U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Lepidium ostleri

Common Name:

Ostler's Peppergrass

Lead region:

Region 6 (Mountain-Prairie Region)

Information current as of:

05/03/2016

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Taxon mistakenly included in past notice of review

___ Taxon does not meet the definition of "species"

___ Taxon believed to be extinct

___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

___ Insufficient information exists on taxonomy, or biological vulnerability and threats, to support listing

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 07/30/2007

90-Day Positive:08/18/2009

12 Month Positive:02/23/2011

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The ï¿½Progress on Revising the Listsï¿½ section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Utah
- **US Counties**: Beaver, UT
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Utah
- **US Counties**: Beaver, UT
- **Countries**: United States

Land Ownership:

All known populations of *Lepidium ostleri* (Ostler's peppergrass) occur on private lands in the southern San Francisco Mountains in Beaver County, Utah.

Lead Region Contact:

ASST REGL DIR-ECO SVCS, Craig Hansen, 303-236-4749, Craig_Hansen@fws.gov

Lead Field Office Contact:

UT ESFO, Jennifer Lewinsohn, 801-975-3330, jennifer_lewinsohn@fws.gov

Biological Information

Species Description:

Lepidium ostleri (Ostler's peppergrass) is a long-lived perennial herb in the mustard family (Brassicaceae). For the purposes of this document, we will refer to *Lepidium ostleri* as "Ostler's peppergrass." It grows in dense cushion-like tufts up to 2 inches (in.) (5 centimeters (cm)) tall (Welsh *et al.* 2008, p. 328). The grayish-green hairy leaves are 0.16 to 0.59 in. (4 to 15 millimeters (mm)) long, generally linear, and entire or with lobed basal leaves (Welsh *et al.* 2008, p. 328). Flowering stalks are approximately 0.39 in. (1 cm) long with 5 to 35 flowers that are white or have a purple tint (Figure 1; Welsh *et al.* 2008, p. 328).

Figure 1. Ostler's peppergrass. Photo: D. Roth, USFWS

Taxonomy:

Ostler's peppergrass was first described as *Lepidium ostleri* in 1980 by Stan Welsh and Sherel Goodrich based on a collection by Stan Welsh and Matt Chatterly (Welsh and Goodrich 1980, entire; Kass 1992, p. 1). Ostler's peppergrass has not undergone any taxonomic revisions since it was originally described. We accept the current taxonomy and consider Ostler's peppergrass a listable entity under the Endangered Species Act (ESA).

Habitat/Life History:

Ostler's peppergrass is a narrow endemic restricted to soils derived from Ordovician limestone outcrops (Evenden 1998, p. 5). There are approximately 845 acres (ac) (342 hectares (ha)) of Ordovician limestone outcrops in the San Francisco Mountains (Miller 2010a, Appendix F). In addition, there are 719 ac (291 ha) of Cambrian dolomite substrates in the San Francisco Mountains where there is the potential for small "islands" of Ordovician limestone outcrops to occur within these substrates (Miller 2010a, Appendix F, p. 7). We do not know if there are other limiting factors associated with the limestone formations that restrict the habitat use and distribution of Ostler's peppergrass within this suitable habitat substrate, but Ostler's peppergrass occupies only a fraction of the available habitat.

Ordovician limestone is rare within a 50-mile (mi) (80-kilometer (km)) radius of the San Francisco Mountains (Miller 2010a, Appendix F). Cambrian dolomite substrates are present in the Wah Wah Mountains to the west of the San Francisco Mountains (Miller 2010a, Appendix F). However, there is no indication that additional populations of the species occur in these areas.

Ostler's peppergrass is associated with pinion-juniper and sagebrush communities between 6,200 and 7,228 ft (1,890 and 2,203 m) in elevation. Plants are typically found on sparsely vegetated exposed slopes with *Ephedra spp.* (Mormon tea), *Gutierrezia sarothrae* (snakeweed), *Cercocarpus intricatus* (dwarf mountain-mahogany), and *Petradoria pumila* (rock goldenrod). Associated rare species include *Eriogonum soredium* (Frisco buckwheat) and *Trifolium friscanum* (Frisco clover).

Flowering generally occurs from June to early July, followed by fruit set from July to August (Welsh *et al.* 2008, p. 328). No additional information is available on the life history of Ostler's peppergrass.

Historical Range/Distribution:

Ostler's peppergrass is historically and currently known from four populations in the southern San Francisco Mountains in Beaver County, Utah (Kass 1992, p. 5; Evenden 1998, p. 5; Miller 2010a, p. 6; Roth 2010, pp. 1–2; Hildebrand 2013, p. 18).

Current Range Distribution:

The total range of Ostler's peppergrass is less than 5 square miles (sq mi) (13 square kilometers (sq km)). We know of only four populations of this species; all four populations are on private lands in the southern San Francisco Mountains in Beaver County, Utah (Miller 2010a, p. 6; Roth 2010, pp. 1–2). Each population occupies a relatively small area ranging between 5 ac (2 ha) and 29 ac (12 ha) with localized high densities of plants (Figure 2; Evenden 1989, Appendix C; Miller 2010a, Appendix B). The total area occupied by Ostler's peppergrass is only 52 ac (21 ha), or just 6 percent, of the available Ordovician limestone outcrops. Despite additional searches in the San Francisco Mountains and surrounding areas (including the Confusion Range, the Mountain Home Range, and the Tunnel Springs Mountains), no other populations are known to occur in these areas (Kass 1992, pp. 4–5; Evenden 1998, pp. 6–7, Appendix C; Evenden 1999, pp. 2–3; Miller 2010c, pp. 1, 4; Miller 2010d, pers. comm.; Roth 2010, p. 4; Hildebrand 2013, p. 19).

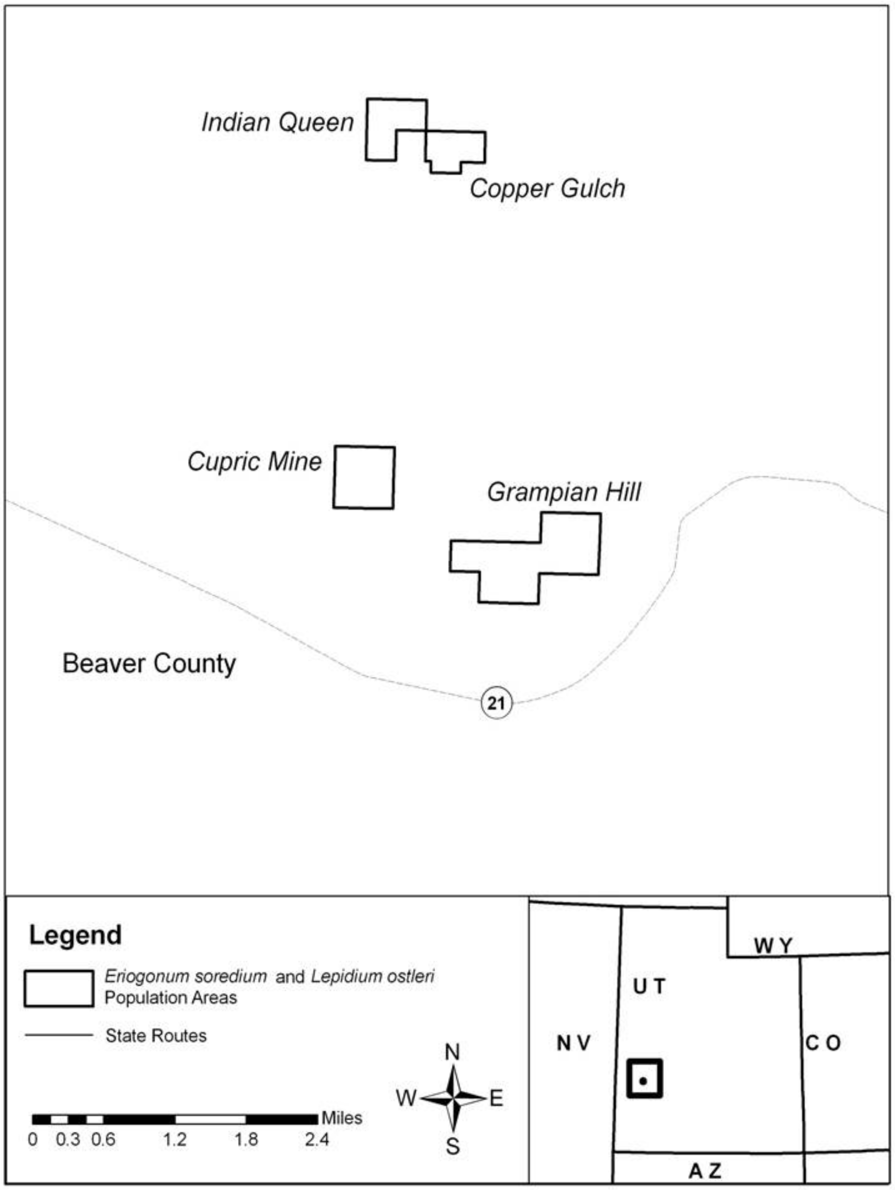

Figure 2. Ostler's peppergrass' range.

Population Estimates/Status:

All known Ostler's peppergrass populations are located on private lands (Miller 2010a, p. 6; Roth 2010, pp. 1–2). Their occurrence on these private lands hinders our ability to collect accurate long-term population counts or trend information because of access limitations. Populations were visited sporadically over the last couple of decades; however, we have no information on sampling methods used by individual surveyors. Common field techniques used to estimate population size tend to be highly subjective in the absence of actual population counts. Population estimates also may be skewed by how the species grows. The species grows in low, mound-forming clusters, making it difficult to distinguish individual plants—some observers may assume each cluster is one plant and other observers might apply a multiplier to each cluster to count them as multiple plants; therefore, using either of these methods would greatly skew the resulting population estimate. We believe these biases help explain the seemingly large fluctuations in numbers of plants observed during different surveys (see below). Ostler’s peppergrass is a robust, long-lived perennial plant that is unlikely to exhibit such extreme population fluctuations (Garcia *et al.* 2008, pp. 260–261).

We lack demographic information, which is measured by studying the size, distribution, composition, and changes within a specified population over time. Rather, we have surveys that were done over time with varying degrees of effort. Accordingly, available population estimates range from a total of 700 individuals (Kass 1992, p. 8) to approximately 17,000 individuals in the 1990s (Evenden 1998, Appendix C). Currently, the total number of Ostler's Peppergrass plants is estimated at approximately 42,000 (Table 1; Miller 2010a, pers. comm.; Miller 2010b, pp. 2–5; Roth 2010a, p. 4). However, due to the aforementioned survey inaccuracies, we are not able to determine accurate population estimates or trends for this species. In 2010, the most recent year surveys were done, the species was documented at all four known populations (Miller 2010a, entire).

Table 1. Estimated number of Ostler’s peppergrass plants (Miller 2010a, entire; Miller 2010c, entire; Roth 2010, entire).

Population	Land Ownership/Sites	Survey Year	Estimated Population Size
Grampian Hill	Private (3 sites)	2010	2,000
Cupric Mine	Private (3 sites)	2010	1,000
Copper Gulch	Private (2 sites)	2010	34,000
Indian Queen	Private (1 site)	2010	5,000
Estimated Total Population			42,000

Distinct Population Segment(DPS):

Not applicable.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Our February 23, 2011, 12-month finding (76 FR 10166) evaluated multiple potential threats to

Ostler's peppergrass. Our discussion below is focused on the primary threats affecting the species, including habitat destruction and associated impacts from precious metal and gravel mining on private lands, and the invasion of nonnative species.

Mining

Mining activities that occur throughout Ostler's peppergrass' range include mining for precious metals and gravels. Mining activities can impact Ostler's peppergrass by removing habitat substrate, increasing erosion potential, fragmenting habitat through access road construction, degrading suitable habitat, and increasing invasive plant species (Brock and Green 2003, p. 15; BLM 2008a, pp. 448–449). Impacts to Ostler's peppergrass individuals include crushing and removing plants, reducing plant vigor, and reducing reproductive potential through increased dust deposits, reduced seedbank quantity and quality, and decreased pollinator availability and habitat (Brock and Green 2003, p. 15; BLM 2008a, pp. 448–449).

Precious Metal Mining

The San Francisco Mountains have an extensive history of precious metal mining activity (Evenden 1998, p. 3). All four of the known populations and much of the species' potential habitat overlapped with precious metal mining activities in the past, as evidenced by a high density of mine shafts, tailings, and old mining roads throughout the habitat of Ostler's Peppergrass (Table 2; Kass 1992, p. 10; Evenden 1998, p. 3; Roth 2010, p. 2).

Historical precious metal mining related activities resulted in surface disturbance, increased foot and vehicle traffic, vegetation disturbance, and removal of top soil and overburden. Surface disturbance was extensive and concentrated around the Horn Silver and Cactus Mines due to the high productivity of these mines. As a result, the majority of the 21 acres within these claims were disturbed. Less productive mines resulted in 1 acre or less of disturbance within the 21 acre claim. This footprint includes mine shafts, prospect pits, overburden areas, and roads (Ginouves 2015b). Potential impacts to Ostler's peppergrass from these activities include mortality of individuals, localized population mortality, habitat loss, degradation and fragmentation, increased soil erosion, reductions in pollinator populations, reductions in plant vigor and reproductive potential, reductions in seed bank quantity and quality, and increasing invasive plant occurrences (Brock and Green 2003; BLM 2008c). There is also the potential for release or exposure to toxic chemicals and wastes. Similar impacts to Ostler's peppergrass would be expected in the future if precious metal mining continues.

Large-scale precious metal mining ceased decades ago. However, all precious metal mining claims in the southern San Francisco Mountains are patented (a claim for which the Federal Government has passed its title to the claimant, making it private land) and continued occasional explorations for silver, zinc, and copper deposits are reported for the area (Bon and Gloyn 1998, p. 12; Franconia Minerals Corporation 2002, p. 1). In fact, in 1998 this area was one of the most active precious metal exploration areas in the state (Bon and Gloyn 1998, pp. 11–12). The San Francisco mineral district is the sixth most productive copper mining district in Utah and approximately the eighth largest metal district in Utah (BLM 2012, p. 107).

Table 2. Mining activities in Ostler's peppergrass' habitat.

	MINING ACTIVITY		
Population	**Historical**	**Current**	**Future**
Grampian Hill	silver, lead, copper, zinc (Horn Silver Mine)	None	silver, lead, copper, zinc, landscape gravel quarrying
Cupric Mine	silver, lead, copper, zinc, gravel quarrying (Cupric Mine)	gravel quarrying (Southern White/Mt Rose Mine)	silver, lead, copper, zinc, landscape gravel quarrying
Copper Gulch	silver, lead, copper, zinc, gravel quarrying (Cactus Mine)	gravel quarrying	silver, lead, copper, zinc, landscape gravel quarrying
Indian Queen	silver, lead, copper, zinc, gravel quarrying (Cactus Mine)	gravel quarrying	silver, lead, copper, landscape gravel quarrying

We believe precious metal mining will occur in the future at all four Ostler's peppergrass populations. The likely continuation of precious metal mining within the range of Ostler's peppergrass is supported by economic forecasts of an increasing future demand for silver and copper (Crigger 2010, pp. 1–2; Murdoch 2010, pp. 1–2). The price for silver nearly tripled over the last decade (Stoker 2010, p. 2), and the market for silver is expected to grow in the future due to its high demand for industrial uses in solar panel construction, wood preservatives, and medical supplies (Ash 2010, p. 1). Since 2009, the value of copper increased more than 140 percent (Crigger 2010, pp. 1–2; Murdoch 2010, pp. 1–2). The market for copper, one of the world's most widely used industrial metals, is expected to increase in the future due to demand for electrical wiring, plumbing, and car fabrication (Crigger 2010, pp. 1–2; Murdoch 2010, pp. 1–2). In Utah, precious metals accounted for approximately 14 percent of the total value of minerals produced in 2009 (up from 8 percent in 2008) (Utah GOPB 2010, pp. 195–196). Utah's precious metal gross production value increased $221 million (57 percent) compared to 2008, due to increased production of both gold and silver (Utah GOPB 2010, p. 196). Because the San Francisco Mountains area was one of the most productive areas during the last large-scale precious metal mining effort, it is reasonable to assume that it will become important again, particularly given the ongoing exploration activities at the mines.

The Grampian Hill population is surrounded to the east by old mine shafts associated with the King David Mine, which is part of the historical Horn Silver Mine. The Horn Silver Mine was one of the largest silver mines in the country until it collapsed in 1885 (Murphy 1996, p. 1; Evenden 1998, p. 3). Exploration activities were reinitiated at the Horn Silver Mine in 2002, confirming that extensive amounts of sphalerite (the major ore of zinc) remain in the mine (Franconia Minerals Corporation 2002, p. 1). Therefore, we anticipate precious metal mining to continue and expand in the Grampian Hill population.

The Cupric Mine population is located immediately above a mine shaft associated with the Cupric Mine, a historical copper mine. Although large-scale precious metal mining in the Cupric Mine ceased decades ago, we believe mining is likely to occur again in the foreseeable future due to patent rights and ongoing exploration for silver, zinc, and copper deposits, as evidenced by recent exploration activities at the Horn Silver Mine.

Old mine shafts are also located within 0.3 mi (0.5 km) of the Copper Gulch population; at the Cactus Mine, another historical copper mine. Despite past production from the Cactus mine of approximately 1.27 million tons (1.40 million standard tons) of recovery grade precious metals, the mine is reported to still contain a similar amount of unrecovered mineral resource (BLM 2012, p. 107). Therefore, we anticipate precious metal mining to continue and expand in the area of the Cactus mine and Copper Gulch population.

The Indian Queen population contains two mine shafts directly within the population and three additional mine shafts immediately adjacent to this population. These mine shafts also are part of the historical Cactus Mine. As mentioned in the above paragraph, a large amount of recoverable mineral resources remain in the deposits associated with the historical Cactus Mine. Therefore, we anticipate precious metal mining to continue and expand in the area of the Cactus mine and Indian Queen population.

In 2012, the Utah Division of Oil, Gas and Mining's (UDOGM) Abandoned Mine and Reclamation Program coordinated with us on a project to implement avoidance and minimization measures for Ostler's peppergrass when closing mine openings in the vicinity of the species. The purpose of closing the mine openings is for human safety, and does not indicate that a mine is permanently closed to future mining. Once closed, a mine may be reopened again by the claimant at any time. As of 2014, UDOGM had completed the closure of 150 abandoned mine openings (Rohrer 2015a, p. 1). To date, Ostler's peppergrass has not been found at or near any of the completed or proposed mine closing locations (Transcon Environmental 2012). The original scope of the project was reduced from 220 closures due to the planned continuation of mining at currently closed mines. At this time, there are no plans to complete future mine closures in the San Francisco range where Ostler's peppergrass populations occur (Rohrer 2015b, p. 1).

Gravel Mining

Gravel mining is known to occur within Ostler's peppergrass' range in the San Francisco Mountains. Ostler's peppergrass is endemic to soils derived from Ordovician limestone that is removed from quarries and sold for marble landscaping gravel. Marble landscaping gravel quarries in Ostler's peppergrass' range are open-pit mines that result in the removal of the habitat substrate for these species.

Gravel mining results in surface disturbance, increased foot and vehicle traffic, vegetation disturbance, and removal of top soil and overburden. The bedrock deposits sought for crushed gravel are found at ground level and extend to various depths within the Ordovician limestone deposit. This means that surface materials are removed and the plant's habitat including its seed bank may be permanently lost. Stockpiled materials that include a reject pile of finer particles and possibly a shallow topsoil layer are used to reclaim the area (Ginouves 2015c, p. 1). Potential impacts to Ostler's peppergrass from these activities include mortality of individuals, localized population mortality, habitat loss, degradation and fragmentation, increased soil erosion, reductions in pollinator populations, reductions in plant vigor and reproductive potential, reductions in seed bank quantity and quality, and increasing invasive plant occurrences (Brock and Green 2003; BLM 2008c).

Four active gravel pits associated with two gravel mines occur within a couple hundred feet of three of the species' populations—Cupric Mine, Copper Gulch, and Indian Queen populations (Table 3). Ostler's peppergrass currently grows along the edge of the gravel mine at the Cupric Mine population (Red Butte Garden 2015). Based on habitat similarities and proximity, we estimate historical gravel mining at these three populations resulted in the loss of 26 ac (11 ha) of suitable habitat adjacent to currently known plant locations (Table 3; Darnall *et al*. 2010, entire). We believe the species may have occupied these areas prior to the mining activity and that past impacts resulted in the loss of 50 percent of the total habitat for Ostler's peppergrass.

The two gravel mines at the Cupric Mine, Copper Gulch, and Indian Queen populations of Ostler's peppergrass are State regulated (see Factor D, *Inadequacy of Existing Regulatory Mechanisms*). Generally, gravel quarries are maintained below 10 ac (4 ha) of surface disturbance to avoid large mine status, which requires environmental review during the State permit process (Munson 2010, pers. comm.; Brinton 2015b, p. 1). A mine also may stay below 10 ac (4 ha) as long as previously disturbed areas at the quarry site are reclaimed prior to expanding quarrying operations (Munson 2010, pers. comm.). The gravel mine at the Cupric Mine population, the Southern White/Mountain Rose mine, is operating under a UDOGM small mine permit and was not required to perform an environmental review (Brinton 2015b, p. 1). The gravel mine at the Copper Gulch and Indian Queen populations is operating under a UDOGM large mine permit (Brinton 2015b, p. 1), and an environmental assessment was performed in 2001 during the permit application process (Brinton 2015c, attachment).

We believe gravel mining will occur in all four populations of Ostler's peppergrass in the future (it also occurred historically at three populations — Cupric Mine, Copper Gulch, and Indian Queen) (Table 2). At the Cupric Mine population, expansion of the State regulated Southern White/Mountain Rose mine is anticipated with an additional 2.5 acres of disturbance planned under the current permit (Brinton 2015a, p. 1). The perimeter of the planned area of disturbance is 20 m (65.6 ft) from the Cupric Mine population. In 2016, the operator of the Cupric Mine notified the State that they intend to expand the mine and to construct a new road to improve access to the existing mine (Brinton 2016, p. 1). We will meet with the State to discuss potential impacts from these activities and will continue to work with our partners to avoid or minimize impacts to this population.

The Cupric Mine provides landscape gravel to Home Depot stores nationwide from a distribution center near Milford, Utah (Munson 2010, pers. comm.).

No quarrying activity was observed in the vicinity of the gravel mine adjacent to the Copper Gulch and Indian Queen populations in 2010; however, the gravel mine has not been reclaimed and thus additional gravel mining could occur at any time. We do not know the expansion plans of the gravel mine at this time, but we believe these operations will also expand in the foreseeable future, as evidenced by the expansion plans at the Southern White/Mountain Rose mine. The remaining occupied habitat in the Cupric Mine, Copper Gulch, and Indian Queen populations (23 ac (9 ha))is located next to active gravel mines and represents 44 percent of the total habitat for Ostler's peppergrass and supports 95 percent of the total population (Table 3; Darnall *et al*. 2010, entire). The remaining occupied habitat at these three populations is similar in area to the existing surface disturbance from gravel mines (Table 3; Darnall *et al*. 2010, entire). Given the close proximity of these three populations to existing gravel mines, future expansion of existing operations will likely impact the remaining occupied habitat of the three populations and the majority of the total population through additional quarrying activities (i.e., removal of the entire substrate) or when roads and other infrastructure are constructed. Future expansion of the existing gravel mining operations has the potential to result in the complete extirpation of these three populations of Ostler's peppergrass.

Table 3. Areas of surface disturbance associated with gravel mining in the vicinity of Ostler's peppergrass.

Population	**Occupied Area**	**Adjacent Surface Disturbance**
Indian Queen	9 ac (3.6 ha)	14 ac (5.7 ha)
Copper Gultch	5 ac (2.0 ha)	5 ac (2.0 ha)
Cupric Mine	9 ac (3.6 ha)	7 ac (2.8 ha)
TOTAL	23 ac (9.2 ha)	26 ac (10.5 ha)

Although gravel mining is not actively occurring at the Grampian Hill population, the Southern White/Mountain Rose mine is located within 1 mile (mi)(1.6 kilometers (km)) of this population. Due to the limited extent of the Ordovician limestone deposits in the San Francisco Mountain range, it is likely that future gravel mining activities will occur at the Grampian Hill population. In addition to future gravel mining, we previously established that this population is likely to be impacted by future precious metal mining (see *Precious Metal Mining*, above). Since the Grampian Hill population is 29 ac (12 ha) in size, and roughly equivalent in size to past gravel mining operations in the other three Ostler's peppergrass populations, future gravel mining operations in conjunction with future precious metal mining has the potential to result in the complete extirpation of this population.

The likely continuation and future expansion of gravel mining within four Ostler's peppergrass populations is supported by economic forecasts of an increasing future demand for gravel sources in order to support future human population growth in nearby Washington and Iron counties (U.S. Census Bureau 2010b, entire; Utah GOPB 2010, p. 48). Construction sand, gravel, and crushed stone production rank as the second most valuable commodity produced among industrial minerals in Utah (Bon and Krahulec 2009, p. 5; Stark 2008, p. 1). Gravel, stone, and rock are generally mined for local and regional distribution due to the high cost of transport. The gravel mines in the San Francisco Mountains are the closest crushed limestone gravel mines to Washington County, one of the fastest growing counties in Utah (Mine Safety and Health Administration 2010, p. 1). In general, there has been a net loss of local sand and gravel supply mines in the Washington County area due to ongoing urban development and the lack of available gravel mine operations on surrounding Federal lands (Blackett and Tripp 1999, p. 33). The close proximity of the existing gravel mining operations within the range of Ostler's peppergrass to Washington County make it likely that these operations will become a primary source of gravel for Washington County and other nearby communities. In addition to regional distribution, crushed limestone quarried from the vicinity of the Copper Gulch, Indian Queen, and Cupric Mine populations is transported to a distribution center for the Home Depot in the nearby town of Milford, where it is packaged and shipped nationwide (Munson 2010, pers. comm.).

To summarize, precious metal mining and gravel mining have occurred throughout the entirety of Ostler's peppergrass' range (Table 2; Table 3). Three of the four populations—the Cupric Mine, Copper Gulch, and Indian Queen populations—co-occur with active gravel mines and comprise 95 percent of the total population. Available information suggests that all populations are likely to be impacted by precious metal and gravel mining in the foreseeable future based on mineral availability and market projections. Future mining activity will likely result in the loss of plants and available habitat and has the potential to lead to the complete extirpation of all four populations and the extinction of the species. Therefore, mining is a threat to Ostler's peppergrass now and in the foreseeable future.

Nonnative Invasive Species

The spread of nonnative invasive species is considered the second largest threat to imperiled plants in the United States (Wilcove *et al*. 1998, p. 608). Invasive plants—specifically exotic annuals such as cheatgrass (*Bromus tectorum*)—negatively affect native vegetation, including rare plants. Invasive plants can reduce the abundance of native plants by outcompeting natives for soil nutrients and water (Melgoza *et al*. 1990, pp. 9–10; Aguirre and Johnson 1991, pp. 352–353). They can also completely exclude native plants from their habitat and alter pollinator behaviors (D'Antonio and Vitousek 1992, pp. 74–75; DiTomaso 2000, p. 257; Mooney and Cleland 2001, p. 5449; Levine *et al*. 2003, p. 776; Traveset and Richardson 2006, pp. 211–213). One of the most substantial effects of cheatgrass is the change in vegetation fuel properties that, in turn, alter fire frequency, intensity, extent, type, and seasonality (Menakis *et al*. 2003, pp. 282–283; Brooks *et al*. 2004, p. 677; McKenzie *et al*. 2004, p. 898). Shortened fire return intervals make it difficult for native plants to reestablish or compete with invasive plants (D'Antonio and Vitousek 1992, p. 73).

Cheatgrass is considered the most ubiquitous invasive species in the Intermountain West due to its ability to rapidly invade native dryland ecosystems and outcompete native species (Mack 1981, p. 145; Mack and Pyke, 1983, p. 88; Thill *et al*. 1984, p. 10). If already present in the vegetative community, cheatgrass increases in abundance after a wildfire, increasing the chance for more frequent fires (D'Antonio and Vitousek 1992, pp. 74–75; Brooks and Pyke 2002, p. 5; Grace *et al*. 2002, p. 43; Brooks *et al*. 2003, pp. 4, 13, 15). The risk of fire is expected to increase from 46 to 100 percent when the cover of cheatgrass increases from 12 to 45 percent or more (Link *et al*. 2006, p. 116). In the absence of exotic species, it is generally estimated that fire return intervals in xeric sagebrush communities range from 100 to 350 years (Baker 2006, p. 181). In some areas of the Great Basin (e.g., Snake River Plain), fire return intervals due to cheatgrass invasion are now between 3 and 5 years (Whisenant 1990, p. 4). In addition, cheatgrass invades areas in response to surface disturbances (Hobbs 1989, pp. 389, 393, 395, 398; Rejmanek 1989, pp. 381–383; Hobbs and Huenneke 1992, pp. 324–325, 329, 330; Evans *et al*. 2001, p. 1308). Cheatgrass is likely to increase due to climate change (see Factor E) because invasive annuals increase biomass and seed production at elevated levels of carbon dioxide (Mayeux *et al*. 1994, p. 98; Smith *et al*. 2000, pp. 80–81; Ziska *et al*. 2005, p. 1328).

In the absence of cheatgrass, Ostler's peppergrass grows in sparsely vegetated communities unlikely to carry fires (see Habitat / Life History section). Although cheatgrass is present in all populations of Ostler's peppergrass (Miller 2010a, p. 5; Roth 2010, p. 1), cheatgrass cover is low to nonexistent, with no more than 5 percent cover by cheatgrass at the Cupric Mine population (Red Butte Garden 2015, p. 3). Photographs indicate that cover by cheatgrass is similarly low in other intact occupied habitat (Roth 2010, pp. 5 – 8). However, increased mining activities and associated surface disturbances are anticipated to occur in and adjacent to all four Ostler's peppergrass populations (see Mining, above), which will likely promote cheatgrass expansion into the species' habitat.

In our 2011 12-month finding, we identified invasive nonnative plants as a threat to Ostler's peppergrass. However, since that time we have received additional information that indicates the historical fire regime within the range of Ostler's peppergrass appears to be more frequent than we previously inferred from the best available scientific literature. Historical fire return intervals in the Wah Wah Mountains near the range of Ostler's peppergrass varied widely from 24.8 – 100.2 years (Kitchen 2012, p. 58). For areas with a documented fire record in the Wah Wah Mountains, these fire intervals are much shorter than the 100 – 350 year interval we state above for xeric sagebrush communities. Additionally, fires have been less frequent in the Wah Wah Mountains since Euro-American settlement than the historical fire frequency (Kitchen 2012, p. 64). This is the opposite trend of many areas dominated by sagebrush in the Western United States (Bukowski and Baker, p. 546, 558). This information indicates Ostler's peppergrass may have experienced more frequent fires in the past and that an increase in fire frequency in the future may not negatively impact the species if it returns to a similar historical fire frequency. We also cannot state that cheatgrass is likely to establish the coverage and continuity of fine fuels within intact Ostler's peppergrass habitat that would promote an altered fire regime much shorter than the historical regime in intact habitat. The habitat differences are too great between Ostler's peppergrass habitat and cheatgrass dominated sagebrush habitats for us to suggest this is in fact the case. Both the soil type and higher elevation of Ostler's peppergrass habitat are not consistent with the well-developed soils and lower elevations of cheatgrass dominated habitats (Chambers *et al*. 2007, pp. 139 – 140; Chambers *et al*. 2013, p. 366, 370; Davis and Pelsor 2001, p. 421 - 422). Other poorly developed soils were highly resistant to cheatgrass invasion and had a low risk of an altered fire regime (Davies and Hulet 2014, p. 7). Although it is possible for cheatgrass to spread within Ostler's peppergrass habitat without associated surface disturbance, various environmental factors and ecosystem attributes influence a plant community's resiliency and resistance to cheatgrass invasion (Chambers *et al*. 2013, pp. 365 – 366; Davies and Hulet, 2014, pp. 1 – 2), and a careful analysis of the existing integrity of the habitat and its response to disturbance is needed to assess a community's risk of cheatgrass invasion and dominance (Chambers *et al*. 2013, pp. 365 – 366). At this time, we do not have coverage estimates of cheatgrass in the habitat, only a documented presence of cheatgrass in the habitat and photographs depicting little to no cheatgrass in intact habitat. One field report mentioned cheatgrass was a dominant species along the lower slopes of the Grampian Hill population, likely occupying highly disturbed areas from past mining activity (Roth 2010, p. 1). This stressor's impact to Ostler's peppergrass may not be as robust or imminent in intact habitat as previously believed. However, this stressor (cheatgrass) is likely to increase in the future due to increased disturbance from mining activities (see *Mining*, above).

In summary, we have limited information on how much nonnative invasive weeds have impacted Ostler's peppergrass across its range, although it is likely this is a stressor that will increase in the future due to increased disturbance from mining and potentially climate change. Based on new information, we do not currently consider nonnative invasive species alone to be a threat to Ostler's peppergrass. However, with the amount of mining that is likely to occur across the range of the species in the future (see *Mining*, above), and the likelihood that nonnative invasive species will increase with surface disturbance from mining, we conclude that nonnative invasive species, when evaluated cumulatively with mining activities, are a future threat to Ostler's peppergrass.

Summary of Factor A

Mining activities impacted Ostler's peppergrass habitat in the past and are likely to continue to negatively impact the species and its habitat throughout its range in the foreseeable future. All of the populations and the majority of habitat are located on private lands with an extensive history and recent successful exploration activities for precious metal mining. Three of the four populations are located in the immediate vicinity of active gravel mines and contain the majority of the total individuals (95 percent). We anticipate an increase in the demand for precious metals and landscape rock based on the economic outlook for these commodities, regional availability, and the proximity of these gravel mines to a rapidly expanding urban area and, therefore, an increase in impacts to Ostler's peppergrass. Mining activity is anticipated to result in the loss of large numbers of individuals and has the potential to completely extirpate all four populations and result in the extinction of the species.

Cheatgrass occurs in all four populations of Ostler's peppergrass, but we have no information that cheatgrass is spreading within the habitat or will likely establish a fine fuel layer in undisturbed habitat that supports an altered fire regime. The invasion and expansion of annual nonnative species invasions will likely be exacerbated by mining activities and possibly global climate change (see the Climate Change and Drought section under Factor E). The small population sizes and extremely limited distribution of Ostler’s peppergrass make this species vulnerable to stochastic extinction events, including localized mining activities and an increase in annual nonnative species (see the Small Population Size section under Factor E, below).

Therefore, the present or threatened destruction, modification, or curtailment of the species’ habitat or range is a threat to Ostler's peppergrass, now and in the foreseeable future, based on impacts from mining activities and nonnative invasive species.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

Ostler’s peppergrass is considered an attractive rock garden plant. Seeds are available commercially and they are harvested from wild populations (Alplains Seed Catalog 2010, p. 2). Plants are located on private lands, which may provide some protection from collectors because access is restricted on these private lands. Despite the attractiveness of the species to horticultural enthusiasts, we have no information indicating that collection in the wild is a threat to the species.

C. Disease or predation:

Disease and herbivory of the species are unknown. We do not have any information indicating that disease is impacting Ostler’s peppergrass. We also do not have any information indicating herbivory is occurring from livestock, wildlife, or insects (Kass 1992, p. 9; Evenden 1998, entire; Miller 2010b, entire; Miller 2010c, entire; Miller 2010e, entire; Roth 2010, entire). Thus, we do not consider disease and predation to be threats to these species.

D. The inadequacy of existing regulatory mechanisms:

There are no endangered species laws protecting plants on private, State, or tribal lands in Utah. Ostler’s peppergrass is listed as a bureau sensitive plant by the BLM. Should the species be located on BLM lands, limited policy-level protection by the BLM is afforded through the Special Status Species Management Policy Manual # 6840, which forms the basis for special status species management on BLM lands (BLM 2008b, entire). However, the species is not currently known to occupy BLM lands.

Mining related activities are the predominant threat to Ostler's peppergrass (see Factor A). Over 90 percent of the species’ known potential habitat and all of the known populations are located on lands with private, patented mining claims (Kass 1992, p. 9; Evenden 1998, p. 9; Roth 2010, pp. 1–2). Mineral mining is subject to the Utah Mined Land Reclamation Act of 1975, which includes mineral mining on State and private lands, including lands with patented mining claims (Utah Code Title 40, Chapter 8).

The Utah Mined Land Reclamation Act mandates the preparation of State environmental impact assessments for large mining operations, which are defined as mining operations which create more than 10 ac (4 ha) of surface disturbance in unincorporated areas (Brinton 2015b, p. 1). The existing gravel mining activities within Ostler's peppergrass' range (see Factor A, Mining) are near or above the 10 ac (4 ha) regulatory threshold. Mines under the threshold still need to obtain a small mine permit from the State, but there is no requirement for an environmental assessment (Brinton 2015b, p. 1).

State environmental impact assessments must address, at a minimum, the potential effects on State and federally listed species (Baker 2010, pers. comm.). Ostler's peppergrass is not State listed but is on the BLM sensitive species list. If UDOGM is made aware of this rare species being impacted by mining activities, they could consider minimizing and mitigating impacts; however, there is no requirement to address species that are not federally listed in UDOGM's mine permitting process (Baker 2010, pers. comm.). Therefore, the Utah Mined Land Reclamation Act is inadequate to protect Frisco buckwheat from expansion of mining activities into its habitat.

In summary, the existing regulatory mechanisms are not adequate to protect Ostler's peppergrass from the threat of gravel mining on private lands. The active gravel pits are near or above the 10 ac (4 ha) threshold that would incur regulatory environmental impact assessments. However, even if an environmental impact assessment is completed for any of the mines, the existing mining laws do not necessarily apply to BLM sensitive species: They recommend, and do not mandate, species protection or mitigation.

E. Other natural or manmade factors affecting its continued existence:

Below we evaluate potential natural and manmade threats to Ostler's peppergrass' survival, including: small population size, climate change, and drought.

Small Population Size

Small populations and species with limited distributions are vulnerable to relatively minor environmental disturbances (Given 1994, pp. 66–67). Small populations also are at an increased risk of extinction due to the potential for inbreeding depression, loss of genetic diversity, and lower sexual reproduction rates (Ellstrand and Elam 1993, entire; Wilcock and Neiland 2002, p. 275). Lower genetic diversity may, in turn, lead to even smaller populations by decreasing the species' ability to adapt, thereby increasing the probability of population extinction (Barrett and Kohn 1991, pp. 4, 28; Newman and Pilson 1997, p. 360).

As previously described (see the Current Range / Distribution section), the entire range of the species is located in an area of less than 5 sq mi (13 sq km). Within this range, each of the four individual populations' occupied habitat areas are very small, ranging from 5 ac (2 ha) to 29 ac (12 ha) (based on Miller 2010a, Appendix B). Ostler's peppergrass can be dominant in small areas of occupied habitat, containing thousands of individuals. However, the small areas of occupation and the narrow overall range of the species make it highly susceptible to stochastic extinction events and the effects of inbreeding depression. Despite the overall lack of information on the population ecology of Ostler's peppergrass, we know that small populations are at an increased risk of extinction due to the potential for inbreeding depression, loss of genetic diversity, and lower sexual reproduction rates (Ellstrand and Elam 1993, entire; Wilcock and Neiland 2002, p. 275).

Mining, or a single random event such as a wildfire (see Factor A), could extirpate an entire or substantial portion of a population given the small acreages of occupied habitat. Species with limited ranges and restricted habitat requirements also are more vulnerable to the effects of global climate change (see the Climate Change and Drought section below; IPCC 2002, p. 22; Jump and Penuelas 2005, p. 1016; Machinski *et al.* 2006, p. 226; Krause 2010, p. 79).

In the absence of information identifying threats to the species and linking those threats to the rarity of the species, we would not consider rarity alone to be a threat. A species that has always been rare, yet continues to survive, could be well equipped to continue to exist into the future. Overall, we consider small population size an intrinsic vulnerability of Ostler's peppergrass, because it occurs in four highly localized small populations. At this point in time, we conclude that small population size is a concern for Ostler's peppergrass given the likelihood of future mining impacts that will likely reduce the size of or extirpate all four populations that comprise all known individuals of the species (see Factor A).

Climate Change and Drought

Our analyses under the ESA include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Predicted changes in climatic conditions include increases in temperature, decreases in rainfall, and increases in atmospheric carbon dioxide in the American Southwest (Walther *et al*. 2002, p. 389; IPCC 2007, p. 48; Karl *et al*. 2009, p. 129). Hot extremes, heat waves, and heavy precipitation will increase in frequency due to climate change, with the Southwest experiencing the greatest temperature increase in the continental United States (Karl *et al*. 2009, pp. 28, 129). Approximately 20 to 30 percent of plant and animal species are at increased risk of extinction if increases in global average temperature exceed 2.7 to 4.5 degrees Fahrenheit (°F) (1.5 to 2.5 degrees Celsius (°C)) (IPCC 2007, p. 48). In the southwestern United States, average temperatures increased approximately 1.5 °F (0.8 °C) compared to a 1960 to 1979 baseline (Karl *et al*. 2009, p. 129). By the end of this century, temperatures are expected to warm a total of 4 to 10 °F (2 to 5 °C) in the Southwest (Karl *et al*. 2009, p. 129).

Annual mean precipitation levels are expected to decrease in western North America and especially the southwestern States by mid-century (IPCC 2007, p. 8; Seager *et al.* 2007, p. 1181). The levels of aridity of recent drought conditions and perhaps those of the 1950s drought years will become the new climatology for the southwestern United States (Seager *et al.* 2007, p. 1181). Although droughts occur more frequently in areas with minimal precipitation, even a slight reduction from normal precipitation may lead to severe reductions in plant production. Therefore, the smallest change in environmental factors, especially precipitation, plays a decisive role in plant survival in arid regions (Herbel *et al.* 1972, p. 1084).

Atmospheric levels of carbon dioxide are expected to double before the end of the 21st century, which may increase the dominance of invasive grasses leading to increased fire frequency and severity across western North America (Brooks and Pyke 2002, p. 3; IPCC 2002, p. 32; Walther *et al.* 2002, p. 391). Elevated levels of carbon dioxide lead to increased invasive annual plant biomass, invasive seed production, and pest outbreaks (Smith *et al.* 2000, pp. 80–81; IPCC 2002, pp. 18, 32; Ziska *et al*. 2005, p. 1328) and will put additional stressors on rare plants already suffering from the effects of elevated temperatures and drought.

Climate change effects present substantial uncertainty regarding the future environmental conditions in the range of Ostler's peppergrass and may place an added stress on the species and its habitat. Although we have no information on how Ostler's peppergrass will respond to effects related to climate change, persistent or prolonged drought conditions are likely to reduce the frequency and duration of flowering and germination events, lower the recruitment of individual plants, compromise the viability of populations, and impact pollinator availability (Tilman and El Haddi 1992, p. 263; Harrison 2001, p. 78). Drought conditions led to a noticeable decline in survival, vigor, and reproductive output of other rare plants in the Southwest during the drought years of 2001 through 2004 (Anderton 2002, p. 1; Van Buren and Harper 2002, p. 3; Van Buren and Harper 2004, entire; Hughes 2005, entire; Clark and Clark 2007, p. 6; Roth 2008a, entire; Roth 2008b, pp. 3–4). Similar responses are anticipated to adversely affect the long-term persistence of Ostler's peppergrass.

As discussed in the Small Population Size section above, Ostler's peppergrass has a limited distribution and populations are localized and small. In addition, these populations are restricted to very specific soil types. Global climate change exacerbates the risk of extinction for species that are already vulnerable due to low population numbers and restricted habitat requirements (IPCC 2002, p. 22; Jump and Penuelas 2005, p. 1016; Machinski *et al*. 2006, p. 226; Krause 2010, p. 79).

The actual extent to which climate change itself will impact Ostler's peppergrass is unclear, mostly because we do not have long-term demographic information that would allow us to predict the species' responses to changes in environmental conditions, including prolonged drought. Any predictions at this point on how climate change would affect the species would be speculative. However, as previously described, mining activities are a threat to the species (see Mining, Factor A), which will likely result in the loss of large numbers of individuals and maybe even entire populations. Increased surface disturbances associated with mining activities will likely increase the extent and densities of nonnative invasive species in the habitat (see Nonnative Invasive Species section under Factor A). Given the cumulative effects of the potential population reduction and habitat loss (of already small populations) associated with mining, and invasive species, we are concerned about the impacts of future climate change to Ostler's peppergrass.

In summary, we find it difficult to analyze the potential effects of global climate change on Ostler's peppergrass in the absence of demographic trend data, which would allow us to analyze how the species responds to climate change over time. However, the cumulative effects posed by mining, nonnative species, and small population size may exacerbate the effects of climate change for Ostler's peppergrass in the future. At this time, we believe that the state of knowledge concerning the localized effects of climate change is too speculative to determine whether climate change is a threat to this species in the foreseeable future. However, we will continue to assess the potential of climate change to pose a threat to the species as better scientific information becomes available.

Summary of Factor E

Ostler's peppergrass has a highly restricted distribution and exists in four populations scattered over an area that is less than 5 sq mi (13 sq km). Individual populations occupy very small areas with large densities of plants. Even in the absence of information on genetic diversity, inbreeding depression, and reproductive effort, we believe a random stochastic event could impact a substantial portion of a population. Small populations that are restricted by habitat requirements also are more vulnerable to the effects of climate change, such as prolonged droughts and increased fire frequencies.

While naturally occurring droughts are not likely to impact the long-term persistence of the species, an increase in periodic prolonged droughts due to climate change could impact the species across their entire range in the future. Global climate change, particularly when assessed cumulatively with small population sizes and threats from mining activities, could increase the density of invasive annual plants, which are already present in Ostler's peppergrass' habitat (see Factor A).

Although small population size and climate change make the species intrinsically more vulnerable, we are uncertain whether they would rise to the level of threat by themselves. However, when combined with the threats listed under Factor A (mining and nonnative invasive species), small population size may rise to the level of threat in the foreseeable future. At this time, we are uncertain of the degree to which climate change constitutes a threat to the species.

Conservation Measures Planned or Implemented :

Data collected through 2012 contributed to our knowledge of Ostler's peppergrass' current status. We now have a better understanding of the relative importance of the various factors implicated in the species' extinction risk. The BLM worked with the Southern Utah University (SUU) to conduct inventories for Ostler's peppergrass and provide baseline information on its distribution (Pontarolo 2013, pers. comm.). During the summer of 2012, SUU surveyed for additional locations of Ostler's peppergrass but did not find any (Hildebrand 2013, pers. comm.). Future surveys should target areas with similar topographic features of occupied Ostler's peppergrass habitat.

The Nature Conservancy of Utah initiated communication with the Horn Silver Mine to discuss the potential for establishing conservation measures, including potential conservation easements for the known populations on private lands (York 2013, pers. comm.). At the time, Horn Silver Mine was not interested in protecting the species (York 2013, pers. comm.).

Red Butte Garden collected seeds in 2015 from the Cupric Mine population to evaluate the germination and viability of seeds and to place seeds in long-term storage (Red Butte Garden 2015, entire). Additional seed collections from populations are needed, but depend on funding and the willingness of landowners to grant access.

Summary of Threats :

The primary threat to the species is habitat destruction from precious metal and gravel mining on private lands (Factor A). All populations are located in the vicinity of historical precious metal mining activities. Ongoing exploration activities show the potential for continued mining activities in the foreseeable future. Three of the four populations are in the immediate vicinity of limestone quarries, all of which are considered active. We expect an increase in precious metal and limestone mining at these locations in the foreseeable future, with associated loss and fragmentation of Ostler's peppergrass populations.

Cheatgrass occurs within all four Ostler's peppergrass populations. It is a highly invasive nonnative species that spreads quickly in response to surface disturbances such as mining. As previously discussed, cheatgrass occurs in the immediate vicinity of precious metal and limestone mines and will likely increase in areas where surface disturbance from mining occurs. Global climate change is expected to increase drought conditions in the Southwest and increase the spread of nonnative invasive species. The biggest concern associated with the increase in invasive species is an increase in vegetative competition, a reduction in the suitability of occupied habitat, and possibly an altered fire regime (Factor A), particularly when considering the small population sizes and small occupied habitat area associated with this species.

The magnitude of the biological threats posed by the species' small population size and limited range is not well understood due to the lack of information available on Ostler's peppergrass' ecology. Future studies may provide us with a more thorough understanding of threats posed by pollinator limitation, inbreeding depression, and the potential lack of genetic diversity over the species' range. However, the small areas of occupied habitat make the species highly vulnerable to habitat destruction through mining-related activities as well as random extinction events, including invasive species (and the inherent risk of increased fires) and the potential future effects of global climate change (Factor E).

The existing regulatory mechanisms are not adequate to protect Ostler's peppergrass from the primary threat of mining, particularly because the species occurs entirely on private lands. The inadequacy of regulatory mechanisms (Factor D) on private land, combined with the economic and commercial value of the limestone and precious metals, poses a serious threat to Ostler's peppergrass' continued existence. Ongoing mining in Ostler's peppergrass' habitat has the potential to extirpate one of the four populations in the near future; all populations have the potential to be extirpated by mining-related activities in the foreseeable future (Factor A; Table 1).

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

• Pursue habitat protection for existing populations on private lands through land purchases or exchanges, conservation easements, and candidate conservation agreements.
• Determine habitat suitability on Federal lands for future surveys and introduction efforts.
• Develop successful propagation methods and pursue long-term seed collection.
• Determine pollinators and pollinator requirements.
• Implement pilot introductions within suitable or reclaimed habitat on Federal or protected lands.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotypic genus	7
	Imminent	**Species**	**8**
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

Moderate. We consider the threats that Ostler's peppergrass faces to be moderate in magnitude because the major threats (mining and nonnative species associated with mining activity), vulnerabilities (small population size and climate change), and the inadequacy of existing regulatory mechanisms, while serious and occurring rangewide, do not collectively rise to the level of high magnitude. For example, active mining is currently impacting only one of the four populations.

The magnitude of Factor A is considered moderate because although we think that all populations have been impacted by mining in the past and three of the four populations occur in the immediate vicinity of gravel mines, mining activities are currently ongoing in one of these gravel mines.

We considered the magnitude of Factor D high. All populations are located on private lands with patented mining claims. Existing regulatory mechanisms do not adequately protect Ostler's peppergrass from the impacts of mining on private lands. Although only one population is currently impacted by gravel mining, all populations have the potential to be impacted by gravel and precious metal mining in the future.

We consider the magnitude of Factor E moderate because although small population size and climate change make the species intrinsically more vulnerable, we are uncertain of whether they would rise to the level of threat by themselves. However, when collectively analyzed with the threats identified under Factor A, they may rise to the level of threat in the foreseeable future. Although we are uncertain about the direct impacts of global climate change on Ostler's peppergrass, we expect the species to respond negatively to changed environmental conditions and drought, primarily from an increase in nonnative invasive species as a result of mining activity (see Factor A). The threats of mining activity and associated nonnative invasive species invasions could result in the extirpation of all populations, especially when the populations are small in size.

Imminence :

Imminent. We consider all of the threats to be imminent because we have information that the threats are identifiable and that the species is currently facing them across its entire range. These actual, identifiable threats are covered in greater detail in Factors A, D, and E. The majority of threats are ongoing and therefore imminent, although gravel mining is currently impacting only one of the populations. In addition to their current existence, we expect these threats to continue and likely intensify in the foreseeable future.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

We determined that issuing an emergency regulation temporarily listing the species is not warranted at this time because there is no emergency posing a significant risk to the well-being of

Ostler's peppergrass. We do not believe that any of the potential threats are of such great immediacy and severity that would threaten all of the known populations with the imminent risk of extinction. However, if at any time we determine that issuing an emergency regulation temporarily listing Ostler's peppergrass is warranted, we will initiate emergency listing at that time.

Description of Monitoring:

SUU completed their surveys of Ostler's peppergrass in 2012 (Pontarolo 2014, pers. comm.). No additional surveys are planned. There is a low likelihood that the species inhabits nearby mountain ranges based on targeted surveys in habitat with high potential in the Wah Wah Mountains. Locating potential habitat is hindered by incomplete data on soils and geology in nearby mountain ranges (Hildebrand 2014, pers. comm.). No demographic or threats monitoring of existing known populations is currently underway because all populations are located on private lands.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Utah

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

Ostler's peppergrass is endemic to Utah. UDOGM provided information and comments on this assessment. No new information about the status of this species was available from the Utah Natural Heritage Program (UNHP) for this review. The UNHP actively tracks the status of this species and we will incorporate any updates or new information gathered in future assessments.

Literature Cited:

Aguirre, L. and D.A. Johnson. 1991. Influence of temperature and cheatgrass competition on seedling development of two bunchgrasses. Journal of Range Management 44: 347–354.

Alplains Seed Catalog. 2010. *Lepidium ostleri*. Accessed online at: http://www.alplains.com/ [accessed September 14, 2010]

Anderton, L. 2002. Summary of Spence's *Schoenocrambe barnebyi* Monitoring Plot, 1998–2001. Unpublished report prepared for the Capitol Reef National Park. 1 pp.

Ash, A. 2010. The case for silver – 25th March 2010. Accessed 9/14/2010 online via http://goldnews.bullionvault.com/silver_case_032520106

Baker, P. 2010. Environmental Manager. Minerals Reclamation Program. Utah Division of Oil, Gas, and Mining. Telephone conversation with D. Roth, Botanist, USFWS Utah Field Office, Salt Lake City, UT. October 25, 2010.

Baker, P. 2015. Environmental Manager. Minerals Reclamation Program. Utah Department of Oil, Gas, and Mining. Personal communication with Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. April 16, 2015. 1 p.

Baker, W.L. 2006. Fire and Restoration of Sagebrush. Wildlife Society Bulletin, Vol. 34, No. 1 (2006), pp. 177–85.

Baker, W.L. In press. Pre-Euroamerican and recent fire in sagebrush ecosystems. Studies in Avian Biology. 50 pp.

Barrett S.C.H. and J.R. Kohn. 1991. Genetic and evolutionary consequences of small population size in plants: implications for conservation. In Genetics and Conservation of Rare Plants, ed. D.A. Falk, K.E. Holsinger, pp. 3–30. New York: Oxford Univ. Press.

Bon, R. L. and R.W. Gloyn. 1998. 1998 summary of mineral activity in Utah. Unpublished report by the Utah Geological survey. Accessed online at http://geology.utah.gov/utahgeo/rockmineral/activity/min1998.pdf [accessed on October 29, 2010].

Bon, R.L. and K. Krahulec. 2009. 2008 Summary of mineral activities in Utah. Utah Geological Survey. Circular 109, 14 pp.

Brinton, P. 2015a. “Data request for San Francisco Mt endemic candidate plants”. Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. Dated March 24, 2015. 1 p.

Brinton, P. 2015b. Utah Department of Oil, Gas, and Mining Environmental Scientist Engineer. Personal communication with Jennifer Lewinsohn USFWS UT Field Office, Salt Lake City, UT. April 16, 2015. 1 p.

Brinton, P. 2016. “Data request for San Francisco Mt endemic candidate plants”. Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. Dated March 10, 2016. Utah Department of Oil, Gas, and Mining Environmental Scientist Engineer. 1 p

Brock, J.H. and D. M. Green. 2003. Impacts of livestock grazing, mining, recreation, roads, and other land uses on watershed resources. Journal of the Arizona–Nevada Academy of Science, Vol. 35(1): 11–22.

Brooks, M.L. and D. Pyke. 2002. Invasive plants and fire in the deserts of North America. p. 1–14 In: K. Galley and T. Wilson (eds.), Proceedings of the Invasive Species Workshop: The Role of Fire In the Control and Spread of Invasive Species. Fire Conference 2000: The First National Congress on Fire, Ecology, Prevention and Management. Miscellaneous Publications No. 11, Tall Timbers Research Station, Tallahassee, Florida, USA.

Brooks, M.L., T.C. Esque and T. Duck. 2003. Fuels and fire regimens in creosotebush, blackbrush, and interior chaparral shrublands. Report for the Southern Utah Demonstration Fuels Project. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, Montana. 18pp.

Brooks, M., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of Invasive Alien Plants on Fire Regimes. Bioscience Vol. 54(7): 677–688.

Bukowski, B.E. and W.L. Baker. 2013. Historical fire regimes, reconstructed from land-survey data, led to complexity and fluctuation in sagebrush landscapes. Ecological Applications 23(3): 546 – 564.

Bureau of Land Management (BLM). 2008a. Proposed RMP and Final EIS, Chapter 4: Environmental Consequences. 628 pp.

Bureau of Land Management (BLM). 2008b. BLM Manual, MS-6840. Accessed online at http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/blm_manual.html on July 26, 2010. OR Bureau of Land Management. 2008. ESA and BLM Guidance and Policy Manual 6840: Special Status Species Management. Revised manual. 48 pp.

Bureau of Land Management (BLM). 2012. Mineral Potential Report for the Cedar City Planning Area, Cedar City Field Office. 151 pp. + Appendices

Chambers, J.C., B.A. Roundy, R.R. Blank, S.E. Meyer, A. Whittaker. 2007. What Makes Great Basin Sagebrush Ecosystems Invasible by *Bromus tectorum*? Ecological Monographs 77(1): 117 – 145.

Chambers, J.C, B.A Bradley, C.S. Brown, C. D'Antonio, M.J. Germino, J.B. Grace, S.P. Hardegree, R.F. Miller, D.A. Pyke. 2013. Resilience to Stress and Disturbance, and Resistance to *Bromus tectorum* L. Invasion in Cold Desert Shrublands of Western North America. Ecosystems 17(2): 360 – 375.

Clark, T.O. and D.J. Clark. 2007. *Sclerocactus wrightiae* monitoring in Capitol Reef National Park. Unpublished report prepared for the Capitol Reef National Park. 23 pp.

Crigger, L. 2010. Can copper climb higher? Accessed online at: http://www.hardassetsinvestor.com/features-and-interviews/1/2041.html?Itemid=22&topic=3 [accessed September 14, 2010]

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.

Darnall, N., K. McAbee, and D. Roth. 2010. Quarry sites and populations areas for *Eriogonum soredium*, *Lepidium ostleri*, and *Trifolium friscanum*. GIS map. U.S. Fish and Wildlife Service, Utah Field Office. September 22, 2010.

Davies, K.W. and A. Hulet. 2014. Risk of Exotic Annual Grass-Fire Cycle in Goose Creek milkvetch habitat. Report prepared for the U.S. Fish and Wildlife Service Utah Field Office, Salt Lake City, Utah. 9p.

Davis, M.A. and M. Pelsor. 2001. Experimental support for a resource-based mechanistic model of invisibility. Ecology Letters 4: 421 – 428.

DiTomaso, J.M. 2000. Invasive weeds in rangelands: species, impacts, and management. Weed Science, Vol. 48(2):255–265.

Ellstrand, N.C. and D.R. Elam. 1993. Population genetic consequences of small population size: implications for plant conservation. Annual Review of Ecology and Systematics 24: 217–242.

Evans, R. D., R. Rimer, L. Sperry, and J. Belnap. 2001. Exotic plant invasion alters nitrogen dynamics in arid grassland. Ecological Applications 11:1301–1310.

Evenden, A. 1998. San Francisco Mountain/Grampian Limestone endemics site report. Unpublished report prepared for the Nature Conservancy, Salt Lake City, UT. 12 pp +& appendices.

Franconia Minerals Corporation. 2002. News release: Laboratory studies enhance Franconia's high grade zinc discovery at San Francisco property, Utah; conference call set for 9:30AM, October 16, 2002. Accessed online at: http://www.franconiaminerals.com/s/NewsReleases.asp?ReportID=77944&_Type=News-Releases&_ [accessed November 1, 2010].

Frates, T. 2006. "Eriogonum soredium and other pics". Email to Elaine York, The Nature Conservancy, Salt Lake City, UT. April 26, 2006

Garcia Mar-a B., F. Xavier Pic o, 3,4 and Johan Ehrlon. 2008. Lifespan correlates with population dynamics in perennial herbaceous plants. American Journal of Botany 95(2): 258–162.

Ginouves, E. 2015. "Data request for San Francisco Mt endemic candidate plants". Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. Dated March 4, 2015. 1 p.

Ginouves, E. 2015b. "Mineral Potential Report Cover Page". Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. Dated May 7, 2015. 1 p.

Ginouves, E. 2015c. "Mineral Potential Report Cover Page". Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. Dated May 8, 2015. 1 p.
Given, D. R. 1994. Principles and Practice of Plant Conservation. Timber Press, Portland, Oregon, USA.

Grace, J.B., M.D Smith, S.L. Grace, S.L. Collins, T. 2002. Interactions between fire and invasive plants in temperate grasslands of North America. p. 40–65. In: K. Galley and T. Wilson (eds.), Proceedings of the Invasive Species Workshop: The Role of Fire in the Control and Spread of

Invasive Species. Fire Conference 2000: The First National Congress on Fire, Ecology, Prevention and Management. Miscellaneous Publications No. 11, Tall Timbers Research Station, Tallahassee, Florida, USA.

Harrison, R.D. 2001. Drought and the consequences of El Nino in Borneo: a case study for figs. Population Ecology, Vol. 43:63–75.

Herbel, C. H., F. N. Ares, R.A. Wright. 1972. Drought effects on a semidesert grassland range. Ecology, Vol. 53(6):1084–1093.

Hildebrand, T. 2013. Southern Utah University Botany Professor. Personal communication with Jennifer Lewinsohn March 22, 2013.

Hildebrand, T. 2013. Frisco Mountain Endemic Plant Study, 2012 Report. Prepared for the BLM Cedar City Office and Southern Utah University, April 2013. 20 p. + Appendix A, B, C.Hildebrand, T. 2014. “Re: Data request for San Francisco Mt endemic candidate plants_GIS data needed”. Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. April 3, 2014.

Hobbs, R.J. 1989. The nature and effects of disturbance relative to invasions. Pages 389–405 in J.A. Drake, J.A. Mooney, F. di Castri, R.H. Grove, F.J. Kruger, M. Rejmanek, and M. Williamson, editors. Biological invasions. A global perspective. Wiley, Chichester, England.

Hobbs, R.J. and L.F. Huenneke. 1992. Disturbance, diversity, and invasion: implications for conservation, Conserv. Biol. 6, pp. 324–337.

Hughes, L. 2005. An Update. Arizona Strip Rare Plant Monitoring and Inventory. Unpublished annual report prepared for the BLM AZ Strip District. 18 pp.

Intergovernmental Panel on Climate Change. 2002. Climate Change and Biodiversity. IPCC Technical Paper V. 74pp. + appendices.
http://www.ipcc.ch/publications_and_data/publications_and_data_technical_papers.htm

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.
http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html

Jump, A.S. and J. Penuelas. 2005. Running to stand still: adaptation and the response of plants to rapid climate change. Ecology Letters, Vol. 8:1010–1020.

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

Kass, R. 1992. Status report of *Lepidium ostleri*. Unpublished document prepared for the USFWS Utah Field Office, West Valley City, UT. 16pp.

Krause, C. 2010. Conservation ecology of endemic plants of the Colorado Plateau: climate change impacts on range shifts. PhD Thesis. Northern Arizona University, Department of Biological Sciences. 156pp.

Levine, J.M., M. Vila, C.M. D'Antonia, J.S. Dukes, K. Grigulis, S. Lavorel. 2003. Review paper. Mechanisms underlying the impacts of exotic plant invasions. Proceedings: Biological Sciences, Vol. 270(1517): 775–781.

Link, S.O., C.W. Keeler, R.W. Hill, and E. Hagen. 2006. *Bromus tectorum* cover mapping and fire risk. International Journal of Wildland Fire 15:113-119.

Kitchen, S. 2012. Historical fire regime and forest variability on two eastern Great Basin fire-sheds (USA). Forest Ecology and Management 285: 53 -66.

Machinski, J. J.E. Baggs, P.F. Quintana-Ascencio, E.S. Menges. 2006. Using population viability analysis to predict the effects of climate change on the extinction risk of an endangered limestone endemic shrub, Arizona cliffrose. Conservation Biology, Vol. 20(1): 218–228.

Mack, R.N. 1981. Invasion of *Bromus tectorum* L. into western North America: An ecological chronicle. Agro-Ecosystems 7:145–165.

Mack, R.N. and D.A. Pyke. 1983. The demography of *Bromus tectorum*: variation in time and space. Journal of Ecology, Vol. 71(1): 69–93.

Mayeux, H.S., H.B. Johnson, and H.W. Polley. 1994. Potential interactions between global change and intermountain annual grasslands. Paper presented at the symposium on "Ecology, Management, and Restoration of Intermountain Annual Rangelands," May 18–22, 1992, Boise, Idaho. General Technical Report INT 313: 95–100.

McKenzie, D. Z. Gedalof, D.L. Peterson, and P. Mote. 2004. Climate Change, Wildfire, and Conservation. Conservation Biology. 18(4): 890–902.

Melgoza, G., R.S. Nowak, and R.J. Tausch. 1990. Soil water exploitation after fire: competition between Bromus *tectorum* (cheatgrass) and two native species. Oecologia 83: 7–13.

Menakis, J.P., D. Osborne, and M. Miller. 2003. Mapping the cheatgrass-caused departure from historical natural fire regimes in the Great Basin, USA. USDA Forest Service Proceedings RMRS-P-29. pp. 281–287.

Miller, L. 2010a. 2010 ARRA wind energy management project BLM, Cedar City Field Office field survey and status report for Eriogonum soredium and Lepidium ostleri. Unpublished report prepared for the BLM Cedar City Field Office. 9 pp + appendices.

Miller, L. 2010b. Individual Special Status Plant Observation Form. Unpublished observation record prepared for the BLM Cedar City Field Office. 3pp.

Miller, L. 2010c. "ERISOR,LEPOST, TRIFRI locations"". Email to Daniela Roth, USFWS UT Field Office, Salt Lake City, UT. June 21, 2010.

Miller, L. 2010d. Survey summary for Trifolium friscanum at the Indian Queen Mine. Unpublished report prepared for the BLM Cedar City Field Office. 2 pp.

Miller, L. 2010e. "RE: FW: shapefiles for calcium carbonate areas on BLM Cedar City Field Office-manages lands". Email to Daniela Roth, USFWS UT Field Office, Salt Lake City, UT. June 24, 2010.

Mine Safety and Health Administration. 2010. Mines by state and then commodity mined. Accessed online at http://www.msha.gov/drs/asp/extendedsearch/statebycommodityoutput2.asp# [accessed October 21, 2010].

Mooney, H.A. and E.E. Cleland. 2001. The evolutionary impact of invasive species. PNAS 98: 5446–5451.

Munson, T. 2010. Hydrologist. Department of Oil, Gas, and Mineral, UT. Telephone conversation with Daniela Roth, USFWS UT Field Office, Salt Lake City, UT. October 25, 2010.

Murdoch, J. 2010. Copper: short-term moves, long-term outlook. Accessed online at: http://www.hardassetsinvestor.com/features-and-interviews/1/2097-copper-short-term-moves-long-te [accessed September 14, 2010].

Murphy M. B. 1996. When the Horn Silver Mine crashed in. Utah History to Go. Accessed online at: http://historytogo.utah.gov/utah_chapters/mining_and_railroads/whenthehornsilverminecrashedin.htm [accessed September 21, 2010].

NatureServe. 2004. A habitat-based strategy for delimiting plant element occurrences: guidance from the 2004 working group. Arlington, Virginia. 15 p.

Newman, D. and D. Pilson. 1997. Increased probability of extinction due to decreased genetic effective population size: experimental populations of *Clarkia pulchella*. Evolution 51: 354–362.

Pontarolo, C. 2013. "RE: email to Daniela Roth on January 25, 2012". Email to Bekee Hotze, USFWS UT Field Office, Salt Lake City, UT. March 28, 2013.

Pontarolo, C. 2014. "Frisco Mt endemic SUU study". Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. April 2, 2014.

Red Butte Garden and Arboretum. 2015. Frisco Mountain Seed Collection Notes, Summary of Work 2015. 3 pages.

Rejmanek, M. 1989. Invasibility of plant communities. Pages 369–388 in J.A. Drake, J.A. Mooney, F. di Castri, R.H. Grove, F.J. Kruger, M. Rejmanek, and M. Williamson, editors. Biological invasions. A global perspective. Wiley, Chichester, England.

Robinson, M. 2004. Frisco Buckwheat, *Eriogonum soredium*, status report. Unpublished BLM challenge cost share project report prepared by Rocky Mountain Environmental Research for the BLM State Office, Salt Lake City, UT.

Rohrer, C. 2015a. “Data request for San Francisco Mt endemic candidate plants”. Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. Dated March 5, 2015. 2 p.

Rohrer, C. 2015b. “Data request for San Francisco Mt endemic candidate plants”. Email to Jennifer Lewinsohn, USFWS UT Field Office, Salt Lake City, UT. Dated March 6, 2015. 1 p.
Roth, D. 2008a. Monitoring Report, *Pediocactus bradyi*, Marble Canyon, Coconino Co., AZ. Unpublished report prepared for the Navajo Natural Heritage Program, Window Rock, AZ. 9 pp.

Roth, D. 2008b. Monitoring Report, *Sclerocactus mesae-verdae* Transplant Project Northern Navajo Fairgrounds, Shiprock, San Juan County, NM. Unpublished report prepared for the Navajo Natural Heritage Program, Window Rock, AZ. 8 pp.

Roth, D. 2010. Field report & population estimate summary, Frisco Mountain endemics. Memorandum to file. June 24, 2010. USFWS Utah Field Office, West Valley City, UT. 8 pp.

Seager, R., T. Mingfang, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, N. Harnik, A. Leetmaa, N. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. Science 316: 1181–1184.

Smith, S.D., T.E. Huzman, S.F. Zitzer, T.N. Charlet, D.C. Housman, J.S. Coleman, L.K. Fenstermaker, J.R. Seeman, and R.S. Nowak. 2000. Elevated CO2 increase productivity and invasive species success in an arid system. Nature 408: 79–81.

Stark, M. 2008. Rock business is rolling in Utah. Salt Lake Tribune, 10/20/2008. Accessed online at:
http://nl.newsbank.com/nl-search/we/Archives?p_product=SLTB&p_theme=sltb&p_action=search&p_
[accessed September 14, 2010]

Stoker, B. 2010. Skyrocketing silver prices now dwarf the price of gold! Accessed online via wallstreetstocks.net on 9/14/2010.
http://www.wallstreetstocks.net/skyrocketing-silver-prices-now-dwarf-the-price-of-gold

Thill, D.C., K.G. Beck, and R.H. Callihan. 1984. The biology of downy brome (*Bromus tectorum*). Weed Science 32(1): 7–12.

Tilman, D. and A. El Haddi. 1992. Drought and biodiversity in grasslands. Oecologia, Vol. 89(2): 257–264.

Transcon Environmental, Inc. 2012. Rare Plant Survey Summary Report: San Francisco Peak Mine Closure Project, Beaver County, Utah. Transcon Environmental, Inc. 3740 East Southern Avenue, Suite 218. Mesa, Arizona. October 2012. 10 pp. + Appendices.

Traveset, A. and D.M. Richardson. 2006. Biological invasions as disruptors of plant reproductive mutualisms. Trends in Ecology and Evolution 21: 208–216.

Utah Governor's Office of Planning and Budget. 2008. Demographic and economic analysis: Subcounty population projections. Accessed online at http://governor.utah.gov/dea/popprojections.html [accessed September 14, 2010].

Utah Governor's Office of Planning and Budget. 2010. 2010 Economic Report to the Governor. State of Utah. 254 pp. Accessed online at: http://governor.utah.gov/DEA/ERG/2010ERG.pdf [accessed September 14, 2010].

U.S. Census Bureau. 2010. Resident population estimates for the 100 fastest growing U.S. counties with 10,000 or more population in 2009: April 1, 2000 to July 1, 2009. Accessed online at: http://www.census.gov/ [accessed September 14, 2010].

Van Buren, R. and K.T. Harper. 2002. 2001 Status Report *Lesquerella tumulosa*. Kodachrome Bladderpod Demography. Order No. JC-POO-3015A. 9 pp + appendices.

Van Buren, R. and K. T. Harper. 2004. Two-Year annual monitoring report – 2003 & 2004. Holmgren milk-vetch (*Astragalus holmgreniorum*). Unpublished report prepared for the Bureau of Land Management, St. George Field Office, UT. Agreement Number JCA031006. 30pp.

Walther, G. E. Post, P. Convey, A. Menzel, C. Parmesan, T.J.C. Beebee, J. Fromentin, O. Hoegh-Guldberg, F. Bairlein. 2002. Ecological responses to recent climate change. Nature, Vol. 416:389–395.

Welsh, S.L. and S. Goodrich. 1980. Miscellaneous plant novelties from Alaska, Nevada, and Utah. Great Basin Naturalist 40:78–88.

Welsh, S.L., N.D. Atwood, S. Goodrich, and L.C. Higgins. 2008. A Utah Flora. 4rd ed. Print Services, Brigham Young University, Provo, UT. 1,019 pp.

Whisenant, S. 1990. Changing fire frequencies on Idaho's Snake River plains: ecological and management implications. Pp. 4-10. In: Proceedings from the symposium on cheatgrass invasion, shrub die off and other aspects of shrub biology and management. USFS General Technical Report INT-276.

Wilcock, C. and R. Neiland. 2002. Pollination failure in plants: why it happens and when it matters. Trends in Plant Science Vol. 7 (6): 270–277.

Wilcove, D. S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. Bioscience Vol. 48(8): 607–615.

York, E. 2013. West Desert Regional Coordinator. The Nature Conservancy, UT. Conversation with B. Hotze, USFWS UT Field Office, Salt Lake City, UT. March 28, 2013.

Ziska, L.H., J.B. Reeves III, and B. Blank. 2005. The impact of recent increases in atmospheric CO_2 on biomass production and vegetative retention of cheatgrass (*Bromus tectorum*): implications for fire disturbance. Global Change Biology 11:1325–1332.

Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: 06/02/2016
Date

Concur: 11/14/2016
Date

Did not concur: ______________________ ________
Date

Director's Remarks: