ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM

Plant Abstract **Element Code:** PDPAP02010
Data Sensitivity: No

CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE

NAME: *Arctomecon californica* Torrey & Fremont
COMMON NAME: Las Vegas bearpoppy, California bearpoppy, California bear poppy, Yellow-flowered desert-poppy, Golden bear claw poppy, Golden bear-claw poppy
SYNONYMS:
FAMILY: Papaveraceae

AUTHOR, PLACE OF PUBLICATION: *Arctomecon californica* Torrey & Fremont, Report of the exploring expedition to the Rocky Mountains in the year 1842. 312(174), pl. 2. 1845.

TYPE LOCALITY: United States of America, Utah, Las Vegas, near the Rio Virgin, in southern Utah. Notes by S.L. Welsh, 1990, "The camp at Las Vegas, present Clark Co. Nevada, was on 3 May 1844, where it was taken 'on the bank of a creek'. Two huge springs coalesced into a stream – the only one in the vicinity."

TYPE SPECIMEN: HT: NY-387532. J.C. Fremont 429, 3 May 1844. Verified by S.L. Welsh, 9 Sept 1990.

TAXONOMIC UNIQUENESS: The genus *Arctomecon* has three species: *californica*, *humilis*, and *merriamii*. All three are rare species endemic to the Mojave Desert (Sheldon 1994). Botanists familiar with both Nevada and Arizona populations have question the taxonomic status of the Arizona specimens based on morphological and ecological differences. Until a formal description of Grand Canyon plants and their habitat is published, they continue to be recognized as Las Vegas bearpoppy. (TNC 2007)

DESCRIPTION: A short-lived perennial herb, 8-24 inches high (20-60 cm), with stout taproot, rather numerous grayish-blue basal leaves, and large bright-yellow flowers. Leaf blades are wedge-shaped, broadest above the middle, shallowly to deeply 3-7 lobed distally, up to 15 cm long (6 in; FNA 1993+ reports 3-20 cm (1.2-8 in)) and 5 cm (2 in) wide distally, covered with long white, shaggy hairs, sometimes also minutely hirsute, narrowed at the base to a stalk about as long as the blade. Upper leaves may be sessile, lack the three-toothed blunt apex. Inflorescences 3-20 flowered, branching, glabrous throughout or long-pilose proximally; stems leafless; buds glabrous. Flower petals caduceus, usually 6 (sometimes 4 or up to 8), deep yellow, 1-2 inches long; stamens numerous; style absent. Sepals 2 or 3, glabrous, falling soon after the flowers open. Fruit form as egg-shaped persistent capsules up to 1 inch long, upright, 6-ribbed, opening at the top by flaps that develop as the fruit dries;

dehiscing not more than ¼ length. Seeds usually at least 100 (up to 160) per fruit, shiny black. (Mistretta et al. 1996; FNA 1993+; Falk and Jenkins et al. 2001)

AIDS TO IDENTIFICATION: *Arctomecon californica* closely resembles *A. merriami* (from Nevada) and *A. humilis* (from Utah), but is easily separated by presence of yellow (not white) flowers that are clustered at the top of the flowering stalks (Brian, 2000). Also, *A. californica* produces a single flowering stem per rosette, with multiple yellow flowers borne by the stem, whereas *A. merriamii* has multiple flowering stems arising from a single rosette, but with one white flower per stem (Sheldon 1994).

Plants in the Grand Canyon populations are generally larger and occur on a different substrate and in a different habitat from those around Lake Mead (gypsum-rich clay soils), and may merit separate taxonomic treatment (Falk and Jenkins et al., 2001).

ILLUSTRATIONS:

Color photo (Christopher Christie, *in* http://www.rangenet.org/directory/christiec/plants/papaveraceae/ARCA4.jpg)
B&W line drawing (Falk and Jenkins et al., 2001)
Color photo of plant (Barb Phillips, *in* Falk and Jenkins et al., 2001)
Color photo of habitat (Art Phillips, *in* Falk and Jenkins et al., 2001)
Color photos of plant and habitat (A.M. Phillips, III, *in* Brian 2000)
Color photos of plants and flowers: http://heritage.nv.gov/taxon_detail/16283.
Color photos, herbarium mounts: http://swbiodiversity.org/seinet/taxa/index.php?tid=529.

TOTAL RANGE: The vast majority of known populations are found in east central Clark County, Nevada, and are associated with the Las Vegas Valley and on gypsum soils associated with the Colorado River drainage. This area is crucial for the long-term survival of the species (The Nature Conservancy 2007). There is another population group in northwestern Arizona, Mohave County. A single collection was reported from Washington County, Utah, but this occurred in cultivation on private property (Welsh et al., 1993).

RANGE WITHIN ARIZONA: There are three general localities where populations of *A. californica* occur in Arizona. All of these are within Lake Mead National Recreation Area or the Grand Canyon National Park in Mohave County. The largest population center is centered around Bonelli Bay, both on the east and west sides. On the east side, the occurrence extends along the Big Gypsum Ledges northeast to East Point. Occurrences are also found to the south in Detrital Valley. A population locale is found east of Virgin Canyon, and extends from Hualapai Bay northeast to Wagon Trail Bay. The third and eastern-most populations are centered near Rampart Cave. There are five known occurrences on both the north and south sides of the river.

This eastern-most group is thought to be distinctive from the others morphologically, ecologically, geographically, and with possible taxonomic repercussions. However, until there

is a peer-reviewed publication to address this possible distinction, the broader species interpretation still prevails (The Nature Conservancy 2007).

SPECIES BIOLOGY AND POPULATION TRENDS

GROWTH FORM: Perennial forb.

PHENOLOGY: Flowers from March to June, with seed dispersal occurring from mid-May to late June (Sheldon 1994). Rosettes present all year.

BIOLOGY: *Arctomecon californica* is a short lived (3-10 years, 4-5 on average), hardy plant that lives in areas with seasonal temperature extremes and low rain fall (<10 inches annually). It can withstand summer temperatures that regularly exceed 120ºF and winter temperatures that may reach as low as 20ºF.

Local populations experience drastic year-to-year fluctuations (Meyer 1987, in The Nature Conservancy 2007) and large populations have been observed to suddenly die off. Following these die-offs, the mature plants will often be replaced by new cohorts. The reproductive strategy for this species resembles that of an annual plant—populations typically have high reproductive output by producing copious seed (Meyer 1987). With abundant rainfall, non-dormant seeds germinate en masse in spring and a new cohort is established from few surviving seedlings or the soil seed bank. Established populations experience gradual attrition over years, especially during periods of drought when many individuals lose vigor. If a drought is protracted, eventually all plants succumb resulting in population dormancy. However, this condition is *not* a local extirpation of a population. The Las Vegas bearpoppy population persists in the seed bank (The Nature Conservancy 2007). The existence of this permanent seed bank is critical to success of this species given the fluctuations in population size and reproductive success (Sheldon 1994). This trait underscores the need to protect large habitat areas, allowing cohorts to die off and return in the same place or elsewhere.

Sheldon (1994) demonstrated that *A. californica* was reproductively self-incompatible, and is an obligate out-crosser. Common pollinators of this species include bees, butterflies, humming birds, and even flies. The majority of the insects collected on *A. californica* by Sheldon (1994) were Hymenoptera (67%). Other insects collected were Coleoptera (25%) and Lepidoptera (8%). Contiguous sites had greater numbers and diversity of pollinators, including specialists visiting plants. Among the solitary, ground nesting bees are two important pollinators: the rare specialized Mojave poppy bee, *Perdita meconis,* which visits plants in the poppy family only; and, the larger more common *Megandrena enceliae*, previously thought to specialize on creosote bush only. Two beetles were deemed important pollinators as well (*Schizopus laetus* and *Trichochroides* sp.). Griswold *et al.* (1999) characterize important pollinators as having high plant fidelity and efficiency—that is, they collect pollen from one plant species and visit multiple flowers on a single foraging trip). Fragmented sites had fewer pollinators, none of the specialized important pollinators, and

with the pollinator role played by generalist bees that lack fidelity in foraging choices, waste pollen, and consequently are less effective pollinators (The Nature Conservancy 2007).

A. californica is known to have a high estimated reproductive output (4098 +/– 757 seeds *per plant*) for a perennial species (Meyer 1987, Megill 2007). *Capsules* contain approximately 100 to 160 seed (Sheldon 1994), although Meyer (2001) calculated a mean of 91 for use in population modeling (The Nature Conservancy 2007).

Megill (2007), and Megill et al (2011) has conducted research on *A. californica,* its habitat and the dynamics of its seedbank. She found that seeds were rare, even though *A. californica* is known to have a high estimated reproductive output for a perennial species (Meyer 1987, Megill 2007). There was density of 0.651 viable seeds per m^2, and 60% were found within the top 2 cm from the surface and 40% at the 2–4 cm depth. Seed viability among the different sites she studied ranged from 26% to 79%. She offered several possible explanations for the paucity of seeds: (1) the sampling period corresponded with a low point in *A. californica* seed populations in the study area because of a mass germination event during spring 2005, just prior to sampling. The large number of seedlings in this study supports this supposition; (2) seed production within the study area may have been hindered by a lack of pollinators, thereby lowering the number of seeds to be dispersed relative to the number of plants; and (3) results may underestimate the soil seed bank because the sampling design was randomized across the entire site and was not centered around parent plants.

Megill (2007) and Megill (2011) reported that seeds of *A. californica* travel 0.5 m on average from the parent plant in the prevailing wind direction during primary dispersal and that these seeds tend to form significantly clumped deposits approximately 60–100 cm away from the parent plant. The seeds have external structures which could function as elaiosomes, an edible lipid-rich body attached to seeds to attract dispersers, and Meyer observed ants dispersing seeds from under maternal plants (Meyer 1987, 2001, in The Nature Conservancy 2007). Granivory experiments at Lake Mead NRA suggested that approximately 40% of *A. californica* seeds that reached the surface were dispersed and/or consumed by ants and rodents (Megill 2007). However, Megill at al 2011 noted that no *A. californica* seeds were found in any of the 7 excavated ant mounds.

Las Vegas bearpoppy seeds initially possess seed coat dormancy with a slow but progressive loss of dormancy over time (Meyer 2001). This appears to be an adaptation to variable precipitation which decreases the risk of seed bank loss from total germination in wet years (The Nature Conservancy 2007). Meyer reported to Megill (2007) that preliminary indications suggest that the seeds can remain viable for nineteen years.

Megill's (2007) concludes that *A. californica* does maintain a residual soil seed bank, and therefore populations should not be assumed extinct simply because no established aboveground plants are present.

Seedlings are mostly found in the spring, and do not flower their first year. Mortality is highest during the seedling stage which reached 60-87%. Loss of reproductive potential was

highest for both species at the bud and capsule stages. Overall survivorship of *A. californica*, including plants present at the beginning of the study as well as seedlings germinated during the study, was very low for all three sites, ranging from a low of 14% at Stewart Point to a high of 38% at Temple Bar (Sheldon 1994)

Meyer (1996) investigated a possible cause for high adult plant mortality in wet years. In 1995, she took living tissue samples from dying plants to Dr. David Nelson, a plant pathologist, who cultured the tissue and identified *Alternaria* as the one pathogen present in every diseased tissue. This organism has related species which cause various leaf spot diseases in crop plants, and intriguingly, it infects plants via spores that require free water in order to germinate and penetrate the leaf surface suggesting why mortality is more evident in wet years (TNC 2007).

Herbivory on the stems and leaves o f *A. californica* was observed at both Overton Beach and Stewart Point, although much greater damage occurred at Stewart Point. Damage was due to rabbits, as evidenced by the large number of fecal pellets found near the damaged plants. There was some damage by burro digging at another site (Sheldon 1994).

Arctomecon californica contain several alkaloids, and if eaten freely, are said to be poisonous to sheep, less so to cattle. Two chemicals, protopine and allocryptopine, made up 95% of the alkaloid content of the plant (Sheldon 1994).

HABITAT: Barren, gravelly desert flats, shale, hummocks and slopes in the creosote bush zone, that are heavily gypsiferous or otherwise chemically unusual (borate-bearing, lithium-bearing), Meyer 1987. Per Morgan (1995), "It tends to occur predominantly on the Moenkopi and Horse Springs geological formations in association with desert washes where cryptogrammic crust has developed." The spongy, finely textured, and crusted gypsic soils form relatively barren, low-competition sites within creosote bush, saltbush, and rarely blackbrush ecological systems more typical of the Mojave Desert. Generally occurs in areas of low relief, but sometimes also in hummocked, dissected, or badland micro-topography (The Nature Conservancy 2007).

A recent study (Childers 2004), using observational data (2,575 observations) and GIS compatible data to characterize *A. californica* habitat, indicated that 34.6% of populations occur on limestone soils. This result contradicts previous research, which characterized this species as a gypsic obligate species. However, these findings need to be reinforced by on the ground field research.

Phillips and Phillips (1988, in The Nature Conservancy 2007) state that Las Vegas bearpoppy occurs in Arizona on openly vegetated sites in association with perennial shrubs and surface crusts. These plants are on gentle to moderate slopes with coarse, gravelly soils of limestone origin, while the gypsiferous clay soils typical of Nevada localities are not present. Falk and Jenkins et al (2001) add that within the Grand Canyon, the species is found on narrow gravelly Formation and Devonian limestone shelves high on the slopes of side canyons, between 1,600-2,200 feet (480-670 m) in elevation.

ELEVATION: 1,100 – 3,340 feet (335 to 1018 m.), The Nature Conservancy 2007.

EXPOSURE: It typically occurs on gentle slopes around four degrees, but slopes may infrequently be steep and up to 35 degrees. Las Vegas bearpoppy occurs on all exposures, although southeast, east, and south are most prevalent while north and northwest are least common exposures. It appears to have no preference for slopes providing cooler and moister conditions versus warmer and drier conditions, which is consistent with its C4 physiology (The Nature Conservancy 2007).

SUBSTRATE: Soil analysis consistently shows that sites which support *A. californica* have lower phosphorus and magnesium (ppm) levels than nearby sites that do not support the species. Calcium levels are very high on site, as are soluble salts. Sulfur levels are very high in the top layer of soil at both on- and off-site locations, but diminish greatly in the lower layer of soil at the off-site locations. The high sulfur levels where *Arctomecon* is present may have an effect on the eventual success of recently established plants, as the sulfur content has been hypothesized to be a factor in the establishment and success of plants on gypsum soils, and perhaps results in the floristic endemism (Parsons 1976, in Sheldon 1994). These findings were reiterated in Thompson and Smith 1997, but the magnitude of the differences were also provided. Soil analyses for three *A. californica* sites indicated that these sites had much higher levels of sulfur, calcium, and soluble salts, and much lower phosphorous contents, than did typical off-site locations that contain the dominant *Ambrosia-Larrea* vegetation type. Total sulfur was over 10-fold higher on *A. californica* dominated sites than on adjacent off-site locations, total salts were about 4-fold higher on-site, and total calcium was almost 3-fold higher than for off-site locations. In contrast, total phosphorous was about 9-fold higher off-site than on-sites with *A. californica*; off-site soils were also consistently more basic (higher pH) than on-site soils.

It was also proposed by Meyer (1986) that the important factor allowing some species to establish on gypsum while others do not is due to surface structure of the soil, not due to chemical factors of the bulk soil. Another factor which may be important for *A. californica* is the cryptogamic crusts. These crusts have been shown to increase nutrient levels in the top layer of the soil, which may be a factor in the success o f *A. californica* on gypsum soils (Meyer 1986, Harper and Pendleton 1993, in Sheldon 1994).

Saxena's (2005) research suggested that soil surface characteristics such as percent rock fragments, crust strength and surface sulfur levels were more important determinants for finding *A. californica* populations than was soil chemistry. In addition, her study found that *A. californica* can occur on a wider variety of soils and parent materials than suggested by previous studies, and that it was not limited to gypsum soils. She found no significant difference in soil sulfur and total soluble sulfate between habitat locations, which suggests that sulfur, and thus gypsum, may not be a requirement for species establishment and existence.

Another study by Megill et al (2011) found no significant association between seed densities and soil penetrance, mean cryptobiotic crust, or rock cover among sites. They also found no evidence that rock and cryptogamic crust cover can help characterize *A. californica* habitat, and that there was not a significant relationship between the mean amount of crust cover at a site and the number of *A. californica* plants.

Populations most commonly occur on Moenkopi Formation, Quaternary alluvial deposits, Permian cherty limestones, Triassic continental sedimentary rocks, Horse Spring Formation, tufaceous sedimentary rocks, and Chinle Formation, in order of prevalence. Las Vegas bearpoppy occur on many soil associations, many of which are comprised of soil series derived from gypsum rock. Across its distribution in Clark County, Las Vegas bearpoppy most commonly occurs on Guardian-Baseline and Baseline-Guardian soil associations. In the Lake Mead NRA, it most commonly occurs on Baseline-Callville-Badland, Drygyp-BlueGyp, and Drygyp-Guardian- Baseline soil associations (Powell 2003, in The Nature Conservancy 2007).

An investigation into soil map units and bearpoppy populations was conducted by Powell. Although Las Vegas bearpoppy occurrences overlay with 23 different soils map units, 90% (n=212) were on 13 soil map units and 66% were on only six soil map units. Gypsum derived soils were most often associated with larger bearpoppy locations, but some occurrences fell on soil series and map units derived from limestone or mixed rock sources. This supports Meyer's (1986) designation of the plant as a gypsocline—one that primarily occurs on gypsum, but is found on other unusual substrates as well (The Nature Conservancy 2007).

PLANT COMMUNITY: Mohave desertscrub. Associated species (also edaphically specialized) include: *Anulocaulis leiosolenus* (Chihuahuan ringstem), *Enceliopsis covillei* (panamint daisy), *Ephedra torreyana* (Torrey's Mormon-tea), *Petalonyx parryi* (Parry sandpaper-plant), *Phacelia palmeri* (Palmer's scorpion-weed), and *Lepidium fremontii* (Fremont's pepper-grass). *Larrea-Ambrosia* associations surround these edaphic islands. Dominants in the western end of Grand Canyon may include: *Gutierrezia microcephala* (small-head snakeweed), *Sclerocactus johnsonii* (Johnson barrel cactus), *Sphaeralcea ambigua* (desert globemallow), and *Stephanomeria exigua* (small skeletonplant). According to records in SEINet (accessed 2005), associated species in Arizona include: *Acacia*, *Agave utahensis* (Utah agave), *Atriplex confertifolia* (shadscale), *Dalea* (prairie-clover), *Echinocactus*, *Echinocereus* (hedgehog-cactus), *Ephedra torreyana*, *Fouquieria splendens* (Ocotillo), *Gutierrezia microcephala*, *Larrea tridentata* (creosotebush), *Lepidium fremontii*, *Mortonia*, *Neolloydia* (=*Sclerocactus*), *Opuntia*, *Stanleya pinnata* (desert prince-plume), and *Yucca*. (SEINet accessed 2005).

Common shrub species of the Mojave Desert, such as *Larrea tridentata, Ambrosia dumosa*, and *Ephedra nevadensis*, are represented in greatly diminished numbers on *Arctomecon* sites. Lowered species diversity on these areas leads to a more open environment.

Other species reported associated with *A. californica* are plants also believed to be gypsum-tolerant species. These include *Petalonyx parryi, Psorothamnus fremontii, Enceliopsis*

argophylla, Mentzelia pterosperma, Tiquilia latior, Eriogonum insigne, Phacelia palmeri, Phacelia pulchella, and *Psathyrotes pilifer* (Mistretta et al. 1996 from Saxena 2005, and The Nature Conservancy 2007). Thompson and Smith 1997 add *Eriogonum inflatum, Stephanomeria paucifllora, Tidestromia oblongifolia,* and *Hymenoclea salsola* to this list,

POPULATION TRENDS: The first comprehensive surveys for Las Vegas bearpoppy using GPS were done by BLM in 1993. That year and the previous year in 1992 had much above average precipitation resulting in favorable conditions for germination and establishment. The surveys were conducted across its Clark County distribution and involved six population groups. Total numbers of individuals estimated are likely underestimates of actual population sizes, but numbers of acres are reasonably accurate as they were calculated by planimetry (from The Nature Conservancy 2007):

Population Group Name	Estimated Number of Individuals (NNHP)	Range of Individuals Estimated (BLM Database)	Number of Acres
Las Vegas Valley	5,000+		78
Las Vegas Dunes	20,000+	1,787-5,359	240
Sunrise Valley	71,000+	21,376-52,054	3,940
Gale Hills	1,000+	668-1,925	446
Bitter Spring Valley	5,000+	1,204-4,375	860
Gold Butte	50,000+	2,658-9,425	1,620

NNHP = Nevada Natural Heritage Program

The 7,184 acres represented 0.2 % of their Las Vegas District (The Nature Conservancy 2007).

The Sunrise Valley population group was the largest population on BLM lands based on 1993 surveys, but many roads and OHV activity has reduced its long term viability even though the BLM has made some restoration attempts. Similarly, legal OHV activity has caused population and habitat loss resulting in highly fragmented remnant populations in this area (The Nature Conservancy 2007).

Based on a report by Mistretta et al. (1996), "The total surviving documented population in Nevada now comprises about 580,000 plants on less than 21,000 acres divided among 91 populations. Four other populations remain poorly documented." The eastern half of the species' range in Nevada is large, remote, and relatively secure under Federal management, rendering extinction of the species highly unlikely in the short term. In the western half, however, populations and genetic diversity are rapidly being lost, potentially posing a long-term threat of extinction. Thirty of ninety-one populations in the Las Vegas Valley have been extirpated due to rapid urban expansion.

The Las Vegas Valley population group had 34 historically documented populations of Las Vegas bearpoppy according to Mistretta et al. (1996), in an area that was estimated to possess about 17% of the species native range (USFWS 2000). By 1996, 12 of these were extirpated by urban development, leaving 22 populations estimated at 996 acres and 66,525 plants in the Las Vegas Valley (Mistretta et al. 1996). Development continued to eliminate or disturb

habitat and in 1998 ten more populations were documented as extirpated and four populations were in imminent danger of extirpation (Glenne 1998), as reported in The Nature Conservancy 2007.

"In Arizona, 8 sites under NPS and Hualapai Indian Reservation management are now reported but are largely unquantified. Four of these sites in the Grand Canyon are probably an undescribed taxonomic variant." Threats to the Arizona sites appear much lower, and past impacts have resulted mainly from impoundment of water behind Hoover Dam, inundating portions of two sites (Mistretta et al., 1996).

The first known human-caused extirpations of Las Vegas bearpoppy populations occurred with the construction of Hoover Dam and the creation of Lake Mead within the Valley of Fire population group. This destroyed the Boulder Basin populations (Morefield 2001) and inundated potential habitat in the Overton Arm based on geology (The Nature Conservancy 2007).

A long term survey mapping effort for Las Vegas bearpoppy was initiated at Lake Mead NRA in 1998 (Powell 1999). These 1998 surveys expanded the known distribution of Las Vegas bearpoppy at Lake Mead NRA beyond the range indicated in the conservation status report by Mistretta et al. (1996) which included survey data through 1994. They documented 174 sites with live plants and another four dormant sites (dead plants present) out of 199 potential habitat sites surveyed (The Nature Conservancy 2007).

Lake Mead NRA surveys in 1998 noted viability (condition) information (Powell 1999). Cryptobiotic crust occurred on 71% of the sites and rocks were present on 46% of the sites. Disturbance was noted at most sites with 29% having heavy disturbance, 14% having moderate disturbance, and 57% with light disturbance. Most disturbance was from burros (65% of sites) and then from erosion (39% of sites), and they were frequent co-factors in over a quarter of all sites. Other disturbances noted in these sites (Bitter Spring Valley and Valley of Fire) included ORV use, human, horses, old roads, animal burrows, and trails. Exotics occurred on Las Vegas bearpoppy habitats, including red brome, Mediterranean grass, saltcedar, and the suspected exotic woolly plantain (*Bromus madritensis* ssp. *rubens*, *Schismus barbatus*, *Tamarix ramosissima*, and *Plantago ovata*). In 2005, Sahara mustard was present at Bonelli Bar (Arizona), where the weed team did mechanical removal. Populations at Grand Canyon are in undisturbed condition (Phillips 1994, Powell 2003, in The Nature Conservancy 2007).

Powell (2003 from The Nature Conservancy 2007) estimated a total of 39,872 acres of potential habitat (about 28,800 acres of Las Vegas bearpoppy populations and 11,072 acres of un-occupied habitat) at Lake Mead.

Morefield (2001) summarizes the status of Las Vegas bearpoppy as of 2000 surveys with total estimated individuals at 445,000+, total estimated area of 20,614 acres, and a rapidly declining trend. The areal estimate is probably a more constant indication of size of

populations over time than the number of individuals because Las Vegas bearpoppy numbers fluctuate from year to year. 2005 surveys showed populations present where they had not been seen in the late 1990s.

A substantial population in Las Vegas Valley was recently documented in 2005 during surveys for environmental reviews of proposed disposal lands. The land supporting this population was removed from the land disposal list. The area was not identified as significant during the 1990s, perhaps because it was dormant during that period, and it highlights the need to identify and protect suitable habitat rather than concentrating solely on extant populations (The Nature Conservancy 2007).

TNC 2007 presented viability ranks for all Las Vegas bearpoppy population groups. The Gold Butte, Government Wash, Middle Point, Sunrise Valley, and Valley of Fire populations were ranked as good viability. The Bitter Spring Valley, Gale Hills, Las Vegas Dunes, and White Basin were ranked as fair. The Arizona, Grand Canyon, Meadview NW Populations (AZ) were considered to have very good viability.

Meyer (1987) noted that recolonization of sites where local extinction has occurred is not likely because of apparently low dispersal ability of seeds, low probability of establishment from limited immigrant seed, and island-like distribution of gypsum habitats. This may be why apparently suitable sites are unoccupied and it suggests that Las Vegas bearpoppy does not possess a metapopulation dynamic (The Nature Conservancy 2007).

Meyer and Forbis (2006, in The Nature Conservancy 2007) present a population viability analysis (PVA) based on years of demographic data, seed bank study, and contemporary seed longevity work. Their preliminary PVA model runs indicate that small, fragmented populations (e.g. Las Vegas Valley remnants) suffer from severe pollen limitation and set little seed. Some of these populations appear extant solely as a consequence of seeds produced before habitat fragmentation occurred and they are predicted to have little chance of persistence once their seed bank becomes depleted. They conclude that long term conservation for *A. californica* lies in the protection of large tracts of occupied habitat, including adjacent non-gypsum habitat that can support pollinator populations during the frequently-occurring periods when Las Vegas bearpoppy is present only as a seed bank.

Note that all published data and surveys are outdated by more than a decade.

SPECIES PROTECTION AND CONSERVATION

ENDANGERED SPECIES ACT STATUS: None (USDI, FWS 1996)
[Category 2 USDI, FWS 1983]
[Category 1 USDI, FWS 1980]

STATE STATUS: Salvage Restricted (ARS, ANPL 2016)
[Salvage Restricted (ARS, ANPL 1993)]

OTHER STATUS: Critically Endangered (State of Nevada)

MANAGEMENT FACTORS: NatureServe (2019, but last species update 1997) lists threats to *A. californica* as roadside flower-pickers, off-road vehicles and increased development in Las Vegas Valley that is extirpating populations. Additional potential threats noted Air Force bombing and gunnery range activities and gypsum mining. Sheldon (1994) adds that trampling by feral burros is a major concern as these animals damage both the plants and the soft ground they inhabit. Mistretta et al (1996) cited reasons for the species' decline as loss of habitat due to urbanization, habitat fragmentation, wild animal grazing, mineral exploration, highway development, off-road vehicle use, and desert recreation. Saxena (2005) believes the most important conservation measure for this species is the protection of areas with *A. californica* populations from further development. Sheldon (1994) goes even further when she states that, given the affinity of the species for gypsum soils, gypsum outcrops themselves must be preserved in order to successfully preserve *A. californica*.

Because *Arctomecon californica* is a short-lived perennial plant, it has been considered extinct at a site when live plants are absent during a survey, opening the way for land development. Accordingly, understanding seed bank dynamics and habitat based indicators for *A. californica* success is the only workable approach for managing this species. *A. californica* maintains a residual soil seed bank that likely overlaps generations and provides a buffer against catastrophic events. The inclusion of seeds within the seed bank reveals the presence of a substantially larger population than previously considered. For species such as *A. californica* that have sporadic germination, multi-year monitoring is not just recommended but essential (Megill 2011).

Sheldon (1994) believes that unoccupied soils that are near and similar to those with extant plants are important for future growth and maintenance of the population. She believes seed dispersal could promote expansion onto these currently unoccupied lands. In the future, current population sites could be composed of mostly senescent individuals, with younger, reproductively vigorous plants forming new populations on previously un-colonized soil. She also cites Diamond's (1984) theory that extinction rates are inversely area-dependent—the larger the area the species in question has to utilize, the lower its probability of extinction.

When using seeds from the seedbank as an indicator of *A. californica* population presence, Abella et al (2013) caution that only the extraction method of separating the seeds from the soil and confirming their identification can be used. The emergence method of actually germinating the seeds from the soil is not recommended because it has yet to be successful.

PROTECTIVE MEASURES TAKEN: In Arizona, this species does obtain some protection by growing mostly within the Lake Mead National Recreation Area, under National Park Service supervision.

SUGGESTED PROJECTS: Due to the limited distribution in Arizona, additional surveys should be undertaken to better understand the current extent of the species. In addition, the taxonomic issue should be prioritized and resolved (including genetic analysis).

According to The Nature Conservancy (2007), the Las Vegas bearpoppy has been monitored by agency botanists at Lake Mead NRA and BLM lands, and at the North Las Vegas Airport population continuously since 1998. The current status of these studies and the data collected should be ascertained.

Meyer and Forbis (2006) have synthesized thirty years of demographic information for Las Vegas bearpoppy into a life history model and PVA (population viability analysis). Preliminary PVA model runs indicate that even large, intact populations are at considerable risk of local extinction due to environmental stochasticity alone. They note that small, fragmented populations are limited by pollen transfer and therefore set little seed. Some populations seem to be extant solely as a consequence of seeds produced before fragmentation occurred and such populations are predicted to have little chance of persistence. They conclude that effective conservation hinges on protection of large tracts of occupied habitat, including adjacent matrix vegetation that can support pollinators when Las Vegas bearpoppy is present only as a seed bank. The current status of this research needs to be ascertained.

Soil mycorrhizae relations and seed germination ecology are other research needs.

LAND MANAGEMENT/OWNERSHIP: BLM – Kingman Field Office; NPS – Grand Canyon National Park and Lake Mead NRA; State Land Department; and possibly BIA – Hualapai Nation and Private.

SOURCES OF FURTHER INFORMATION

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ADDITIONAL INFORMATION: Plants cannot be transplanted and apparently no one has been able to grow plants successfully from seed to maturity. Known populations of this taxon should be monitored (Mozingo and Williams 1980). The name *Arctomecon* is from either the Greek word *arktos* meaning bear or the Latin word *arcto* meaning close or tight and the Greek word *mecon* meaning poppy (Brian, 2000). The name *californica* was named for the Mexican territory of Alta California, where this plant was found in 1844 by John Charles Frémont. Alta California historically included the area of present Las Vegas, Nevada.

Revised: 1995-05-22 (DBI)
2003-08-14 (SMS)
2005-09-15 (SMS)
2019-05-22 (BDT)

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Arizona Game and Fish Department. 20XX **(= year of last revision as indicated at end of abstract)**. X...X **(= taxon of animal or plant)**. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. X pp.