

Monardella linoides* subsp. *viminea
(Willowy Monardella)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service

Carlsbad Fish and Wildlife Office

Carlsbad, California

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5-YEAR REVIEW
Monardella linoides subsp. *viminea* (Willow Monardella)

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5-YEAR REVIEW

Monardella linoides subsp. *viminea* (Willow Monardella)

1. GENERAL INFORMATION

Monardella linoides ssp. *viminea* is a perennial herbaceous plant in the mint family (Lamiaceae) with a woody base and aromatic foliage. The waxy, green hairy stems bear conspicuously gland-dotted bracts, linear or lance-shaped leaves, and dense, terminal heads of white to rose-colored flowers. This species primarily inhabits sandy washes and floodplains in coastal sage scrub or riparian scrub vegetation. Of the 11 extant populations, most are concentrated in the Miramar area of San Diego County, while one disjunct and possibly different subspecies population extends south into Baja California, Mexico (63 FR 54938, Jokerst 1993, Elvin and Sanders 2003).

1.1. Reviewers

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

Lead Field Office: Jim A. Bartel, Field Supervisor, Carlsbad Fish and Wildlife Office, 760-431-9440

1.2. Methodology used to complete the review: This review was compiled by staff of the Carlsbad Fish and Wildlife Office (CFWO), U.S. Fish and Wildlife Service (Service). The review was completed using documents from office files as well as available literature on *Monardella linoides* subsp. *viminea*. We relied on our 1998 listing rule, our proposed critical habitat designation, our final critical habitat designation, and reports and information in our files, sent to us during the public response period. The subspecies' status and threats at the time of listing are compared to current status and threats.

1.3. Background:

1.3.1. FR Notice citation announcing initiation of this review:

A notice announcing initiation of the 5-year review for this subspecies and the opening of a 60-day period requesting information from the public was published in the Federal Register on March 22, 2006 (71 FR 14538). During the 60-day period we received information from two respondents but neither provided new information relevant to this review.

1.3.2. Listing history

Original Listing

FR notice: Federal Register 63: 54938-54956

Date listed: October 13, 1998

Entity listed: *Monardella linoides* subsp. *viminea* (willow monardella), a plant subspecies.

Classification: Endangered

1.3.3. Associated rulemakings

Critical Habitat

FR notice: Federal Register 71: 65662-65683

Date published: November 8, 2006

1.3.4. Review History

None.

1.3.5. Species' Recovery Priority Number at start of 5-year review:

The recovery priority number for *Monardella linoides* subsp. *viminea* is 2, according to the Service's 2006 Recovery Data Call for the Carlsbad Fish and Wildlife Office. This priority indicates that this plant is a subspecies facing a high degree of threat but having a high potential for recovery.

1.3.6. Recovery Plan or Outline

No recovery plan or outline has been completed or assigned.

2. REVIEW ANALYSIS

2.1.1. Application of the 1996 Distinct Population Segment (DPS) policy: This policy is not applicable to plant species.

2.1.2. Is the species under review a vertebrate? No.

2.1.3. Is the species under review listed as a DPS?

No. The Endangered Species Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing as DPS to only vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

2.2. Recovery Criteria

No recovery plan has been finalized or approved; therefore assessment of recovery criteria is not applicable.

2.3. Updated Information and Current Species Status

2.3.1. Biology and Habitat

Spatial distribution and trends in spatial distribution: This narrow endemic plant persists in small isolated occurrences within a 72-square-mile (186 square-kilometer) area between Los Penasquitos Canyon and Mission Gorge in San Diego County and northern Baja California (Epling 1925; 63 FR 54938). When listed in 1998, all but one population (supporting ca. 200 individuals) were found in between Penasquitos Canyon and Mission Gorge in San Diego County, California (63 FR 54938). Willowy monardella has been found from a single population in northern Baja California, Mexico. This taxon occupies the same range that it did at the time of listing (Table 1).

Abundance and population trends: At the time of listing in 1998, there were approximately 6,000 individuals known from 20 populations within the United States (63 FR 54940). Seven populations were considered extirpated prior to listing of the subspecies in 1998 (Table 1; 63 FR 54938). At the time of listing, 15 of the 20 populations had fewer than 100 plants per population; six of these had fewer than 15 individuals (63 FR 54940). The Marine Corps Air Station Miramar (Miramar) populations had the most plants (1,500 individuals in 1998; see also Rebman and Dossey 2006). At the time of listing, the combined Miramar occurrences supported an estimated 2,000-3,000 plants (CNDDDB 1998).

Table 1. Areas historically and/or currently occupied by *Monardella linoides* subsp. *viminea*.

CNDDDB #	Name	Current trend	Last observed	Last surveyed	Reference
1	Lopez Canyon Ж	Decreasing	2006	2006	**
2	Cuervo (Lopez) Canyon Ж	Decreasing	1987	1987	CNDDDB 1998, 1999, 2007, **
3	Cemetery Canyon	Extirpated	1978	1987	CNDDDB 1998, 1999, 2007
4	Carrol Canyon	Extirpated	1979	1987	CNDDDB 1998, 1999, 2007
6	Kearney Mesa/Carrol Canyon	Extirpated	1977	1987	CNDDDB 1998, 1999, 2007
7	Carrol Canyon Drainage	Extirpated	1987	1987	CNDDDB 1998, 1999
8	Sycamore Canyon	Decreasing	2006	2006	**, ***
11	San Clemente Canyon	Extirpated	1993	<2004	CNDDDB 1998, 1999, 2007
12	San Clemente Canyon/Miramar	Extirpated	1987	1987	CNDDDB 1998, 1999, 2007
13	San Clemente Canyon/Miramar	Extirpated	1987	Unknown	CNDDDB 1998, 1999, Elvin 2000 notes
14	Murphy Canyon	Extirpated	1987	2003	CNDDDB 1998, 1999, 2007, ***
15	Murphy Canyon, Rifle Range	Decreasing	2000	2000	CNDDDB 1998, 1999
16	San Clemente Park	Extirpated	1987	<2004	CNDDDB 1998, 1999, 2007
17	San Clemente Park, Genessee Ave.	Extirpated	1981	<2004	CNDDDB 1998, 1999, 2007
18	San Clemente Canyon	Extirpated	1981	1987	CNDDDB 1998, 1999
20	Carroll Canyon (Pomerado Terrace)	Extirpated	1981	<1985	CNDDDB 1998, 1999, 2007
21	West Sycamore Canyon	Decreasing	2006	2006	**, ***
23	Lopez Canyon, Mira Mesa Ж	Decreasing	2002	2006	CNDDDB 1998, 1999, 2007, **
24	South edge Miramar (Elanus Canyon)	Decreasing	1987	2002	CNDDDB 1998, 1999, 2007, ***
25	Carroll Canyon (south Mira Mesa)	Extirpated	2000	2000	CNDDDB 1998, 1999, Elvin 2000 notes
26	Spring Canyon	Stable	2002	2002	CNDDDB 1998, 1999, Elvin 2000 notes, ***
27	San Clemente Canyon, E. I-15	Unknown	2002	2002	CNDDDB 1998, 1999, 2007, ***
29	Sycamore Canyon, SW Goodan Ranch	Unknown	2002	2002	CNDDDB 1998, 1999, 2007
31	MCB Miramar	Decreasing	Unknown	Unknown	CNDDDB 1998, 1999, 2007
*	Otay Lakes	Decreasing		2006	**
*	Marron Valley	Unknown		2006	**

CNDDDB identification # = occurrence number assigned by the California Natural Diversity Database (CNDDDB 2007).

Ж = Treated as one population by the City of San Diego.

Bold = extirpated.

* Currently not considered by CNDDDB or California Native Plant Society to represent *Monardella linoides* subsp. *viminea*; therefore, these populations have lost their CNDDDB *M.l.* subsp. *viminea* number.

** <http://www.sandiego.gov/planning/mscp/pdf/monitor/monardella2006.pdf>

*** Rebman and Dossy 2006.

Of the 26 areas historically and/or currently known to be occupied in California, current records indicate that at least 13 previously known occurrences have been extirpated (Table 1) (Kelly and Burrascano 2001). Nine occurrences have been discovered since listing in 1998, including one that was subsequently extirpated (see Table 1). The Miramar population had the most plants (1,500 individuals in 1998; see also Rebman and Dossey 2006). However, for unknown reasons (potentially due to invasive plants outcompeting willow monardella), this population now appears to be rapidly declining (Kassebaum, MCAS Miramar, *in litt.* 2007). Merkel and Reiser (1998, p. 17) also report “*Willow monardella is severely declining in total numbers in San Diego County...all populations should be protected*” [italics added].

The Service is now aware of only 11 extant populations of willow monardella in San Diego County, 10 of which have decreasing populations. Some of these populations are decreasing rapidly (Burrascano, California Native Plant Society *in litt.* 2007, Greer, City of San Diego, *in litt.* 2007, Kassebaum *in litt.* 2007). These are located on lands managed by Marine Corps Air Station Miramar, California Department of Forestry, Bureau of Land Management, and on other areas covered by approved subarea plans under the San Diego Multiple Species Conservation Program (MSCP). These subarea plans include the City of San Diego Subarea Plan and County of San Diego Subarea Plan. Currently, there are no proposed impacts, as the subspecies mostly occurs on reserve lands.

Despite surveys and anecdotal observations in historical *Monardella linoides* subsp. *viminea* habitat during favorable collection periods, current observation data are limited. Population demography for the subspecies is unknown; life history parameters (seed viability, annual productivity, mortality) are also currently unknown (Kassebaum *in litt.* 2007). Surveys (historical or recent) appear to have not been conducted at all locations, and the few recent specifics regarding plant survival suggest rapidly declining populations throughout the subspecies’ contiguous United States range (Burrascano *in litt.* 2007, Greer *in litt.* 2007, San Diego 2007). This loss has been known for at least the past seven years in several areas, with a lack of recruitment and “*dramatic and rapid decline*” [italics added] (Rebman and Dossey 2006, p. 10) in the population occurring over the past three years (Kassebaum *in litt.* 2007, Burrascano *in litt.* 2007, Greer *in litt.* 2007). Repeated, systematic population status studies of willow monardella have occurred on Miramar and are showing a declining population with limited reproduction (Rebman and Dossey 2006). Little is known regarding the subspecies’ extant population status in Mexico, including the locations known at the time of listing.

Historically and currently there are few surveys that indicate numbers of plants present across all of the known occurrences. Because this is a perennial subspecies that reproduces vegetatively to some extent (Elvin and Sanders 2003), decline in a population due to lack of seedling establishment may be difficult to detect. Some occurrences may consist mostly of persisting older plants and thus show little or no capacity for recruitment.

Genetics, genetic variation, or trends in genetic variation: No information has been available regarding genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, or inbreeding) for this taxon. Small population size and separation distance between populations suggest that genetic threats may cause perturbations in *Monardella linoides* subsp. *viminea* survival, long-term retention, and recovery.

Subsequent to the publication of a paper by Elvin and Sanders (2003) indicating segregation of *Monardella linoides* subsp. *viminea* from *M. linoides* and recognition at the species rank, we initiated independent analysis by the research staff at Rancho Santa Ana Botanic Garden, Claremont, California. Specifically we wanted to know if the morphological evidence presented by Elvin and Sanders was supported by genetic analysis. The Elvin and Sanders (2003) classification is based, in part, on vegetative features, a category they considered to be variable. More research will be necessary to review the subspecies derivation and taxonomic position. The Service has initiated this review; currently the work is continuing by Rancho Santa Ana Botanical Garden in an attempt to ascertain morphological and genetic differences using advanced assay techniques. It is anticipated that this research will use population genetics analysis to assess the relationships and taxonomic boundaries of all of the *M. linoides* taxa and the limits and taxonomic position of *M. linoides* subsp. *viminea*.

Taxonomic classification or changes in nomenclature: Willowy monardella was first described as *Monardella viminea* (Greene 1902) based on a specimen collected by Vasey in 1880. Greene later renamed the plant *Madronella viminea* (Greene 1906). Munz (1935, p. 450) recognized willowy monardella at the varietal rank as *Monardella linoides* var. *viminea*. Abrams (1951, p. 655) renamed it at the subspecies rank as *Monardella linoides* subsp. *viminea*.

Since the listing, Elvin and Sanders (2003) split the taxon into two separate entities. They elevated the southern occurrences to species status as *Monardella stoneana*. The remaining occurrences were still considered willowy monardella but were elevated by Elvin and Sanders (2003) to the original rank of species as *M. viminea*. At the time it was published, this taxonomic alignment was not accepted by the Service (Bartel and Wallace 2004) because of the belief that Elvin and Sanders (2003) did not provide adequate supportive evidence in their paper. The Service believed that it was prudent to continue to treat all populations as listed and at the subspecies rank. Bartel and Wallace (2004) unpublished critique was addressed solely to the Service files for the purpose of litigation (*California Native Plant Soc. v. Norton*, 01-1742-IEG). The Elvin and Sanders (2003) placement has since been ... “*recognized by the* [California Department of Fish and Game] *California Natural Diversity Data Base, California Native Plant Society, the 4th edition of the Checklist of San Diego County Vascular Plants, and the Jepson Online Interchange*” [italics added] (Roberts and Fieitner 2006, p.5). None of these sources provide additional data applicable to the classification. To date, the Service has considered all occurrences of willowy

monardella identified in the listing rule as *M. linoides* subsp. *viminea* a subspecies protected by the Endangered Species Act.

It is anticipated that upon completion of the genetic analyses described above and the upcoming revision of the genus *Monardella* in the Jepson Manual, there will be clarification of the status, relationships, and circumscription of willow monardella.

Habitat or ecosystem conditions: *Monardella linoides* subsp. *viminea* is found in sandy washes, benches, and floodplains of perennial streams of extreme southern California and northern Baja California. This plant needs specific components of ecosystem structure, function, and integrity. These include natural ephemeral watersheds with regular flooding regimes that periodically scour riparian vegetation and move alluvial material, and flowing water only after peak seasonal rains (63 FR 54938). Habitat and soil requirements include coarse, rocky, and sandy alluvium on terraced floodplains (including benches, stabilized sandbars, channel banks, and sandy washes) within ephemeral drainages. *Monardella linoides* subsp. *viminea* is sustained by the natural processes and conditions of perennial streams and threatened by those factors that disrupt those processes and conditions. Finally, the subspecies needs semi-open canopies of coastal sage and riparian scrub with limited herbaceous understory. It is frequently associated with *Eriogonum fasciculatum* (California buckwheat), *Platanus racemosa* (sycamore), *Quercus agrifolia* (coast live oak), *Artemisia californica* (California sagebrush), and *Baccharis sarathroides* (broom baccharis) (Scheid 1985).

2.3.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms).

2.3.2.1. Factor A – Present or threatened destruction, modification or curtailment of its habitat or range:

As noted in the 1998 final listing rule, *Monardella linoides* subsp. *viminea* populations have been affected and reduced by grazing/trampling, urban and residential development, various recreational activities (e.g., off road vehicles and off trail hiking), altered hydrological regimes, road construction, soil removal, sand and gravel mining, trash dumping, and erosion (63 FR 54938, CNDDDB 2007).

Some unprotected private lands throughout the subspecies' range currently host small remnant populations of *Monardella linoides* subsp. *viminea*. To date, the cities of San Diego and Santee have been purchasing private property as reserve land for *Monardella linoides* subsp. *viminea*. Most of these private lands have been surveyed since the time of the subspecies' listing, and conditions of these lands and the populations of *Monardella linoides* subsp. *viminea* are known (San Diego 2007). Urbanization and habitat fragmentation remain one of the biggest threats to the subspecies. Up to 1992, San Diego had grown by “*a factor of 10 over the last 50 years*” [italics added] (Soule et al. 1992, p. 39). Currently, all areas with willow

monardella that were to be developed apparently have been developed and remaining populations are protected by the MSCP (Carlsbad Fish and Wildlife Office files). However, populations located on reserves may still be subject to the habitat threats noted above. For example, erosion of drainages adjacent to willow monardella populations can impact the subspecies even in reserves; Lopez Canyon is a good example of where erosion from urban runoff has already occurred and impacted willow monardella populations (City of San Diego willow monardella monitoring report, 2002, Carlsbad Fish and Wildlife Office files).

Of the 20 populations known at the time of listing, five had fewer than 100 individuals and none of these five populations were protected at the time of listing. Two other populations at Miramar were partially destroyed by road construction. Two large populations were on private property; the larger of the two populations (340 individuals) was threatened by sand and gravel mining. The second of these (200 individuals) was on property proposed for development, which, to date, has not occurred. A smaller population in San Clemente Park (City of San Diego) had approximately 60 plants in the early 1980s, and fewer than 35 plants in 1987 (CNDDDB 1998); its status at the time of listing was unknown. Habitat in Los Penasquitos City Regional Park has become degraded by stream erosion, trash dumping, and the invasion of non-native species; the fate of this population was unknown at listing but suspected to be generally protected due to site-specific restrictions (City of San Diego 2004).

Almost all known populations were affected by the 2003 fires that burned much of San Diego County (SDSU 2007). The best-protected, most robust, and largest population associated with Miramar is located on land with shared ownership between the military, the City of San Diego, and private parties. This population was damaged by off-road vehicles and the fires of 2003; both threats increased potential for nonnative species incursions. The cascading effect(s) of the 2007 fires are currently unknown. Recent monitoring of this population indicates that the population has declined significantly for unknown reasons that are likely not related to past threats (Rebman and Dossey 2006, Kassebaum *in litt.* 2007).

Wildfire, fire exclusion within serotinous habitat (known but not described at time of listing), trash dumping, off-highway vehicles, changes in hydrology, development and fragmentation of habitat, and drought have all contributed to additive negative impacts to *Monardella linoides* spp. *viminea*. Direct, indirect or cumulative effects of anthropogenic development of suitable habitat in San Diego County are currently unknown. Based on the human footprint in Southern California, and specifically San Diego County, there is high probability that some populations (known and unknown) have been degraded or eliminated since the time of listing. As noted in section 2.3.1. above, even the healthiest populations, despite their protection on reserve lands, are declining. Reduction of the already scarce total population suggests long-term genetic issues may become operative as a threat factor in causing further demise to individuals of the subspecies, causing a population vortex leading to extinction.

Sand and gravel mining also adversely affects willowy monardella habitat (63 FR 54946) and has broad-scale disruptive qualities to native ecosystems (Kondolf et al. 2001). Gravel mining has the potential to eliminate or disrupt local populations through changes in hydrology and elimination of individual plants. Although we have no specific information on locations where gravel mining is now occurring, we recognize it as a serious threat that we are unable to monitor on private lands.

Monardella linoides subsp. *viminea* continues to be threatened by habitat loss and degradation by trampling, various recreational activities (e.g. off-road vehicles and off-trail hiking), altered hydrological regimes, sand and gravel mining, trash dumping, and erosion. Habitat of this subspecies can also be impacted by uncontrollable fires or flood events. In summary, of the 11 extant populations, many are located on Federal lands or non-Federal reserve lands where they receive varying levels of protection from development. Nonetheless, even the populations located on protected lands are still subject to other habitat threats noted above. Monitoring of most of those populations has not occurred since listing, and exact numbers are unknown; furthermore, some populations cross jurisdictional borders and do not allow easy categorization of their protection status.

2.3.2.2. Factor B – Overutilization for commercial, recreational, scientific, or educational purposes:

The listing rule suggested that professional and private botanical collecting could exacerbate the extirpation threat to the subspecies due to botanists favoring rare or declining species (63 FR 54938). Since the time of listing, the Service has approved permits that allow for legal scientific collection of the subspecies. Current permits are limited to the following: the City of La Mesa (permit number 830420), Roderick Dossey (832717), and Recon Environmental, Inc. (797665) (USFWS 2007). No specific threat from overcollection of this taxon has been found. We do not believe this factor is a threat to this subspecies.

2.3.2.3. Factor C -- Disease or predation:

Neither disease nor predation was known to be a threat affecting *Monardella linoides* subsp. *viminea* (63 FR 54938) at the time of listing. Although grazing pressure as a form of predation was identified at one site (CNDDB 2007), currently there are no significant threats attributable to this factor.

2.3.2.4. Factor D – Inadequacy of existing regulatory mechanisms:

Currently, *Monardella linoides* subsp. *viminea* is listed under the Federal Endangered Species Act as endangered (63 FR 54938). Provisions for its protection and recovery are outlined in Sections 4, 7, 9 and 10 of the Act. This law is the primary mechanism for protecting *Monardella linoides* subsp. *viminea*.

Monardella linoides subsp. *viminea* could potentially be affected by projects requiring a permit from the U.S. Army Corps of Engineers (Corps) under section 404 of the Clean Water Act (33 U.S.C. § 1251, *et seq.*) to place fill in certain waters or wetlands. Although the objective of the Clean Water Act is to “*restore and maintain the chemical, physical, and biological integrity of the Nations waters*” [italics added], which include navigable and isolated waters, headwaters, and adjacent wetlands, there are no specific provisions that adequately address the need to conserve species of riparian and floodplain habitats such as willowy monardella. Listed species in general, however, receive consideration under section 404. The listing rule suggested that lack of effectiveness of other Federal laws has impacted the recovery of the subspecies, and these laws’ efficaciousness is dependent on the discretion of the agencies involved (63 FR 54938). However, the Corps has been reluctant to withhold permits unless the Service determines a particular action may jeopardize listed species (63 FR 54938).

Monardella linoides subsp. *viminea* was listed by the State of California as endangered in 1979 (CDFG 2007); hence the subspecies receives special attention from the California Environmental Quality Act and the California Endangered Species Act. The analysis provided in the listing rule (63 FR 54948) of protections afforded this taxon by the State is still valid.

About 95 percent of the United States range (including occupied and unoccupied habitat) of *Monardella linoides* subsp. *viminea* occurs within the regional San Diego MSCP area. Although less than 20 percent of the occurrences of willowy monardella are in the MSCP plan area, almost all of those remaining locations have been protected in MSCP reserves and are annually monitored (see San Diego 2007). The management plan for the San Diego MSCP has not been finalized, thus long-term management and monitoring provisions for this plant are not in place.

We excluded areas that contained features essential to the conservation of willowy monardella from critical habitat designation within the boundaries of the City and County of San Diego where the subspecies was covered by the MSCP (71 FR 65662). A total of 115 acres of essential habitat were designated as critical habitat for the subspecies (71 FR 65662-65683). Owing to the MSCP, anthropogenic impacts to populations of willowy monardella will, where possible, be avoided within reserve areas, and will be monitored and managed appropriately if resources are available.

At least one additional small population occurs within the Poway Subarea Plan area. Current efforts in the MSCP and Poway, while proposing adequate conservation within their respective areas, are not enough to support recovery of the entire subspecies on their own.

Only about 20 percent of the remaining habitat for *Monardella linoides* subsp. *viminea* occurs outside Miramar. Although Miramar is not participating in the MSCP, the Marine Corps completed an Integrated Natural Resources Management Plan (2006-2010) (INRMP) with the advice of the Service (USMCASM 2006). This

INRMP spatially and temporally protects known populations on Miramar, most of which are unfragmented. Despite the INRMP and the protection provided, the subspecies continues to decline, due probably to the synergistic effects of the 2003 wildfires and subsequent increase in invasive plant populations.

In summary, the Federal Endangered Species Act provides for conservation of *Monardella linoides* subsp. *viminea*, especially on Federal lands and in those areas designated as critical habitat. We consider that the available regulatory mechanisms in the absence of listed status would be inadequate to sufficiently alleviate the threats to *Monardella linoides* subsp. *viminea*. Habitat conservation plans and multiple species conservation plans approved under section 10 of the Endangered Species Act are intended to protect covered species by avoidance, minimization, and mitigation of impacts and by setting aside habitat to be protected in perpetuity. However, the San Diego MSCP has no final monitoring and management plan for willowy monardella. Likewise, the Marine Corps INRMP (which is not a regulatory mechanism and is subject to available military funding) has not been fully implemented at Miramar. Therefore, we conclude that the existing regulatory mechanisms would still be inadequate to protect this subspecies in the absence of Endangered Species Act status.

2.3.2.5. Factor E – Other natural or manmade factors affecting its continued existence:

Various other factors continue to affect the continued existence of *Monardella linoides* subsp. *viminea*, including trampling, invasive plant species, fire, drought, changing hydrological regimes, and stochastic effects in small populations.

Trampling

Trampling was identified as a threat to this subspecies in the listing rule (63 FR 54938). Trampling of willowy monardella occurs via human travel through the habitat of willowy monardella. This factor has not been quantified, and to date is only suspected to cause a threat to willowy monardella via direct mortality and increasing rates of erosion. Trampling on private lands cannot currently be controlled and could impact all populations; however, we believe this threat is far overshadowed by impacts associated with urbanization and invasive plant species.

Invasive plant species

Invasive nonnative species were considered to be a threat to *Monardella linoides* subsp. *viminea* at the time of listing (63 FR 54938). San Diego County and the range of the willowy monardella are in a mild, Mediterranean climate which favors nonnative species incursion. Nonnative plants currently within San Diego County are altering natural landscapes and available habitat (Soule et al. 1992). Some of these biological impacts include competition with willowy monardella for water, soil nutrients, space, and natural pollinators. Invasive plants also have potential for lowering water tables and altering rates of sedimentation and erosion by altering soil

chemistry, nutrient levels, and physical structure of soil. As such, they can often outcompete native species such as willow monardella (see Kassebaum *in litt.* 2007). Invasive plants also alter fire frequencies, size, and intensity (flame duration and length, soil temperature during a fire, and after-effects of soil glassification and long-term porosity) (see Vitousek et al. 1997; Arno 2005).

Invasive native plants such as bulrush (*Scirpus* spp.) and willow (*Salix* spp.) are cited as a threat for several willow monardella occurrences (CNDB 1998, 2007). This is likely attributable to the alteration of fire and/or natural flood cycles or the time interval between these cycles (as discussed further below). It appears that in the absence of adequate natural disturbance processes, especially flooding events that affect associated moisture regimes, invasive nonnative as well as native plants can take over otherwise suitable habitat for willow monardella (Kassebaum *in litt.* 2007). This process is likely affected and/or exacerbated by fires.

Fire

Fire was not considered a severe threat to the subspecies in the listing rule; however, our understanding of fire in serotinous habitat has changed since the listing of the subspecies in 1998 (Dyer 2002). Fire is a natural component for regeneration and maintenance of *Monardella linoides* subsp. *viminea* habitat. However, *Monardella linoides* subsp. *viminea* faces two seemingly diametrically opposed forces; lack of fire (which is a threat because eventual fires can be catastrophic), and re-introduction of fire (accidental and purposeful) to the altered landscape (which is a threat because fires become catastrophic because of previous lack of fire). The San Diego county wildfires of 2003 and 2007 exemplify these dual threats (see below).

Threats to the habitat from fire exclusion, which impacts processes that historically created and maintained suitable habitat for the subspecies, may make it even more vulnerable to extinction. The cascading ecological effects of fire exclusion in the habitat of southern California have not been specifically detailed for *Monardella linoides* subsp. *viminea*; however, we believe the habitat structure and fire ecology processes there are comparable to locations in the Rockies, Cascades, and Sierra Nevada mountains (Keane et al. 2002). Fire exclusion in southern California habitat affects 1) *nutrient recycling*, 2) *natural regulation of succession via selecting and regenerating plants*, 3) *biological diversity*, 4) *biomass*, 5) *insect and disease populations*, 6) *interaction between plants and animals*, and 7) *biological and biogeochemical processes (i.e., soil property alteration)* (after Keane et al. 2002). The listing rule mentioned briefly that fuel modification to exclude fire could affect *Monardella linoides* subsp. *viminea* (63 FR 54950) however, the severe threat that fire exclusion could pose synergistically and via cascading effects (listed above) with serotinous invasive plants was underemphasized. Where naturally-occurring fire is excluded, species that are adapted to fire (such as *Monardella linoides* subsp. *viminea*) are replaced by invasive nonnative species that are better suited to the same areas in the absence of fire (Keane et al. 2002).

In contrast, invasive, nonnative plants have exacerbated fire danger to coastal sage scrub plants in other areas by creating micro-climates that increase the risk of conflagrations during more times of the year (see MALGBC 2007). Although the habitat occupied by *Monardella linoides* subsp. *viminea* is dependent upon some form of disturbance to reset succession processes (e.g., periodic fire and scouring floods), fire can severely impact or eliminate populations by killing individual plants, their underground rhizomes, and the soil seed bank, and leave the soil under hydrophobic conditions (Agee 1993, Keane et al. 2002, Keeley 2002, Arno and Fiedler 2005). Historically, this might not have been a problem where there were other adjacent populations that could recolonize depopulated sites.

Today, however, the threat of catastrophic wildfire is high in southern California. Many habitats have been affected by extended drought, severe insect infestation, fire exclusion, and now a high density of nonnative plant species (Field *et al.* 1999). Wildfire in southern California can cause effects over large areas of habitat. In 2003, three fires in San Diego County burned almost all known willowy monardella locations (SDSU 2007). We believe the threat from fires is likely to persist and increase in the future. A model by Snyder *et al.* (2002) suggests higher average temperatures for every month in every part of California, which would create drier, more combustible fuel types. Also, Miller and Schlegel (2006) suggest that Santa Ana conditions may significantly increase during fire season under global warming scenarios. Small escaped fires have the potential to turn into large conflagrations due to wind, weather conditions of temperature and humidity, lack of prescribed fires to control fuels, invasive vegetation, and inadequate wildfire control/prevention response. For example, the March 2007 Windy Ridge fire near Orange, California, turned into a large size class fire in less than 12 hours, and the June 2007 Angora fire near Lake Tahoe in northern California burned over 2,000 acres in its first 24 hours (CDF 2007).

Thus, while fire exclusion may adversely affect regeneration patterns of willowy monardella, we believe that catastrophic conflagrations pose the greatest stochastic single-event risk to the few remaining small and declining concentrations of *Monardella linoides* subsp. *viminea* in southern California.

Drought/Changes in Hydrology

Periodic droughts compounded by water table effects and resulting changes in hydrology were indicated as a threat to *Monardella linoides* subsp. *viminea* in the listing rule (63 FR 54938). Periodic and successive droughts are considered an underestimated ecological stress and selection factor that impacts forest and glade biological diversity, depending on species-specific ability to withstand these effects (Gutschick and BrassiriRad 2003, Archaux and Wolters 2006). Since about the time of listing in 1998, an extended drought in the region (White and Greer 2004, San Diego County Water Authority 2007) has created unusual habitat conditions. From 1996 to 2005 at one of the closer precipitation gauges to the southern population (Lake Cuyamaca, San Diego County, California), seven of 10 years had precipitation

significantly below normal (San Diego County Water Authority 2007). This extended drought has additively affected moisture regimes, riparian habitat, and vegetative conditions in and around suitable habitat for willowy monardella.

Changes in local and regional hydrology have had detrimental effects on willowy monardella. Increases in surface and subsurface soil moisture, via direct effects to the water table by watershed urbanization, and changing streams from ephemeral to perennial, adversely affects native plants adapted to a drier Mediterranean climate. Watershed urbanization alters the riparian vegetation community through changes in median and minimum daily discharges, dry season run-off, and flood magnitudes, specifically for Los Penasquitos Creek and other locations (White and Greer 2004). Nonnative species incursion has been exacerbated by the changing water regime (underground hydrology), and willowy monardella has been unable to adapt to the increased soil moisture (Burrascano 2007). The synergistic and cumulative effects of these combined hydrological threats were identified at the time of listing and continue to threaten the existence of populations of the subspecies today.

Climate change is expected to affect plants and wildlife in southern California, as well as throughout the world by expediting alterations of naturalized conditions in which the species have evolved, and by creating conditions where invasive species outcompete the endemics (Field et al. 1999, CEPA 2006, IPCG 2007). From an ecological context, current models and scientific thought suggest that southern California likely will be adversely affected by global climate change through prolonged seasonal droughts, and rainfall coming at unusual periods and amounts (Pierce 2004, Cayan et al. 2006, CEPA 2006). A number of threats may cumulatively coalesce to decrease the overall population of *Monardella linoides* subsp. *viminea* under global climate change scenarios. Climate change related effects appear to already be causing impacts on site-specific adaptations of species and endemic terrestrial biodiversity (McDonald and Brown 1992, Boggs and Murphy 1997, Parmesan and Yohe 2003, Parmesan 2006, Schwartz et al. 2006, Thomas et al. 2004, 2006), including habitat and species components of *Monardella linoides* subsp. *Viminea* (see Rebman and Dossey 2006).

Small and declining populations

While few localities of *Monardella linoides* subsp. *viminea* were known at the time of listing, loss of any of the 11 remaining populations in California, most of which are small and declining, may accelerate extirpation of core populations (considered at present to be those on/near Miramar) (S. Wynn, USFWS, pers. obs. 2007).

Chance events outside the range of natural variability, such as floods, fires, or drought, can substantially reduce or eliminate small populations and increase the likelihood of extinction (Lande 1993). Small, declining, and peripheral populations are more vulnerable to natural catastrophes and stochastic demographic, genetic, and environmental events. Genetic effects may further influence population demography via inbreeding depression and genetic drift. Allee (1931) suggested small, single

populations are vulnerable to extirpation when opportunities for reproduction diminish because of reduced opportunity of individuals to find each other (Allee effect or depensation). Stephens et al. (1999) and Dennis (2002) suggest that the Allee effect is a density-dependent event that is inversely related to population size. Aspects of conservation biology literature commonly notes the vulnerability of taxa known from one or very few locations and/or from small populations, and the effects on the demography of declining populations (e.g., Caughley 1994, Groom et al. 2006). Small population and declining populations are affected in different ways. Loss of peripheral populations that are a part of small or declining populations may expedite extirpation or extinction events for central/core populations. Small, declining, and peripheral (disjunct or connected) populations are more vulnerable to demographic, genetic, and environmental stochastic events, and natural catastrophes (see Caughley 1994). Genetic stochastic events can further influence population demography via inbreeding depression and genetic drift (Lande 1987).

In particular, small population size makes it difficult for this subspecies to persist while sustaining the impacts of fire, flooding, and competition with invasive plants. Because *Monardella linoides* subsp. *viminea* is found in small and declining populations, immediate action to conserve the subspecies may be inadequate as the extinction threshold (vortex) for the subspecies may already have been reached. Because of already small populations that may not be able to persist (Kassebaum *in litt.* 2007), it is unlikely that even populations protected in reserves will retain long-term viability if other threats affecting extant populations are not managed or removed. No empirical information is readily available to estimate the rate of population decrease (λ) or time to extinction for *Monardella linoides* subsp. *viminea*; however, its habitat and population have decreased since the time of listing .

2.4. Synthesis

Monardella linoides subsp. *viminea* suffers from the same continued and exacerbated threats outlined in the listing package (63 FR 54938), including loss and degradation of habitat associated with urbanization, off-road vehicle activity, trampling, invasive species, and stochastic events. Direct, indirect or cumulative effects of anthropogenic development of suitable habitat in San Diego County are currently unknown. Based on the human footprint in Southern California, and specifically San Diego County, there is high probability that some populations (known and unknown) have been degraded or eliminated since the time of listing. To date, even the best, unfragmented populations are in decline due to competition from invasive plants, especially after the 2003 fires in San Diego County. The subspecies has received attention from private and public entities involved in its conservation and recovery, through the San Diego MSCP and Miramar INRMP. Private non-governmental organizations are actively working to restore the subspecies in Lopez and Los Penasquitos Canyons. There is limited information on the number and status of remaining occurrences at locations outside of MSCP and Miramar purview. Nonetheless, when listed in 1998, there were 20 extant occurrences, and currently there are only 11 known occurrences, of which 10 are declining. *Monardella*

linoides subsp. *viminea*'s potential for continued and long-term existence is unknown due to lack of recent population data for some occurrences, and recent analysis of populations once considered the "best" suggests an unexplained, rapid decline. Therefore, *Monardella linoides* subsp. *viminea* continues to meet the definition of endangered, and we recommend no change in status.

3. RESULTS

3.1. 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
- No change is needed

3.2. New Recovery Priority Number

No Change. The subspecies condition for ascertaining its priority number has not changed since the time of listing.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- 1) Conduct field surveys of all known and historic *Monardella linoides* subsp. *viminea* sites to gather data on presence, annual survivorship, demographic representation, reproduction, threats, and conservation needs.
- 2) Provide viable *Monardella linoides* subsp. *viminea* seeds to a seed bank operating under the Center for Plant Conservation guidelines.
- 3) Determine causation and remedy for rapid declines.
- 4) Identify the most vulnerable life history stages and effective remedies to invasive plant species impacts, and implement control measures for invasive native and nonnative plants.
- 5) Develop a threats-based recovery plan and conservation strategy that provides guidance for best management practices for species recovery.

- 6) Provide significant levels of expedited funding and CFWO resources to assist volunteer efforts protecting the species.
- 7) Host annual meeting(s) with key cooperators to evaluate progress in developing process for species population resurgence.

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U.S. FISH AND WILDLIFE SERVICE 5-YEAR REVIEW
Monardella linoides spp. viminea

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Carlsbad Fish and Wildlife Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 3-27-08

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve  Date 4/18/08