# Draft Recovery Plan for *Deinandra conjugens* (Otay Tarplant)

# DRAFT RECOVERY PLAN

# FOR

# *DEINANDRA CONJUGENS*

# (OTAY TARPLANT)

**December 2003**

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Manager, California/Nevada Operations Office
Region 1, U.S. Fish and Wildlife Service

Date: _____

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Recovery plans delineate actions required to recover and protect federally listed plant and animal species. We (the U.S. Fish and Wildlife Service) publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and other affected and interested parties. Recovery teams serve as independent advisors to the U.S. Fish and Wildlife Service. Draft recovery plans are published for public review and submitted to scientific peer review before we adopt them. Objectives of the recovery plan will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific recovery actions and do not necessarily represent the view, official position, or approval of any individuals or agencies involved in the plan formation other than our own. They represent our official position **only** after they have been signed by the Director, Regional Director, or California/Nevada Operations Manager as **approved**. Approved recovery plans are subject to modification as directed by new findings, changes in species status, and the completion of recovery actions.

**Literature Citation** should read as follows:

U.S. Fish and Wildlife Service. 2003. Draft Recovery Plan for *Deinandra conjugens* (Otay Tarplant). Portland, Oregon. xi + 51 pp.

An electronic version of this recovery plan will also be made available at http://pacific.fws.gov/ecoservices/endangered/recovery/default.htm and at http://endangered.fws.gov/recovery/index.html#plans.

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## EXECUTIVE SUMMARY

Current Status: *Deinandra conjugens* (Otay tarplant) is federally listed as a threatened species. The species occurs in southwest San Diego County, California, and in northern Baja California, Mexico. Critical habitat for the species was designated on December 10, 2002. Within San Diego County, the species occurs entirely within the Multiple Species Conservation Planning (MSCP) area, including three associated subarea plans: City of San Diego Subarea Plan (approved in 1996), County of San Diego Subarea Plan (approved in 1998), and the City of Chula Vista Subarea Plan (approved in 2003). These subarea plans provide for the conservation of *D. conjugens* and many other listed and non-listed species in perpetuity by developing a reserve system, protection of key populations, and a monitoring and management framework. Primary threats to the species include the ongoing loss and degradation of suitable habitat, and fragmentation of remaining populations.

Habitat Requirements and Limiting Factors: *Deinandra conjugens* is an annual plant in the family Asteraceae, with a self-incompatible breeding system (an individual plant cannot pollinate itself, so successful reproduction requires pollination from an individual with a different genetic structure). The species is strongly correlated with clay soils, subsoils, or lenses (isolated areas of clay soil) which typically support grasslands, but may support some woody vegetation. Much of the area with clay soils and subsoils within the historical range of *D. conjugens* likely was once vegetated with native grassland, open coastal sage scrub and maritime succulent scrub, which provided suitable habitat for *D. conjugens*. Development and agriculture, invasion of nonnative species, and habitat fragmentation and degradation have resulted in the loss of suitable habitat across the species' range. The species annual habit and self-incompatible breeding system potentially create additional threats from population fluctuations, reduced populations of pollinators and a decline in genetic variation. Maintenance of the genetic variability within the species, through cross-pollination, may be critical to long-term survival. The extensive fragmentation of remaining populations may exacerbate these threats by reducing connectivity between populations and potentially limiting suitable pollinators, and hence gene flow between populations.

Recovery of the species is dependent upon: conservation of sufficient habitat to sustain populations of *Deinandra conjugens*, as well as populations of its primary pollinators;

maintenance of genetic variability within the species; and providing connections between conserved populations to ensure gene flow (through cross pollination).

Recovery Priority: This species' recovery priority number is 5, per criteria published in the Federal Register (U.S. Fish and Wildlife Service 1983a, 1983b). The priority is based on designation as a species with a high degree of threat and a low potential for recovery.

Recovery Goal: The goal of this recovery plan is to recover *Deinandra conjugens* sufficiently to warrant delisting.

Recovery Objectives:

1. Stabilizing and protecting habitat that supports known populations within areas identified for conservation under the MSCP;

2. Identifying and protecting populations outside of the MSCP that are important to maintain genetic diversity and connectivity between established reserves.

3. Reducing and managing threats to this species, such as invasion and competition by invasive non-native weeds and reduction in genetic diversity, within areas identified for conservation under the MSCP, and other populations as necessary.

4. Conducting research necessary to refine recovery criteria.

Recovery Criteria:

*Deinandra conjugens* may be considered for delisting when the following conditions are met:

1. Known populations (including naturally occurring seedbanks) within areas identified for conservation under the MSCP are permanently protected from future development or other significant threats and adequate, permanent funding and management mechanisms are in place as required under the MSCP.

2. Monitoring indicates that established reserves (e.g., MSCP preserve lands, National Wildlife Refuge lands, State preserve lands) provide sufficient suitable habitats and

space to sustain the full ecological needs of *Deinandra conjugens*, including habitats that sustain its pollinators.

3. A collection of seeds from wild plants, which represents the range of genetic variability currently exhibited in *Deinandra conjugens*, and which includes sufficient seed to allow for future propagation/population augmentation, is securely stored at a certified Center for Plant Conservation botanical garden or other appropriate seed storage facility (or facilities).

4. Techniques for the propagation and reintroduction of *Deinandra conjugens* are developed and successfully implemented when deemed appropriate.

5. The management program identified under the MSCP, including actions identified under individual Subarea Plans that positively affect the conservation of D. conjugens must be fully funded and implemented in perpetuity.

6. The monitoring program identified under the MSCP, including actions identified under individual Subarea Plans must be fully funded and implemented in perpetuity.

7. The population trend of *Deinandra conjugens* is stable or increasing within established reserves.

8. The population trends of *Deinandra conjugens* pollinators are stable or increasing within each reserve.

9. Genetic variation currently existing in *Deinandra conjugens* is maintained across its range.

10. No conserved population of *Deinandra conjugens* is experiencing significant genetic loss or is threatened by inbreeding depression.

Actions Needed:

1. Stabilize and protect habitat supporting known populations within the conserved areas under the MSCP.

2. Conduct surveys to search for new populations and implement actions to protect populations outside of established reserves when necessary to maintain genetic diversity and/or connectivity between larger reserves.
3. Assess the status of all known populations to determine: population size (area and number of individuals), reproduction, distribution, threats to stability or viability, and land management objectives.
4. Adaptively manage and monitor conserved areas.
5. Identify research needs and conduct studies on the biology and ecology of *Deinandra conjugens*.
6. Develop and implement a community outreach program.

Total Estimated Cost of Recovery: $2,792,000 over 24 years, plus additional costs that cannot be determined at this time.

Date of Recovery: Delisting could be initiated by 2027, if recovery criteria are met.

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# I. INTRODUCTION

## A. Brief Overview

*Deinandra conjugens* (Otay tarplant) was listed as a threatened species on October 13, 1998 (U.S. Fish and Wildlife Service 1998). Critical habitat was designated for this plant on December 10, 2002 (U.S. Fish and Wildlife Service 2002). *Deinandra conjugens* has a narrow ecological distribution and is endemic to southwestern San Diego County, California, and northwestern Baja California, Mexico. The primary reasons for the decline of *D. conjugens* are the loss, fragmentation, and degradation of its habitat by urban and agricultural developments.

The distribution of *Deinandra conjugens* in southwestern San Diego County (Figure 1) occurs entirely within the planning area for the San Diego Multiple Species Conservation Plan (MSCP). The San Diego MSCP is a regional habitat conservation planning program that provides long-term preservation for multiple species and their habitats, as well as the preservation of natural communities in southwestern San Diego County. The range of *Deinandra conjugens* is entirely within three participating MSCP jurisdictions with approved subarea plans: City of San Diego Subarea Plan, approved in 1996; County of San Diego Subarea Plan, approved in 1998; and the City of Chula Vista Subarea Plan, approved in 2003. However, certain populations of *D. conjugens* occur on water district or other lands that, although within the boundaries of the subarea plans, are not subject to the plans' requirements. Each jurisdiction has prepared a Subarea Plan that identifies reserve boundaries, and requires the development and implementation of management and monitoring plans to permanently maintain species covered under their plans, including *Deinandra conjugens*, within designated open space preserves.

In reviewing and approving the San Diego MSCP, we concluded that implementation of the plan will not jeopardize the continued existence of *Deinandra conjugens*. In other words, the MSCP will not appreciably reduce the likelihood of survival and recovery. We also acknowledged that the MSCP incorporates measures that will allow for the species' eventual recovery. The recovery strategy identified below includes actions that go beyond those specified in the MSCP that will enhance the prospects for recovery of *D. conjugens*. However, this recovery plan does not change the requirements or specified activities within the MSCP. Participating jurisdictions must continue to implement the conservation measures provided for under their respective Subarea Plans to protect

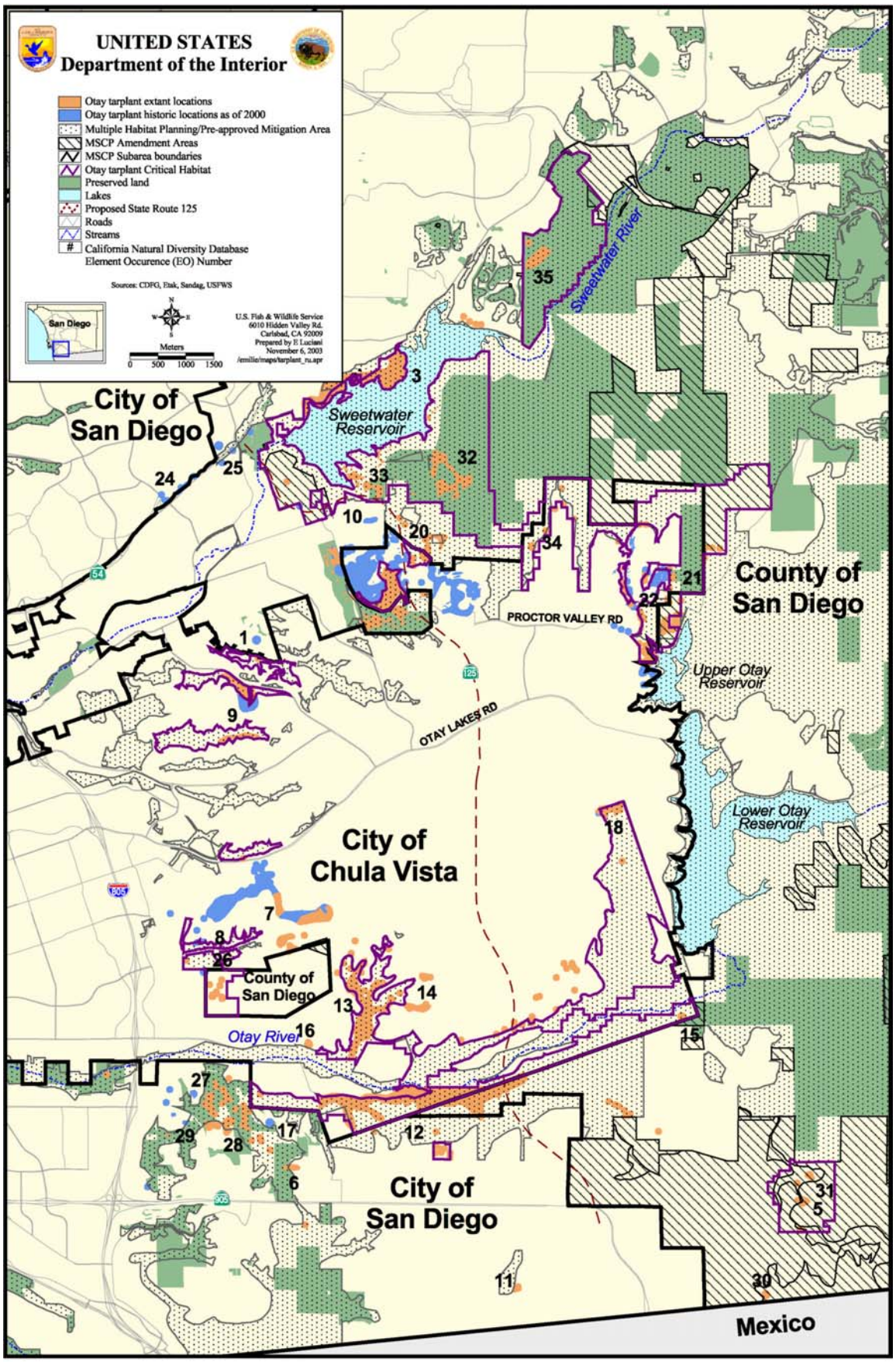


Figure 1. Historic and current distribution of principal *Deinandra conjugens* localities, and boundaries of preserved and mitigation land under MSCP Subareas.

*D. conjugens*; however, they are not required to implement additional measures identified in the recovery plan. Any additional measures to provide for recovery of this species will be undertaken by us or another willing entity.

**B. Description and Taxonomy**

*Deinandra conjugens* was known as *Hemizonia conjugens* when it was originally listed as threatened (U.S. Fish and Wildlife Service 1998). Since then, studies analyzing plant and floral morphology and genetic information prompted Baldwin (1999) to revise the Madiinae (tarplants), a subtribe of the tribe Heliantheae in the Asteraceae (sunflower) family), and segregate several taxa into new or different genera. As a result, *Deinandra conjugens* is now the accepted scientific name for *Hemizonia conjugens*. This taxonomic change does not alter the geographic range, identifying characteristics, or definition of the species. We have changed the name of *Hemizonia conjugens* to *Deinandra conjugens* in the List of Threatened and Endangered Plants, 50 CFR 17.12 (h), and will refer to the species as *Deinandra conjugens* in this recovery plan.

*Deinandra conjugens* is a glandular, aromatic annual plant in the family Asteraceae. It was first described by David D. Keck (1958) as *Hemizonia conjugens* based on a specimen collected by L.R. Abrams in 1903 from river bottom land in the Otay Valley area of San Diego County, California. It has a branching stem that generally ranges from 5 to 25 centimeters (2 to 10 inches) in height with deep green or gray-green leaves covered with soft, shaggy hairs. The yellow flower heads are composed of 8 to 10 ray flowers and 13 to 21 disk flowers with hairless or sparingly downy corollas (fused petals). The phyllaries (small bracts associated with the flower heads) are ridged and have short-stalked glands and large, stalkless, flat glands near the margins. *Deinandra conjugens* occurs within the range of *D. fasciculata* [= *Hemizonia f.*] (fasciculated tarplant) and *D. paniculata* [= *Hemizonia p.*] (San Diego tarplant). *Deinandra conjugens* can be distinguished from other members of the genus by its ridged phyllaries (bracts below the flower head), black anthers (part of flower that produces pollen), and by the number of disk and ray flowers. The disk and ray flowers each produce different types of fruits (heterocarpy), which has been correlated to differential germination responses (Tanowitz *et al.* 1987).

## C. Life History and Ecology

*Deinandra conjugens*, like most other tarplants, is sporophytically self-incompatible (Keck 1959, B. Baldwin *in litt*. 2001). Within a sporophytic self-incompatibility mating system, a species typically has one self-incompatible gene, often with many different alleles (alternative forms of a particular gene). A self-incompatible individual cannot be fertilized with its own pollen or with pollen from another plant that has the same self-incompatible allele; an individual plant will only produce viable seeds when cross pollinated by an individual with a different allele. Sporophytic refers to the type of self-incompatibility: if the genotype of the stigma (female reproductive organ of a plant) shares an allele with the genotype of the pollen, rejection of the pollen occurs and the plant is not fertilized.

Gene flow among plant populations through pollination is important for the long-term survival of self-incompatible species (Ellstrand 1992). Gene flow in *Deinandra conjugens* is primarily achieved through pollen movement among occurrences and is critical to maintaining genetic diversity between extant populations and within the species. Seed dispersal can also facilitate limited gene flow in contiguous habitat areas. Some of the smaller populations of *D. conjugens* are believed to be essential to the survival and conservation of the species because they may be strategically located between larger populations, facilitating gene flow among them, and may contain unique frequencies of self-incompatible alleles. Conservation of these populations may be critical to maintaining genetic diversity in *D. conjugens*.

Likely pollinators of *Deinandra conjugens* include, but are not limited to, bee flies (Bombylliidae), hover flies (Syrphidae), digger bees (Apidae), carpenter and cuckoo bees (Anthophoridae), leaf mason and leaf cutting bees (Megachilidae), and metallic bees (Halictidae) (Krombein *et al.* 1979; Bauder *et al.* 2002; M. Dodero, RECON, pers. comm. 2001). The following bee species have been documented visiting *Deinandra* species: *Nomia melanderi*, *Colletes angelicus*, *Nomadopsis helianthi*, *Ventralis claypolei ausralior*, *Anthidiellum notatum robertsoni*, *Heriades occidentalis*, *Anthocopa hemizoniae*, *Ashmeadiella californica californica*, *Svastra sabinensis nubila*, *Melissodes tessellata*, *M. moorei*, *M. personatella*, *M. robustior*, *M. semilupina*, *M. lupina*, *M. stearnsi*, *Anthophora urbana urbana*, and *A. curta curta* (Krombein *et al.* 1979).

*Deinandra conjugens* fruits are each one-seeded and are likely to be dispersed by small to large-sized mammals and birds based on the sticky nature of the remaining flower parts that are attached to the fruits and the discontinuous distribution of other tarplants (B. Baldwin *in litt*. 2001; M. Dodero, pers. comm. 2001; E. Friar, Claremont Graduate University, pers. comm. 2001; G. Hazard, U.S. Fish and Wildlife Service, pers. comm. 2001). Potential seed/fruit dispersal organisms known to occur in the region include, but are not limited to, mule deer (*Odocoileus hemionus*), gray fox (*Urocyon cinereoargenteus*), coyote (*Canis latrans*), black-tailed jackrabbit (*Lepus californicus bennettii*), bobcat (*Felis rufus*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), and various small land birds.

A seed bank (a reserve of dormant seeds, generally found in the soil) is important for year-to-year and long-term survival of many annual or short-lived perennial species (Rice 1989, Given 1994). A seed bank includes all of the seeds produced in a population from the current and previous growing seasons (generations) and generally covers an area larger than, or somewhat discontinuous from, the extent of observable plants seen in a given year. The number and location of standing plants in a population of an annual species varies each year due to a number of factors, including the amount and timing of rainfall, temperature, soil conditions, and the extent and nature of the seed bank. Large annual fluctuations in the number of standing plants of *D. conjugens* in a given population have been documented. Population size has ranged from 1 to over 5,400 standing plants at a site on northwest Otay Mesa (City of San Diego 1999, California Natural Diversity Data Base 2002), from approximately 100 to 50,000 at a site in Rice Canyon (California Natural Diversity Data Base 2002), and from approximately 280,000 to 1.9 million at San Miguel Ranch South (Merkel & Associates 1999, California Natural Diversity Data Base 2002). In any given year, the observable plants in a population are only the portion of the individuals from the seed bank that germinated that year. These annual fluctuations make it appear as though a population of annual plants "moves" from year to year, when in actuality, a different portion of a population germinates and flowers each year. The spatial distribution of a standing population of annual plants is generally the result of the spatial distribution of the micro-environmental conditions conducive to seed germination and growth of the plants.

The presence of *Deinandra conjugens* is strongly correlated with clay soils, subsoils, or lenses (isolated areas of clay soil) (Bauder *et al*. 2002). Such soils typically support grasslands, but may also support some woody vegetation. Much of the area with clay

soils and subsoils within the historical range of *D. conjugens* likely was once vegetated with native grassland, open coastal sage scrub and maritime succulent scrub, which provided suitable habitat for *D. conjugens*. Based on Geographic Information System (GIS) analysis, most current and historical *D. conjugens* occurrences are found on clay soils or lenses in one of the following soil series: Diablo; Olivenhain; Linne; Salinas; Huerhuero; Auld; Bosanko; Friant; and San Miguel-Exchequer rocky silt loams (Bauder *et al*. 2002).

*Deinandra conjugens* is also strongly associated with particular vegetation types. The species is found in vegetation communities classified as, but not limited to, grasslands, open coastal sage scrub, and maritime succulent scrub, as well as the margins of some disturbed sites and cultivated fields (Keck 1959; Keil 1993; California Native Plant Society 2001; California Natural Diversity Data Base 2002; D. Hogan *in litt.* 1990; B. Baldwin, Jepson Herbarium, University of California, Berkeley, pers. comm. 2001; M. Dodero, pers. comm. 2001; S. McMillan, McMillan Biological Consulting, pers. comm., 2001). Plant species common to these vegetation communities include *Nassella* spp. (needlegrass), *Bloomeria crocea* (common goldenstar), *Dichelostemma pulchella* (blue dicks), *Chlorogalum* spp. (soap plant), *Bromus* spp. (brome grass), *Avena* spp. (oats), *Deinandra fasciculata* (fasciculated tarweed), *Lasthenia californica* (common goldfields), *Artemisia californica* (California sagebrush), *Eriogonum fasciculatum* (flat-top buckwheat), *Lotus scoparius* (deer weed), *Salvia* spp. (sage), *Mimulus aurantiacus* (bush monkeyflower), *Malacothamnus fasciculatum* (bushmallow), *Malosma laurina* (laurel sumac), *Rhus ovata* (sugar bush), *R. integrifolia* (lemonade berry), *Lycium* spp. (boxthorn), *Euphorbia misera* (cliff spurge), *Simmondsia chinensis* (jojoba), *Opuntia* spp. (prickly pear and cholla cactuses), *Ferocactus viridescens* (coastal barrel cactus), *Ambrosia chenopodiifolia* (San Diego bur sage), and *Dudleya* spp. (live-forevers).

**D. Distribution and Population Status**

Throughout this document, “occurrence”, “site”, “patch”, or “population” will represent either a site as described in the listing rule (U.S. Fish and Wildlife Service 1998) or a corresponding California Natural Diversity Database Element Occurrence code (EO-codes). The Element Occurrence code will be listed in parentheses. These terms are used in a practical sense to indicate the occurrence of one or more plants at a defined

geographical location, and not to imply that the designated group of plants is necessarily a "population" in the strict biological sense of the word.

*Deinandra conjugens* has a narrow geographic and elevational range (Figure 1), which at the time of listing in 1998 was generally defined by at least 25 historic populations near Otay Mesa in southern San Diego County and 1 population near the United States border in Baja California, Mexico (California Department of Fish and Game 1994; Reiser 1996; California Natural Diversity Data Base 1997; Roberts 1997; S. Morey *in litt*. 1994). Since listing, the known range for *D. conjugens* in San Diego County has been extended from the Mexican border north to Spring Valley and Paradise Valley, a distance of about 24 kilometers (15 miles), and from Interstate 805 east to Otay Lakes Reservoir, a distance of about 13 kilometers (8 miles) (herbarium records at the San Diego Natural History Museum, California Natural Diversity Data Base [2002]). Further, the elevational range for *D. conjugens* appears to be between 25 and 300 meters (80 and 1,000 feet).

Determining the actual size of an occupied site (area) or magnitude of a given *Deinandra conjugens* population (number of individual plants) is difficult due to the major fluctuations that have been documented in extant populations (Merkel & Associates 1999, California Natural Diversity Data Base 2002). Conditions during some years are better for growth and reproduction of *D. conjugens* in some populations (and even some portions of a population) than during other years. Because the number of standing plants in a given population can vary by orders of magnitude from one year to the next, the number of standing plants observed in a population in any one year does not necessarily indicate the potential magnitude of that population.

At the time of listing (1998), the five largest populations of *Deinandra conjugens* (Rancho San Miguel [EO 10 and 20], Rice Canyon [EO 9], Dennery Canyon [EO 6, 17, 27, 28, and 29], Poggi Canyon [EO 7, 8, and 26], and Proctor Valley [EO 21 and 22]) were known to support about 98 percent of all reported standing plants (City of Chula Vista 1992; San Diego Gas and Electric 1995; Roberts 1997; S. Morey *in litt.* 1994; Brenda Stone *in litt.* 1994) with each occurrence reportedly containing more than 10,000 standing plants. Portions of the two larger populations, Rancho San Miguel and Proctor Valley, have been lost to development, with the remaining areas protected through dedicated open space reserves under the MSCP, or as part of the San Diego National Wildlife Refuge. Surveys conducted in 2003 documented approximately 265,000

individuals, across the range of the species; however, these surveys were not systematic but represent only a general estimate of the species status. The current status of most known extant populations is described below; some populations have not been surveyed recently and no information is available for them (Figure 1).

The Otay/Sweetwater unit of the San Diego National Wildlife Refuge (EO 32 and 35) includes scattered populations of *Deinandra conjugens*, with the larger populations occurring along the western slopes of Mother Miguel Mountain (EO 32). These populations occur in open grassland areas (native and non-native) that are surrounded by coastal sage scrub and chaparral habitats. We are conducting surveys to better document these occurrences and have begun weed abatement activities. A management plan is being developed.

The Sweetwater Reservoir populations (EO 3, 33) occur mostly on land managed by the Sweetwater Authority, with a small portion of EO 33 protected by the San Diego National Wildlife Refuge. The population is estimated to be about 50,000 individuals. The historical location on the northeast side of the reservoir has been extirpated by residential development. These populations (EO 3 and 33) occur on opposite sides of the reservoir and are not directly connected. Although these populations are not currently protected by any open space agreement, the Sweetwater Authority is preparing a Habitat Conservation Plan and is actively managing the population to minimize impacts. In addition, we have initiated intensive surveys on our Refuge property. Currently, the populations are generally threatened by invasive non-native plants, maintenance of access roads and firebreaks, and trail activity. The native grassland and coastal sage scrub surrounding this population are in poor condition, with most of the area converted to non-native annual grassland (S. McMillan *in litt.* 2003). Two additional populations west of Sweetwater Reservoir (EO 24 and 25) have been extirpated by development.

The Rancho San Miguel/Horseshoe Bend population (EO 10 and 20) was surveyed in 2003 and an estimated 50,000 plants were found. In 1998, this population was estimated at 1.9 million plants (Merkel & Associates 1999). A portion of the population in the southern part of the Ranch has been lost to an approved residential development. The maintenance of utilities, grazing, fire, and weed invasion are continuing threats to the remaining population (S. McMillan *in litt.* 2003). The remaining population will become part of the Otay/Sweetwater Unit of the San Diego National Wildlife Refuge.

A small population (EO 34) occurs along the south side of Mother Miguel Mountain in the San Miguel Habitat Management Area, owned and managed by the Otay Water District. This population is surrounded by a golf course to the south. The occurrence is not currently protected under a conservation easement or subarea plan under the MSCP.

The Proctor Valley population (EO 21 and 22) occurs south of San Miguel Mountain. Two major developments that have already been approved, Rolling Hills Ranch and Eastlake Woods, will result in the loss of *Deinandra conjugens* habitat and plants within this complex. However, the remaining areas will be protected and managed in designated open space reserves under the County of San Diego and City of Chula Vista's Subarea Plans, and under a special *D. conjugens* reserve that was established as part of the Rolling Hills Ranch mitigation. Some occurrences in this area occupy native grasslands and sparse coastal sage scrub habitats, however, the species is generally found in areas dominated by non-native grasses. Threats to this population include off-road activity, grazing, and trash dumping, and indirect effects of urban development; however, such threats .

The Bonita/Long Canyon population (EO 1), occurring in the canyons between Rice Canyon and Rancho San Miguel/Horseshoe Bend populations, is in good condition with an estimated 5,000 individuals (S. McMillan *in litt.* 2003). However, this figure likely underestimates the total population because additional patches have been documented but population estimates are not currently available. This population occurs within the area covered under the City of Chula Vista's Subarea Plan. The population occurs in suitable clay soils with many native plant associates, including the endangered *Acanthomintha ilicifolia* (San Diego thornmint). Although invasion by non-native annual weeds is a serious threat to this site (S. McMillan *in litt.* 2003), the State of California has received a grant under section 6 of the Endangered Species Act, to implement weed abatement activities, and the implementation of Chula Vista's Subarea Plan will include active management to minimize this threat. This population is surrounded with good quality coastal sage scrub (S. McMillan *in litt.* 2003).

The Rice Canyon population (EO 9) occurs within the Rancho Del Rey and Rice Canyon designated open space areas of the City of Chula Vista's Subarea Plan. Although this population is large and supports a relatively dense population it continues to decline due to edge effects from the residential development. Weed invasion continues to increase every year and the populations continue to decline in area and in density. Portions of

these populations are associated with native grassland and coastal sage scrub habitats; however, much of the population is surrounded by non-native annual grassland. This population is threatened by weed invasion (especially non-native annual grasses and forbs), trail access (and other edge effects from residential development), and off-road vehicle activity. The State of California has received a grant under section 6 of the Endangered Species Act to implement weed abatement activities. It is also anticipated that these impacts will be reduced through implementation of Chula Vista's Subarea Plan, which requires management and monitoring of the population.

The Poggi Canyon population (EO 7,8, and 26) consists of numerous scattered patches. Much of Poggi Canyon has been developed for residential purposes, which has adversely affected many of the *D. conjugens* populations known from the canyon. Those that remain are within the designated open space reserve under the City of Chula Vista's Subarea Plan and will be managed and monitored under the plan.

The Wolf Canyon (EO 13) population occurs along the slopes and ridges of Wolf Canyon and the associated drainages. Surveys estimated a standing population of approximately 50,000 plants (S. McMillan *in litt.* 2003). Most of the lower portions of Wolf Canyon have been set aside as designated open space under the City of Chula Vista's Subarea Plan. The population in the upper portions of the canyon has been extirpated by residential development. An on-going restoration program is also being conducted in Wolf Canyon, much of which is specifically designed for *D. conjugens*. The weed control component of the restoration program has been very effective on controlling the non-native annual weed species that previously dominated these areas.

The Dennery Canyon population (EO 6, 17, 27, 28, and 29) occurs within Dennery Canyon and the associated mesa remnants that surround the canyon. Surveys in 2003 estimated 5,000 plants. Many of the historical occurrences were destroyed when residential development began. It is possible that all of EO 29 has been extirpated. Most of the remaining populations are, or will be, included in dedicated open space as part of the City of San Diego's MSCP Preserve. The habitats continue to suffer from illegal off-road activities, although at reduced impact levels. On-going habitat restoration programs are also being conducted within the area, much of which is specifically designed for *Deinandra conjugens* (S. McMillan, pers. comm. 2003). These programs include weed control, which has been very effective in controlling the non-native annual weed species that dominated these areas prior to restoration efforts.

The Johnson Canyon/Upper Otay Valley (EO 12, 15, and 16) occurrence is a series of populations scattered along the upper (eastern) end of Otay Valley in heavy clay soils. Most patches of *Deinandra conjugens* can be found along the southern slopes, extending up onto the mesa near the vernal pool areas along the edge of the mesa (EO 12). Scattered patches also occur along the north slopes of the valley (EO 16), with a couple of populations along the base of Rock Mountain (EO 14). Portions of these populations are adjacent to native grassland and coastal sage scrub, but much of the occurrence is associated with non-native annual grassland. Invasion by non-native annual weeds is currently the most serious threat to these populations. The native grassland and coastal sage scrub habitats surrounding these populations are in poor condition, with most of the area converted to a non-native annual grassland. Most of these populations occur within a designated mitigation area or within proposed designated open space reserves under the City of Chula Vista's, and City of San Diego's Subarea Plans and are required to be managed and monitored under the plans.

The Salt Creek population (EO 18) occurs at the northern end of Salt Creek. Most of the population occurs within an area that has been proposed as designated open space under the City of Chula Vista's Subarea Plan, however, a residential development is located immediately upstream of this occurrence. The population occurs in a ruderal (disturbed, weedy) area in heavy clay soils, and is threatened by continued maintenance of access roads to aqueduct lines, sewer lines, and other utilities. The indirect effects of urban development will be minimized through management and monitoring required under the Subarea Plan.

Several populations near the Mexican border (EO 5, 11, 30, and 31) are likely still extant; however, they have not been surveyed recently and we have no specific information about current population status.

Two new, previously unknown populations have recently been documented in Paradise Valley and along Plaza Boulevard to the north (not mapped). Both populations are within designated open space under the City of San Diego's Subarea Plan. The populations are in good quality native grassland and non-native annual grassland surrounded by coastal sage scrub. These populations were found while conducting rare plant surveys for the City of San Diego in 2001 (S. McMillan *in litt.* 2003). Although these populations are protected as designated open space, adjacent residential

development may have indirect impacts on these populations. These impacts should be minimized in the future as part of the City's adjacency criteria in their Subarea Plan.

A new population was also recently discovered on a large clay lens in the middle of the California Department of Fish and Game's Jamul Ranch Preserve (not mapped). This population was found while conducting rare plant surveys for the Department of Fish and Game (McMillan 2001); surveys in 2003 estimate the population at 2,000 plants (S. McMillan *in litt*. 2003). Although only one population was found, it is likely that more populations of *Deinandra conjugens* occur on Jamul Ranch. Invasive non-native weeds are the most serious threat to the population now that grazing has been removed from the property. This population currently represents the most eastern population of *D. conjugens*, and is isolated from the other populations to the west. We anticipate that these lands will be managed as part of the preserve.

**E. Critical Habitat**

On December 10, 2002, we published the final rule designating critical habitat for *Deinandra conjugens* (U.S. Fish and Wildlife Service 2002). This rule became effective on January 9, 2003. Critical habitat is defined as specific areas that provide the physical and biological features (primary constituent elements) essential to the conservation of the species and which may require special management considerations or protection. The primary constituent elements for *D. conjugens* consist of:

1) soils with a high clay content (generally greater than 25 percent) (or clay intrusions or lenses) that are associated with grasslands (native, non-native, and mixed), open coastal sage scrub, maritime succulent scrub communities or disturbed habitat between 25 and 300 meters (80 and 1,000 feet) elevation; and

2) plant communities associated with *Deinandra conjugens* which include, but are not limited to grasslands (native, non-native, and mixed), open coastal sage scrub, and maritime succulent scrub between 25 and 300 meters (80 and 1,000 feet) elevation in southwestern San Diego County, California and adjacent northwestern Estado de Baja California, Mexico. These plant communities contain areas that provide nesting, foraging, and dispersal sites for pollen and seed dispersal agents of *D. conjugens*. These openings may have soil inclusions that contain a significantly higher concentration of sandy soils than the adjacent clay soils.

## F. Reasons for Decline and Current Threats

Species are placed on the endangered species list based on one or more of the five listing factors for Federal listing of a species in section 4(a)(1) of the Endangered Species Act. The five listing factors are: (1) The present or threatened destruction, modification, or curtailment of habitat or range; (2) Overutilization for commercial, recreational, scientific, or educational purposes; (3) Disease or predation; (4) Inadequacy of existing regulatory mechanisms; and (5) Other natural and manmade factors affecting the species' continued existence.

*Deinandra conjugens* was listed as a threatened species on October 13, 1998 (U.S. Fish and Wildlife Service 1998). Since its listing, information relating to the distribution of the species, as well as information pertaining to threats to its continued existence, have become more refined. However, the basic factors identified in the listing rule as responsible for the species' decline still apply to some extent. Therefore, the following discussion briefly restates and offers an expanded discussion of some of the threats to the species based on current information.

### *1. Loss and Degradation of Habitat*

As discussed in the final rule, the primary cause of the decline of *Deinandra conjugens* was the loss and degradation of occupied and suitable habitat, primarily due to urban development and agriculture, resulting in the fragmentation and isolation of remaining populations. While the MSCP will provide protection for most remaining populations, the existing fragmentation and isolation of extant populations continue to be threats to the long-term recovery of the species. We anticipate that habitat degradation affecting populations within approved subarea plans will be managed by the local jurisdictions as management plans are fully implemented.

At the time the species was listed in 1998, we estimated that about 11,930 hectares (30,310 acres) of land with clay soils or clay subsoils were within the general range of *Deinandra conjugens* in San Diego County (U.S. Fish and Wildlife Service 1998). Also at that time, about 4,200 hectares (10,600 acres) (about 37 percent) of this area had been urbanized and about 4,155 hectares (10,555 acres) (about 37 percent) had been heavily cultivated and grazed. Additional areas have been lost to urbanization since this time. New information from herbarium records at the San Diego Natural History Museum

indicates that the historical range of *D. conjugens* extended farther to the north and northwest. Most of the habitat in this area was lost to development some time ago. Much of the cultivated and grazed land within this range could be restored to support *D. conjugens* (M. Dodero, pers. comm. 2001; S. McMillan, pers. comm. 2001). However, most of these lands are available for development under the San Diego MSCP.

Several populations of *Deinandra conjugens* are subject to impacts from off-road vehicle activity, even within conserved open space. Although implementation of the MSCP requires that these effects be alleviated, this activity continues to threaten some populations. We anticipate this threat will diminish as the subarea plans are fully implemented.

*2. Habitat Fragmentation/Isolation*

Habitat loss and degradation often result in the fragmentation of remaining habitat patches and the isolation of habitat from the surrounding biological community. The result is a disruption or impairment of processes within the biological community upon which *Deinandra conjugens* depends. Remnant patches of native vegetation become habitat islands and are subject to changes in their physical environment and microclimate that can disrupt or curtail their ability to function as suitable habitat. The effects of these changes may be modified by the size, shape and location of the remnant habitat in relation to the surrounding landscape. Fragmentation and isolation of native habitat can affect abiotic factors such as temperature, wind, erosion, and soil nutrients and cycling. For example, fragmentation can lead to changes in temperature; smaller remnants and edges of larger patches may experience higher air temperatures resulting from increased radiation. Higher temperatures may change nutrient cycling and soil microorganisms, and lower soil moisture. Such changes may affect germination and reproduction, and alter the plant community composition (Saunders *et al.* 1991).

Several interacting factors are likely to affect the biotic (plant and animal) communities of fragmented habitats. Time since isolation, distance to other remnants, connectivity with the remaining intact landscape, and size and shape of fragments will all affect the species composition of fragmented habitats and the rate of species loss. Recently isolated patches will likely have more species than can be sustained in the long-term, and species of both plant and animal will be lost over time (Soulé *et al.* 1988; Saunders *et al.* 1991; Bolger *et al.* 1997), while invading species are likely to gain a foothold. Hence,

the presence of a species at the time a patch is isolated does not indicate that the species will continue to persist into the future. As remaining populations of *Deinandra conjugens* are further fragmented by surrounding urban development, the remaining patches of habitat will be more susceptible to changes that affect vegetation and animal communities. Changes in the diversity, distribution, and abundance of plants and animals could adversely affect *D. conjugens* directly or indirectly through changes in habitat suitability, disruption of plant/pollinator relationships, changes in seed dispersal, and demographic changes in extant populations.

*3. Non-native plant interactions*

Field observations indicate that *Deinandra conjugens* does not compete well in areas of dense invasive weeds (A. Davenport, Davenport Biological Services, pers. comm. 2003; S. McMillan, pers. comm. 2003). Invasive weeds and the associated buildup of thatch can have significant impacts on local populations of *D. conjugens*. Greenhouse experiments with *D. conjugens* have documented significant reductions in plant biomass, plant height, extent of branching on individual plants, and flower production in plants grown in high densities of invasive weeds (Bauder *et al.* 2002). These factors can affect successful reproduction and seed set. The adverse effects of invasive weeds on *D. conjugens* may be greatest in years of abundant rainfall, resulting in depressed populations when conditions would otherwise be most favorable for population growth (Bauder *et al.* 2002).

*4. Population Dynamics*

As stated in section I.C above (Life History and Ecology), *Deinandra conjugens* is an obligate out-crosser (is self-incompatible); individual plants exhibiting this trait will not set viable seed when pollinated by pollen from the same plant, and pollination between full siblings will result in significantly reduced fecundity and successful reproduction (e.g. DeMauro 1993). Consequently, cross pollination between unrelated individuals and annual seed set are essential for long-term population survival and recovery. Limited seed dispersal or cross pollination can result in populations with localized clusters of related individuals. Such situations in *D. conjugens* may significantly reduce compatible matings, resulting in lowered annual reproduction.

The number of standing plants and reproductive success fluctuates yearly depending upon environmental conditions including rainfall, temperature, and soil conditions. Insufficient rain can significantly reduce or even preclude germination, or result in lowered seed set, while adequate or above average rainfall can result in large robust plants and high seed production, however, this relationship may be complicated in areas where invasive weeds predominate (Bauder *et al.* 2002). Repeated surveys of the same populations demonstrate the wide population fluctuations inherent in this species. Population size has ranged from 1 to over 5,400 standing plants at a site on northwest Otay Mesa (City of San Diego 1999, California Natural Diversity Data Base 2002), and from approximately 100 to 50,000 at a site in Rice Canyon (California Natural Diversity Data Base 2002). The spatial distribution of a standing population of annual plants is generally the result of the spatial distribution of the micro-environmental conditions conducive to seed germination and growth of the plants, which may vary from year to year. Smaller populations in years of reduced rainfall can also result in lowered opportunities for compatible matings between individuals.

A significant decline in a local population, coupled with other environmental and demographic factors and the extensive habitat/population fragmentation and isolation, could result in the complete extirpation of *Deinandra conjugens* from a reserve. It is unlikely that a locally extirpated population can be naturally recolonized from adjacent sites through seed dispersal, especially if the sites are separated by urban development. The lack of connectivity between many extant populations of *D. conjugens* renders these populations susceptible to deterministic or stochastic extirpations (Gilpin and Soulé 1986; Lande 1988; Frankham and Ralls, 1998), and increases the risk of species extinction.

*5. Genetics*

Genetic variation is positively correlated with population size and/or species range, and is inextricably linked to population viability and long-term species survival. Large populations occupying contiguous habitat, or a large range, generally have higher levels of genetic diversity, while smaller populations, or species occurring within restricted ranges or on islands, have lower levels of genetic variation (Frankham *et al*. 2002). A reduction in population size, or permanent fragmentation of formerly contiguous populations can result in reduced genetic diversity.

Both theoretical and empirical evidence indicates that smaller populations (those also possessing lower genetic variation) tend to have higher mortality rates and reduced fecundity, which leads to demographic fluctuations (e.g., slower population growth, reduced mating success and lowered recruitment) (Lande 1988, Les *et al.* 1991, DeMauro 1993, Heywood 1993, Lacy 1997, Frankham *et al.* 2002). At the extreme, very small populations suffer from inbreeding depression and the adverse effects of genetic drift (the accumulation of deleterious mutations or fixation of alleles that reduce fitness) (Barrett and Kohn 1991, Les *et al.* 1991). In plant species exhibiting self-incompatibility, the level of genetic diversity at the S allele can have significant implications for long-term survival. Because successful reproduction can only occur between plants with different genotypes at the S locus, a minimum number of S alleles is necessary to sustain a population. A reduction in population size, due to demographic or environmental stochasticity, or long-term fragmentation of populations could reduce the pool of S alleles, thereby reducing successful cross-pollination and reproduction (Les *et al.* 1991, DeMauro 1993). Maintenance of S allele diversity within and between populations of *Deinandra conjugens* will assure a high probability of cross pollination and successful reproduction.

The impacts of population fragmentation on genetic diversity depend upon the resulting population size, structure and connectedness of the remaining patches. Larger populations and populations with sufficient cross pollination or seed dispersal between patches are more likely to sustain the level of genetic diversity and suffer little adverse effect from fragmentation in the short or mid term. Complete population isolation, with no cross pollination or seed dispersal between remaining patches (e.g., population islands) will likely result in the greatest reduction in genetic diversity, and will occur at a faster rate in the short or mid-term (Frankham *et al.* 2002).

The current reserve design for *Deinandra conjugens* includes many fragmented populations surrounded by urban development. The level of genetic diversity across the range of the species, including diversity at the S locus, in *D. conjugens* is unknown; however, initial studies of two populations indicate that diversity is high (Bauder and Truesdale 2000). Maintenance of the genetic diversity and gene flow (through cross pollination and/or seed dispersal) between fragmented populations could be critical to long-term survival and recovery. Nevertheless, it is anticipated that all remaining populations may lose varying levels of genetic diversity without active intervention through intensive management. Those populations in complete isolation may experience

the adverse effects of increased genetic drift and inbreeding depression (lowered population growth, reduced fitness, and higher susceptibility to environmental catastrophes) at a faster rate (Frankham *et al.* 2002). These effects can be accelerated in populations that experience repeated and dramatic fluctuations in population size (Hard 1995, Lande 1999), which may occur in annual plant populations such as *D. conjugens* that depend on adequate environmental conditions for germination and reproduction (see section I.F.4, Population Dynamics, above).

*6. Plant/pollinator interactions and ecology*

Due to the self-incompatible trait inherent in *Deinandra conjugens*, successful cross pollination between unrelated individuals is essential to the long-term survival of populations of *D. conjugens*. The impacts of fluctuating population size and increased population fragmentation and isolation can be further complicated through changes in plant/pollinator interactions. Habitat fragmentation and degradation can be deleterious to both native pollinators and to the plants that depend upon pollination service. Increased fragmentation and/or decreased patch (population) size can lead to a reduction in frequency of pollinator visits and pollinator diversity, and decrease seed set (Jennersten 1988). If the distance between habitat patches is greater than the foraging range of pollinators, or if pollinators ignore small plant populations or small habitat patches, reduction in pollination service may result. Individual plant size, patch (population) size, and/or plant density of the target species can also contribute to pollination limitation; isolated plants or patches may receive fewer pollinator visits and/or reduced deliverance of pollen from conspecifics (versus foreign pollen) (Kearns *et al.* 1998 and references therein). Non-native plant densities may also affect plant/pollinator interaction. Bauder *et al.* (2002) noted much lower visitation to *D. conjugens* by potential pollinators in an area dominated by non-native vegetation, as opposed to a patch growing in proximity to native scrub vegetation. Further, non-native vegetation may reduce the floral display of *D. conjugens* thereby reducing their attractiveness to potential pollinators, and likely reducing seed set.

While these effects may be offset by honeybees (including africanized bees), which can successfully pollinate patches in disturbed habitats, they may also contribute to a reduction in native pollinator species. Further, honeybees may be less successful pollinators than native species and may compete with native pollinators for resources,

although additional studies on the interactions of native and non-native pollinators are necessary (Kearns *et al.* 1998 and references therein).

Habitat management and maintenance of native pollinator populations and nest sites should be an important consideration in the long-term conservation of *Deinandra conjugens*. Many native pollinators are ground nesters and may not find suitable nest conditions within the clay soils that sustain populations of *D. conjugens*. Further, insect populations relying on nectar as a food resource generally require a suite of flowers available throughout the year. Consequently, maintenance of the surrounding native vegetation/habitats must be considered in recovery of *D. conjugens*. The specific pollinators of *D. conjugens* and their biology/ecology are largely unknown. Although many species of flies and bees have been observed visiting *D. conjugens*, flower visits or nectaring does not necessarily ensure successful pollen transfer between individual plants.

**G. Conservation Measures**

Section 7 of the Endangered Species Act requires Federal agencies to consult with us if any action they may fund, authorize, or carry out may affect listed species. Section 7 also requires that these agencies use their authorities to further the conservation of federally listed species. This consultation process promotes interagency cooperation in finding ways to avoid or minimize adverse effects to listed species or to compensate for unavoidable adverse impacts and ensures that Federal actions do not jeopardize the continued existence of the species.

Section 9 of the Endangered Species Act and the corresponding implementing regulations found at 50 CFR 17.71 and 17.72 set forth a series of prohibitions and exceptions that apply to all threatened plant species not covered by a special rule. No special rule has been published for *Deinandra conjugens*. These prohibitions, in part, make the following activities illegal for any person subject to the jurisdiction of the United States: import or export; transport in interstate or foreign commerce in the course of a commercial activity; sell or offer for sale this species in interstate or foreign commerce; remove and reduce to possession this species from areas under Federal jurisdiction; and maliciously damage or destroy this species on any other area in knowing violation of any State law or regulation or in the course of any violation of a State criminal trespass law. The term “plant” means any member of the plant kingdom,

including seeds, roots and other parts. Because *D. conjugens* is a threatened plant species, seeds from cultivated specimens are exempt from these prohibitions provided that a statement of "cultivated origin" appears on their containers. Certain exceptions apply to agents of the U.S. Fish and Wildlife Service and State conservation agencies.

With regard to designated critical habitat, section 7(a)(2) of the Endangered Species Act requires Federal agencies, including us, to ensure that actions they fund, authorize, or carry out do not destroy or adversely modify critical habitat to the extent that the action appreciably diminishes the value of the critical habitat for the survival and recovery of the species. Individuals, organizations, states, local governments, and other non-Federal entities are affected by the designation of critical habitat only if their actions occur on Federal lands, require a Federal permit, license or other authorization, or involve Federal funding.

*1. Regional Planning*

The San Diego MSCP was initiated by local jurisdictions including the City of San Diego, County of San Diego, other cities, and private interests, and is being integrated as a component of California's Natural Community Conservation Plan Act. Implementation of the MSCP will extend protection to many natural habitat communities in San Diego County. *Deinandra conjugens* is a covered species under the San Diego MSCP.

The MSCP encompasses approximately 236,000 hectares (582,000 acres) of southwestern San Diego County, and involves multiple jurisdictions. Approximately 69,600 hectares (172,000 acres) are targeted to be conserved within the preserves in the planning area. Goals of the MSCP include: conserving listed and sensitive species, conserving biodiversity in the MSCP Plan Area, and achieving certainty in the land development process. Each take authorization holder will prepare a framework management plan to provide general direction for all preserve management issues. We and the California Department of Fish and Game approved the overall MSCP and the City of San Diego's Subarea Plan in July 1997. The County of San Diego's Subarea Plan was approved in 1998. The City of Chula Vista's Subarea Plan was approved in 2003. The preservation, management and monitoring of reserves will occur in perpetuity. Some areas within the MSCP boundary are designated as "amendment areas" and are not covered under the MSCP. In amendment areas, development and conservation areas will be determined by future negotiations between landowners, local jurisdictions, and the

wildlife agencies. Any activities within these areas that may affect *Deinandra conjugens* will need to be addressed in the future.

*2. San Diego National Wildlife Refuge*

Habitat conservation efforts include protection of *Deinandra conjugens* populations on the San Diego National Wildlife Refuge. The San Diego National Wildlife Refuge was established in 1996, with the acquisition of 745 hectares (1,840 acres) at Rancho San Diego in San Diego County. The Refuge Planning Area for the Otay-Sweetwater Refuge Unit encompasses 18,605 hectares (45,974 acres) within southwest San Diego County, with 3,112 hectares (7,691 acres) currently managed by the Refuge, and 2,129 hectares (5,262 acres) managed by the California Department of Fish and Game. Funding for acquisition from the Land and Water Conservation Fund has remained steady at about $2 million per year. Our staff conducted *D. conjugens* surveys on the Refuge in 2001 and 2003. Surveyed locations were primarily in the vicinity of San Miguel Mountain.

*3. California Department of Fish and Game*

The California Fish and Game Commission listed *Deinandra conjugens* as endangered in November 1979, under the California Endangered Species Act. The State of California has also passed the Natural Community Conservation Planning Act, which was designed to protect California's flora and fauna at the regional/ecosystem level while allowing continued development. Under the California Environmental Quality Act, an analysis of direct, indirect, and cumulative project impacts to biological resources, including *D. conjugens*, is required. The California Environmental Quality Act sometimes requires development and implementation of mitigation plans for projects that result in loss of habitat. The California Department of Fish and Game has conserved populations of *D. conjugens* under the Natural Community Conservation Plan and land acquisition.

**H. Recovery Strategy**

The San Diego MSCP is a regional habitat conservation planning program that provides long-term preservation for multiple species and their habitats, as well as the preservation of natural communities in southwestern San Diego County. The range of *Deinandra conjugens* is entirely within three participating MSCP jurisdictions: County of San Diego, City of San Diego, and the City of Chula Vista. Each jurisdiction has prepared a

Subarea Plan that identifies reserve boundaries, and requires the development and implementation of management and monitoring plans to permanently maintain species covered under their plans, including *D. conjugens*, within designated open space preserves. In reviewing and approving the San Diego MSCP, we concluded that the plan will not jeopardize the continued existence of *D. conjugens*. In other words, the MSCP will not appreciably reduce the likelihood of survival and recovery. The recovery strategy identified below includes actions that go beyond those specified in the MSCP that will enhance the prospects for recovery of *D. conjugens*. However, this recovery plan does not change the requirements or specified activities within the MSCP. Participating jurisdictions must continue to implement the conservation measures provided for under their respective subarea plans to protect *D. conjugens*; however, they are not required to implement the additional measures identified in the recovery plan. Any additional measures to provide for recovery of this species will be undertaken by us or another willing entity.

The long-term survival and conservation of *Deinandra conjugens* is dependent upon a number of factors, including:

- Protecting and managing existing populations, especially those in MSCP Preserve areas. Protection of any populations outside of MSCP Preserves would also be beneficial to the overall recovery of this species. Regardless of where they occur (in reserves or out), smaller populations that occur between larger populations, and which can provide connectivity (i.e., gene flow), have the potential to contribute to the recovery and conservation of the species.

- Maintaining normal ecological conditions within protected areas. These conditions include, but are not limited to, areas of appropriate soils that are sufficiently weed-free to allow germination of *Deinandra conjugens* and that have an adequate suite of pollinators and seed dispersal agents to allow gene flow within and among populations.

- Preserving and maintaining areas with suitable micro-habitat that could be recolonized and allow a population to survive a catastrophic event.

Artificial manipulation (management) that adequately mimics or otherwise addresses the necessary ecological functions for *Deinandra conjugens* may also suffice, however, natural regimes are preferred.

Given that *Deinandra conjugens* is an obligate outcrosser (self-incompatible), and population/habitat fragmentation may significantly limit gene flow between remaining populations, the recovery strategy must also address the importance of maintaining and conserving the genetic diversity currently exhibited in the species (including genetic variability of currently unprotected populations). This task may include conserving genetic diversity by establishing a seed bank from all available populations across the extant range of the species. High levels of genetic diversity, or heterozygosity, and continued, adequate exchange of genes between populations (through cross pollination) are important to maintain adaptability to changing environmental conditions, and thereby ensure the long-term persistence of the species (Lynch *et al.* 1995; Lande 1999). The small, fragmented distribution of this species, coupled with its breeding system (*i.e.*, self-incompatibility and annual habit), makes it especially vulnerable to natural and anthropogenic effects including disturbance from human and agricultural activities; spread of non-native species; and nearby use of herbicides, pesticides, and other contaminants (U.S. Fish and Wildlife Service 1998; B. Baldwin, pers. comm. 2001; S. McMillan, pers. comm. 2001).

To ensure long-term viability of *Deinandra conjugens* populations, population monitoring and intensive habitat management will likely be required. Survival and recovery will depend upon the implementation of a scientifically valid monitoring program to ensure that each conserved population allows for natural shifts in population size and distribution and maintains adequate numbers to survive extinction risks from environmental, demographic and genetic variation. Monitoring must also ensure that populations demonstrate stable or positive growth rates as measured by recruitment and fecundity over a period that spans a minimum of three drought cycles (estimated at approximately 24 years). Ensuring successful reproduction and establishment of seed banks within reserves will allow populations to persist through demographic and environmental fluctuations. Management plans must be developed and implemented across the reserve network to insure that non-native vegetation, which can create unsuitable growing conditions for *D. conjugens* and competition for resources, is controlled within established reserves using techniques that are not harmful to the persistence of *D. conjugens* populations.

Finally, a research program should be developed and implemented to better understand aspects of the biology and ecology of *Deinandra conjugens*, as well as the biology and ecology of its primary pollinators. Broad research topics include: identifying the genetic variation in *D. conjugens* and its geographic distribution; determining the level of outcrossing needed to sustain fragmented/isolated populations of *D. conjugens*; identifying the primary pollinators and assessing habitat requirements, dispersal distances and population trends necessary to ensure their viability; and developing propagation techniques for *D. conjugens* and reintroduction methods.

## II. RECOVERY

### A. Objectives

The goal of this recovery plan is to recover *Deinandra conjugens* sufficiently to warrant delisting. The recovery objectives include:

1. Stabilizing and protecting habitat that supports known populations within areas identified for conservation under the MSCP;

2. Identifying and protecting populations outside of the MSCP that are important to maintain genetic diversity and connectivity between established reserves.

3. Reducing and managing threats to this species, such as invasion and competition by invasive non-native weeds and reduction in genetic diversity, within areas identified for conservation under the MSCP, and other populations as necessary.

4. Conducting research necessary to refine recovery criteria.

### B. Recovery Criteria

*Deinandra conjugens* may be considered for delisting when the following conditions are met:

1. Known populations (including naturally occurring seedbanks) within areas identified for conservation under the MSCP are permanently protected from future development or other significant threats and and adequate, permanent funding and management mechanisms are in place as required under the MSCP.

2. Monitoring indicates established reserves (e.g., MSCP preserve lands, National Wildlife Refuge lands, State preserve lands) provide sufficient suitable habitats and space to sustain the full ecological needs of *D. conjugens*, including habitats that sustain its pollinators.

   If long-term monitoring and research indicate that the established reserves are insufficient (either in areal extant, configuration, or quality), alternative measures

will be developed and implemented in a timely fashion. These measures may include, but are not limited to, land acquisition or creation of suitable habitat to increase the area or provide for an appropriate configuration of suitable habitat to be sufficient to sustain *D. conjugens* and its pollinators, active management that compensates for insufficiencies in reserve size and/or configuration, and/or other appropriate measures based on research.

3. A collection of seeds from wild plants, which represents the range of genetic variability currently exhibited in *D. conjugens*, and which includes sufficient seed to allow for future propagation/population augmentation, is securely stored at a certified Center for Plant Conservation botanical garden or other appropriate seed storage facility (or facilities) agreed upon by us. Seeds must be collected and stored according to the most current, accepted guidelines represented in the literature.

4. Techniques for the propagation and reintroduction of *D. conjugens* are developed and successfully implemented when deemed appropriate.

5. The management program identified under the MSCP, including actions identified under individual Subarea Plans that positively affect the conservation of *D. conjugens*, must be fully funded and implemented in perpetuity.

   If it is determined through research and monitoring that additional management is needed to meet the recovery criteria, a supplemental management program that includes all activities determined to be necessary for the conservation of *D. conjugens*, must be developed and fully funded and implemented in a timely fashion by us or another willing party, in perpetuity.

   At a minimum, the complete management program must:

   - Control invasive, non-native weeds, including "thatch" build-up, within suitable and occupied *D. conjugens* habitat.

   - Eliminate threats from off-road vehicle activity.

- Sustain populations of pollinators and seed dispersers associated with each reserve.

- Maintain natural levels of genetic diversity within and among populations of *D. conjugens*.

- Incorporate scientifically valid and peer reviewed management actions.

- Include appropriate reaction mechanisms and implementation trigger points to identify when a specific action must be implemented.

6. The monitoring program identified under the MSCP, and actions identified under individual Subarea Plans that lead to and support recovery of *D. conjugens*, must be fully funded and implemented in perpetuity.

   If it is determined that additional monitoring is needed to meet recovery criteria, a supplemental monitoring program, including all activities that are necessary to adequately evaluate the delisting criteria and that are not sufficiently covered under the MSCP (and Subarea Plans), must be developed and fully funded and implemented by us or another willing party, in perpetuity.

   The complete monitoring program must be scientifically valid and peer reviewed, and must include:

   - An effective method for monitoring population changes in *D. conjugens*, including both spatial and temporal components.

   - An effective method for monitoring population changes in *D. conjugens* pollinators and their pollination effectiveness within an individual reserve.

   - A method for tracking the genetic variability (including variability at the S locus) within and between populations of *D. conjugens*, sufficient to identify the source of and a solution to a significant decline in genetic variability or inbreeding depression.

7. Populations of *D. conjugens* are stable or increasing within established reserves.

8. Populations of *D. conjugens* pollinators are stable or increasing within each reserve.

9. Genetic variation currently existing in *D. conjugens*, or the level determined by scientific research to be necessary to sustain wild populations, is maintained across its range.

10. No conserved population of *D. conjugens* is experiencing significant genetic loss or irreversible threat of inbreeding depression.

Monitoring to assess criteria 7 through 10 must continue for a minimum period of 24 years, which is anticipated to incorporate three drought cycles. However, this time period may change should additional scientific information on the amount of time necessary to adequately determine the population trend of *Deinandra conjugens* indicate otherwise. If the species is delisted, the monitoring period will be extended for an additional 5 years after delisting, as required by the Endangered Species Act for species that are delisted due to recovery.

Research on several critical aspects of the species' biology and ecology, as detailed in the stepdown narrative below (action 5), is necessary to adequately assess these recovery criteria. The results of this research may result in changes to the strategy for recovery. In particular, it is necessary to understand:

- The maximum period for which a downward trend in population size/recruitment in *Deinandra conjugens* can be sustained without significantly increasing the risk of demographic/genetic extirpation or a genetic bottleneck.

- The spatial scale at which an occurrence of *D. conjugens* is sufficiently independent from other occurrences to be considered a separate population for the purposes of monitoring.

- The amount of suitable and occupied habitat necessary to sustain a viable population of *D. conjugens* within an established reserve.

- The number of populations of *D. conjugens* and area of suitable and occupied habitat that must be maintained to conserve the species in perpetuity.

- The minimum number of S alleles that must be maintained within a population of *D. conjugens* to sustain cross pollination and successful reproduction, and avoid genetic drift and/or inbreeding depression.

- The habitat/ecological needs of *D. conjugens* pollinators and the amount of suitable/occupied habitat necessary to sustain a population(s) within a reserve.

- The level of cross pollination that must occur between populations of *D. conjugens* to maintain genetic diversity across the range of the species.

- The maximum dispersal/movement distance of *D. conjugens* pollinators, beyond which cross pollination between populations (occurrences) is precluded.

**C. Stepdown Narrative**

Given that the entire U.S. range of *Deinandra conjugens* occurs within the boundaries of the MSCP, it is anticipated that many of the recovery actions identified below will be addressed through implementation of the Subarea Plans for the County of San Diego, City of San Diego and City of Chula Vista. If it is determined that the MSCP and Subarea Plans are not required to address a specific action, the action will be addressed by us or another willing entity. Jurisdictions and agencies anticipated to contribute to implementation of each action are identified in the Implementation Schedule below. Each recovery action addresses threats to the species and contributes to fulfillment of recovery criteria needed for delisting, as summarized in the Appendix.

1. Protect habitat supporting known populations within areas identified for conservation under the Subarea Plans for the County of San Diego, City of San Diego, and City of Chula Vista.

Habitat for *Deinandra conjugens* occurs entirely within the Multiple Species Conservation Program for the County of San Diego and the City of San Diego Subarea Plans and the City of Chula Vista Subarea Plan in southwestern San Diego County. These Subarea Plans identify specific areas to be conserved for *D. conjugens* (City of San Diego Subarea Plan and City of Chula Vista Subarea Plan) or describe pre-approved mitigation areas (County of San Diego Subarea Plan).

Subarea Plans have identified boundaries for reserves and pre-approved mitigation areas. Future urban or agricultural development within these reserve boundaries should avoid suitable and occupied *Deinandra conjugens* habitat. Habitat for this species is to be conserved by land acquisition (fee or conservation easement), donation, and exactions. Certain lands within San Miguel Ranch that support *D. conjugens* have been conveyed to and acquired as part of the San Diego National Wildlife Refuge.

Areas conserved for *Deinandra conjugens* should allow opportunities for plant populations to disperse to areas of suitable, unoccupied habitat, and should include sufficient area to provide for the ecological needs of *D. conjugens* pollinators. Conserved habitats should provide buffers against the adverse effects of adjacent development, such as altered soil moisture and enhanced weed establishment.

2. Conduct surveys to search for new populations and implement actions to protect populations outside of established reserves when necessary to maintain genetic diversity and/or connectivity between larger reserves.

*Deinandra conjugens* is an annual plant whose distribution and abundance can change dramatically from one year to the next. Populations outside of MSCP reserves may be important for maintaining genetic diversity and connectivity between established reserves. Surveys for *D. conjugens* should continue within areas of suitable habitat. New populations should be assessed according to action 3, and management plans adjusted to protect new populations. Specific methods should be developed and implemented to ensure that surveyors accurately distinguish *D. conjugens* from the sympatric *D. fasciculata*. We

should ensure that surveys for this species are conducted using a standardized monitoring protocol within conserved areas.

3. Evaluate the status of all known populations.

The purpose of this action is to assemble all available information necessary to make informed decisions regarding actions necessary to stabilize and manage protected populations and identify those populations outside of established conservation areas that require protection to ensure survival and recovery. Population size (area and number of individuals), reproduction, distribution, threats to stability or viability, and land management objectives should be determined for all sites. Populations should be ranked according to status and level of threat. A single methodology should be developed to conduct population assessments and implemented across all reserves.

4. Adaptively manage and monitor conserved areas.

Public and private lands conserved for *Deinandra conjugens* should be adaptively managed to reduce and minimize threats and maximize their potential to recover this species.

4.1 Develop and implement appropriate techniques to control invasive weeds within suitable *Deinandra conjugens* habitat.

Greenhouse studies have demonstrated that *Deinandra conjugens* experiences reduced growth and seed set and produces fewer inflorescences in the presence of dense stands of invasive weeds (Bauder *et al.* 2002). Surveys conducted in 2003 indicate that most populations of *D. conjugens* are threatened by invasive weeds (S. McMillan *in litt*. 2003). Appropriate techniques should be developed and implemented to control invasive weeds within suitable *D. conjugens* habitat, while avoiding adverse impacts to the species or its habitat.

4.2 Develop and implement appropriate management plans for conserved areas.

Management plans that address the biological and ecological needs of *Deinandra conjugens* should be developed and implemented for conservation areas. Based on the information gathered under action 3 and supplemented through ongoing research identified under action 5, threshold levels should be established to indicate when appropriate actions should be implemented or when specific changes in management practices are required. Actions should be implemented with relative priority according to the population ranking conducted in action 3. If new threats are identified, or other new information becomes available, then management plans should be revised.

At a minimum, management plans should include: specific methods for the control and removal of invasive weeds and thatch; actions necessary to maintain populations of native *Deinandra conjugens* pollinators including providing sufficient nectar resources; and actions necessary to control unauthorized use of off-highway vehicles. Management activities should be evaluated periodically and adjusted to maximize the potential for the conservation and recovery of *D. conjugens*. Results of new biological research should be considered in adaptive management plans. Management plans should be consistent between reserves and management agencies.

4.3 Develop and implement a monitoring plan for conserved areas.

A standardized and coordinated monitoring program should be established and implemented across all reserves to ensure that data collection is consistent and comparable across the range of the species. The program should develop specific methods for tracking population dynamics in *Deinandra conjugens* and their pollinators, and to monitor the genetic variability within *D. conjugens*. The monitoring program should also determine whether the existing reserves provide the necessary ecological requirements for recovery of *D. conjugens*. For the purposes of assessing whether *D. conjugens* is sufficiently viable to warrant delisting, the monitoring program must be implemented for a minimum period of 24 years (encompassing at least three drought cycles). If the species is delisted, this monitoring period will be extended by an additional 5 years

of post-delisting monitoring, as required by the Endangered Species Act for species delisted due to recovery.

Monitoring components should include (but are not limited to): abundance, distribution, recruitment, and seed production in *Deinandra conjugens*; genetic variability within and among populations of *D. conjugens*; pollinator abundance and population dynamics (the plan should be refined as additional knowledge of specific *D. conjugens* pollinators becomes available), invasion by non-native weeds, and the extent of impact from existing and potential threats. The monitoring program should specify the appropriate timing and frequency for implementing each component that reflects environmental conditions (e.g. rainfall) and will enable identification of population trends and characteristics. The monitoring program must be approved by us and the California Department of Fish and Game prior to adoption.

Monitoring results should be provided to us and the California Department of Fish and Game to be incorporated into the annual review of the Subarea Plans, adaptive management, and recovery program.

5. Identify research needs and conduct studies on the biology and ecology of *Deinandra conjugens*.

Research is needed to identify limiting ecological and genetic factors for *Deinandra conjugens* and determine methods for controlled propagation & reintroduction.

5.1 Conduct research to determine the population dynamics of conserved populations of *Deinandra conjugens*.

Research is needed to better understand the population dynamics of *Deinandra conjugens*. Important questions that should be answered to evaluate recovery criteria include: What is the extent of suitable and occupied habitat necessary within a reserve to sustain a viable independent population of *D. conjugens* in the context of natural fluctuations? What constitutes an independent population for the purposes of monitoring?

What is the number of populations and area of habitat that must be maintained to conserve the species in perpetuity? What is the maximum period for which a downward trend in population size/recruitment can be sustained without significantly increasing the risk of demographic or genetic extirpation or a genetic bottleneck (founder event)?

5.2 Conduct research to determine ecological requirements of the species.

Ecological studies should also address: the influence of disturbance on the species' habitat, various life history stages, and population dynamics; effective fire management requirements; techniques for maintaining habitat openings; soil characteristics (pH, texture, hydrology, slope, etc.) of the species' habitat; fine scale mapping of soil distribution (limited pockets of clay soils); seed bank characteristics; seed dispersal mechanisms; and the impact of herbivory.

5.3 Assess and plan for conservation of genetic variability within the species.

5.3.1 Conduct a baseline census of current genetic structure of populations and genetic diversity of the species.

Preliminary results indicate that *Deinandra conjugens* may have a high level of genetic diversity (Bauder and Truesdale 2000). All known populations should be examined to expand on this preliminary information and assist in identifying populations with unique genetic diversity.

Collection and analysis of plant tissue will be needed to determine genetic lineages within and among populations. Understanding genetic lineages among *Deinandra conjugens* populations may be important for determining the feasibility of long distance crosses, and to increase genetic diversity within populations, if necessary. Determination of the genetic variability within and among populations can provide an accurate estimate of effective population size and recovery potential. Maintenance of the genetic

diversity in *D. conjugens* should enhance long-term viability and adaptability to changing environmental conditions.

5.3.2 Determine the level of variability at the S locus within and among populations of *Deinandra conjugens*, and identify isolated populations that may need genetic augmentation.

An assessment of genetic variability at the S locus would further clarify self-pollination limitations and identify small, isolated populations which may become extirpated due to limited genetic diversity. These studies could identify the degree to which inbreeding depression in small populations is a problem and how much genetic variation is needed for viable restoration. Populations that are genetically similar may require augmentation to increase the genotypic diversity and potentially restore reproductive ability. Research should be able to identify the minimum number of S alleles necessary to sustain an independent population.

5.3.3 Identify appropriate management techniques to provide genetic exchange and/or genetic augmentation among populations.

The maintenance or augmentation of genetic variability between/within populations may be accomplished by a variety of techniques including the distribution of seeds among populations, establishment of seedlings from nursery stock, and/or collection and transfer of pollen. Appropriate techniques should be developed and evaluated.

5.4 Based on research and monitoring of population dynamics in *Deinandra conjugens*, and the extent of genetic variability within the species, determine the number of populations, the spatial distribution, and the amount of suitable and occupied habitat necessary to recover the species.

5.5 Study *Deinandra conjugens* pollinators and their management needs.

A variety of native and non-native bees have been observed on *Deinandra conjugens* plants and are potential pollinators. However, flower visitation by insects does not necessarily indicate that the particular insect species is an effective pollinator of *D. conjugens*. Research is needed on the biology and ecology of important pollinators and an assessment should be made to determine if pollinator species have been, or may be, extirpated from conserved areas.

5.5.1 Conduct research to identify the primary and secondary pollinators of *Deinandra conjugens*.

5.5.2 Identify the habitat requirements of *Deinandra conjugens* pollinators and assess population status in conserved areas.

Research on the habitat requirements to maintain viable populations of primary and secondary pollinators will be important for the long-term survival of *Deinandra conjugens*. Pollinators may require different soils and vegetation types for nest sites and adequate food resources. The size and distribution of pollinator populations should also be evaluated. Management actions within conserved areas may need to be developed to ensure that adequate habitat needs for pollinators are being provided.

5.5.3 Determine what distances pollinators can travel and how fragmentation affects pollinators' ability to contribute to long distance pollen transfer between populations of *Deinandra conjugens*.

5.6 Continue to develop techniques to germinate and propagate *Deinandra conjugens*.

Restoration of habitat and reintroduction of *Deinandra conjugens* may be necessary for recovery. These techniques for artificial enhancement, repatriation, and/or introduction reduce the risk of local extirpation from random disturbance and natural events and to maintain genetic diversity. Seedbanked seed and seed from nursery propagated plants can provide

material for potential enhancement of existing populations and/or introducing plants to new sites. Plants can be reintroduced to historical occurrences if the site is currently unoccupied. Experimental introductions of this plant into appropriate habitats should be monitored to determine the validity of this technique for recovery of this species.

5.7 Develop seed banking techniques for *Deinandra conjugens* and collect seeds from all available sources.

Seed banking is a prudent strategy for maintaining listed plants such as *Deinandra conjugens* that exist as a narrowly distributed endemic species where only a small portion of its native habitat is extant. This strategy helps to guard against chance catastrophic disturbance, which often occurs in source populations of these species. Detailed guidelines for seed collection have been published by the Center for Plant Conservation (1991). Seeds from non-contiguous populations should be segregated and stored separately from each other to prevent mixing. Seeds from both ray and disc flowers should be stored in the seed bank. Rancho Santa Ana Botanic Garden is the local seed storage facility for southern California. An agreement that ensures long term storage and seed banking of adequately represented populations of *D. conjugens* should be developed with Rancho Santa Ana Botanic Garden or other appropriate facility.

Seeds should be collected from as many different populations as possible, to ensure that the widest array of genetic diversity is captured in the seed bank. Priority should be placed on collecting seeds from extant populations outside of designated reserves, which may be lost in the near future. Capturing the greatest level of genetic diversity in the seed bank will facilitate long-term survival of *Deinandra conjugens*. Collection should be conducted according to established guidelines.

6. Develop and implement a community outreach program.

6.1 Continue to develop and implement outreach efforts to conserve *Deinandra conjugens*.

Outreach is an important component of implementing all recovery plans. Outreach efforts should be developed to enhance the public's understanding of issues related to conservation and recovery of *Deinandra conjugens* and its associated habitat. Participation from both public and private entities should be encouraged for the establishment of conservation plans for this species.

6.2 Continue to develop informational outreach materials on conserved lands.

Agencies such as City of San Diego, City of Chula Vista, County of San Diego, and the U.S. Fish and Wildlife Service should develop outreach material (perhaps including exhibits) to inform the public on the value of regional conservation planning, rare biota, and compatible recreational use of the conserved areas.

## III. IMPLEMENTATION SCHEDULE

The schedule that follows is a summary of actions and estimated costs for the *Deinandra conjugens* recovery program. It is a guide to meet the objectives of the recovery plan. This schedule indicates recovery action priorities, action numbers, action descriptions, duration of actions, responsible agencies, and estimated costs. These actions, when accomplished, should achieve the recovery objectives. Actions are further elaborated in Section II.C (Stepdown Narrative). The estimated costs for some actions remain to be determined, and funding for some actions will come from sources not wholly attributable to *D. conjugens*. Our staff salary is not included in cost estimates. Cost is not separated by responsible agency; cost distribution among agencies is to be determined. Listing a party as responsible does not necessarily mean that responsibilities are increased above and beyond prior responsibilities or costs, nor are responsibilities necessarily obligatory. The list of responsible parties is not exhaustive.

Definitions and Abbreviations Used in the Implementation Schedule:

Priorities in column one were assigned as follows:

1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

2: An action that must be taken to prevent a significant decline in species' population, habitat quality, or some other significant negative impact short of extinction.

3: All other actions necessary to meet the recovery objectives.

Key to Acronyms used in the Implementation Schedule:

| | |
|---|---|
| BLM | Bureau of Land Management |
| BP | Border Patrol |
| Caltrans | California Department of Transportation |
| CCV | City of Chula Vista |
| CDF | California Department of Forestry |
| CDPR | California Department of Parks and Recreation |
| CSD | City of San Diego |
| NGO | Nongovernmental Organizations |
| SDC | San Diego County |
| SDNHM | San Diego Natural History Museum |
| USFWS | U.S. Fish and Wildlife Service |

| | |
|---|---|
| * | Lead responsible agency |

| IMPLEMENTATION SCHEDULE FOR *DEINANDRA CONJUGENS* (OTAY TARPLANT) RECOVERY PLAN | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Priority # | Action # | Action Description | Estimated Action Duration (Years) | Primary Responsible Parties | Cost ($1,000's) | | | | | | Comments |
| | | | | | Total Cost | FY 04 | FY 05 | FY 06 | FY 07 | FY 08 | |
| 1 | 2 | Conduct surveys to search for new populations outside of established reserves. | 4 | USFWS*, CDFG, CSD, SDC, CCV, | 50 | 15 | 15 | 10 | 10 | | |
| 1 | 5.3.1 | Conduct a baseline census of current genetic structure of populations and genetic diversity of the species | Continuous | USFWS* | 200 | 50 | 30 | 0 | 0 | 0 | $30K to re-evaluate every 5 years |
| 1 | 5.3.2 | Determine the level of variability at the S locus within and among populations of *Deinandra conjugens*, and identify isolated populations that may need genetic augmentation. | Continuous | USFWS* | 230 | 50 | 50 | 25 | 25 | | $20K to re-evaluate every 5 years |

| IMPLEMENTATION SCHEDULE FOR *DEINANDRA CONJUGENS* (OTAY TARPLANT) RECOVERY PLAN | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Priority # | Action # | Action Description | Estimated Action Duration (Years) | Primary Responsible Parties | Cost ($1,000's) | | | | | | Comments |
| | | | | | Total Cost | FY 04 | FY 05 | FY 06 | FY 07 | FY 08 | |
| 1 | 5.7 | Develop seed banking techniques for *Deinandra conjugens* and collect seeds from all available sources | 5 | USFWS*, CSD, SDC, CCV, CDFG | 80 | 10 | 20 | 20 | 10 | | repeat collections periodically to ensure fresh supply and diversity |
| Priority 1 Actions subtotal | | | | | 560 | 125 | 115 | 55 | 45 | 0 | |
| 2 | 1. | Protect habitat supporting known populations within areas identified for conservation under the County of San Diego, the City of San Diego and the City of Chula Vista Subarea Plans | Ongoing | USFWS, CSD*, SDC*, CCV*, CDFG | TBD | TBD | TBD | TBD | TBD | TBD | Costs will reflect MSCP planning for multiple species. |
| 2 | 3. | Evaluate the status of all known populations. Population size (area and number of individuals), reproduction, distribution, threats to stability or viability, and land management objectives should be determined for all sites. | Continuous | USFWS*, CSD*, SDC*, CCV*, CDFG* | 310 | 50 | 20 | 20 | 20 | 20 | Every other year after 2008 |

| IMPLEMENTATION SCHEDULE FOR *DEINANDRA CONJUGENS* (OTAY TARPLANT) RECOVERY PLAN | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Priority # | Action # | Action Description | Estimated Action Duration (Years) | Primary Responsible Parties | Cost ($1,000's) | | | | | | Comments |
| | | | | | Total Cost | FY 04 | FY 05 | FY 06 | FY 07 | FY 08 | |
| 2 | 4.3 | Develop and implement a monitoring plan for conserved areas. Monitoring components should include (but are not limited to): abundance, distribution, recruitment and seed production in *Deinandra conjugens*; pollinator abundance and population dynamics (the plan should be refined as additional knowledge of specific *D. conjugens* pollinators becomes available), invasion by non-native weeds, and the extent of impact from existing and potential threats. | Ongoing | USFWS*, CSD*, SDC*, CCV*, CDFG | 300 | 30 | 30 | 20 | 20 | 20 | Every other year after 2008 |
| Priority 2 Actions subtotal | | | | | 610 | 80 | 50 | 40 | 40 | 40 | |
| 3 | 4.1 | Develop and implement appropriate techniques to control invasive weeds within suitable *Deinandra conjugens* habitat. | Ongoing | USFWS, CSD*, SDC*, CCV*, CDFG | 340 | 50 | 50 | 30 | | 30 | $30K Every other year after 2008 |

| IMPLEMENTATION SCHEDULE FOR *DEINANDRA CONJUGENS* (OTAY TARPLANT) RECOVERY PLAN | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Priority # | Action # | Action Description | Estimated Action Duration (Years) | Primary Responsible Parties | Cost ($1,000's) | | | | | | Comments |
| | | | | | Total Cost | FY 04 | FY 05 | FY 06 | FY 07 | FY 08 | |
| 3 | 4.2 | Develop and implement appropriate management plans for conserved areas. At a minimum management plans should include: specific methods for the control and removal of invasive weeds and thatch; actions necessary to maintain populations of native *Deinandra conjugens* pollinators including providing sufficient nectar resources; and actions necessary to control unauthorized use of off-highway vehicles | Ongoing | USFWS*, CSD*, SDC*, CCV*, CDFG* | 490 | 30 | 20 | 20 | 20 | 20 | Annually after 2008 |
| 3 | 5.1 | Conduct research to determine the population dynamics of conserved populations of *Deinandra conjugens*. | Continuous | USFWS*, CSD, SDC, CCV, CDFG | 300 | 30 | 30 | 20 | 20 | 20 | Every other year after 2008 |
| 3 | 5.2 | Conduct research to determine ecological requirements of the species | 10 | USFWS*, CSD, SDC, CCV, CDFG | 200 | 20 | 20 | 20 | 20 | 20 | |
| 3 | 5.3.3 | Identify appropriate management techniques to provide genetic exchange and/or genetic augmentation among populations | Continuous | USFWS* | 90 | 10 | 10 | 10 | 10 | 10 | $10K every 5 years after 2008 |

| IMPLEMENTATION SCHEDULE FOR *DEINANDRA CONJUGENS* (OTAY TARPLANT) RECOVERY PLAN | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Priority # | Action # | Action Description | Estimated Action Duration (Years) | Primary Responsible Parties | Cost ($1,000's) | | | | | | Comments |
| | | | | | Total Cost | FY 04 | FY 05 | FY 06 | FY 07 | FY 08 | |
| 3 | 5.4 | Based on research and monitoring of population dynamics in *Deinandra conjugens*, and the extent of genetic variability within the species, determine the number of populations, the spatial distribution, and the amount of suitable and occupied habitat necessary to recover the species. | 2 | USFWS* | TBD | TBD | TBD | TBD | TBD | TBD | Costs dependent on research results |
| 3 | 5.5.1 | Conduct research to identify the primary and secondary pollinators of *Deinandra conjugens*. | 4 | USFWS*, CSD, SDC, CCV, CDFG | 80 | | 20 | 20 | 20 | | 1 additional year to complete research |
| 3 | 5.5.2 | Identify the habitat requirements of *Deinandra conjugens* pollinators and assess population status in conserved areas | Continuous | USFWS*, CSD, SDC, CCV, CDFG | 190 | | | 20 | 20 | 15 | Every other year after 2008 |
| 3 | 5.5.3 | Determine what distances pollinators can travel and how fragmentation affects pollinators' ability to contribute to long distance pollen transfer between populations of *Deinandra conjugens*. | 4 | USFWS*, CSD, SDC, CCV, CDFG | 80 | | | 20 | 20 | | 2 additional years to complete research |

| IMPLEMENTATION SCHEDULE FOR *DEINANDRA CONJUGENS* (OTAY TARPLANT) RECOVERY PLAN | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Priority # | Action # | Action Description | Estimated Action Duration (Years) | Primary Responsible Parties | Cost ($1,000's) | | | | | | Comments |
| | | | | | Total Cost | FY 04 | FY 05 | FY 06 | FY 07 | FY 08 | |
| 3 | 5.6 | Continue to develop techniques to germinate and propagate *Deinandra conjugens* | 3 | USFWS*, CSD, SDC, CCV, CDFG | 30 | 0 | 10 | 10 | | | Techniques currently being developed; 1 additional year to complete |
| 3 | 6.1 | Continue to develop and implement outreach efforts to conserve *D. conjugens* | Continuous | USFWS, CSD*, SDC*, CCV*, CDFG | 71 | 0 | 5 | 3 | 3 | 3 | $3K annually after 2008 |
| 3 | 6.2 | Continue to develop educational information on conserved lands. | Continuous | USFWS*, CSD*, SDC*, CCV*, CDFG* | 74 | 3 | 3 | 3 | 3 | 3 | $3K annually after 2008 |
| Priority 3 Actions subtotal | | | | | 1,945 | 148 | 168 | 176 | 136 | 121 | |
| Total Estimated Cost of Recovery: $3,115,000 + additional costs that cannot be estimated at this time | | | | | | | | | | | |

Total costs for continuing and ongoing actions are calculated based on an estimated 24-year timeframe for recovery.

Habitat to be protected under the MSCP will also serve to conserve other co-occurring endangered species, so the cost of habitat protection is only partially attributable to conservation of *Deinandra conjugens*.

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## APPENDIX. Summary of Threats and Recommended Recovery Actions

| LISTING FACTOR | THREAT | STILL A THREAT? | RECOVERY ACTION NUMBERS | RECOVERY CRITERIA |
|---|---|---|---|---|
| A | Habitat loss due to agriculture and urbanization | yes | 1, 2 | 1, 2 |
| A | Habitat fragmentation | yes | 1, 2 | 1, 2 |
| A | Off-road vehicle use | yes | 4.2 | 5 |
| A | Trampling | yes | 4.2 | 5 |
| A,E | Competition from nonnative plant species. | yes | 4.1, 4.2, 4.3 | 2, 5 |
| B | Overcollection [Possible; not currently known to be a threat] | N/A | | |
| C | None | | | |
| D | Inadequacy of CEQA, CESA, and Mexican laws | yes | Beyond scope of recovery plan; would take legislative action to change | N/A |
| E | Inbreeding depression and infertility due to self-incompatible breeding system and genetic homogeneity | yes | 5.3.1, 5.3.2, 5.3.3, 5.4 | 3, 4, 5, 6, 9,10 |
| E | Loss of pollinators | yes | 4.2, 4.3, 5.5.1, 5.5.2, 5.5.3 | 2, 5, 8 |
| E | Susceptibility to extirpation from random environmental fluctuations due to small population size | yes | 4.3, 5.1, 5.2, 5.4, 5.6, 5.7, 6.1, 6.2 | 2, 3, 4, 6, 7 |

**Listing Factors**:

**A**. The Present or Threatened Destruction, Modification, or Curtailment Of Its Habitat or Range

**B**. Overutilization for Commercial, Recreational, Scientific, Educational Purposes (not a factor)

**C**. Disease or Predation

**D**. The Inadequacy of Existing Regulatory Mechanisms

**E**. Other Natural or Manmade Factors Affecting Its Continued Existence