

*Astragalus phoenix*  
(Ash Meadows milkvetch)

**5-Year Review:  
Summary and Evaluation**



*Photo by Gina Glenne, U.S. Fish and Wildlife Service, March 2003*

**U.S. Fish and Wildlife Service  
Nevada Fish and Wildlife Office  
Las Vegas, Nevada**

**Date Signed  
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## 5-YEAR REVIEW

### *Astragalus phoenix* (Ash Meadows milkvetch)

#### I. GENERAL INFORMATION

##### **Purpose of 5-Year Reviews:**

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the status of the species has changed since listed (or the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must evaluate these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

##### **Species Overview:**

Rupert Barneby formally described *Astragalus phoenix* in 1970, although partial specimens were collected as early as 1898 by Carl Anton Purpus (Barneby 1970, pp. 396-397). The species is a long-lived, perennial herb in the Fabaceae (pea family) that develops into low spreading mounds that can reach 5.5 inches (in) (15 centimeters (cm)) high and 19.5 in (50 cm) in diameter (Reveal 1978, pp. 2-4). The specific name, *phoenix*, refers to being born of ashes and is descriptive of the plant's dense, ashen mound of leaves partly covered over with fine, white soil (Mozingo and Williams 1980, p. 119). The pink-purple flowers are produced in spring in clusters of one to three on short stems that rise above the mound (Reveal 1979, pp. 2-4). The Ash Meadows milkvetch is adapted to hard, white, barren, saline clay flats, knolls, and slopes (Mozingo and Williams 1980, p. 119). The Ash Meadows milkvetch is endemic to the Ash Meadows area of Nye County, Nevada. The range of the Ash Meadows milkvetch encompasses the Ash Meadows National Wildlife Refuge (Refuge) and adjacent Bureau of Land Management (BLM) and private lands.

##### **Methodology Used to Complete This Review:**

Following the Service's Region 8 guidance issued in March 2008, the Service's Nevada Fish and Wildlife Offices in Las Vegas and Reno prepared this review. We used information from the Recovery Plan for the Endangered and Threatened Species of Ash Meadows (Recovery Plan) (Service 1990), survey information from experts who have monitored various localities of this species, and the database maintained by the Nevada Natural Heritage Program. The Recovery Plan and personal communications with experts were our primary sources of information used to update the status of and threats to the species. We received no information from the public in

response to our Federal Register (FR) notice initiating this 5-year review. This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next five years.

**Contact Information:**

**Lead Regional Office**

Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist, Region 8, California and Nevada; (916) 414-6464.

**Lead Field Office**

Janet Bair, Nevada Fish and Wildlife Office, Las Vegas, Nevada; (702) 515-5230, and Steve Caicco, Nevada Fish and Wildlife Office, Reno, Nevada; 775-861-6300.

**Federal Register Notice Citation Announcing Initiation of This Review:**

On March 5, 2008, the Service announced initiation of the 5-year review for the Ash Meadows milkvetch and the opening of a 60-day period to receive information from the public regarding the species' status (73 FR 11945). We received no information from this solicitation.

**Listing History:**

**Original Listing**

**FR Notice:** October 13, 1983; 48 FR 46590

**Date of Final Listing Rule:** May 20, 1985; 50 FR 20777

**Entity Listed:** Ash Meadows milkvetch (*Astragalus phoenix*)

**Classification:** Threatened

**State Listing**

The State of Nevada listed the Ash Meadows milkvetch (*Astragalus phoenix*) as a fully protected plant species in 1979.

**Associated Rulemakings:**

Critical habitat was designated at the time of original listing on May 20, 1985 (50 FR 20777).

**Review History:**

The status of the Ash Meadows milkvetch has not been reviewed since the species was listed in 1985.

### **Species' Recovery Priority Number at Start of 5-Year Review:**

The recovery priority number for Ash Meadows milkvetch is 8. This rank is based on the Service's 2008 Recovery Data Call for the Nevada Fish and Wildlife Office and based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983) This number indicates the species faces a moderate degree of threat and has a high potential for recovery.

### **Recovery Plan or Outline:**

#### **Name of Plan or Outline**

Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada.

#### **Date Issued**

September 28, 1990.

## **II. REVIEW ANALYSIS**

### **Application of the 1996 Distinct Population Segment (DPS) Policy:**

The Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. Because the species under review is a plant, the DPS policy is not applicable, and the evaluation of this species under the DPS policy is not addressed further in this review.

### **Information on the Species and its Status:**

#### **Species Biology and Life History**

Rupert Barneby formally described the Ash Meadows milkvetch in 1970, although partial specimens were collected as early as 1898 by Carl Anton Purpus (Barneby 1970, pp. 396-397). The Ash Meadows milkvetch is a long-lived, perennial herb in the Fabaceae (pea family). Over time, soil and organic matter accumulate within its low spreading branches so that the plant develops into low spreading mounds that can reach 5.5 in (15 cm) high and 19.5 in (50 cm) in diameter (Reveal 1978, pp. 2-4). The specific name, *phoenix*, refers to being born of ashes and is descriptive of the plant's dense, ashen mound of leaves partly covered over with fine, white soil (Mozingo and Williams 1980, p. 119). One to three, 0.5 to 1.0 in (2 to 2.5 cm) pink-purple, pea-like flowers are borne on tiny erect stems from April to early May (Reveal 1979, pp. 2-4 and 14-15). Dense, grayish white hairs cover the finely divided (pinnately compound), 0.5 to 1.5 in (1.5 to 3.5 cm) long leaves and 0.25 inch (2 cm) pea-pod-like fruits (Reveal 1978, pp. 2-4).

The biology and life history of the Ash Meadows milkvetch are consistent with a stress-tolerant life history as described by Grime (1977, pp. 1175-1181; 1984, pp. 29-33). Stress-tolerant plants are typically relatively long-lived with low annual seed production, except during favorable conditions (Grime 1977, pp. 1174 and 1180). Reveal (1978, p. 13) notes winter and early spring rains are required to produce large numbers of flowers, but some flowering probably occurs each year no matter the conditions. Research conducted by Pavlik et al. (2006, p. 27) indicates

population growth is probably constrained by low seed output per plant. During a year with above average precipitation, they estimated seed production to be between 45 and 246 fully formed seeds per average size plant. An examination of the seed to ovule ratio in mature fruits suggested that the Ash Meadows milkvetch is an inbreeding species with no pollinator limitations (Pavlik et al. 2006, p. 29). More recent studies indicate that Ash Meadows milkvetch is visited by a bee (*Anthophora porterae*) that is likely a vital pollinator for the species (Bio-West 2009, pg 3). Wind and water appear to be the primary vectors for dispersal (Reveal 1978, p. 12). Reveal (1978, p. 14) observed much of the seed produced probably does not disperse long distances and remains within the leaves and branches of the parent plant.

Germination events and Ash Meadows milkvetch seedlings are rare (Reveal 1978, p. 12). Pavlik et al. (2006, p. 24) did not observe germinules or seedlings in five subpopulations at four of the six known sites (see below) during a year with 162 percent above average precipitation. They hypothesized either the soil seed bank was depleted or the species is dependent on the most extreme and infrequent precipitation events. In a demographic analysis Pavlik et al. (2006, pp. 24-26) determined only two out of five subpopulations studied had “recent” germination and establishment events, perhaps during the 1997-1998 growing season which had 211 percent of average precipitation. They found that small plants, i.e., those less than 7.7 in<sup>2</sup> (50 cm<sup>2</sup>) in diameter, were completely absent from one subpopulation and comprised less than 5 percent of the sampled plants at all populations (Pavlik et al. 2006, p. 14). These findings strongly suggest that establishment of Ash Meadows milkvetch is sporadic and unlikely in most years, and that population persistence depends heavily on the longevity of individual plants which must, therefore, tolerate unpredictable environmental variations through time (Pavlik et al. 2006, p. 15).

The lifespan of individual Ash Meadows milkvetch plants is not known, but we believe that they are relatively long-lived, with the largest plants, which can form mounds up to 20 in (50 cm) across, likely exceeding 10 years or more in age. Recent studies on rabbit herbivory using caged and uncaged plants have shown that some plants can grow in diameter by as much as 1.6 in (4 cm) and 0.8 in (2 cm) per year, respectively (Pavlik and Stanton 2008, p. 17). Although the relationship between growth rate and diameter is unlikely to be linear, this suggests that a plant could reach 20 in (50 cm) in as little as 12.5 years if growth is not hindered by herbivory. The actual growth rate, especially in the presence of herbivory, is likely to be much slower and individual plants could take decades to reach their maximum size.

Stress-tolerant species are generally slow to recover from disturbance because of harsh environmental conditions (Grime 1977, pp. 1175-1181; Grime 1984, pp. 29-33). Given the life history of Ash Meadows milkvetch, and in particular, its naturally low rate of reproduction, it is unlikely that severely disturbed habitat, such as areas cleared for development and agriculture (see Factor A discussion below), have recovered. Some populations that experienced light to moderate disturbance may have improved and recruited new individuals since the Refuge was established. Therefore, we conclude the population size of the Ash Meadows milkvetch has likely increased since establishment of the Refuge, albeit at a very slow rate. We have no data by which we can determine whether this increase is reflected merely in plant density or whether the overall extents of the plant populations are also increasing.

Based on superficial observations of its habitat, it was initially assumed the Ash Meadows milkvetch is a xerophyte, adapted to arid upland conditions (Service 1990, pp. 9 and 25). However, Pavlik (2006, p. 25) suggests that this characterization may be misleading and based on observations made during low rainfall years. During a high precipitation year, Pavlik (2006, p. 25) observed the species growing directly in channels with running and slow moving water. Further, it is suggested that the heavy alkaline soils where the species is present (Beatley 1977, p. 17; Reveal 1978, p. 4) are poorly drained and when combined with a shallow water table, could be reliably wet from year to year, though high salt concentrations could make this water physiologically unavailable (Pavlik et al. 2006, p. 25). There are many similarities between salt stress and drought stress (Munns 2002, pp. 239-250). Given the presence of salt crusts and occurrence of halophytes such as salt grass (*Distichlis spicata*) and shadscale (*Atriplex confertifolia*), it is likely that Ash Meadows milkvetch also has physiologic adaptations that allow it to tolerate saline soils.

### **Spatial Distribution/Abundance**

The Ash Meadows milkvetch is endemic to the Ash Meadows area of Nye County, Nevada. The range of the species includes the Refuge, a small portion of the BLM Ash Meadows Area of Critical Environmental Concern (ACEC) adjacent to the northeastern Refuge boundary, and private lands within the approved Refuge boundary. In 1977, the species was known from nine occurrences at three sites (Beatley 1977, pp. 18-19). Reveal (1978, p. 11) estimated the population to contain 1,000 individuals. Cochrane (1981) identified 19 localities at which the Ash Meadows milkvetch had been observed (Figure 1). Knight and Clemmer (1987) reviewed the available data on the rare plants of Ash Meadows and identified six general areas from which the Ash Meadows milkvetch had been reported (Figure 2). In 1998, surveys were targeted on the six general areas identified by Knight and Clemmer (1987) and the total population was estimated to be about 1,800 plants on 847 acres (ac) (343 hectares (ha)) (BLM and Service 2000, p. 3-5). Refuge-wide surveys of listed and rare plants, including the Ash Meadows milkvetch, were begun in 2008. As a result of these surveys, the total population on the Refuge is now estimated at 11,643 individuals on about 800 ac (Bio-West 2008, p. 24). A large area on public land occupied by Ash Meadows milkvetch was newly discovered adjacent to a previously known population on private land during the 2008 survey; in addition, the occupied area at most other previously reported sites was extended (Bio-West 2008, p. 25). Additional surveys are planned for 2009.

The six general sites where the species is known to occur include:

1. Rogers-Longstreet Springs: Sections 14 and 15, Township (T) 17 South (S) Range (R) 50 East (E);
2. Cold Spring; Section 21, T17S R50E ;
3. Five Springs: Sections 22, 23, and 26, T17S R50E;
4. Collins Ranch: Sections 1 and 12, T18S R50E ;
5. Jackrabbit-Big Springs: Sections 7, 8, and 19, T18S R51E; Section 13, T18S, R50E; and
6. South Springs Meadow Road: Sections 14 and 24, T18S R50E.

The ownership and management of Ash Meadows milkvetch habitat is primarily Federal, consisting within the refuge boundary of approximately 50 percent BLM land, 45 percent Service land, and 5 percent private lands. These values are likely to become more precise when the 2009 surveys have been completed. We have no accurate estimate of the amount of Ash Meadow milkvetch habitat, or the number of individuals, that occur outside the northeastern Refuge boundary within the BLM Ash Meadows ACEC or on private lands.

### **Habitat or Ecosystem**

The Ash Meadows milkvetch grows between 2,200 and 2,300 feet above mean sea level (AMSL) (700 to 750 meters AMSL) elevation within the Mojave Desert Ecoregion. The Ash Meadows milkvetch is restricted to flats and knolls of hard, white, alkaline clays in the Ash Meadows area (Knight and Clemmer 1987, p. 28). The specific hydrologic requirements for the species are uncertain (see Species Biology and Life History discussion above); however, surface and/or subsurface ground water that reaches the surface through capillary action may be an important habitat determinant for at least some populations of the species. Ash Meadows milkvetch habitat is naturally sparsely vegetated (Reveal 1978, p. 10). In Ash Meadows milkvetch habitat, the overall occurrence of potential nurse plants is very low; it is unknown whether nurse plants are important to the species (Pavlik et al. 2006, p. 21). Other plant species associated with the Ash Meadows milkvetch include: salt grass, shadscale, Ash Meadows blazing star (*Mentzelia leucophylla*), alkali golden bush (*Isocoma acradenius*) and Ash Meadows sunray (*Enceliopsis nudicaulis* var. *corrugata*) (Knight and Clemmer 1987, pp. 28 and 33).

The primary constituent elements of designated critical habitat consist of the biological and physical attributes essential to the species' conservation within those areas. For the Ash Meadows milkvetch, primary constituent elements described in the final listing rule include dry, hard, white, barren, saline, clay flats, knolls, and slopes. The distribution and ecological requirements of the Ash Meadows milkvetch were poorly understood when the Service designated critical habitat; consequently, some areas of designated critical habitat may no longer provide suitable habitat for the species due to changes in soil structure as a result of past agricultural activities, and some designated areas may not have supported the species to begin with. While a considerable amount of information has been gained over the past few years, many aspects of the species ecological requirements, especially with respect to its hydrological requirements and watershed processes, remain unknown.

### **Changes in Taxonomic Classification or Nomenclature**

The nomenclature or taxonomy of the Ash Meadows milkvetch has not changed since 1985.

### **Genetics**

Ash Meadows milkvetch genetics remains unstudied.

### **Species-specific Research and/or Grant-supported Activities**

A 2006 demographic investigation (Pavlik et al. 2006, p. 1-39) identified rabbit herbivory as a potential limiting factor to Ash Meadows milkvetch reproduction. In 2007, the Service funded the installation of rabbit exclosures and continued population monitoring to investigate the potential effects on seed production. This study will be completed in September 2009. As noted

previously, Refuge-wide surveys for this species were initiated in 2008 and are scheduled to be completed during the 2009 field season.

### **Five-Factor Analysis:**

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act. Due to threats to the entire Ash Meadows ecosystem, the five-factor threats analysis in the proposed and final listing rules for the Ash Meadows milkvetch also included six additional plants and one insect. These consist of the Ash Meadows blazing star, Ash Meadows gumplant (*Grindelia fraxino-pratensis*), Ash Meadows ivesia (*Ivesia eremica*), Ash Meadows sunray, Amargosa niterwort (*Nitrophila mohavensis*) spring-loving centaury (*Centaureum namophilum*), and Ash Meadows naucorid (*Ambrysus amargosus*).

### **Background**

In 1983, the Service proposed to list all the Ash Meadows species as endangered. Prior to publishing the 1985 final listing rule, however, the federal government acquired much of the land and water rights, and established the Refuge. Under the final listing rule the Ash Meadows milkvetch, Ash Meadows ivesia, Ash Meadows blazing star, Ash Meadows sunray, Ash Meadows gumplant, spring-loving centaury and Ash Meadows naucorid were listed as threatened with critical habitat and the Amargosa niterwort was listed as endangered with critical habitat because its known distribution was outside of the Refuge. Because of the type of analysis completed in the 1985 final listing rule, it is difficult to separate specific threats to the Ash Meadows milkvetch from threats to the other Ash Meadows plants and ecosystem. We have broadened our analysis to include threats not specifically mentioned for the Ash Meadows milkvetch but that are applicable to the Ash Meadows ecosystem.

Threats to the Ash Meadows milkvetch and its ecosystem described in the final listing rule are summarized below:

#### Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

- Groundwater withdrawal is a threat to the entire Ash Meadows ecosystem.
- Surface mining.
- Proposed road construction.

#### Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

- Over-utilization is not a known threat to the seven listed Ash Meadows plants.

#### Factor C: Disease or Predation

- Disease and predation are not identified as known threats to Ash Meadows milkvetch.

#### Factor D: Inadequacy of Existing Regulatory Mechanisms

- The absence of adequate regulatory mechanisms is a threat to all the Ash Meadows species.

#### Factor E: Other Natural or Manmade Factors Affecting Continued Existence

- Trampling by wild horses is a threat to all the listed Ash Meadows plants.

Potential threats to the Ash Meadows milkvetch not included in the final listing rule include:

#### Under Factor A:

- Weedy, non-native plant species are a potential threat to the Ash Meadows milkvetch because they can compete with and displace the listed species from occupied habitat.

#### Under Factor C:

- Rabbit herbivory of flowers and fruits could be a potential threat to the Ash Meadows milkvetch by reducing the amount of seed available for recruitment.

#### Under Factor E:

- Off-highway vehicles (OHVs).
- Species with restricted ranges or small populations are potentially vulnerable to stochastic events.
- Climate change is a potential threat.

To understand threats to the Ash Meadows milkvetch it is important to understand the period over which they will operate. The principal difference between an “endangered” and a “threatened” species under the Act is whether the species is currently in danger of extinction (the definition of endangered), or if it is likely to become so “within the foreseeable future” (the definition of threatened). The Act does not define the term foreseeable future. The Ash Meadows milkvetch is currently a threatened species. For the purposes of this review, we used “foreseeable future” to define the period over which the threats to the listed Ash Meadows plants and their habitat are like to operate under current and future management conditions. While the management approach for the listed Ash Meadows plants focuses on the entire ecosystem, the foreseeable future for the Ash Meadows milkvetch is unique to its life history, population status, trend, and the threats that it faces. The Service has issued draft guidance that states that when we do not have sufficient information to reliably assess the effects of threats on a species over a clear timeframe, we will:

- a. Use the metric of “the longer of 10 years or 3 generations” to define foreseeable future;
- b. Use the International Union for Conservation of Nature (IUCN) guidelines which define “generation length” as the average age of the parents of the current cohort, which is greater than the age at first breeding and less than the age of the oldest breeding individual (Standards and Petitions Working Group 2006, p. 19); and

- c. Modify this measure to meet the specific circumstances of individual species where information is convincing that the above approach would be inappropriate for a particular species

As discussed previously in the section on species biology and life history, Ash Meadows milkvetch has a demographic structure that suggests germination and establishment events are rare, perhaps occurring only in response years with extreme precipitation, and its persistence over time is dependent on the longevity of individual plants which may live for decades. The most recent reproductive event appears to date from 1997-1998 when precipitation was 211 percent of average precipitation (Pavlik et al. 2006, p. 24); no seedlings were observed in 2003 or 2005 when precipitation was 113 percent of average and 162 percent of average, respectively (Pavlik et al. 2006, p. 12). Based on the IUCN criteria (2006, p. 19), our best estimate of the minimum generation length of Ash Meadows milkvetch is about 10 years and, therefore, we believe that the foreseeable future for this species is on the order of two to three decades.

#### **Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range**

The Ash Meadows milkvetch faces three threats under listing Factor A that were identified in the final listing rule (May 20, 1985; 50 FR 20777): groundwater pumping, surface mining, and proposed road construction. After listing, non-native species were identified as a potential threat to the Ash Meadows milkvetch.

Habitat Loss or Degradation from Groundwater Pumping. At the time of listing, groundwater development was a major threat to the entire Ash Meadows ecosystem. Prior to listing, local groundwater pumping within Ash Meadows was responsible for declines in the wetlands at Ash Meadows. The Ash Meadows milkvetch depends, in part, on near-surface water for its survival (see Species Biology and Life History discussion above); it is, therefore reasonable to conclude adverse impacts to the ecosystem from groundwater pumping would also negatively affect many populations of this species.

Numerous measures have been implemented that, in part, address this threat. A 1976 Supreme Court decision established a minimum water level in Devils Hole, a 40-ac disjunct unit of Death Valley National Park that occurs within the boundaries of the Refuge, to protect the endangered Devils Hole pupfish (*Cyprinodon diabolis*); as a result of this decision water levels in Devils Hole are carefully monitored. The Service has established water rights for 16,376 acre-feet (ac-ft) (2,020 hectare-meters (ha-m) of annual spring discharge (Mayer 2000, pp. 2-3). This constitutes approximately 96 percent of the 17,025 ac-ft (2,100 ha-m) annual discharge by the springs and seeps at Ash Meadows (Mayer 2000, pp. 2-3). A groundwater level and spring discharge monitoring program developed by the Service and the U.S. Geological Survey in 1998 has been implemented as part of a larger monitoring program for the Amargosa Desert hydrographic basin, which supports the Ash Meadows region.

On July 16, 2007, the Nevada State Engineer issued Ruling 5750 denying numerous water rights applications in the Amargosa Valley, and finding that the groundwater basin is over-appropriated (State of Nevada 2007, p. 22). On November 4, 2008, the Nevada State Engineer issued Order

1197 further stipulating that any new applications for water rights in the Amargosa Valley will be denied and that change applications that seek to move pumping more than 0.5 mi (0.8 km) closer to Devils Hole will also be denied (State of Nevada 2008, p. 1). Order 1197, however, provides several exceptions including provisions to allow: 1) a change in the place of diversion of less than 0.5 mi (0.8 km) as long as the place of use remains the same; 2) applications for less than 2.0 ac-ft (0.2 ha-m) per year; and, 3) a process for considering the net impacts of changes of multiple existing rights which could permit changes that are the same or less than the impacts to Devils Hole base rights as long as no new diversions are within 10 mi (16 km) of Devil's Hole.

Water levels in Devils Hole stabilized after groundwater pumping on the properties that ultimately became the Refuge stopped in 1975; however, the water level in Devils Hole declined 2.76 in (7 centimeters) between 1988 and 2004 (NPS 2004). The water level subsequently increased in 2005 following an extremely wet year. Mayer (2006, pp. 19 and 28) indicates groundwater monitoring wells and spring discharges on the Refuge are currently stable to slightly declining. After groundwater pumping was ceased on the Refuge, it began to increase in the Amargosa Valley, located about 10 mi (16 km) northwest of the Refuge. In 1987, groundwater pumping in the Amargosa Valley was estimated to be 5,670 ac-ft (699 ha-m) per year (USGS 2005). In 2003, groundwater pumping was estimated to have increased to 13,518 ac-ft (1,667 ha-m) per year (USGS 2005). Most groundwater monitoring wells in the Amargosa Valley have shown a significant decline in water levels since 1992 (USGS 2003), and groundwater pumping is currently occurring in some areas of the basin at about twice the rate predicted to be sustainable (USGS 2005).

Water right acquisition by the Refuge, the 1976 Supreme Court order protecting the water level in Devils Hole, and the recent ruling and order by the Nevada State Engineer have all reduced the imminence and the magnitude of the threat that groundwater pumping poses to wetland ecosystems at the Refuge, and populations of species such as Ash Meadows milkvetch that depend upon them. They have not however totally eliminated this threat and the significance of the remaining threat posed by groundwater pumping must be evaluated with respect to each of these measures.

The Supreme Court ruling applies specifically to the water level in the Devils Hole, which is the highest hydrological point within the Refuge. It remains uncertain, however, to what extent maintenance of the court stipulated water level in Devils Hole affords protection to other spring-fed habitats within the Refuge, many of which originate to the north and west of Devils Hole and could potentially be affected by either local groundwater pumping on the few remaining inholdings within the Refuge or by the incremental effects of groundwater pumping in the Amargosa Valley. While the Nevada State Engineer's ruling and order preclude new water right applications within the Amargosa Valley and place constraints on change applications, exceptions are included for applications for less than 2.0 ac-ft (0.2 ha-m) per year and for applications that do not change the place of use. These exceptions, while seemingly minor, could have cumulative effects that result in lowering of the groundwater table within the Refuge. While the State Engineer's Order 1197 identifies a process for identifying the net effect of changes to multiple existing rights, the analytical process for evaluating the effects of these changes has not been specified.

Numerous active applications for solar energy projects in the Amargosa Valley north of the Refuge have been received by BLM (BLM 2009). The Service (2008a, pp. 1-3) has expressed concern to BLM over the potential amount of water that would be required, which could be as much as 50,000 ac-ft (6,168 ha-m) per year if projects that use wet-cooled concentrating solar thermal technology or other water-use intensive technologies are approved and implemented. The Amargosa Valley has recently been selected as a Solar Energy Study Area to be fully evaluated for its environmental and resource suitability for large-scale solar energy production (Department of Interior 2009, p. 1). The objective is to provide landscape-scale planning and zoning for solar projects on BLM lands in the West, allowing a more efficient process for permitting and locating responsible solar development. If selected, the Amargosa Valley would be available for projects capable of producing 10 or more megawatts of electricity for distribution to customers through the transmission grid system. Companies that propose projects on that scale in areas already approved for this type of development would be eligible for priority processing. BLM may also decide to use alternative competitive or non-competitive procedures in processing new solar applications for selected areas.

Since Order 1197 precludes the issuing of new water rights in the basin, developers of these projects are expected to purchase existing rights and file applications to change the manner of use, place of use, and/or the location of pumping. It also remains uncertain whether all existing water rights are currently being fully exercised; if they are not, the full utilization of all existing water rights in this over-appropriated basin may lead to a lowering of the groundwater table that affects spring-discharge within the Refuge. Industrial uses may also lead to a reduction in return flows when compared to the current agricultural uses of water in the Amargosa Valley.

Although the Service has established water rights to 96 percent of the spring discharge within the Refuge, the Service will have to demonstrate through analyses that the net impact of any change applications will have a negative effect on Ash Meadows. To the extent that the Service is unsuccessful in demonstrating net negative impacts in at least some of these cases, additional incremental declines in spring discharge may occur at Ash Meadows. Such incremental declines could be difficult to attribute to any particular cause or causes after the fact and, therefore, would be difficult to remedy.

Because of the uncertainties that exist regarding the potential effects of the full exercise of existing water rights in the Amargosa Valley, the incremental effects of additional pumping or changes in the manner or place of use or location of pumping, and the specifics of the process that the Nevada State Engineer will use to evaluate the net effects of such changes, we are unable to conclude at this time that the threat that groundwater pumping poses to Ash Meadows milkvetch is no longer significant.

Habitat Loss or Degradation from Surface Mining. Mining for clay minerals occurs in the Ash Meadows area. The playa sediments covering much of the Ash Meadows area contain clays and other minerals, which may be considered “uncommon varieties,” and therefore could potentially be classified as “locatable minerals” under existing mining laws. Specific specialty clays located in the area include bentonite, sepiolite, and saponite; zeolite has also been mined from deposits on lands south of the Refuge and commercial deposits likely occur within the Refuge (Wallace 1999, pp. 15-17). Mineral entry on Federal lands is authorized by the Mining Act of 1872; the program is administered by BLM. Under this program, surface disturbance and impacts to rare

species that do not have federal protection are permissible as long as operations comply with all pertinent Federal and State laws. New mineral claims and subsequent mining could cause direct loss of Ash Meadows milkvetch habitat, as well as indirect impacts by diverting or draining water away from occupied habitat.

Establishment of the Refuge and BLM ACEC has diminished the potential threat posed by surface mining. The ACEC is now temporarily closed to new mineral claims while BLM processes an application/petition to withdraw mineral entry. We do not have accurate estimates of either the total acres or population sizes of any Ash Meadows milkvetch occurrences within the ACEC. Within the Refuge, the Service owns mineral rights on approximately 17 percent of the acres on which the Ash Meadows milkvetch was known to occur prior to 2008. The 2008 surveys revealed some extensions of known populations into areas with Service-owned minerals (Bio-West 2008, p. 25; BLM and Service 2000, pp. 4-2, A-8). Precise figures are not available but the total habitat acreage on lands with Service-owned minerals likely remains less than 20 percent. Mineral entry on these lands is unlikely because obtaining the necessary authorizations would require the project proponent to commit to an extended process that would include a Refuge compatibility analysis. It is unlikely that surface mining would be found to be compatible with the refuge purpose.

Another 17 percent of the Ash Meadows milkvetch habitat acres within the Refuge known to occur prior to 2008 is on BLM lands open to public mineral claims. In addition, the largest concentration of Ash Meadows milkvetch documented within the Refuge in 2008 is on BLM land with public minerals (Bio-West 2008, p. 25; BLM and Service 2000, pp. 4-2, A-8). Precise figures are not available but the total habitat acreage on BLM lands open to public minerals may comprise as much as 50 percent of the total habitat acreage within the Refuge (Bio-West 2008, p. 25; BLM and Service 2000, pp. 4-2, A-8). The remaining Ash Meadows milkvetch occurrences comprise about 30 percent, including approximately 5 percent on private lands, and approximately 25 percent on Service-owned lands with public minerals.

Overall, about 80 percent of the known occurrences of Ash Meadows milkvetch within the Refuge are open to mineral entry. Existing mineral claims for specialty clays exist both within and outside of the Refuge and BLM ACEC (BLM and Service 2000, p. A-6; D. Fanning, BLM, in litteris. 2007). An existing claim in Section 26, T17S, R53E is adjacent to the Five Springs population within the Ash Meadows ACEC and there is a high probability that additional mining will occur on these private lands (Wallace 1999, p. 12). A portion of the Five Springs populations has also been designated as critical habitat for Ash Meadows milkvetch. A mineral withdrawal would not interfere with valid existing mineral rights. Even if the ACEC is withdrawn from mineral entry, there could be adverse effects to this population due to alterations in the local groundwater table due to mining activities. Surface mining of a valid existing mining claim on private land within the Refuge, therefore, poses a significant threat to one of the six known populations of Ash Meadows milkvetch. Alteration of the local groundwater table because of mining could negatively affect this population and adversely modify its critical habitat on adjacent public land.

Of the other five populations of Ash Meadows milkvetch, only the Rogers-Longstreet Springs population within the Refuge appears to be secure from the threat of mining as it occurs entirely

on Service lands with acquired minerals (BLM and Service 2000, p. A-6). As noted above, a portion of this population extends onto the adjacent ACEC which is under temporary segregation while the withdrawal petition is being processed. The remaining four populations occur either in part on BLM land open to mineral entry, or are immediately adjacent to either BLM land open to mineral entry or are on private land. The significance of the threat posed by mineral entry is difficult to assess because there is no available information on the actual occurrence or potential value of minerals on these specific parcels of land. Most of these lands, however, remain open to mineral entry nearly a decade after they were petitioned for withdrawal, so some degree of threat remains.

Proposed Road Construction. Proposed road construction is no longer a threat to Ash Meadows milkvetch. There remains a concern, however, that some populations along the Ash Meadows Road (formerly, the PEC [Preferred Equity Corporation] road) may have been affected by the disruption of surface flows due to prior road construction. The Ash Meadows milkvetch is often found on the floor of washes and water has been identified as one of the vectors by which its seed may be distributed (Reveal 1978, p. 12).

Non-native Species. Approximately 42 percent of all federally listed species in the U.S. are threatened by non-native species (Pimental et al. 2005, p. 275). Non-native plants directly compete with rare species for water, nutrients, and sunlight. Non-native plants can also indirectly affect rare species by altering ecosystem processes such as nutrient cycling and fire regimes (Brooks et al. 2004, pp. 677-688). Over 100 non-native species, approximately 16 percent of the total flora, occur on the Refuge. Of these, salt cedar (*Tamarix ramosissima*), Russian knapweed (*Acroptilon repens*), five hook bassia (*Bassia hyssopifolia*), Malta star thistle (*Centaurea melitensis*), yellow star thistle (*Centaurea solstitialis*), and hoary cress (*Cardaria draba*) are noxious weeds that could potentially threaten the Ash Meadows milkvetch (Service 2006, p. 8). Cheatgrass (*Bromus tectorum*), red brome (*Bromus madritensis* ssp. *rubens*), Mediterranean grass (*Schismus arabicus*), and annual fescue (*Vulpia myuros*) are annual grasses that could potentially threaten the Ash Meadows milkvetch because they also have been found near milkvetch habitat.

The flats and knolls of hard, dry, alkaline clay that support the Ash Meadows milkvetch is a harsh environment. Recent surveys of milkvetch habitat indicate weeds are not currently a threat (Pavlik et al. 2006, p. 30). Of five species of non-native annuals identified within sampled subpopulations, only Mediterranean grass actually occurred within sample quadrats and it had an overall frequency of only 3 percent (Pavlik et al. 2006, p. 22). However, infestations of salt cedar, Russian knapweed, and annual grasses occur elsewhere on the Refuge, and could provide a potential propagule source for invasion (Pavlik et al. 2006, p. 30). To determine the amount of Ash Meadows milkvetch habitat presently threatened by non-native plant species, we overlaid recent Geographic Information System weed mapping with known, occupied Ash Meadows milkvetch habitat (Figure 3). There are two areas of overlap; one near Jackrabbit Spring in an area designated as critical habitat where Ash Meadows milkvetch was confirmed to occur during recent surveys (BLM and Service 2000, p. A-6; Bio-West 2008, p. 25); and the second on approximately 6 ac (2.4 ha) of private land near Cold Spring, which has also been designated as critical habitat. This population was recently found to extend over a much larger area on adjacent public land (Bio-West 2008, p. 25).

The Service is addressing the potential threat posed by non-native plant species in two ways. First, the Refuge recently completed an Integrated Pest Management (IPM) Plan (Service 2006, pp. 1-149) and Geomorphic and Biological Assessment for the Refuge (Otis Bay 2006, pp. 1-229). Second, the Refuge is treating weeds through a grant funded by the Southern Nevada Public Land Management Act (SNPLMA). The IPM Plan is the Refuge's long-term approach for managing all invasive species on the Refuge and includes mapping and monitoring, and restoration planning. Under this plan, in 2005 the Service began comprehensive vegetation mapping of the Refuge, and these efforts continue today. The Geomorphic and Biological Assessment for the Refuge describes targets for hydrologic and biologic functioning, and provides a framework for restoring and managing the abandoned agricultural infrastructure that supports weed populations threatening the Ash Meadows milkvetch. In 2005, the Refuge received funds through the SNPLMA to remove salt cedar over a three-year period. In 2007, the Refuge was successful in removing salt cedar trees on 75 percent of the Refuge (SWEAT Inc., presentation, Ash Meadows Symposium, 2008). The Refuge completed the initial treatment and removal in 2008, and follow-up treatments will continue. The removal of salt cedar trees is anticipated to create new habitat for the Ash Meadows milkvetch.

While non-native plant species will continue to be a potential threat to the Ash Meadows milkvetch and the entire Ash Meadows ecosystem there is no evidence at this time to suggest that they currently pose a significant threat to Ash Meadows milkvetch. There is the potential for this threat to increase over the foreseeable future, however, its significance is not easily assessed. The Refuge has clearly had some recent success combating weeds, notably salt cedar. However, fire could increase the density of annual grasses and hydrological modifications could enable the spread of knapweed (Pavlik et al. 2006, p. 30). In addition, continued success in controlling the spread of weeds is contingent on continued sufficient funding.

#### **Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes**

Overutilization is not a threat to the Ash Meadows milkvetch.

#### **Factor C: Disease or Predation**

Rabbit Herbivory. Rabbit (either the desert cottontail (*Sylvilagus audubonii*) or black-tailed jackrabbit (*Lepus californicus*) herbivory on the Ash Meadows milkvetch seed pods was first reported by Glenne (1998), who observed heavy grazing at each of the three sites that she visited. A demographic study was initiated in 2005 at four of the six known sites (referred to by the researchers as subpopulations) for Ash Meadows milkvetch (Pavlik et al. 2006, During a demographic study initiated in the spring of 2005, Pavlik et al. (2006, p. 9) found that a very high proportion of developing fruits had been clipped off at the pedicel and eaten by rabbits. They immediately modified their methodology to quantify the impacts of rabbit herbivory and found an 80 percent loss of potential reproductive output across all subpopulations and a loss of 27 to 35 percent of reproductive output across all subpopulations in the 20 percent of fruits that survived rabbit herbivory (Pavlik et al. 2006, p. 28). Both the frequency and intensity of herbivory tended to be highest in the mature subpopulations, i.e., those with the larger individuals. A lack of large individuals, however, makes younger subpopulations more susceptible to extirpation (Pavlik et al. 2006, p. 28).

In April 2007, the researchers installed 10 rabbit exclosures around medium size plants in each of two of the Ash Meadows milkvetch subpopulations; caged and uncaged plants were measured and characterized prior to installation (Pavlik and Stanton 2008, pp. 4-5). Within 40 days, caged plants at one of the two sites had significantly more flowers than uncaged plants; while the results at the other site were not significant (Pavlik and Stanton 2008, p. 8). In the spring of 2008, one year after installation of the cages, the caged plants exhibited lateral canopy expansion 2 to 10 times greater than that of the uncaged plants (Pavlik and Stanton 2008, p. 6). The total number of flowers on caged plants in 2008 was five times greater than that on uncaged plants; as the uncaged plants continued to produce flowers until early May; rabbits continuously removed them (Pavlik and Stanton 2008, p. 7). By May 2008, the caged plants had produced nine-times more fully formed fruits than the uncaged plants that were almost completely devoid of fruits (Pavlik and Stanton 2008, p. 8). Overall, the uncaged plants produced 95-99 percent fewer mature fruits than caged ones during 2007-2008 (Pavlik and Stanton 2008, p. 8).

Rabbit populations in arid environments are cyclic and tightly coupled to rainfall and abundance of forage (Wood 1980, pp. 72-77). In the western U.S., black-tailed jackrabbit populations fluctuate sharply, cycling from low to high densities in 7 to 10-year periods (Wagner and Stoddart 1972, p. 329; Gross et al. 1974, pp. 64-66). Overgrazing because of high rabbit populations is common during high rainfall years, such as 2004-2005, and is a major reason for subsequent rabbit population crashes (Wood 1980, p 77). At Ash Meadows, however, observations of heavy rabbit “pruning” and herbivory were noted in 1998, and were documented in each year from 2005 to 2008 that included several years during which the precipitation was well below average. This suggests that the impacts of rabbit herbivory on Ash Meadows milkvetch may be more chronic than cyclical (Pavlik and Stanton 2008, p. 11). In an environment similar to Ash Meadows at Jackass Flat on the Nevada Test Site, jackrabbits have been documented to concentrate around artificial water sources during the winter months (Hayden 1966, p. 837).

As discussed under Species Biology and Life History above, the researchers observed no evidence of seed germination or seedling establishment in 2005, a year in which precipitation was 162 percent of average (Pavlik et al. 2006, p. 24); and the size class structure of the studied populations suggests that the last establishment even occurred during the spring of 1998, when precipitation was 213 percent of average (Pavlik et al. 2006, p. 26). Thus, reproduction in Ash Meadows milkvetch may be episodic and dependent on years of extreme precipitation. The pervasive and ongoing impacts to reproductive output that has been documented in Ash Meadows milkvetch, however, suggests the alternative hypothesis that its seed bank has been impacted by chronic herbivory (Pavlik and Stanton 2008, p. 12). If this is the case, its subpopulations may only be buffered from extirpation by the longevity of established plants (Pavlik and Stanton 2008, p. 12).

Rabbit grazing is a natural part of the Ash Meadows ecosystem and Ash Meadows milkvetch has evolved in the presence of rabbits. Abandoned agricultural fields, overgrazing, hydrologic alterations, and predator control are among the past activities that may have influenced rabbit populations in the past and, although there has been no active predator control program since the Refuge was established, the effects of all of these factors may continue to affect rabbit population levels (Pavlik and Stanton 2008, p. 11). Herbivory poses no short-term threat to Ash

Meadows milkvetch because individual plants are long-lived, but the significance of any threat posed by rabbits to its persistence over the foreseeable future is poorly understood. The significance of herbivory as a stressor depends not only on its frequency and intensity but also on whether it significantly interferes with replenishment of the seed bank (Pavlik and Stanton 2008, p. 9), a question that remains unanswered. In addition, a fungus has been observed to have apparently killed plants at the Rogers-Longstreet Spring site but the significance of this potential threat, if any, is unknown (Glennie 1998).

#### **Factor D: Inadequacy of Existing Regulatory Mechanisms**

When the final listing rule was published, the Ash Meadows milkvetch was included on the State of Nevada list of critically endangered plants. At that time, the Nevada law was interpreted as simply providing recognition of the species' status, but no legal protection was afforded the individual plants or their habitats. The State of Nevada has since implemented regulations that clarify the Nevada Revised Statutes (NRS) and provide increased protection for state listed species and their habitat. Presently, the Ash Meadows milkvetch is listed as critically endangered under NRS 527.260 *et seq.* Under this law, no member of its kind may be removed or destroyed at any time by any means except under special permit issued by the State Forester. The State of Nevada will continue to manage these plant species under the NRS independent of protection under the Act.

The Ash Meadows milkvetch is designated a BLM Special Status Species. Special Status Species are managed to “ensure that actions authorized, funded, or carried out do not contribute to the need for the species to become listed” (BLM 2008, Manual 6840.06C). Under recent revisions to BLM Manual 6840, since the Ash Meadows milkvetch is State listed, State laws protecting it would apply to all BLM programs and actions to the extent that they are consistent with the Federal Land Policy and Management Act of 1976 (FLPMA; Public Law 94-579, 43 U.S.C. 1701). Protection offered within the BLM ACEC will continue independent of protection under the Act (BLM Manual 6840.06D).

Establishment of the Refuge and the adjacent BLM Ash Meadows ACEC added new layers of Federal protection not present at the time the final listing rule was published. The Service manages National Wildlife refuges in accordance with the National Wildlife Refuge System Improvement Act of 1997. This act establishes the protection of biodiversity as the primary purpose of the National Wildlife Refuge System. Lands within the National Wildlife Refuge System are different from other multiple use public lands in that they are closed to all public uses unless specifically and legally opened. Activities that are specifically and legally opened by the Service on National Wildlife Refuges are determined by the purpose for which the particular refuge was established and the Compatibility Policy (603 FW 2), which includes guidelines for determining if a use proposed on a National Wildlife Refuge is compatible with the purposes for which the refuge was established. According to the Service's 1984 Environmental Assessment: Proposed Acquisition to Establish Ash Meadows National Wildlife Refuge, the purpose of the Refuge was “...to protect the endemic, endangered, and rare organisms (plants and animals) found in Ash Meadows...” Continued protection and management of the Ash Meadows milkvetch are central to the Refuge mission and will continue independent of protection under the Act.

In 1998, the BLM established the approximately 27,870-acre (11,279-hectare) Ash Meadows ACEC on public lands surrounding the Refuge. The BLM Las Vegas District Resource Management Plan (RMP) (BLM 1998) guides management of the ACEC. Management directions for the ACEC include closing the area to livestock; limiting vehicles to existing roads and trails; closing the area to locatable, salable, and leasable minerals; and closing the area to geothermal prospecting and leasing. The area has also been designated a right-of-way avoidance area except within designated corridors. BLM has closed the area to livestock and limits vehicles to existing roads and trails.

Because the primary distribution of the Ash Meadows milkvetch is on federal lands, additional regulations that provide partial conservation benefit include the National Environmental Policy Act (NEPA, 42 U.S.C. 4321-4347) and the Federal Land Policy and Management Act of 1976 (FLPMA, Public Law 94-579, 43 U.S.C. 1701). NEPA requires federal agencies, such as the BLM and Service, to describe the proposed action, consider alternatives, identify and disclose potential environmental impacts of each alternative, and involve the public in the decision making process.

FLPMA requires BLM “to establish public land policy; to establish guidelines for its administration; to provide for the management, protection, development and enhancement of the public lands; and for other purposes.” Section 102(c) of FLPMA states that the Secretary shall “give priority to the designation and protection of areas of critical environmental concern” in the development of plans for public lands. Although BLM has a multiple use mandate under FLPMA, which allows for grazing, mining, OHV use, and other activities, it may also establish and implement special management areas such as ACECs, wilderness areas, and research areas, that can reduce or eliminate actions that adversely impact Special Status Species or other important resources. The partial protection afforded these species under NEPA and FLPMA will continue independent of protection under the Act.

In 2000, BLM and the Service completed an Environmental Assessment on a proposal to withdraw lands and minerals on approximately 5,360 ac (2,169 ha) of Federal minerals within the Refuge boundary from mining for 20 years and 9,460 ac (3,828 ha) of public lands from mineral entry and mining for 20 years (BLM and Service 2000, p. 1-5). As part of the withdrawal process, these lands were temporarily segregated from mineral entry for a two-year period. Although the NEPA process was completed, no decision document has been issued. The withdrawal package for the lands and minerals within the Refuge boundary was transmitted to BLM’s Nevada State Office (State Office) in 2008. The State Office has the responsibility to take those reviews, findings, and recommendations, and if they concur, prepare a transmittal of same, or modifications, to BLM’s Washington Office. If, after further review, the State Office submission is found acceptable, the case file and a draft public land order (PLO) are transmitted to the Assistant Secretary for Land and Minerals Management at the Department of the Interior. If approved by the Assistant Secretary, the PLO is forwarded to the Federal Register for publication (BLM and Service 2000, p. 1-8).

The withdrawal becomes effective on the publication date of the PLO. Section 204(c)(1) of FLPMA limits withdrawals of 5,000 ac (2,023 ha) or more to a period of no more than 20 years. However, upon review by the Secretary of Interior (Secretary) toward the end of the withdrawal

period, the withdrawal may be extended for a period of time no longer than the original withdrawal period if the Secretary determines that the purpose for which the withdrawal was first made requires the extension (Section 204(f) of FLPMA).

The Clark County Public Land and Natural Resource Act of 2002 (Public Law 107-282, November 6, 2002) included a mineral withdrawal of all ACECs identified in BLM's Las Vegas Field Office RMP for a five-year period. A subsequent two-year extension of this temporary segregation was published on November 1, 2007, that included the Ash Meadows ACEC (72 FR 61898). The process for formal withdrawal of these lands is the same as that described above for the withdrawal of lands and minerals within the Refuge boundary.

In summary, since the final listing rule was published, existing regulations have been strengthened and new regulatory mechanisms have been developed to protect and conserve the Ash Meadows milkvetch. These measures will continue independent of protection under the Act. The process for the withdrawal of lands and minerals within the Refuge is ongoing but not yet complete. Until the PLO is approved and published in the Federal Register, 14,820 ac (5,795 ha), about 63 percent of the public land with the Refuge boundary, remains open to mineral entry. In the interim, land within the adjacent ACEC is temporarily segregated until November 1, 2009 (72 FR 61898). Unless a PLO is published prior to that date, or a temporary segregation is again published, these lands will also again be open to mineral entry. Neither withdrawal will affect valid existing mining claims. A complete analysis of the significance of the threat posed by surface mining to Ash Meadows milkvetch is provided in the Factor A discussion above. We believe that surface mining of an existing valid mining claim on private land within the Refuge poses a direct threat to one of the six known populations of Ash Meadows milkvetch and would likely adversely modify designated critical habitat. Moreover, because of the uncertainties that exist regarding the actual publication of a PLO withdrawing lands within the Refuge and ACEC from mineral entry, the timing of any withdrawals, and the likelihood that surface mining would be proposed in either of these areas, we conclude that regulatory mechanisms to protect Ash Meadows milkvetch and its habitat are currently inadequate.

#### **Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence**

Trampling by Wild Horses and OHV activity. The final listing rule described trampling by wild horses as a threat to the Ash Meadows milkvetch. Since listing, an increase in OHV use within the Refuge and ACEC has been identified as a potential threat. Wild horse and OHV activity on the Refuge were stopped or limited by construction of fencing on the perimeter of the Refuge (see Factor C discussion above). Periodically, illegal OHV trespass has been a minor problem on the Refuge, likely due to downed sections of fencing (C. Baldino, Refuge, pers. comm. 2006). In 2007, the Refuge added a law enforcement officer to its staff. Occasional illegal OHV activity will likely be an ongoing threat; however, the addition of law enforcement and periodic maintenance of Refuge fencing will continue to minimize this threat. Prior to listing, OHV races were permitted by BLM in the Ash Meadows area, however, these races are no longer permitted. Within the BLM ACEC, OHV activity is confined to existing roads and trails (BLM 1998, Chapter 2, p. 14). Because of the positive management practices on the Refuge and BLM

ACEC, trampling by wild horses and illegal OHV activity are no longer significant threats to the Ash Meadows milkvetch.

Vulnerability to Environmental Uncertainty. Small populations like the Ash Meadows milkvetch have a higher risk of extinction due to environmental stochasticity (Shaffer 1981, p. 131; Shaffer 1987, pp. 69-75; Gilpin and Soule 1986, pp. 24-28). The environment at Ash Meadows is stable; however, extreme flash flooding is a potential environmental event that could affect the Ash Meadows milkvetch. The Ash Meadows milkvetch is distributed over multiple major and minor subpopulations in the area. This distribution creates population redundancy. Because of this redundancy, we do not consider the Ash Meadows milkvetch to be vulnerable to a catastrophic flash flood; therefore, we do not consider the Ash Meadows milkvetch threatened by environmental stochasticity.

Climate Change. The Ash Meadows milkvetch and the Ash Meadows ecosystem are dependent on the springs and seeps on the Refuge. The potential effects of climate change to the regional aquifer that supports the Ash Meadows ecosystem are largely unknown. Current climatic modeling predicts the southwestern United States is likely to experience increased frequency of regional drought in response to elevated levels of atmospheric carbon dioxide (Seager et al. 2007, p. 1181). The springs and surface streams that support the Ash Meadows milkvetch are perennial and they originate from a regional aquifer that includes runoff from the Spring Mountains approximately 100 mi (161 km) to the northeast (USGS 2002, pp. 19-21). The potential increased frequency of drought could interfere with groundwater recharge. However, climate predictions also suggest the intensity of precipitation events may increase in response to elevated levels of atmospheric carbon dioxide (IPCC 2007, p. 8). The potential for increased rainfall associated with more intense storms could offset increased periods of drought. It is likely the timescale over which climate change and recharge of the regional aquifer occur are beyond the foreseeable future as defined in this review. Continued groundwater monitoring of the Ash Meadows ecosystem (see Factor A discussion above) is important to identify climate change as a potential threat in the future. Based on the present information, there is not enough information to consider climate change a significant threat to the Ash Meadows milkvetch.

### **III. RECOVERY CRITERIA**

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management. Assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that

has been made toward recovery since the species was listed by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

The Service completed the Recovery Plan in 1990 using the best available information (Service 1990). The primary objective of the Recovery Plan was to restore the 12 listed plant and aquatic species to a non-listed status, with the exception of the Devils Hole pupfish (the Recovery Plan concluded that complete recovery and delisting of the Devils Hole pupfish are unlikely due to its extremely restricted habitat requirements, population size, and threats that will never be eliminated). Recovery of the Ash Meadows milkvetch and other listed Ash Meadows species is addressed through an ecosystem approach with the intent of either reclassifying or delisting them simultaneously.

Eight of the recovery objectives in the Recovery Plan apply to the Ash Meadows milkvetch. Four of the eight are derived from downlisting criteria for the Ash Meadows endangered species. These objectives address major threats to the entire Ash Meadows ecosystem. Delisting objective number 1 for the seven threatened species, including the Ash Meadows milkvetch, requires that threats to the ecosystem be addressed before delisting of the seven threatened species can be realized. The remaining recovery objectives are concerned with reestablishing the historic range of all the species.

#### Downlisting Objectives from the Recovery Plan that apply to Ash Meadows milkvetch

1. All non-native animals and plant species must be eradicated for essential habitat. These non-native species currently include sailfin mollies, mosquito fish, largemouth bass, black bullheads, bullfrogs, crayfish, turban snails, wild horses, salt cedar, and Russian olive.
2. Secure and protect the Ash Meadows aquifer so that all spring flows return to historic discharge rates, and the water level in Devils Hole is maintained at a minimum level of 1.4 feet below the copper washer.
3. Reestablish water to historic springbrook channels, which are free of barriers that eliminate genetic exchange between populations by preventing movement of native fishes throughout their historic range.
4. The essential habitat must be secure from detrimental human disturbance including mining, OHVs, and the introduction of non-native species.

#### Delisting Objectives from the Recovery Plan that apply to Ash Meadows milkvetch

1. Criteria shown above for downlisting from endangered to threatened.

2. Secure, protect, and maintain in natural vegetation, corridors, and adjacent buffer areas for gene flow and dispersal of listed plant species within the essential habitat.
3. Native plant communities and aquatic communities have been reestablished to historic structure and composition within all essential habitats.
6. All of the listed plant species and the candidate plant species are present in all the sites that they have historically occupied as identified in Appendix A Table XV of the Recovery Plan. Within each critical habitat unit, the listed plant has a frequency value equal to or greater than the frequency value determined by Task 644 needed as an indicator of a self-sustaining plant population.

Downlisting objective 1 requires the management of non-native species that could compete with or alter habitat for the listed plants and the removal of wild horses that could graze or trample these species. The threat posed by non-native species can never be completely removed; however, the Refuge has made significant progress toward addressing this threat, including the removal of salt cedar on more than 75 percent of the Refuge and by developing and implementing an IPM Plan (see Factor A discussion above). In our threats analysis we conclude that non-native species do not currently pose a significant threat to the Ash Meadows milkvetch although they remain a potential threat in the foreseeable future (see Factor A discussion above); therefore, we determine this recovery objective has been achieved for Ash Meadows milkvetch. Downlisting objective 1 also requires the removal of wild horses from the Refuge. This issue has been resolved and trampling by wild horses and livestock is no longer a threat to the Ash Meadows milkvetch (see Factor E discussion above). Based on this information, we conclude downlisting objective 1 is complete.

Downlisting objectives 2 and 3 requires the Ash Meadows ecosystem hydrology be protected and secure. Due to the uncertainties that remain regarding the full exercise of existing water rights in the Amargosa Valley and its potential effects on spring flow and groundwater levels within the Refuge, we conclude that objectives 2 and 3 have not been met.

Downlisting objective 4 requires the range and habitat of these species to be protected from OHV activities, mining, and the introduction of non-native species. As discussed under Factor E, the Refuge is closed to OHV recreation and OHV activity within the BLM ACEC is limited to existing roads, trails, and dry washes. As discussed under Factors A and D, while the Service owns some mineral rights and surface estates, about 62 percent of the public lands within the Refuge remain open to land and mineral entry nearly a decade after a petition was filed to withdraw them. Public land within the ACEC is under a temporary segregation that expires on November 1, 2009. Valid existing mining claims would not be affected by either withdrawal action. We believe that surface mining of an existing valid mining claim on private land within the Refuge poses a direct threat to one of the six known populations of Ash Meadows milkvetch and would likely adversely modify designated critical habitat. Moreover, because of the uncertainties that exist regarding the actual publication of a PLO withdrawing lands within the Refuge and ACEC from mineral entry, the timing of any withdrawals, and the likelihood that

surface mining would be proposed in either of these areas, we conclude that regulatory mechanisms to protect Ash Meadows milkvetch and its habitat currently remain inadequate. Increased law enforcement on the Refuge and discontinuation of racing on adjacent BLM lands will prevent future OHV activity from becoming a threat to the Ash Meadows milkvetch. As discussed under Factor A, the Refuge has taken significant steps to manage non-native plant species and we do not believe that non-native plant species currently pose a significant threat to Ash Meadows milkvetch. However, because the threats posed by mining have not been adequately addressed through the completion of withdrawals of public lands and minerals, we conclude that Objective 4 is not complete.

Delisting objective 2 requires that habitat for the Ash Meadows milkvetch be protected for gene flow and dispersal. At the time of listing, a large portion of Ash Meadows was privately owned; however, the Service has actively acquired most of the inholdings within the Refuge. Habitat for the Ash Meadows milkvetch is now almost entirely protected from development within the Refuge boundary and surrounding BLM ACEC (see Factor A discussion above). Based on this information, we conclude delisting objective 2 has now been achieved.

Delisting objectives 3 and 6 require the habitat structure and composition (objective 3) and range and distribution (objective 6) of the Ash Meadows milkvetch be returned to historic conditions. It is likely not feasible to recreate the historic distribution of the Ash Meadows milkvetch due to the severe disturbance that occurred prior to listing. The conversion of Ash Meadows milkvetch habitat into agricultural fields and sites for development may have altered the soils and hydrology needed to support the species. In some areas, tilling and the addition of sand, and organic matter, to make these sites suitable for agriculture, likely destroyed the unique soils that the species requires. Grading and tilling has locally destroyed the surface drainage patterns characteristic of Ash Meadows milkvetch habitat. Given the biology and life history of the Ash Meadows milkvetch, it is likely most of the locations that historically supported the species and are presently able to support the species are occupied. Based on this information, establishing the Ash Meadows milkvetch in all historic sites as required by the Plan is no longer practical and we believe that the emphasis of recovery should be on ensuring and maintaining the viability of the species.

Finally, Task 644, under delisting objective 6, calls for monitoring plots to be established to determine reference conditions and to track vegetation change on recovered sites. Since most of the recovery to date has been through natural succession and 23 years have elapsed, this type of data can no longer be collected to determine recovery. Based on the present distribution of the Ash Meadows milkvetch, we conclude the intent of delisting objectives 3 and 6 has been achieved.

In summary, the ecosystem approach outlined in the Recovery Plan allows for a broad range of activities to be conducted, which directly or indirectly benefit Ash Meadows milkvetch on the Refuge. Recovery Plan objectives that address livestock and wild horse trampling, non-native species, and OHV activity have been addressed or are currently being managed in such a way they no longer pose a significant threat to the Ash Meadows milkvetch. However, uncertainties remain about the significance of the threats posed by groundwater pumping, surface mining, and rabbit herbivory.

#### IV. SYNTHESIS

The status of the Ash Meadows milkvetch has substantially improved since it was petitioned for listing in 1983. When it was listed, Ash Meadows milkvetch was known from six general sites in the Ash Meadows area, all threatened by ongoing and proposed agriculture, urban development, and groundwater pumping. Viable populations of the species remain at all six sites and the threats posed by wild horse trampling, OHV use, and invasive species are no longer considered to be significant. Recent surveys have expanded the boundaries of all known populations. Nearly all Ash Meadows milkvetch habitat and the surface water rights that support it are now under Service and BLM ownership and are managed as special resource areas, including the Refuge and BLM Ash Meadows ACEC. Both groundwater pumping and surface mining remain a threat of uncertain significance to Ash Meadows milkvetch in the foreseeable future. In addition, rabbit herbivory of flowers and fruits has been documented as a potentially significant threat to its long-term viability.

Ash Meadows milkvetch occurs in several populations scattered in suitable habitat across a broad enough area and in a diverse range of conditions that the species is likely not threatened by environmental stochasticity. The potential effects of climate change on the Ash Meadows milkvetch and the Ash Meadows ecosystem are uncertain but are not likely to pose a significant threat in the foreseeable future.

Many recovery objectives described in the Recovery Plan for this species have largely been achieved or are no longer relevant. However, because of the remaining uncertainties regarding the potential significance of groundwater pumping, surface mining, and herbivory in the foreseeable future, we conclude that the Ash Meadows milkvetch continues to meet the definition of a threatened species.

#### V. RESULTS

##### **Recommended Listing Action:**

- Downlist to Threatened
- Uplist to Endangered
- Delist (indicate reason for delisting according to 50 CFR 424.11):
  - Extinction*
  - Recovery*
  - Original data for classification in error*
- No Change

##### **New Recovery Priority Number and Brief Rationale:**

No Change.

##### **Listing and Reclassification Priority Number and Brief Rationale:**

N/A

## **VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT FIVE YEARS**

Over the next five years, the Service should focus on clarifying or resolving the uncertainties regarding the significance of the remaining threats to Ash Meadows milkvetch, i.e., groundwater pumping, surface mining, and herbivory.

We anticipate that major issues with respect to the significance of the threat posed by groundwater pumping will become clear over the next five years. Specifically, we expect that the Nevada State Engineer will clarify how Order 1197 will be implemented. In addition, environmental analyses will likely be completed on the anticipated effects of at least some of the proposed solar energy projects, and these should include detailed assessments of the potential effects of any groundwater development requirements on the regional and local aquifers, including potential effects on the springs and groundwater table within the Refuge. The Service should participate in the review of these analyses to ensure that they adequately disclose all potential impacts that could affect Ash Meadows milkvetch. The Service will also continue its participation in interagency monitoring, modeling, and assessment of the Death Valley Groundwater Flow System.

The Service and BLM should continue to work toward the completion of the land and mineral withdrawals for public lands within the Refuge and the ACEC. This will likely require that once the withdrawal packages have been forwarded by BLM's Nevada State Director to BLM's Washington Office, that briefings be scheduled with the Service's Washington Office to ensure that the importance of this withdrawal to all of the listed species at Ash Meadows, as well as the Ash Meadows ecosystem, is recognized.

Research on the potential significance of the rabbit herbivory on the long-term viability of Ash Meadows milkvetch should be prioritized, especially research focused on whether a sufficient seed bank is present to support recruitment when the proper environmental conditions occur. This research should also address potential management options to mitigate the impacts of herbivory on Ash Meadows milkvetch. Additional research is also needed on the sensitivity of the species to hydrological alterations and, in particular, its dependency on soil moisture drawn by capillary action from the near surface groundwater table. Finally, research is needed on the role of hydrologic process in seed dispersal and the extent to which past surface modifications have disrupted this process and the degree to which that affects the viability of current populations.

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**U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW**

*Astragalus phoenix* (Ash Meadows milkvetch)

**Current Classification:**

**Recommendation Resulting from the 5-Year Review:**

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

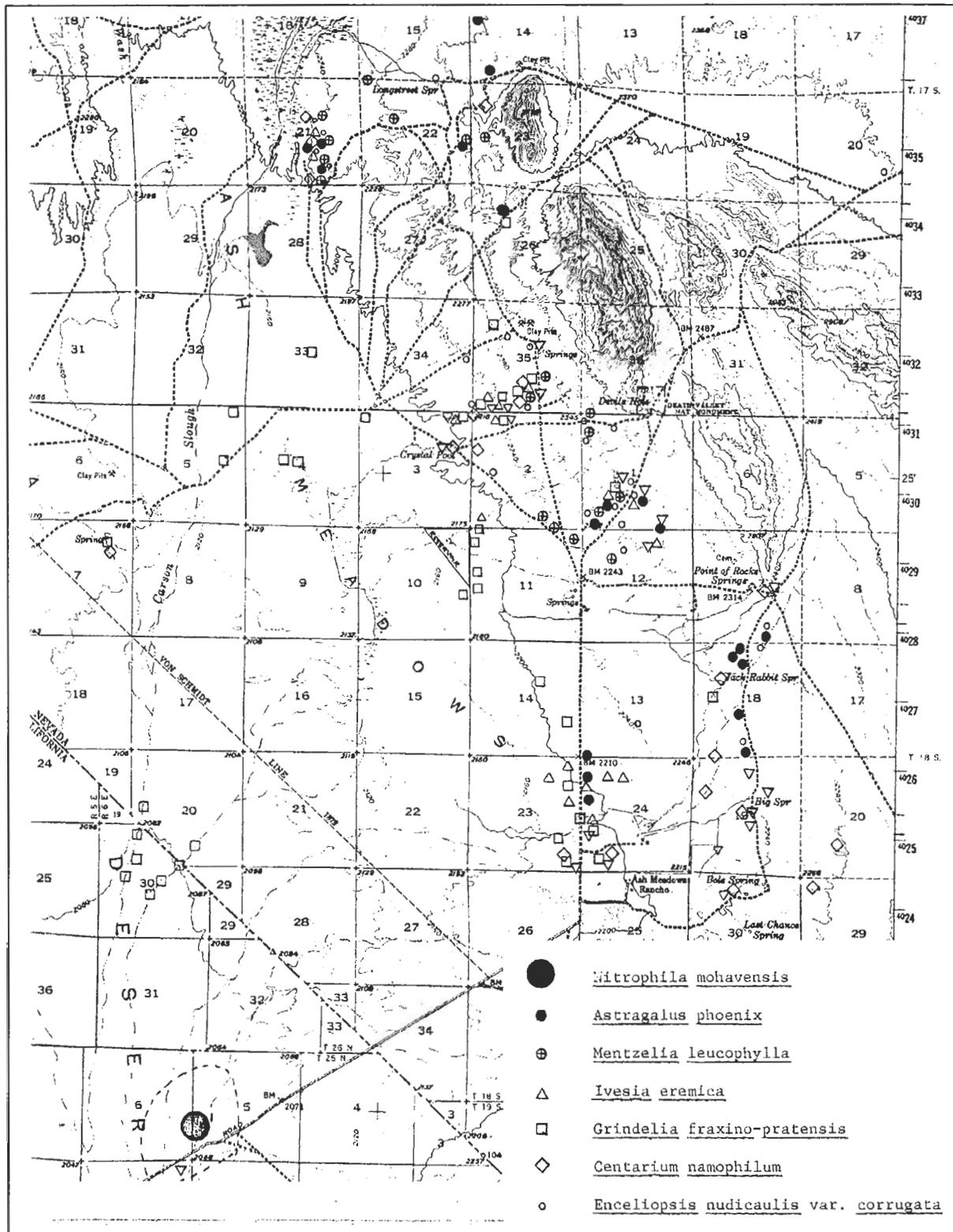
**Appropriate Listing/Reclassification Priority Number:** *[Delete if not applicable.]*

**Review Conducted By:** Steve Caicco, Nevada Fish and Wildlife Office

**FIELD OFFICE APPROVAL:**

**State Supervisor, U.S. Fish and Wildlife Service**

Approve  Date 8/13/09



**Figure 1. Map of Rare and Endangered Plants of Ash Meadows Nye County, Nevada.** Compiled by Susan Cochran, February 24, 1981, based on personal observations and fieldwork 1977-1980 and from "Endangered (and Threatened) Plant Species of the Nevada Test Site, Ash Meadows and Central-Southern Nevada" by Janice C. Beatley, February 1977. Updated November 4, 1981 from July, August and October 1981 fieldwork.



U.S. Fish & Wildlife Service  
**Ash Meadows National Wildlife Refuge**  
 Nye County, Nevada

**Ash Meadows Milkvetch (*Astragalus phoenix*) Distribution and Critical Habitat**

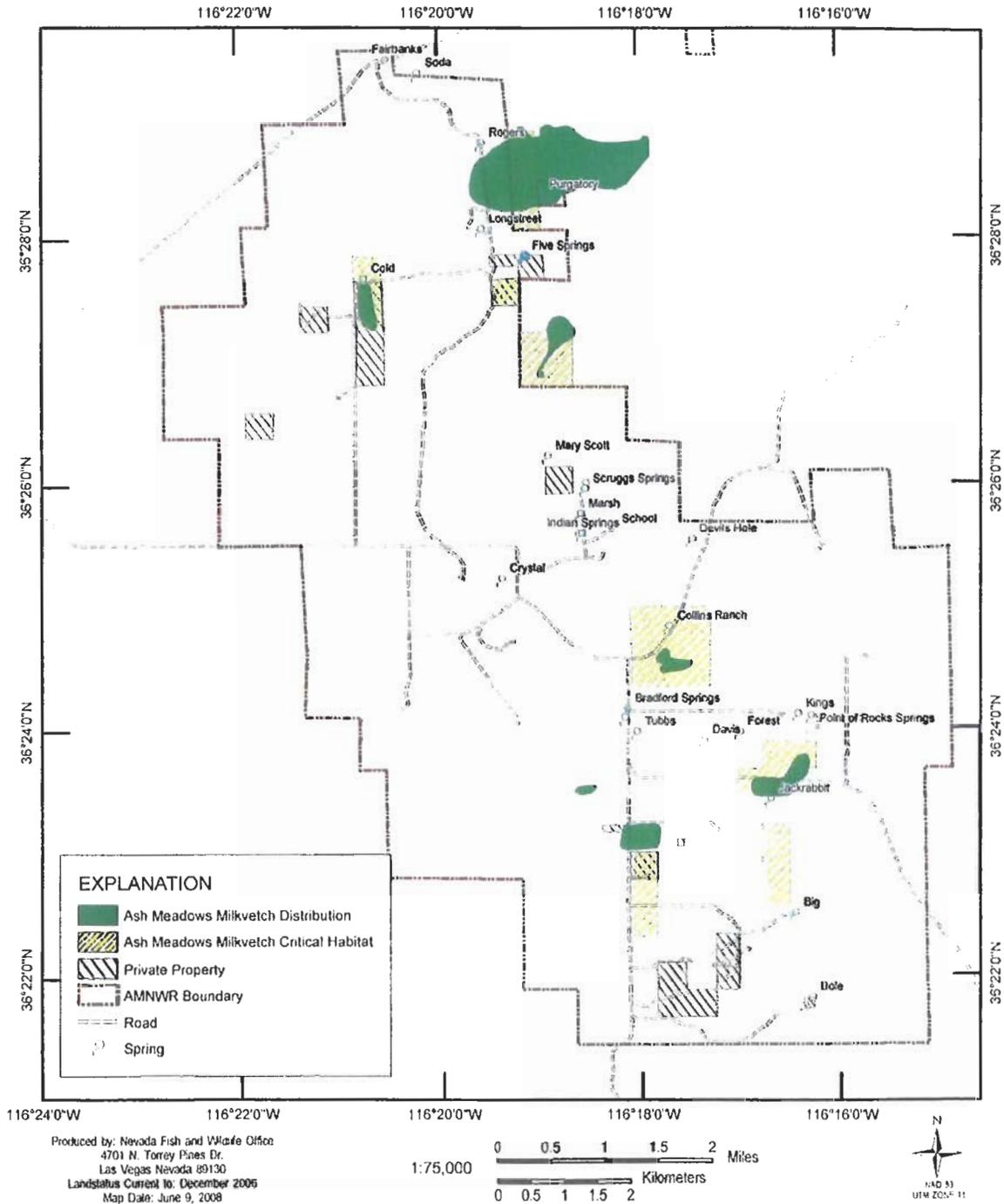


Figure 2. Six general sites identified by Knight and Clemmer (1987) where the Ash Meadows milkvetch (*Astragalus phoenix*) occurs; polygon boundaries are based on Glenne 1998. Areas designated as critical habitat at the time of listing are also shown. Map prepared by the U.S. Fish and Wildlife Service June 2008.