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

Scientific Name:

Astragalus schmolliae

Common Name:

Chapin Mesa milkvetch

Lead region:

Region 6 (Mountain-Prairie Region)

Information current as of:

05/25/2016

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:12/15/2010

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 Progress on Revising the Lists 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**: Colorado
- **US Counties**:County information not available
- **Countries**:Country information not available

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Colorado
- **US Counties**: Montezuma, CO
- **Countries**:Country information not available

Land Ownership:

Land ownership is approximately 50 percent federal and 50 percent tribal. Chapin Mesa milkvetch habitat collectively occupies approximately 1,619 hectares (ha) (4,000 acres (ac)) in Mesa Verde National Park (Mesa Verde) and on the Ute Mountain Ute Tribal Park. About 809 ha (2,000 ac) are in Mesa Verde on Chapin Mesa including Fewkes and Spruce Canyons, on the West Chapin Spur, and on Park Mesa (Colorado Natural Heritage Program (CNHP) 2010, pp. 12–-19; Anderson 2004, p. 25, 30; Nelligan 2010, p.1). Occupied habitat on Chapin Mesa in the Ute Mountain Ute Tribal Park south of Mesa Verde probably covers another 809 ha (2,000 ac), where surveys have not been done (Anderson 2004, p. 6; Friedlander 1980, p. 53; CNHP 2010, pp. 20-21).

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Biological Information

Species Description:

Chapin Mesa milkvetch plants are upright perennials, 30 to 60 centimeters (cm) (12 to 24 inches (in.)) tall with one to several stems branching from an underground root crown. Its leaves are typical of many of the legumes, with 11 to 20 small leaflets on a stem. Leaves and stems are ash-colored due to a covering of short hairs. Flowers are creamy white, on upright stalks that extend above the leafy stems. The fruit is a pod, 3 to 4 cm (1 to 1.5 in.) long, covered with flat, stiff hairs, pendulous and curving downward (Barneby 1964, pp. 277–278). The deep taproot grows to 40 cm (16 in.) or more (Friedlander 1980, pp. 59–62). Young Chapin Mesa milkvetch plants without flowers or fruit strongly resemble young plants of a similar species, *Astragalus wingatanus* (Fort Wingate milkvetch) (Wender 2012a, p.1).

Taxonomy:

Astragalus schmolliae was first collected in Montezuma County, southwestern Colorado, in 1890. It was formally described as a species in 1945, when C.L. Porter named it after Dr. Hazel Marguerite Schmoll (Porter 1945, pp. 100–102; Barneby 1964, pp. 277–278; Isely 1998, p. 417). *Astragalus*

schmolliae is a member of the family Fabaceae (legume family), and was previously known by the common name Schmoll's milkvetch.

The new common name of Chapin Mesa milkvetch was proposed in 2015 to replace Schmoll's milkvetch. Representatives from Mesa Verde, the Ute Mountain Ute Tribe, CNHP, and the U.S. Fish & Wildlife Service (Service) agreed that it is appropriate to associate the species' common name with its location (San Miguel 2015, pers. comm; Natori 2015, pers. comm.; Rondeau 2015, pers. comm.). Therefore, we have accepted Chapin Mesa milkvetch as the new common name for *Astragalus schmolliae* and use that name hereafter in this document.

Habitat/Life History:

Chapin Mesa milkvetch plants emerge in early spring and usually begin flowering in late April or early May. Flowering continues into early or mid-June (Friedlander 1980, p. 63, Peterson 1981, p. 14). Fruit set begins in late May and occurs through June, and by late June most fruits, while still attached to the plant, have opened and released their seeds. The typical plant lifespan of Chapin Mesa milkvetch is unknown, but individuals are thought to live up to 20 years (Colyer 2002 in Anderson 2004, p. 11). During very dry years, and like many other Astragalus species, as observed in 2002, the plants can remain dormant with no above-ground growth (Colyer 2003 in Anderson 2004, p. 11). Emergence of above ground stems from mature plants and corresponding stem abundance is highly correlated with the amount of winter precipitation (Figure 1) (Rondeau *et al.* 2016, p. 10–11). Winter precipitation allows moisture to soak deeper into the soil where it may be more available to the deep roots of the Chapin Mesa milkvetch, which extend at least 40 cm (16 in.) into the soil (Friedlander 1980, p. 63).

Seed viability is high, between 94 and 100 percent (Anderson 2004, p. 49), and, the patterns of seed germination suggest the species maintains a persistent seed bank (Anderson 2004, p. 47). The longevity of seeds of Chapin Mesa milkvetch is not known, but many legumes, including members of the genus Astragalus, have seeds as long-lived as 97 years (Anderson 2004, p. 48). Chapin Mesa milkvetch seeds collected in 2003 were still viable in 2015, 12 years after collection (Rondeau *et al*. 2016, p. 4). Recruitment appears to be highly episodic and is probably greatest in years that are moist in April through May (Anderson 2004, p. iv; Rondeau *et al.* 2016, p. 19). Studies of other Astragalus species indicate that the group generally possesses hard impermeable seed coats with a strong physical germination barrier. As a result, the seeds are generally long-lived in the soil and only a small percentage of seeds germinate each year (Morris et al. 2002, p. 30). However, we do not know if the seed germination strategy for other Astragalus species is comparable to that used by Chapin Mesa milkvetch. Most seedlings germinate between April and June after at least three days of moist soil conditions from spring moisture (Rondeau et al. 2016, p. 18).

Chapin Mesa milkvetch requires pollination by insects to set fruit. Flowers require a strong insect for pollination, such as a bumblebee, because the insect must force itself between the petals of the butterfly-shaped flowers. Pollinators observed on Chapin Mesa milkvetch include several species of bumblebees (Bombus spp.) and beeflies (Bombylius spp.) (Friedlander 1980, p. 63). In a 2012

study, nearly all observed pollinators were ground-nesting bees, which indicates that their preferred nesting habitats should be identified and protected from compaction and trampling disturbances (Green 2012, p. 6). Several herbivores including mule deer, feral horses, cottontail, and pocket gophers, feed on Chapin Mesa milkvetch (Rondeau *et al.* 2016, p. 20-21).

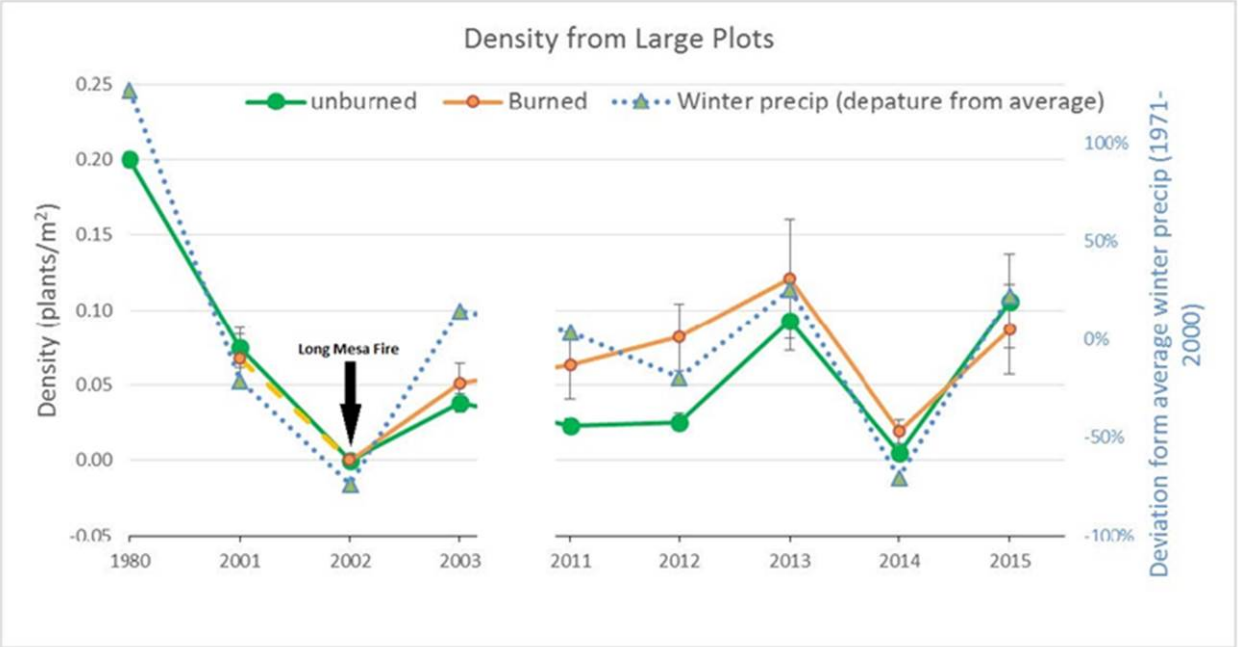

Figure 1: Average density of Chapin Mesa milkvetch individuals in burned (n=17) and unburned (n=22) transects across eight sampling years, in relation to deviation from average winter precipitation. Error bars represent plus-or-minus (+/-) 1 standard error. Note that 2002 data is assumed to be 0 based on Mesa Verde staff observations rather than actual field data collected from transects. Also note that 1980 data is from Friedlander (1980), while all other data points are from CNHP (Rondeau *et al.* 2016, p. 12).

The habitat for Chapin Mesa milkvetch is mature pinyon-juniper woodland of mesa tops in the Mesa Verde area and the Ute Mountain Ute Tribal Park at elevations between 1,981 to 2,286 meters (m) (6,500 to 7,500 feet (ft)) (Anderson 2004, p. ii). The plants are found in both sunny and shaded locations (Peterson 1981, p. 12), primarily on deep, reddish loess soils, and are generally less common near cliff edges and in ravines where the soil is shallower. No Chapin Mesa milkvetch plants are found in the mountain shrublands at the upper elevations on Mesa Verde.

Historical Range/Distribution:

The historical range of the species, prior to being described in 1945, is unknown. We have no information to indicate that the historical range differs or is the same as the current range.

Current Range Distribution:

Chapin Mesa milkvetch habitat collectively occupies approximately 1,619 ha (4,000 ac) in Mesa Verde and on the Ute Mountain Ute Tribal Park. About 809 ha (2,000 ac) are in Mesa Verde on Chapin Mesa including Fewkes and Spruce Canyons, on the West Chapin Spur, and on Park Mesa (CNHP 2010, pp. 12–19; Anderson 2004, p. 25, 30; Nelligan 2010, p.1). Occupied habitat on Chapin Mesa in the Ute Mountain Ute Tribal Park south of Mesa Verde probably covers another 809 ha (2,000 ac), where surveys have not been done (Anderson 2004, p. 6; Friedlander 1980, p. 53; CNHP 2010, pp. 20–21). In 2012, 9 plants were found in Navajo Canyon and 7 along canyon benches near Square Tower House. Therefore, Chapin Mesa milkvetch is not limited to mesa tops, although these mesa tops remain the species' core habitat (Wender 2012b, p. 1).

The distribution of Chapin Mesa milkvetch is typical of some narrow endemics, the species is common within its narrow range (Rabinowitz 1981 in Anderson 2004, p. 3). Interestingly, similar habitat is widespread on nearby mesas where the species has not been found. The species' distribution may be limited by habitat variables that are not yet understood (Anderson 2004, p. 8).

On the Ute Mountain Ute side of Chapin Mesa, most Chapin Mesa milkvetch plants are on higher ground near the border with Mesa Verde. Plants are most abundant and many recruits are observed where they are shaded by pinyon pine. Plants become increasingly sparse and no recruits are seen on the lower southern tip of Chapin Mesa, where there is less tree cover and the ground is warmer and drier (Natori and Clow 2011, pers. comm.).

Population Estimates/Status:

It is estimated that there are approximately 250,000 and 500,000 Chapin Mesa milkvetch plants, with earlier estimates higher than later estimates (Anderson 2004, p. 6, 30; CNHP 2010, pp. 1-21; Wender and Owen 2012; Wender 2012b, p. 1). Monitoring data for Chapin Mesa milkvetch is limited. A slight decline in density of Chapin Mesa milkvetch on Chapin Mesa was found in a comparison of monitoring results from 2003 and 2011 (Figure 1) (Anderson and Kuhn 2012, p. 3). Below-average precipitation in 2012 resulted in smaller, less vigorous plants than in 2011 (Figure 1) (Wender 2012b, p.1). In 2013, a new patch of several plants was found on a bench in the slope northwest of Pictograph Point at about 1,980 m (6,500 ft) (San Miguel 2014, p. 7). In 2015, the number of plants emerging in monitored plots increased to their second highest density since monitoring began in 2001 due to above average winter precipitation (Figure 1) (Rondeau *et al.* 2016, p. 10–14). The highest density recorded during this monitoring effort was in 2013 where winter precipitation was also above average (Figure 1) (Rondeau *et al.* 2016, p. 10–14).

Abundant plants were observed on the tribal land in 1987 (Colyer 2002, in Anderson 2004, p. 4; CNHP 2010, p. 21). Survey data was collected from the Ute Mountain Ute Tribal Park in 2016, but the results are not yet available (Clow 2016, pers. comm.).

Chapin Mesa milkvetch is considered critically imperiled globally (G1) by CNHP, a rank used for

species with a restricted range, a global distribution consisting of less than five occurrences, a limited population size, or significant threats (CNHP 2006, p. 1).

Distinct Population Segment(DPS):

Not applicable.

Threats

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

The following potential factors that may affect the habitat or range of Chapin Mesa milkvetch are discussed in this section, including: (1) Wildfire; (2) invasive nonnative plants; (3) post-fire mitigation; (4) wildfire and fuels management; (5) feral horse activity; (6) development of infrastructure; and (7) drought and climate change.

Wildfire

Six large wildfires burned within Mesa Verde between 1989 and 2003, and extensive portions of those burned areas have been invaded by nonnative plant species (Floyd *et al.* 2006, p. 247). Historically, small, lightning-caused fires have been frequent in Mesa Verde. Most of the fires started in the pinyon-juniper woodlands and burned less than 1 ha (2.5 ac). Therefore, until recently, the southern half of Mesa Verde was covered with dense, old-growth pinyon-juniper woodlands that had not burned for several centuries. Best estimates for “natural” fire turnover times in Mesa Verde were previously about 100 years for shrubland vegetation and about 400 years for pinyon-juniper vegetation. The annual average number of fire starts between 1926 and 1969 was 5 per year, which increased to 18 per year between 1970 and 1997. Since 1996, Mesa Verde has seen more large fires and more cumulative area burned than occurred during the previous 200 years (Romme *et al.* 2006, p. 3). This recent increase in fire activity is a result of severe drought conditions preceded by wet climatic conditions and increasing fuel load due to fire suppression in the pinyon-juniper woodlands, all coinciding with the natural end of a long fire cycle (Floyd *et al.* 2006, p. 247).

In addition, the recovery processes following fire has been dramatically altered from historical processes (Floyd *et al.* 2006, p. 248). Recurrent fires favor resprouting of clonal shrub species such as Quercus gambelii (gambel oak), Amelanchier utahensis (Utah serviceberry), Symphoricarpos oreophilus (mountain snowberry), Fendlera rupicola (cliff fendlerbush), and Rhus trilobata (three-leaf sumac), and gradually eliminate the fire-sensitive pinyon and juniper (Floyd *et al.* 2000, p. 1667, 1677). Chapin Mesa milkvetch does not grow in the shrub-dominated areas of Mesa Verde now, and we cannot predict the long-term success of the species following loss of the pinyon-juniper due to fire and fire break construction.

From July 29 to August 4, 2002, the Long Mesa Fire burned 1,053 ha (2,601 ac) on Chapin and Park Mesas, which included about 306 ha (756 ac) of Chapin Mesa milkvetch habitat (Anderson 2004, p. 28). Between 1996 and 2008, 308 ha (762 ac) of habitat were burned by wildfires, and 6 ha (15 ac), by prescribed burns (Nelligan 2010, p. 1). On the Ute Mountain Ute Tribal Park habitat, several small fires appear to have burned a total of about 23 ha (57 ac) (Glenne 2010, map). Altogether, these recent fires have impacted about 21 percent of the total habitat for the species.

The average density per square meter of plants on monitoring plots in Mesa Verde decreased 39 percent from 2001 to 2003 (Anderson 2004, pp. 30, 37). Density declined in both burned and unburned transect segments between 2001 and 2003. The decline in density was slightly lower in burned transect segments than in unburned, but the difference in density in 2003 between burned and unburned transect segments was not statistically significant, suggesting that burning did not significantly impact plant mortality, nor did it result in any benefit to the species. The cycle of higher density on burned plots was repeated in 2011-2013. In 2014 and 2015 there were no significant differences found in density between burned and unburned plots (Rondeau *et al.* 2016, p. 15).

In 2015, although there was no significant difference in density between burned and unburned plots, there were 3.6 times more seedlings in unburned plots than burned plots (Figure 2) (Rondeau *et al* 2016, p. 16-18), which indicates the population structure of the species differs between burned and unburned areas. Plant populations rebounded in 2013 and 2015 in both burned and unburned areas due to an increase in winter precipitation (Figure 1). In 2015, fruit production and seedling germination was 3.6 times higher in intact, unburned areas, suggesting that the post-fire environment may be less suitable for seedling germination and establishment. We do not understand what, if any, these long term effects this difference in seedlings between burned and unburned areas may have on the species, particularly reproduction and recruitment. Fire may have a direct negative effect over the longer timeframe that constitute a threat to Chapin Mesa milkvetch, although future data will be informative.

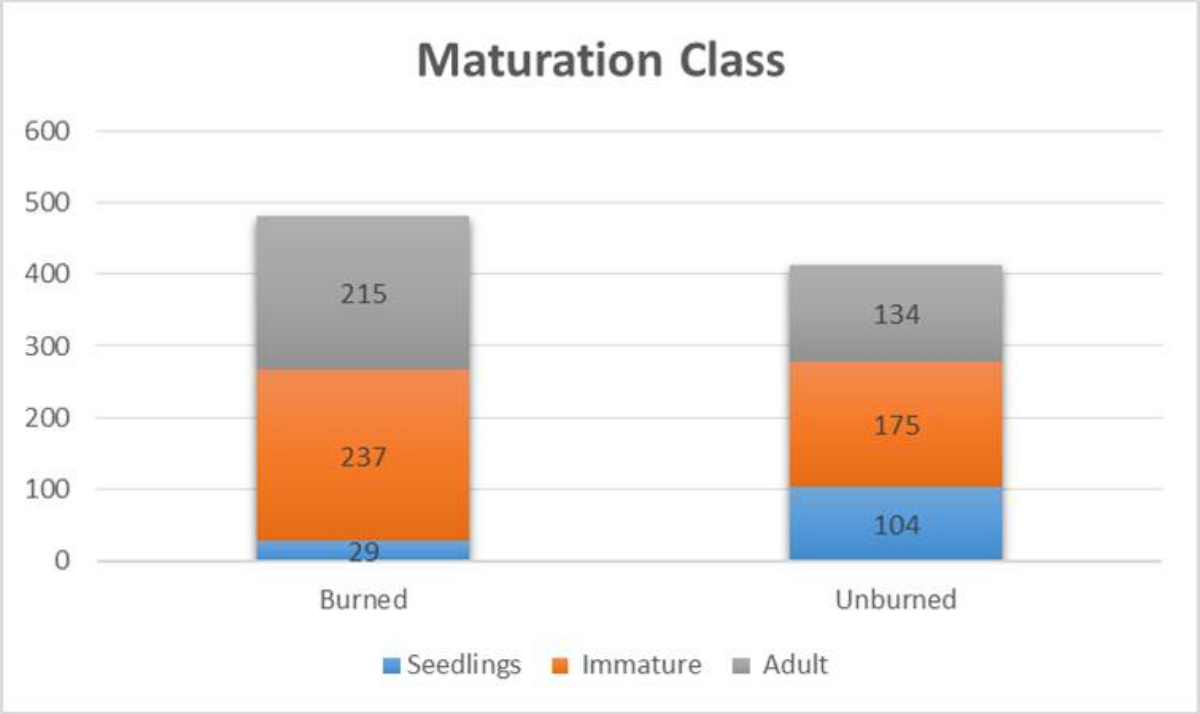

Figure 2: Number of Chapin Mesa milkvetch individuals in each maturation class in burned and unburned demography plots in 2015 (n=11 for each treatment) (Rondeau *et al.* 2016, p. 17).

In contrast, plants in areas burned in 2002 displayed higher reproductive effort and vigor, and produced approximately 241 times more seeds per plant than did plants in unburned areas (Anderson 2004, p. 57). There were no clear differences in seedling success between burned and unburned areas during early summer surveys in 2003, though survivorship of seedlings through their first summer could not be determined (Anderson 2004, p. 48). Plants in areas burned in 1996 on Park Mesa had very high vigor in 2003 (possibly due to high soil nitrate levels after fire), but did not set fruit, although flowers were produced and insect visitation was observed (Anderson 2004, p. iv).

The growth habit of Chapin Mesa milkvetch suggests it may be tolerant of fire, with its deep taproot and shallowly buried root crown, to which the plant dies back during winter months. Reproductive effort and fecundity were clearly higher in areas burned in 2002, and vigor also appeared to be greater (Anderson 2004, p. 57). However, by 2015, this trend may have changed because plants in the burned areas produced 3.5 fewer fruits and 3.6 times fewer seedlings than those in the unburned area (Rondeau *et al.* 2016, p. 16). The post-fire environment affects population structure although the mechanism for the chance is not understood. We suspect that invasion of non-native species, herbivory and changes in soil moisture after fires may cause this population structure shift.

Monitoring by CNHP in 2013 and 2015 revealed an increase in density of Chapin Mesa milkvetch on Chapin Mesa since 2002. The mean number of individuals per transect has been higher in the burned transects versus unburned across 5 years of sampling except in 2015 where density in the unburned plots exceeded those in the burned plots (Rondeau *et al.* 2016, p. 10–15). Differences in

density were not statistically significant between burned and unburned plots for any of the monitored years except in 2012 (Rondeau *et al*. 2016, p. 15). Continued monitoring will be needed to determine the long term trends in post-fire transects (San Miguel 2014, p. 1).

New information indicates that local scale climatic conditions may favor Chapin Mesa milkvetch growing within intact, woodland habitats. Although plant density was not significantly different between burned, grass dominated areas and unburned, intact pinyon-juniper habitat, monitoring in 2015 showed that plants in unburned areas produced more fruits and had higher seedling germination than burned areas (Rondeau *et al.* 2016, entire). The tree canopy can moderate temperature extremes on cold spring nights and hot summer days, and may decrease herbivory (Rondeau *et al.* 2016, pg. 21). Intact pinyon-juniper woodland habitat resists invasion of cheatgrass (Rondeau *et al.* 2016, pg. 16).

We conclude that the direct effects of fire on Chapin Mesa milkvetch are both positive and negative. Plants burn to the ground and then resprout the following spring if the fire is not too intense, but then have competition from nonnative plant species and grasses. Fire alters the habitat removing tree canopy and increasing light and exposing plants to temperature extremes. The entire burned and unburned habitat on Mesa Verde and the Ute Mountain Ute Tribal Park is at risk of burning within the foreseeable future. Continued monitoring of burned and unburned sites suggested that fire may have benefited the species soon after the fire, but those benefits may have been short-term in nature. Further monitoring is needed to understand the long-term direct effects. However, the indirect effect of wildfire in altering the post-fire environment by facilitating invasion of cheatgrass, increasing herbivory and fluctuating temperature extremes may pose a significant threat to the species (see Invasive Nonnative Plants for more discussion).

Invasive Nonnative Plants

As discussed above, the main threat to the species is the indirect effect of invasion by nonnative plant species. This invasion is facilitated by the increased frequency of burns as well as the creation of fire breaks within occupied Chapin Mesa milkvetch habitat (CNHP 2006, p. 4). In Mesa Verde, large wildfires that occurred earlier in the twentieth century (1934, 1959, 1972) were not associated with nonnative plant invasion (Floyd *et al.* 1999, p. 148), but the pinyon-juniper forests that have burned extensively in the past two decades are being replaced by significant invasions of nonnative species, especially cheatgrass (*Bromus tectorum*), musk thistle (*Carduus nutans*), and Canada thistle (*Cirsium arvense*) (Floyd *et al.* 2006, p. 1). Musk thistle was not found in either disturbed or undisturbed ground in 1980, but it was particularly invasive in burned areas of Mesa Verde by 1999 and is aggressively invading areas occupied by Chapin Mesa milkvetch (Floyd-Hanna *et al.* 1999, p. 148; Romme *et al.* 2003, p. 344).

A recent development in the post-fire habitat response is the remarkably rapid spread of cheatgrass. This weedy winter annual germinates in the fall, grows slowly during the winter, and

then grows rapidly in the early spring. By early summer it has set seed and died, creating a continuous fuel bed of quick-drying, flashy fine fuel that can readily carry fire, even without wind. Cheatgrass has been in Mesa Verde for many years. However, it was never widespread until 2000, when unusually warm dry summers and winters coupled with heavy fall rains allowed cheatgrass to rapidly expand its range, especially in places where fire or other disturbances have created bare ground (Romme *et al.* 2006, p. 3). Cheatgrass is now a dominant species in much of the area burned in Mesa Verde (Romme *et al.* 2006, pp. 2–3) and it has inundated the burned and disturbed portions of Chapin Mesa milkvetch habitat on Chapin Mesa (Hanna *et al.* 2008, p. 18). The highest infestation occurred in an area that burned both in the 1996 and the 2002 fires on Park Mesa. This area had been a old-growth pinyon-juniper woodland before the 1996 fire, and was seeded with native grasses. After re-burning in 2002, this area was inundated by cheatgrass (Hanna *et al.* 2008, p. 9). Mature pinyon-juniper woodlands are highly vulnerable to post-fire weed invasion (Floyd *et al*. 2006, p. 254). Given the seasonal overlap of Chapin Mesa milkvetch seedling growth with the peak growth of cheatgrass, it is likely that the presence of cheatgrass in populations of Chapin Mesa milkvetch compromises its viability (Anderson 2004, pp. 60–61).

Landscape modeling of the effects of projected cheatgrass increase on fire frequency in Mesa Verde indicates the potential for frequent reburning. Projections show a fire rotation of about 45 years for Mesa Verde. Such a frequent disturbance regime would be far outside the historical range of variability for the pinyon-juniper, and would likely impact or eliminate many native plant species. We have no data to indicate whether Chapin Mesa milkvetch will successfully adapt to a post-fire habitat of open clearings between shrubs, and competition from cheatgrass, thistles, and native grasses versus a pinyon-juniper dominated community.

Control of cheatgrass is extremely difficult and with other non-native species well established in the park, control of cheatgrass without the establishment of other native species may result in invasion from these other non-native species, especially smooth brome (*Bromus inermis*). In 1980, cheatgrass was found in 8 percent of survey samples in picnic grounds and 0 percent of undisturbed samples (Friedlander 1980, pp. 75–76). Since that time, the prevalence of cheatgrass has increased to 53 percent cover in burned areas within occupied Chapin Mesa milkvetch habitat (Rondeau *et al.* 2016, p. 16), such that we now consider the invasion of nonnative weedy plants, particularly cheatgrass, to be a threat of high magnitude to Chapin Mesa milkvetch because: (1) cheatgrass has invaded all of the burned and disturbed habitat of Chapin Mesa milkvetch in Mesa Verde, covering at least 40 percent of its entire range; (2) it competes with seedlings and resprouting adult plants for water and nutrients; (3) no landscape scale successful control methods are available; and (4) the proven ability of cheatgrass to increase fire frequency, thereby facilitating further rapid spread, threatens both burned and previously unburned occupied habitat. No cheatgrass was found in intact, unburned areas within Chapin Mesa milkvetch habitat (Rondeau *et al.* 2016, p. 16) strongly suggesting that intact habitat is important for the stability of the species.

Cheatgrass continues to spread into recently burned areas in Mesa Verde, and is altering the previous regime of infrequent fires occurring only during extremely dry periods to a new regime of frequent fires. Because the native flora is adapted to the historical fire regime, this change could produce rapid and irreversible degradation of native vegetation in the park (Floyd *et al.* 2006, p.

257). We conclude that cheatgrass invasion is likely to cause fire frequency to increase, with the result that only small patches of undisturbed habitat will remain for Chapin Mesa milkvetch within Mesa Verde. The extent of cheatgrass invasion on the Ute Mountain Ute Tribal Park is unknown, because no surveys have been completed.

Post-fire Mitigation

Various post-fire mitigation actions (aerial seeding of native grasses, and the control of weeds through mechanical removal, herbicides, and bio-control) have been effective in reducing the density of weeds after fire, but none of these techniques has prevented the weeds from becoming major components of the post-fire plant community. Post-fire mitigation activities were conducted in Mesa Verde under the Burned Area Emergency Rehabilitation program from 1996 to 1997 to prevent weed invasion and severe erosion and to encourage native plant species. Aerial seeding of native grasses was applied intensively in the burned out former old-growth pinyon-juniper community. The density of musk thistle was significantly reduced by seeding in burned areas. There has been no evidence that the diversity of native forbs has declined by introducing native perennial grasses (Floyd *et al.* 1999, p. 155), but Chapin Mesa milkvetch was not specifically monitored. Therefore, we are unsure if these efforts to prevent weed invasion negatively affect Chapin Mesa milkvetch.

Seeding of native grasses has not prevented the spread of cheatgrass into burned areas. Despite the seeding, cheatgrass invasion has increased (Floyd *et al.* 2006, p. 254). Cheatgrass covered 23 percent of burned areas sampled in 2011 (Wender 2012c, p.1) and 53 percent of sampled burned areas in 2015 (Rondeau *et al.* 2016, p. 16).

Releases of two biological control weevils on musk thistle have been highly effective in reducing the density, vigor, and net fecundity of the thistle plants in Chapin Mesa milkvetch habitat on Mesa Verde.
Post-fire nonnative plant control by aerial seeding of native grasses, mechanical removal, herbicides, and bio-control has reduced competition by invasive nonnative plants other than cheatgrass. Until 2011 there was little documentation of negative effects of these post-fire mitigation efforts on Chapin Mesa milkvetch. This study found burned, seeded and unsprayed plots had significantly higher densities of Chapin Mesa milkvetch than plots that were burned, seeded and sprayed (Kuhn and Anderson 2012, pp. 15, 28). We consider herbicide application to have a negative impact on the species. The impact does not rise to the level of a threat because applications were done in very limited areas, and Mesa Verde plans to minimize use of aminopyralid herbicides that affect milkvetch plants.

Mesa Verde has completed an Invasive Plant Management Plan (IPMP)/Environmental Assessment and Biological Assessment (NPS 2015a, entire) which analyzed potential impacts to Chapin Mesa milkvetch from the preferred alternative. The most significant proposed change from

current practice will be to allow for future emergency aerial application of pre-emergent herbicide (Imazapic) directed at stunting the establishment of cheatgrass after a future wildfire within the milkvetch habitat. The IPMP may affect, but is not likely to adversely affect, the Chapin Mesa milkvetch (USFWS 2016, pp. 1,2).

As described in the IPMP, musk thistle, Canada thistle, and other invasive exotic plants will be spot treated within portions of Chapin Mesa milkvetch habitat in Mesa Verde. Efforts will concentrate on roadsides, trail corridors, developed zones, and small burn areas on Park Mesa and Chapin Mesa. Work will primarily be done with backpack sprayers, using aminopyralid (roadsides only) and glyphosate herbicides (Wender 2011, p.2; 2012c, p. 4). Additional care will be taken when applying herbicides with the active ingredient aminopyralid, which is highly active on plants in the Fabaceae family. Use of this herbicide within Chapin Mesa milkvetch habitat will be minimized, except immediately along roadsides.

The Mesa Verde IPMP calls for the aerial application of imazapic herbicide (e.g., Plateau®) following severe wildfires in sites with or projected to attract moderate to heavy cheatgrass infestations. In order to clarify the potential effects of aerial Plateau® applications on Chapin Mesa milkvetch, Mesa Verde conducted an herbicide trial in fall of 2011. The trial was designed to replicate the application timing, herbicide rate, and broadcast pattern that would most likely occur under an operational aerial cheatgrass treatment scenario. They applied Plateau® to several plots of Chapin Mesa milkvetch in 2011 during the fall when Chapin Mesa milkvetch plants are dormant and cheat grass is germinating, and reexamined the plots in 2012.

There was no apparent herbicide damage on any milkvetch species plants in any treatment plot. Live cheatgrass cover declined in all plots, including the control plot one year after treatment. Herbicide treatment effects on cheatgrass were obscured by lack of late-season germination due to low precipitation in late summer (Wender 2012c p. 3) It was planned that pending the final results of this trial, aerial Plateau® applications would be prohibited within Chapin Mesa milkvetch habitat. After the trial concludes, a determination would be made about the effects of aerial herbicide applications. Data from the 2011 to 2016 Chapin Mesa milkvetch population status surveys and previous surveys in 2001 and 2003 would be used to develop a threshold of acceptable Chapin Mesa milkvetch injury and mortality resulting from herbicide application (Wender 2012c, p.3). However, this herbicide study was discontinued in 2013 until the vegetation ecologist position at Mesa Verde can be filled long enough to complete it.

There have been effects to Chapin Mesa milkvetch from post-fire mitigation efforts. And, future post-fire mitigation efforts may impact Chapin Mesa milkvetch. Given the uncertainty of the study looking at impact to Chapin Mesa milkvetch from aerial Plateau® we are unable to determine the impacts to Chapin Mesa milkvetch from post-fire mitigation efforts at this time.

Wildfire and Fuels Management

Wildfire management at Mesa Verde includes the creation of fire breaks, fire lines, and staging areas, all of which remove or alter the mature pinyon-juniper woodland habitat where Chapin Mesa milkvetch is found. A cattle fence 4.2 km (2.6 mi) long separates the northern half of the species' habitat on Mesa Verde from the southern half on the Ute Mountain Ute Tribal Park. Mesa Verde created a fire break about 30 m (100 ft) wide along this fence by cutting all vegetation to ground level. The break covers about 14 ha (34 ac) at the center of the distribution for Chapin Mesa milkvetch, or 0.9 percent of the species total habitat.

On the Ute Mountain Ute Tribal Park side of the fence, the pinyon-juniper woodland is cut in a mosaic pattern, leaving trees and clumps of trees standing with cleared areas around them. This fire break covers about 189 ha (467 ac), or 12 percent of the species' total range. Response of Chapin Mesa milkvetch to the two different treatments has not been compared.

Fire breaks are also created by prescribed burns. Based on new information in the draft Fire Management Plan, mechanical removal and prescribed burning together have altered about 14 percent of the species total range, including the fence line fire breaks described above with 2 percent occurring at Mesa Verde and 12 percent on the Ute Mountain Ute Tribal Park (NPS 2015b). In 2011, a survey on the tribal fire break documented the presence of foreign mulching materials, non-native seeded plant species, and feral horse bedding areas, all of which are habitat alterations likely to impede the regrowth of Chapin Mesa milkvetch. Information on the status of Chapin Mesa milkvetch within this area was not included in the survey report provided by the tribe (Natori 2012, p.1).

The ecological conditions for Chapin Mesa milkvetch within the cleared areas are different from its typical pinyon-juniper woodland habitat. Cleared areas are exposed to more sun and wind that dry the soil and the Chapin Mesa milkvetch seedlings, and cold spring season mornings expose young sprouts and blossoms to frost damage. In addition to invasion by cheatgrass, removal of woody vegetation appears to result in competitive release of native grasses. In sites where no seeding has been done, removal of woody vegetation favors Poa fendleriana (muttongrass), the most common grass species on Mesa Verde (Anderson 2004, p.73). This response is seen in mechanical fuels reduction areas on Chapin Mesa, where cover of muttongrass can approach 75 percent (Anderson 2004, p. 60). Density, reproductive effort and vigor of Chapin Mesa milkvetch appears low in these areas, although there are few quantitative data with which to compare density. Plants were growing among large, crowded bunches of muttongrass and appeared small and unhealthy (Anderson 2004, p. 73). This effect is probably due to competition with muttongrass for water and nutrients.

In addition, the Fire Program uses mechanical vegetation clearing around certain park resources to mitigate for fire hazards. Much of this work focuses on areas around buildings, roads, and picnic areas on Chapin Mesa, within Chapin Mesa milkvetch habitat. In 2014, brush cutters and weed whackers were used by fire crews to clear vegetation within 6 m (20 ft) of buildings on 27.24 acres (about 1.4 percent) of Chapin Mesa milkvetch habitat in the Park. In addition, tree and brush thinning occurred out to 30.5 m (100 ft) from structures on Chapin Mesa, which when added to the

6 meters (20 feet) of vegetation clearing, affected 17.6 ha (43.5 ac) of suitable and occupied Chapin Mesa milkvetch habitat. Prior to vegetation removal activities, Fire Program personnel notify Vegetation Program personnel, who flag all emerged Chapin Mesa milkvetch plants for avoidance.

Mesa Verde's draft Fire Management Plan proposes additional impacts to Chapin Mesa milkvetch habitat (NPS 2015b). Specifically roadside thinning, removal of roadside dead and down woody material and thinning along trails would alter 162.6 ha (401.9 ac), or 20 percent of Chapin milkvetch habitat within Mesa Verde. Proposed impacts coupled with existing impacts totals 290.7 ha (718.4 ac), or 35.7 percent of Chapin Mesa milkvetch habitat within Mesa Verde and 18 percent of the species' entire range (NPS 2015b).

Fuels management activities have direct and indirect impacts to Chapin Mesa milkvetch plants and habitat. Fuels management activities occur in the summer and fall when impacts to mature Chapin Mesa milkvetch plants are diminished or negligible because the seeds have matured and plants are dying back for the season. Direct impacts to the plants, such as trampling during the cutting and hauling out of wood and slash and scorching during prescribed burns, are short term because most plants likely will be able to resprout the following spring. Impacts to juvenile plants and seedlings are not documented, but could be greater because young plants are more delicate. Mechanical fuels reduction activities result in a low to moderate level of surface disturbance, which we believe results in little direct impact to Chapin Mesa milkvetch. However, the fuels management activities tend to facilitate nonnative species invasion by creating disturbance favored by these species. In addition to cheatgrass, musk thistle appears to thrive on the disturbance created by fuels management, and to out-compete Chapin Mesa milkvetch (Floyd-Hanna *et al.* 1999). Numerous musk thistle plants were found in areas where mechanical fuels reduction activities took place (Anderson 2004, p. 73.). The canopy of Chapin Mesa milkvetch can act as a seed trap for musk thistle, which greatly increases the likelihood of negative impacts to Chapin Mesa milkvetch from competition (Anderson 2004, pp. 63, 70).

Clearing for fuel reduction can impact Chapin Mesa milkvetch in the following ways: (1) Above-ground stems are directly removed; (2) plants that resprout the following spring have less water available because the soil dries due to exposure to sun and wind; and (3) invasive weeds, the native grass muttongrass, and seeded native grasses provide increased competition. However, we have no data that indicates the degree to which these impacts are occurring or will occur in the future. Because clearing and prescribed burns affect 18 percent of the range of Chapin Mesa milkvetch, we believe that clearing or burning for fire management may have a detrimental effect on the species. As with wildfire, the indirect effect of facilitating invasion of the habitat by cheatgrass poses a threat to the species because it increases the likelihood of more frequent fires.

Fuel reduction projects at Mesa Verde during 2012 resulted in very little direct mortality of Chapin Mesa milkvetch due to avoidance measures used by work crews (Wender 2012b, p. 2). In 2013, fuel reduction was conducted on 17 acres, about 1 percent, of occupied habitat within the Park. An unknown number of Chapin Mesa milkvetch plants were cut because there was no time to flag them (San Miguel 2014, p.4). Therefore, there were negative impacts to plants in this area, but the impacts to the species overall were small in scale. Additional proposed fuel management activities

will increase the number of acres of Chapin Mesa milkvetch habitat that is altered in the future (NPS 2015b).

Mesa Verde's draft Fire Management Plan recommends the widespread use of pile burning as the primary means of eliminating cut slash in fuel reduction areas, including Chapin Mesa milkvetch habitat, and reliance on this method is likely to be in the preferred alternative with the EA to be released in 2016. The cutting and burning is expected to result in trampling of the milkvetch plants, disturbance of the soil, and an increase in nonnative invasive plants. Mesa Verde's draft Fire Management Plan estimates that 3,837 burn piles of approximately 6 square meters (m^2) (64 square feet (ft^2)) each would be scattered over the 163 ha (402 ac) of proposed activities within Chapin Mesa milkvetch habitat (NPS 2015b). Park management is also considering a new helibase on Chapin Mesa at a location that would permanently impact "some" occupied habitat for the Chapin Mesa milkvetch (San Miguel 2014, p. 7). Current and future fuels reduction activities are and will have a negative impact on 18 percent of the species range and are therefore a threat to the species, although this threat is of less magnitude than the threat from increased wildfire and cheatgrass invasion.

Feral horse activity

Feral horses have created dirt trails and large patches of bare ground within Chapin Mesa milkvetch habitat. These areas also serve as exotic species vectors. In Mesa Verde's post-fire plant communities, nonnative species are often present and sometimes dominate large areas. Horses create bare patches of disturbed soil, further encouraging the spread of weedy species such as musk thistle (Carduus nutans), alyssum (Alyssum simplex), and redstem stork's bill (*Erodium cicutarium*) (San Miguel 2014, p. 1).

A Trespass Livestock Management Plan is currently being developed by the wildlife program, and will result in the future removal of feral horses and cattle from the park. At this time, however, the scope of these impacts is not large enough to be considered a threat to the species.

Development of Infrastructure

For the most part, Chapin Mesa milkvetch habitat is protected by being within a National Park and on Tribal lands that are not open to the public. However, some limited development of infrastructure does occur.

As of 1980, about 17.7 ha (44 ac) of Chapin Mesa milkvetch habitat was graded or paved for roads

within Mesa Verde, which was 1.7 percent of the habitat known in the park at that time (Friedlander 1980, p. 78). As of 2015, about 71.7 ha (235.3ac) or 11.65 percent of the known range of Chapin Mesa milkvetch within Mesa Verde was classified as hardened surfaces, i.e., roads, buildings, parking lots, water tanks, trails, etc. (NPS 2015b). A recent impact was the installation of thousands of meters of underground fiber optic cables throughout the developed areas of the park (Anderson 2004, p. 70; Nelligan 2010, p. 2). Information on the number of plants destroyed or new recruits that appeared following the installation is not available (San Miguel 2010a, pers. comm.).

More than 10 percent of Chapin Mesa milkvetch's habitathas been eliminated during the development of visitor facilities in Mesa Verde (NPS 2015b). Regular maintenance and construction projects at Mesa Verde will continue to result in a small amount of plant mortality. Building modifications and utility upgrades in 2012 affected less than 0.04 ha (<0.1 ac) and an estimated maximum of 50 plants. Most of the plants within project areas were flagged and avoided (Wender 2012b, p.2). Trampling of plants by people using trails, roads, and picnic areas in the developed portion of Mesa Verde also eliminates a small number of plants (Nelligan 2010, p.2). Likewise on the Ute Mountain Ute Tribal Park, most foot traffic is limited to routes used by escorted tour groups and, therefore, likely to have a very small impact on the species. Planning began in 2014 for the development of a new visitor access and distribution plan for Mesa Verde. A preferred alternative has yet to be advanced, but discussions included the creation of some new public trails in Chapin Mesa milkvetch habitat that could extend for several miles.

Trampling of plants by visitors and staff is an ongoing impact that does not rise to the level of a threat because it affects plants in a very limited portion of the species' range in Mesa Verde and in the Ute Mountain Ute Tribal Park. Chapin Mesa milkvetch may recover from this kind of disturbance if the below-ground parts are not damaged, or if undamaged plants remain nearby to provide a seed source and the disturbance is not constantly repeated or followed up with additional disturbances. One attempt to transplant mature plants that were growing in a planned construction area was unsuccessful because the taproots were severed (Nelligan 2010, p. 2).

Construction of new roads, a visitor center, and campground in Mesa Verde occurred in 2010. Most of the new construction was outside of Chapin Mesa milkvetch habitat. Most of the disturbance in occupied habitat was related to a water pipeline, and because it was directionally drilled from one pad of about 4 by 24 m (14 by 80 ft) alongside the park road, the impact on the plants was negligible (San Miguel 2010b, pers. comm.).
Development impacts can extend beyond the footprint of development. Ground disturbance to create infrastructure can increase invasive weeds, and reduce forage and nest sites for pollinators. Wind and water erosion may also increase around development where disturbance from staging occurs.

The habitat for Chapin Mesa milkvetch on tribal land is within the Ute Mountain Ute Tribal Park, which is managed for protection of its cultural and natural resources. It is an undeveloped area without surfaced roads or permanent facilities. We are not aware of any development activities on the Ute Mountain Ute Tribal Park that would impact Chapin Mesa milkvetch (Mayo 2010, pers. comm.).

Overall, and based on updated information, the impact of existing development appears moderate, impacting about 11.65 percent of the species' range on Mesa Verde (NPS 2015b) and 8 percent of the species entire range. Impacts from development extend beyond the footprint of the infrastructure as indirect effects such as to pollinator foraging and nest sites, and increase in suitable sites for invasive weed establishment. In contrast, Mesa Verde will likely continue to locate most of its major facilities outside of Chapin Mesa milkvetch habitat, and minimize infrastructure within the habitat in the future to the extent possible. Most of the habitat within Mesa Verde is protected from development, because it is within a National Park. Likewise, the Tribal Park is likely to remain undeveloped.

Drought and Climate Change

Drought may negatively affect Chapin Mesa milkvetch. In 2002, severe drought caused most Chapin Mesa milkvetch individuals to remain dormant (Anderson 2004, p. 4). The total annual precipitation measured at Mesa Verde in 2002 was 28 cm (11 in.), well below the average of 44 cm (17.5 in.) from 1948 to 2003. However, there were 5 years between 1948 and 1989 where Mesa Verde received less than 28 cm (11 in.) of precipitation. Tree ring analysis indicates that droughts were as common during the Ancestral Puebloan occupation of Mesa Verde, from approximately A.D. 600 to A.D. 1300, as they are today. It is likely that drought is common enough that Chapin Mesa milkvetch can recover from its effects (Anderson 2004, p. 35), provided that severity and duration of drought does not exceed historical levels, or that threats such as nonnative plant invasion do not increase significantly as a result. Periodic drought causes Chapin Mesa milkvetch plants and seedlings to dry out during a given year, and contributes to increased fire frequency and nonnative plant invasion. We believe that short-term drought has a low-level direct impact on the species and it also indirectly facilitates cheatgrass invasion and increased fire frequency.

Our analysis under the Endangered Species Act includes the 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.

Climate change projections for the Southwestern United States include increased temperatures, more intense and longer-lasting heat waves, and an increased probability of drought, that are worsened by higher temperatures, heavier downpours, increased flooding, and increased erosion (Karl *et al.* 2009, pp. 129–134). Projections for western Colorado indicate that temperature could increase an average of 2.5 degrees Celsius (°C) (4.5 degrees Fahrenheit (°F)) by 2050 (UCAR 2009, pp. 1-14).

The increasing frequency of large-scale fires is largely due to periodic drought conditions preceded by years of wet climatic conditions that allowed heavy fuel loads to accumulate (Floyd *et al.* 2006, p. 247). The occurrence of this specific combination of a wet season followed by drought, which is likely to be exacerbated by climate change, is unpredictable at this time. We expect that Chapin Mesa milkvetch will be affected negatively by the effects of climate change on precipitation, primarily due to the timing of the precipitation. The emergence of Chapin Mesa milkvetch is strongly tied to winter precipitation and its germination is strongly tied to summer monsoonal moisture but future climate projections predict lower snowpack amounts, earlier winter warming, and warmer summers, which could reduce available moisture needed for emergence and germination. Climate change may rise to constitute a threat to Chapin Mesa milkvetch.

Climate change has the potential to change the plant community, allow cheatgrass to increase, and potentially increase the risk of wildfire, which would likely have a negative effect to Chapin Mesa milkvetch. It is difficult to assess the threat of climate change to Chapin Mesa milkvetch given the uncertainties associated with future projections. However, based on the best available information on climate change projections into the next several decades, we find climate change to be a threat to Chapin Mesa milkvetch based on how predicted changes could negatively influence the species. We recognize there are many uncertainties, and projections further into the future become even more uncertain, making it even more difficult to predict how climate change might affect the species. Recognizing the uncertainty, but further considering the threat of climate change exacerbating wildfire frequency and nonnative plant invasion, we now find climate change to be a threat to Chapin Mesa milkvetch.

Summary of Factor A

The highest threat to Chapin Mesa milkvetch habitat is still the invasion of nonnative cheatgrass following wildfires, prescribed fires, and fire break clearings. Recent wildfires have burned 21 percent of the pinyon-juniper woodland habitat for the species. Another 19 percent has been burned and/or cleared to discourage further spread of wildfires within Mesa Verde. Additional fuels management is proposed within Mesa Verde. Dense stands of cheatgrass have invaded all of these areas, which cover 53 percent of the habitat on Mesa Verde, and 40 percent of the entire range of the species. Cheatgrass is highly flammable and greatly increases fire frequency on both burned and nearby unburned but disturbed habitat. Although mature Chapin Mesa milkvetch plants recover strongly after fire, cheatgrass competes with seedlings for water and nutrients, and we are

unsure of their long-term reproductive success in open areas exposed to drying sun and wind. Cheatgrass covered 23 percent of sampled post-fire habitat in 2011 (Wender 2012a, p.1) and increased to 53 percent of the plant cover in 2015 (Rondeau *et al.* 2016, p. 16). Frequent fires are likely to prevent recovery of the pinyon-juniper woodland. A new biopesticide control agent (a bacteria: Pseudomonas fluorescens, D7 or ACK 55) shows promise for controlling cheatgrass where it has been tested and may become available commercially in 2016, but its potential effectiveness to control cheatgrass on Chapin Mesa is unclear at this time. Therefore, we consider the dominance of cheatgrass in occupied Chapin Mesa milkvetch habitat to be a significant threat to the long-term survival of the species. No wildfires occurred within Chapin Mesa milkvetch habitat on Mesa Verde between 2012 and 2015, but wildfires, prescribed fires, and clearings for fire breaks are still considered a moderate threat to the species because they destroy plants, modify the habitat and facilitate the invasion of cheatgrass.

Drought facilitates increased fire frequency. Climate change may exacerbate the threat of cheatgrass invasion and more frequent wildfires and therefore poses a threat to the species.

Based on an updated analysis, the impact of infrastructure development and visitor use is moderate. About 95 ha (235 ac) of Chapin Mesa milkvetch habitat on Mesa Verde have been used for roads, buildings, parking lots, etc., which is 5.9 percent of the species' entire range. Impacts from development extend beyond the footprint of the infrastructure as indirect effects such as to pollinator foraging and nest sites, and increase in suitable sites for invasive weed establishment. No permanent development has been reported on the Ute Mountain Ute Tribal Park. Because impacts have occurred and because impacts will likely be small into the future, we find the threat from infrastructure development to be a threat, although less than the threat from increased wildfire frequency and cheatgrass invasion.

Post-fire nonnative plant control by aerial seeding of native grasses, mechanical removal, herbicides, and bio-control has reduced competition by nonnative invasive plants other than cheatgrass, and there is little documentation of negative effects on Chapin Mesa milkvetch other than from the ingredient aminopyramid. We consider the impacts of these activities to be low, not rising to the level of a threat to the species.
Further, habitat disturbance by feral horses results in impacts that are limited in scope, and do not rise to the level of a threat to the species.

We find that Chapin Mesa milkvetch is impacted by the present or threatened destruction, modification, or curtailment of the species' habitat or range. These impacts pose a threat to the species that is expected to continue or increase in the foreseeable future.

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

We are not aware of any threats involving the overutilization or collection of Chapin Mesa milkvetch

for any commercial, recreational, scientific, or educational purposes. Therefore, we do not consider overutilization to be a threat to the species now, nor is it expected to become so in the foreseeable future.

C. Disease or predation:

Herbivory and trampling

Herbivory by feral horses, stray cattle and mule deer was “frequently observed” in Mesa Verde early in the 2011 season (Wender 2012a, p. 1). During the 2011 and 2012 field seasons, many Chapin Mesa milkvetch plants were nipped off in areas with heavy horse trampling (San Miguel 2014, p. 1). In 2015, biologists monitoring Chapin Mesa milkvetch study plots observed frequent predation of Chapin Mesa milkvetch in the burned areas, including by pocket gophers, which have become more common in the open early successional habitat (Rondeau et al. 2016, p. 20–21).

On the Ute Mountain Ute Tribal Park, the most abundant grass (muttongrass) associated with Chapin Mesa milkvetch is highly palatable to cattle, which graze the grass in preference to the milkvetch. Chapin Mesa milkvetch is palatable so cattle do likely eat the plant. Because it has not been monitored or studied, we do not understand grazing impacts at this time well enough to evaluate this threat.

Seed predation by snout beetles or weevils caused loss of seeds in about 12.5 percent of Chapin Mesa milkvetch plants in plots sampled in 1980 (Friedlander 1980, p. 64). Beetle predation has not been observed since 1980, and is not considered a threat to the species. Larvae of the clouded sulfur butterfly (Colias philodice) have been reported to cause severe defoliation of Chapin Mesa milkvetch (Anderson 2001, p. 11). Aphids also appeared to have an impact on reproductive output for this species (Anderson 2001, p. 11). In addition, about 10 percent of the large multi-stemmed plants observed in 2012 within the burned area on Chapin Mesa were damaged by unidentified insect larvae that caused stems to weaken and break (Wender 2012b, p.1). However, these events were unusual, and insect predation is considered a low-level impact that does not rise to the level of a threat.

A white filamentous fungal blight covered a few Chapin Mesa milkvetch plants during the late growing seasons of 2014 and 2015. It is not known whether this infestation has a negative effect on the plant or how widespread it might be. No diseases are known to affect Chapin Mesa milkvetch. Therefore, we do not consider disease to be a threat to the species.

Summary of Factor C

With the current and anticipated increase in trampling and herbivory by feral horses and cattle, herbivory is considered a low level impact to the species.

No diseases are known to affect Chapin Mesa milkvetch.

D. The inadequacy of existing regulatory mechanisms:

The species is offered some protection based on its presence within a National Park. The National Park Service Organic Act (1916, p. 1) states that wildlife are to be conserved and left unimpaired for future generations to enjoy. The Mesa Verde mission is to preserve and protect more than 4,000 archeological sites and also to protect wildlife, birds, and other natural resources from willful destruction, disturbance, and removal.The plants are protected from visitor impacts in undeveloped areas of Mesa Verde by regulations that restrict visitor access to designated trails, roads, and campgrounds to protect cultural resources. Visitors found hiking off developed areas or designated trails when not accompanied by a uniformed National Park Service employee are subject to penalties provided for in title 36 of the Code of Federal Regulations (maximum fine of $500 and 6 months imprisonment). Mesa Verde does not have a management plan specific to Chapin Mesa milkvetch, nor does their draft Fire Management Plan or IPMP specifically mention management for this species (San Miguel 2010a, pers. comm.). Mesa Verde gives Chapin Mesa milkvetch special consideration when planning park projects in an effort to minimize impacts to the species (Nelligan 2010, p. 3). Since 2011, management for Chapin Mesa milkvetch includes plant surveys and mapping efforts, avoidance and minimization of habitat disturbance during work projects, tracking of plants that were impacted during work projects, long-term population trend research, exotic plant control, and trial application of Plateau herbicide to control cheatgrass (Wender 2012b, pp. 2-3).

The habitat for Chapin Mesa milkvetch on the Ute Mountain Ute Tribal Park is maintained as part of a 50,586-ha (125,000-ac) undeveloped area to protect cultural and environmental resources. Visitors are allowed only on guided tours. The management goal for Chapin Mesa milkvetch occupied habitat on the Ute Mountain Ute Tribal Park is for no ground-disturbing activities. Grazing is allowed (Clow 2010, pers. comm.), but we do not understand the impacts to Chapin Mesa milkvetch.

The Ute Mountain Ute Tribe has been drafting a management plan for species at risk that will include monitoring of Chapin Mesa milkvetch plants and habitat (Clow 2010, pers. comm.). The management plan will assist us in better understanding the extent to which the Tribe plans to conserve the species and its habitat. The final plan is not yet available.

Despite the positive management for Chapin Mesa milkvetch that occurs within Mesa Verde and the Ute Mountain Ute Tribal Park, the existing regulatory mechanisms are not addressing the primary threats from cheatgrass and other fire effects on the scale necessary to conserve the species. Therefore, the existing regulatory mechanisms are not adequate.

Summary of Factor D

We expect that Chapin Mesa milkvetch habitat on the Ute Mountain Ute Tribal Park is generally protected from human disturbance by tribal regulations that do not allow public access or

unauthorized activities. Human impacts in undeveloped areas of Mesa Verde are minimized by regulations that restrict visitor access to designated trails, roads, and campgrounds to protect cultural resources. While currently needed management actions are ongoing and management plans have been drafted, no plans, policies, or regulations have been signed and implemented for the specific purpose of monitoring and protecting Chapin Mesa milkvetch from cheatgrass invasion and recurrent fires. We anticipate that Mesa Verde and the Ute Mountain Ute Tribe will formalize their management plans at some future time.

The existing suite of local, State, and Federal laws that we evaluated do not address the primary threat to Chapin Mesa milkvetch of cheatgrass invasion following fire. Additionally, the existing plans rely on the resilience of the plants and their ability to resprout after impacts, which is insufficient to provide for their recovery post-fire. Therefore, we find that the existing regulatory mechanisms for the species do not address the threats to the continued existence of the species.

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

Restricted Range

The global range of Chapin Mesa milkvetch is restricted to pinyon-juniper woodlands on about 1,619 ha (4,000 ac) on three adjacent mesas. The species does not grow in grasslands below the mesas or in adjacent shrublands at higher elevation on the mesas, nor has it been found in pinyon-juniper woodlands on nearby mesas. Such a restricted range makes the species vulnerable to habitat modification caused by wildfire, cheatgrass invasion, increased drought, and climate change, but is not considered a threat in itself.

Herbicides

Less than 10 percent of Chapin Mesa milkvetch habitat on Mesa Verde has been sprayed with herbicide to control identified high-density stands of musk and Canada thistles. These herbicide applications have been performed carefully to minimize overspray that might land on native species (Nelligan 2010, p. 2). We are not aware of any use of herbicides on the tribal land habitat. Prior to 2011, we had no information indicating that herbicide use has affected Chapin Mesa milkvetch, so we did not consider herbicide use to be a threat to the species. However, a report on monitoring conducted in 2011 shows a significantly higher density of Chapin Mesa milkvetch in post-fire areas that were seeded but not sprayed compared to post-fire seeded areas that were sprayed (Kuhn and Anderson 2012, pp. 6, 15). These results introduce uncertainty about the level of impact caused by herbicides.

Summary of Factor E

The small range of Chapin Mesa milkvetch makes it vulnerable to existing and future threats, but does not constitute a threat in itself. Herbicides are used within the habitat, but prior to 2011 they were not known to affect the species. Herbicide use occurs in a small portion of the species' habitat and is conducted so as to minimize impacts to the species. However, we are not certain at this time

whether impacts from herbicides rise to the level of a threat that may affect the continued existence of the species.

Conservation Measures Planned or Implemented :

We discussed planned or implemented conservation measures under the discussion of each threat above.

Summary of Threats :

Table 1 below provides an overview of the threats to Chapin Mesa milkvetch. We consider degradation of habitat by fire followed by cheatgrass invasion and subsequent increase in fire frequency to be the most significant threats (Table 1). Cheatgrass is likely to increase given its rapid spread and persistence in habitat disturbed by wildfires, fire and fuels management and development of infrastructure, and the inability of land managers to control it on a landscape scale. Threats to Chapin Mesa milkvetch and its habitat from nonnative plant invasion following wildfires and fire and fuels management currently affect about 53 percent (431 ha (1,066 ac)) of the species' range on Mesa Verde and 26 percent (212 ha (524 ac)) on the Ute Mountain Ute Tribal Park for a total of 40 percent of the species entire known range (Table 2). Fires, fire break clearings, and drought are considered moderate threats to Chapin Mesa milkvetch but are proposed to increase. All existing and proposed impacts from fuel management and facilities development are significant, totaling 12 percent on Mesa Verde and another 12 percent on the Ute Mountain Ute Tribal Park (NPS 2015b). Regulatory mechanisms continue to be inadequate to protect the species from these threats, and this has a moderate impact on the species. Other impacts not considered threats include post-fire native grass seeding, thistle invasion, aminopyralid herbicide use, infrastructure development, trampling and herbivory by feral horses, and pollinator availability.

The Tribe reports that they did not conduct surveys, or have any new information on the species' status on their lands in 2016.

TABLE 1. Threat summary for factors affecting Chapin Mesa milkvetch.

Listing Factor	Threat or Impact	Scope of Threat or Impact	Intensity	Exposure %	Likelihood of Exposure	Species' Response	Foreseeable Future	Overall Threat
A	Nonnative Invasive Cheatgrass	Moderate	High	Currently 40. Likely to increase.	High	Increased fire frequency	Increasing with rapid increase possible	High
						Strong		

A	Wildfires	Moderate	Moderate	Currently 21. Likely to increase.	High	regrowth, reduced reproduction, increased cheatgrass and fire frequency.	More frequent	Moderate
A	Prescribed burns completed and proposed	Low	Moderate	0.37 and 0.34	High	Strong regrowth, unknown net reproduction, Increased cheatgrass and fire frequency	Continue	Moderate
A	Fire break clearing completed and proposed	Moderate	Moderate	14 and 10	High	Outcompeted by grasses, decline of growth, increased cheatgrass	Increase	Moderate
A	Nonnative Invasive thistles	Low	Moderate	5	High	Competition	Decline	None
A	Periodic Drought	Moderate	Moderate	97	Moderate	Plants fail to sprout, or seedlings dry up. Increased cheatgrass and fire frequency	Unpredictable but likely to increase	Moderate
A	Climate Change	Moderate	Moderate	97	Moderate	Increased fire frequency / Plants may fail to emerge or germinate	Climate models predict 40-year changes	Moderate
A	Infrastructure Development	Moderate	High	5.9	Moderate	Loss of habitat, loss of plants	Small increase	None

A	Trampling	Moderate	Moderate	4	Moderate	Loss of plants	Increase	None
A	Native Grass Seeding Post-fire	Moderate	Low	21	High	Competition	Continue	None
A	Pollinator Availability	Low	Low	21	Low	Decreased seed production	Increase	Low
B	None			0			Not likely to change	None
C	Herbivory	Low	Low	1	Low	Plants resprout, seedlings destroyed	Likely to continue and luctuate with feral horse population	None
C	Chemical and Mechanical Invasive Plant Treatment	Low	Low	7	Moderate	Some mortality, strong regrowth by survivors	Continue	None

Listing factors include: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; or (E) other natural or manmade factors affecting its continued existence.

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 :

We recommend:

- Continued implementation of the plans for cheatgrass control, monitoring population trends in response to fire management, invasive species, and tracking of development impacts that are now being conducted by Mesa Verde;
- Additional plant surveys to document the entire range of the species on Mesa Verde and Tribal lands;
- Removal of feral horses from Mesa Verde;

- Avoidance of impacts to the plants during ground disturbing activities within Mesa Verde:
- Reduction of areas proposed for fuels management clearing and thinning
- Trial of biopesticide to control of cheatgrass in conjuction with seeding of native species to prevent invasion of other weeds.
- Control of other non-native grasses such as smooth brome (*Bromus inermis*)

Planning, Management, and Conservation:

Key future needs include: investigating and tracking impacts and findings regarding Chapin Mesa milkvetch, including studying the effects of imazapic herbicide on and developing a Conservation Plan for this species.

Additional appropriate conservation measures for this candidate species will depend on the results of ongoing research regarding effective measures for controlling cheatgrass and other invasive species that are competing with Chapin Mesa milkvetch on Mesa Verde.

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
		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 Chapin Mesa milkvetch faces to be moderate in magnitude because the major threats (nonnative plant invasion facilitated by fire, management of fire and fuels

management, and drought), plus inadequacy of existing regulatory mechanisms, while serious and occurring rangewide, do not collectively rise to the level of high magnitude. For example, the last known populations are not about to be completely lost due to the effects of wildfires.

The magnitude of Factor A is considered moderate because about 40 percent of Chapin Mesa milkvetch habitat has been modified by fires and fire-related activities, followed by unprecedented invasion by cheatgrass, facilitated by drought. The threats in Factor A are shown to have occurred in the past, and are clearly a threat today and into the future. These impacts affect the competitive ability and reproductive success of Chapin Mesa milkvetch individuals, and increase the likelihood of more frequent fire intervals in the future.

Imminence :

Imminent. We consider all of the threats to be imminent because we have factual information that the threats are identifiable and that the species is currently facing them in many portions of its range. These actual, identifiable threats are covered in greater detail in Factor A and the inadequacy of existing regulatory mechanisms is covered in Factor D of this finding. All of the threats are ongoing and, therefore, imminent, although the likelihood of exposure varies (Table 1). In addition to their current existence, we expect these threats, except for inadequate regulations, 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 believe that there are enough occurrences of Chapin Mesa milkvetchand the threats are not so immediate or of high enough magnitude to warrant emergency listing.

Description of Monitoring:

Starting on January 1, 2011, Mesa Verde began closely tracking disturbances from facility and utility construction and maintenance within Chapin Mesa milkvetch habitat. Tracking is focused on disturbance events that displace soil, potentially damaging below-ground perennial plant structures, and disturbance events that will permanently harden ground surfaces, thereby preventing plant growth or colonization. Prior to disturbance, project sites are examined to determine if Chapin Mesa milkvetch plants are present. The number of plants observed within the project site is recorded and mitigation measures are recommended. When projects occur outside of Chapin Mesa milkvetch growing season (when plants cannot be identified), the area of disturbance is multiplied by the 2003 population density estimate of 0.037 plants/m2 to calculate the potential number of plants disturbed by the project (Wender 2011, pp. 2-3).

Because this species' distribution in the park has been mapped and sampled extensively by CNHP,

the park's Natural Resource staff no longer surveys for this species; however, some new occurrences are found incidentally. New locations for small numbers of plants were found in 2012 and 2013 on the sides and bottom of canyons below Chapin Mesa, showing that the species is not entirely limited to mesa tops (Wender 2012b, p. 1; San Miguel 2014, p. 1). Preliminary data suggest that Chapin Mesa milkvetch populations depend on winter precipitation for emergence and spring precipitation for seed germination. Density of plants has increased in 2013 and 2015 in long-term sampling plots in response to an increase in winter precipitation (Rondeau *et al* 2016, p. 10–14).

Demography plots at Mesa Verde were sampled at Sun Point, Sun Temple, and West Chapin Spur in 2012 and 2013; and long term population trend data were collected in 2001, 2003, 2011, 2012, 2013, 2014, and 2015 (Wender 2012b, p. 2; San Miguel 2014, p.2). The population density level in transects on Chapin Mesa rose for the first time in 2013, from the 2012 level of 0.036 plants per square meter to 0.08478 plants per square meter (San Miguel 2014, p. 2). Low levels of winter precipitation in 2014 resulted in very low plant emergence and densities. Densities increased again in 2015 responding to increased winter precipitation (Rondeau et al. 2016, p. iii).

Following the 2015 monitoring, CNHP (Rondeau *et al.* 2016, entire) provided the following conclusions updating our conclusions from the 2014 season:

- Density is positively correlated with winter precipitation. In previous years we did not have enough data to determine this correlation but the addition of the 2015 data was sufficient to analyze and determine this correlation.
- In all but one year of monitoring, there are no significant differences between the density of stems in burned and unburned plots.
- In 2015, fruit production per plant was 3.5 times higher in unburned areas than in burned areas.
- In 2015, more seedlings (3.6 times more) were found in unburned areas than in burned areas.
- Seedlings were noted germinating April-June and correlated with 0.29 inches of rainfall over 3 days. Significant germination and seedling establishment occurs only in certain years.
- Seeds collected in 2003 were still viable and successfully germinated in 2015.
- Cheatgrass cover in burned areas averaged 53 percent whereas no cheatgrass was found in unburned areas.

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

Colorado

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

none

State Coordination:

Colorado Natural Heritage Program conducted monitoring and provided updated reports, element occurrence records and element global and state ranking forms.

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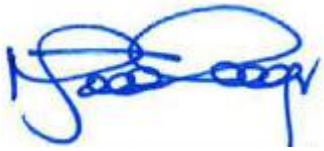
Approval/Concurrence:

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: