RECOVERY OUTLINE

DeBeque phacelia
(*Phacelia submutica*)

Western Colorado Ecological Services Field Office
January 2013

DeBeque phacelia
Photo by Peggy Lyon, CNHP, used with permission

DeBeque phacelia habitat, Western Colorado
Photo by Eugene Schupp, USU, used with permission

I. INTRODUCTION

This document provides an overview of the known information for DeBeque phacelia (*Phacelia submutica*) and serves to guide recovery efforts and inform consultation and permitting activities until a comprehensive recovery plan for the species is approved. Recovery outlines are intended primarily for internal use by the U.S. Fish and Wildlife Service (Service), and formal public participation will be invited upon the release of the draft recovery plan. For more information on Federal survival and recovery efforts for DeBeque phacelia, or to provide additional comments, interested parties may contact the Western Colorado Ecological Services office for this species at the below address and telephone number.

Listing and Contact Information:

Scientific Name:	*Phacelia submutica*
Common Name:	DeBeque phacelia
Listing Classification:	Threatened rangewide
Effective Listing Date:	August 26, 2011 (76 FR 45054)
Proposed Designation of Critical Habitat:	July 27, 2011 (76 FR 45054)
Designation of Critical Habitat, Final Rule:	August 13, 2012 (77 FR 48367)
Effective Critical Habitat Date:	September 12, 2012 (77 FR 48367)
Lead Agency, Region:	U.S. Fish and Wildlife Service, Region 6
Lead Field Office:	Western Colorado Field Office
Contact Biologists:	Ellen Mayo, (970) 243-2778x 14, Ellen_Mayo@fws.gov
	Gina Glenne, (970) 243-2778x 20, Gina_Glenne@fws.gov
	Alicia Langton, (970) 243-2778, Alicia_Langton@fws.gov

II. RECOVERY STATUS ASSESSMENT

A. BIOLOGICAL ASSESSMENT

Description, Habitat, and Life History: DeBeque phacelia (*Phacelia submutica*) is a small herbaceous (non-woody), low-growing spring annual (living only one season) in the waterleaf family (Hydrophyllaceae). Plants grow 0.8 to 3 inches (2 to 8 centimeters) tall with many branches originating at the base. Stems are often deep red and its leaves 0.2 to 0.6 inches (5 to 15 millimeters) long are oval to shovel-shaped with smooth or widely toothed margins. Leaves often become slightly purple tinted in maturity. Both leaves and stems are covered with stiff, straight hairs of varying density (Howell 1944). Creamy white, tubular flowers are 0.16 to 0.19 in (4 to 5 mm) long and arranged on one side along erect inflorescences. Unlike many members of the genus Phacelia, its pollen

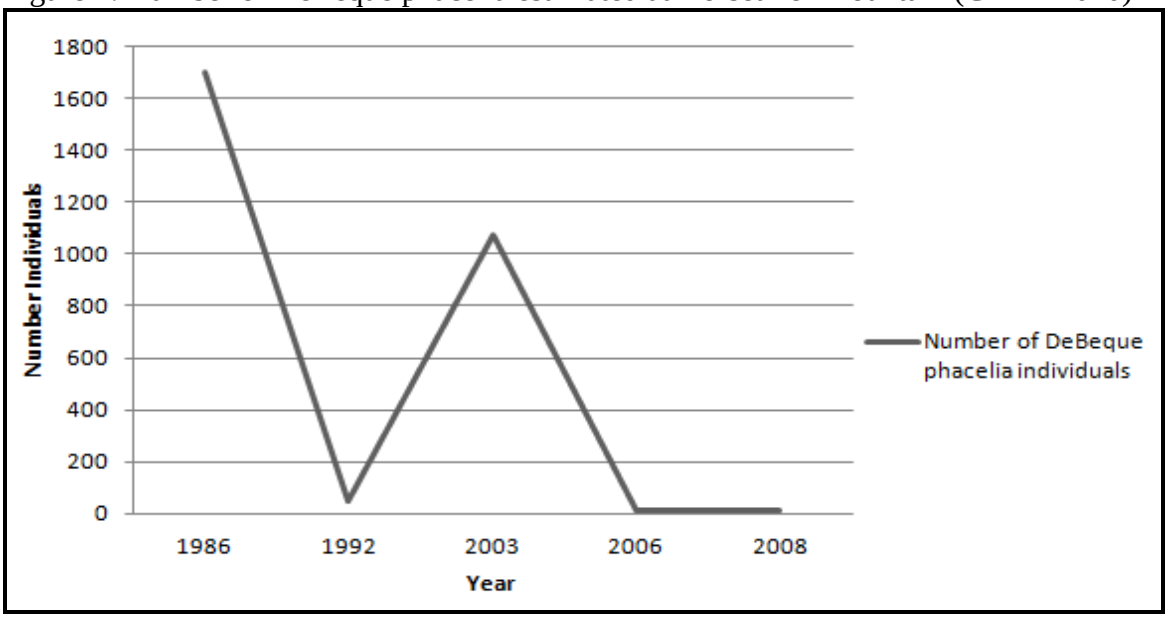
producing and receiving organs do not project outside of the petals. The reproductive organs are contained within the petals. The fruits end abruptly without a sharp point and contain 6 to 12 elongate-ovate seeds. Seeds are brown to black, 0.6 to 0.8 in (1.5 to 2mm) long, numerously corrugated, and appear somewhat iridescent (Halse 1981; Howell 1944; O'Kane 1987).

DeBeque phacelia is restricted to barren clay exposures (clay barrens) of the Atwell Gulch and Shire members of the Wasatch formation (Donnell 1969; O'Kane 1987). In general, the species occurs on moderately steep slopes, benches, and ridge tops above valley floors. It can be found growing on unique spots of ground with heavier clay soils than surrounding unoccupied soils with more silt and sand (U.S. Geological Survey 2012, preliminary report). These patches are often visibly distinguishable as they show a slightly different texture, color, and crack pattern than the similar surrounding soils (Burt and Spackman, 1995). These cracks produced from the frequent shrinking and swelling of the clay soils may serve as "safe sites" for species growth and development (Fowler 1988; Burt and Spackman 1995). Additional research is necessary to describe the soil conditions required to support this species.

The plant community near DeBeque is dominated by juniper, sagebrush, and greasewood. Pinyon is present but not a dominant species because it is sparsely distributed. Within this landscape are barren areas including badlands and clay barrens that support few species. On these clay barrens, DeBeque phacelia can be found alone or in association with other "pioneer" species able to colonize dry and poor quality soils (Burt and Spackman 1995). These species include the nonnative cheatgrass (*Bromus tectorum*) and native species pointed gumweed (*Grindelia fastigiata*), Gordon buckwheat (*Eriogonum gordonii*), Nutall povertyweed (*Monolepis nuttalliana*) and tufted evening primrose (*Oenothera caespitosa*) (Burt and Spackman 1995).

DeBeque phacelia plants flower between late April and late June and set seed from mid-May through late June. Preliminary evidence on the pollination biology of the species indicates that insect pollinators are not necessary for reproduction (Langton and Schupp 2012a). Yearly germination is variable depending on precipitation patterns and can fluctuate widely (Burt and Spackman 1995). For example, DeBeque phacelia numbers at Horsethief Mountain fluctuated from 1,700 plants in 1986, to 50 in 1992, up to 1,070 in 2003, and down to only a few from 2006 to 2008 (Colorado Natural Heritage Program (CNHP) 2010) (Figure 1). This strategy of maintaining seed dormancy through unfavorable conditions is common among annual plant species of arid environments (Anderson *et al.* 2012; Baskin and Baskin 1998). Maintenance of a large seed bank is also vital to the persistence of these species through unpredictable and long periods of drought (Anderson *et al.* 2012). No information is currently available on the density and longevity of the species' seed bank, nor the environmental conditions required to break seed dormancy, but studies are under way (Langton and Schupp 2012b).

Figure 1: Number of DeBeque phacelia estimated at Horsethief Mountain (CNHP 2010)



Distribution, Abundance, and Trends: DeBeque phacelia is endemic to the southern Piceance Basin in Garfield and Mesa Counties, Colorado. Its range lies within an approximate 12 mile radius from the town of DeBeque, encompassing 82,231 ac (34,896 ha) (Service 2011a). Plants occur at elevations ranging from approximately 5,000 to 7,150 ft (1,500 to 2,175 m) (Service 2011b). The species currently occupies a total of 558.6 acres (226.1 hectares) (CNHP 2012a). Upper counts from surveys over the past 30 years estimated a total of 68,371 individuals. CNHP tracks these occupied areas as 20 element occurrences (EOs) which define the species' present and historical geographic locations and separated into distinct units by their representation of a natural population or community. For DeBeque phacelia, EOs are supposed to be separated by two kilometers to delineate populations (CNHP 2012b). However, CNHP stores DeBeque phacelia occurrences by the original twenty EO's identified in an early status report. These EOs are often comprised of multiple sites and many are within two kilometers of each other. For critical habitat units and population identification, we combined EOs if they were within two kilometers of each other. This resulted in nine populations. CNHP not only tracks EOs but ranks them based on their assessment of estimated viability, probability of persistence, or status. Many EOs of DeBeque phacelia (30 percent) are considered 'historical' because they have not been observed in over 20 years and 35 percent are in fair or poor condition (see Table 1 below). Several sites were revisited and confirmed to be occupied in 2011 and 2012. An additional site was found in 2012, but has not been incorporated into the CNHP database.

The majority (86.6 percent) of occupied habitat occurs on lands managed by the Bureau of Land Management (BLM), 4.2 percent is on private lands, 7.8 percent is on lands managed by the United States Forest Service (USFS) Grand Mesa Uncompahgre Gunnison National Forest and White River National Forest (13.2 ac (5.34 ha) and 29.5 ac (11.9 ha)), respectively), and 1.3 percent is on lands managed by the Colorado Parks and Wildlife (Service 2012). See Table 1 below for a breakdown of ownership by EO and

population.

We do not have rangewide, long-term status or trend population data for DeBeque phacelia. There are no long-term monitoring plots.

Critical Habitat: On August 13, 2012, nine units of critical habitat on Federal lands were designated for DeBeque phacelia (77 FR 48368). These units were delineated around the nine populations identified in 2010, which accounted for the two kilometer separation distance between occupied sites. The units are: 1) Sulphur Gulch; 2) Pyramid Rock; 3) Roan Creek; 4) DeBeque; 5) Mount Logan; 6) Ashmead Draw; 7) Baugh Reservoir; 8) Horsethief Mountain; and 9) Anderson Gulch (see Figure 2).

Primary Constituent Elements (PCEs) for the species include: 1) Expansive clay soils of the Atwell Gulch and Shire members of the Wasatch formation; 2) Moderately steep slopes, benches, and ridge tops adjacent to valley floors; 3) Elevations between 4,600 to 7,450 feet (1,400 to 2,275 meters) with climatic conditions similar to those around DeBeque, Colorado; 4) Small barren areas with less than 20 percent plant cover within the barren areas, and presence of appropriate associated species that may include *Grindelia fastigiata*, *Eriogonum gordonii*, *Monolepis nuttalliana*, and *Oenothera caespitosa*, and within the appropriate clay badland communities within the greater pinyon-juniper woodlands; and 5) Disturbance levels that leave seed banks intact; areas with light disturbance when dry and no disturbance when wet.

The 25,484 ac (10,313 ha) of critical habitat encompass all known population areas. Many areas between critical habitat units have been identified as potential habitat. It is likely that increased survey efforts in the following years may find additional areas of occupied habitat outside of the designated critical habitat units

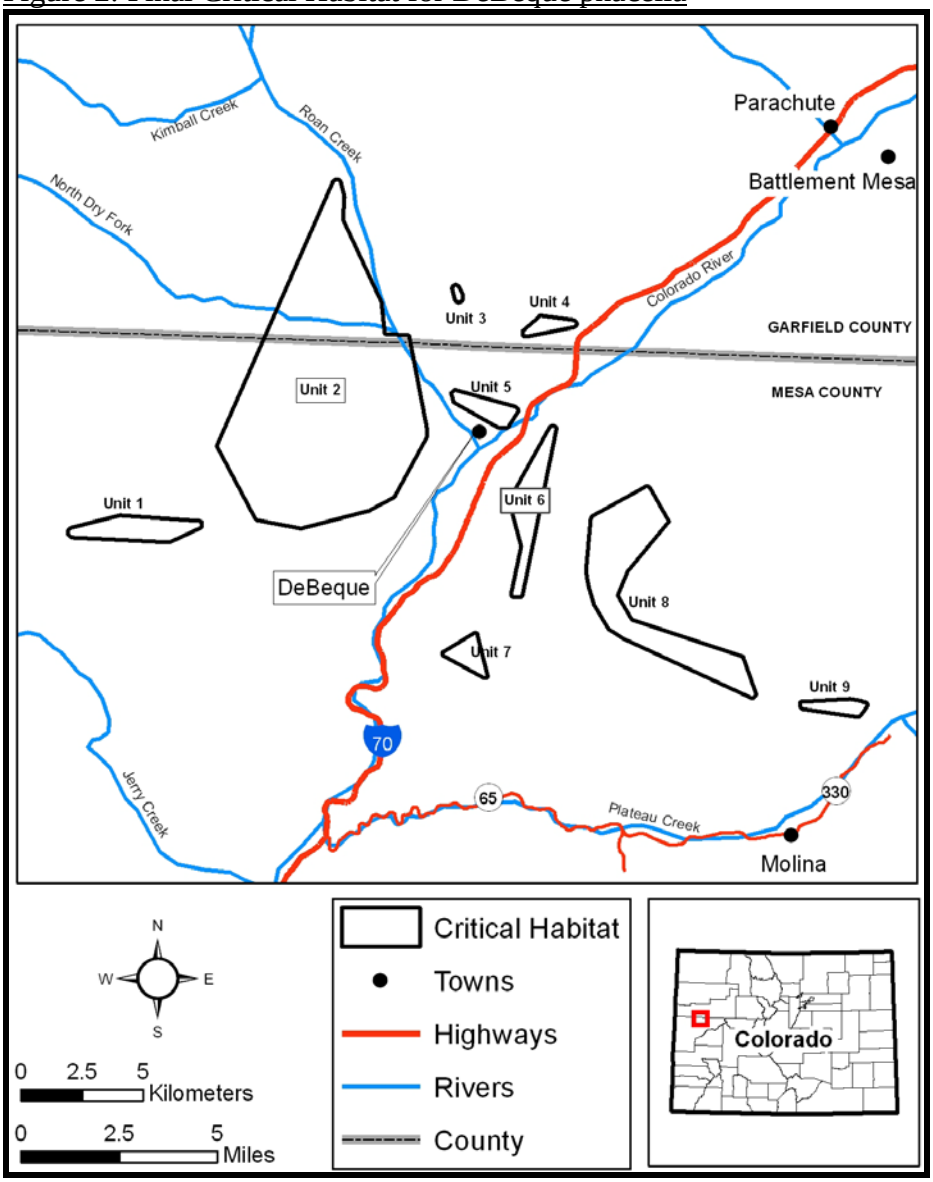
Table 1. DeBeque phacelia Element Occurrences (EOs) by Critical Habitat Unit; ownership and threats are presented (CNHP 2012a; Service 2012)

EOs by Critical Habitat Unit	EO number (#)	High Count Estimates	Habitat acres (ac)	Habitat hectares (ha)	Viability Rank*	Percent Owner-ship	Threats
SULPHUR GULCH							
Sulphur Gulch	26, 28	70	5.9	2.4	H	BLM 100	Weeds
Winter Flats, Sulphur Gulch	42	25	7.7	3.1	D	BLM 100	Weeds
PYRAMID ROCK							
Pyramid Rock	7	3,050	215.9	87.4	B	BLM 100	Off-highway-vehicle (OHV), near road, pipeline, weeds
Pyramid Ridge, Coon Hollow South	3	1,500	49.5	20.0	B	BLM 100	Livestock, near roads, OHV, well pads, weeds
Coon Hollow/B/C	11	11,000	62.5	25.3	AB	BLM 100	Livestock, OHV, pipelines, well pads, weeds
Mount Low, West of DeBeque	17	10,000	13.6	5.5	B	BLM 88 Private 12	Livestock, near roads, OHV, weeds
Dry Fork, Roan Creek	10	800	19.8	8.0	BC	BLM 75 Private 25	Livestock, near roads, pipelines, well pads, weeds
Bloat Gulch, Logan Wash	15	5,820	15.4	6.3	H	BLM 75 Private 25	Near roads
Coon Hollow	25	200	2.1	0.8	H	BLM 100	
ROAN CREEK							
Roan Creek	_	195	5.8	2.3	C	Private 100	
DEBEQUE							
DeBeque West	2	500	7.7	3.1	H	BLM 88 Private 12	Near roads, OHV, weeds
DeBeque East, Cemetery Road	43	20	23.9	9.7	D	BLM 100	Near road, pipelines, weeds

EOs by Critical Habitat Unit	EO number (#)	High Count Estimates	Habitat acres (ac)	Habitat hectares (ha)	Viability Rank*	Percent Owner-ship	Threats
MOUNT LOGAN							
Mount Logan	46	50	7.0	2.8	C	BLM 100	Near roads, OHV, pipelines, weeds
ASHMEAD DRAW							
South of DeBeque	30	67	4.3	1.8	C	BLM 100	Weeds
DeBeque Reservoir, Ashmead Draw	8	210	11.2	4.5	C	BLM 93 Private 7	Livestock, near roads
BAUGH RESERVOIR							
Baugh Reservoir	9	1,000	8.3	3.4	C	BLM 60 Private 40	Livestock, near roads, pipelines, weeds, well pads
HORSETHIEF MOUNTAIN							
Jerry Gulch	_	300	3.2	1.3	C	Private 100	
Moffat Gulch	31	20	2.0	0.8	H	BLM 100	
Housetop Mtn., Jerry Gulch, Atwell Gulch,	48	4,000	20.4	8.2	B	BLM 56 USFS 44	Livestock, weeds, well pads
Horsethief Mtn. NW-SW-WSW, Shire Gulch, South of Horsethief Creek	19	14,429	73.7	29.8	AB	BLM 43 USFS 57	Livestock, near roads, OHV, pipelines, weeds
ANDERSON GULCH							
Anderson Gulch, Round Mtn.	47	15,100	7.5	3.0	A	Private 10 State 90	Livestock, shooting range, weeds
Totals		**68,371**	**558.6**	**226.1**			

*An A indicates those occurrences with the highest number of individuals and best habitat, while a D represents those occurrences with the fewest individuals and degraded habitat. An H represents an occurrence that has not been re-visited in over 20 years.

Figure 2: Final Critical Habitat for DeBeque phacelia



B. VULNERABILITY AND THREATS ASSESSMENT

A detailed discussion of the threats to DeBeque phacelia can be found in the final listing rule published in the Federal Register on August 26, 2011 (76 FR 45054). The final rule identifies the primary threats affecting the survival of DeBeque phacelia. Threats include energy development, utility corridors, livestock use, off-highway vehicle (OHV) recreation, water reservoirs, an inadequacy of regulatory mechanisms, and climate change. We are including nonnative invasive plant species (weeds) as an additional threat, citing new evidence. Descriptions of these threats are detailed below.

a. **The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range (Listing Factor A)**

Oil and Gas Development: Increasing oil and gas development in the Piceance Basin is a significant concern in the recovery of the species. About 95 percent of occupied habitat is on BLM lands leased for energy extraction (Service 2012). Ongoing energy development activities include well pad and road construction, installation of pipelines, and construction of associated buildings, holding tanks, and other facilities. Oil and gas pipelines and well pads are present within thirteen EOs (Service 2012). Several pipelines and pipeline right-of-ways already exist within 20 ft (6 m) of DeBeque phacelia EOs (Lincoln 2008, pers. comm.; Service 2012). Roads used for energy extraction bisect and cross the edges of eleven EOs (Service 2012). Energy activities and the associated development can result in the following impacts to DeBeque phacelia and its habitat:

1. Surface disturbances such as construction of well pads, pipelines, roads, and associated infrastructure can directly affect DeBeque phacelia by removing or damaging live plants and the seed bank.

2. Indirect effects of surface disturbances include:

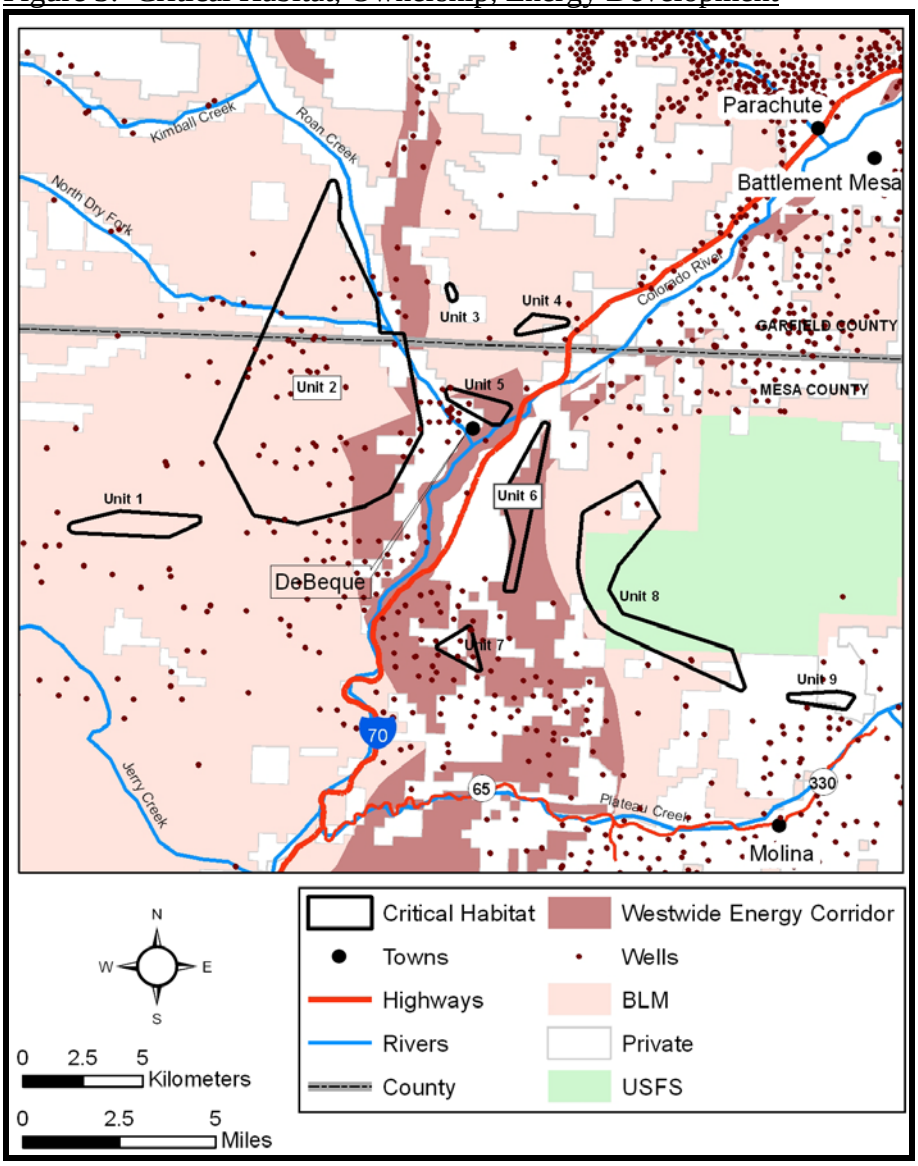
    a. Moist compaction of the soil, burial of seed bank, erosion and removal of seed bank. Disturbances when the soil is moist is of particular concern as moist compaction can form an impenetrable barrier preventing seed germination and reducing water infiltration (DeFalco *et* al. 2009). Ground disturbance that churns of compacts the soil or changes the shrink-swell crack structure is likely to have a deleterious effect on the *in situ* seed bank and, therefore, on successful plant recruitment and survival of the species in subsequent years (Meyer *et al.* 2005).
    b. Increases in fugitive dust and deposition. Dust accumulation on leaf surfaces increases tissue temperature and reduces photosynthesis, thus decreases plant growth, vigor, and water use efficiency (Farmer 1993; Sharifi *et al*. 1997). Dust deposition on stigmatic surfaces can reduce seed production (Farmer 1993). Effects from dust can extend to 300 m from roads (Everett 1980).
    c. Increases in invasive nonnative plant (weed) infestations. See below for additional information about invasive nonnative plants.
    d. Accelerated soil erosion from nearby disturbances may erode soil into occupied habitat or subject habitat to increased runoff.
    e. Alterations of the soil chemical environment of habitat (including an increase in pollutants such as dust, heavy metals, and salt concentrations)
    f. Alterations of the physical environment of habitat (hydrology, sedimentation, erosion, dust).

The cumulative impacts of energy development may create a situation that makes it

difficult to protect these areas. As of August 2, 2012, there were 61 wells (21 abandoned locations, 1 dry and abandoned, 13 plugged and abandoned, 1 waiting on completion, 4 shut in, and 21 producing) within critical habitat. There were also 14 pits that serve as burial sites for gas extraction refuse. Within DeBeque phacelia potential habitat (CNHP 2009) there are 4,382 wells; 3,219 are producing.

Utility and Energy Corridors: Utility and energy corridors provide pathways for future pipelines and electrical transmission lines. A portion of the designated Westwide Energy Corridor crosses 22,404 ac (9,066.6 ha) of BLM land within the range of DeBeque phacelia (see Figure 3) (Service 2012). Eight of the 20 EOs and 13 percent of critical habitat are within the Westwide Energy Corridor (Service 2012). Continued development of pipeline and transmission lines within the energy corridor is likely to affect DeBeque phacelia and its habitat.

Figure 3: Critical Habitat, Ownership, Energy Development



Livestock Use and Trampling: Potential threats related to livestock, deer, and elk use include the direct effects from trampling, and the indirect effects of habitat degradation. Ninety percent of DeBeque phacelia EOs are under management by the BLM as a grazing allotment (Service 2011a). Livestock trampling has occurred or is a threat at 14 EOs (CNHP 2010). Livestock can easily trespass from BLM or private grazing allotments onto USFS property where grazing is not allowed. This has been documented at two occurrences, one obtaining frequent disturbance from its proximity to a pond (Langton 2012). No research or monitoring has been conducted to evaluate the effects of livestock, deer, or elk use on DeBeque phacelia. However, the deleterious effects of livestock on western arid ecosystems are well documented (Milchunas *et al.* 1992; Jones 2000). Some of the adverse effects from livestock include changes in water infiltration due to soil compaction (Jones 2000, Table 1); changes to the physical and structural properties of soils (Kinlock and Friedel 2002); disturbance to soil microbiotic crusts (Evans and Belnap 1999; Jones 2000); subsequent nonnative invasive plant invasions (Parker *et al.* 2006); and soil erosion from hoof action (Jones 2000). Effects from livestock grazing to DeBeque phacelia and its habitat are occurring will likely continue.

Off-Highway Vehicle Use: Off-highway-vehicle (OHV) use occurs on lands throughout the range of DeBeque phacelia. OHV recreation has damaged plants and habitat at seven EOs (CNHP 2012). On Federal lands, vehicles stray from designated roads to climb clay barrens for recreational purposes (Johnston 2012; Mayo 2008d). OHV trespass has even been documented within the Pyramid Rock Natural Area and BLM Area of Critical Environmental Concern (ACEC). The ACEC is fenced with post and cable, and an information sign is posted near an access point. The visible effects of OHV recreation within DeBeque phacelia habitat has been seen to persist for several years (Johnston 2012). Surface disturbances from OHV recreation cause accelerated erosion, fugitive dust production, soil compaction, sedimentation, and potentially irreversible changes to soil physical properties and chemistry (Iverson *et al.* 1981; Pagliali *et al.* 2003). Additionally, these changes in the soil environment can affect ecosystem function (DeFalco 2009. OHV use is expected to increase in the region with the construction of additional roadways for energy development and the increasing popularity of OHV recreation. With OHV recreation within the range of the species, direct losses of plants and the seed bank, as well as indirect affects to the species and its habitat will continue to occur.

Invasive Nonnative Plants: The threat from invasive nonnative plant species (weeds) is a growing concern in the recovery of DeBeque phacelia. Weeds have been documented at 15 EOs (CNHP 2012a). Disturbances such as roads, grading, and livestock grazing generally introduce and spread exotic species (Gelbard and Belnap 2003). Weeds invade and alter all types of plant communities, sometimes resulting in nonnative plant monocultures that support little wildlife or native plants (D'Antonio and Vitousek 1992; Olson 1999; Mooney and Cleland 2001). Many experts believe that, following habitat destruction, nonnative invasive plants are the next greatest threat to biodiversity (Randall 1996). Nonnative invasive plants alter different ecosystem attributes including geomorphology, fire regime, hydrology, microclimate, nutrient cycling, and productivity (Dukes and Mooney 2004). Species known to occur within DeBeque phacelia habitat

include cheatgrass (*Bromus tectorum*), bur buttercup (*Ranunculus testiculatus*), and annual wheatgrass (*Eremopyrum triticeum*). These weeds are prevalent on public and private lands within the range of the DeBeque phacelia. Recent data suggest that weed cover in DeBeque phacelia sites is related to distance from roads, while the number of flowers was found to be higher at distances away from roads (BioLogic 2011). The control of weeds on public lands, especially around well pads, utility corridors, and roads, may also pose a danger to DeBeque phacelia. For example, herbicide drift from well pad spraying has led to the mortality of Colorado hookless cacti near DeBeque (Perkins 2012, pers. comm.).

Water Reservoirs: Two water reservoir projects known as Roan Creek and Sulphur Gulch were proposed within potential and occupied habitat of DeBeque phacelia (Bray and Drager 2008, pers. comm.; Grand River Consulting Corporation 2009). The proposals were withdrawn and are not imminent. However, the sites have been identified as potential reservoir locations that could be developed within 20 years if warranted by increased demands for water. Increased demands are likely, depending on the oil shale market, urban development in Colorado, and less (or altered) precipitation due to climate change. If developed, construction and inundation of these reservoirs would permanently destroy DeBeque phacelia plants and habitat within the project areas.

b. **Overutilization for Commercial, Recreational, Scientific, or Educational Purposes (Listing Factor B)**

We are not aware of activities resulting in the overutilization of DeBeque phacelia plants.

c. **Disease or Predation (Listing Factor C)**

We have no data indicating that disease or predation poses a threat to this species.

d. **The Inadequacy of Existing Regulatory Mechanisms (Listing Factor D)**

Removal, damage, or destruction of plants on private lands is not prohibited under the Endangered Species Act (Act). We are not aware of any state, county, city, or local laws, ordinances or zoning that provide for the protection or conservation of DeBeque phacelia or its habitat. Though no state regulations protect rare plants in Colorado, the Colorado Natural Areas Program manages a State Natural Area on BLM land protecting 510.9 ac (206.7 ha) of the species' habitat within the Pyramid Rock population. This agreement between Colorado Natural Areas Program and the BLM can; however, be terminated with a 90-day written notice by either party. Additional habitat on state land includes 7.5 ac (3 ha) of the Anderson Gulch population. This population contains the only "A"-ranked Elemental Occurrence (CNHP 2012a) meaning it has excellent estimated viability/ecological integrity. The majority of this population (90 percent) is within the Piceance Creek State Wildlife Area and is managed by Colorado Parks and Wildlife.

Removal from Federal lands is prohibited without a permit, but can be allowed through

consultation with the Service. For oil and gas related activities, conservation needs of DeBeque phacelia are addressed through the section 7 process. Through this process, conservation measures are implemented on a project-by-project basis to mitigate or minimize the loss of plants and habitat from energy related activities. Additional protective measures and mitigation of threats are allowed for in the BLM's Resource Management Plans (RMPs):

- The Colorado River Valley Field Office applies no surface occupancy (NSO) stipulations to prevent surface disturbing activities on habitat areas for listed species, which includes occupied and suitable habitat necessary for the maintenance or recovery of the species. Since suitable habitat has not been well defined, CRVFO has only applied NSOs to occupied habitat.
- The Grand Junction Field Office's (GJFO) current RMP does not include direct stipulations for DeBeque phacelia as the species was not a candidate or listed during the RMP process. However, GJFO implements protective measures on a mutual agreement level with project proponents and coordinates with the Service, which serves as an interim guideline to protect the species in the absence of RMP directives.

Both offices are in the process of updating their RMPs. The RMPs do include protective stipulations for DeBeque phacelia, but because these RMPS are still draft and therefore, likely to change we have not discussed specifics here.

Regulations on USFS lands restrict activities to avoid disturbing listed species, unless the activities are not considered a threat. These regulations include No Surface Occupancy stipulations, and address livestock grazing and OHV recreation. However, impacts to DeBeque phacelia are occurring on these lands (Johnston 2012; Langton 2012).

In the final listing rule, we determined that regulatory mechanisms existing prior to listing did not address the threat of energy development, utility corridors, OHV recreation, livestock grazing, and water reservoirs (76 FR 45054). With the listing, projects on Federal lands are required to undergo section 7 consultation to avoid and minimize affects to the species.

e. Other Natural or Manmade Factors Affecting its Continued Existence (Listing Factor E)

<u>Climate Change and Drought:</u> According to the Intergovernmental Panel on Climate Change (IPCC), "Warming of the climate system in recent decades is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global sea level" (IPCC 2007). Research indicates that warming is occurring more rapidly in the southwest region of the United States that elsewhere in the country with an increase of 1.5°F (0.8°C) since 1979 (Karl *et al.* 2009). Additionally in the west, the onset of spring has been advancing since the 1970's (Cayan *et al.* 2001). Annual temperature is predicted to increase approximately 2.2°C (4°F) in the southwest by 2050, with summers warming more than winters (Ray et

al. 2008). Effects of climate change include persistent or prolonged drought conditions, changes in the vegetative community including increased invasions by weeds (Everard et al. 2010). Climate change is likely to affect many rare plant species because seed germination, seed dormancy, and persistence of the seed bank are all directly dependent on precipitation and temperature patterns (Levine *et al.* 2008). However, we do not understand how these changes may affect the long-term persistence of DeBeque phacelia because no information is available on the ecology of the species. Improved localized projections and precipitation models are also needed to better understand the threat of climate change to the species. The potential impacts of climate change will be significant at a global scale and we expect the predicted increased drought conditions to affect the recovery of DeBeque phacelia.

III. PRELIMINARY RECOVERY STRATEGY

A. RECOVERY VISION

DeBeque phacelia is listed as threatened throughout its range. The goal of recovery efforts will be to develop and implement proactive conservation measures that reduce threats to the species to the point that it no longer requires the protections of the Act and may be removed from the Federal List of Endangered and Threatened Wildlife and Plants (delisted). Recovery efforts will focus primarily on Federal lands, since over 86.6 percent of the species' habitat occurs on these lands. By priority number, we envision recovery for DeBeque phacelia to include:

Potential criteria #1: Protect and maintain all extant populations

Potential criteria #2: Prevent or minimize habitat-disturbing threats

Potential criteria #3: Develop and implement rangewide monitoring

B. RECOVERY PRIORITY NUMBER WITH RATIONALE

DeBeque phacelia is currently assigned a recovery priority number of 14C. This ranking recognizes that:
(1) DeBeque phacelia is a full species;
(2) It faces a low degree of threat;
(3) It has a high potential for recovery; and
(4) It is in conflict with development activities or other forms of economic activities.

We determined the threats to DeBeque phacelia are low because plants and habitat will be protected by section 7 consultations on Federal lands, OHV impacts are dispersed, and invasive nonnative plants are not at the point where they are competitively excluding the growth and reproduction of the species. Recovery potential is high because of the potential for protection of known populations, and the likelihood of discovering of new populations.

Additional information from current and future studies could influence the recovery priority number. This includes data on the species reproductive biology, habitat requirements, range, genetics, long-term demographics, and threats. Therefore, this recovery priority number will be reviewed periodically by the Service and as new data are made available.

C. INITIAL ACTION PLAN

Recovery needs for DeBeque phacelia include: 1) Protection of populations from direct and indirect threats; 2) surveys to accurately document populations and suitable habitat; 3) rangewide monitoring program to track species trend, abundance, and threats; 4) and continuation of current research and initiation of new studies to obtain habitat requirements, effects of threats, and other information necessary to develop effective recovery actions. Specific actions include:

Protection of Extant Populations and Habitat

- Establish and implement protective measures for all known populations.

Threats Abatement

- Implement protective measures such as fencing, controlled management of livestock use, nonnative species control and additional measures to avoid or minimize impacts to the species and its habitat.
- Coordinate with land managers, project proponents, and other partners early in the planning process to limit direct and indirect effects of oil and gas development, grazing, OHV recreation, weeds, and additional threats that arise.
- Work with land management agencies and other partners to formally establish land management designations to provide for long-term protection of populations and habitat.
- Ensure that additional oil and gas leases avoid or take into consideration occupied and suitable habitat.
- Consider installing livestock exclosures for both protection and monitoring purposes.

Surveys and Monitoring

- Complete a comprehensive survey throughout the species' range, including areas designated as "potential habitat". Survey results should provide an accurate population estimate and allow us to identify core population areas so we can more effectively protect the species.
- Establish a survey protocol to identify areas of suitable habitat during years in which few above-ground plants are found. This protocol must take into account an evaluation of habitat components that support DeBeque phacelia.
- Establish a long-term monitoring plan to document rangewide population demographics and trends, and quantify the affects from threats. An adaptive management approach that uses feedback from implemented, site-specific recovery tasks should be integrated into the plan to inform recovery activities.
- Gain permission from private landowners to survey for DeBeque phacelia on

private lands with potential habitat.

Research

- Continue research into DeBeque phacelia life history and ecology, including pollination biology, seed bank density, seed bank longevity, seed germination ecology, and habitat and soil requirements.
- Study population genetics and demographics.
- Conduct a population viability analysis.
- Conduct investigations that project DeBeque phacelia vulnerability and response to climate change.
- Improve our understanding of livestock and native ungulate grazing impacts.
- Monitor changes in invasive species prevalence and conduct research on impacts to DeBeque phacelia.
- Continue to refine a survey protocol for delineating suitable habitat.
- Continue to analyze the effects of dispersed oil and gas development and roads.

Seed Banking

- Store genetic material in the form of seed in an appropriate repository to provide a back-up supply of genetic stock that represents as much of the available genetic diversity within the species as possible.

IV. PREPLANNING DECISIONS

A. PLANNING APPROACH

A recovery plan will be prepared for DeBeque phacelia pursuant to section 4(f) of the Act. The recovery plan will include objective, measurable criteria which, when met, will result in a determination that the species be removed from the Federal List of Endangered and Threatened Plants. Recovery criteria will address all threats meaningfully impacting the species. The recovery plan will estimate the time and costs required to carry out those measures needed to achieve the goal of recovery and delisting. This plan will be a single-species plan.

Plan preparation will be under the stewardship of Western Colorado Ecological Services Field Office. At the present time, this species does not warrant the appointment of a recovery team. The Service will coordinate recovery efforts with an informal network of experts and involved parties (see Stakeholder Involvement below). A recovery team may be formally appointed at a later date, if deemed necessary. Periodically, meetings among these parties may be convened for the species with the purpose of sharing information and ideas about advancing DeBeque phacelia recovery.

B. INFORMATION MANAGEMENT

General: All information relevant to recovery of DeBeque phacelia will be housed in administrative files found at our Western Colorado Ecological Services Field Office in

Grand Junction, Colorado. The lead botanists will be responsible for maintaining the official record for the recovery planning and implementation process. Copies of new study findings, survey results, records of meetings, comments received, and other relevant information should be forwarded to this office (see Listing and Contact Information section above).

Reporting requirements: Information needed for annual accomplishment reports, the Recovery Report to Congress, expenditures reports, and implementation tracking should be forwarded to this office (see Listing and Contact Information section above). Copies of the completed reports can then be disseminated to all contributors upon request.

C. RECOVERY PLAN PRODUCTION SCHEDULE

The following dates are dependent on personnel and funding being available to complete the recovery planning process.

Internal review draft:	December 2013
Public review draft:	April 2014
Public comment period ends:	July 2014
Final recovery plan:	April 2015

D. STAKEHOLDER INVOLVEMENT IN THE RECOVERY PROCESS

Possible Stakeholders:

- Public land managers with DeBeque phacelia on their lands, including representatives of BLM (Grand Junction Field Office, Colorado River Valley Field Office, BLM State Office), USFS (White River National Forest and Grand Mesa Uncompahgre Gunnison National Forest)
- State land managers such as Colorado Parks and Wildlife and Colorado Natural Areas Program
- Conservation organizations such as The Nature Conservancy, the Center for Plant Conservation, Denver Botanic Gardens, and Colorado Natural Heritage Program
- Research institutions including Utah State University and the U.S. Geological Survey
- Town and county officials for Mesa and Garfield Counties, Colorado
- Representatives from energy corporations
- Western Colorado environmental consultants
- Individuals with livestock grazing leases and affiliated livestock industry organizations
- Local OHV recreation organizations
- Private landowners
- Mining lease holders on public lands

Stakeholder Involvement Strategy: Early in the recovery planning process, we will hold a meeting of individuals working with DeBeque phacelia to exchange status information and identify recovery issues. Information emanating from this discussion will help shape the initial draft for the recovery plan. We will reach out to the above potential stakeholder groups to facilitate involvement of all interested parties.

DeBeque phacelis (*Phacelia submutica*) Recovery Outline

Approve: _____ Date 1·11·13

Deputy Regional Director, Region 6

References Cited

Anderson, T. M., Schütz, M., & Risch, A. C. (2012). Seed germination cues and the importance of the soil seed bank across an environmental gradient in the Serengeti. *Oikos, 121*(2), 306-312.

Baskin, C. C., and J.M. Baskin. (1998). Seeds: ecology, biogeography, and evolution of dormancy and germination. Academic Press, New York, New York, USA., 666 p.

BioLogic Inc. Natural Resource Consultants. (2011). A study of the impacts of oil and gas development on *Phacelia submutica* and *Sclerocactus* spp; 2011 Field Study Report, February 16, 2012. 13 pp.

Burt, J., and S. Spackman. (1995). Status Report for *Phacelia submutica* Howell. Unpublished Report, Colorado Natural Heritage Program, Fort Collins, Colorado. 45 pp.

Cayan, D.R., S.A. Kammerdiener, M.D. Dettinger, J.M. Caprio, & D.H. Peterson. (2001). Changes in the onset of spring in the western United States. *Bulletin of the American Meterological Society, 82*(3), 399-415.

Colorado Natural Heritage Program (CNHP). (2010). Element Occurrence Reports for *Ipomopsis polyantha*, *Penstemon debilis*, and *Phacelia submutica*. Colorado State University, Fort Collins, Colorado. 82 pp.

Colorado Natural Heritage Program (CNHP). (2012a). Element Occurrence Reports for *Phacelia submutica*. Colorado State University, Fort Collins, Colorado. 54 pp.

Colorado Natural Heritage Program (CNHP). (2012b). Element Global Reports. Colorado State University, Fort Collins, Colorado. 167 pp.

D'Antonio, C.M., and P.M. Vitousek. (1992). Biological invasions by exotic grasses, the grass/fire cycle, and global change. *Annual Review of Ecology and Systematics, 23*, 63-87.

DeFalco, L. A., Esque, T. C., Kane, J. M., & Nicklas, M. B. (2009). Seed banks in a degraded desert shrubland: Influence of soil surface condition and harvester ant activity on seed abundance. *Journal of Arid Environments, 73*(10), 885-893.

Dukes, J.S. and H.A. Mooney. (2003). Disruption of ecosystem processes in western North America by invasive species. *In* Bradshaw, P.A. Marquet, H.A. Mooney (editors), How landscapes change: Human disturbance and ecosystem disruptions in the Americas, series: Ecological studies Vol 162. G.A.. 66 pp.

Donnell, J.R. (1969). Paleocene and Lower Eocene Units in the Southern Part of the Piceance Creek Basin, Colorado. *Contributions to Stratigraphy. U.S. Geological Survey Bulletin* 1274-M. 18 pp.

Evans R. D., and J. Belnap. (1999). Long-term consequences of disturbance on nitrogen dynamicsin an arid ecosystem. *Ecology 80*(1):150-160.

Everard, K., E.W. Seabloom, W.S. Harpole, and C. deMazancourt. (2010). Plant water use affects competition for nitrogen: why drought favors invasive species in California. *The American Naturalist 175*:85-97.

Everett, K.R. (1980). Distribution and properties of road dust along the northern portion of Haul Road. *In* Brown, J. and Berg, R. (eds.). Environmental engineering and ecological baseline investigations along the Yukon River-Prudhoe Bay Haul Road. *U.S. Army Cold Regions Research and Engineering Laboratory, CRREL Report,* 80-19: 101-128.

Farmer, A.M. (1993). The effects of dust on vegetation—a review. *Environmental Pollution 79*:63-75.

Fowler, N. L. (1988). What is a Safe Site?: Neighbor, Litter, Germination Date, and Patch Effects. *Ecology, 69*(4), 947-961.

Federal Register Notice. (2011). Volume 76, Pages 45054-45075. Endangered and threatened wildlife and plants; determination of endangered status for *Ipomopsis polyantha* (Pagosa skyrocket) and threatened status for *Penstemon debilis* (Parachute beardtongue) and *Phacelia submutica* (DeBeque phacelia).

Federal Register (Notice). (2012). Volume 77, Pages 48368-48418. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for *Ipomopsis polyantha* (Pagosa skyrocket), *Penstemon debilis* (Parachute beardtongue) and *Phacelia submutica* (DeBeque phacelia).

Gelbard, J.L. and J. Belnap. (2003). Roads as conduits for exotic plant invasions in a semiarid landscape. *Conservation Biology 17*(2): 420-432.

Grand River Consulting Corporation. (2009). Summary of Preferred Alternative – 10825 Waterfrom Granby and Ruedi Reservoirs. Glenwood Springs, Colorado. 15 pp.

Halse, R.R. (1981). Taxonomy of *Phacelia* sect. *Miltitzia* (Hydrophyllaceae). *Madroño 28*(3):121-132.

Howell, J.T. (1944). A Revision of *Phacelia* section *Miltitzia* (Hydrophyllaceae). *Proceedings of the California Academy of Sciences 25* (15):357-376.

Intergovernmental Panel on Climate Change (IPCC). (2007). Climate Change 2007: Synthesis Report. An Assessment of the Intergovernmental Panel on Climate Change. 52 pp.

Iverson, R. M., Hinckley, B. S., Webb, R. M., & Hallet, B. (1981). Physical Effects of Vehicular Disturbances on Arid Landscapes. *Science, 212*(4497), 915-917.

Johnston, B. (2012). Photographs of OHV impacts on National Forest lands: DSC_5574.jpg, DSC_5587,jpg, and 2-4.jpg. Grand Mesa Uncompahgre Gunnison National Forest, Montrose, CO.

Jones, A. (2000). Effects of cattle grazing on North American arid ecosystems: A quantitative review. *Western North American Naturalist*, 60 (2), 155 – 164.

Karl, T.R., J.M. Melillo, and T.C. Peterson [eds]. (2009). Global Climate Change Impacts in the United States. Cambridge University Press. 196 pp.

Kinlock, J.E., M.H. Friedel. (2005). Soil seed reserves in arid grazing lands of central Australia. Part 2: Availability of 'safe sites'. *Journal of Arid Environments* 60: 163-185.

Langton, A.M. (2012). Proposal to fence *Phacelia submutica* research site [on USFS land]. April 4, 2012.

Langton, A.M. and E.W. Schupp (2012a). Report to Colorado Natural Areas Program: *Phacelia submutica* breeding system and seed bank study. January 25, 2012.

Langton, A.M. and E.W. Schupp (2012b). Report to Colorado Natural Areas Program: *Phacelia submutica* breeding system, seed bank, and habitat study. November 1, 2012.

Levine, J.M., A.K. McEachern, and C. Cowan. (2008). Rainfall effects on rare annual plants. *Journal of Ecology 96*:795–806.

Mayo, E. (2008d). Photograph of ORV impact on *Phacelia submutica* occurrence ID# 4167. U.S. Fish and Wildlife Service, Grand Junction, CO.

Meyer, S.E., D. Quinney and J. Weaver. (2005). A life history study of the Snake River plains endemic *Lepidium papilliferum* (Brassicaceae). *Western North American Naturalist 65*(1): 11-23.

Milchunas, D.G., W.K. Lauenroth, P.L. Chapman. (1992). Plant competition, abiotic, and long- and short-term effects of large herbivores on demography of opportunistic species in a semiarid grassland. *Oecologia 92*: 520-531.

Mooney, H.A. and E.E. Cleland. (2001). The evolutionary impact of invasive species. *Proceedings of the National Academy of Sciences, 98*(10), 5446-5451.

O'Kane, S.L. (1987). Status Report for *Phacelia submutica*. Unpublished document, Colorado Natural Areas Program, Denver, Colorado. 71 pp.

Olson, B. E. (1999). Impacts of noxious weeds on ecologic and economic systems. Pages 4-18 in R. L. Sheley and J. K. Petroff, eds. Biology and Management of Noxious Rangeland Weeds. Corvallis, OR: Oregon State University Press.

Pagliai, M., Marsili, A., Servadio, P., Vignozzi, N., & Pellegrini, S. (2003). Changes in some physical properties of a clay soil in Central Italy following the passage of rubber tracked and wheeled tractors of medium power. *Soil and Tillage Research, 73*(1–2), 119-129.

Parker, J.D., D.E. Burkepile, M.E. Hay. (2006). Opposing effects of native and exotic herbivores on plant invasions. *Science 311*: 1459 – 1461.

Randall, J. (1996). Weed control for the preservation of biological diversity. *Weed Technology 10*:370-383.

Ray, A.J., J.J. Barsugli, K.B. Averyt, K. Wolter, M. Hoerling, N. Doesken, B. Udall, and R.S. Webb. (2008). Climate change in Colorado: A synthesis t support water resources management and adaptation. A report by the western water assessment for the Colorado Water Conservation Board. 8 pp.

Sharifi, M.R., A.C. Gibson and P.W. Rundel. (1997). Surface dust impacts on gas exchange in Mojave Desert shrubs. *Journal of Applied Ecology 34*(4): 837-846.

U.S. Fish and Wildlife Service (Service). (2011a). Occupied, critical habitat, and threat areas for *Ipomopsis polyantha*, *Penstemon debilis*, and *Phacelia submutica* with ownership. 13 pp.

U.S. Fish and Wildlife Service (Service). (2011b). Physical features for *Ipomopsis polyantha*, *Penstemon debilis*, and *Phacelia submutica*. 3 pp.

U.S. Fish and Wildlife Service (Service). (2012). Geospatial analysis of DeBeque phacelia and threats. 2 pp.

U.S Geological Survey. (2012). Preliminary report on some soil characteristics of *Phacelia submutica* habitat. 7pp.

Personal Communications

Bray, T., and J. Drager. (2008). E-mail message from Denver Water and Northern Colorado Water Conservancy District regarding the proposed Sulphur Gulch Reservoir. 1 p.

Lincoln, A. (2008). E-mail message from Anna Lincoln regarding surveys of DeBeque phacelia in pipeline right-of-ways.

Perkins, J. (2012). E-mail message from Judy Perkins regarding damage to *Sclerocactus glaucus* plants by herbicide treatment on BLM property.