United States Department of the Interior

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IN REPLY REFER TO:
AES/Recovery

Memorandum

To: Director, Fish and Wildlife Service
Washington, D.C.

From: Manager, California/Nevada Operations Office
Sacramento, California

Subject: 12-month Finding on the Petition to Delist *Astragalus magdalenae* var. *peirsonii* (Peirson's Milk-vetch)

On October 25, 2001, we received a petition to delist *Astragalus magdalenae* var. *peirsonii* (Peirson's milk-vetch) that was prepared for the American Sand Association (ASA), San Diego Off-Road Coalition, and Off-Road Business Association (ASA et al. 2001). On September 5, 2003, we published a 90-day finding in the *Federal Register* that the petition presented substantial information to indicate the petitioned action may be warranted (68 FR 52782).

In accordance with section 4(b)(3)(A) of the Act, we have carefully assessed the best scientific and commercial information available on this species and threats it faces. We reviewed the petition, information available in our files, information submitted to use during the public comment period following our 90-day petition finding, and consulted with recognized dune plant experts.

With your concurrence, this memorandum constitutes our finding that the petitioned action requesting the delisting of Peirson's milk-vetch is not warranted at this time.

Please sign below to indicate your approval or disapproval regarding this matter. If you approve, we will publish a notice of this finding in the *Federal Register*.

Date: 5-28-04 Approved ✓ Disapproved

TABLE OF CONTENTS

1. THE PETITION AND RESULTING SERVICE REQUIREMENTS
   - 1.1 Petition Background and Required Actions
   - 1.2 Description of the Petition

2. SPECIES INFORMATION
   - 2.1 Taxonomy and Description
   - 2.2 Life History
   - 2.3 Seed Biology
   - 2.4 Habitat
   - 2.5 Distribution
   - 2.6 Abundance

3. PUBLIC AND PEER REVIEW

4. DISCUSSION OF LISTING FACTORS
   - 4.1 Factor A: The Present or Threatened Destruction, Modification, or Curtailment of the Species' Habitat or Range
   - 4.2 Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes
   - 4.3 Factor C: Disease and Predation
   - 4.4 Factor D: The Inadequacy of Existing Regulatory Mechanisms
   - 4.5 Factor E: Other Natural or Manmade Factors Affecting the Continued Existence of the Species

5. PETITION FINDING

6. LITERATURE CITED

1. The Petition and Resulting Service Requirements

1.1 Petition Background and Required Actions

On October 25, 2001, we received a petition to delist *Astragalus magdalenae* var. *peirsonii* (Peirson's milk-vetch) dated October 24, 2001, from David P. Hubbard, Ted J. Griswold, and Philip J. Giacinti, Jr. of Procopio, Cory, Hargreaves & Savitch, LLP, that was prepared for the American Sand Association (ASA), the San Diego Off-Road Coalition, and the Off-Road Business Association (ASA *et al.* 2001). On September 5, 2003, we announced a 90-day finding in the *Federal Register* that the petition presented substantial information to indicate the petitioned action may be warranted (68 FR 52782). In accordance with section 4(b)(3)(A) of the Act, we have now completed a status review of the best available scientific and commercial information on the species, and have concluded that the petitioned action is not warranted. This determination meets deadline requirements established by a court-approved settlement agreement (*ASA et. al. v. USFWS and Gale Norton*, Stipulated Settlement Agreement, Civ. No. 03-315L LAB).

Section 4(b)(3)(B) of the Act requires that within 12 months after receiving a petition to revise the List of Threatened and Endangered Species that contains substantial information indicating that the petitioned action may be warranted, the Secretary shall make one of the following findings (a) the petitioned action is not warranted, (b) the petitioned action is warranted, or (c) the petitioned action is warranted but precluded by pending proposals. Such 12-month findings are to be published promptly in the Federal Register.

The factors the Secretary is required to consider for listing, delisting, or reclassifying species are described at 50 CFR 424.11. The factors considered in listing, delisting or reclassifying a species are those in paragraph (c) of the section as they relate to the definitions of endangered or threatened species. These factors are: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; or (5) other natural or manmade factors affecting the continued existence of the species. Delisting must be supported by the best scientific and commercial data available and only if such data substantiate that it is neither endangered nor threatened, under the factors described above, for one or more of the following reasons: (1) extinction, (2) recovery, or (3) original data available when the species was listed, or the interpretation of such data, were in error.

1.2 Description of the Petition

The October 25, 2001, petition to delist Peirson's milk-vetch (ASA *et al.* 2001) asserts that our original decision to list this species was in error, based on the following: (1) the original listing decision was made without an actual plant count; (2) the original listing relied on data developed prior to the implementation of the California Desert

Protection Act (CDPA); (3) the original listing decision relied on field studies which the Bureau of Land Management (BLM) has since determined were biased and scientifically unsound; (4) BLM's November 2000 study documents healthy Peirson's milk-vetch populations throughout the dune system; (5) BLM's June 2001 monitoring study confirms that Peirson's milk-vetch is abundant in the Algodones Dunes; (6) Thomas Olsen Associates, Inc. (TOA) 2001 spring surveys confirm that the Imperial Sand Dunes support more than 100,000 Peirson's milk-vetch individuals; (7) Peirson's milk-vetch behaves more like an annual than a perennial; (8) the seedbank of Peirson's milk-vetch determine the species overall viability; (9) Peirson's milk-vetch is not threatened by OHV use or habitat alteration; and (10) Peirson's milk-vetch no longer meets the five criteria for listing.

We offer the following regarding the petition's points that our listing decision was made without adequate data on the abundance of Peirson's milk-vetch. A species may be determined to be an endangered or threatened species because of one or more of five factors described in section 4(a)(1) of the Act. Listing decisions are also based on the best available commercial and scientific information available. Our decision to list Peirson's milk-vetch was based on an evaluation of applicable threats under all five of the listing factors, and not solely on plant census data. As described in the final listing rule, this species was threatened by the present or threatened destruction, modification or curtailment of its habitat and range, including a decline in the condition of the dune habitat (Factor A); the inadequacy of existing regulatory mechanisms (Factor D); and other natural or human-caused factors affecting their continued existence (Factor E) (63 FR 53596). The delisting petition presents new data on plant counts; however, it does not provide convincing information that the threats to this species have been ameliorated or were in error. The petition also states that our listing decision relied on the 1990 ECOS study to support our conclusions that Peirson's milk-vetch populations have declined sharply since 1977. However, as discussed earlier, our decision to list Peirson's milk-vetch was based on an analysis of the five listing factors, a decline in the condition of the dune habitat, and threats from OHVs. The decision to list Peirson's milk-vetch was not based on declines in populations. Please see Section 4. Discussion of Listing Factors, for additional information on threats.

Information on how we considered implementation of the California Desert Protection Act is discussed in Section 4.4. Information replying to the petition's statements that our listing decision relied on studies later found to be biased and technically unsupportable is presented in Section 4.1. The petitions assertion that the reports by BLM (November 2000 and June 2001 studies) and Thomas Olsen Associates, Inc. (TOA) 2001 confirm that Peirson's milk-vetch is abundant in the Algodones Dunes are addressed in Section 2.6. The petition's assertion that Peirson's milk-vetch behaves more like an annual than a perennial is discussed in Section 2.2. Seedbank points are discussed in Section 2.3. And, impacts from OHV use are discussed in Section 4.1. The petition's final point, data developed since 1998 demonstrate that Peirson's milk-vetch no

longer satisfies listing criteria, is also addressed in Section 4.

2. Species Information

2.1 Taxonomy and Description

Peirson's milk-vetch was originally described as *Astragalus peirsonii* by Munz and McBurney (Munz 1932) based on two separate collections (cotypes) from the Algodones Dunes in Imperial County, one collected by Philip Munz and C. Leo Hitchcock in 1932 and another by Frank Peirson in 1927. This taxon has been considered a synonym of *Astragalus crotalariae* var. *piscinus* (Jepson 1936) and *A. niveus* (Barneby 1944). Its currently accepted name, *A. magdalenae* var. *peirsonii* (Munz and McBurney) Barneby, was published by Barneby (1958). This name has been accepted by all systematic (Barneby 1964, Isely 1998) and floristic treatments (Barneby 1959, Munz 1974, Spellenberg 1993, and Felger 2000).

Peirson's milk-vetch is an erect to spreading, herbaceous, short-lived perennial in the Fabaceae (Pea family) (Barneby 1959, 1964). Plants may reach 8 to 27 inches (20 to 70 centimeters) in height and develop taproots (Barneby 1964) that penetrate to the deeper, moister sand. According to Phillips and Kennedy (2003) plants largely die back to a root crown in the summer. The emergent root-crown is clearly evident in some of the photos in Phillips and Kennedy (2002). This habit has been noted for other dune species of *Astragalus*. Barneby (1964) states in the description of *Astragalus pseudiodanthus*, a dune plant, ". . . .withdrawal of the root-crown to a subterranean position so common among psammophytic astragali." The stems and leaves are covered with fine silky appressed hairs. Young seedlings often retain their cotyledons (Phillips and Kennedy 2003). The leaflets, which may fall off in response to drought, are small and widely spaced, giving the plants a brushy appearance. This taxon is unusual in that the terminal leaflet is continuous with the rachis rather than articulated with it. The purple flowers are arranged in 10- to 17-flowered axillary racemes. Romspert and Burk (1979) found inflorescences present from December through at least April. *Astragalus lentiginosus* var. *borreganus*, easily distinguished by its conspicuously broad leaflets, and *Astragalus insularis* var. *harwoodii*, easily distinguished by its smaller stature and shorter banner petals, are the only other *Astragalus* taxa found nearby.

2.2 Life History

Recent contributions to the natural history are described below. Peirson's milk-vetch has variously been considered an annual or perennial (Munz 1932, 1974, Barneby 1959, 1964, Spellenberg 1993, Willoughby 2001). Willoughby (2001) states that Peirson's milk-vetch apparently is a short-lived perennial and as such its response to rainfall was predictable. Documented persistence of individuals also attests to the perennial nature of Peirson's milk-vetch (Phillips and Kennedy 2002, 2003).

Peirson's milk-vetch plants have been reported to flower in their first year (Romspert and Burk 1979, TOA 2001). However this has not been shown to be true by field studies nor has the importance of such individuals been shown. Under cultivated conditions at Rancho Santa Ana Botanic Garden, the first flower buds formed in March on plants about one year old (Porter *in litt.* 2003a). This is depicted in the phenological diagram in Porter (*in litt.* 2003b). Ramifications of both strategies are discussed later. Under field conditions, not all plants flower every year (Phillips and Kennedy 2003). Barneby (1959) considers that Peirson's milk-vetch is a winter annual, because it flowers before spring when most annual plants flower. Plants are reportedly in flower from as early as mid-November through May (Barneby 1965, Porter in litt. 2003b, Phillips and Kennedy 2002).

Porter (in litt. 2003b) provides a diagram depicting the order and general timing of the life history phases of Peirson's milk-vetch. These are based on his field observations from December 2001 to December 2003 and from plants under cultivation from February 2002 through December 2003. The onset of germination and flowering are expected to vary from year to year depending upon the timing of winter rains the previous calendar year. Porter's (in litt. 2003b) circular diagram is divided into four sectors with months as indicators. Each phase of the life history is paced by the onset of the prior phase. The onset of germination may occur anytime between the beginning of January and the end of February (Porter's in litt. 2003b). This is coincident with cooler temperatures and a likely hydrated dune substrate. As noted above, plants survive for about a year before flowering can occur. According to Porter's (in litt. 2003b) diagram, flowering can start anytime between the beginning of January through mid June. After this period, plants support developing fruits. Mature fruits generally may be found on the plants as early as the beginning of February or as late as the latter part of June (Porter's in litt. 2003b). Not uncommonly, flowers for the current season are present at the same time as fruits developed from the flowers of the preceding season.

Not all plants, even those seemingly capable of flowering, flower in a given year even under favorable conditions (Phillips and Kennedy 2003). Smaller first year specimens, if flowering, produce relatively few flowers that contribute little to the seed bank of Peirson's milk-vetch compared with larger older individuals that have more flowers (Romspert and Burk 1979). Phillips and Kennedy (2002) estimated that there had been 5 fruits per plant counted in the spring 2001 survey. They calculated, from a small sample in winter 2001-2002, that plants about six months older had an average of 171 fruits per plant (Phillips and Kennedy 2002). It is likely that this number may have been much higher because numerous fruits likely fell off in the fall.

As part of his studies of the natural history and pollination biology of Peirson's milk-vetch, Porter (*in litt.* 2002a) has identified a white-faced, medium-sized, solitary bee as the only effective pollinator. His preliminary experiments in the field and under

greenhouse conditions indicate that Peirson's milk-vetch plants are not capable of self-pollination in the absence of pollinators. Also, Porter (in litt. 2003b) reported from microscopic examination of hand pollinated flowers that pollen from the same flowers did not adhere the stigmatic surface while pollen from another plant did adhere. Unless pollen grains adhere, fertilization is not possible. These results indicate that Peirson's milk-vetch exhibits traits consistent with self incompatibility. Self incompatibility is a genetic mechanism in plants that prevents self pollination thereby requiring cross pollination. This is a significant consideration for population structure and function. Large populations of standing individuals are likely necessary to provide adequate numbers of individuals for cross pollination and to ensure adequate seed set.

Based on current understanding of the species' life history, sufficient rain in conjunction with wetter-than-average fall weather appears to trigger germination events. Seedlings may be generally present in suitable habitat throughout the dunes, especially during above-normal precipitation years. In intervening drier years, plant numbers decrease as individuals die and are not replaced by new seedlings. This species likely depends on the production of seeds in the wetter years and the persistence of the seed bank from previous years to survive until appropriate conditions for germination occur again. Further research and modeling are necessary to better understand the dynamics of this system and how the species may be responding to natural and man-made disturbances within its range. As one of the peer reviewers noted, this species has a complex life history, and while it can act as a perennial, it is more apt to behave as an annual (McCue, 2003).

The petition includes a quote from TOA (2001), repeated here:

> "Although Peirson's milk vetch is potentially a perennial, most plants that germinated in October 2000 were flowering in March 2001 and setting fruit by May. This means that they contributed to the replenishment and enhancement of the seed bank during their initial growing season; many may not survive if dry conditions occur during the following winter, but their survival is not necessary for the preservation of the species since they have already reproduced."

The next portion of the paragraph in TOA (2001) not cited in the petition, reads:

> "There appeared to be a second germination event associated with the rains in March 2001; many of these plants had not flowered by late May and it is likely that they will succumb to summer heat and drought before reproducing. Their reproduction is not essential for the species since so many of the plants that germinated in the fall produced seeds."

As discussed above, Peirson's milk-vetch has a complex life history. However, the petition's assertion that the reproductive success of Peirson's milk-vetch is not dependent on the longevity of individual plants, but on each plant's ability to produce and drop seeds in their first year warrants further examination in three areas discussed further

below: 1. the relative contribution of first year plants to the seed bank and survival of the taxon; 2. the age classes of plants may have been misidentified during surveys; and 3. survival of any cohort to reproductive maturity.

First, the relative contribution of first year plants of Peirson's milk-vetch to the seed bank and survival of the taxon is not fully understood. The available data suggest that older age classes may produce substantially more seeds than first year plants and that therefore the older persisting plants may be more important for reproductive success (Phillips and Kennedy 2002, Romspert and Burk 1979). Phillips and Kennedy (2002) reported that the older plants produced a mean of 171 fruits per plant, compared to an estimated 5 fruits per each younger plant in the earlier spring survey. Romspert and Burk (1979) state that Peirson's milk-vetch plants that become reproductive the first season do not contribute a great deal to the seed bank but that mature plants produced copious amounts of seeds.

The TOA (2001) report states that most plants were flowering in March 2001 and setting fruit by May, but it is not clear what proportion of the 71,926 plants counted in the census set fruit. At one site, TOA (2001) counted 3,738 plants of which 90 percent were noted as reproductive. They estimate that if each plant produced five fruits and each fruit had 14 seeds, about 235,000 seeds would be produced (TOA 2001). However, there was no discussion of the various potential or actual fates of the flowers or seeds, particularly predation by beetles or sterility. The TOA (2001) study did not provide an estimation of the actual reproductive success of the 2000–2001 cohort. Nor did they provide an assessment or measures of the health of the seed bank, data on rates of deposition to the seed bank, loss from the seed bank, or longevity of the seed cohorts in the seed bank. The petition presents no reference to the actual numbers of Peirson's milk-vetch plants in flower in 2001. Discussions are speculative as to the numbers of fruits the plants of 2001 would produce, and the statement that they had already produced seeds was not supported by data or discussion in their referenced source, TOA (2001). Additionally there are no data presented to show that the older, persisting plants are unnecessary to the survival of the taxon. Without knowledge of the relative contribution of each of the age classes of plants to the reproductive success and persistence of the taxon, it would be speculative to imply that only an annual form of Peirson's milk-vetch is necessary for the persistence of the taxon.

Second, we are also concerned that the age classes of plants may have been misidentified during surveys, thus confounding the issue on the importance of the age of individual plants, and each plant's ability to produce and drop seeds in their first year. It appears that, except for 5 older plants, TOA (2001) likely counted 71,926 individuals that belonged to different annual cohorts, 2000 and 2001, but considered them of uniform age. Older plants may have also been included.

According to TOA (2001) five of the 71,926 plants encountered were more than

one season old. The five, presumably larger, plants would be survivors of an older cohort. The majority of the plants counted by TOA were reportedly the result of an "explosive germination event" in response to wet conditions during the winter of 2000-01 (TOA 2001) and considered that the germination occurred in October of 2000. However, TOA (2001) did not observe an October germination event. Although TOA (2001) states: "The vast majority of Peirson's milk-vetch plants were of uniform age and in their first year," they also state that there appeared to be a secondary germination event and that it was likely that these plants ". . . will succumb to summer heat and drought before reproducing." This is supported by Phillips and Kennedy (2003) who state that many of the sterile (non-flowering) plants from the spring 2001 survey may have been seedlings that germinated in late winter from late February 2001 storms. We do not know how many of the 71,926 plants observed by TOA (2001) were from a 2000 germination event and how many were from a 2001 germination event. Phillips and Kennedy (2003) described germinants of a March 2003 cohort as still having cotyledons and only a few leaves, however, the TOA (2001) report did not report measures of how the age of the plants was determined.

In addition to the younger plants discussed above, at least five older plants that may have germinated in 1998 were counted. Phillips and Kennedy (2002) reported that Peirson's milk-vetch plants largely die back to the root crown during the summer and remain dormant. They noted that similar to other psammophytic astragali, Peirson's milk-vetch likely persists as a perennial as a root crown or buried branches, and produces new aerial shoots when conditions are suitable. Thus based on Phillips and Kennedy (2002), it is possible that the TOA count of 71,926 plant may have included some resprouted plants as seedlings.

We also do not know how many of the 71,926 plants were non-flowering, or flowering, or fruiting. The petition assumed that the non-flowering plants were from the second (2001) event; however, Phillips and Kennedy (2003) report that not all of the plants old enough to flower actually flower. This places into question any figures relating to abundance of life history phase of the species in a year, numbers of germinants from TOA (2001) and any subsequent numerical data relating to survivorship in Phillips and Kennedy (2002, 2003), and the percentage of plants that flower in their "first year."

The "second" germination event in March 2001, reported but not analyzed by Phillips and Kennedy (2002), is coincident with the timing of the March 2003 germination event described by Phillips and Kennedy (2003). This is further indication that the 2000 germination event responsible for most of the spring 2001 cohort (TOA 2001) most likely occurred in February or March 2000 rather than October 2000 as stated. This would also be coincident with plants flowering among plants that were not flowering in Spring 2001.

In keeping with germination patterns noted by Phillips and Kennedy (2003) and

Porter (in litt. 2003a), as well as information in TOA (2001), it is likely that plants surveyed by TOA in March and May of 2001 included plants that germinated in February and March of 2000, plants that germinated in February and March of 2001, and resprouted older plants. Without accurate knowledge of the time of germination of the plants seen by TOA (2001), or that of any other cohort, the petition's statement that Peirson's milk-vetch is able to produce and drop seeds in their first year is without foundation.

The third area warranting discussion is survival of the cohorts to reproductive maturity. Phillips and Kennedy (2003) noted a March germination event, included a description of seedlings that germinated in the field that year, and projected the loss of most of the 2003 cohort. Their projection was later confirmed by Porter (in litt. 2003) when he documented a 99.97 percent loss of the 2003 cohort at 33 monitored sites. None of the TOA (2001) or Phillips and Kennedy (2002, 2003) studies tracked the fates of particular plants or plots to allow any estimate of their fates. It appears that there may be little or no germination some years and in other years nearly an entire cohort may die without reproducing.

In desert plants, the majority of seedlings may die off at the onset of the dryer season as noted by previous reports. Pavlik and Barbour (1988), studied the establishment and survivorship pattern of *Astragalus lentiginosus* var. *micans*, another dune endemic plant, and recorded a complete crash of the 1984–1985 seedling cohort. These authors also reported that 54 percent of the 1985–1986 cohort of seedlings survived, however, none of these plants reached reproductive maturity within the year. Thus, a large number, even a very large number of seedlings of Peirson's milk-vetch may succumb prior to producing and dispersing seeds. Peirson's milk-vetch populations must then rely on the cumulative seed bank, not the seed production of a single year even if germination was high. This demonstrates the need for long-term analysis of the population dynamics of this plant to adequately assess adaptive management concerns and recovery actions.

The petition's statement that the reproductive success is dependent upon the plants' ability to produce and drop their seeds in the first year is not supported. As discussed above, the relative contribution of first year plants to the seed bank and survival of the taxon is not fully understood, the apparent misidentification of the age classes reported to have set seed their first year, and knowledge that nearly an entire cohort may die off in a given year without producing seeds, do not support the petition's statements.

2.3 Seed Biology

The fruits of Peirson's milk-vetch are 0.8 to 1.4 in (2 to 3.5 cm) long, one chambered, hollow, and inflated. Peirson's milk-vetch fruits contain 11 to 16 large flattened black seeds. The seeds, among the largest seeds of any *Astragalus* in North

America (Barneby 1964), average less than 0.1 ounces (oz) (15 milligrams (mg)) each in weight and are up to 0.2 in (4.7 millimeters (mm)) in length (Bowers 1996). Seeds are either dispersed locally by falling out of partly opened fruits on the parent plant, salt-shaker style, or by their release from fruits blown across the sand after falling from the parent plant. Seeds require no pre-germination treatment to induce germination, but show increased germination success when scarified (outer cover is broken). Porter (in litt. 2002a) reported about 98 percent of scarified seeds germinated while only 21 percent of unscarified seeds germinated. In germination trials conducted by Romspert and Burk (1979), 92 percent or more seeds germinated within 29 days at temperatures of 77F (25C) or less, and no seeds germinated at temperatures of 86F (30C) or higher. This indicates that seeds on the dunes may likely germinate in the cooler months of the year. Porter (in litt. 2002a) reported that under greenhouse conditions, seed germinated within 5 days of sowing. In the same report, Porter identified the primary dormancy mechanism in Peirson's milk-vetch is the impermeability of the seed coat to water. He demonstrated little loss of viability in seeds stored for three years, consistent with species having a seed bank (Given 1994). Dispersed seeds that do not germinate during the subsequent growing season become part of the seed bank (Given 1994). Romspert and Burk (1979) noted that older plants were the primary seed producers, and plants that become reproductive in the first season do not make significant contributions to the seedbank. Considering statements by Phillips and Kennedy (2002) that plants in early 2001 were estimated to produce 5 fruits per plant compared to 171 counted in a small sample of older plants that year, it is likely that older plants are important contributors to the seed bank and survival of Peirson's milk-vetch.

The petition states that ". . . Peirson's milk-vetch's reproductive success is not dependant on the longevity of individual plants, but on each plant's ability to produce and drop seeds in their first year of life." and "It is the Peirson's milk-vetch's collective seed bank that determines its overall viability as a species." In reference to this statement, the petition includes a quote, repeated here, from TOA (2001):

> "The potential for a desert annual or short-lived perennial rests not in the plants that are actively growing at any particular time but in the seed bank, the dormant seeds resting in the soil awaiting the return of brief, favorable conditions for their germination (Pavlik and Barbour 1988; Venable and Pake 1999). Dormant seeds in the soil allow plants to survive long periods of unfavorable growing conditions, both seasonal and annual. The contribution of the 2000–2001 cohort of Peirson's milk-vetch to replenishing the seed bank is impressive."

In a given year, an annual or short-lived species can fluctuate between large numbers of plants to few or even no plants. Many species, and Peirson's milk-vetch may be one of them, have periodic "rescue" episodes from the seed bank where large flushes appear when germination conditions are suitable (Elzinga *et al.* 1998). To the extent that plants are precluded from adding seeds to the seed bank by being eliminated by summer

drought, herbivory, and OHV impacts, these individuals cannot be expected to contribute to the reproductive success of Peirson's milk-vetch. Development of a seed bank and associated dormancy, allows plant species to grow, flower, and set seed in years with most favorable conditions (Given 1994). When measuring seed bank dynamics rate of seed mortality and aging, the amount of seed removed by predators, and the variability in germination events are among the factors considered necessary (Elzinga *et al.* 1998). With little data regarding the population biology of Peirson's milk-vetch and relative contribution and constraints of the various life history phases to the success of this plant, the first sentence from the paragraph quoted above from TOA (2001) regarding reproductive success is unfounded. Neither the petition nor TOA (2001) describe the seed bank dynamics relative to plants from various cohorts. For example, the TOA (2001) study did not provide measures of productivity (numbers of seeds produced per plant), which would allow comparison of the contribution of plants stated as being in their first year plants to that of persisting older plants. Based on figures in Phillips and Kennedy (2002) the persisting 26 percent of the 71,926 plants counted in early 2001 would produce many more seeds than that ventured by TOA (2001) as possible if all 71,926 plants produced five fruits in their first year. The contribution of the persisting specimens to the seed bank is likely considerable. However, the relative contribution of these particular seed cohorts to the survival of Peirson's milk-vetch is unknown.

Phillips and Kennedy (2002) sampled the soil seed bank at sites selected by TOA (2001) where there were concentrations of Peirson's milk-vetch plants and describe the seeds as having been produced and dispersed at some time prior to the fall of 2001. They provide two figures for numbers of seeds estimated to potentially be in the seed bank of Peirson's milk-vetch. One figure, 2.5 million seeds, is based on persisting reproductive plant counts. The other figure, 5.6 million, is based on total plant counts. Table 7 (Phillips and Kennedy 2002) provides an estimate of the numbers of seeds produced in 2001. The figure is derived by multiplying the mean number of seeds produced per plant by the percentage of reproductive plants counted in 2001. Their calculation of mean number of seeds produced per plant appears to be flawed because it attributes all seeds found in a plot, regardless of age, to the plants standing in the plot at the time of the count. Insufficient evidence is available to support this assumption. Their seed bank estimate of over 5 million seeds seems to be based on the assumption that each of the young plants present in spring 2001 produced the mean number of seeds calculated for older plants as noted above. This assumption is not valid since Phillips and Kennedy (2002) report that 74 percent of these plants did not survive to the fall 2002. The lack of correspondence between estimates of the numbers of seeds in a seed bank and the persistence of resultant seedlings was presented by a follow-up report (Phillips and Kennedy 2003) and noted by Porter (*in litt.* 2003). McCue (*in litt.* 2003) states: "Even if half of the 2.5 million seeds germinate, there is no data on how many of those would actually survive to seedling stage, let alone maturity." Even if Phillips and Kennedy's estimated numbers of seeds are correct, relative to the importance of large numbers of seeds, Pavlik (*in litt.* 2003) points out:

"...there is another reason why 5, 10, or even 20 million seeds is not extravagant; many seeds die during dispersal because they are buried, damaged, exposed to predation, or simply get blown into unfavorable habitat. Given the vast, apparently unfavorable expanses of active sand accumulation and movement at Algodones (Phillips *et al.* [TOA] 2001, pg 13), and the island nature of the dunes in general, the latter fate is particularly probable."

In a study of the seed production and seed bank dynamics of a similar short-lived perennial, psammophytic plant, Pavlik and Barbour (1985, 1986) describe seed production, dispersal, herbivory, survivorship, seed bank dynamics, and frequency of establishment of *Astragalus lentiginosus* var. *micans* from the Eureka Dunes in Inyo County California. They found that seed production is a function of plant (canopy) volume and larger plants would be expected to produce more seeds.

Intervening areas lacking standing plants were not sampled for seeds by Phillips and Kennedy (2002) although Phillips and Kennedy's (2003) report clusters of Peirson's milk-vetch where no plants were seen in 2001 and old clusters of plants that had few if any seedlings in 2003. There is considerable annual and seasonal variation in the distribution of seeds among different desert microhabitat types (Reichman 1984, Pavlik and Barbour 1986, Pake and Venable 1996) and clustered distributions of seeds in the soil is common in desert plants (Kemp 1989). If areas lacking standing plants had systematically been included in the seed bank sampling by Phillips and Kennedy (2002), data on the seed longevity and OHV impacts to deposition and depletion of the seed bank may have been available.

The petition notes the existence of "ample seed stores" and "a healthy seed bank" without defining "ample" or describing aspects of seed bank dynamics of this taxon that could affect the size of the seed bank, such as the rate of seed deposition to the seed bank, the longevity of seed bank cohorts, or the impact of seed predatory beetles (Bruchidae) on the seed bank noted to be a cause of high seed mortality of Peirson's milk-vetch (Romspert and Burk 1979). Elzinga *et al.* (1998) emphasize the different fates for seeds in taxa with seed banks. Of the seeds produced, some are non-viable, some are lost to seed predators, some germinate, and some are stored in the seed bank. With no knowledge of the timing of origin or the fate of the seeds, and the population biology of Peirson's milk-vetch, description of the seed bank as "ample seed stores" is vague and unsupported. In addition, no information was provided on the rates of seed deposition to the seed bank or germination rates in areas with high OHV use, versus medium or low OHV use. Likewise the lack of definition or means of determining seed bank health, renders this statement by the petition unsupported.

Estimations of the size and status of the seed bank of Peirson's milk-vetch provided by Phillips and Kennedy (2002) do not seem supportable. From the description

of the methods used and data presented, Phillips and Kennedy (2002) present estimates numbers of seeds in a portion of the seed bank, but no information on the dynamics of the seed bank. Phillips and Kennedy (2002) and available information do not provide support for the petition's claims of adequacy or health of the dynamic seed bank.

2.4 Habitat

The habitat for Peirson's milk-vetch is slopes and hollows of the Algodones Dunes. The Algodones Dunes are one of the largest dune fields in North America. The Algodones Dunes are often referred to as the Imperial Sand Dunes, a designation derived from their inclusion in the Imperial Sand Dunes Recreation Area (ISDRA) established by the BLM. Nearly all lands in the Algodones Dunes are managed by BLM. However, the State of California and private parties own small inholdings in the dune area. Approximately 52,780 ac (21,359 ha) have been proposed as critical habitat for Peirson's milk-vetch (August 5, 2003, 68 FR 46143).

The dunes extend about 40 miles (mi) (64 kilometers (km)), trending from northwest to southeast (Norris and Norris 1961). Winds from the northwest are prevalent in the winter, while in the summer the winds are from the southeast (Romspert and Burk 1979). This regime is likely responsible for the dune-building (Norris and Norris 1961) and fruit dispersal that result in the persistence of the plants in the dune system. The dunes are generally considered to have formed from sands from Lake Cahuilla that historically occupied the Cahuilla Basin. The western boundary of the dunes is marked by a series of parallel, longitudinal southeast trending ridges. The northern third of the dunes is narrow, about 2 mi (3 km) wide, and increases in elevation from 200 to 300 feet (ft) (60-91 meters (m)) in the northern portion to 300 to 400 ft (91 to 121 m) in the southern portion north of Highway 78. Areas in the central portion of the dunes reach an elevation 500 ft (152 m) south of State Highway 78, but reach elevations of only 200 ft (60 m) for most areas just north of Interstate 8. The central portion of the dunes is wider, about 5 mi (8 km), and is characterized by deep bowls (hollows among the dunes) and slip faces (areas so steep that the loose sand naturally cascades downward) that run transverse to the primary ridge line (Norris and Norris 1961). The area south of Interstate 8 is generally characterized by lower elevation, under 300 ft (91 m), dunes.

The Algodones Dunes are one of the driest and hottest regions in the United States. Romspert and Burk (1979) reported average precipitation between 1941 and 1970 was 2.6 in (67.8 mm) per year. Rainfall amounts differ from place to place and from year to year with areas to the northwest being generally dryer than those to the southeast (Willoughby 2001). A soil survey for the Imperial Valley area of Imperial County (Zimmerman 1981) did not include the areas east of the Coachella Canal but did depict a few adjacent portions of the Algodones Dunes as Rositas fine sand with 9 to 30 percent slopes. Rositas fine sand are described as deep, somewhat excessively drained, sloping soils formed in wind-blown sands of diverse origin. Dean (1978) describes the sand as

quartz with a mean grain size of 0.006 in (0.17 mm). Norris and Norris (1961) report that the dunes contain 60 to 70 percent quartz and 30 to 40 percent feldspar sand. Further analysis of the sands of the Algodones Dunes found its source was likely sediment from the Colorado River that flowed into the Cahuilla Basin (Muhs *et al.* 1995)

Habitat for this plant is found in a band that runs parallel to the active, linear dunes on the western edge of the dune field in a northwest to southeast direction. The band is between these active linear dunes on the west and transverse ridge dunes to the east. The dunes in this band are composed of a series of transitional crescentic ridges (Muhs *et al.* 1995). Peirson's milk-vetch occurs on the open, higher, more active dune areas generally under 20 degrees slope, in a vegetation community referred to as psammophytic (dune loving) scrub (Thorne 1982, Willoughby 2000). Desert psammophytic scrub transitions to sandier phases of creosote bush scrub toward the more stabilized lower edges of the dunes. *Helianthus niveus* ssp. tephrodes (Algodones Dunes sunflower), *Croton wigginsii* (Wiggins'croton), *Palafoxia arida* ssp. *gigantea* (giant Spanish needle), *Pholisma sonorae* (sand food), and *Eriogonum deserticola* (desert eriogonum) are associated taxa restricted to desert psammophytic scrub (Thorne 1982). Thorne (1982) included *Astragalus lentiginosus* var. *borreganus* (Borrego milk-vetch), *Dicorea canescens* (dune bugseed), *Petalonyx thurberi* (sandpaper plant), and *Tiquilia* species as taxa more widely distributed off the dunes. Many of these taxa are also found in association with *A. m.* var. *peirsonii* in the Gran Desierto of Sonora, Mexico (Felger 2000). Usually, one or more of the other psammophytic scrub taxa (Thorne 1982) are found with *A. m.* var. *peirsonii*. Creosote bush scrub is rarely found in deep sand dunes, but may encroach in adjacent areas especially where the base soil is exposed. Psammophytic scrub does not occur where creosote bush scrub is well developed. Psammophytic scrub in the dunes proper occurs on the relatively stable substrates on the leeward side of the dune ridge tops in areas gradually sloping up from the bowls at the bases of the steep leeward slip faces (Phillips and Kennedy 2002). Because of the tiered nature of the dune system, a system of alternating slopes and swales, areas suitable for development of psammophytic scrub and thus Peirson's milk-vetch occur as scattered occurrences distributed among the dunes. These areas are protected from extreme deposition or removal of sand (Phillips and Kennedy 2002) and may shift in position over time. The roots of Peirson's milk-vetch penetrate the deeper, more moist layers of the sand, as well as spread out in the upper surface layers. The distribution and relative abundance of the plant varies from place to place and over time (WESTEC 1977, Willoughby 2000, 2001; Phillips and Kennedy 2003). The tendency of plants to be found in patches is likely due to the localized dispersal of the fruits and seeds as well as local habitat characteristics described above.

2.5 Distribution

In the United States, this plant is restricted to about 53,000 ac (21,500 ha) in a narrow band of the central portion of the Algodones Dunes of eastern Imperial County

California. It was reported once from Borrego Valley, San Diego County, but this record has not been confirmed and the plant has not been reported from there since. Peirson's milk-vetch is reported from northeastern Baja California, Mexico (Barneby 1959, 1964, WESTEC 1977, Spellenberg 1993) and has been verified in the Gran Desierto of Sonora, Mexico (Felger 2000). The Algodones Dunes are often called the Imperial Sand Dunes, a designation derived from a land use area called the Imperial Sand Dunes Recreation Area (ISDRA) established by BLM. A map of the range of Peirson's milk-vetch in the Algodones Dunes (WESTEC 1977) was derived from data gathered from 66 transects of the dunes. Other maps (Willoughby 2001, BLM 2002) depict the distribution based on BLM surveys along 34 of the 66 WESTEC (1977) transects. One document (BLM 2002), includes a map entitled "Peirson's Milk-vetch Distribution" based on the cumulative data from surveys of these 34 transects for 1998, 1999, and 2000. The TOA (2001) report includes a map of survey sites and depiction of aerial surveys. The known current distribution is described in the proposal for critical habitat for Peirson's milk-vetch published in the Federal Register on August 5, 2003 (68 FR 46143).

2.6 Abundance

Peirson's milk-vetch exhibits temporal variability in plant numbers apparently associated with annual precipitation patterns. In dune-wide surveys conducted in 1997, 1998, 1999, and 2000, the species was most abundant in 1998, the highest rainfall year, and least abundant in 2000, the lowest rainfall year (Willoughby 2001). Based on current understanding of the plant's life history, sufficient rain in conjunction with cooler fall weather appears to trigger germination events. Seedlings may be generally present in suitable habitat throughout the dunes, especially during above-normal precipitation years. In intervening drier years, plant numbers decrease as individuals die and are not replaced by new seedlings. The species likely depends on the production of seeds in the wetter years and the persistence of the seed bank.

Considering the areal extent of the Algodones Dunes, Peirson's milk-vetch is a rare plant. Thomas Olsen Associates (TOA) (2001) counted 71,926 plants of Peirson's milk-vetch over an area of 35,000 acres (14,165 ha) Phillips and Kennedy (2003). That is about 2 plants per acre or 5 per hectare during what TOA considered an "explosive germination event." Most recently Willoughby (2004) reports densities of Peirson's milk-vetch from nine belt transects in the wilderness area, closed to OHVs, to be 57 plants/ac (23/ha) and 76/ac (31/ha) in the Gecko Management Area, open to OHVs. Densities for *Helianthus niveus* ssp. *tephrodes* (Algodones Dunes sunflower), a plant with closely parallel distribution to Peirson's milk-vetch, were reported as 490 plants/ac (198.27/ha) in the wilderness area and 270/ac (109.54/ha) in the Gecko Management Area. By even a qualitative comparison with data from the TOA (2001) and Phillips and Kennedy (2003), as well as Willoughby (2004), Peirson's milk-vetch is quite rare in the landscape even when compared to the co-occurring State endangered *Helianthus* noted above.

The petition states that BLM's November 2000 study documents healthy Peirson's milk-vetch populations throughout the dune system. The BLM document (Willoughby 2000) reports the results of a 1998 survey for six sensitive plant taxa, including Peirson's milk-vetch, and compares findings with those of the earlier WESTEC (1977) study. The BLM study provides valuable Peirson's milk-vetch monitoring information; however, the petition overstates the facts and does not consider the limitations of the comparisons that were made in the BLM monitoring study. For instance, in the conclusions and recommendations of the BLM study, Willoughby (2000) does not state that Peirson's milk-vetch is abundant and thriving. Rather, Willoughby (2000) concludes that all six of the plants taxa monitored in 1998 are at least as abundant and widespread in the entire dune system as they were in the 1977 WESTEC study, yet cautions that the data are not directly comparable because the rainfall amounts were different for the two years and different methodologies were used in the two studies.

The 1998 BLM surveys were not "throughout the dune system" but rather across 34 selected west-east transects. The BLM transects were a subset of those used by WESTEC and intentionally avoided those that crossed State Highway 78 and Interstate 8. The BLM survey (Willoughby 2000) did not define or measure the health of the populations, but rather recorded the abundance classes of plants in each of the squares (quadrants) WESTEC (1977), along the 34 transects. Each team of monitors traversed the dunes along a designated latitude using a GPS unit. Observers tallied adult plants encountered in each cell and, if not too numerous, seedlings were tallied as well. Counts were not made for the entire square. Closed areas were sampled by two people on foot, open areas were sampled by two persons on a dune buggy. The surveys were not line intercept measures and it is not known how wide the "encounter" zone was from team to team and transect to transect. Abundance classes were recorded for all of the sensitive plants except *Pholisma sonorae* (sand food) which is a root parasite visible only by its inflorescences. Abundance Classes were defined as 0 = 0 plants; 1 = 1 to 10 plants; 2 = 11 to 100 plants; 3 = 101 to 1000 plants; 4 = 1,001 to 10,000 plants; 5 = > greater than 10,000 plants.

WESTEC (1977) was a study done under contract to BLM to determine, among other things, the distribution and abundance of seven sensitive plant taxa. *Astragalus lentiginosus* var. *borreganus*, Peirson's milk-vetch, *Croton wigginsii, Eriogonum deserticola, Helianthus niveus* ssp. *tephrodes, Palafoxia arida* var. *gigantea*, and *Pholisma (Ammobroma) sonorae*. WESTEC (1977) used teams in three OHV's running transects west to east, parallel to one another and one half to one mile apart, to survey most of the areas open to OHV use. However, in the area south and west of the All American Canal, transects were run from north to south (WESTEC 1977). Field surveys of areas closed to OHVs used an initial assessment by helicopter that ranked of plant densities plotted on map strips (WESTEC 1977). Further analysis in this area, when required, was made by ground survey teams placed by helicopter. Density class measures

for all plants except *Pholisma sonorae* were provided but were not tied to areal extent. Density Class 1 = Presence of one or more plants occurring in low numbers, particularly adjacent to the observer, but not conspicuous farther away; 2 = Presence of a moderate number of individuals of a species, visible at a distance of up to 1/4 mile from the observer; 3 = Presence of moderately high numbers of a species, forming a conspicuous element of the landscape; 4 = Presence of very high numbers of a species, occurring throughout the quadrant (square), representing some of the most dense populations encountered during the survey. Each quadrant was approximately 0.45 mi (0.72 km) on a side (WESTEC 1977).

In his conclusions Willoughby (2000, p. 34) addresses the limitations of the monitoring data:

> "It is important to realize the limitations of these monitoring data. Because it is very unlikely that the same areas of each cell were surveyed in both 1977 and 1998, it is quite possible that the differences observed result from the spatial variability within cells instead of or in addition to any changes that may have occurred between the two time periods. Thus, increases observed in the sample values between 1977 and 1998, even though statistically significant, cannot be used as "proof" that particular species were more abundant and/or widespread in 1998 than in 1977. Additionally, weather station data indicate that precipitation was more favorable during the 1997-1998 growing season than during the 1976-1977 growing season preceding the WESTEC study. Thus, differences between 1977 and 1998 may reflect the more favorable weather of the 1997-1998 growing season."

Willoughby (2000) describes the WESTEC (1977) abundance classes as too subjective and impractical and described different abundance classes used in the Spring 1998 BLM surveys. Consequently, he recognized that the 1998 BLM data might not be directly comparable to the 1977 (WESTEC 1977) data (Willoughby 2000).

We consider the density classes of WESTEC (1977) to be qualitative and not based on particular numbers of individual plants but rather on the apparent visual density of plants as a feature of the landscape. Likewise, there is no measure of density in terms of numbers of plants per unit area. Although Willoughby (2000) saw the limitations of the WESTEC data, he converted the qualitative measures into quantitative measures for comparison with the BLM survey data. The magnitude of non-sampling error in the WESTEC study makes comparison with the BLM data impossible (L. Ball USFWS *in litt* 2003). Peer reviewers also commented on the inappropriateness of comparisons between the BLM study results and those of WESTEC (1977). The comments centered on the lack of comparability between two studies with such different methodologies. In his peer review comments, Pavlik (*in litt.* 2003) states that "Any attempt to establish population trends by comparison to the 1977 WESTEC study should be rejected because there is no

objective way to replicate with certainty WESTEC's vague and highly subjective relative abundance codes. This applies to the 1998 BLM survey (Willoughby 2000, 2001) and the Petition (Hubbard et al. 20001, pg 17). There is no evidence that, for example, the code of "3" used by BLM in 1998 for 122 plants in a sample cell (0.45 X 0.45 mile) would have been assigned a density class of "2" (moderate number of individuals up to 0.25 mile away) or "3" (moderately high number, conspicuous in the landscape) in 1977. This uncertainty would completely negate any conclusion regarding trends in abundance." Pavlik also states "It is mathematically incorrect to calculate a mean abundance class . . . because the code values used by BLM were logarithmic (1, 10, 100, . . .), in addition to their possible lack of correspondence to the 1977 density class values discussed above." Finally, Pavlik (*in litt.* 2003) states that rainfall during the October through March period, most critical for germination, was less in 1977 than in 1998 and that therefore if more plants were present in 1998 it could have been due to increased rainfall rather than lack of OHV impacts. Pavlik continues, noting that this was stated explicitly in Willoughby (2000) but not in the Petition. Claims of trends of population increases based on comparisons of BLM surveys (Willoughby 2000) and WESTEC (1977) are not valid and as such are not supported.

Another main point presented in the petition is that BLM's June 2001 monitoring study confirms that the Peirson's milk-vetch is abundant in the Algodones Dunes. The petition appears to quote Willoughby (2001) in the statement, "Although 1999 and 2000 were much drier than 1998 had been, the June 2001 Monitoring Study still concluded that most of the plant species under review, including the Peirson's milk-vetch, were at least as abundant in 1999 and 2000 as they were in 1977." However, it appears the petition may overstate the facts provided in the BLM study. Page v. of Willoughby (2001) states: "As noted in Willoughby (2000) all six species were at least as abundant and widespread in 1998 as they were in 1977." The year 1998 was a wet year, while 1999 and 2000 were dry years. Considerably fewer Peirson's milk-vetch plants were found in these drier years; 942 plants in 1999 and only 86 plants were found along BLM's transects in 2000 (Willoughby 2001). There is no supporting documentation for the petition's assertion that Peirson's milk-vetch was as abundant in 2000 as it was in 1977 or 1998. Willoughby (2001) states "It [Peirson's milk-vetch] was most abundant in 1998, the highest rainfall year, and least abundant in 2000, the lowest rainfall year." Further, as noted above, comparisons of abundance between the BLM abundance class values in Willoughby (2000, 2001) and WESTEC (1977) are invalid because of the disparity and ambiguity between abundance measures between the BLM and WESTEC studies.

The third point regarding Peirson's milk-vetch abundance presented in the petition follows. The petition asserts that plant counts conducted in spring 2001 by Thomas Olsen and Associates, Inc. (TOA) confirm that the Imperial Sand Dunes support more than 100,000 individual Peirson's milk-vetch and confirm that Peirson's milk-vetch is abundant and thriving throughout the Imperial Sand Dunes. The TOA (2001) study is the first survey to report numbers of Peirson's milk-vetch plants over significant portions

of the Algodones Dunes. The petition contains several statements related to the purpose and study design of the TOA (2001) study that warrant further discussion. Chief among these is the presumption that the TOA (2001) survey could be interpreted representing the condition of the entire dunes population of Peirson's milk-vetch. The TOA biologists describe their survey as a multi-stage, non-probabilistic survey (TOA 2001). We agree with their statement that non-probabilistic methodologies should not be used to make statistical approximations of the distribution of the plants within the total survey area. The petition, however, appears to interpret the TOA report as encompassing the entire dunes and population of Peirson's milk-vetch. Porter (*in litt.* 2003) questioned why TOA (2001) applied methods designed for archaeological surveys rather than standard procedures for demographics and census of rare plants (e.g., Elias 1987, Falk and Holsinger 1991, Pavlik and Barbour, 1988). The majority of the references cited for methodology in TOA (2001) relate to archaeological surveys. These methodologies are not likely to accommodate the different spatial distributions and phenological stages of a living plant.

According to the petition and as stated in TOA (2001), the purpose of the investigation was ". . . to locate occurrences of Special Status Plants, with particular emphasis on Peirson's milk-vetch." The investigation was designed ". . . to conduct and record a complete census of occurrences of Peirson's milk-vetch and other Special Status plants" (TOA 2001). "Sampling methodology was not included in this survey design, since the purpose of the investigation was to locate as many occurrences of the subject plants as possible, and to completely census every area in which they were discovered" (TOA 2001). No description was provided of measures taken to avoid double-counting of areas during the 13 days of visits over the nearly 3 month survey period.

The surveyors interviewed persons familiar with the dunes to determine the location of known occurrences of Peirson's milk-vetch. They also performed a general reconnaissance of the open areas of the dunes, and then conducted intensive surveys of selected areas. This non-random site selection is of significance in interpretation of this and subsequent phases of the study. The acreage of the Algodones Dunes covered by the census was not provided by TOA (2001). It is difficult to associate the specific area covered by TOA (2001) with the footprint of previous monitoring efforts (WESTEC 1977, Willoughby 2000, 2001). Neither the petition nor the TOA (2001) report, provide discussion, interpretation or direct comparison of their data with those from previous monitoring efforts.

Phillips and Kennedy (2002) provide information on methods used in the initial TOA (2001) study. For example, on page 6 they state that 35,000 acres (14,165 ha) representing 59 percent of the open area of the dunes was covered in the initial census study (TOA 2001). Using figures from TOA (2001) and Phillips and Kennedy (2002, 2003), the area surveyed seems closer to 51 percent of the 110,402 ac (44,679 ha) area then open to OHV activity. Although they reportedly surveyed only about 59 percent of

the open areas of the dunes, TOA (2001) states that 70-75 percent of the dune system does not contain habitat suitable for Peirson's milk-vetch. No description differentiating suitable from unsuitable habitat, or map depicting the relative distribution of both types was provided.

Five areas, closed to vehicle access at the time, were surveyed from a helicopter (TOA 2001). There was no indication of the amount of suitable habitat surveyed, or a control over flight of an open area that was also surveyed on the ground. No relationship was presented between the occurrence and density of Peirson's milk-vetch in ground surveys versus over flights. The petition states:

> "In the areas open to OHV use, TOA counted more than 71,000 Peirson's milk-vetch plants. TOA also conducted low-altitude helicopter surveys of the closed areas and found that they supported Peirson's milk-vetch plants in numbers similar to those observed in the open areas. These data reflect a thriving plant species with more than 100,000 individuals, ample seed stores, and a high probability of continued reproductive success."

No explanation of how the plants were counted in aerial surveys was provided. Furthermore, TOA (2001) did not include procedures designed to define "thriving," quantify "ample" seed stores or report the reproductive success.

In the TOA (2001) study, 71,926 plants were found in 13 days of ground surveys conducted between March and May 2001. These were arrayed in a series of 'sites' and 'points' by TOA (2001). The Master Database in TOA (2001) presents locations of all of the sites and points surveyed. "When plants were discovered, a site number was assigned to the area. . ." TOA (2001). The team leader completed a data form at each site, recording general habitat characteristics, associated species, condition of plants present, and total counts for each special status species. "Areas that were too small [not defined in the report] to circumscribe, and that contained a smaller number [not defined in the report] of Peirson's milk-vetch plants, were designated 'points', at which milk-vetch plants were counted and a geographic coordinate was entered, but a data sheet was not completed." TOA (2001). Because of this, apparently no data on occurrences of associated species, the condition of Peirson's milk-vetch plants or numbers of those impacted by OHVs, comparable to those collected at 'sites' were available for 'points'. Based on the descriptions provided and noted above, it is difficult to understand the definitions of sites and points. Eleven of the 61 sites had 50 or fewer Peirson's milk-vetch plants, including one with no plants, and 19 of the 66 points had 50 or more Peirson's milk-vetch plants, including one with 1,420 plants.

Peirson's milk-vetch exhibits a wide variation in numbers of standing individuals found in any given year. This is evident in survey results of the same 34 transects conducted by BLM in several consecutive years. Along the same series of west to east

transects, surveyors counted a total of 5,064 plants in 1998, a heavy rainfall year, and 86 plants in 2000, a low rainfall year (Willoughby 2001). The record of steep decline of the cohort counted by TOA in 2001 was tracked by Phillips and Kennedy (2002) who reported that 26 percent of the plants seen in Spring of 2001 were present in late 2001 and Phillips and Kennedy (2003) who reported that only 0.26 percent of the plants counted in Spring 2001 survived to Spring 2003. A survey count of standing individuals obtained in any single year is of limited use in attempting to chart population trends. The survey reported in TOA (2001) and described in Phillips and Kennedy (2002), subjectively selected sites to maximize the likelihood of encountering individuals in an area of about 35,000 acres of the approximately 185,000 acres of the ISDRA. This is not an adequate representation of the plant across its range. It does not address the natural fluctuation between numerous plants seen in some years and relatively few plants seen in others as noted by Willoughby (2001). TOA (2001) does not describe the distribution of Peirson's milk-vetch plants, relative to the distribution of suitable habitat or the area surveyed. There is no discussion of the relationship of the area surveyed by TOA to the total area of the dune system. Even if these numbers were for a long-lived perennial plant, the facts presented do not support the petition's contention that Peirson's milk-vetch is abundant and thriving, throughout the Imperial Sand Dunes.

From the discussion above, it is clear that TOA (2001) did not conduct a 'census', a count of all members of a population, but rather conducted a survey of a portion of the population. As such, extrapolation to imply the range-wide condition of the population is unwarranted. Incorporation of helicopter surveys does not seem appropriate to fill out the ground surveys. Survey sites subjectively selected where plants were known to be located is not an appropriate survey technique. Even considerations of abundance are questionable because measurement of plants per area surveyed was not a focus of discussion. To the degree that petition relies on the TOA (2001) report as a census or survey representing the abundance of Peirson's milk-vetch, their claims are not supported.

3. PUBLIC AND PEER REVIEW COMMENTS

In response to our September 5, 2003, Notice (68 FR 52784) requesting information on the status of Peirson's milk vetch, we received comments and information from several organizations. To ensure that our status review and 12-month finding are based on the best available scientific and commercial information available, we also solicited peer review of the key documents supporting the ASA petition. The documents sent for peer review included Willoughby (cited as BLM) 2000, 2001; TOA (2001); and Phillips and Kennedy (2002, 2003). These documents represent considerable effort to address complex ecological issues. They provide some useful data relative to the life history and ecology of Peirson's milk-vetch. However, survey methodology and measures often differed among these studies. The survey methodology and especially measures of WESTEC (1977), a base line study for several sensitive plant taxa, including

Peirson's milk-vetch, were different from all of the more recent studies. Because of these differences, the seeming inappropriateness of some methods, documentation and conclusions, we sought peer review of these documents. Comments and information provided by the public and the peer reviewers are cited in this document where appropriate.

We solicited peer review of these documents from Dr. Kimberlie McCue, Conservation Coordinator for the Missouri Botanical Garden, Saint Louis, Missouri, who has published papers on genetic diversity and seed banks; Dr. J. Mark Porter, Associate Professor of Botany and Research Scientist at Rancho Santa Ana Botanic Garden, Claremont, California, who has published on systematics and conservation of rare plant taxa and conducted research on population genetics on the Astragalus desperatus complex; and Dr. Bruce Pavlik, Letts-Villard Professor of Natural Sciences, Mills College, Oakland, California who developed conservation plans for plants endemic to the Eureka Dunes, developed a monitoring plan for the dune endemic Amsinckia grandiflora. In addition, Dr. Lianne Ball, a bio-monitor on our staff, provided comments on the sampling used in some of these studies and the impact on conclusions drawn.

4.0 Discussion of Listing Factors

When considering an action for listing, delisting, or reclassifying a species, we are required to determine whether a species is endangered or threatened based on one or more of the five listing factors identified in Section 4(a)(1) of the Act. These factors are given as: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) over utilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting the continued existence of the species. Delisting a species must be supported by the best scientific and commercial data available and only if such data substantiates that the species is neither endangered nor threatened for one or more of the following reasons: (1) the species is considered extinct; (2) the species is considered to be recovered; and/or (3) the original data available when the species was listed, or the interpretation of such data, were in error (50 CFR 424.11).

4.1 Factor A: The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Habitat.

The final listing rule (63 FR 53596) identifies off-highway vehicles (OHV's) as a serious threat to Peirson's milk-vetch, citing the fragile nature of the plants. Numbers and distribution of OHVs has increased, sometimes dramatically over the years (BLM 2003 and references cited therein).

Although few quantitative data are available, impacts of OHV use on Peirson's

milk-vetch plants and habitat have been noted by most studies of the dune plants. For example, "The occurrence of dune plants and heavy use areas for vehicles is, to a large extent, mutually exclusive" (TOA 2001). This supports similar findings by Willoughby (2000, 2001), WESTEC (1977), Luckenbach and Bury (1983), and ECOS (1990). Because of the generally transient nature of surface structure of the dunes, most quantitative measures of OHV impacts are given in terms of numbers of plants impacted. The survey of TOA (2001) reported finding 667 OHV impacted plants during 13 survey days. Phillips and Kennedy (2003) reported finding 430 impacted plants during six survey days. But in neither study were plants marked to determine survival or reproductive success at a later date. Impacts to Peirson's milk-vetch from OHVs continue to be noted (Phillips and Kennedy 2003, Willoughby 2004) although no follow-up to measure long term impact or relative severity of impact has been done.

The impacts of OHV use on other types of desert vegetation have been documented. Bury *et al.* (1977) compared eight paired sites in the Mojave Desert in 1974 and 1975, examining the impact of OHV use on creosote bush scrub and associated wildlife. There were fewer creosote shrubs per hectare in plots with higher OHV use and the proportion of shrubs per plot damaged by OHVs increased with increased OHV use.

The recently released Recreation Area Management Plan (RAMP) (BLM 2003) proposes to reopen to OHV use all temporarily closed areas of the dunes. The North Algodones Dunes Wilderness will continue to be closed to OHV use. Technological advances, such as affordable GPS units and cell phones, and OHVs with greater range have enabled OHV use to penetrate further into the dunes. Thus, equipped vehicles can now travel further on a tank of gas and are less likely to get lost in the featureless expanses of the dunes.

Visitorship continues to increase in the ISDRA (BLM 2003) and has outpaced previous estimations (BLM 1987). The petition did not address visitorship patterns or increases relative to the distribution of Peirson's milk-vetch. Since this plant was listed, visitorship to the recreation area has continued to increase. Based on BLM (in litt. 2002), visitorship increased an additional 79 percent between 1996 and 1999 and 111 percent over the base year of 1994, cited in the final rule. The visitorship levels recorded in 1999-2000 (BLM *in litt.* 2002) were in fact 149 percent higher than those projected for the year 2000 by BLM (1987). Visitorship is projected to increase by 29 percent over fiscal year 1999/2000 by fiscal year 2002/2003 and by at least 82 percent over fiscal year 1999/2000 by fiscal year 2012/2013 (BLM 2002). In plain figures, there were 792,000 visitor use days in 1985 and now there are over 3 million annually (BLM 1987, 2003). User groups are advocating for building as many camping pads as possible until "Over a span of time 100 percent of both sides of the road would be camping pads" (ASA 2002). Shifts in visitation have also been reported by BLM (Schoeck, BLM *in litt.* 2001) indicating that by the late 1990s and early 2000s, day use of the central dunes between State Highway 78 and Interstate 8 had become heavy and continues to increase. In the

late 1970s visitation was concentrated primarily to major winter holiday weekends with Thanksgiving week receiving the highest numbers of visitors. However, day use has been reported to be increasing on non-holiday weekends as well (Schoeck, BLM *in litt.* 2001). These contributing factors make it likely that Peirson's milk-vetch will experience impacts across more of its range and over a longer period of each year.

Significant impacts from OHV use on Peirson's milk-vetch habitat have been observed at or near the OHV staging areas (Willoughby 2000). The TOA (2001) report, cited in the petition, supports the BLM findings (Willoughby 2000, 2001) regarding limited occurrence of dune plants associated with heavy OHV activity: "The occurrence of dune plants and heavy use areas for vehicles is to a large extent mutually exclusive (TOA 2001)." This corroborates earlier findings by WESTEC (1977), Luckenbach and Bury (1983), ECOS (1990), and was reported in the final rule listing the plant as threatened. The coincidence of timing of seedling establishment and the cooler months (OHV season) are among the reasons for the plants' susceptibility to impacts from OHVs (Romspert and Burk 1979). Luckenbach and Bury (1983) in non-replicated studies of paired plots along Highway 78 in the Algodones Dunes, report reduced numbers of herbaceous and perennial plants, arthropods, lizards, and mammals between areas closed to entry (control plots) and those exposed to heavy OHV use. Control plots had 2.4 times the number of species, 10 times the species density, 9.4 times the vegetative cover, and 40 times the volume of shrubby perennials as compared to the OHV impacted areas (Luckenbach and Bury 1983). These data are from localized plots and were not intended to be extrapolated to the dune system as a whole but rather are presented here to categorize the effects of OHV use on biota. Willoughby (2001) presented data, albeit limited, that for Peirson's milk-vetch, there were higher percentages of seedlings in the areas closed to OHV use compared to areas open to OHV use.

The petition also states that we relied on the 1990 ECOS study to conclude that OHV use is the primary threat to the continued survival of this species. The petition correctly notes that BLM's analysis (BLM 2000) of the protocol used in ECOS (1990) resulted in that agency abandoning the use of the ECOS (1990) sampling methodologies for a dune-wide monitoring program. We agree that the ECOS (1990) sampling methodologies were flawed; however, this does not invalidate the conclusions that we used in our decision to list the Peirson's milk-vetch as a threatened species.

BLM identified several flaws in the 1990 ECOS monitoring protocol: 1) study sites were located near roads and were not representative of the entire dune system; 2) the areas open to OHV use were not adequately sampled; 3) four of the 11 study sites were close to potential OHV access sites and were likely biased towards heavy OHV use; and 4) the southern and eastern portion of the open area were not sampled (Willoughby 2000). We agree that sampling errors associated with study site selection may result in a biased long-term, dune-wide monitoring of this plant. However, substantive aspects of the report that document the long term ecology of the plant and relate to the listing decision

were not invalidated by the methodological weaknesses of the ECOS report. For example, ECOS (1990) states:

> "It was necessary for us to establish the sensitive plant populations well away from the heavy use open areas. This is because we could not locate ASMA [*Astragalus magdalenae* var. *peirsonii*] or HENI [*Helianthus niveus* ssp. *tephrodes*] in the heavy use areas. The populations are located in medium use areas. The difference is that medium use areas are less traveled and riders tend to ride around clumps of vegetation. It is clear that repeated riding within ASMA populations will have a detrimental long term effect on the species. If perennial plants are killed, there will be fewer and fewer seeds in future generations to maintain the populations. Eventually, the species will be eliminated from the area, as evidenced by our observations."

Concerns over the 1990 ECOS survey methodology do not alter the validity of the observation that Peirson's milk-vetch could not be located in the heavy OHV use areas (ECOS 1990). Further, albeit unquantified, ECOS (1990) found that populations of Peirson's milk-vetch in the closed area were in better health, in terms of evidence of green tissue, and presence of flowers and fruits, than populations in open areas. The final listing rule relied on other studies, such as WESTEC (1977) and Bury and Luckenback (1983), to document that sensitive plant taxa seedlings could not be found in the dune areas receiving high OHV use when seedlings were abundant in other regions of the dunes. These qualitative observations contribute to the evidence that OHV use is a threat to Peirson's milk-vetch and its habitat.

A vehicle track map (Willoughby 2000) along selected transects of the Algodones Dunes on a single day in 1998 showed that considerable areas of potential habitat have been impacted. We have no evidence that the extent of vehicle tracks will diminish in the future. Nor do we know how the distribution and intensity of these tracks changes over a growing season or recreation season. Presumably Peirson's milk-vetch plants, if present in those areas, may have been impacted, however, on-the-ground counts coincident with the vehicle track mapped areas were not performed. Because of the transient nature of sand dunes, usually reports of impacts from OHVs are in terms of plant numbers impacted or occasionally the condition of the impacted plants. In their report, TOA (2001) found 667 plants impacted by OHVs over the course of 13 survey days. They also state that the winds obliterate the tracks leaving no signs of effects to the plants. The acreage of associated habitat impacted was not reported. However, when plants are impacted habitat is most likely impacted as well. Also, a considerable area of habitat may have been disturbed by OHVs before and after surveys and gone undetected by those surveys. Most recently, during their short survey period, Phillips and Kennedy (2003) report that they found several hundred Peirson's milk-vetch plants that had been impacted by OHVs. Neither TOA (2001) nor Phillips and Kennedy (2003) gave a description of the degree, pattern, or frequency of impacts to the habitat occupied by the plants, or to

adjacent suitable habitat used as access avenues to the impacted plant site. An adequate description of the nature of the impacts and follow-up surveys to determine the effects of the impacts on the individual plant's survival and reproductive output were likewise not included. Willoughby (2004) did not record the area of sites associated with the OHV impacted plants he recorded.

In a very limited study, Pavlik (1979) quantified the immediate physical effects of direct contact with an OHV to four specimens of each of three psammophytic plant taxa found on the Eureka Dunes in Inyo County, California. One was *Astragalus lentiginosus* var. *micans* (shining milk-vetch), a short-lived perennial to annual desert plant similar to Peirson's milk-vetch. Damage to each of the plants impacted was assessed in terms of percentage of shoots severed, apices removed, flowers removed, foliage loss or damage, and damage to underground parts of the plants. The *Astragalus* in the study lost fifty to ninety percent of the shoots and stem apices with light to moderate OHV activity.

The petition presents three related points regarding the impacts of OHVs on Peirson's milk-vetch. The first is based on the BLM monitoring studies (Willoughby 2000, Willoughby 2001) and TOA (2001) and states that the Peirson's milk-vetch is thriving in the open and closed portions of the Imperial San Dunes (Algodones), and will continue to do so regardless of OHV use in the areas. The petition refers to the vehicle track map (Map 24) in Willoughby (2000) and states "According to this track map, many of the interior portions of the open area – where there are impressive stands of Peirson's milk-vetch – receive very little OHV traffic." This map was not accompanied by a map depicting the coincident distribution of "impressive stands" of Peirson's milk-vetch, nor did the petition present such a comparison. The petition overstates the context of the map. Map 24 (Willoughby 2000), is labeled, "Frequency of Vehicle Tracks on 16 Aerial Photo Transects of the Algodones Dunes taken on Saturday, April 11, 1998 (Easter Weekend)". The frequency of vehicle tracks likely varies over time. The map does not depict the co-occurrence of OHV tracks and Peirson's milk-vetch, nor cumulative impacts to standing plants, seed banks, or the habitat. The map also shows some evidence of tracks in the wilderness area. Without direct and timely comparisons between aerial imagery and on the ground impacts to plants and habitat, meaningful correlation is problematic at best.

Willoughby (2000) notes a similar abundance trend in both the closed and open areas for OHV activity for five of the six monitored plant taxa, including Peirson's milk-vetch. Willoughby (2000) states that this is likely due to the fact that intensive OHV use did not encroach on much of the plant's habitat over relatively large portions of the open area (all of the dunes except the wilderness area at that time). Willoughby (2000) further notes that this trend may be expected to continue unless OHV use patterns change. Patterns of visitorship have reportedly changed according to BLM with the advent of GPS units and cell phones, which apparently embolden riders to use more remote areas (Schoeck *in litt.* 2001). Also, the projected 82 percent increase in visitorship by

2012/2013 over 1999/2000 levels (BLM 2002) will likely result in intensification and dispersal of OHV impacts. This may also alter the OHV use patterns. Willoughby (2000) also states that the BLM surveys are monitoring programs and not research and there are limitations to using the information to assess the impacts of OHV use on the plants monitored. This indicates the observational nature of the monitoring rather than research that tests hypotheses related to measures of OHV impacts on plants.

The second point in the petition is that OHV travel patterns rarely intrude into Peirson's milk-vetch colonies. The petition states that TOA (2001) supports BLM findings (Willoughby 2000, 2001) regarding the lack of occurrence of dune plants in heavy OHV activity areas. TOA (2001) states "The occurrence of dune plants and heavy use areas for vehicles is to a large extent mutually exclusive." This is in accordance with findings by WESTEC (1977), Luckenbach and Bury (1983), ECOS (1990), and as reported in the final rule listing the plant as threatened. Significant impacts from OHV use on all six dune plants monitored have been observed at or near the OHV staging areas (Willoughby 2000). This pattern was apparent in WESTEC (1977), where areas of intensive OHV use depicted in Figure 1-3 coincide with areas of lower concentration of Peirson's milk-vetch. There has been little or no documentation of the graded effects of medium and low use areas for vehicles. By the time the vehicle use level is "heavy" the plants are presumably gone. The exact process is not known but we may speculate that it includes repeated depletion of preflowering seedlings, thereby depleting the seed bank, or elimination of standing seed producing plants thereby diminishing input to the seed bank, or perhaps untimely or excessive scarification of the seeds by the grinding actions of sand moved by OHVs, causing the seeds to desiccate. Maps depicting changes in OHV use levels over time may allow predictions of changes in Peirson's milk-vetch occurrences.

The third point presented in the petition is based on TOA (2001) and states that less than one percent, 667 of 71,926, Peirson's milk-vetch plants observed in the areas open to OHVs showed signs of contact with OHVs, and that most of these plants suffered no permanent damage. This figure, 667, is from the 13 days of surveys in 2001, but only from areas termed "sites." This figure apparently does not include any potentially impacted plants among the approximately 4,600 plants counted at the 66 "point" localities where no data on OHV impacts was gathered by TOA (2001). No discussion of numbers of plants likely to be impacted over the course of a year was provided. This figure does not include plants that were killed, damaged beyond recognition, or were covered by sand prior to the survey visits. TOA (2001) states that nearly all plants that were run over were resilient and popped back up with no damage to the stems or flowers. The report further states that as soon as the wind obliterated the tracks, there was no sign of any effect. These determinations of impact and resilience were made without determining the duration of persistence or the productivity of the plants damaged. Additionally, no follow-up visits were noted. We do not find justification for TOA's (2001) statement that there was "no permanent damage." Phillips and Kennedy (2003) noted 430 plants impacted by OHVs in six survey days. However, no measures of impact

to the habitat, description of type of damage, or effects on plant reproductive capacity were provided. Most recently Willoughby (2004) reports that only six plants exhibited signs of OHV impact along more than 150 mi (240 km) of belt transects. Three were in the open areas south of Highway 78 and three were in the wilderness area north of Highway 78. Direct and indirect impacts to habitat for Peirson's milk-vetch undoubtedly occurred in association with plant impact incidences but were not described or measured.

The reported absence of dune plants from areas of heavy OHV use, and the documented trends of increasing visitorship in the Algodones Dunes indicate the persistence of OHV threats to Peirson's milk-vetch and the other sensitive dune plants. The petition and associated documents report hundreds of impacted plants detected during relatively brief survey periods. With these reports and the recorded and projected increases in visitorship to the dunes, the petition's suggestion that Peirson's milk-vetch will continue to thrive in the open and closed areas of the Algodones dunes "regardless of OHV use in the areas" seems speculative and incorrect.

The early, and most sensitive, life history phases of Peirson's milk-vetch plants occur between late October and late February. This period directly overlaps five of the peaks of visitorship to the Algodones Dunes that occur in the same time frame. These peaks in visitor use include Thanksgiving (250,000), New Years (150,000), and Presidents Day (100,000) as well as Halloween and Martin Luther King Day. Only two other visitor peaks over 50,000 visitors occur during a typical recreation year.

The period of plant sensitivity, approximately late October to late February, includes seed germination as well as seedling emergence. A seedling's roots are especially sensitive to drying out if the plants or sand surface are disturbed. There are potential direct impacts if OHVs run over the delicate seedlings and indirect impacts, such as higher soil and root desiccation, if sand disturbance occurs in close proximity to the seedlings. Seedling death may result from both types of impacts. Seedlings damaged but not killed may produce fewer flowers and seeds than undamaged seedlings leading to a gradual diminishment of the seed bank.

The early elimination of a portion of a seedling cohort means that there will be fewer plants to potentially survive to become older plants. Older plants have been shown to produce many more seed pods per plant than younger first year plants. Surveys that found hundreds of plants impacted in 2001 (TOA 2001) and 2003 (Phillips and Kennedy 2003) were conducted between early March and mid May. These surveys were conducted after the period of plant sensitivity and higher levels of vehicular traffic noted above. Impacts prior to this time would have gone undetected in scope and distribution and likely would have involved many more plants. Earlier impacted seedlings could have desiccated and been undetectable at the time of the surveys.

Documentation available attests to historical and ongoing OHV impacts to

Peirson's milk-vetch (WESTEC 1977, ECOS 1990, Willoughby 2000, 2001, 2004, TOA 2001, Phillips and Kennedy 2003). Areas within the dunes subject to intensive OHV use have a lower abundance of Peirson's milk-vetch (e.g., staging areas). Plants within the interior portions of the dunes have remained less affected by OHV use, however, the advent of GPS and increased vehicle fuel efficiency now enable OHV users to travel further into the interior of the dunes. Available information suggests OHV use will continue to pose a threat to the survival of *Astrasgalus magdalenae* var. *peirsonii*.

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

Current data do not indicate that these factors constitute a threat to Peirson's milk-vetch at this time.

4.3 Factor C: Disease or Predation.

Herbivory was reported for some of the taxa of *Astragalus* in the final rule listing Peirson's milk-vetch as threatened. As part of a series of reports on the natural history of Peirson's milk-vetch, Porter (*in litt*, 2003a) noted the general poor health of adult plants and attributed it to evidenced rodent and insect herbivory. Porter (*in litt*. 2002a) reported "nearly ubiquitous" harvesting of leaflets and young inflorescences by rodents in Peirson's milk-vetch populations. Most of the plants had leaves, leaflets and/or terminal portions of the stems removed, likely by unidentified rodents that had left abundant tracks around the milk-vetch plants. Porter (*in litt*. 2003a) also found similar results 2003. To the extent that rodents remove photosynthetic tissue and young inflorescences, plants are likely to exhibit a loss of vigor and reduction in reproductive output (i.e. seeds). Indeed, Phillips and Kennedy (2002) noted that seed bank counts were lower in areas where they noted kangaroo rat tracks and dens and suggested that this should be investigated. Pavlik (*in litt*. 2003) noted that rodents may be a constant, long-term source of high seed mortality that could dramatically reduce the seed bank. As yet unidentified weevils were observed to strip the epidermis from the stems, which would affect the movement of food and water in the plants (Porter *in litt*. 2003a).

Beetles, in the family Bruchidae, were reported to contribute to the high mortality of seeds and reduced seed crop for Peirson's milk-vetch by Romspert and Burk (1979). Larvae of these beetles eat the contents of the seeds before emerging as adults. Fruits collected in April continued to release beetles, into October (Romspert and Burk 1979). Porter (*in litt*. 2003a) found between 45 and 86 percent of the fruits on the few Peirson's milk-vetch plants, where he could find fruits, were infested with bruchid beetles. The range was 0 to 29 percent for dispersed fruits on the ground. Similarly, for the obligate dune plant *Astragalus lentiginosus* var. *micans*, Pavlik and Barbour (1985) found that dispersed fruits had about 66 percent of the seeds eaten or damaged by insect larvae

compared to 86 percent of the seeds in fruits still on the plant. Also the number of undamaged seeds decreased by more than 60 percent between April and May, indicating that predation is highest at dispersal time. The reduction of productivity of any given cohort of Peirson's milk-vetch from seed predation is unknown but may locally be considerable in a given year. Seed predation has been reported to cause significant loss of ovules or seeds in *Sidalcea nelsoniana* (Malvaceae), a Federal threatened species (Gisler and Mienke 1997), in *Astragalus canadensis* Boe et al. (1989), and in two other species of *Astragalus* (Green and Palmbald 1974).

Available information shows that rodent herbivory and seed predation, as noted above, may be augmentative threats to Peirson's milk-vetch in the presence of other stressors.

4.4 Factor D: The Inadequacy of Existing Regulatory Mechanisms

The lack of regulatory protections for Peirson's milk-vetch by the State of California cited in the final rule (63 FR 53596) still hold true. Pursuant to the Native Plant Protection Act (California Department of Fish and Game (CDFG) Code) and the State Endangered Species Act (CESA), Peirson's milk-vetch was listed as endangered in 1979. Because this plant is only known to occur on BLM managed lands, provisions of CESA do not apply. The BLM and CDFG developed a habitat management plan (HMP) in 1987 that included provisions for monitoring transects every other year until trends were established. However, little monitoring specific to sensitive species was carried out by BLM prior to the listing of Peirson's milk-vetch. Since the listing, BLM and CDFG have been conducting periodic monitoring for the rare plants on the Algodones dunes.

There has been no assessment of the relative contribution of the portion of the populations present in the North Algodones Dunes Wilderness to the persistence of Peirson's milk-vetch. The petition did not provide any data related to the contribution likely represented by the portions of the populations of Peirson's milk-vetch preserved by the interim closure areas, to the persistence of the plant. Even though the North Algodones Dunes Wilderness is considered closed to OHV use, there are indications of illegal entry in the form of OHV tracks in the area.

The Bureau of Land Management (BLM) temporarily closed areas of the Algodones Dunes to off-highway and other vehicular traffic effective November 3, 2000. The recent RAMP for the ISDRA (BLM 2003) proposes to reopen those areas temporarily closed to OHV activity. The opening of the temporarily closed areas will increase the threat to Peirson's milk-vetch to some degree from current levels. This would open all areas of the dunes to OHV use, except for the North Algodones Dunes Wilderness, which was the case at the time of the original listing. The vast majority of OHV users are responsible recreationists on the dunes and most avoid vegetated sites (TOA 2001). However, there may be significant damage to populations of Peirson's

milk-vetch and its habitat, especially closer to the staging areas. This would be the result of the focus of increased OHV activity in a smaller area.

One of the petition's points was that our listing decision relied on data developed prior to the implementation of the California Desert Protection Act (CDPA) and notes that the protected status of Peirson's milk-vetch populations in the North Algodones Wilderness Area was not accounted for in our listing decision. However, designation of the North Algodones Dunes Wilderness was fully considered and was one of the reasons for changing the listing status from endangered, published in the proposed rule (57 FR 19844), to threatened in the final rule (63 FR 53609). As stated in the final listing rule, (USFWS 1998) "While this taxon remains vulnerable to the OHV use occurring over most of its dune habitat, the Service believes that the dispersed nature of its colonies and the wilderness designation reduce the potential for immediate extinction."

Review of the available information and completion of this status review does not demonstrate that adequate regulatory mechanisms are in place to support removing the protections of the Act.

4.5 Factor E: Other Natural or Manmade Factors Affecting Its Continues Existence

The vast majority of OHV users likely avoid Peirson's milk-vetch and other biota on the dunes for safety and aesthetic reasons. The impacts from OHVs can be incidental or purposeful. Although the range-wide impact is difficult to assess, there has been an increase in reports of vandalism to the habitat and individuals of Peirson's milk-vetch. This was a specific concern expressed in the final listing rule in regard to the designation of critical habitat. There has been no monitoring specifically for the distribution, extent, and impact of vandalism to the plant across its range. Porter (in litt. 2002) describes both tracks and incursions of OHVs into areas closed to OHV traffic and all an instance where all of the aerial stems of a plant had been cut off. These closed areas are outside of the wilderness. This activity was noted on at least two separate trips to the same area about a month apart. The result was the loss of 3 of the 20 plants in one of Porter's monitored plots (Porter *in litt.* 2002 [May 30 letter]). The fragile nature of standing plants of Peirson's milk-vetch and susceptibility to damage from OHVs is evident in the documentation provided by Dr. J.M. Porter, of Rancho Santa Ana Botanic Garden, (*in litt.*, 2002). He observed a plant that was severed at the base by the unauthorized traverse of an OHV through an area posted as closed to OHV use by BLM. There have been other reported incidents of vandalism, some by our staff, and others, but because of the time, lack of knowledge of intent, precision of the description of the location, frequency of occurrence, and percentage of the plant's range involved it is difficult to assess the cumulative impact to the species.

This species is also threatened by of low numbers of reproducing individuals, a

circumstance that occurs from time to time. As noted earlier, not all plants flower each year. Movements and fluctuations of populations have not been recorded for a long enough period to assess the full impact significance to the survival of the taxon. The BLM (Willoughby 2001) reported a total of only 86 plants throughout their transect areas in the 2000 survey. The petitioner, without explanation, reported that TOA (2001) found only five plants more than a year old in their survey of all of the areas open to OHV use. This would be an extremely important fact requiring explanation and assessment if only five plants of a herbaceous perennial taxon had persisted from the previous season, especially in light of seed production as mentioned before. The older, larger plants contribute more to the seed bank than younger flowering juveniles (Romspert and Burk 1979, Phillips and Kennedy 2002). Random events may have a significant detrimental effect on the species when so few individuals are present or when the habitat requirements are so narrow that random environmental conditions can result in the demise of an entire cohort. This was apparently the case with the loss of the entire 2003 cohort of seedlings (Phillips and Kennedy 2003, Porter in litt 2003). The ecological impact of any cyclic depletion and restoration of the seed bank is unknown.

Peirson's milk-vetch, like some other narrow endemic dune taxa, is subject to periodic debilitating or lethal natural environmental conditions, such as drought or excessive unseasonal winds, across its entire range that can affect an entire cohort of plants. Pavlik and Barbour (1988), noting the establishment/survivorship pattern of *Astragalus lentiginosus* var. *micans*, another dune endemic plant, reported a complete crash of the 1984–1985 seedling cohort and that even though 54 percent of the 1985–1986 cohort of seedlings survived, none of these plants reached reproductive maturity within the year. This was apparently the case for the 2003 cohort of Peirson's milk-vetch. Phillips and Kennedy (2003) noted that many of the germinants were already dead and that large numbers of those remaining would likely die. Porter (in litt. 2003a) reports a similar mean seedling survival of 0.19 percent in monitored plots for the 2003 cohort of Peirson's milk-vetch. Environmental conditions unsuitable for this plant can occur at irregular intervals or can persist for several years. Low numbers combined with periodic, range wide, debilitating environmental conditions pose an ongoing potential threat to this plant.

The petition and supporting documents do not demonstrate that plants are not affected impacted by casual or intentional OHV impacts or that plant cohorts are not subject to decline from range-wide environmental conditions.

5. PETITION FINDING

We have carefully assessed the best scientific and commercial information regarding the biology of this species and its threats. We reviewed the petition and associated documents, information available in our files, other published and unpublished information submitted to us during the public comment period following our 90-day

petition finding. We reviewed new data and information on the life history and ecology of Peirson's milk-vetch; however, we did not find convincing information that Peirson's milk-vetch was listed in error.

The North Algodones Dunes Wilderness (Wilderness) will continue to be closed to OHV use. However, the Wilderness alone is not sufficient to ensure the long-term survival of Astragalus magdalenae var. peirsonii because this area provides only a small percentage of the entire habitat for this species within the Algodones Dunes and the area provides less available habitat for this plant relative to the areas south of State Highway 78 that are open to OHV use.

The Bureau of Land Management estimates that only approximately 14-16 percent of the habitat for Astragalus magdalenae var. peirsonii occurs within the Wilderness. Between 75-80 percent of all known colonies of Astragalus magdalenae var. peirsonii in 1977 were found in the areas open to OHV activity; only approximately 20% of the larger occurrences were found in the Wilderness (WESTEC 1977). Further, the habitat within the Wilderness is not all suitable for this species. Creosote bush scrub habitat, which does not support Astragalus magdalenae var. peirsonii is more abundant in the Wilderness than in the areas south of State Highway 78. The distribution of Astragalus magdalenae var. peirsonii from 1998-2000 indicates a higher relative abundance of plants in the central dunes south of State Highway 78 (BLM 2003). Thus, the Wilderness is not sufficient to sustain this species because it does not provide sufficient habitat and habitat quality to ensure the long-term survival of this species.

This species likely depends on the production of seeds in the wetter years and the persistence of the seed bank from previous years to survive until appropriate conditions for germination occur again. However, assertions that the reproductive success of Peirson's milk-vetch is not dependent on the longevity of individual plants but on each plant's ability to produce and drop seeds in their first year is not supported by the available documentation. First year plants produce substantially less seeds than older plants (5 fruits per plant as opposed to 171 fruits per plant) (Phillips and Kennedy 2002). TOA (2001) reported plants produce seeds their first year, however those age classes may have been misidentified. In addition, an entire cohort of seedlings may die off in a given year without producing seeds (Phillips and Kennedy 2003, Porter in litt 2003). Therefore, the key to survival and recovery is having a large seed bank. The available information on the rate of seed deposition to the seed bank and the longevity of seeds in the seed bank does not support claims of a healthy seed bank. Given, the low numbers of Pierson's milk-vetch, other natural predators (seed predatory beetles and kangaroo rats) further threaten the species by depleting an already low seed bank reserve. Peirson's milk-vetch also exhibits a wide variation in numbers of standing individuals found in any given year. Plant count data between years is often not directly comparable due to differences in rainfall amounts and methodologies. Long –term studies need to be undertaken to show the population trends for the species.

Documentation available attests to historical and ongoing OHV impacts to Peirson's milk-vetch (WESTEC 1977, ECOS 1990, Willoughby 2000, 2001, 2004, TOA 2001, Phillips and Kennedy 2003). Areas within the dunes subject to intensive OHV use have a lower abundance of Peirson's milk-vetch (e.g., staging areas). Plants within the interior portions of the dunes have remained less affected by OHV use, however, the advent of GPS and increased vehicle fuel efficiency now enable OHV users to travel further into the interior of the dunes without getting disoriented and lost. Available information suggests OHV use will continue to pose a threat to the survival of Peirson's milk-vetch. Given the low numbers, other threats such as rodent and insect herbivory, seed predation, and vandalism are contributing to the cumulative threats to the Peirson's milk-vetch.

After a thorough review and consideration of all information available, we find that delisting Peirson's milk-vetch is not warranted at this time and that this species should remain classified as a threatened species. In making this determination we have followed the procedures set forth in section 4(a)(1) of the Act and regulations implementing the listing provisions of the Act (50 CFR part 424).

We will continue to monitor the status of the species, and to accept additional information and comments from all concerned governmental agencies, the scientific community, industry, or any other interested party concerning this finding.

6. LITERATURE CITED

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