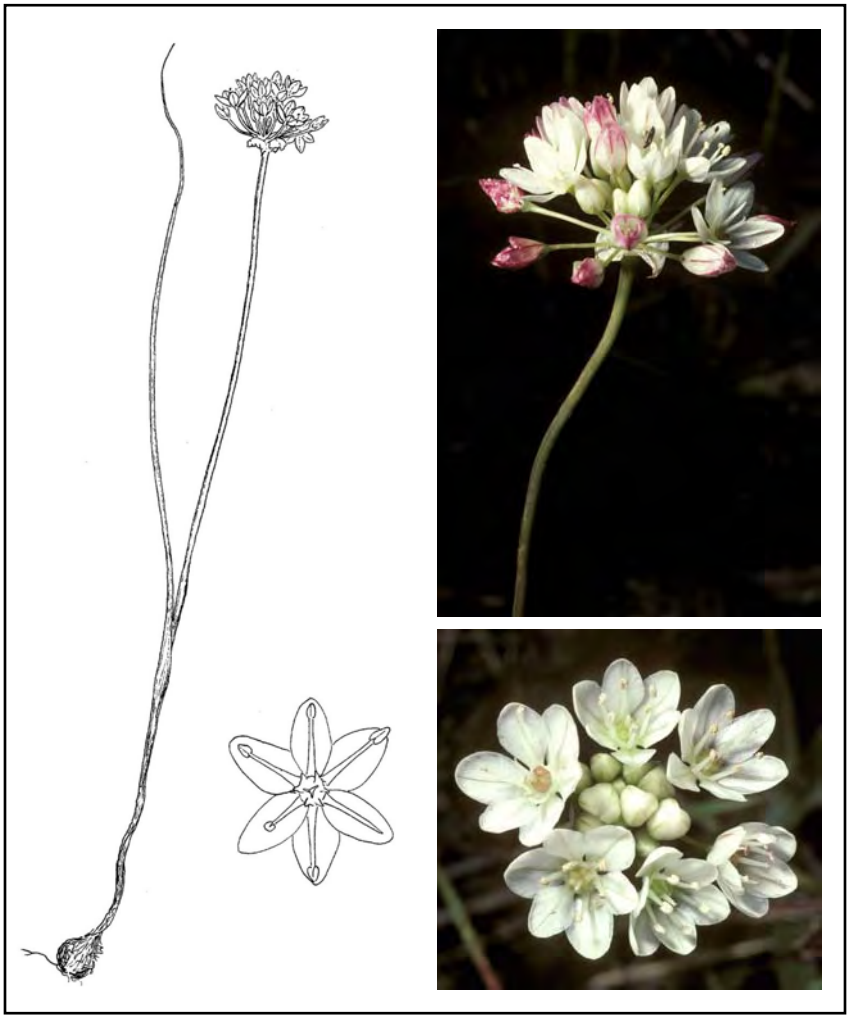
Allium munzii
Munz's Onion

5-Year Review:
Summary and Evaluation



U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
Carlsbad, California

June 17, 2009

5-YEAR REVIEW
***Allium munzii* (Munz's Onion)**

I. GENERAL INFORMATION

Purpose of 5-Year Review:

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

Species Overview:

Allium munzii is a bulb-forming perennial herb that annually produces a single cylindrical leaf and, depending on the amount of rain and the age of the plant, a flower stalk. It is a narrow endemic species that is generally restricted to mesic (wet) heavy clay soils along the southern edge of the Perris Basin in western Riverside County, California (Boyd 1988, p. 2; Roberts et al. 2004, pp. 10 and 130).

Methodology Used to Complete the Review:

This review was conducted by Gjon Hazard (with input from Sally Brown) of the Carlsbad Fish and Wildlife Office following the Region 8 draft guidance issued in March 2008. We relied on our 1998 final listing rule (Service 1998, pp. 54975–54994); proposed and final critical habitat rules (Service 2004a, pp. 31569–31582; Service 2005a, pp. 33015–33033, respectively); the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) (County of Riverside 2003, whole document in general) and its supporting documents, including the MSHCP biological opinion (FWS-WRIV-870.19, June 22, 2004; Service 2004b, pp. 1–1203); information from species experts, as well as reports and information in our files. We received one response as a result of the "notice of review" we published in the *Federal Register* on March 22, 2006 (Service 2006, pp. 14538–14542). This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing or since the last 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information

to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

Contact Information:

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Federal Register Notice Citation Announcing Initiation of This Review:

A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register on March 22, 2006 (Service 2006, pp. 14538–14542). We received information from one commenter that included general information on status and threats to *Allium munzii*.

Listing History:

On December 15, 1994, we proposed to list four southwestern California plants, including *Allium munzii* (Service 1994, pp. 64812–64823), and on October 13, 1998, we published the final rule (Service 1998, pp. 54975–54994). Prelisting history is summarized in the final rule.

Original Listing:
FR Notice: 63 FR 54975.
Date of Final Listing Rule: October 13, 1998.
Entity Listed: *Allium munzii* (Munz's onion), a plant species.
Classification: Endangered.

State Listing:
In January 1990, the State of California listed *Allium munzii* (Munz's onion) as threatened under the California Endangered Species Act (see Factor D, below).

Associated Rulemakings:

On June 7, 2005, we published a final rule designating 176 acres of Federal land as critical habitat for this species (Service 2005a, pp. 33015–33033). The rule became effective on July 7, 2005.

Review History:

This is the first 5-year review since the species was listed in 1998. We have not conducted a five-factor analysis since listing, although the 2005 final rule designating critical habitat (Service 2005a, pp. 33015–33033) included a general summary of threats known at the time.

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

Per our 1983 guidance, as amended, the recovery priority number for *Allium munzii* is 2, according to the Service's 2008 Recovery Data Call for the Carlsbad Fish and Wildlife Office based on a 1 to 18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Service 1983a, pp. 43098–43105; Service 1983b, p. 51985). This number indicates the taxon is a full species that faces a high degree of threat but also has a high potential for recovery.

Recovery Plan or Outline:

Neither a recovery outline nor a recovery plan has been developed for this species. On September 27, 2002, we initiated a contract (#10181-2-M618) to develop a multi-species recovery plan that included *Allium munzii, Atriplex coronata* var. *notatior,* and *Brodiaea filifolia.* An incomplete preliminary draft of the plan was presented to the Service on September 10, 2003. The internal draft is currently being revised.

II. REVIEW ANALYSIS

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

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

Updated Information on Current Species Status, Biology, and Habitat:

Since listing in 1998, we have updated the species' information in our proposed and final rules for critical habitat (Service 2004a, pp. 31569–31582; Service 2005a, pp. 33015–33033). Additionally, we analyzed the species throughout its range as part of the biological opinion for the Western Riverside County MSHCP (FWS-WRIV-870.19; June 22, 2004) (Service 2004b, pp. 320–327).

Taxonomy

The name and description of *Allium munzii* have not changed since it was listed (Service 1998, p. 54975). At that time all *Allium* taxa were placed in the Liliaceae (Lily family). Although the

name of the species remains the same, the genus *Allium* has been segregated from Liliaceae and placed in the family Alliaceae (Onion family).

Family Placement—Liliaceae versus Alliaceae

When the Service listed *Allium munzii*, the genus *Allium* was included in the large, broadly defined family Liliaceae (Lily family). *Allium* and several other genera including *Bloomeria, Dichelostemma, Triteleia,* and *Brodiaea* historically have been placed in the Amaryllidaceae (Amaryllis family) or Liliaceae (Lily family) based on perceived importance of characters related to the position of the ovary or the inflorescence type. The genus has also been segregated in the family Alliaceae. Recent molecular and anatomical studies support this latter alignment (Fay and Chase 1996, pp 441–451).

Following a now abandoned format, *Allium* was retained in the Liliaceae in the recent continental flora, Flora of North America (McNeal and Jacobsen 2002, pp. 224–276). However, the author of the family description (Utech 2002, p. 52) included a table that listed *Allium* as a member of the Alliaceae and stated that the available evidence strongly supported this placement.

Alliaceae, including *Allium*, will be recognized as a separate family in the upcoming revision of the Jepson Manual, the authoritative current treatment of the flora of California. Upon review and in agreement with available systematic and floristic literature and consultation with species experts, we intend to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations to reflect the transfer of *Allium munzii* from Liliaceae to Alliaceae. This transfer does not alter the definition or distribution of the listed species, *A. munzii*.

Life History

Native *Allium* species typically require 3 to 5 years after seeds germinate for plants to reach maturity and produce flowers (Schmidt 1980, p. 164). *Allium munzii* plants are dormant from mid-summer through autumn. If conditions are adequate (see below) *A. munzii* plants produce a leaf prior to flowering in spring and early summer. The flowering period for this species varies from year to year but is generally from March to May (California Native Plant Society [CNPS] 2001, p. 67). *Allium munzii* shares its range and habitat with a portion of the range of the similar-appearing *A. haematochiton* (red-skinned onion). Though the two species can occur within several feet of each other, the species do not interbreed (California Department of Fish and Game [CDFG] 1989, p. 2). After flowering and seed dispersal, the aboveground portions of *A. munzii* plants die back to the bulb. *Allium munzii* is adapted to seasonal (summer and autumn) drought and variable annual rainfall. McNeal (1992, p. 413) observed that flowering in the *A. fimbriatum* complex, which includes *A. munzii*, appeared to be correlated with rains in the late fall and early winter. He also noted that when rainfall was plentiful most plants within a population would flower; when rainfall was light most plants would sprout leaves, but very few would produce inflorescences (McNeal 1992, p. 413). As a result, during a given growing season, *A. munzii* may occur in various states: (a) as dormant underground bulbs; (b) as seedlings and other pre-reproductive plants that only produce one leaf; (c) as adults with only a leaf that, for whatever reason, do not produce an inflorescence that year; (d) as adults that

produce a leaf as well as an inflorescence; and (e) as seeds in a soil seedbank. It is not known how long *A. munzii* seeds can remain viable in the soil nor what proportion of a population may occur as seeds in a soil seedbank.

In addition to sexual reproduction through seed production, *Allium munzii* plants can reproduce asexually through vegetative division of the bulbs (Ellstrand 1999, p. 1; Ellstrand 1993, p. 5). The resulting "daughter" plants are genetically identical to the originating plant. Such daughter plants are sometimes referred to as "clones". Ellstrand (1999, p. 4) observed that the percentage of clones varied among the populations *A. munzii* he sampled. For example, at one population 30 to 40 percent of the sampled individuals were clones, whereas in a different population no more than 8 percent were clones; however, the total number of *A. munzii* individuals within clonal groups was small, ranging from 2 to 8 (Ellstrand 1999, p. 4). He also noted that *A. munzii* plants that were separated by greater than about an inch were "almost certain to be genetically distinct" and he concluded that "genetically identical individuals resulting from division of bulbs can be fairly common, but formation of large [groups of] clones, in either numbers of plants or geographical area, does not occur in *Allium munzii*" (Ellstrand 1999, p. 4).

Genetics and Pollination

No studies are available regarding *Allium munzii* seed dispersal and the amount of information available about the species' genetic diversity within and among populations is limited to a preliminary genetic assessment of samples from two locations at Lake Skinner and from Harford Springs Park by Ellstrand (1999, pp. 1–4). In that limited study he concluded the "genetic variation found in [*A. munzii*] . . . is exceptionally high" (Ellstrand 1999, p. 4). He speculated that the high genetic diversity he observed may have resulted from *A. munzii* plants' ability to perpetuate genotypes through time via asexual reproduction (Ellstrand 1999, p. 4). Although not explicitly stated by him, we assumed this result occurs because sexual reproduction (seed formation) is also occurring at the same time in the same populations—that is, individual genetic lineages are being maintained by asexual reproduction at the same time additional genetic combinations are entering the population through sexual reproduction.

It is not known whether *Allium munzii* is self-incompatible. Some cultivated *Allium* species are self-compatible (Benedek and Gaál 1972, p. 175; Williams and Free 1974, p. 409; Kumar et al. 1985, p. 62; Gray and Steckel 1986, p. 167; Ceplitis 2001, p. 722; Molano-Flores et al. 1999, p. 753). However, at least one species, *A. tricoccum* (wild leek), was suggested to be self-incompatible (Jones 1979, p. 41).

There is no definitive information regarding pollinators of *Allium munzii*, and it is likely that a number of insect species serve that function (S. Boyd, Rancho Santa Ana Botanic Garden, pers. comm., 2007). Bees, flies, and beetles have been found to pollinate cultivated and native *Allium* species (Benedek and Gaál 1972, pp. 175–180; Williams and Free 1974, pp. 409–417; Keller and Hammer 1999, p. 65; Kotlińska 1999, pp. 66–67; Clement et al. 2007, pp. 131–135). Further, small beetles of the Anthicidae family were observed to occupy about one-third of the *A. munzii* inflorescences in a population in Temescal Canyon (The Environmental Trust 2002, p. 16). Anthicid beetles can serve as pollinators for other flowering plants (e.g., Armstrong and Drummond 1986, p. 35), and although the report by The Environmental Trust implied that the

observed beetles on *A. munzii* were serving that role (The Environmental Trust 2002, p. 16), it did not provide any specific details.

Habitat

Allium munzii is generally restricted to heavy clay soils, although at least one population on Bachelor Mountain (California Natural Diversity Database [CNDDB] EO 10) was reported to be associated with pyroxenite outcrops instead of clay (CNDDB 2008, p. 11). Clays where *A. munzii* is found typically have a sticky, adobe consistency when wet and form large cracks when dry (Boyd 1988, p. 4). Known clay soil types include: Altamont, Auld, Bosanko, Claypit, and Porterville clays (Service 2005a, p. 33022). Clay soils may occur over large areas or in discrete, island-like patches or "lenses" within other soil types. Clay lenses within other soil types may not be identified on coarse-scale soil maps (Service 2005a, p. 33022). Further, *A. munzii* is generally restricted to the locally wetter (mesic) sites (Boyd 1988, p. 2) on level or slightly sloping areas (Service 2005a, p. 33022).

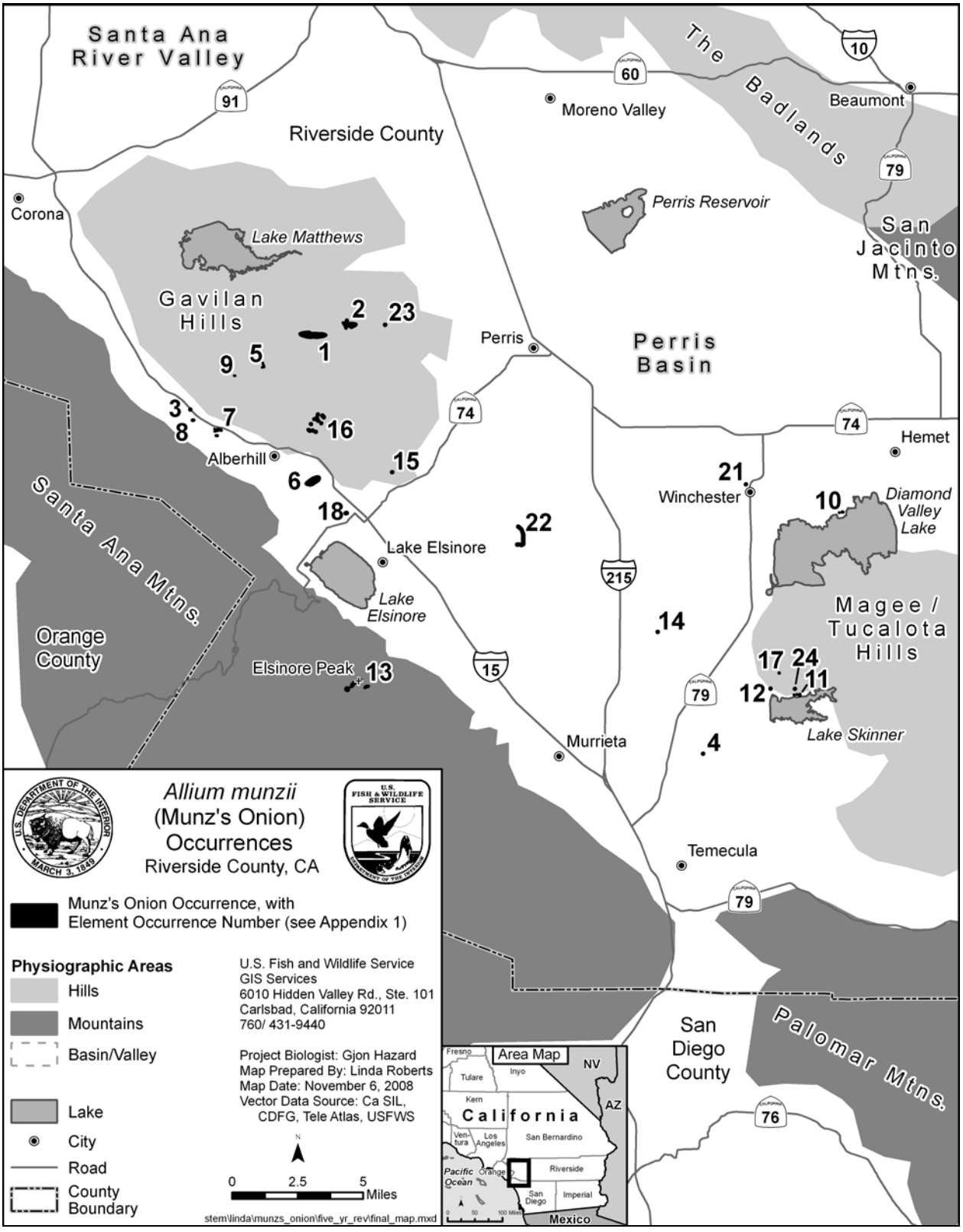
The clay deposits in southwestern Riverside County typically support characteristic flora (see Boyd 1988; Service 2005a, p. 33022). Surveys in areas of clay soils with *Allium munzii* in the Gavilan Hills, Boyd (1983, p. 67) identified *Nassella lepida* (foothill needlegrass), a native perennial bunchgrass, to be the most abundant native perennial species on the clay soils, with 25 to 50 percent cover (Boyd 1983, p. 67). Additionally, *Erodium macrophyllum* (round-leaved filaree), a sensitive species of clay soils, is also known to occur in areas with *Allium munzii* (Gillespie 2005, p. 56). *Allium munzii* may be associated with *Nassella* grasslands, which may occur as a dominant plant community or found in a mosaic with Riversidean coastal sage scrub, scrub-oak chaparral, chamise chaparral, coast live oak woodland, or peninsular juniper woodland and scrub (Service 2005a, p. 33022).

Allium munzii is also found with nonnative plants, primarily invasive annuals. Boyd (1983, p. 67) reported that in the clay soil grasslands on the Gavilan Hills *Bromus hordeaceus* (soft chess) and *Hypochoeris glabra* (smooth cat's ear) were "abundant" and *Avena barbata* (slender wild oat) and *Centaurea melitensis* (tocalote) were "common", while *Brassica geniculata* (shortpod mustard), *Bromus madritensis* ssp. *rubens* (red brome or foxtail chess), and *Gallium aparine* (goose grass) were reported to be in smaller amounts.

Distribution

Allium munzii is a narrow endemic species with a naturally discontinuous distribution in western Riverside County (Boyd 1988, p. 2; Roberts et al. 2004, pp. 10 and 130) (Figure 1). *Allium munzii* is generally restricted to clay soils along the southern edge of the greater Riverside–Perris plain area (Perris Basin), from 980 to 3,500 feet in elevation (Boyd 1988, p. 2; Service 2005a, pp. 33021 and 33022). These soils are scattered in a non-continuous band several miles wide and extending approximately 40 miles from the Gavilan Hills, Temescal Canyon, and Lake Elsinore to the southwestern foothills of the San Jacinto Mountains near Lake Skinner and Diamond Valley Lake. The species' distribution is restricted to certain habitat conditions within those clay soils (see Habitat section above).

Figure 1. *Allium munzii* (Munz's onion) occurrences in the greater Perris Basin, western Riverside County, California. See Appendix 1 for element occurrence details.



Appendix 1 summarizes the location and numbers of *Allium munzii*. The table is based on information from the CNDDB (2008, pp. 1–24) and other sources. For the purposes of this 5-rear review, we refer to occupied locations by the element occurrences (EOs) as defined in Appendix 1. These EOs are primarily based on the CNDDB's designations; deviations from the CNDDB's occurrences are noted in footnotes on the table. We included data from field observations, herbarium collections, and focused surveys and studies. Some occurrence data provided in the MSHCP proved to be unsubstantiated by CNDDB data and/or were questioned by a species expert, Steve Boyd (pers. comm. 2007). We did not include these unsubstantiated occurrences in Appendix 1.

We identified 13 occurrences at the time of listing (Service 1998, p. 54975). Since then, three new occurrences have been detected (EOs 17, 18, and 24) (Appendix 1). In addition, we now know of several older (pre-listing) records that we did not know about at the time of listing, further increasing the total number of EOs. Of the 24 EOs listed in the Appendix 1, 18 are presumed to be extant (still in existence) (EOs 2–7, 9–18, 23, and 24), two are thought to be extirpated (locally extinct) (EOs 1 and 8), one listed by CNDDB likely never existed (EO 20), one was listed by CNDDB in error (EO 19), and two are historical and their status is unknown (EOs 21 and 22) (see Appendix 1 for details). Because of scant information for EOs 21 and 22 (the former being over 100 years old) and the amount of anthropogenic disturbance in the vicinity of these locations, we believe it is unlikely that these occurrences are extant. Additionally, the CNDDB recently combined EO 8 with EO 3, presumably because of their close proximity to each other. In this analysis, we continue to treat EO 8 as separate to provide continuity with earlier treatments, although EO 8 has been destroyed and EO 3 has been heavily impacted by urban development (see Appendix 1).

The historical distribution of *Allium munzii* is not known; however, as much as 80 to 90 percent of the potentially suitable clay-soil habitat had been lost by the time *A. munzii* was listed by the State in 1989 (Boyd 1988, p. 2; CDFG 1989, p. 4). Since listing, several new occurrences have been detected; however, the species' extant range has remained about the same. Because of the species' restricted habitat requirements we do not anticipate the extant range will change in the future, even if additional populations are discovered.

Abundance

It is unclear what constitutes a biological "population" in *Allium munzii*. As used here, a population is defined as a spatially discrete group of conspecific individuals (Ellstrand 1992, p. 77). Certain isolated CNDDB Element Occurrences most likely constitute populations by themselves (e.g., EO 13; see Boyd and Mistretta 1991, p. 3). However, some EOs in aggregate, because of their close proximity to each other, may actually represent a single population.

There are limitations in comparing numbers of standing individuals of plant species, including *Allium munzii.* For *A. munzii*, the differences in numbers of plants noted in Appendix 1 may be due to annual differences in environmental conditions, survey timing and methodology, and the extent of habitat surveyed (effort). Annual differences in germination or flowering patterns can cause a population to appear to shrink, expand, or even move spatially from year to year. Furthermore, *Allium munzii* can be difficult to detect. Dormant *A. munzii* bulbs exhibit no

above-ground portions and, thus, are not detectable by visual surveys. This species is best detected when flowering (especially when it is growing with other low, herbaceous plants) because each bulb forms only one thin leaf each year (e.g., see Ellstrand 1993, p. 4; Ellstrand 1996, p. 6). Depending on rainfall conditions in a given year, some *A. munzii* plants with leaves will not flower and may go undetected during most surveys. Plants within any population will flower for only a few weeks during the growing season (Ellstrand 1993, p. 4), further decreasing the likelihood of detection. Finally, the sampling effort is not consistent between years or locations. Therefore, the number of detected plants in any one population varies from year to year and is not necessarily an accurate reflection of the actual population abundance. For example, one occupied site near Harford County Park (a portion of EO 2; Appendix 1) yielded a relatively constant number of *A. munzii* plants from 1992 through 1994 (approximately 4,000, 6,500, and 5,115 individuals); then in 1995 the detectable population ballooned to 28,269 individuals, only to crash (in terms of *detectible* plants) to nearly zero in 1996 (Ellstrand 1996, p. 4).

In the 1998 listing rule, we estimated that there were 20,000 to 70,000 individuals. The data we have now indicate that 9 of the 18 extant EOs have yielded approximately 1,000 or more individuals in at least one year (Appendix 1). The largest occurrence is at Harford County Park and on adjacent private lands (EO 2), with over 50,000 individuals reported in 1995 (Ellstrand 1996, p. 4). The remaining 9 *A. munzii* occurrences appear to be much smaller; several occurrences support 500 or fewer plants. The smallest occurrence (EO 17) consists of two individuals. These visual surveys likely only detected a portion of the actual number of individuals; therefore, the largest number of plants detected at a given location may be considered the *minimum* number of individuals that occupy that site. The data we have are not adequate to determine any overall population trends. Given the life history and local persistence of this species, it is probable that it will take considerable effort to determine abundance trends.

Five-Factor Analysis:

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

The original listing rule identified urban development, agriculture, and clay mining as primary threats to *Allium munzii* under this factor (Service 1998, pp. 54982). Additional threats identified in the listing rule included inundation by a reservoir and degradation and/or fragmentation by agricultural practices, weed abatement activities (especially disking), fire suppression practices, and trampling/grazing.

A complex, multi-species habitat conservation plan (MSHCP) that encompasses the entire range of *Allium munzii* was completed and signed on June 22, 2004. *Allium munzii* is a "Covered Species Adequately Conserved" under the MSHCP, which means the species is adequately addressed in the plan without additional agreements.

The MSHCP defines *Allium munzii* as a "Narrow Endemic Plant Species" and requires surveys for this species as part of the review process for public and private projects in certain areas where one or more of the permittees have discretionary authority for project approval (e.g., where

grading permits are required from local jurisdictions for development projects). These surveys are required where projects are proposed in suitable habitat within a defined boundary of the Criteria Area (see County of Riverside 2003: Narrow Endemic Species Survey Area Map, Figure 6–1 of the MSHCP, Volume I). For locations with positive survey results, the MSHCP calls for 90 percent of those portions of the property that provide long-term conservation value for the species to be avoided until it is demonstrated that the conservation objectives for the species are met. This measure is aimed at precluding the loss of newly discovered populations of *A. munzii*, at least until the species-specific objectives are met. The MSHCP has the following Species-Specific Conservation Objectives (County of Riverside 2003, Appendix E):

- *Objective 1*: Include within the MSHCP Conservation Area at least 21,260 acres of suitable habitat (grassland, coastal sage scrub, chaparral, and peninsular juniper woodland between 984 and 3,281 feet elevation in the Riverside Lowlands and Santa Ana Mountains Bioregions). This will include at least 2,070 acres of clay soils: Altamont (190 acres), Auld (250 acres), Bosanko (600 acres), Claypit (100 acres), and Porterville (930 acres) soils underlying the suitable habitat.

- *Objective 2*: Include within the MSHCP Conservation Area at least 13 localities within Temescal Valley and the southwestern portion of Plan Area, including the following Core Areas: Harford Springs Park, privately owned EO 5 population in Temescal Valley, Alberhill, De Palma Road, Estelle Mountain, Domenigoni Hills, Lake Skinner, Bachelor Mountain, Elsinore Peak, Scott Road, North Peak, and northeast of Alberhill (EO 16).

- *Objective 3*: Conduct surveys for *Allium munzii* as part of the project review process for public and private projects within the Narrow Endemic Plant Species Survey Area where suitable habitat is present (see Narrow Endemic Plant Species Survey Area Map, Figure 6-1 of the MSHCP document). *Allium munzii* located as a result of survey efforts shall be conserved in accordance with procedures described within Section 6.1.3 of the MSHCP document.

Pursuant to section 7 of the Act, we found in the associated biological opinion (FWS-WRIV-870.19, June 22, 2004) that implementation of the MSHCP, including its associated avoidance, minimization, and mitigation measures, would not reduce appreciably the likelihood of both the survival and recovery of *Allium munzii* (Service 2004b, p. 327). However, implementation of this 75-year plan is in its early stages and most of the anticipated impacts and conservation have not yet occurred. We anticipate impacts from urban development, agriculture, and mining will eventually be reduced by the MSHCP, but at the present time, we believe those threats generally continue to varying degrees at the levels described below.

Urban Development

Urban development can destroy *Allium munzii* habitat through grading, paving, and construction activities. For example, prior to listing, *A. munzii* habitat at EO 1 was impacted when the area was converted to citriculture (Boyd 1988, p. 2) and any remaining individuals were lost when the area was converted to urban development (CNDDB 2008, p. 1). Also, portions of the habitat at

EO 3 were destroyed by construction of Interstate 15 and associated infrastructure (CNDDB 2008, p. 4).

Since listing, urban development has continued in the region and has directly affected *Allium munzii* habitat. The entire habitat at EO 8 was destroyed by urban development, as were portions of the available habitat at EOs 3 and 7 (Appendix 1). Additionally, proposed urban development may affect portions of the habitat at EOs 2, 6, and 16 (Appendix 1). However, many of these past and proposed developments took or are proposing to take steps to avoid and minimize impacts to *A. munzii*. For example, the development footprint of the Rancho Bella Vista project intentionally avoided occupied *A. munzii* habitat at EO 4 (Service 2000, p. 30). As mentioned, implementation of the MSHCP is anticipated to prevent or limit the amount of impact future urban development will have on this species. Nevertheless, urban growth is expected to continue in western Riverside County (County of Riverside 2002, pp. 285–287). Therefore, at this time we believe urban development continues to be a significant threat to the species; however, through time, we anticipate the implementation of the MSHCP will reduce this threat.

Agriculture

Agricultural activities typically involve repeated tilling, which increases disturbance regimes and can change soil properties and natural hydrological conditions. Agriculture also generally involves weed abatement activities to prevent all but the desired crop from growing. Even after agricultural activities (tillage) ceases, sites that have undergone severe disturbance may not recover their native plant communities for decades (Stylinski and Allen 1999, p. 550).

Past agricultural activities, primarily planting, cultivation, and tillage of the soil, have impacted areas known to be occupied with *Allium munzii* (CDFG 1989, p. 4; CNDDB 2008, pp. 1–23, database report pp. 1–21). As stated above, the habitat at EO 1 was initially impacted by citriculture (Boyd 1988, p. 2) and portions of the available habitat at EO 14 showed signs of past agricultural activities when observed in 1992 (CNDDB 2008, p. 15). Recently, existing agricultural lands have been used for urban development.

We have no new information indicating habitat at extant EOs is threatened with agricultural activities. Agriculture is an activity covered by the MSHCP and we anticipate that implementation of the plan's avoidance and minimization measures will prevent or limit impacts from agriculture to known *Allium munzii* occurrences. We believe the magnitude of the threat from agricultural activities has been greatly reduced since the time of listing.

Clay Mining

Clay mining can remove suitable soils, heavy equipment activity can compact remaining soil, spoil material can burry habitat areas (e.g., Boyd 1988, p. 3), and resulting changes in landform can change hydrological patterns. Prior to listing, portions of EO 6 were destroyed by clay mining activities (Appendix 1).

Clay pit mining is an ongoing activity within the range of *Allium munzii*. Although no *A. munzii* plants continue to exist within the footprints of active clay mines, any remaining *A. munzii*

occurences around the periphery of existing mines are threatened by mine growth. For example, our analysis indicates portions of the habitat at EO 6 still exist (Appendix 1) and this habitat may continue to support some individual plants outside of the mine footprint. New mines have been proposed near currently occupied habitat. For example, in Temescal Canyon two new mines have been proposed, Corona Clay Mine (Permit #SMP00197) and Cleo Owens (Permit #SMP00208) (County of Riverside 2007, pp. 1–7). Should these projects go forward, we anticipate impacts to *A. munzii* habitat will likely be prevented or limited due to the avoidance and minimization requirements of the MSHCP. New mines within the narrow endemic plant survey areas defined by the MSHCP must conduct focused surveys for *A. munzii*. Although clay mining continues to be a threat, the magnitude of this threat is not as great as it was in the past and, through time, we anticipate that implementation of the MSHCP will further reduce this threat.

Wildland Fire Management

Allium munzii habitat may be destroyed, modified, or curtailed during the creation and maintenance of fire breaks. This has been identified as a threat to *A. munzii* in the past (Boyd 1988, p. 1; Boyd and Mistretta 1991, pp. 4 and 5). Fire breaks may be created well before any wildland fire, but they can also be created at the time of a wildland fire as a specific response to contain or control that fire. In the latter case, the emergency-response atmosphere may prevent or limit consideration of biologically less destructive alternatives. As discussed in Factor E below, we expect wildland fires to regularly occur in the western Riverside County region. We anticipate the creation and maintenance of fire breaks to continue, though we can not predict where emergency-response fire breaks will be created. Moreover, burned areas are sometimes intentionally reseeded with nonnative plants with the intent to control erosion (e.g., O'Leary and Westman 1988, p. 779; Keeler-Wolf 1995, pp. 127–139; Beyers 2004, pp. 947–956). This practice may exacerbate the threats to *A. munzii* posed by nonnative species (see Factor E). Therefore, we believe wildland fire management may still be a threat to the species, but the magnitude of this threat is not clear.

Off-highway Vehicle Activity

Off-highway vehicle (OHV) activity has been identified as a threat to *Allium munzii* (CDFG 1989, p. 4; Winter 1992, p. 7; Gillespie 2005, p. 58). *Allium munzii* is a small, herbaceous plant and OHVs are likely to crush or damage the above-ground portions of the plant. This may result in the death of the plant or reduced reproductive output. Moreover, OHV activity may modify or curtail *A. munzii* habitat by promoting erosion, compacting the soil (especially if OHV activity is conducted when the soil is wet), and promoting invasion by nonnative plants (Lovich and Bainbridge 1999, p. 316; see also Kuss 1989, pp. 637–650). Off-highway vehicle activity may also stir up dust, which may cause water loss in plants (Eveling and Bataillé 1984, p. 234), increasing stress on *A. munzii*. Our visual inspection of recent aerial imagery shows that trails and disturbance from OHV activity are obvious in several areas occupied by *A. munzii*. We believe OHV activity is a threat to the species, although the magnitude of the threat is unclear.

Summary for Factor A

The destruction of *Allium munzii* habitat continues to be significant since listing. Urban development was and continues to be the primary source of habitat loss for the species. Other sources of habitat loss, especially agricultural practices and clay mining, appear to be less significant now than at the time of listing. This may be due, in part, to changes in land use away from agriculture and mining toward urban development. However, the implementation of the MSHCP is anticipated to reduce impacts from urban development and further reduce impacts from agriculture and mining. Off-highway vehicle activity may affect certain EOs, but the level of this threat is not clear. Wildland fire and associated fire control activities are likely to increase in frequency, but are geographically and temporally unpredictable with unclear effects on the species.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

This factor was not known to be a threat at the time of listing nor do we consider it a threat now.

FACTOR C: Disease or Predation

The 1998 listing rule did not identify disease or predation as significant threats. Predation in the form of grazing by cattle or sheep could impact this species. Grazing by livestock appears to have been identified as a threat by some observers at several EOs prior to listing (Appendix 1), but it was not included in our final rule. Grazing is not known to be a significant threat at this time. Likewise, disease is not known to be a threat at this time.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of listing we noted that although this species was listed by the State as Endangered, unauthorized impacts were occurring to *Allium munzii* (Service 1998, p. 54985). The final listing rule (Service 1998, p. 54985–54988) details additional regulatory mechanisms that afford some level of protection to this species (e.g., California Endangered Species Act [CESA] and the California Environmental Quality Act [CEQA]).

The current status of existing State and Federal regulatory mechanisms for *Allium munzii* follows.

State Protections

The State's authority to conserve rare wildlife and plants is comprised of four major pieces of legislation: the California Endangered Species Act, the Native Plant Protection Act, the California Environmental Quality Act, and the Natural Community Conservation Planning Act.

California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA): The CESA (California Fish and Game Code, section 2080 *et seq*.) prohibits the unauthorized take of State-listed threatened or endangered species. The NPPA (Division 2, Chapter 10, section 1908)

prohibits the unauthorized take of State-listed threatened or endangered plant species. The CESA requires State agencies to consult with the California Department of Fish and Game on activities that may affect a State-listed species and mitigate for any adverse impacts to the species or its habitat. Pursuant to CESA, it is unlawful to import or export, take, possess, purchase, or sell any species or part or product of any species listed as endangered or threatened. The State may authorize permits for scientific, educational, or management purposes, and to allow take that is incidental to otherwise lawful activities. *Allium munzii* was listed by the California Fish and Game Commission as threatened under CESA and NPPA.

Furthermore, with regard to prohibitions of unauthorized take under NPPA, landowners are exempt from this prohibition for plants to be taken in the process of habitat modification. Where landowners have been notified by the State that a rare or endangered plant is growing on their land, the landowners are required to notify the California Department of Fish and Game 10 days in advance of changing land use in order to allow salvage of listed plants. Recently, salvage and translocation of *Allium munzii* plants has occurred but it is unclear whether such activities will be effective.

California Environmental Quality Act (CEQA): The CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

Natural Community Conservation Planning Act: The Natural Community Conservation Program is a cooperative effort to protect regional habitats and species. The program helps identify and provide for area wide protection of plants, animals, and their habitats while allowing compatible and appropriate economic activity. Many Natural Community Conservation Plans (NCCPs) are developed in conjunction with Habitat Conservation Plans (HCPs) prepared pursuant to the Federal Endangered Species Act. On June 22, 2004, NCCP Approval and Take Authorization were issued by CDFG for the Western Riverside MSHCP. *Allium munzii* is a "Covered Species" under the MSHCP.

Federal Protections

National Environmental Policy Act (NEPA): NEPA (42 U.S.C. 4371 *et seq*.) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

Endangered Species Act of 1973, as amended (Act): The Act is the primary Federal law providing protection for this species. The Service's responsibilities include administering the Act, including sections 7, 9, and 10 that address take. Since listing, the Service has analyzed the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 CFR 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project.

Section 9 prohibits the taking of any federally listed endangered or threatened species. Section 3(18) defines "take" to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Service regulations (50 CFR 17.3) define "harm" to include significant habitat modification or degradation which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. Harassment is defined by the Service as an intentional or negligent action that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. The Act provides for civil and criminal penalties for the unlawful taking of listed species. Incidental take refers to taking of listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 CFR 402.02). For projects without a Federal nexus that would likely result in incidental take of listed species, the Service may issue incidental take permits to non-Federal applicants pursuant to section 10(a)(1)(B). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved Habitat Conservation Plan (HCP) that details measures to minimize and mitigate the project's adverse impacts to listed species. Regional HCPs in some areas now provide an additional layer of regulatory protection for covered species, and many of these HCPs are coordinated with California's related NCCP program.

With regard to federally listed plant species, section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out does not jeopardize a listed plant species. Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the "take" of federally endangered wildlife; however, the take prohibition does not apply to plants. Instead, plants are protected from harm in two particular circumstances. Section 9 prohibits (1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and (2) the removal, cutting, digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation or in the course of any violation of a state criminal trespass law. Federally listed plants may be incidentally protected if they co-occur with federally listed wildlife species.

As previously discussed, the Western Riverside County MSHCP addresses impacts to *Allium munzii* throughout its range. The MSHCP is a large-scale, multi-jurisdictional NCCP/HCP that addresses 146 listed and unlisted "Covered Species" within a 1,260,000-acre Plan Area in western Riverside County. The MSHCP was designed to establish a multi-species conservation program that minimizes and mitigates the expected loss of habitat and the incidental take of

Covered Species. Although "take" only applies to listed wildlife, *Allium munzii* is "covered" under a 10(a)(1)(B) permit issued for the Western Riverside MSHCP in recognition of the conservation measures incorporated into the MSHCP for plant species. We concluded that planned activities covered by the MSHCP in combination with this conservation strategy would not jeopardize the continued existence of *Allium munzii* (Service 2004a). However the MSHCP has not yet been fully implemented, and the conservation objectives for *A. munzii* have not yet been achieved.

National Forest Management Act (NFMA): The National Forest Management Act (36 C.F.R. 219.20(b)(i)) has required the USDA Forest Service to incorporate standards and guidelines into Land and Resource Management Plans, including provisions to support and manage plant and animal communities for diversity and for the long-term, range-wide viability of native species. Recent changes to NFMA may affect future management of listed species, particularly rare plant occurrences, on National Forests. On January 5, 2005, the Forest Service revised National Forest land management planning under NFMA (70 FR 1023). The 2005 planning rule changed the nature of Land Management Plans so that plans generally would be strategic in nature and could be categorically excluded from NEPA analysis, and thus not subject to public review. Under the 2005 planning rule, the primary means of sustaining ecological systems, including listed species, would be through guidance for ecosystem diversity. If needed, additional provisions for threatened and endangered species could be provided within the overall multiple-use objectives required by NFMA. The 2005 planning rule did not include a requirement to provide for viable populations of plant and animal species, which had previously been included in both the 1982 and 2000 planning rules. On March 30, 2007, however, the United States District Court in *Citizens for Better Forestry et al. v. USDA* (N.D. Calif.) enjoined (prohibited) the USDA from implementing and utilizing the 2005 rule until the Forest Service provided for public comment and conducted an assessment of the rule's effects on the environment, including listed species.

On April 21, 2008, the Forest Service published a final 2008 planning rule and a record of decision for a final environmental impact statement examining the potential environmental impacts associated with promulgating the new rule (Forest Service 2008, pp. 21468–21512). The 2008 planning rule also does not include a requirement to provide for viable populations of plant and animal species on Forest Service lands. As part of the environmental analysis, a biological assessment was prepared to address the 2008 planning rule's impact to threatened, endangered, and proposed species and designated and proposed critical habitat. The assessment concluded that the rule does not affect, modify, mitigate, or reduce the requirement for the Forest Service to consult or conference on projects or activities that it funds, permits, or carries out that may affect listed or proposed species or their designated or proposed critical habitat. On August 8, 2008, the Forest Service published an interim directive and requested public comment on its section 7 consultation policy for developing, amending, or revising Land Management Plans under the 2008 planning rule. Thus, the impact of the 2008 rule to listed species is unknown at this time.

In 2005, the Forest Service consulted with us under section 7 of the Act for the land management plan developed under NFMA for the Cleveland National Forest (Service 2005b, pp 1–339). This consultation programmatically addressed the plan's potential effects to *Allium munzii*.

Summary for Factor D

In summary, while State law offers some protection to this species on private lands through the permit requirements of CESA and NPPA, the Act remains an important regulatory mechanism to address existing threats to the known occurrences of the *Allium munzii* on Federal lands. Along with the State's NCCP, the Act provides the primary mechanism to work with private landowners and local jurisdictions on voluntary actions, such as the western Riverside County MSHCP, that promote the recovery of the species.

FACTOR E. Other Natural or Manmade Factors Affecting Its Continued Existence:

The 1998 listing rule identified crowding and competition for resources from nonnative grasses as threats to *Allium munzii* at all of the then known locations (Service 1998, p. 54988). In particular, the final rule identified *Avena barbata* (slender oat) and *Bromus madritensis* (foxtail chess) as dominant nonnative grasses on clay soils. Drier climatic conditions (droughts) were also identified as a threat.

We discuss below the current/on-going impacts from invasive nonnative plants and drought. In addition, we describe threats from changes in fire regime, which we did not address in the 1998 listing rule.

Invasive Nonnative Plants

The final listing rule did not elaborate much beyond "crowding and competition" (Service 1998, p. 54988). Crowding, *per se*, is here examined as well as additional factors associated with nonnative plants that were not specified in the listing rule. In this discussion we have broadened our reference to invasive nonnative plants. Invasive nonnative plants are now prevalent (though not necessarily dominant) throughout much of cismontane southern California (Kirkpatrick and Hutchinson 1980, p. 30; Freudenberger et al. 1987, p. 15; Keeley et al. 2005, p. 2113), including western Riverside County (Westman 1981, p. 180; Minnich and Dezzani 1998, p. 368) where *Allium munzii* occurs.

Invasive nonnative plants may affect the ecosystem and associated plant taxa, both native and nonnative, in a variety of ways. These include direct competition for resources (e.g., water and light) and changes in growing conditions (i.e., thatch accumulation, and fire frequency) (D'Antonio and Vitousek 1992, pp. 63–87; see also Dukes and Mooney 2004, pp. 411–437). Increased soil nitrification (see below) may favor invasive nonnative plants, thereby likely exacerbating threats these plants pose to *Allium munzii*.

Direct Competition

It has been widely reported that invasive nonnative plants may out-compete native plants (Nelson and Allen 1993, pp. 40–50; Allen et al. 1998, p. 136; Alpert et al. 2000, pp. 52–66; Stohlgren et al. 2001, pp. 37–50; Dukes and Mooney 2004, pp. 411–437; Vilà and Weiner 2004, pp. 229–238). Reports were often anecdotal assuming plants were tapping the same resource in the same manner. The discussion here includes direct competition for water and light.

"Crowding", as identified in the listing rule, is essentially competition for space, which is likely inseparable from competition from other available resources like water and light.

Water Availability

Allium munzii plants, like all plants, require adequate water to survive, but water is critical for seedlings that require adequate soil moisture for germination and establishment. Sufficient water to hydrate the clay soils allows the developing bulb to reach the appropriate soil horizon for survival. There is no specific information on competition for soil moisture for *A. munzii*. However, Welker et al. (1991, pp. 461, 465) found that the nonnative grass *Bromus hordeaceus* reduced soil water availability and consequently shoot and root mass of co-occurring *Quercus douglasii* (blue oak) seedlings more than the native grass *Nassella pulchra*. Similarly, Dyer and Rice (1999, pp. 2701, 2704) noted that nonnative grasses (*Bromus* spp. and *Hordeum murinum*) reduced soil moisture availability in both clay and non-clay soils to the extent that it impacted the growth of the native *N. pulchra*. Hamilton et al. (1999, p. 523) found a similar pattern but reported that perennial *N. pulchra* drew water from a greater depth than annual, nonnative grasses and continued to draw water into the summer (in contrast to nonnative annual grasses that had already senesced). These studies show that nonnative invasive plants, and especially nonnative annual grasses, affect the amount of available soil moisture. Therefore, invasive nonnative plants are likely to be detrimental to the germination and establishment phase of *A. munzii* bulbs where they co-occur. Because of the prevalence and continuing invasion of nonnative plants, including annual grasses, we believe *A. munzii* is facing persisting competition for soil moisture.

Light Availability

All green plants need light to carry on photosynthesis. Native plants compete with nonnative plants (as well as other natives) for light (D'Antonio and Vitousek 1992, pp. 68–69). No information for light competition specific to *Allium munzii* is available; however, Dyer and Rice (1999, pp. 2701 and 2704) found plots with annual grasses *Bromus* spp. and *Hordeum murinum* had reduced amounts of light available near the ground compared to plots where nonnative plants were removed. They considered competition for light to be a contributing factor that reduced the growth and reproductive output in the native grass *Nassella pulchra* (Dyer and Rice 1999, pp. 2701 and 2704). Also, in a study in western Riverside County, Gillespie and Allen (2004, p. 650) suspected that competition for light with nonnative species contributed to high losses of seedlings of *Erodium macrophyllum*, a rare annual forb (non-woody plant) sometimes found in the same clay soil areas as *A. munzii*. The relatively short, single-leaved *A. munzii* plants, especially seedlings, are likely to be negatively impacted by earlier germinating, faster growing, larger nonnative plants in competition for light.

Changes in Growing Conditions

Although not mentioned in the listing rule, available evidence indicates that invasive nonnative plants may negatively alter the growing conditions for individual plants. Two such impacts are accumulation of thatch and changes in fire regime.

Thatch Accumulation

Annual plants generally die at the onset of the dry season. By the onset or during the wet season the dead aerial portions of the plants have fallen over onto the ground. Nonnative annuals often produce more biomass than associated native plants, which typically decay rapidly. Dead nonnative plants may consequently accumulate in a thick layer over otherwise unvegetated soil. When the dead material takes more than one year to decay, it forms a persistent layer of fallen or partially standing material termed "thatch". Within the range of *Allium munzii*, this phenomenon is most pronounced in sites with nonnative annual grasses. At the onset of the next wet season the more mesic annual grasses may be able to germinate before the native species and grow through the thatch, perpetuating the cycle (Heady 1956, p. 811).

The seedlings of some native plants are less successful at growing through the thatch (Eliason and Allen 1997, p. 252). Boyd (pers. comm. 2007) observed fewer *Allium munzii* plants flowering in areas with thatch compared to areas where the thatch had been removed by a fire. Thatch may also affect the microclimate (D'Antonio and Vitousek 1992, pp. 72; Dukes and Mooney 2004, pp. 419) (e.g., soil moisture and soil temperature). Thatch may act as a mulch to retain soil moisture, thereby favoring early germination and growth of the more mesic nonnative plants. Gillespie and Allen (2004, p. 648) reported that test plots in western Riverside County where thatch was removed (via fire) experienced significantly higher soil temperatures than control plots, whereas plots where only the standing weeds had been removed had similar temperatures to the control plots. Temperature is important for seed germination in a number of wild *Allium* species (Specht and Keller 1997, p. 513) and is likely important for bulbs to break dormancy (to sprout) (see Specht and Keller 1997, p. 509). It is unclear whether a layer of thatch from nonnative grasses and forbs significantly affects *A. munzii*, but it is a potential threat that should be investigated.

Changes in Fire Regime

Invasive nonnative plants and resulting thatch also have a negative effect on an area's fire regime (D'Antonio and Vitousek 1992, pp. 63–87; Brooks et al. 2004, pp. 677–688; Dukes and Mooney 2004, pp. 477–478), and can be deleterious to native plant species (Keeley et al. 2005, p. 2123). A changed fire regime was not addressed in the 1998 listing rule.

Attempts to determine the natural (baseline) wildland fire regime for the region have generated academic controversy (e.g., Keeley and Fotheringham 2001, pp. 1536–1548; Minnich 2001, pp. 1549–1553). In the recent past, southern California has seen an increase in the number of fires, both in frequency (Fruedenberger et al. 1987, p. 25) and extent (Minnich and Dezzani 1998, p. 382). The latter report states that these fires were "carried primarily by exotic [nonnative] annual grasslands". Wildland fire frequencies are closely correlated with human population growth (Keeley and Fotheringham 2001, p. 1542; Keeley 2004, p. 178). It is widely accepted that nonnative plants are important contributors to changes in fire regimes (D'Antonio and Vitousek 1992, pp. 63–87; Brooks et al. 2004, pp. 677–688; Dukes and Mooney 2004, pp. 411–437).

There is little specific information regarding fire or changes in fire regime on *Allium munzii*. However, as a bulb-forming geophyte, the plants can probably survive fires during the non-

growing season (S. Boyd, pers. comm. 2007). The presence of nonnative plants, especially annual grasses and any associated thatch, may change the seasonal timing and duration of fires—that is, thatch may change the wildland fire regime. Thatch increases fuel loads, thereby potentially sustaining larger, hotter fires earlier in the spring or later in the fall than what was historically typical (Brooks et al. 2004, p. 680; Keeley et al. 2005, p. 2123). These fires may burn when *A. munzii* is in a vulnerable, vegetative or reproductive state rather than a secure, dormant state. A changed wildland fire regime may also increase how often *A. munzii* habitat and surrounding natural areas burn, which would likely result in changes in plant and animal (including pollinator) communities. However, it is unclear to what extent changes in fire frequency will affect *A. munzii*.

Summary of Invasive Nonnative Plants

Nonnative plants are pervasive in western Riverside County, including areas where *Allium munzii* grows. Although there are no species-specific studies on the impact of nonnative species on *A. munzii,* studies indicate that the species likely faces threats from competition with nonnative plants for resources. There is little to suggest that this threat has diminished since listing. Evidence also suggests that invasive nonnative plants change growing conditions and fire regimes associated with *A. munzii*. The magnitude of these threats is difficult to quantify, but given that nonnative plants threaten native species through a number of pathways discussed here, we believe invasive nonnative plants continue to be a threat to *A. munzii*.

Drought

The final listing rule identified drier climatic conditions (aseasonal or prolonged drought, as opposed to typical, seasonal, summertime drought) as a source of stress for the species, and thus a potential threat to *Allium munzii*. Drought conditions were also thought to reduce germination and survival rates.

Annual rainfall in southern California is generally variable and prone to periodic droughts. We are not aware of any specific studies documenting the effects of drought on *Allium munzii*; however, *A. munzii* plants are less likely to flower during years of lower rainfall (McNeal 1992, p. 413). It is also likely that fewer *A. munzii* seeds in the soil seedbank germinate during dry years. Thus, we expect drought to reduce the reproductive capacity of *A. munzii*. We do not know the extent to which established *A. munzii* plants can tolerate prolonged periods of reduced water availability, but cultivated onion species are generally considered to be drought resistant (IPGRI et al. 2001, p. 28). Nor do we know the length of time *A. munzii* seeds can survive in the soil seedbank—long-lived seeds may survive periods of drought, but short-lived seeds might not. If *A. munzii* plants are drought-hearty, and/or if *A. munzii* seeds are long-lived, then the magnitude of this threat may not be high. Additional research is needed on the effects of prolonged drought on this species.

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, pp. 1–63; Cayan et al. 2006, pp, 1–47; Meehl et al. 2007, pp. 747–843). However, predictions of climatic conditions for smaller sub-regions such as California remain

uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular species at this time.

Summary of Factor E

Allium munzii may be threatened by effects associated with invasive nonnative plants. Although little direct information exists for *A. munzii*, nonnative plants have been shown to effectively compete for soil moisture and light in habitats similar to that of *A. munzii*. The profusion of nonnative plants, especially annual grasses, often results in a layer of thatch that has been shown to alter microclimates and affect other plant species and through anecdotal observation is suspected to affect *A. munzii*. Thatch may also alter wildland fire regimes by allowing fires to occur earlier in the year, which may burn vegetative *A. munzii* plants, or by increasing how often *A. munzii* habitat and surrounding natural areas burn, which may change plant and animal (including pollinator) communities. Prolonged or aseasonal drought may reduce recruitment of new *A. munzii* plants into the population, but additional research is needed to determine the effects of drought on established plants or seeds in the soil seedbank.

III. RECOVERY CRITERIA

Neither a recovery outline nor a recovery plan has been developed for this species.

IV. SYNTHESIS

Allium munzii occurs in approximately 18 extant EOs that are patchily distributed on heavy clay soils in western Riverside County. The exact number of individuals of *Allium munzii* is not clear because the number of observable plants varies from year to year and from EO to EO. Urban development continues to destroy and curtail the species' habitat, although continued implementation of the western Riverside County MSHCP is anticipated to reduce this threat and provide some habitat management. *Allium munzii* plants likely face increased competition for resources from invasive nonnative plants, although the magnitude of this threat is unclear. Nonnative plants and resulting thatch likely affects local fire regimes and the growth of *A. munzii*. Drought may also affect the species, but at an unknown level. We anticipate ongoing impacts to continue during the 75-year implementation of the MSHCP; however, this plan has only been in effect for a few years and the identified threats continue. At this time, we believe *A. munzii* is still in danger of extinction throughout its range in western Riverside County and therefore recommend no change in listing status.

V. RESULTS

Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (indicate reasons for delisting per 50 CFR 424.11):
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
_X_ No Change

New Recovery Priority Number and Brief Rationale:

This taxon is a full species that still faces a high degree of threat but also has a high potential for recovery. Additionally, this species has been in conflict with construction or other development projects. Therefore, per our 1983 guidance, as amended (Service 1983a, pp. 43098–43105; Service 1983b, p. 51985), we are changing the recovery priority number for this species from 2 to 2C. We anticipate that continued implementation of the western Riverside County MSHCP will reduce the degree of threat and conflict in the near future.

VI. RECOMMENDATIONS FOR FUTURE ACTIONS

- Work with Western Riverside Regional Conservation Authority and MSHCP Permittees to increase the number of "Conserved" EOs in Appendix 1 (see "Current Conservation Status" column), including the use of grants and other monies to purchase fee-title or conservation easements.

- Identify opportunities to conserve EOs on private lands through the Service's Partners Program and other programs.

- Coordinate with the Western Riverside Regional Conservation Authority and MSHCP Permittees to encourage the development of land management plans and to establish land management practices that will benefit the species for conserved EOs. Begin with EOs 2 and 14 that have been affected by weed abatement activities (pre-fire wildland fire management).

- Work with researchers and land managers to determine key stressors affecting *Allium munzii* in areas protected from development and expand and refine management actions to improve the species' status on conserved land.

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Appendix 1. Occurrence table for *Allium munzii*.

EO # [a]	Geographic Reference Name [b]	Threats known prior to or at time of 1998 listing [c]	Threats since 1998 listing [d]	Current Conservation Status [e]	Abundance History [f]
1[g]	Gavilan Plateau	Factor A: Cleared for agriculture (citrus) (Boyd 1988, p. 2; CNDDB 2008, p. 1)	Factor A: Citrus cleared for urban development (housing) (CNDDB 2008, p. 1)	Extirpated	1930: Present (CNDDB 2008, p. 1)
2	Harford Springs County Park	Factor A: Urban development; disking (Boyd 1986, p. 1; Boyd 1988, p. 2; Mistretta 1993, p. 3; CNDDB 2008, p. 2) Factor E: Non-native plants (Ellstrand 1994, p. 4)	Factor A: Urban development (Service 2007, pp. 1–2)	Partially Conserved: about 27 acres (53 percent) of available habitat (suitable soils) conserved—17 acres (33 percent) on County Park land, 10 acres (20 percent) conserved through implementation of MSHCP on the "Gavilan 160" project (Service 2007, pp. 1–2).	1979: Present (CNDDB 2008, p. 2) 1987: Present (CNDDB 2008, p. 2) 1990: >1,256 (CNDDB 2008, p. 2) 1991: Present (CNDDB 2008, p. 2) 1992: >4,000 (CNDDB 2008, p. 2) 1993: 45,200 (Ellstrand 1996, p. 4; CNDDB 2008, p. 2) 1994: 28,980 (Ellstrand 1996; CNDDB 2008, p. 2) 1995: 50,994 (Ellstrand 1996 p. 4) 1996: none flowering (Ellstrand 1996 p. 4) 1998: >7,500 (CNDDB 2008, p. 2) 2003: Present (L&L Environmental 2006) 2005: Present (L&L Environmental 2006) 2006: Present (L&L Environmental 2006)
3[h]	Sycamore Creek (Indian Truck Trail, north)	Factor A: Urban development (Interstate 15) (CNDDB 2008, p. 4) Factor E: Non-native plants (Boyd 1988, p. 2)	Factor A: Urban development (Service 2001a, p. 4; Anonymous 2002, p. 5)	Partially Conserved: 18.3 acres of suitable habitat conserved and 6.2 acres of clay soils translocated to onsite conserved area (Service 2001a, p. 10; Anonymous 2002, p. 9).	1982: Present (CNDDB 2007, p. 4) 2000: 200–300 (NRA 2000, p. 10)

EO # [a]	Geographic Reference Name [b]	Threats known prior to or at time of 1998 listing [c]	Threats since 1998 listing [d]	Current Conservation Status [e]	Abundance History [f]
4	Skunk Hollow	Factor A: Urban development (CNDDB 2008, p. 5) Factor E: Non-native plants (Sweetwater Environmental Biologists 1996, p. 12)		Conserved: Areas known to be occupied were conserved under the Rancho Bella Vista HCP (Service 2000, p. 30), but this area is not yet being managed (Maher 2008, p. 1).	1986: 50–75 (CNDDB 2008, p. 5) 1995: ~250 (Service 2000, p. 30)
5	Gavilan Hills	Factor A: Existing road, nearby development (CNDDB 2008, p. 6) Factor C: Grazing (CNDDB 2008, p. 6) Factor E: Non-native plants (*Avena* spp.) (CNDDB 2008, p. 6)		Not Yet Conserved: Implementation of MSHCP Narrow Endemic Plant Species policy is anticipated conserve at least 90 percent of this EO (Service 2004b, pp. 28 and 326).	1982: "locally common" (CNDDB 2008, p. 6) 1986: >2,000 (CNDDB 2008, p. 6)
6	Alberhill Mountain, south slope	Factor A: Clay mining (Boyd 1983, p. 81; Boyd 1986, p. 1; Boyd 1988, p. 2; CNDDB 2008, p. 7) Factor C: Sheep grazing (Boyd 1988, p. 2; CNDDB 2008, p. 7) Factor E: Non-native plants (*Avena* spp.) (Boyd 1986, p. 1; Boyd 1988, p. 2; CNDDB 2008, p. 7)	Factor A: Urban development (City of Lake Elsinore 2000, p. 3-1)	Partially Conserved: Most of the areas known to be occupied appear to be within an area purchased by the Western Riverside County Regional Conservation Authority, but suitable clay soil habitat (occupancy not determined) extends outside conserved area.	1982: <1,000 (CNDDB 2008, p. 7) 1986: 150–200 (Boyd 1988, p. 2; CNDDB 2008, p. 7) 2000: 7,732 (NRC 2000, p. 19)
7	De Palma Road (Saddle-back)	Factor A: Highway maintenance; anticipated urban development (CNDDB 2008, p. 8) Factor C: Grazing (CNDDB 2008, p. 8)	Factor A: Urban development; surface mining (Glenn Lukos Associates 2005, Exhibit 3); wildland fire containment activities (Dudek 2007, p. 4)	Partially Conserved: Partial onsite conservation and translocation of salvaged bulbs from impact areas from implementation of Saddleback Estates conservation measures (Dudek 2007, p. 4).	1986: >2,000 (CNDDB 2008, p.8) 2000: Present (CNDDB 2008, p. 8) 2003: 2,899 (Dudek 2007, p. 6) 2005: Similar numbers to those found in 2003 (Dudek 2007, p. 6;) 2006: 45 (CNDDB 2008, p. 8)

EO # [a]	Geographic Reference Name [b]	Threats known prior to or at time of 1998 listing [c]	Threats since 1998 listing [d]	Current Conservation Status [e]	Abundance History [f]
8[i]	Sycamore Creek (Indian Truck Trail, South)	Factor E: Non-native plants (*Avena* spp.) (Boyd, 1988, p. 2)	Factor A: Urban development (Sycamore Creek project) (Service 2001a)	Extirpated: EO impacted by Sycamore Creek development project, but 75 bulbs translocated to nearby conservation area (S. Brown, Service, pers. comm. 2008).	1986: ~1000 (CNDDB 2007, p. 9)
9	Estelle Mountain	Factor A: Potential urban development; road maintenance (CNDDB 2008, p. 10) Factor C: Grazing (CNDDB 2008, p. 10)		Conserved: EO is within Lake Mathews–Estelle Mountain Reserve.	[1986]: >2,000 (CNDDB 2008, p. 10)
10	North Domenigoni Hills	Factor A: Past disturbance from mining (CNDDB 2008, p. 11)		Conserved: EO is within Southwestern Riverside County Multi-Species Reserve.	1991: 441 (CNDDB 2008, p. 11)
11[j]	Lake Skinner, north shore (base of Bachelor Mountain)	Factor E: Drought; non-native plants (*Avena* spp., *Brassica* spp.) (CNDDB 2008)	Factor A: Chemical spill (Moen 2007)	Conserved: EO is within Southwestern Riverside County Multi-Species Reserve, though its status after the chemical spill is unclear.	1990: 700 (Ellstrand 1996, p. 4; CNDDB 2008, p. 12) 1992: 202 (Ellstrand 1996, p. 4; CNDDB 2008, p. 12) 1993: 3,343 (Ellstrand 1996, p. 4; CNDDB 2008, p. 12) 1994: 480 (Ellstrand 1996, p. 4; CNDDB 2008, p. 12) 1995: 3,538 (Ellstrand 1996, p. 4; CNDDB 2008, p. 12) 1996: 3 (Ellstrand 1996, p. 4; CNDDB 2008, p. 12)
12	Bachelor Mountain, southwest slope		Factor E: Non-native plants (Moen 2005, p. 2)	Conserved: EO appears to be within Southwestern Riverside County Multi-Species Reserve.	1989: 150 (CNDDB 2008, p. 13) 2005: Present (Moen 2005, p. 2)

EO # [a]	Geographic Reference Name [b]	Threats known prior to or at time of 1998 listing [c]	Threats since 1998 listing [d]	Current Conservation Status [e]	Abundance History [f]
13	Elsinore Peak	Factor A: Road grading, OHV activity, development (Boyd and Mistretta 1991, p. 4; Mistretta 1993, p. 3; CNDDB 2008, p. 14). Factor E: Non-native plants, wildland fire control measures, fragmentation (Boyd and Mistretta 1991, p. 4; Mistretta 1993, p. 3; CNDDB 2008, p. 14).		Partially Conserved: Partly on Cleveland National Forest Land, which has guidelines to avoid and minimize impacts to this species (Winter 1992; Service 2005b) and any impacts will be addressed through section 7 consultation.	1991: "Thousands" (Boyd and Mistretta 1991, p. 2; CNDDB 2008, p. 14) 1995: Present (CNDDB 2008, p. 14) 2005: Present (CNDDB 2008, p. 14)
14	Scott Road	Factor A: Agriculture (CNDDB 2008, p. 15) Factor E: Non-native plants (CNDDB 2008, p. 15)		Conserved: EO partially within an area now owned by the Western Riverside County Regional Conservation Authority (avoided as a conservation measure for a subdivision development) (Service 2002, p. 2) and partially within an area in the process of being preserved (off-site preservation as a conservation measure for a gas pipeline) (Service 2001b, p. 35).	1992: ~1,000 (CNDDB 2008, p. 15)
15	North Peak, North of Lake Elsinore	Factor C: Herbivory (MBA 1995, p. 3)		Conserved: The EO is on lands purchased and conserved by Western Riverside County Regional Conservation Authority. This land will become part of the Additional Reserve Lands under the MSHCP (Service 2004b, p. 323).	1990: "Large population" (CNDDB 2008, p. 16) 1991: Present (CNDDB 2008, p. 16) 1993: "Several thousand" (CNDDB 2008, p. 16) 1995: 6,800 (MBA 1995, p. 3)

EO # [a]	Geographic Reference Name [b]	Threats known prior to or at time of 1998 listing [c]	Threats since 1998 listing [d]	Current Conservation Status [e]	Abundance History [f]
16	Northeast of Alberhill	Factor A: Road construction (CNDDB 2008, p. 17) Factor E: Non-native plants (CNDDB 2008, p. 17)	Factor A: Urban development (L&L Environmental 2003, p. 1–22; Service 2005c, pp. 1–2, CNDDB 2008, p. 17)	Not Yet Conserved: Implementation of MSHCP Narrow Endemic Plant Species policy is anticipated conserve at least 90 percent of this EO (Service 2004b, pp. 28 and 326; Service 2005c, pp. 1–2). A portion of the EO appears to be outside the proposed "Village at Walker Canyon" impact area (L&L Environmental 2003, pp. 1–22).	1989: Present (CNDDB 2008, p. 17) 1993: ~300 (CNDDB 2008, p. 17) 2003: ~3,000 (White 2003, p. 8; CNDDB 2008, p. 17)
17	Bachelor Mountain, north slope			Not Yet Conserved: Implementation of MSHCP Narrow Endemic Plant Species policy is anticipated conserve at least 90 percent of this EO (Service 2004b, pp. 28 and 326).	1999: 2 (CNDDB 2008, p. 18)
18	Warm Springs Valley (Alberhill Marsh)			Not Yet Conserved: Implementation of MSHCP Narrow Endemic Plant Species policy is anticipated conserve at least 90 percent of this EO (Service 2004b, pp. 28 and 326).	2000: Present (CNDDB 2008, p. 19)
19[k]	—	—	—	—	—
20[l]	Gavilan Peak	—	—	—	—
21	Winchester			Unknown: Location information vague. The age of report and amount of development in vicinity of mapped location suggests extant status unlikely. If extant, it may benefit from MSHCP Narrow Endemic Plant Species policy.	1897: Present (CNDDB 2008, p. 21)
22	Railroad Canyon Road			Unknown: Location information vague, plus CNDDB mapped location does not fit with textual location. Much development in vicinity. Extant status seems unlikely.	1962: Present (CNDDB 2008, p. 22)

EO # [a]	Geographic Reference Name [b]	Threats known prior to or at time of 1998 listing [c]	Threats since 1998 listing [d]	Current Conservation Status [e]	Abundance History [f]
23	Ida Leona (Toussaint)			Not Yet Conserved: Occupied area avoided during apparent lot split and subsequent development (Greene 1999, pp. 1). Conservation status of avoided area unknown (easement?). Not in an MSHCP Narrow Endemic survey area, but is within Criteria Area.	1999: 12 (Greene 1999, pp. 1–2; CNDDB 2008, p. 23)
24[m]	Bachelor Mountain, south slope			Conserved: EO is within Southwestern Riverside County Multi-Species Reserve.	1994: 69 (Ellstrand 1996, p. 4) 1995: 835 (Ellstrand 1996, p. 4) 1996: 0 (Ellstrand 1996, pp. 3–4)

[a] Element Occurrence (EO) number, as generally defined by the California Natural Diversity Database (CNDDB 2008, pp. 1–21) (except where noted).

[b] The location name for each EO, for general reference purposes only. Not all *Allium munzii* populations are necessarily circumscribed within geographic location listed.

[c] Threats, by listing factor (with citations), for each EO from the time of listing or before. This table only lists threats identified by available sources for a particular EO. *Allium munzii* plants may face other threats not specifically listed here (see five-factor analysis above).

[d] Threats, by listing factor (with citations), for each EO since listing. This table only lists threats identified by available sources for a particular EO. *Allium munzii* plants may face other threats not specifically listed here (see five-factor analysis above).

[e] Our best assessment from the information available as to the conservation status of each EO. Conservation classes:

- Conserved = The land where the EO occurs is not expected to be developed because it has been set aside for conservation purposes or other generally compatible uses (but the *Allium munzii* plants may still be subject to other, non-development threats); population presumed extant.
- Partially Conserved = Only a portion of the land where the EO occurs has been conserved; population presumed extant.
- Not Yet Conserved = The land where the EO is located has not been set aside for conservation purposes but is subject to protections afforded by the MSHCP; population presumed extant.
- Unknown = Information about EO is inadequate to determine conservation status; status of population unclear (extant vs. extirpated).
- Extirpated = The habitat at the EO has been destroyed and the *Allium munzii* population is thought to be locally extinct.

[f] Abundance information (with citations). "Present" indicates the *Allium munzii* was detected, but the numbers of individuals were not indicated in the information available. The geographic extent surveyed and survey methodologies may differ within and among EOs from year to year. See also comments regarding the detectability of this species in the text. As such, the numbers presented in this column *should not be considered comparable*, even within EOs, and are presented as general information only. Maximum numbers detected should be considered the *minimum* number of individuals that may occur.

[g] See EO 20.

[h] Very close to EO 8; recently combined by CNDDB with EO 8 presumably because of their close proximity.

[i] See EO 3; recently combined by CNDDB with EO 3 presumably because of their close proximity.

[j] See EO 24.

[k] EO 19 was created in error and has since been removed by the CNDDB.

[l] Assumed to be same as EO 1 (S. Boyd, pers. comm. 2007).

[m] Not an official CNDDB EO at this time; the location is identified by Ellstrand (1994, p.4) as "Skinner-3" which is mapped in Ellstrand (1993, p. 22).

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *ALLIUM MUNZII* (MUNZ'S ONION)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

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

Review Conducted By: Gjon Hazard, Carlsbad Fish and Wildlife Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve _____ Date June 17, 2009