Sacramento Prickly Poppy
Argemone pinnatisecta

5-Year Review
Summary and Evaluation

Photograph by Bob Sivinski, New Mexico State Forestry Division

U.S. Fish and Wildlife Service
New Mexico Ecological Services Field Office
Albuquerque, New Mexico

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5-YEAR REVIEW
Sacramento Prickly Poppy / *Argemone pinnatisecta*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Southwest Regional Office, Region 2
Susan Jacobsen, Chief Threatened and Endangered Species, 505-248-6641
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1.2 Purpose of 5-Year Reviews:

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

1.3 Methodology used to complete the review

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act, as amended (Act) (16 U.S.C. 1531 et seq.). This 5-year review of the poppy was a collaborative effort comprised of biologists from the New Mexico State Forestry Division, the University of New Mexico, the Service's New Mexico Ecological Services Field Office, and Region 2 Regional Office. Robert Sivinski, botanist for the New Mexico State Forestry Division, was contracted through a section 6 grant to gather relevant information and prepare a draft of the review. He also subcontracted the draft review with Phil Tonne, botanist for the Natural Heritage New Mexico Program, Department of Biology, University of New Mexico. Final updates, synthesis, and recommendations were prepared by the New Mexico Ecological Services Field Office.

Note that we use the scientific name *Argemone pinnatisecta* for this taxon, which is supported by recent molecular and geographic data, although this name has yet to be changed in the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12). The Sacramento prickly poppy was first described in George Ownbey's 1958 monograph of the North and Central American species of *Argemone* (U.S. Fish and Wildlife Service 1994) as *Argemone pleiacantha* ssp. *pinnatisecta*. This botanical description was based on a specimen collected by George and Findley Ownbey on August 12, 1953, 15.4 kilometers (9.6 miles) west of Cloudcroft, at an altitude of 2,012 meters (m) (6,600 feet [ft]) in Otero County, New Mexico. In 2010, molecular assessment of population-level variation from samples of *Argemone pleiacantha* ssp. *pinnatisecta* and related geographically proximate members of *Argemone* identified the Sacramento prickly poppy as a genetically unique population system that should be reclassified as the species *Argemone pinnatisecta* (G.B. Ownbey) S.D. Cervantes & C.D. Bailey comb. et stat. nov. (Cervantes et al. 2010). The genetic analysis results, in combination with geographic isolation and morphological differentiation, are consistent with contemporary taxonomic concepts of plant species.

1.4 Background

1.4.1 FR Notice citation announcing initiation of this review:

71 FR 20714 – 20716; April 21, 2006

1.4.2 Listing history

Original Listing
FR notice: 54 FR 35302
Date listed: August 24, 1989
Entity listed: Subspecies, *Argemone pleiacantha* ssp. *pinnatisecta*
Classification : Endangered, without critical habitat

Revised Listing: None.

1.4.3 Associated rulemakings: None.

1.4.4 Review History:

A 5-year review was initiated on November 6, 1991, (56 FR 56882) for all species listed before 1991, but no document was prepared for this species.

1.4.5 Species' Recovery Priority Number at start of 5-year review: 3C

The recovery priority number is 3C, meaning a high degree of threat, a high recovery potential, and the listed entity is a subspecies (U.S. Fish and Wildlife Service 2012a).

Most recent status in biennial Recovery Report to Congress:

Stable (U.S. Fish and Wildlife Service 2012a).

1.4.6 Recovery Plan or Outline

Name of Plan: Sacramento Prickly Poppy (*Argemone pleiacantha* ssp. *pinnatisecta*) Recovery Plan
Date issued: August 31, 1994
Dates of previous revisions: The recovery plan has not been revised.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy:

The Distinct Population Segment policy does not apply to the poppy, because it is not a vertebrate animal.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes, the species has a final recovery plan; however, it contains only downlisting criteria. The downlisting criteria are broad, and the objectives are incompletely developed within the plan. The plan states that "due to the present status of the species and unknown nature of its biological requirements, it is impossible at this time to predict what measures will be sufficient to delist this species."

2.2.2 Adequacy of recovery criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

____ **Yes**
__X_ **No**

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?

____ **Yes**
__X_ **No**

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

The recovery plan contains only downlisting criteria; delisting criteria are not provided. The downlisting criteria for the poppy are:

1. Ensure long-term protection of the populations from human threats on Forest Service, City of Alamogordo, and Bureau of Land Management lands, and on land affected by New Mexico State Highway Department activities. Cooperation among these local, State, and Federal agencies is critical to implementing the recovery plan and any additional protective measures necessary to ensure long-term protection for this species. This protection includes designation of special management areas or zones appropriate to each agency. The Service will provide technical advice and assistance needed and funding as available to carry out recovery actions. However, the majority of responsibility for managing, preserving, and recovering the Sacramento prickly poppy will fall on the various local, State, and Federal agencies with populations of this species on lands under their jurisdiction.

2. Maintain reproducing populations of Sacramento prickly poppy within each of 10 canyons occupied prior to 1994 on the western slope of the Sacramento Mountains. These canyons include Dry, Alamo, Caballero, Fresnal, La Luz, Salado, Mule, San Andres, Dog, and Escondido canyons. Based on the available information, we assume a population to be all the reproductive individuals within a canyon. The maintenance of populations designated for downlisting must be documented through monitoring over at least a 10-year period. Evidence for reproduction during the 10-year period must include the presence of adult, flowering, and fruiting plants, and the germination and establishment of seedlings. We lack the knowledge at this time to determine the numbers of individuals required to maintain a viable population. However, canyons with low numbers (e.g., 1 to 18 individuals) require evaluation for the possibility of reintroduction. If population numbers in canyons with larger populations decline, reintroduction may also be required. The need for reintroduction would be most urgent if plants at the upper ends or heads of canyons, which presumably provide seed for the establishment of new locations downstream, were to disappear or die.

3. Determine requirements for the germination and establishment of new individuals. It is most important to understand the critical factors that are essential for recruitment in this species. The species may be dependent on disturbance to provide open habitat, without other vegetation, for the establishment of seedlings. Alternatively, although there is less evidence for this possibility, the poppy may be able to successfully reproduce in sites with vegetative ground cover where mature plants already exist.

4. Study genetic variability within the subspecies. Genetic analysis will provide assistance in determining how many populations are required to maintain that variability.

Although these criteria provide guidance for recovery, they do not offer measurable standards by which recovery progress can be objectively determined or that specifically address current threats.

Criteria as they relate to the 5-listing factors:

Factor 1 – Present or threatened destruction, modification, or curtailment of its habitat or range: All four downlisting criteria are relevant to this listing factor.
Factor 2 – Overutilization for commercial, recreational, scientific, or educational purposes: Not relevant.
Factor 3 – Disease or predation: None of the downlisting criteria address the recently identified potential threat of a fungal mold disease.
Factor 4 – Inadequacy of existing regulatory mechanisms: Downlisting criterion #1 relates to this factor.
Factor 5 – Other natural or manmade factors affecting its continued existence: All four downlisting criteria potentially relate to this factor.

Criterion 1. Long-term protections from human threats to Sacramento prickly poppy populations on Forest Service, City of Alamogordo, Bureau of Land Management lands, and on land affected by New Mexico State Highway Department activities have been only partially addressed. Many long-term protections still require further development and implementation, particularly developing conservation agreements with private landowners, as described in section 4.0 Recommendations for Future Recovery Actions. Variable degrees of progress have been made on the following protective measures and are described under 2.3.3 Five-Factor Analysis, including Threats, Conservation Measures, and Regulatory Mechanisms, 2.3.3.1 Present or threatened destruction, modification, or curtailment of its habitat or range:

a. Develop a management plan for the City of Alamogordo's water pipeline project in the Alamo and Fresnal Canyon systems with measures to avoid or reduce impacts to populations (U.S. Fish and Wildlife Service 2008).

b. Develop a management plan with the Lincoln National Forest and the Bureau of Land Management for Sacramento prickly poppy plants located on lands under their jurisdiction.

c. Develop a management plan with the New Mexico State Highways and Transportation Department for populations occurring in the Highway 82 right-of-way and any other plants affected by their management.

Criterion 2. While maintaining populations in the 10 canyons occupied prior to 1994 (Dry, Alamo, Caballero, Fresnal, La Luz, Salado, Mule, San Andres, Dog, and Escondido canyons) is a valid objective, it does not identify any population-specific objectives, nor provide goals for plant numbers in a given canyon or canyon-system. Important population parameters are not addressed, such as identifying the percent loss that would be acceptable within and among the 10 populations. The core of the population is contained within the Alamo-Caballero Canyon system. Poppies may be currently extirpated from three of these canyons: Dry, La Luz, and Mule canyons. For example, Dry Canyon was listed as one of the 10 populations that would need to be maintained in order to satisfy the recovery criteria, and this population appears to be

extirpated (Tonne 2008). While it is unfortunate that the poppy may have been extirpated from Dry Canyon, re-establishing a population in this area may not be the best use of conservation resources for this species. However, Dry Canyon could potentially be important as a gene distribution corridor for the species. Similarly, no poppies have been observed in La Luz Canyon since 1987, nor in Mule Canyon since 1990 (Worthington 2002; U.S. Fish and Wildlife Service 2012b). While poppies could still be present in these areas, they were not observed at the locations indicated on maps and/or the geographic place names in the location description. Additional surveys following periods of increased precipitation may determine whether poppies are truly extirpated from these canyons. Furthermore, three canyons known to be occupied prior to 1994 were not included under Criterion 2: Marble, Gordon, and Deadman canyons, the latter two of which are tributaries of Alamo Canyon (U.S. Forest Service 1987, 1992).

In examining recent data, maintaining populations in 10 canyons may not be among the most important aspects in determining recovery of the poppy. If only one of these populations cannot be relocated or reintroduced, for example, the stated recovery criteria would not be met. In addition, monitoring of populations has been incomplete in most years, and only Alamo and Caballero canyons are monitored regularly (Worthington 2002; Barker 2006; Tonne 2008).

Criterion 3. Requirements for the germination and establishment of new individuals are currently being studied and results thus far are described below in section 2.3.1.1 Germination and establishment.

Criterion 4. Genetic variability within the species is currently being studied at New Mexico State University in Las Cruces and results thus far are described below in section 2.3.1.3 New information on genetics, genetic variation, and trends.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

The poppy is an herbaceous perennial that lives approximately seven to nine years. The species often dies back to the root crown each year when moisture is limited. Mature plants can be large and vigorous for multiple years, and then can remain dormant in a subsequent year. Germination has been observed to occur between October and November, through late winter into spring, and in August. Successful recruitment into the population requires sufficient moisture for the establishment of seedlings (U.S. Forest Service 2004). Seedlings grow slowly, producing a juvenile rosette the first year. Seedlings are delicate, susceptible to desiccation, and may be dislodged by floods or livestock trampling. Young plants occupy open, disturbed habitat with minimal competing vegetation (U.S. Fish and Wildlife Service 2004a).

The poppy is endemic to canyons along the western face of the Sacramento Mountains of Otero County in south-central New Mexico (U.S. Fish and Wildlife Service 1994).

The species' known historical range covered 13 canyons in 8 canyon systems of the Lincoln National Forest (Figure 1). Populations existed in Fresnal Canyon, including Salado and La Luz canyons; Dry Canyon; Marble Canyon; Alamo Canyon, including Caballero, Gordon, and Deadman canyons; Mule Canyon; San Andres Canyon; Dog Canyon; and Escondido Canyon. Currently, poppies are known to be extant in 11 of these canyons. The poppy is thought to be extirpated from Dry and Mule canyons (U.S. Fish and Wildlife 1994, 2012; Tonne 2008). In 2009, adult poppies were found in Marble Canyon, and approximately 10 plants were also found in Gordon Canyon, a small tributary to Alamo Canyon (U.S. Forest Service 2010; U.S. Fish and Wildlife 2012). In 2010, five adult plants were rediscovered occupying Escondido Canyon (U.S. Fish and Wildlife Service 2012b). The species is also known to occur on Bureau of Land Management lands, private lands, Oliver Lee State Park, and on State of New Mexico and City of Alamogordo rights-of-way. The entire range is estimated to be 230 square kilometers (90 square miles) (U.S. Fish and Wildlife 1994).

Habitat for the poppy extends through a variety of plant biotic communities within the Sacramento Mountains. The species occurs in steep, rocky canyons between the pinyon/juniper zone of the Chihuahuan Desert Scrublands and Grasslands (1,310 m [4,300 ft]), and the lower edge of the ponderosa pine community of the Great Basin Conifer Woodlands (2,164 m [7,100 ft]) (Brown 1982; U.S. Fish and Wildlife Service 1994). Habitats vary from xeric uplands to mesic sites, and include arid canyon bottoms, dry terraces above riparian areas, and stream banks, as well as areas around springs and seeps (U.S. Forest Service 2004). Plants grow directly in the rocks and gravel of stream beds; on vegetated bars of silt, gravel, and rock; on cut slopes; and on terraces above stream channels (U.S. Fish and Wildlife 2004).

At the time of listing in 1989, major threats to the poppy included drought, livestock grazing, water diversion and pipeline construction, road construction and maintenance activities, and flooding (U.S. Fish and Wildlife Service 1994). When the Sacramento Prickly Poppy Recovery Plan was completed in 1994, off-highway vehicle use was added as a threat (U.S. Fish and Wildlife Service 1994). Since 1999, a fungal disease with symptoms similar to those of a stem canker has been added as a potential threat to the species (Sivinski 1999).

The range-wide population of poppies has been in decline for many years. The core population of poppies in Alamo Canyon and its tributary, Caballero Canyon, contained 73 percent of all poppies found on all ownerships in 1987 and 72 percent of the plants known to exist on Forest Service lands in 1999 (U.S. Fish and Wildlife Service 1994; U.S. Forest Service 2004). Populations of the poppy have decreased significantly since 1987 in Alamo and Caballero canyons (U.S. Fish and Wildlife Service 2009, 2012; U.S. Forest Service 2010). The Alamo/Caballero canyon system once supported 955 adult and seedling poppy plants, of which approximately 818 were adult poppy plants on Forest Service-managed land (Malaby 1987; U.S. Forest Service 2009). By 2011, the number of adult poppies located in the Alamo/Caballero canyon system on Forest Service land had fallen steadily to 316 plants, a decrease of 62 percent over 23 years

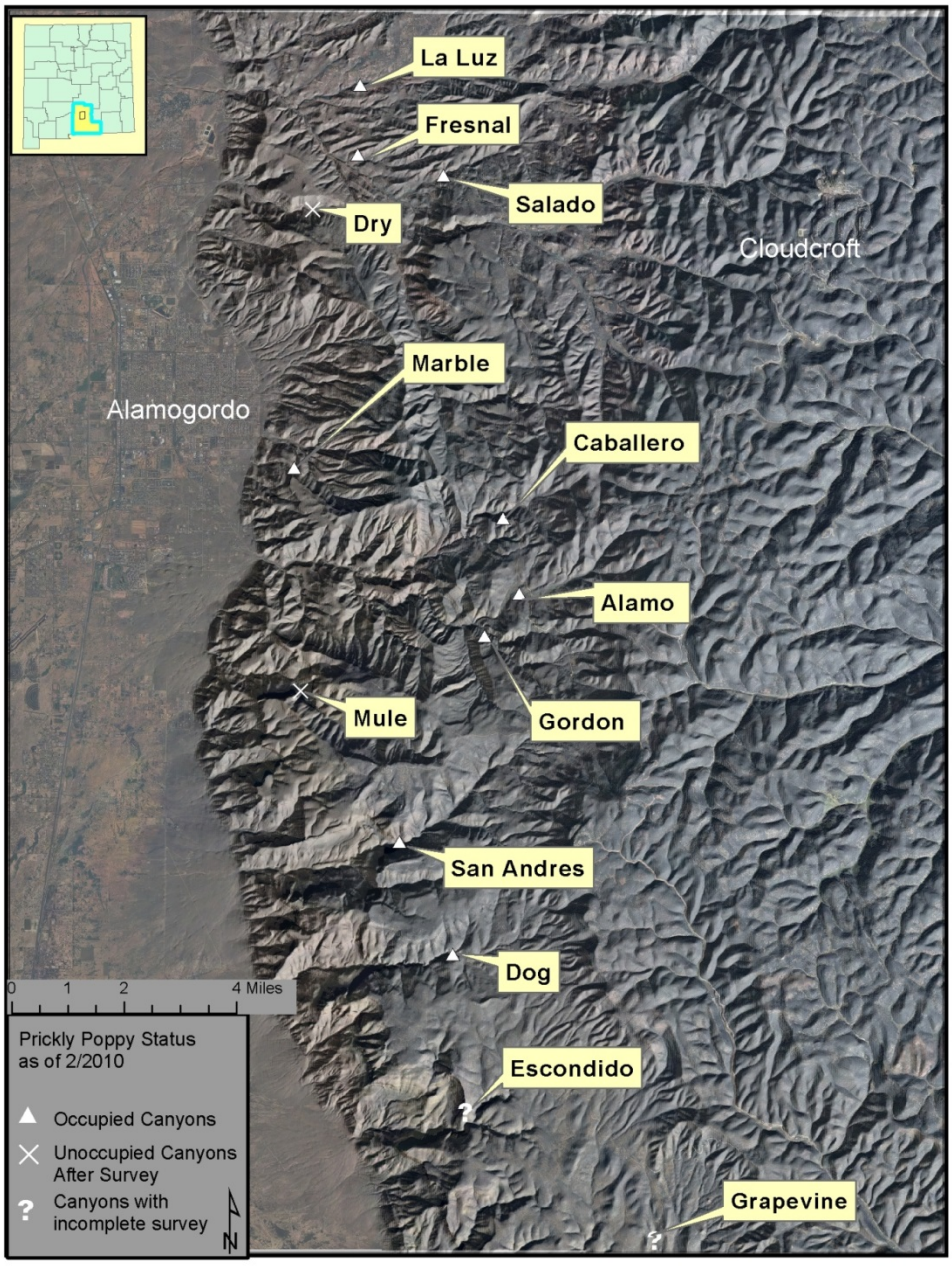

Figure 1. Known Distribution of the Sacramento Prickly Poppy in 2010 (U.S. Forest Service 2010)

(U.S. Fish and Wildlife Service 2012b). While range-wide population numbers are difficult to precisely determine due to past inconsistencies in monitoring, most analyses have shown a steep decline in adult poppy numbers since the discovery of the first populations. Recent surveys did not relocate past poppy occurrences in Dry and Mule canyons, further indicating the declining status of this endangered plant.

Reasons for this significant decline in poppy numbers are not fully understood, but may involve the interaction of a variety of factors, including floods, drought, livestock impacts, disease, water diversion, and road and pipeline maintenance activities (U.S.

Fish and Wildlife Service 2004a, 2012; Tonne 2008). *The greatest management concerns for the poppy involve activities that might either prevent seedling establishment or destroy adult plants.* With the present low number of plants, it is important to have successful seedling recruitment and maintain seed-producing adult plants (U.S. Forest Service 2004; 2012). The added threat of decreasing genetic diversity is a growing concern, as the numbers of individuals and occupied canyon habitats decline (U.S. Fish and Wildlife 2004).

In 1989, approximately 1,313 poppy plants were identified range-wide (U.S. Fish and Wildlife Service 1989). These plants were not separated into age classes, but were described as including approximately 95 percent mature plants and 5 percent seedlings (Malaby 1987). This would equate to 1,247 mature poppy plants. Malaby noted that poppy seedlings were difficult to find and that her seedling count may be low. Other surveyors have similarly described difficulty in locating seedlings when other vegetation is dense. For example, Tonne (2008, p.12) described comparable difficulty in detecting young plants:

> "The height and density of grasses, forbs, and shrubs prevented a complete sampling of plants discovered in 2006 and also made it impossible to adequately survey the Dog Canyon bench this year. Prickly poppies were entangled within or below the thick growth of other species, making it difficult to detect young plants. Even when standing directly over them, I often had to move the vegetation to get a view of the ground below. Monitoring under these conditions was only possible because of the accurate GPS positions aided by flagging left by some of the plants. With all of the competing vegetation, access to resources may become a problem."

This site in Dog Canyon had not been grazed by livestock, and high, dense vegetation developed with increased precipitation in 2006. Similarly, by 1989, very little or no livestock grazing had occurred for at least 6 years in the core of the poppy population in the Alamo/Caballero canyon complex, and Malaby's surveys followed a period of increased precipitation (U.S. Forest Service 2004). Malaby's population total of 1,313 plants in 1987 still stands as the highest number of poppy plants ever described. Numbers of poppies have fallen steadily since then, by approximately 60 percent overall. The absence of livestock grazing in conjunction with increased precipitation may have been important factors resulting in the highest number of adult poppy plants present in the late 1980s. Beginning in 1991, high-intensity livestock grazing occurred in Alamo and Caballero canyons, with utilization rates of 70 percent or more, and a prolonged period of drought also began (U.S. Forest Service 2004). In the 1990s, the number of poppies began to decline there, and the increased intensity of grazing has been recognized as a causal factor in this decline (U.S. Forest Service 2004).

2.3.1.1 New information on the species' biology and life history

Germination and establishment

The poppy becomes established in a narrow range of habitats and undergoes inter- and intra-annual population fluctuations. While this poppy can produce a relatively large amount of seed, germination rates and seedling success are strongly influenced by available moisture. Following germination, young plants have insufficient roots to survive a prolonged dry spell. Lack of moisture at the optimal time during germination is likely to result in wide fluctuations in seedling occurrences from year to year (U.S. Fish and Wildlife Service 2004a). The poppy is an early successional species, but the optimal type and amount of disturbance for maintenance of populations are not clearly understood.

Sivinski (1992) studied the germination of poppy seed, which is encased within a thick, impermeable seed coat. He found that the radicle, which surfaces from the seed coat first and becomes the root, emerges following scarification and moist cold stratification. Cold treatment is needed for successful germination. The tumbling action of the water and gravel is believed to provide scratching or scarification of the seed coat, which has also been found to enhance germination (Sivinski 1992).

Tonne (2005) began a research and educational seed bank and plant population of the poppy at the Rio Grande Botanic Garden in Albuquerque, New Mexico. In further studies of poppy germination, Tonne (2008) found that when the seed coat is carefully removed with a razor blade, without damaging the enclosed seed, the radicle emerges within 48 hours, and sometimes immediately. Radicle emergence was observed in almost 100 percent of the seeds studied, and it appeared that when the radicle did not emerge, it was likely due to damage to the seed during dissection. If the seed coat was not removed, 17 weeks of moist cold storage were required before the seed coat naturally cracked and the radicle slowly emerged and developed into a root. Using radicle emergence as the test of germination in this taxon does not predict the potential of the embryo to develop into a seedling. Development of the stem with the first true leaves lags considerably behind the emergence of the radicle, after the root has begun to establish. A next research step might be to place refrigerated seed into cool moist soils after 13 to 15 weeks, prior to radicle emergence, to see if this might be a successful method of cultivating the poppy. If allowed to emerge naturally into soils, it would be unlikely that the radicle would break and abort, as it often does following dissection.

Seedling emergence has been documented several times in the field, and most commonly follows a period of elevated precipitation. The emergence of seedlings is episodic, both temporally and spatially. Emergence may skip dry periods, and then occur subsequent to periods of above-average precipitation. Successful recruitment into the population requires sufficient moisture for

establishment. Seedlings grow slowly, producing a juvenile rosette the first year. Similar to many other plant species, few seedlings survive to reproduce, and periods of drought can lower seedling recruitment further (U.S. Fish and Wildlife Service 2004a; Tonne 2008).

The location of seedling establishment within a suitable area can be relatively random, leading to management challenges, particularly for placement of livestock exclosures. During the winter of 2006 into 2007, moisture in the Sacramento Mountains was sufficient to keep many seedlings alive, and precipitation in early 2007 allowed the germination and development of additional seedlings (Tonne 2008). For example, the Dog Canyon population received sufficient moisture to produce more emerging seedlings, reflected in added observations of seedling survival in the fall and winter of 2006 and in August 2007. Survival of seedlings measured in October 2006 on the Dog Canyon bench was 52 percent, and was 8.3 percent in a side channel of Dog Canyon arroyo (Tonne 2008). This was compared to the lower seedling survival rate in Alamo Canyon, where cattle were documented as having uprooted some seedlings, and Fresnal Canyon, where few, if any, of the 2006 cohort remained in summer 2007 (Tonne 2008).

In 2009, the poppy seed bank at the Rio Grande Botanic Garden supplied seeds to the Lincoln National Forest to start a small outdoor experimental population for study and future reintroduction of poppies into historical habitats. Approximately 100 seeds were cold-stratified and sown in March 2009. Initially, nine seedlings emerged, and four of these died from desiccation or predation, and five poppies continued to grow through the next year (Johnson 2010). By 2012, there were 20 to 30 adult poppy plants in this experimental outdoor population (U.S. Forest Service 2012a). Seeds from these plants are being grown by the Los Lunas Plant Materials Center in New Mexico, and over time, hundreds of poppy plants should be ready for experimental transplant studies into the historical range of the poppy on the Lincoln National Forest. These field transplant studies were initiated in 2012 (U.S Forest Service 2012b, 2013).

Dormancy

Unlike seedlings, established poppy plants appear to be capable of weathering periods of drought by becoming dormant. Adult plants have deep tap roots that can access water below the surface. Subsurface water likely supports plants through dry periods and allows them to develop a stem and even reproduce during brief periods without precipitation. Recent observations in Dog Canyon showed that adult plants may endure dry periods by eliminating surface growth and going dormant. In order to investigate dormancy, four plants in Dog Canyon that appeared dead or dormant in July and August 2006 were marked for future monitoring. Two had re-sprouted by October 25, 2006, indicating that this taxon has the ability to remain dormant for at least 3 months. This ability to survive

long periods of drought by postponing above-ground development until precipitation improves may be significant to the poppy's persistence (Tonne 2008).

Pollination biology

Tepedino (1992) studied the pollination ecology and breeding system of the poppy in Alamo Canyon. He documented 36 arthropod taxa visiting this species. Of these, Hymenoptera were the most abundant and effective pollinators; visits by 29 bee and 7 wasp species were documented (Tepedino 1992). Several investigators have noted the presence and abundance of carpenter bees (*Xylocopa californica arizonensis*) on poppies (Malaby 1988; Tepedino 1992; Tonne 2008). Under some conditions, these bees appear to be the primary visitors to poppy flowers and they are likely important pollinators of this plant. Carpenter bees have been observed to circle the axis of the flower, stamens, and stigma, apparently gathering and depositing pollen. They vigorously defend access to poppy flowers and exclude conspecifics (Tonne 2008).

Generally, plants bloom during the second year, if moisture availability has allowed for sufficient growth. Flowering begins in May and continues throughout the summer depending on elevation and moisture conditions. The flowers have a variety of pollinators that include carpenter bees (*Xylocopa californica arizonensis*), honey bees (*Apis mellifera*), bumblebees (*Bombus ssp.*), soldier beetles (*Cantharidae*), lizard beetles (*Liguriidae*), flies (*Diptera*), and butterflies (*Lepidoptera*) (U.S. Forest Service 2004). Studies of pollination biology and subsequent fruit set and seed production show that prickly poppy will set little or no fruit unless visited by pollinators. Self-pollination, either within one flower or among flowers of the same plant, results in significantly fewer fruits and fewer seeds per fruit (Tepedino 1992).

Tepedino (1992) also examined the poppy's breeding system by treating flowers with several hand-pollination variables to determine if pollinators were necessary for sexual reproduction. They found that the poppy will produce little or no fruit in the absence of pollinators. While they found that the poppy was capable of self-pollination, fruit and seed production were significantly higher in the out-crossed treatment, as shown in Table 1. The poppy requires cross-pollination for maximum seed set, and self-pollination, either within one flower or among flowers of the same plant, results in significantly fewer fruits and fewer seeds per fruit in this species.

Reduced productivity of poppies from lack of cross-pollination may have been observed in Alamo Canyon in 2004. The remaining fruits on poppy plants from 2003 revealed that 46 percent of the plants in a sample of 124 adult plants failed to fully mature fruits and release seeds. Of 124 plants observed, 57 plants had at least 40 percent of their fruits aborted. Of the 57 with any aborted fruits, 37 plants had at least 50 percent of their fruits aborted, and some plants had up to

100 percent of their fruits aborted (U.S. Fish and Wildlife Service 2005). The reduction of numbers of plants and their proximity within a population (patch size) may decrease the likelihood of pollinator visits as a result of the reduction in visual or chemical cues emitted to passing pollinators (Jennersten 1988). As possible evidence of the effect of increasing isolation on reproduction, R. Sivinski found a solitary, healthy poppy at the bottom of Dog Canyon in September 2004, which contained about 50 aborted fruits that apparently had not been cross-pollinated (U.S. Fish and Wildlife Service 2005). A small number of capsules with a few seeds in each developed on this plant, possibly from self-pollination, but the viability of these seeds is unknown.

Table 1. Poppy breeding system productivity (Tepedino 1992).

Treatment	Autogamy: flowers covered, unmanipulated	Geitonogamy: flowers pollinated using another flower from the same plant	Xenogamy: flowers crossed to flower of another plant
Fruits produced	3	8	19
Mean seeds per fruit (+/- SD)	2.0 (+/- 1.0)	30.8 (+/- 27.7)	96.6 (+/- 38.0)

Plant pathogen

In 1998, a pathogen or suite of pathogens was observed in the Dog Canyon population of poppies (Sivinski 1999). The initial phase of decay appeared similar to a bread mold with gray discoloration of the infected plant's epidermis. The leaves and stems are most commonly infected superficially, followed by spreading to buds, flowers, and fruits, and in some cases the disease, now known to be comprised at least in part by a fungus, moves deeper into the plant tissues. In later stages, the infection develops passageways through the plant's tissue that may be created by an insect. It is unclear whether the insect creates access to the plant tissue for the fungus or the opposite. It is also possible that they work in synchrony to parasitize poppies.

Andrea Porras-Alfaro, a mycologist at the University of New Mexico, isolated the pathogen in 2005. Her initial identification of the fungus as a mold in the genus *Alternaria* was later confirmed using DNA analysis. However, DNA sequencing was unable to determine the species, either due to an unsequenced taxon or a new species (Tonne et al. 2008).

Some members of the genus *Alternaria* are well-documented plant pathogens. In crops, this mold is commonly associated with leaf and fruit damage. In the

poppy, the mold appears to start on the stem and spread to the fruits. Stressed plants are sometimes completely covered by the fungus and all aerial tissues die. Plant mortality due to the fungus is suspected, but is not well-documented (Sivinski 1999). *Alternaria* may only kill plants that are already quite stressed, or is possibly restricted to the aerial portion of the plant and does not affect the roots. It is unclear whether plants that die back are able to re-sprout.

Decreased seed set is another likely result of the *Alternaria* pathogen, but may be difficult to investigate, as stressed plants appear to produce less seed independent of mold activity. Examining the relative abundance of and damage due to *Alternaria* within and between canyons and during various climatic conditions needs further investigation.

Alternaria sp. has not been observed in great abundance in recent surveys. Although present throughout the population, it was only acutely parasitizing a few plants in 2006 and 2007 (Tonne 2008). This pathogen was rare during the summer of 2006, but often comes on more strongly in the fall. However, there was little notable increase in the abundance of, or damage inflicted by this pathogen during surveys in fall 2006. These were relatively wet years during the growing season. The absence of considerable *Alternaria* infestations during this period of moisture may be further evidence that this mold is more widespread and damaging in drought years. With few exceptions *Alternaria* does not appear to be actively parasitizing the poppy during favorable conditions for the host plant. However, under conditions of drought stress the frequency of *Alternaria*-related disease appears to increase in frequency as does the amount of necrotic tissue in infected individuals. *Alternaria* may simply be a common agent of decay on the poppy, but when the defenses of the host plant are weakened, the relationship becomes more parasitic (Tonne et al. 2008).

2.3.1.2 New information on abundance, population trends, demographic features or trends

Poppy abundance declined steeply since the first range-wide survey in 1987-1988, and decreases vary from canyon to canyon (Table 2 on page 36). Accurate population analyses have been complicated by variations in survey methodology, especially whether seedlings are included, and by incomplete surveys throughout the range in the majority of years. The observed decline was approximately 56 to 57 percent between the first range-wide survey to 2003, and this decline continued to 2011 (U.S. Fish and Wildlife Service 2012b). As described previously, the decrease is even greater where population numbers are most accurately known in the Alamo/Caballero canyon system on Forest Service land, where a decrease of approximately 64 percent occurred over the 24 years from 1987 to 2011 (U.S. Fish and Wildlife Service 2012b). In 2012, detailed surveys of poppies on Forest Service land included surveys on newly acquired occupied habitat. These results indicated a higher number of poppies on Forest Service land compared to recent years (U.S. Forest Service 2012b, 2013). Forest Service

land contained 589 mature poppies, with an additional 142 counted on private land (U.S. Forest Service 2013).

Alamo-Caballero Canyon: The Alamo and Caballero Canyon system contains the majority of mature plants range-wide. Alamo Canyon is approximately 13 kilometers (km) (8 miles [mi]) long and Caballero Canyon is approximately 6.4 km (4 mi) long. The majority of poppies is scattered throughout the canyon bottoms, along alluvial benches and within the stream channels. There was a precipitous decline in mature plants from 955 mature plants in 1987 to 316 in 2011 (Table 2 on page 36; U.S. Forest Service 2011, U.S. Fish and Wildlife Service 2011, 2012). Two surveys were conducted in Alamo Canyon during 2011, with 281 mature plants located in Alamo and 35 in Caballero Canyon (U.S. Forest Service 2011; U.S. Fish and Wildlife Service 2011, 2012). In 2009, 10 plants were also found in Gordon Canyon, a small tributary to Alamo Canyon (U.S. Forest Service 2010a). In 2010, the Lincoln National Forest acquired private land occupied by the poppy, and performed a detailed survey for poppies in 2012. They documented an increased number of adult poppy plants in the Alamo-Caballero Canyon system: 437 mature poppy plants on Forest Service land and an additional 142 on private land (U.S. Forest Service 2012b, 2013).

Fresnal/La Luz and Salado Canyons: Fresnal and La Luz Canyons were surveyed in parts over various dates between 2006 and 2011 (except 2009). Survey efforts were conducted along the U.S. Highway 82 right-of-way in 2006 and along a City of Alamogordo pipeline right-of-way on the Lincoln National Forest in 2007, 2008, 2010, and 2011. Surveys in 2011 located 86 mature plants, significantly lower than the 125 located during 2010 in this canyon system (U.S. Fish and Wildlife Service 2010c, 2011). About 163 poppies occurred in this canyon system in 1987, with the majority of poppies scattered among City and private lands. In 2012, a detailed survey documented 131 adult poppy plants in the Fresnal and Salado Canyon system on Forest Service land. An additional 28 plants were found on private land. Since 2006, no plants have been located within the La Luz Canyon drainage above its junction with Fresnal Canyon (U.S. Forest Service 2012b; 2013).

San Andres Canyon: This canyon is located between Alamo and Dog Canyon. Currently, occupied habitat occurs at the mouth of the canyon on land administered by the BLM. Tonne (2008) surveyed four locations that contained 19 plants in 1988 and found 12 mature plants in two locations. Worthington (2002) found only two plants in the same area in 2002. In 2007, the Bureau of Land Management conducted surveys of San Andres Canyon bajada (below the mouth of the canyon) and located 52 plants, in an area that contained only 2 plants in 2006. Although the numbers have fluctuated between 1987 and 2007, this small population of poppies continues to persist.

Dog Canyon: Malaby (1987) located 157 poppies on Forest Service land, of which eighty were located on a bench while others were growing around the

bench and near Fairchild Springs. Two plants were found near the entrance of Oliver Lee State Park. A 2002 survey on Forest Service land found just one mature plant (Worthington 2002) and a 2004 Forest Service survey reported locating 32 mature plants, with 12 dying from the bottom upwards (U.S. Forest Service 2004). Additional surveys located 14 mature poppies and 150 seedlings on the bench and in an arroyo in 2006 and about 17 plants total were found in these locations in 2007 (Tonne 2008). An attempt to revisit the areas surveyed by Malaby was prevented by flooding in August 2006 (Tonne 2008). In 2007, 34 to 37 poppies were observed below the mouth of Dog Canyon, an area where poppies were previously unknown (Tonne 2008). The occurrence of these plants was attributed to a wet monsoon season and flooding.

Mule and Dry Canyons: These canyons supported small populations of less than twelve poppies in 1987. Searches in Mule Canyon have failed to locate plants since 1990, and the population is considered extirpated (U.S. Fish and Wildlife Service 2004a; U.S. Forest Service 2009). The last poppy observed in Dry Canyon was in 1994. Surveys conducted in 2002 and 2007 failed to find the species in Dry Canyon (U.S. Fish and Wildlife Service 2004b; Tonne 2008). This population is also considered extirpated. Dry Canyon spans over half the distance between the Fresnal/La Luz and the Alamo/Caballero Canyon systems. Previously suitable poppy habitat appeared to be degraded and unsuitable, with cattle observed well past their permitted removal date (Tonne 2008). The loss of this canyon likely decreases opportunities for gene flow.

Escondido Canyon: In 1989, 45 poppies were located at Dripping Spring on private lands (Malaby 1989). Between 1988 and 2002, the roads leading to the mouth of the canyon were gated, restricting access (Worthington 2002, Tonne 2008). An incomplete survey accessed the Canyon from Westside Road in 2007, but failed to locate any poppies (Tonne 2008). Tonne (2008) reported that the main spring above the locality Malaby located in 1988 appeared to be capped, eliminating the water source for the poppies. In 2009, these roads remained gated (U.S. Forest Service 2009). Without direct access to the canyon, future surveys are difficult because the steep and rugged terrain makes it dangerous to access the canyon from areas off Westside Road (U.S. Fish and Wildlife Service 2012b). In 2010, the Forest Service was able to document five adult poppies in the upper portion of Escondido Canyon (U.S. Fish and Wildlife Service 2012b).

2.3.1.3 New information on genetics, genetic variation, and trends

In 2010, principle coordinate analysis of *A. pleiacantha* ssp. *pinnatisecta* provided evidence for weak divergence of populations found in different canyon systems. Specifically, the Fresnal and La Luz canyon accessions clustered in one cohort and the three remaining canyon systems into another. Population structure on the level of species differentiation was not demonstrated, but these preliminary results may be significant to future management practices. The authors recommended that resource managers should not assume that genetic

variation in the poppy is randomly distributed across the species' range (Cervantes et al. 2010).

Chambers addressed the potential importance to the viability of the poppy of preserving the genetic integrity of plants from each of the canyons within the range. The small distances involved and lack of habitat differences among the populations of this species suggest that the risk of strong genetic structure that could result in outbreeding depression is unlikely. Outbreeding depression is more likely in a situation where seeds are taken from widely separated areas, or from a different subspecies, or if there were obvious habitat differences that would exert strong differential selection on the different populations. Chambers believes that none of these conditions exist for this species (U.S. Fish and Wildlife Service 2006).

2.3.1.4 New information on taxonomic classification or changes in nomenclature

In 2010, molecular assessment of population-level variation from samples of *Argemone pleiacantha* ssp. *pinnatisecta* and related geographically proximate members of *Argemone* identified that the Sacramento prickly poppy is a genetically unique population system that should be reclassified as a full species, *Argemone pinnatisecta* (G.B. Ownbey) S.D. Cervantes & C.D. Bailey comb. et stat. nov. (Cervantes et al. 2010). The genetic analysis results, in combination with geographic isolation and morphological differentiation, are consistent with contemporary taxonomic concepts of plant species.

2.3.1.5 New information on spatial distribution and trends, or change in distribution of the species' within its historical range

Recent surveys have failed to locate poppies in the once-occupied Dry and Mule canyons. While we cannot assume that the poppy has been extirpated from these areas, they have not been found during relatively wet recent years. If Dry Canyon no longer contains occupied habitat, the loss in plant numbers is relatively small. However, this is a potentially important gene distribution corridor. Dry Canyon is, like most canyons on the western escarpment of the Sacramento Mountains, oriented in a generally east-west direction, but higher up this canyon switches to a north-south trend. Previously occupied habitat in Dry Canyon spans over half the distance between the Fresnal/La Luz and Caballero/Alamo Canyon systems. The loss of such a corridor would decrease opportunities for occasional north-south gene flow between these two important and distinct metapopulations. Similarly, the loss of the Mule Canyon population could potentially remove two of the stepping stones available to pollinators and seed dispersers within the current range of the species (Tonne 2008).

2.3.1.6 New information on habitat or ecosystem conditions

Flooding

Flooding and erosion are known threats to the poppy (Soreng 1982; U.S. Fish and Wildlife Service 1989, 1994, 2004, 2012; Sivinski 1992; Forest Service 2004; Tonne 2008). In 1977, severe floods were observed to remove up to 100 plants from lower Alamo Canyon (Fletcher 1978; Soreng 1982). Two years later, when Fletcher found only six plants in this location in 1979, he speculated that the population might be in jeopardy of extirpation. Observations since this time have shown that plants in and along arroyos are subject to periodic damage and loss of mature plants from floods, and numbers fluctuate considerably in response to flooding. Some plants are completely removed or buried by floods, and others re-sprout from roots (Tonne 2008). Recent floods have had severe, damaging effects to individual poppy plants, but long-term impacts to populations are unknown (U.S. Forest Service 2008).

The summer of 2006 was characterized by violent monsoon thunderstorms after a 7-month drought that caused repeated high-volume flash floods within Alamo, Caballero, and Dog Canyons. Five-hundred-year floods were reported within the Sacramento Mountains on June 22, 2006. These destructive deluges caused major changes in poppy habitat along arroyo systems. Some plants that were observed early or midway through the growing season were no longer present or became visible again later in the survey period due to flooding. The June 22 flood removed the upper portions of some plants and then July floods removed these individuals completely. At least one plant was observed to re-sprout from two root breaks in the 18-day interim between floods (Tonne 2008).

Severe rains and flooding during late summer and early fall of 2006 altered the habitat primarily by changing stream channels and removing bars, banks, and terraces in some areas. Impacts were noted within and beyond the 100-year-flood plain. Portions of arroyo channels were scraped down and moved throughout the summer and large portions of vegetated bars and banks were severely cut away or completely removed. These changes caused immediate disturbances within poppy habitat and caused loss of plants. These alterations may continue to impact the habitat in years to come due to changes in the hydrology of the arroyo system. The distribution of water within these drainages is likely to have shifted with these events, causing some habitat to receive more water through surface flows and some less (Tonne 2008; Bureau of Land Management 2010). Large areas were cleared of associated plants and soils, and it is unclear which areas may be re-colonized by the poppy.

In healthy riparian areas, moderate levels of flooding appear to benefit the poppy by contributing additional water, silt, and nutrients for increased germination and establishment (U.S. Forest Service 2004). Unfortunately, the 2006 floods were catastrophic and appear to have resulted in a net loss of habitat. Whole river-bar

islands and stream banks were removed or reduced. While it is difficult to know what the long-term condition of poppy habitat will be, it appears that many areas once occupied by poppies are unlikely to support plants for many years. The intense floods removed almost all of the vegetation and soils from portions of the arroyos that provide habitat for the poppy. This includes losses of both plant associates, such as grasses, forbs, shrubs, and trees that hold soil in place, and the soil structure that supports the poppy. Silt, sand, and loam were largely removed from the system, whereas fresh deposits generally consisting of cobbles and boulders deposited a relatively flat surface, which is suboptimal habitat for this species. Flooding likely destroyed the seed bank within long stretches of the arroyo bottom. While some of this seed may have been deposited in suitable habitat, much of it was likely removed to areas that will not sustain the poppy. Siltation and re-colonization may occur in future years, but the fate of colonies scoured by the floods is currently unknown.

Livestock

The Forest Service's Final Environmental Impact Statement for livestock grazing on the Sacramento Allotment (pages 1-5, 2004) (FEIS), which encompasses the core of the poppy's range, states:

"After acquisition of the Sacramento Allotment grazing permit in 1989, the current grazing permittee began to gradually stock the Sacramento Allotment to full permitted numbers. When the Sacramento Allotment was fully stocked in 1991, forage utilization began to exceed acceptable levels. Excessive forage utilization has been a continual concern since then. An adequate or functional AMP [Allotment Management Plan] does not presently cover the Sacramento Grazing Allotment. Present management is not consistent with the standards and guidelines of the Forest Plan in some areas."

On pages 3 to 5, the FEIS also describes the poor riparian conditions caused by this long-term livestock overutilization, which averaged 70 percent, in the following excerpt:

"The cumulative effects of past management practices have had an effect on the major watersheds within the Sacramento Allotment. Many areas have experienced varying degrees of erosion and vegetation changes due to past management practices. Portions of the allotment are not in satisfactory condition mainly due to historical grazing practices and a decrease in natural fires. Beginning in the late 1870s, the area was heavily grazed until the LNF [Lincoln National Forest] was established in the early 1900s. Since establishment of the National Forest, the level of grazing has been gradually reduced and watershed conditions have been steadily improving from historical impacts of grazing. However, this improving trend on the Sacramento Allotment began to reverse in the early 1990s when full numbers were stocked on the allotment. "

Beginning in 1991, this level of livestock grazing resulted in poor condition of riparian areas, causing the effects of flooding to be catastrophic instead of beneficial to the poppy (U.S. Fish and Wildlife Service 2005). The Sacramento Allotment contains approximately 64 km (40 mi) of perennial streams. Fewer than 10 percent of the riparian zones associated with these perennial waters are in satisfactory condition, based on the Forest Service's Region 3 standards and guidelines for riparian areas (U.S. Forest Service 2003, 2004). Even with implementation of the proposed action for the Sacramento Allotment, the FEIS concluded, "*Population viability of Sacramento prickly poppy may be at risk.*" (page S-7). This one sentence was italicized in the FEIS summary for emphasis. Although monitoring areas and specific forage-use levels are specified in the Record of Decision, these have not been followed (Tonne 2008).

The overlap of ongoing high forage utilization with the yearly germination and establishment of the poppy has caused cumulative impacts on the species and is contributing to its declining status (U.S. Fish and Wildlife Service 2004a). When livestock grazing in the Sacramento Allotment was suspended for many years, the poppy was at its highest known level. When livestock overutilization began again in 1991, the poppy concurrently declined. Historical overutilization may preclude range restoration for decades, even with strict compliance with forage/range guidelines (U.S. Fish and Wildlife Service 2004a).

Livestock not only have direct negative impacts on poppy plants, but also on the habitats that support this species. The xeric nature of the western escarpment of the Sacramento Mountains limits the poppy to areas where sufficient moisture and shading are available. The species is generally confined to the main canyon drainages of this mountain range, with some smaller colonies occurring along tributaries. Cattle frequently congregate in these same relatively mesic and productive canyon bottoms, especially during periods of drought. Continued presence of livestock not only causes negative impacts to the vegetation that holds the alluvial bottoms and terraces together, but also precludes vegetation recovery from historical overstocking of these areas. Removal of vegetation through grazing, combined with the impacts of these heavy ungulate's hooves, increases erosion in these areas and causes or increases channel incision, while decreasing bank stability (Tonne 2008).

Humans have grazed livestock in these areas since the mid-1800s. The arroyos, wetlands, and riparian communities of this area have experienced direct impacts from cattle for over a century, but have not been sufficiently rested to recover from use of this area. Livestock grazing changes the ecology of the landscape in many ways, including the reduction of herbaceous vegetation. This decrease in plant cover leads to accelerated soil loss, increased exposure of soils to downpour events, reduced capacity of the vegetation to filter sediments, loss of top soil, and decreased ability of the soil to retain moisture (U.S. Fish and Wildlife Service 1989, 2005, 2012; U.S. Forest Service 2003, 2004). While the high-volume floods of 2006 may have been destructive in the absence of

livestock, continual livestock presence for more than a century has likely increased the vulnerability of the Sacramento Mountains to these episodic flood events and contributed to their destructive nature (Tonne 2008).

Trampling by cattle has been more frequently observed than herbivory, especially of adult plants. Herbivory by livestock appears to occur mostly during periods of drought, but trampling by livestock can impact the poppy at any time (Salas and Barker 2003; Tonne 2008). Healthy mature plants appear to be capable of re-sprouting after livestock tread on them, but mortality appears likely to occur in young plants or in stressed mature plants suffering from drought or disease. Damage to seedlings by livestock has long been suspected and occasionally reported, but was rarely documented. Direct evidence of cattle dislodging poppy seedlings was observed in 2006 (Tonne 2008). Thirteen seedlings were first noted on August 22, and within 48 hours, two were dislodged, and a cow's hoof print was on the seedlings. This occurred in Alamo Canyon at a time when there should have been no cattle in the pasture. Twenty-two trespass cows were seen near the seedlings and their hoof prints were clearly associated with the upturned seedlings. At higher stocking rates, the threat of seedling mortality is greatly increased because livestock have a direct negative impact on the poppy when their presence coincides with the emergence of seedlings (Soreng 1982; Wagner and Sabo 1982; U.S. Fish and Wildlife Service 1989, 1994, 2005, 2008, 2012; Wood 1992; Salas 2003).
The period between germination and establishment of the mature poppy is the most vulnerable time in this plant's life cycle. This developmental stage is the main impediment to increased abundance in any colony or population of this taxon. Germination has been documented throughout the range of the poppy, sometimes in great abundance. However, as with many plants, few of these seedlings survive to become reproductive adults. Some are killed almost immediately through trampling by livestock, while others face periods of dry weather, flooding, or other disturbance. Rotation dates have sometimes been violated, and cattle have remained in poppy habitat year-round, causing damage to poppy seedlings and likely contributing to poor watershed condition through the reduction of herbaceous and riparian vegetation (Tonne 2008, U.S. Forest Service 2008).

2.3.1.7 Other new information

<u>Herbicide spraying</u>

In 2007, herbicide was sprayed by the New Mexico Department of Transportation on U.S. Highway 82 near High Rolls, New Mexico, to reduce vegetation in the right-of-way. The herbicide was applied directly to at least five adult poppies, killing three of these. The Forest Service flagged areas that should not be sprayed, but this did not successfully protect the plants. The use of flagging does not appear to be adequate because, at best, it protects only adults known to the Forest Service employee deploying the flagging. It does not

protect seedlings or young plants, or adults that are hidden from view (Tonne 2008). Due to this event, the New Mexico Department of Transportation has not sprayed herbicide in poppy habitat again. An agreement to improve protection of poppies from this activity has been discussed among the New Mexico Department of Transportation, U.S. Forest Service, and U.S. Fish and Wildlife Service.

Road Maintenance

During spring 2008, the City of Alamogordo cleared a maintenance road in upper Alamo Canyon, destroying many mature poppies (U.S. Forest Service 2008). During a survey in June 2008, only a few poppies had re-sprouted in this area. Some poppies that were previously located in or adjacent to the roadway were missing and presumed dead, but a few had re-sprouted in the road (U.S. Fish and Wildlife Service 2008).

2.3.2 Conservation Measures

To address recurring issues (discussed below in section 2.3.3.1 under Livestock grazing and trampling) of inconsistent application of forage/range guidelines; inadequate monitoring of livestock entry and exit dates, forage utilization, mineral block placement; and other permit compliance matters, which have historically caused adverse effects to the poppy and its habitats (U.S. Fish and Wildlife Service 2012b), several conservation measures for the poppy have been recently implemented. Environmental analysis, monitoring, and section 7 consultation on the Sacramento Allotment of the Lincoln National Forest (U.S. Fish and Wildlife Service 2010, 2012; U.S. Forest Service 2012, 2013) have resulted in the following conservation measures for the poppy:

- Seventy-eight percent of the mature poppy plants accessible to livestock in upper Alamo Canyon and Caballero Canyon, equaling 98 plants, are now protected by livestock exclosures.
- Two trick tanks were reconstructed in the Mule Pasture during the summer of 2010 to provide an opportunity to move livestock to areas without poppies.
- Monitoring of key forage use areas on the winter grazing units is occurring and forage utilization guidelines have been met on key areas within the Alamo Pasture (U.S. Forest Service 2012).
- Seeding and poppy transplant studies are underway, and thus far, 109 transplanted poppies are being monitored on the Lincoln National Forest (U.S. Forest Service 2012, 2013).

2.3.3 Five-Factor Analysis, including Threats, Conservation Measures, and Regulatory Mechanisms

2.3.3.1 Present or threatened destruction, modification, or curtailment of its habitat or range

The habitats and range of the poppy are threatened by livestock grazing, drought, water extraction, floods, off-road vehicles, and ongoing surface-disturbing activities, such as road and pipeline maintenance.

Livestock grazing, trampling

Alamo and Caballero Canyons contain the majority of the remaining poppies, and these canyons are located in the Sacramento Grazing Allotment. The Forest Service issues a 10-year grazing permit for livestock use of these canyons which extends from May 16 to October 31 on the summer range, and November 1 to May 15 on the winter range. Both canyons are included in the winter pastures. Fresnal/La Luz, San Andreas, and Escondido Canyons occur in other grazing allotments and also contain poppy habitat that is grazed by livestock (Forest Service 2003; U.S. Fish and Wildlife Service 2012b).

Grazing and trampling by livestock can destroy young seedlings and can potentially degrade the quality of poppy habitat. Livestock grazing can affect vegetation species composition, plant density, and plant vigor. Cattle tend to occupy canyon bottoms, where poppy seedlings are most likely to occur, because the steep sides of the canyon render most of the acreage in the pasture inaccessible. Out of the approximately 11,000 acres on the Alamo winter pasture, only about 3,000 acres are usable and accessible to livestock. Livestock may avoid eating most mature poppy plants due to their bitter-tasting latex; however, early season basal rosettes with spines have been grazed to the ground (Forest Service 2005). Detrimental effects to the poppy depend on the timing, intensity, and duration of livestock use.

The Forest Service has concluded that livestock use in Alamo pasture has impacted vegetation and reduced the moisture-holding capacity of soils (Forest Service 2003, 2004). A reduction in vegetative cover, plant root masses, and soil water retention can lead to increased flood-water velocity and subsequent loss of top soil that can impact the poppy (U.S. Fish and Wildlife Service 2004a). Canyon-bottom riparian areas represent the best acres within the Alamo pasture for livestock forage because of early spring plant growth and proximity to water, when it is present. The canyon bottoms also provide shade for livestock during warm temperatures in the spring. These sites support enhanced-moisture, creating habitat most favorable to poppy seedling establishment. Based on observations of poppy germination, the failure to locate very many seedlings, drought conditions, and grazing impacts after germination, the Forest Service is concerned that sites in the canyon bottoms may not be suitable for poppy survival (Forest Service 2003).

Cumulative impacts from a history of inconsistent application of forage and range guidelines and overgrazing have negatively impacted the poppy (U.S. Fish and Wildlife Service 2004a; U.S. Forest Service 2004). Within the winter unit of the Sacramento Allotment, forage utilization levels averaged 70 percent for

many years beginning in 1991. Extreme forage use and drought conditions in 2001 and 2002 resulted in both significant reductions in forage production and the lowest numbers of adult poppies since records have been kept (U.S. Fish and Wildlife Service 2004a). The continued annual overlap of livestock grazing with the period of poppy germination and seedling growth has likely affected the ability of the species to recover during periods of low population levels, low seed production, and drought (U.S. Forest Service 2003).

Related to the presence of livestock, the placement of livestock supplements, such as water and minerals, also impacts the poppy. The Forest Service has documented placement of minerals in riparian bottoms in occupied habitat several times (U.S. Forest Service 2003). Concentration of livestock in occupied poppy habitat as the result of mineral placement and water availability will impact poppies through increased trampling and herbivory (U.S. Fish and Wildlife Service 2004a).

Recruitment of seedlings into the adult population is affected by any actions that lower the moisture-holding capacity of the soil or increase the rate of runoff (U.S. Fish and Wildlife Service 2004a). Flooding presents a periodic threat to poppies located in canyon bottoms or exposed to flash flood events. Poppy seeds show the highest germination rates when the seed coat has been lightly nicked (Sivinski 1992) and poppy plants have been observed to rebound in years subsequent to flooding (U.S. Fish and Wildlife Service 2004a). Under natural conditions, flash floods may provide the disturbances that facilitate seed scarification and preparation of a seed bed. However, historical livestock over-utilization of the poppy's habitat has played a significant role in changes to vegetative cover, riparian health, soil stability, and soil water holding capacity (U.S. Fish and Wildlife Service 2004a; U.S. Forest Service 2004). Exposed, compacted soil conditions can exacerbate the damaging effects of flash floods on the poppy. Impacts to the plant community or soil properties that result in decreased ability for poppies to withstand and recover from flooding will have significant and long-term effects on poppy sustainability and recovery.
Prior to listing, it was assumed that direct herbivory of poppies by livestock did not occur because of the plant's sharp spines and toxic alkaloids. Fletcher (1978) proposed that direct browsing of poppies may be limited to periods when other forage was scarce. The recovery plan states that "under high stocking rates, cattle were observed grazing Sacramento prickly poppy plants to the ground." (U.S. Fish and Wildlife Service 1994). This unreferenced statement was likely derived from a 1977 observation by Fletcher, cited in both Wagner and Sabo (1982) and Soreng (1982), pertaining to consumption of mature plants. Salas and Barker (2003) reported observations of up to 25 percent herbivory and/or trampling in a small sample of 39 plants and stated that juvenile poppies had been observed grazed to the ground. Dale Zimmerman made a similar observation of herbivory on juvenile plants by cattle, cited in Salas and Barker (2003).

Livestock herbivory of poppy plants and trampling of seedlings are documented threats to the species (U.S. Fish and Wildlife Service 1994, 2005; U.S. Forest Service 2003). Seedlings have been described as delicate and intolerant of disturbance until they have had a chance to establish a taproot (Wood 1992). Germination has been documented to occur nearly year-round (in August, late-fall, winter, and spring). The yearly overlap among livestock grazing, poppy germination, and seedling growth has continued to affect the ability of the species to recover during this recent period of low populations levels, low seed production, and drought (U.S. Forest Service 2003, 2007; National Oceanographic and Atmospheric Administration 2008). Moreover, inconsistent application of forage/range guidelines; inadequate monitoring of livestock entry and exit dates, forage utilization, mineral block placement; and other permit compliance issues have historically caused adverse effects to the poppy and its habitats (U.S. Fish and Wildlife Service 2012b), prompting recent conservation measures to be implemented within the Sacramento Grazing Allotment (see section 2.3.2). Livestock grazing and trampling remains a significant threat to the species.

Flooding

While some flooding appears to benefit the poppy by contributing additional water, silt, and nutrients for increased germination and establishment, flash floods in 2006 and 2008 were so large that they resulted in a net loss of habitat and poppies (Tonne 2008; U.S. Forest Service 2008). The Forest Service (2007) concluded that the loss of poppies and soil from the floods was likely aggravated by reduced herbaceous cover from livestock grazing. Intense floods removed almost all of the vegetation and soils from portions of the arroyos that provide habitat for the poppy. The Forest Service indicated that the occupied poppy habitat within lower Alamo Canyon has been substantially affected by flood damage (U.S. Forest Service 2007). For example, surveys conducted in June 2008, failed to locate six mature poppies in lower Alamo Canyon. These were likely lost in the 2006 floods. Additional mature poppies were lost to flooding in same area during July 2008. This flooding likely also destroyed the seed bank within long stretches of the arroyo bottom. Although significant seedling establishment has been observed in some areas following these floods, such as the Dog Canyon bench and bajada and the San Andres bajada (Tonne 2008), no poppy seedlings were observed in Alamo Canyon in 2007 or June 2008 (Tonne 2008). The threat of flooding and its associated modification and elimination of quality habitat is episodic and difficult to predict, and is a moderate threat to the poppy based on information at this time.

Water extraction

The City of Alamogordo captures water at the head of Alamo, Caballero, Fresnal, and La Luz canyons, potentially reducing the amount of water available to the poppy. Because poppy seedlings are delicate and sensitive to drying until

they establish their taproot, any factor that increases soil dryness is likely to affect seedling establishment and recruitment. This permanent removal of water at headwater springs under State water rights by local communities, combined with livestock presence, drought, and climatic fluctuations have degraded riparian and spring habitat (U.S. Forest Service 2003, 2008; Tonne 2008). These relatively mesic areas within the range of the poppy may have historically served as important reserves during periods of drought.

Road and pipeline construction, maintenance

Road and pipeline construction and maintenance activities sometimes destroy poppy plants. The Lincoln National Forest performs road maintenance on approximately 523 km (325 mi) of roads per year. Additional maintenance is conducted on Federal, State, and county non-National Forest System roads (U.S. Forest Service 2004). In Fresnal Canyon, road maintenance by the Otero County Road Maintenance Department resulted in the loss of poppy plants along an unpaved National Forest System road. During spring 2008, the City of Alamogordo cleared a maintenance road in upper Alamo Canyon, destroying many mature poppies (U.S. Forest Service 2008). Surveys in June 2008, reported that only a few poppies had re-sprouted. Many poppies that were previously located in or adjacent to the road were missing and presumed dead (U.S. Forest Service 2008). The loss of plants in the upper reaches of occupied habitat leads to reductions in seed dispersal from this area to existing colonies and potential new habitat downstream. Populations occurring at lower elevations are more vulnerable to the effects of drought and water withdrawal, and in Dry, Alamo, San Andres, and Dog canyons, the number of poppies in these populations fluctuates greatly between wet and dry periods. Some of these lower population segments are ephemeral and only occur following periods of increased precipitation. It seems most critical to assure that the upper elevation colonies are healthy and productive because they have a direct influence on the continued existence of poppy populations downstream. Discussions and agreements are underway with the City of Alamogordo, the New Mexico Department of Transportation, and the Lincoln National Forest to address these impacts in the future.

The City of Alamogordo maintains water pipelines that tap large springs on the upper western slope of the Sacramento Mountains. These pipelines occur in La Luz, Fresnal, Alamo, and Caballero Canyons. The water rights for these systems pre-date the Lincoln National Forest. The pipelines in Alamo, Caballero, and Fresnal Canyons, canyons occupied by poppy, have been replaced over time as the pipes become cemented in with calcium carbonate. The new pipelines no longer leak water along their route through the canyon bottoms, as they historically have, and, consequently, no longer provide water to limited areas that may have supported poppies in the past (U.S. Forest Service 2004). Municipal use of canyon water has changed the natural hydrology, making upland areas and canyons much drier, perhaps reducing poppy habitat. Pipeline repair,

replacement, and maintenance are ongoing in four canyons. These pipelines and associated activities continue to impact the suitability of poppy habitat. Heavy equipment used to transport, excavate, position, and remove large sections of steel pipe may damage or destroy plants if not carefully controlled and monitored. The Forest Service has surveyed, consulted upon, and monitored these activities when informed of them in advance (U.S. Fish and Wildlife Service 2008).

Mowing and herbicide application along roadways

Roadway maintenance, including herbicide use and mowing, may threaten the poppy. Although the poppy is adapted to disturbed habitats, and, therefore, could benefit from some ground-disturbing activities, blading along drainage ditches and the shoulders of unpaved roads has destroyed some poppy plants (U.S. Forest Service 2004). Invasive plants such as Russian thistle, tamarisk, spotted knapweed, and Russian knapweed occur in poppy habitat. At present, the Forest Service and New Mexico State Highway and Transportation Department coordinate efforts at weed control and implement spraying of infested sites along the highways. Because plant competition may be a limiting factor to the distribution of the poppy based on the poppy's preference for sites that are more open and less densely vegetated, eliminating invasive plants may be beneficial for the poppy (U.S. Fish and Wildlife Service 1994). However, any spraying performed near poppy individuals still may pose a threat to the survival of this species. Direct and indirect application of herbicides on poppies in 2007 resulted in loss of plants occurring along the Highway 82 corridor (Tonne 2008). Since this occurrence, the New Mexico State Highway and Transportation Department has ceased spraying herbicides in proximity to poppy plants. In addition, the Lincoln National Forest has completed consultation on their Noxious Weed Control Plan for treatments of noxious weeds in the vicinity of the poppy.

Off-highway vehicles

Off-highway vehicles are recognized to be a potential threat to the poppy. Off-highway use of motorized vehicles on established trails is permitted in Alamo, Caballero, and Dry canyons on the Lincoln National Forest. Dry Canyon is not currently occupied by the poppy, and the mouth and only western access route into Alamo and Caballero canyons through City of Alamogordo land is closed to motorized traffic. Unauthorized off-highway vehicles can crush individual poppy plants and threaten the health of poppy habitat. Off-highway vehicles can destabilize or compact soils, which affect seed germination and plant growth. Motorized travel is prohibited on the Forest beyond 91 meters (m) (300 feet [ft]) from a road, except for purposes of camping or parking. This excludes use in the channels of Fresnal and La Luz canyons on National Forest System lands. Off-highway vehicles can crush or disturb poppy individuals and may modify the soils, local hydrology, and microclimates associated with seed germination and

plant growth (U.S. Forest Service 2004). Furthermore, the creation of trails through poppy habitat can promote the spread of noxious weeds already present in the area (U.S. Forest Service 2004) into these areas which may threaten the poppy's establishment through competition. As an indication of increased interest in off-road riding in poppy habitat, a website exists that provides advice on how to circumvent Lincoln National Forest closures and lists detours to take in the vicinity of Alamo Canyon. Off-highway vehicles present a moderate threat to the poppy at this time.

2.3.3.2 Overutilization for commercial, recreational, scientific, or educational purposes

There is no direct overutilization of the poppy. Collection of seeds without permits has been reported (Tonne 2008), but it is not believed that over-collection is a significant concern at this time.

2.3.3.3 Disease or predation

The presence of *Alternaria* sp., a fungal mold that can be a plant pathogen, has been observed to be an intermittent problem throughout the distribution of the poppy (Tonne 2005). For example, this fungal stem canker caused 7 of 18 plants to fail to set fruit and subsequently die in Dog Canyon (Sivinski 1999). It appears to be most common and damaging in drought years (Tonne 2008). A link between decreased water availability and increased cases of disease may exist, as drying may weaken a plant's resistance to disease. Predation by cattle is discussed in section 2.3.2.1.

2.3.3.4 Inadequacy of existing regulatory mechanisms

The Endangered Species Act prohibits the malicious damage, destruction, or removal, and possession of listed plants on areas under Federal jurisdiction. For all other areas, the Endangered Species Act prohibits removing, cutting, digging up, damaging, or destroying listed plants in known violation of any State law or regulation, or in the course of any violation of a State criminal trespass law. Critical habitat has not been designated for the poppy. The Endangered Species Act and the Lacey Act also prohibit any person subject to the jurisdiction of the United States from selling, offering for sale, importing, exporting, or transporting in interstate or foreign commerce in the course of a commercial activity any listed plant species.

Federal actions and other project proposals that have a Federal nexus, including funding, authorization, or permitting, consult with the U.S. Fish and Wildlife Service to ensure that the Federal action does not jeopardize the continued existence of the poppy. This currently provides some protection to the species. There have been numerous informal consultations addressing concerns associated with the poppy. In addition, formal consultations with the Lincoln

National Forest regarding the City of Alamogordo's water pipeline projects for Fresnal and La Luz Canyons considered potential impacts to the poppy. Other consultations have evaluated effects to the species from Forest Service livestock grazing activities in the Sacramento Allotment Management Plan. No consultation has reached a jeopardy conclusion thus far; however, the species' baseline condition has deteriorated since the species was listed.

Listed in the state of New Mexico as endangered, the poppy is also protected from unauthorized collection, transport, or sale by the New Mexico Endangered Plant Species Act, 9-10-10 NMSA, the Federal Lacey Act Amendments of 1981, and National Forest regulations - e.g. 36 CFR 261.9(b). New Mexico State law prohibits taking of listed plants without a permit, but does not provide for protection of habitats of listed plants. State law does not apply to Tribal lands or to Federal employees working on lands within their jurisdiction (New Mexico Administrative Code 19.21.2.7.C).

Even with these legal protections, there has been a steady decline in the abundance and distribution of the poppy throughout its range. The core population center has experienced approximately 64 percent reduction in plants over the past 20 years. Without markedly accelerated and improved management actions that address the threats and needs of the poppy, this species is likely to remain increasingly in danger of extinction within the foreseeable future throughout all or a significant portion of its range.

2.3.3.5 Other natural or manmade factors affecting its continued existence

Climate change

Global climate change may be a threat to the poppy in the foreseeable future. The global average temperature has risen by approximately 0.6 degrees Celsius during the 20th Century, according to the Intergovernmental Panel on Climate Change (Intergovernmental Panel on Climate Change 2001, 2007). Warming temperatures have been documented in recent decades in the southwestern United States. In New Mexico, mean annual temperature has increased by 0.6 degree per decade beginning in 1970, and warming is greatest in spring (Lenart 2005). Higher temperatures lead to higher evaporation rates which may reduce the amount of runoff, groundwater recharge, and consequently spring discharge (Stewart et al. 2004). Temperature changes and seasonal shifts may stimulate earlier growth in the spring or extend the growing season into the fall that is out of phase with available moisture, possibly leading to increased water stress and decreased survival for the poppy. Flowering phenology may also be affected by temperature shifts, potentially causing asynchronous relationships with pollinators and reducing chances of sexual reproduction for the plant.

High elevation environments influenced by snow, such as the Sacramento Mountains, and the uppermost limits of vegetation and other complex life forms,

are among the most sensitive to climate changes occurring on a global scale (Thompson 2000). Studies have shown that since 1950, the snowmelt season in some watersheds of the western United States has advanced by about 10 days (Dettinger and Cayan 1995; Dettinger and Diaz 2000; Stewart et al. 2004). Such changes in the timing and amount of snowmelt are thought to be signals of climate-related change in high elevations (Peterson et al. 2000; Reiners et al. 2003). This change in mountain hydroclimate would have the effect of drying out historically moist high elevation habitats and intensifying natural drought cycles, thereby placing additional stress upon high elevation flora and fauna (Intergovernmental Panel on Climate Change 2001, 2007; Cook et al. 2004; Breshears et al. 2005; Mueller et al. 2005). Increased warming could result in the shrinkage or disappearance of high elevation habitats that currently support the poppy and exacerbate drought effects on this species.

Impacts from recent, catastrophic flooding have negatively affected the poppy by scouring out its habitat and washing away mature individuals. The violent monsoon thunderstorms of late summer in 2006, after a 7-month drought, caused repeated high-volume flash floods and associated rapid water runoff within Alamo, Caballero, and Dog canyons. Five-hundred-year floods were reported within the Sacramento Mountains on June 22, 2006. The damaging effects of flash floods have likely been exacerbated by changes in vegetative composition and cover in riparian zones, particularly within Alamo/Caballero canyon where historical livestock grazing has reduced many of the grasses and eliminated many forbs. Moreover, this information, in conjunction with the significant increase in the intensity of tropical storms and hurricanes since the 1970s and increases projected in the future, may cause the continuation of the declining trend in poppy abundance. For example, in late July, 2008, the remnants of Hurricane Dolly deposited 4.5 inches of rain, leading to severe flooding, scouring, and loss of mature poppies (Tonne 2008). At this time it is not clear whether these intense floods were rare phenomena, or if their occurrence is on the increase and correlated with more extreme weather events predicted by climate change.

Interactions between changes in precipitation and water extraction are likely to impact the poppy. The City of Alamogordo withdraws water via pipelines at the head of Alamo and Caballero canyons, and mid-way down in Fresnal and La Luz Canyons, reducing water flow to poppy habitat (U.S. Forest Service 2008). Water rights to these springs pre-date the establishment of the National Forest and the listing of the species. Poppy seedlings are very sensitive to drying until they develop their taproot. If seed germination continues to occur without plant establishment, the soil seed bank could become depleted. Prolonged drought, extending beyond the 7- to 9-year lifespan of the plant, could prevent successful recruitment, eliminate the adult plants, and lead to a population crash. Thus, the compounded effects of increased drought conditions and water extraction have a significant impact on the plant's survival.

In recent years, the area occupied by the poppy has been under severe drought. These precipitation levels led to low soil moisture conditions that severely curtailed recruitment of poppies into the population (U.S. Fish and Wildlife Service 2004a; Tonne 2008). From 2008 continuing through to the present, the Palmer long-term drought severity index for Otero County has been primarily in the severe to extreme range (National Oceanographic and Atmospheric Administration 2008-2013). Thus climate change presents a significant threat to the poppy, with impacts likely from not only precipitation and temperature changes, but also from possible interactive effects with grazing, water extraction, and disease (as mentioned in section 2.3.2.3).

Small population size and low genetic diversity

Decreasing genetic diversity is an indirect threat capable of extirpating the limited populations of poppies. Populations composed of smaller numbers of plants with narrow distributions are more susceptible to elimination from stochastic events, such as flooding or drought, or demographic fluctuations, such as reduced numbers of adults or diminished seed banks, than are larger, more widely distributed populations. A loss of populations or individuals may contribute significantly to a reduction in the gene pool and the ability of the species to adapt to environmental changes. With fewer, more widely spaced plants, out-crossing may become more difficult, which Tepedino (1992) has shown reduces fruit and seed set and could preclude population recovery. At this time, the small population size and limited genetic diversity present a minor threat to the Sacramento prickly poppy.

2.4 Synthesis

The poppy is an herbaceous perennial that lives approximately 7 to 9 years and dies back to the root crown most years. In 2010, it was reclassified from a subspecies to a species (Cervantes et al. 2010). It is endemic only to several canyons along the western face of the Sacramento Mountains of Otero County in south-central New Mexico (U.S. Fish and Wildlife Service 1994). This entire range is estimated at 230 square kilometers (90 square miles). Habitat for the poppy extends through a variety of plant biotic communities within the Sacramento Mountains. The species occurs in steep, rocky canyons between the pinyon/juniper zone of the Chihuahuan Desert Scrublands and Grasslands (1,310 m [4,300 ft]), and the lower edge of the ponderosa pine community of the Great Basin Conifer Woodlands (2,164 m [7,100 ft]) (Brown 1982; U.S. Fish and Wildlife Service 1994). Habitats vary from xeric uplands to mesic sites, and may include arid canyon bottoms, dry terraces above riparian areas, and the edges of streams, springs, and seep areas (U.S. Forest Service 2004). Germination has been observed to occur between October and November, through late winter, spring, and in August, and successful recruitment into the population requires sufficient moisture for establishment of seedlings.

At the time of listing in 1989, approximately 1,313 poppy plants were identified from canyons in the Sacramento Mountains (U.S. Fish and Wildlife Service 1989). Major threats to the poppy

included water diversion and pipeline construction, road construction and maintenance activities, drought, flooding, and livestock grazing (U.S. Fish and Wildlife Service 1994). When the Sacramento Prickly Poppy Recovery Plan was completed in 1994, off-highway vehicle use was added as a threat (U.S. Fish and Wildlife Service 1994). Since 1999, a fungal disease with symptoms similar to those of a stem canker was also added as a potential threat to the species. The pathogen has since has been identified and confirmed by DNA analysis to be a mold in the genus *Alternaria*, a genus known to contain plant pathogens (Tonne et al. 2007).

The overlap of ongoing high forage utilization with the yearly germination and establishment period of the poppy may have created cumulative impacts upon the species and played a role in its declining status (U.S. Fish and Wildlife Service 2004a; Forest Service 2004). Consequently, historical overutilization may preclude range restoration for decades, even with strict compliance with forage/range guidelines (U.S. Fish and Wildlife Service 2004a).

The poppy has been in decline throughout its range. The Dry and Mule Canyons populations have not been observed for many years, despite repeated surveys. The population stronghold in the Alamo/Caballero Canyon system decreased by 64 percent between 1987 and 2011. Pressure from livestock in occupied habitats, combined with decreased water availability, appear to be contributing to the decline of the poppy. Flooding and drought have likely contributed to the loss of poppies over the last 20 years. However, flooding also likely benefits the poppy when it is not too severe. The primary bottleneck in recruitment and establishment of the poppy is in the seedling and juvenile stage. Seedlings and young plants cannot tolerate disturbances caused by herbivory and trampling by livestock, drought, flooding, and herbicide use. Adult plants are better equipped to handle these stresses, but they also can succumb to one or more threats.

In summary, data indicate that the entire population dramatically decreased since 1987 from 1,247 to an estimate of 535 mature plants in 2009, a 57 percent reduction (U.S. Forest Service 2007; Tonne 2008; U.S. Forest Service 2008). In 2012, survey results documented 731 adult plants with 589 of these on Forest Service lands. These decreases likely occurred as a result of a variety of factors, including drought, livestock, road construction, stem fungus, and floods. The current environmental baseline of the poppy, in combination with recent information from the Forest Service about the overall lack of monitoring and forage-use guidelines on adjacent private lands, contribute to the grave status of the poppy. Without markedly accelerated and improved management actions that address the threats and needs of the poppy, this species is likely to remain in endangered status and in danger of extinction within the foreseeable future throughout all or a significant portion of its range.

3.0 RESULTS

3.1 Recommended Classification

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist**
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
_X_ **No change is needed in classification**, with the exception that the poppy is now considered to be a full species, not a subspecies.

3.2 New Recovery Priority Number: 5C

Brief Rationale: The Recovery Priority Number has been changed from 3C to 5C, indicating a full species with a high degree of threat and low recovery potential. At this time, the best way to conserve or recover the species is not fully known, supporting a low recovery potential, as indicated by the Recovery Priority Number of 5. The conflict designation is being recommended because of past and current conflicts between recovery of the poppy and livestock grazing and trampling. There may also be future conflicts that develop between increased extraction of water for human use from Sacramento Mountain springs in poppy habitat and the water needs of the species.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The Sacramento Prickly Poppy Recovery Plan should be revised or amended. Recovery plans are not regulatory documents, but are instead intended to provide guidance for the dynamic process of species recovery. As discussed in this review, new information on the species has been discovered that was not known at the time the recovery plan was finalized. The recovery plan should also be amended to include delisting criteria for the poppy.

The following are the major actions needed from the Recovery Plan:

1. Study biological and habitat requirements of the species.

2. Develop a management plan for the City of Alamogordo's water pipeline project in the Alamo and Fresnal Canyon systems with measures to avoid or reduce impacts to populations.

3. Develop a management plan with the Lincoln National Forest and the Bureau of Land Management for Sacramento prickly poppy plants located on lands under their jurisdiction. Conduct long-term monitoring studies to evaluate the impacts of livestock grazing and trampling, and off-road vehicles on these populations.

4. Develop a management plan with the New Mexico State Highways and Transportation Department for populations occurring in the Highway 82 right-of-way and any other plants affected by their management.

5. Develop a conservation agreement with private landowners to protect plants on private property.

6. Conduct surveys in potential habitat.

Except for Item 5, some work has been accomplished on each of these important actions, but much more remains to be done. All of these actions would significantly assist recovery of the poppy and should be pursued.

The most important opportunity to advance the status of this species would be to continue to improve livestock management in poppy habitats. Riparian areas that support the poppy provide important opportunities for recruitment, and improved livestock management would greatly assist this effort. Fencing and rest of riparian corridors and other important core areas should be implemented. Stocking rates should be adjusted to levels that restore and maintain healthy riparian systems and sufficient vegetative cover in uplands. Livestock have contributed to erosion problems within this mountain range and may have increased the destructive potential of flash floods by reducing the vegetation that stabilizes upland and riparian soils (U.S. Fish and Wildlife Service 1989; Tonne 2008).

The development of management plans for the different agencies, as outlined in the recovery plan, should be pursued. If the portion of poppy habitat coinciding with Highway 82 is to be protected, there should be permanent highway signage with appropriate buffers around occupied habitat. The recovery plan calls for the development of poppy-specific management plans with the New Mexico Department of Transportation and the Forest Service. Some progress has been made on these plans, and these should be finalized.

Survey efforts in occupied and potential poppy habitats should be increased and improved, and surveys should always employ an agreed-upon standardized protocol. Surveys should cover the entire range of the species and be repeated at least every three years. Continued monitoring of the effects of precipitation patterns and flooding, and the persistence of plants in lower elevation habitats would also provide needed information for improved management strategies for the poppy.

Finally, research on techniques to restore the poppy into its historical habitats should continue. This would provide opportunities in the future to recover the poppy in areas where it has been extirpated. Additional research on subjects such as poppy plant dormancy (see section 2.3.1.1) and potential treatments for the fungal disease of the poppy has also been suggested.

TABLE 2. SACRAMENTO PRICKLY POPPY SURVEY DATA, 1984-2011 (U.S. Fish and Wildlife Service 2012b).

Canyon	Year																					
	1984	1987	1988	1989	1991	1993	1994	1996	1997	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2011
Alamo (Caballero)		828 [744 Forest Service lands; 84 City lands] (117)[B]	778 [Forest Service lands only][G]	730 [Forest Service lands only][G]						603[I, J]	190 Incomplete count[K]		411 ad, 50 sd (90 ad, 4 sd)[L]	345 ad, 388 sd (80 ad, 6 sd)[M]; 244 ad 127 sd [Forest Service lands only][X] (80ad)[N]	330 ad, 816 sd (57 ad)[N]	438 ad, 178 sd (50 ad, 57 sd)[O]		259 ad, 3 sd[U] (40)[N]	344 ad, 73 sd (33 ad, 7 sd)[V]	303 ad, 78 sd (46 ad, 38 sd)[S]	197 ad, 6 sd (Forest Service) 35 ad, 4 sd (City); (35 ad, 2 sd)[A1]	222 ad, 113 sd (Forest Service) 59 ad, 4 sd (City)[B1]
Alamo Canyon [BLM lands]				6[ZZ]												0			17[ZZ]			
Dog		159[B]										1[K]		32[M]		14 ad, 150 sd[O]	17[O]					
Dog Bajada																34[P,ZZ]	37[O]	7[ZZ]	12[ZZ]			
Dry		11[B]					1ad, 3 sd[H]									0[O]						
Escondido				45[E]													0[O]					
Fresnal		135[B]		13[E]	67[W]								62[K,N]				60[O], 69[Q]	63 ad, 14 sd[T]; 63[O, T]		124 ad, 51 sd[S]		86 ad, 26 sd[B1]
La Luz		33[B]																				
Marble	12A′[A1]																		13[R]			

Canyon	Year																					
	1984	1987	1988	1989	1991	1993	1994	1996	1997	1999	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2011
Mule			7[C]	1[D]															0[N]			
Salado		4[B]																	Occ[Z]			
San Andres		3[B]	16[C]	13[D]	15-30[ZZ]	15-30[F;] 16[ZZ]	2 [Forest Service][H]					2[K]					12[O]					
San Andres Bajada							17[BLM][ZZ]	5[ZZ]	10[ZZ]							2[O, ZZ]	52[O,Z][Z]	7[ZZ]	23[ZZ]			

ad=Adult

sd=Seedlings

Occ=poppies confirmed on private land, but no abundance estimate provided.

If no abbreviation given, number is for adults only.

The 1990 data were deleted because these are duplicates of those reported in the 1990 interim management plan by the Forest Service, which is cited in the 1994 recovery plan as Wood 1990.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
Sacramento Prickly Poppy/*Argemone pleiacantha*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: 5C

Review Conducted By: Patricia G. Zenone, Senior Fish and Wildlife Biologist
New Mexico Ecological Services Field Office, Albuquerque

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 8/26/13

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Region 2

Approve _____ Date 8/29/13