms are ineffective at protecting DeBeque phacelia

There are no federal, state or other regulatory mechanisms that adequately protect the DeBeque phacelia. Though the species has been a Candidate for listing under the ESA for 25 years, the protections afforded to candidate species by the federal agencies To the extent that the BLM has direction from its Manual or its plans to protect rare or Sensitive plants, it is not being followed and/or is ineffective. Forest Service direction for protecting Sensitive species is equally inadequate. The current condition of the plant's habitat, where it faces imminent threats, is evidence enough that the minimal, vague, and often discretionary regulatory mechanisms at every level are inadequate. Based on this analysis, the Secretary is required to list DeBeque phacelia.

D. Other natural or man-made factors affecting the species' continued existence

A variety of natural factors relating to population size and stochasticity may negatively affect the species continued existence, and climate change may exacerbate the impacts of other threats.

1. The extremely limited range, small population size, and the small number of populations make DeBeque phacelia vulnerable to extirpation

a) DeBeque phacelia is vulnerable to anthropogenic impacts due to its limited range, the small number of plants, and the small number of populations

Small populations in general are more susceptible to extirpation due to a variety of influences, and species with a limited range are even more so. These influences can be anthropogenic in nature as well as natural. For example, development of a single wellfield could extirpate an entire site, and there are only three known DeBeque phacelia populations.

b) DeBeque phacelia is vulnerable to demographic, environmental, and genetic stochasticity due to its limited range, and the small number of plants, and the small number of populations

i) Demographic stochasticity

Demographic stochasticity encompasses random events influencing individual birth and death rates (Brussard and Gilpin 1989; Lande 1995). Demographic factors that can vary randomly include "sex ratio, age of first reproduction, number of offspring, distribution of offspring over the lifetime of an individual, and age at death" (Brussard and Gilpin 1989). Larger populations are less influenced by demographic stochasticity because the greater number of individuals decreases the relative importance of the contribution of any one individual to the structure of the population as a whole. Ladyman (2003) notes that

> Where occurrences are small (less than 50 individuals) demographic uncertainties may be significant (Pollard 1966, Keiding 1975). That is, chance events independent of the environment may affect the reproductive success and survival of individuals that, in very small populations, have an important influence on the survival of the whole population. Many [DeBeque phacelia] occurrences are very small, especially in some years, and an individual can be relatively important to those populations.

ii) Environmental stochasticity

Environmental stochasticity usually affects the death and birth rates of all the individuals in a given population in nearly the same way (Lande 1995). Environmental uncertainty can include major disturbances like fires or epidemics, or less catastrophic factors like year-to-year weather fluctuations (Brussard and Gilpin 1989). Changes in climate, competition, disease, resource availability, and predation all may be considered forms of environmental stochasticity (Brussard and Gilpin 1989). Environmental stochasticity can also encompass random, partly unpredictable changes in biotic members of the community (Frankel et al. 1995). Here population size is not as important as the number of extant populations and the extent of their geographic distribution, since entire populations are usually affected.

An example of stochastic environmental variation would be an unusually hard winter or an extended drought that kills numerous plants. Due to DeBeque phacelia's extremely limited global distribution, the species faces an increased the risk that all known populations could be subjected to the same environmental catastrophe at once. As Burt and Spackman (1995) point out, "[o]ccurrences often cover small areas and so may be more vulnerable to chance extinction... Its limited distribution is a natural threat. Unforeseen, catastrophic environmental events such as several consecutive dry years or consecutive late hard freezes could affect survival and reproduction in many occurrences and lead to the species extinction (Menges 1991)." O'Kane (1987) also noted that "[i]ndividual populations [of DeBeque phacelia] are susceptible to extirpation from stochastic variations in population demographics because (1) the species is annual, (2) its population size (number of individuals) varies widely from year to year, and (3) population size in acres is small." Ladyman (2003) lists "variation in precipitation, soil

erosive forces, and perhaps variable populations of arthropods (pollinators, herbivores, granivores) and rodents" as environmental factors that could influence DeBeque phacelia's reproductive success.

iii) Genetic stochasticity

Small, fragmented, and isolated populations have fewer opportunities for genetic flow. Breeding partners are often limited to those found in the immediate area, and loss of fitness due to inbreeding depression can result. Lacy (1997:321) states:

> Inbreeding has been observed to cause higher mortality, lower fecundity, reduced mating ability, slower growth, developmental instability, more frequent developmental defects, greater susceptibility to disease, lowered ability to withstand stress, and reduced intra- and inter-specific competitive ability (Allendorf and Leary 1986; Darwin 1868, 1876; Falconer 1989; Ledig 1986; Lerner 1954; Ralls *et al.* 1988; Wright 1977).

Locally endemic species like DeBeque phacelia tend to exhibit reduced levels of polymorphism (Karron 1991) that may imply genetic vulnerability (Ladyman 2003). In many places, DeBeque phacelia faces exactly these risks because its population size has been as small as ten or twenty plants in some years. Ladyman (2003) notes that "if seed dispersal is limited, pollen transfer between occurrences is critical to maintain gene flow. If self-pollination is the primary reproductive strategy, there may be significant inbreeding among small, dispersed groups of plants leading to vulnerability to genetic uncertainties within populations." For a species such as *Phacelia submutica*, soil surface disturbances that decrease the viability of the seed bank could further exacerbate the effects of genetic stochasticity by further lowering population sizes. As populations decrease in size or are even lost, and the potential for gene flow is reduced and other fragmentation effects increased, the likelihood of extinction continues to grow (Noss 1983; Noss 1991; Noss and Cooperrider 1994; Harris 1984; Hastings and Harrison 1994).

iv) Summary: DeBeque phacelia is vulnerable due to its limited range, the small numbers of plants, and small number of populations

In sum, small populations are *extremely* vulnerable to extinction by way of all these mechanisms. DeBeque phacelia's extremely small range and number of sites indicates that all of the above processes combine to create high-magnitude threats to this species. These risks need to be considered in addition to and in concert with the particular threats outlined above.

2. Climate change will likely exacerbate the effects of all the other threats

Human-caused climate change may lead to the increased frequency and intensity of drought (Houghton *et al.*, 1996). Climate change is certainly likely to affect this species, as its effects are already being noted by researchers in the region this species occupies. In the last 100 years the average temperature in Fort Collins, Colorado, has increased 4.1 °F, and precipitation has

decreased by approximately 5 percent in the Grand Junction area although the decrease has been up to 20 percent in other parts of the state (U.S. Environmental Protection Agency 1997, as cited in Ladyman 2003). Based on projections made by the Intergovernmental Panel on Climate Change and results from the United Kingdom Hadley Centre 's climate model (HadCM2), by 2100 temperatures in Colorado could increase 3 to 4 °F in the spring and fall (range 1 to 8 °F)and 5 to 6 °F in the summer and winter (range of 2 to 12 °F) (Ladyman 2003). HadCM2 is a model that accounts for both greenhouse gases and aerosols.

Hannah *et al.* (2002) summarized some of the effects of climate change as "changing rainfall patterns, declining water balances, increased extreme climate events, and changes in oscillations such as El Niño" (at 264). Although the effects of climate change may show different regional patterns, climate change is occurring on the global scale. Whether or not DeBeque phacelia has been affected by climate change yet, or will be directly affected in the future, is still unknown. However, in assessing population viability, regional climate change is an important factor. Other researchers have pointed out that an extremely geographically limited annual species that occurs in small populations, such as *Phacelia submutica*, is especially sensitive to climate changes. O'Kane (1987) notes that "[t]he species is annual, and is therefore subject to yearly climate to a great degree. In some years a given site may not produce any plants, while in the next year it may produce several thousand plants."

Different species will respond to climate change in varying ways. Species that evolved together and adapted in response to one another's phenology may experience a loss of synchrony whereby natural events such as flowering and pollinator emergence that once were timed concurrently become offset because of differing responses to climatic cues. Species may therefore no longer be able to rely on the services once provided by other species (McCarty 2001). This may have serious implications for DeBeque phacelia pollination.

Successive years of drought conditions may have especially devastating consequences for a species like DeBeque phacelia, which may experience population destabilization if adult plants do not come up for several years in a row (Caswell 1986, *as cited* in Hunt 2001; Silvertown *et al.* 1993, *as cited* in Hunt 2001). Hunt (2001) wrote:

> [I]n a stochastic environment the sequence in which seasons of different quality (from poor to good) occur can also be important in determining the long-term dynamics and the likelihood of local extinction of a population (Kalisz and McPeek, 1993). A series of three consecutive seasons with poor rainfall (summer, winter, summer between October 1987 and March 1989) resulted in an increase in adult mortality in *A. vesicariai* on heavily grazed plots during the final summer season.

At 250-251.

Specifically referring to DeBeque phacelia, Ladyman (2003) notes that "[a]s a minimum winter temperature may be required for successful seed germination (Baskin and Baskin 1989), a warming trend suggests that there exists the potential for depression of seed germination."

Climate change may also contribute to noxious weed invasion. Increases in noxious weeds are to be expected with increased temperatures (McCarty 2001). Alward *et al.* (1999) found that exotic forb density was positively correlated with minimum spring temperatures.

McCarty (2001) wrote that "[o]ngoing climate change is an additional source of stress for species already threatened by local and global environmental changes, increasing the risk of extinction" (at 325). Climate change may exacerbate the effects of habitat fragmentation, for example (McCarty 2001). Maschinski *et al.* (1997) also found that unfavorable climatic conditions coupled with trampling accelerated predicted extinction rates for the listed plant *Astragalus cremnophylax* var. *cremnophylax*.

The threat of climate change makes it even more important that the Service take action to limit the threats it can control. Climate change should also be carefully considered in recovery plans by protecting 1) all extant populations, 2) sufficient habitat for movement through time and space given varying climate regimes, and 3) sufficient habitat to allow for functional ecosystems and natural processes even under compromised climatic situations. McCarty (2001) cautions that:

> [C]onservation scientists need to look at climate change as a current, not just a future, threat to species. Although a causal link to climate cannot yet be rigorously demonstrated, the consistent patterns indicate that the prudent course for conservation is to take these changes seriously. Certainly, cases such as the extinction of the golden toad are of immediate concern, but changes in climate need to be taken into account as a possible factor contributing to declines in other species.

At 327.

The restriction of DeBeque phacelia to the Atwell Gulch and Shire Members of the Wasatch Formation likely increases the threat to it from climate change. Because the plant has such a narrowly defined suitable habitat that is completely fixed in space, a very narrow distribution, and a narrow elevation range, it may lack suitable habitat to move into in reacting to a changing climate.

As Hannah *et al.* (2002) note, recovery plans must factor in climate change. This can be done by employing "regional reserve networks, landscape connectivity, and management of the matrix between core reserves, all concepts that are key in effective conservation responses to climate change (Noss & Harris 1986; Noss *et al.* 1999; Soulé & Terborg 1999; Gascon *et al.* 2000)" (at 267).

Drought, especially multiple consecutive years of drought conditions, will likely exacerbate the effects of all the other threats to DeBeque phacelia detailed in this petition. This substantially increases the importance that the Service take the necessary steps to prohibit those detrimental actions that are within its power to regulate.

E. Summary of why the Secretary is required to list DeBeque phacelia under the ESA

Only one factor needs to be met to require a listing, and here we have unequivocally demonstrated that at least three factors are met: the present or threatened destruction, modification, or curtailment of the species' habitat or range; the inadequacy of existing regulatory mechanisms; and other natural or man-made factors affecting the species' continued existence. Certainly all three of these conditions are in effect, and together they paint a grim picture of the plant's future. DeBeque phacelia is a rare plant facing multiple threats. Most of the known occurrences are in areas already leased for oil and gas development and many of these leases contain no provision to protect the plants from well pad, road or pipeline construction. Further, off-road vehicle use and grazing are allowed across most of the plant's known occurrences and BLM seems to lack analysis or records of the resultant impacts. While clearly the plant's continued existence is threatened by a variety of natural and man-made factors and the existing regulatory mechanisms are inadequate to protect it, the destruction and alteration of the plant's habitat is by far the most significant threat it faces.

The Secretary must list the DeBeque phacelia as either threatened or endangered under the ESA because, as detailed in the preceding discussion, analysis of the five listing factors shows that the species is "in danger of extinction throughout all or a significant portion of its range" (50 C.F.R. § 424.02(e)) or at least "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 50 C.F.R. § 424.02(m). In addition, the species has been listed as a candidate for several decades already, and during that time the protections afforded it by the two federal agencies that manage most of its habitat—the BLM and the U.S. Forest Service—have been inadequate to prevent it from arriving at its current state of imperilment. Thus the Service is required to list DeBeque phacelia as threatened or endangered. As early as 1987, experts on the species came to the same conclusion: "*Phacelia submutica* should be listed as Threatened by the U.S. Fish and Wildlife Service" (O'Kane 1987).

VII. SUBSTANTIAL BENEFITS WILL RESULT FROM ESA LISTING FOR DEBEQUE PHACELIA

The benefits of ESA listing for DeBeque phacelia are substantial:

- Listing will require that federal agencies enter into Section 7 consultation with the Service, and carefully consider the potential impacts to this plant from ongoing and proposed activities under their jurisdictions. The result will be significantly improved protection on federal lands from oil, gas, and mineral extraction, grazing and trampling damage, roads, off-road vehicle use, noxious weeds, and other human disturbance, in the form of a proactive approach to implementing conservation actions prior to opening DeBeque phacelia habitat to development.

- Projects involving a federal nexus will also require Section 7 consultation; therefore the benefits of listing may extend to populations occurring on non-federal lands as well.

- The designation of critical habitat will result in significant additional protection not only for occupied habitat but also for other habitat areas deemed essential to the recovery of the species. The ESA prohibits adverse modification of designated critical habitat.

- Listing will result in the development of a recovery plan aimed at biological recovery (and delisting).

- Listing will help spur research (and the required scientific interest and funding) aimed at improving our understanding of the threats facing the DeBeque phacelia and the steps required for its biological recovery. This research may further the recovery of other imperiled species as well.

- Listing will establish a ban against removing and reducing to possession those plants found on lands under Federal jurisdiction.

- Listing will provide a series of trade prohibitions including a ban on selling or offering to sell DeBeque phacelia in interstate or foreign commerce (exempting seeds from cultivated specimens of threatened plants provided that certain conditions are met).

- Listing will increase the availability of federal funds for private land initiatives that would protect DeBeque phacelia.

- Listing dramatically increases the likelihood of persistence for imperiled species. Since the adoption of the Endangered Species Act in 1973, 81 percent of all species in the U.S. that have gone extinct were not listed under the ESA. Suckling, et al, 2004. This indicates that imperiled species that are not listed under the ESA face a much higher chance of extinction.

The most ambitious (and arguably unlikely) scenario involving state and federal agencies adopting their own conservation measures in the absence of a listing would, at best, result in the reduction of threats to DeBeque phacelia, not an elimination of those threats and certainly not biological recovery. So long as the DeBeque phacelia faces such intense threats it will be at a high risk of extinction. There is no precedent for the State of Colorado or the BLM adopting and implementing a conservation strategy resulting in the biological recovery of a highly imperiled plant. The record of State measures indicates that a conservation plan that involves the state taking active and effective conservation measures is highly unlikely. Thus listing is the critical step that must be taken to preserve DeBeque phacelia.

VIII. RECOVERY NEEDS OF DEBEQUE PHACELIA

Conserving and recovering DeBeque phacelia will require several steps. In general, all activities that disturb the soil surface in DeBeque phacelia habitat should be avoided, as scientists studying the species have already noted (Burt and Spackman 1995: "Surface disturbing activities should be avoided on areas of known and potential habitat;" O'Kane 1987: "Land disturbing activities

must be avoided to preserve the species"). Activities related to oil, gas, and mineral extraction must avoid occupied and suitable (for recovery) DeBeque phacelia habitat. This cannot be emphasized enough given the very sizable oil and gas resources underneath all of the populations of this plant and the rapidly increasing efforts to develop these resources. Each grazing allotment that contains one or more DeBeque phacelia occurrences must be surveyed immediately for impacts to the plants, and management must change if impacts are occurring. Cattle must be kept out of occupied habitat, and stock ponds and salt licks should be kept away from the plant locations. Occupied and suitable DeBeque phacelia habitat must be closed to off-road vehicle use. Burt and Spackman (1995) recommend that "[t]he BLM and Forest Service should discourage OHV use on known occurrences and known habitat." The spread of noxious weeds and the activities that facilitate their spread need to be carefully managed and noxious weed infestations must be controlled using methods that will cause no additional harm to native and rare species such as the DeBeque phacelia. Population monitoring should take place range-wide. Seeds may need to be collected and stored for conservation purposes. The habitat of DeBeque phacelia pollinators must be investigated, and protection must be provided for the plant's assemblages of pollinators that have been identified, including nesting sites.

Finally, the protection and recovery of sufficient habitat to ensure long-term persistence, including providing for the dispersal and movement of the species through time and for the continued unfolding of natural ecological processes and changing climate patterns, must be ensured. Listing DeBeque phacelia under the ESA is a critical step toward the protection and full biological recovery of this species, and even as early as 1987 experts on the species called for this same step (O'Kane 1987).

IX. CRITICAL HABITAT SHOULD BE DESIGNATED AT TIME OF LISTING

The ESA requires the Secretary to designate "critical habitat" for listed species based on certain factors. 16 U.S.C. § 1533(b)(2). The ESA implementing regulations state that "[c]ritical habitat shall be specified to the maximum extent prudent and determinable at the time a species is proposed for a listing." 50 C.F.R. § 424.12(a). In the case of DeBeque phacelia, under this standard, critical habitat must be designated concurrent with the listing proposal.

Existing knowledge about the plant's current distribution and habitat needs make critical habitat determinable at the time of listing. Designating critical habitat is unlikely to appreciably increase risks to the DeBeque phacelia in part because the habitat and distribution of the DeBeque phacelia are already well known and, also, because a proper critical habitat designation, including recovery habitat, will be broad enough to avoid highlighting with great precision the few remaining populations. Moreover, the benefits of critical habitat are considerable. Critical habitat imposes a higher protective standard ("no adverse modification of habitat") than does listing alone ("jeopardize the continued existence") and, furthermore, includes unoccupied habitat essential for recovery of the species. Designating critical habitat is especially important here because it is clear that areas in addition to the locations of existing populations must be protected for the species to persist. Consequently, the benefits of designating critical habitat for the DeBeque phacelia far outweigh the risks. Thus specification of critical habitat concurrent with the listing proposal is both determinable and prudent.

X. MAKING A 90-DAY FINDING REGARDING THIS PETITION IS HIGHLY PRACTICABLE

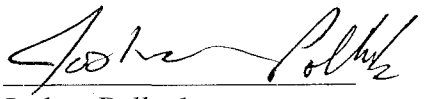
The ESA requires that the Secretary "make a finding" within 90 days after receiving this petition, to the maximum extent practicable, "as to whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1531(b)(3)(A). In the case of DeBeque phacelia, making such a finding in 90 days is highly practicable because the listing factors are so strongly met and we have provided in this petition a thorough synthesis of the best available scientific information on the plant, its status, and threats.

XI. CONCLUSION

The DeBeque phacelia unequivocally warrants listing under the provisions of the ESA. Moreover, without ESA protection, the DeBeque phacelia is likely to become extinct. Each occurrence faces a variety of significant and mounting threats, including the rapidly accelerating oil and gas activity slated for the area where this plant is found. It is highly likely that DeBeque phacelia will only persist if given the protection offered by an ESA listing as threatened or endangered.

This petition and accompanying materials provide substantial scientific and commercial information indicating that Endangered Species Act listing for DeBeque phacelia (*Phacelia submutica)* is appropriate. We appreciate your prompt attention to this petition, and look forward to receiving both an immediate formal acknowledgment of its receipt, and a preliminary finding within 90 days of its receipt.

Respectfully submitted this 25th day of April, 2005,



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