

**2001 MSCP RARE PLANT SURVEY
AND MONITORING REPORT**

Prepared for:

City of San Diego
Planning and Development
202 "C" Street
San Diego, California 92101-4587

Prepared by:

McMillan Biological Consulting
P.O. Box 4137
La Mesa, California 91941
(619) 368-9508

and

Conservation Biology Institute
651 Cornish Drive
Encinitas, CA 92024
(760) 634-1590

February 2002

TABLE OF CONTENTS

1.0 INTRODUCTION

- 1.1 Environmental Setting
- 1.2 Objectives of This Study

2.0 METHODS

- 2.1 Literature and Background Research
- 2.2 Reconnaissance Surveys
- 2.3 Monitoring
 - 2.3.1 Prioritizing Monitoring Locations
 - 2.3.2 Field Methods

3.0 RESULTS

- 3.1 Literature and Background Research
- 3.2 Reconnaissance Surveys
- 3.3 Monitoring

***Acanthomintha ilicifolia* - San Diego thornmint**

Otay Lakes

***Ambrosia pumilla* - San Diego Ambrosia**

***Brodiaea orcuttii* - Orcutt's Brodiaea**

Otay Lakes

Mission Trails (east)

General Dynamics

Scripps Ranch/Miramar

Nobel Drive

Carroll Canyon

Brown Parcel

Del Mar Mesa

***Cordylanthus maritimus* - salt marsh bird's-beak**

***Cordylanthus orcuttianus* - Orcutt's bird's-beak**

Otay Valley

Dennery Ranch

***Dudleya brevifolia* - short-leaved Dudleya**

***Dudleya variegata* - variegated Dudleya**

Goat Mesa/Spring Canyon

California Terraces

Paradise Valley

Otay Lakes

Lake Murray

Margerum Avenue

Mission Trails (west)

Mission Trails (east)

Mercy Road

Black Mountain Ranch

TABLE OF CONTENTS (continued)

***Lessingia filaginifolia* var. *linifolia* - Del Mar sand aster**

Carmel Mountain
Carmel Valley
Overlook Park
Torrey Highlands

***Lotus nuttallianus* - Nuttall's Lotus**

***Monardella linoides* ssp. *viminea* - willowy Monardella**

Otay Lakes

***Muilla clevelandii* - San Diego goldenstar**

Otay Lakes
Mission Trails (west)
Mission Trails (east)
Mercy Road
Del Mar Mesa

4.0 RECOMMENDATIONS

- 4.1 Future Surveys
- 4.2 Monitoring Protocols
- 4.3 Future Monitoring Locations
- 4.4 Management
 - Invasion by Non-native Weed Species
 - Encroachment by Adjacent Homeowners and Businesses
 - Illegal Off-road Activity
 - Unauthorized Trail Access and Development
 - Limited Patrol by City of San Diego Staff

5.0 REFERENCES CITED

TABLES

- 1: Summary of MSCP Covered Plant Species Monitoring 2001
- 2: Rare Plant Populations New to the MSCP Database Based on Literature Survey and Background Research
- 3: Rare Plant Populations/Locations New to the MSCP Database Based on 2000-2001 Reconnaissance Surveys
- 4: Rare Plant Species and Populations Monitored During the 2001 Season
- 5: Recommendations for Future Reconnaissance Surveys on City of San Diego MSCP Lands
- 6: Summary Data for Rare Plant Species Populations Monitored During the 2001 Season
- 7: Common Annual and Perennial Weed Species on City of San Diego MSCP Lands

TABLE OF CONTENTS (continued)

APPENDICES

- Appendix 1: MSCP Reconnaissance Surveys for 2001 Rare Plant Monitoring, City of San Diego
- Appendix 2: Rare Plant Density Monitoring Data Form
- Appendix 3: California Native Plant Society Status Designations
- Appendix 4: MSCP Rare Plant Seed Collection, Storage, and Propagation Protocols

1.0 INTRODUCTION

In 1997, the City of San Diego signed an Implementing Agreement with the wildlife agencies (United States Fish and Wildlife Service [USFWS] and the California Department of Fish and Game [CDFG]) to implement the City's Subarea Plan, prepared to comply with the requirements of the California Natural Community Conservation Planning (NCCP) Act of 1992. The Subarea Plan (City of San Diego, 1997) and the Biological Monitoring Plan for the Multiple Species Conservation Program (MSCP) (Ogden, 1996) direct the implementation and monitoring of the City's portion of the MSCP Preserve. These plans identify the known populations of covered plant and animal species to monitor and also identify the need for more complete distribution information for many of these species. Covered species are those species addressed or "covered" by the MSCP Plan and the City's Subarea Plan, and for which endangered species take authorizations have been issued by USFWS and CDFG.

Although the City has initiated the monitoring for some of the covered plant species, this monitoring has not included all of the covered plant species within the City's MSCP lands and has not included all of the known populations for each of these species. As part of the MSCP requirements, the City of San Diego will establish monitoring programs for these species and will also ensure that the database for the covered plants within the City is accurate and complete.

1.1 Environmental Setting

The City of San Diego's portion of the MSCP Preserve includes a wide range of habitats and geographic settings. Most of the City's MSCP Preserve lands are located along the coastal mesas and canyons from the United States and Mexico border, north to the boundary with the City of Del Mar. Some of the City's lands include the inland foothills and canyons in the unincorporated area of the County of San Diego (Marron Valley, Otay Lakes, San Vicente) as well as lands around Lake Hodges and in San Pasqual Valley.

Both the coastal and inland areas of the City's MSCP lands support numerous native vegetation communities, including coastal sage scrub, chaparral, riparian woodlands, oak woodlands, vernal pools, and native grasslands and other clay soil associations. There are also areas dominated by non-native grasses and other exotic plant species. The habitats within the City of San Diego are part of the California Floristic Province, which includes the cismontane areas from southern Oregon to coastal northwest Baja California. This floristic region is characterized by a Mediterranean climate, which has shaped the evolution and biogeography of its species and habitats (Beauchamp, 1986; Hickman, 1993; Holland, 1986; Munz, 1974; Oberbauer, 1992; Raven and Axelrod, 1978; and Wiggins, 1980).

1.2 Objectives of this Study

The goal of this project was to evaluate the current status of the rare plant populations on MSCP preserve lands administered by the City of San Diego, including population size, density, and habitat quality. Our three primary objectives were:

1. Review existing population status and location information to update the City's database and to identify City-owned lands that have the potential to support populations of MSCP covered plant species.
2. Conduct reconnaissance surveys on MSCP lands to determine if additional populations and locations of covered plants exist and to refine the locations where quantitative monitoring should be conducted.
3. Initiate quantitative monitoring for selected species and populations or locations that have not been monitored previously. This monitoring will establish the baseline data that will be used in conjunction with future monitoring to determine the status of these species and populations. This information will then be used to direct the management of these species' populations and habitats within the City's MSCP lands. The specific questions to be addressed in the long-term monitoring program are:
 - a. What are the status and trends of the target species?
 - b. What are the site conditions that may influence spatial patterns in the population dynamics of the target species?
 - c. What management actions should be taken to minimize threats to the target species, and are these actions effective?

The City of San Diego has conducted quantitative monitoring for short-leaved Dudleya (*Dudleya blochmaniae* ssp. *brevifolia*), San Diego Ambrosia (*Ambrosia pumilla*), and Nuttall's Lotus (*Lotus nuttallianus*). In addition, City staff and volunteers have monitored selected populations of willowy Monardella (*Monardella linoides* ssp. *viminea*) and San Diego thornmint (*Acanthomintha ilicifolia*). Table 1 lists the species that were monitored as part of this study (X) and those species for which the City of San Diego (SD) conducted quantitative monitoring. Although some of the species were not monitored as part of this study, all 11 species listed in Table 1 were included in the literature review and reconnaissance surveys discussed in Section 2.

TABLE 1
SUMMARY OF MSCP COVERED PLANT SPECIES MONITORING 2001

Species	Literature Review	Reconnaissance Surveys	Quantitative Monitoring
<i>Acanthomintha ilicifolia</i> San Diego thornmint	X	X	X
<i>Ambrosia pumilla</i> San Diego Ambrosia	X	X	SD
<i>Brodiaea orcuttii</i> Orcutt's Brodiaea	X	X	X
<i>Cordylanthus maritimus</i> Salt marsh bird's-beak	X	X	SD
<i>Cordylanthus orcuttii</i> Orcutt's bird's-beak	X	X	X
<i>Dudleya blochmaniae</i> ssp. <i>brevifolia</i> Short-leaved Dudleya	X	X	SD
<i>Dudleya variegata</i> Variegated Dudleya	X	X	X
<i>Lessingia filaginifolia</i> var. <i>linifolia</i> Del Mar sand-aster	X	X	X
<i>Lotus nuttallianus</i> Nuttall's Lotus	X	X	SD
<i>Monardella linoides</i> ssp. <i>viminea</i> Willowy Monardella	X	X	X
<i>Muilla clevelandii</i> San Diego goldenstar	X	X	X

2.0 METHODS

2.1 Literature Review and Background Research

Various sources were reviewed for existing information on rare plant populations, or the potential for their occurrence, on the City's MSCP lands, including the MSCP species database, the state's Natural Diversity Data Base (NDDDB), soils maps, topographic maps, recent environmental reports, and the San Diego Natural History Museum (SDNHM) Herbarium. In addition, information was requested from other knowledgeable botanists and biologists from consulting companies, public agencies, and the California Native Plant Society (CNPS). Juda Sarkinson recorded all SDNHM Herbarium specimen information available for the 11 target plant species. Biologist Scott McMillan reviewed all information.

Although new data were found for rare plant populations in San Diego County, the accuracy of some locality information is poor. This is especially true of the NDDDB and SDNHM Herbarium records, which are often too vague to determine the exact locality. Because of this, some of these records were not useful for this project.

2.2 Reconnaissance Surveys

Using the existing MSCP database information and the results of the literature review and background research, reconnaissance surveys were conducted to evaluate the potential for MSCP lands to support covered plant species and to refine the location where quantitative sampling should occur. Reconnaissance surveys were conducted throughout the City's MSCP lands by biologists Scott McMillan, Brenda McMillan, Fred Roberts, and Virginia Moran. Fred Roberts conducted most of the reconnaissance surveys in the Del Mar area, and Virginia Moran conducted most of the surveys in the Lake Hodges and San Pasqual Valley areas. Scott McMillan and Brenda McMillan surveyed the remainder of the City's MSCP lands.

Reconnaissance surveys were conducted primarily during late winter and early spring (December 2000 - April 2001), but they continued into early summer (June) of 2001. Although these surveys were not complete in most areas, there was an attempt to try and survey all the areas of the City's MSCP lands. Parcels were visited by vehicle to determine extent and quality of habitat; in addition, some areas were surveyed on foot.

Surveyors concentrated on areas that appeared to have higher potential for the target species. In many portions of the City's lands, this involved concentrating on the more open areas of native grassland and clay lens habitats, but other vegetation communities (coastal sage scrub, chaparral, riparian woodland) were not ignored.

When visiting a parcel, surveyors assigned the parcel a site number (based on the date) and general location name (e.g., west Otay Valley, Rose Canyon, etc.). The surveyors followed City Guidelines for Conducting Biological Surveys (City of San Diego, 1978

and 1994) and recorded the following information: basic survey information (date, surveyor, etc.), primary vegetation community types (coastal sage scrub, chaparral, etc.), potential to support target species, and information on disturbances and maintenance issues (see Appendix 1).

2.3 Monitoring

Quantitative monitoring conducted during this study was restricted to 7 of the 11 target covered plant species (see Table 1). This monitoring will establish the baseline data that will be used in conjunction with future monitoring to determine the environmental status of these species and populations and to inform management decisions. Once multiple seasons of quantitative monitoring data are collected, these data will be added to the baseline data collected in 2001 to establish trends in density and non-native cover over consecutive years of data collection. This additional information will allow for a reevaluation of the priorities for monitoring (see Section 4.3).

Populations that were not quantitatively monitored during the 2001 season were monitored using qualitative methods. Even though the plants were not counted, the total population size was estimated, and qualitative data were collected on the habitat conditions and threats for each site.

2.3.1 Prioritizing Monitoring Locations

The MSCP Biological Monitoring Plan identifies locations to be monitored for covered plant species. Using the plan and input from City of San Diego staff, populations and locations of target plant species were prioritized for quantitative monitoring using the following criteria in the order given:

1. General Geographic Location. Populations that represent the range of the geographic distribution of each species within the City's MSCP lands were prioritized for monitoring. By sampling across the full geographic range of the species, we hope to monitor populations with a corresponding range of genetic diversity. The City MSCP lands were divided into north, central, and southern portions. Therefore, for a species that occurs across the entire range of City MSCP lands, at least one population each from the north, central, and southern portions of the City's lands was prioritized for monitoring.
2. Types and Level of Disturbance Factors. During reconnaissance surveys, each population was evaluated qualitatively for the types and level of disturbances potentially affecting it. These disturbance factors included trash dumping, increased fire frequency, grazing, off-road activity (and other types of mechanical disturbances), illegal trails and foot traffic, and weed invasion. In general, we prioritized more disturbed populations for monitoring, as monitoring allows for better evaluation of the habitat conditions and provides information for management decisions. We also attempted to monitor at least

one of the less disturbed populations of each species for comparison of species-specific impacts of disturbances.

3. New Population vs. Existing Population in the MSCP Database. A population/location that is new to the MSCP database was prioritized for monitoring. Although most of the known rare plant populations have previously not been monitored quantitatively, some qualitative information (past reports, herbarium records, etc.) is available. As there is no baseline information for the new populations, these were prioritized for quantitative monitoring.

2.3.2 Field Methods

A variation of the methods described in the Biological Monitoring Plan (Ogden, 1996) was used in the monitoring effort. For larger populations distributed over a broad area, a subset of the population was counted using 1 m² quadrats. The only exception was Del Mar sand-aster, which was surveyed with 10 m² quadrat plots. This species is a subshrub, and the 1 m² plots may not accommodate a single individual plant. Total population size was estimated based on the estimated total area occupied by the population and estimated mean density determined by the quadrat sampling. Small, discrete populations (e.g., Orcutt's *Brodiaea* at Nobel Drive) were counted in their entirety to get an accurate number of individuals in the population.

The number of quadrats was determined by the population size and distribution of the population, and never numbered more than ten plots. Relevé-type quadrat plots were used (Braun-Blanquet, 1932), which were purposefully distributed (not randomly) across the observed range of rare plant densities at each locality (i.e., stratified sampling based on visual estimates of density). Quadrats were placed in areas with low, medium, and high densities of the target rare plant species and at varied distances from the center of the population. Quadrats were not permanently marked in the field.

In addition to counting numbers of individuals of a covered species, percent of individuals in vegetation, flower, and fruit was estimated for each quadrat. The slope and slope aspect (slope direction) were recorded for each quadrat, and the percent native cover, non-native cover, and bare ground were also recorded using the relevé method (Braun-Blanquet, 1932). The habitat surrounding the population was described, noting specific management problems and disturbances. The data form that was used during the 2001 rare plant monitoring is included in Appendix 2.

3.0 RESULTS

3.1 Literature and Background Research

As a result of the literature survey and background research effort, 23 new covered plant species locations were added to the MSCP database (Table 2). The 23 locations represent 13 different covered plant species, including 6 of the 11 target species identified for this project (Table 1). Most of these localities were identified through interviews with knowledgeable biologists; three of these localities are from the SDNHM Herbarium records (two for Nuttall's Lotus and one for San Diego goldenstar). All of these populations were confirmed as extant by field surveys during 2001, with the exception of the Nuttall's Lotus populations at Famosa Slough and Sunset Cliffs. Both of these sites were surveyed during 2001, but no plants were found in the habitat that remains there.

Of the 23 localities new to the MSCP database, 17 are in areas conserved as a result of the California Terraces and Dennery Ranch residential developments, currently owned by the Pardee Development Co., which will eventually become part of the City's MSCP lands. While some of these populations were naturally occurring, many were recently re-introduced as part of the vernal pool and canyon restoration program on these properties.

3.2 Reconnaissance Surveys

A total of 119 sites were visited during the 2000 and 2001 season, and 57 of these sites were visited more than once. Appendix 1 lists the species expected at each site, including species recorded previously for the site as well as species and locations not in the MSCP database. Table 3 summarizes the rare plant locations new to the MSCP database (29 new locations) as a result of the 2000-2001 reconnaissance surveys. Population locations discussed in this report are on maps at the City of San Diego MSCP department.

3.3 Monitoring

Table 4 lists the species and localities that were monitored during the 2001 season (selected by the criteria discussed in Section 2.3.1); 19 were monitored quantitatively and 12 were monitored qualitatively, i.e., population size and condition were estimated and disturbances to the habitat were noted. The subsequent sections provide the results of monitoring efforts for each species and location. See Appendix 3 for explanation of CNPS designations. The following abbreviations are used:

M = mean
% FL = percent of individuals flowering
% FR = percent of individuals with fruit
% VEG = percent of individuals without flowers or fruits (vegetative only)

TABLE 2
RARE PLANT POPULATIONS NEW TO THE MSCP DATABASE
BASED ON LITERATURE SURVEY AND BACKGROUND RESEARCH

Species	Locality	Responsibility	Source
<i>Acanthomintha ilicifolia</i> San Diego thornmint	California Terraces Dennery Ranch	Pardee/City of SD Pardee/City of SD	2001B 2001B
<i>Ambrosia pumilla</i> San Diego Ambrosia	California Terraces	Pardee/City of SD	2001B
<i>Cordylanthus orcuttianus</i> Orcutt's bird's-beak	California Terraces Dennery Ranch	Pardee/City of SD Pardee/City of SD	2001B 2001B
<i>Dudleya variegata</i> Variegated Dudleya	California Terraces Dennery Ranch	Pardee/City of SD Pardee/City of SD	2001B 2001B
<i>Hemizonia conjugens</i> Otay tarplant	California Terraces Dennery Ranch	Pardee/City of SD Pardee/City of SD	2001B 2001B
<i>Eryngium aristulatum</i> ssp. <i>parishii</i> San Diego button-celery	California Terraces	Pardee/City of SD	2001B
<i>Lotus nuttallianus</i> Nuttall's Lotus	Famosa Slough Sunset Cliffs	City of SD City of SD	H3 H4
<i>Muilla clevelandii</i> San Diego goldenstar	Otay Lakes	City of SD	H1/H2
<i>Navarretia fossalis</i> Spreading Navarretia	California Terraces Otay Lakes Goat Mesa/Spring Cn	Pardee/City of SD City of SD City of SD	2001B 2001D 2001E
<i>Opuntia parryi</i> var. <i>serpentina</i> Snake Cholla	California Terraces Dennery Ranch	Pardee/City of SD Pardee/City of SD	2001B 2001B
<i>Orcuttia californica</i> California Orcutt grass	California Terraces Goat Mesa/Spring Cn	Pardee/City of SD City of SD	2001B 2001E
<i>Pogogyne nudiuscula</i> Otay Mesa mint	California Terraces	Pardee/City of SD	2001B
<i>Rosa minutifolia</i> Small-leaved rose	California Terraces Dennery Ranch	Pardee/City of SD Pardee/City of SD	2001B 2001B

- H1** - San Diego Natural History Museum Herbarium (SDNHM) record #150007. Collected by Frank F. Gander (Collection #1519) on April 23, 1936.
- H2** - SDNHM Herbarium record #85239. Collected by R.M. Beauchamp and C.F. Harbison on May 21, 1971.
- H3** - SDNHM Herbarium record #132794. Collected by Tim Cass on July 15, 1981.
- H4** - SDNHM Herbarium record #117498. Collected by Edmund R. Cross on August 15, 1942.
- 2001B** - McMillan, S. 2001. Personal communication with Mark Dodero and Bruce Hanson at RECON.
- 2001C** - McMillan, S. 2001. Personal communication with Darren Smith at Dudek and Associates.
- 2001D** - McMillan, S. 2001. Personal communication with Tim Cass at the San Diego County Water Authority.
- 2001E** - McMillan, S. 2001. Personal communication with Cam Patterson at Siskiyou Resource Geographics, Inc.

TABLE 3
RARE PLANT POPULATIONS/LOCATIONS NEW TO THE MSCP DATABASE
BASED ON 2000-2001 RECONNAISSANCE SURVEYS

Species	Locality	Responsibility	Source
<i>Brodiaea orcuttii</i> Orcutt's Brodiaea	Carroll Canyon	City of SD	2001A
	Lopez Ridge	City of SD	2001A
	General Dynamics	City of SD	2001A
	Scrip Rch/Mira (west)	City of SD	2001A
	Nobel Drive	City of SD	2001A
<i>Ceanothus verucosus</i> Wart-stemmed Ceanothus	Torrey Pines State Reserve	Calif. State Parks	2001A
<i>Dudleya variegata</i> Variegated Dudleya	Margerum Ave.	City of SD	2001A
	Paradise Valley	City of SD	2001A
	Mercy Rd.	City of SD	2001A
	Black Mtn. Ranch	City of SD	2001A
	Goat Mesa	City of SD	2001A
	Otay Lakes	City of SD	2001A
<i>Hemizonia conjugens</i> Otay tarplant	Robinhood Ridge	McMillan/CitySD	2001A
	Goat Mesa	City of SD	2001A
	Spring Canyon	City of SD	2001A
	Paradise Valley	City of SD	2001A
<i>Eryngium aristulatum</i> ssp. <i>parishii</i> San Diego button-celery	General Dynamics	City of SD	2001A
	Robinhood Ridge	McMillan/CitySD	2001A
	Goat Mesa	City of SD	2001A
	Spring Canyon	City of SD	2001A
<i>Lessingia filaginifolia</i> var. <i>linifolia</i> Del Mar sand-aster	Torrey Highlands	City of SD	2001A
<i>Muilla clevelandii</i> San Diego goldenstar	Mission Trails (west)	City of SD	2001A
	Mercy Rd.	City of SD	2001A
<i>Navarretia fossalis</i> Spreading Navarretia	Robinhood Ridge	City of SD	2001A
	Otay Lakes	City of SD	2001A
<i>Pogogyne abramsii</i> San Diego mesa mint	General Dynamics	City of SD	2001A
	Carroll Canyon	City of SD	2001A
<i>Pinus torreyana</i> Torrey Pine	Crest Canyon	City of SD	2001A
	Torrey Highlands	City of SD	2001A

2001A - McMillan, S. and Conservation Biology Institute. 2001. Surveys conducted during the spring of 2000-2001 on City of San Diego MSCP properties. Surveys conducted by Scott McMillan, Fred Roberts, and Virginia Moran.

TABLE 4
RARE PLANT SPECIES AND POPULATIONS MONITORED
DURING THE 2001 SEASON

Species	Locality	New to Database	Quantitative Monitoring
<i>Acanthomintha ilicifolia</i> San Diego thornmint	Otay Lakes	No	Yes
<i>Brodiaea orcuttii</i> Orcutt's Brodiaea	Otay Lakes Mission Trails (east) General Dynamics Scripps Rch/Mira (west) Nobel Drive Carroll Canyon Brown Parcel Del Mar Mesa	No No Yes Yes Yes Yes No No	No No Yes No Yes Yes No Yes
<i>Cordylanthus orcuttii</i> Orcutt's bird's-beak	Otay Valley Dennerly Ranch	No No	Yes Yes
<i>Dudleya variegata</i> Variegated Dudleya	Goat Mesa California Terraces Paradise Valley Otay Lakes Lake Murray Margerum Ave. Mission Trails (west) Mission Trails (east) Mercy Road Black Mtn. Ranch	Yes Yes Yes Yes No Yes No No Yes Yes	Yes No No Yes No Yes No No No Yes
<i>Lessingia filaginifolia</i> var. <i>linifolia</i> Del Mar sand-aster	Carmel Mountain Carmel Valley Overlook Park Torrey Highlands	No No Yes Yes	Yes Yes Yes Yes
<i>Monardella linoides</i> ssp. <i>viminea</i> Willowy Monardella	Otay Lakes	No	Yes
<i>Muilla clevelandii</i> San Diego goldenstar	Otay Lakes Mission Trails (west) Mission Trails (east) Mercy Road Del Mar Mesa	Yes Yes No Yes No	Yes Yes No No Yes

***Acanthomintha ilicifolia* - San Diego thornmint**

CNPS: 1B, 2-3-2

State: Endangered

Fed: Threatened

San Diego thornmint is an annual herb that occurs in heavy clay soils associated with native grasslands, coastal sage scrub, chaparral, and vernal pools. This herb blooms between April and July and is found from northern San Diego County south to northwestern Baja California, Mexico (CNPS, 2001).

This species is known from City of San Diego MSCP lands in a number of localities. Most of the known localities have been monitored by City staff or by volunteer efforts. These localities include Mission Trails, Los Peñasquitos Canyon, Black Mountain Ranch, and Sabre Springs (City of San Diego, 2001). Survey and monitoring results for the Otay Lakes population are included here.

1. OTAY LAKES

The Otay Lakes population of San Diego thornmint occurs on a mesa along the southern side of the lake. This mesa is covered in native grassland with pockets of chaparral along the edges. In addition to the thornmint, this mesa supports large populations of San Diego goldenstar and variegated Dudleya. The large clay lens is mapped as Olivenhain soils and also supports many vernal pools of various sizes (USDA, 1973). The vernal pools on this mesa and the two finger mesas to the east support numerous rare vernal pool indicator plant species, including large populations of toothed Downingia (*Downingia cuspidata*), San Diego button-celery (*Eryngium aristulatum* ssp. *parishii*), and a few pools with spreading Navarretia (*Navarretia fossalis*). San Diego fairy shrimp (*Branchinecta sandiegonensis*) were observed in some of these pools during early spring 2001.

Five quadrats were surveyed at this locality. The mean non-native cover for this population was almost 50% during the 2001 season, and the average count per quadrat (18 plants/m²) was very low compared to the large expanse of potential habitat. This mesa is covered in the kind of clay soils that are indicative of San Diego thornmint, but most of it has over 80% non-native cover. These monitoring results support the field observation that the population of thornmint at this site is struggling to persist. Monitoring data were collected from two small thornmint populations that are growing in the clay with many non-native annual plant species, including a non-native plantain (*Plantago* sp.) and numerous annual grass species. Although some of the rare species on this mesa are continuing to thrive in large populations, the small thornmint populations are on the brink of extirpation. Grazing continues to be a problem at this site, with cattle coming in from adjacent private property through highly deteriorated fences. This grazing disturbance appears to contribute to the invasion of non-native species into the clay soils.

2001 MSCP RARE PLANT MONITORING DATA

Acanthomintha ilicifolia

General Locality: Otay Lakes

Site #: 1

Surveyor(s): Scott McMillan

USGS Quad: Jamul Mountains

Date: 5-15-01

QUAD (1m ²)	1	2	3	4	5	M
COUNT	12	28	13	15	21	18
% FL	85	90	90	85	90	88
% FR	5	5	10	10	5	7
% VEG	10	5	0	5	5	5
SLOPE	0	0	0	0	0	0
ASPECT	-	-	-	-	-	-
% NATIVE COVER	35	40	40	60	60	47
% NON-N COVER	60	45	55	40	45	49
% BARE GROUND	5	10	5	5	5	6

Ambrosia pumilla - San Diego Ambrosia

CNPS: 1B, 3-3-2

State: None

Fed: Proposed Endangered

San Diego Ambrosia has been monitored by City of San Diego staff and volunteer efforts. There were no new localities discovered during the 2001 season for this species.

Survey work in the Otay area included the populations of San Diego Ambrosia reported from Otay Valley and Spring Canyon. These populations have been misidentified and are a different species of Ambrosia (*A. confertiflora*). The records for this species in the Otay Valley and Spring Canyon areas should be removed from the City's database, and the populations in the Tijuana River Valley should be confirmed before they are included in the database.

Brodiaea orcuttii - Orcutt's Brodiaea

CNPS: 1B, 1-3-2

State: None

Fed: None

Orcutt's Brodiaea occurs in clay soils and is especially prevalent on Redding soils and their associates. This species is a perennial bulb that blooms from May to August and is found from southern Orange and Riverside Counties to northwest Baja California,

Mexico. This species usually occurs in grasslands, meadows, and vernal pools associated with coastal sage scrub and chaparral habitats (Bauder, 1986; Bauder and McMillan, 1996; Beauchamp and Cass, 1979; CNPS, 2001). This species is found throughout most of the range of the City of San Diego MSCP lands, but is especially concentrated in the central mesas and foothills (Kearny Mesa, Mira Mesa, Clairemont Mesa, Scripps Ranch/Miramar). Four of the eight populations are new to the MSCP database.

1. OTAY LAKES

This population was not relocated during the 2001 season. Locality information from the MSCP database indicates the population is up-slope from the vernal pool area at Otay Lakes, which is consistent with the field observations for potential habitat. A moderate-sized (over 1,000 plants) population of Mesa Brodiaea (*Brodiaea jolonensis*) was seen in and around the vernal pools and associated habitats.

2. MISSION TRAILS (EAST)

As with the Otay Lakes population, this population was not relocated. Surveys in and around the mapped locality indicate habitat more consistent with Mesa Brodiaea than Orcutt's Brodiaea, but neither species was found.

3. GENERAL DYNAMICS

Although Orcutt's Brodiaea was identified on the General Dynamics site prior to this season, it was not included in the MSCP database until now. This population is on property off of Ruffin Road that was once owned by General Dynamics.

This site has over 20 vernal pools, with dense populations of many vernal pool indicator plant species. The vernal pools at this site support San Diego Mesa mint (*Pogogyne abramsii*), San Diego button-celery, and other vernal pool species, along with rough Muilla (*Muilla maritima*) and Orcutt's Brodiaea around the pools. The vegetation on the mima mound and surrounding habitat is broken and disturbed sage scrub, with the western end dominated by Broom Baccharis (*Baccharis sarothroides*). The entire parcel is mapped as Redding soils (USDA, 1973).

This population of Orcutt's Brodiaea has a high density compared to other known populations. The mean density was 71 individuals/m², and the average estimated non-native plant cover was 13%. These data show that the population is doing well (over 10,000 plants), despite the fact that some of these pools have tire ruts and evidence of other past disturbances in them.

2001 MSCP RARE PLANT MONITORING DATA

Brodiaea orcuttii

General Locality: General Dynamics

Site #: 1

Surveyor(s): Scott McMillan

USGS Quad: La Jolla

Date: 5-12-01

QUAD (1m ²)	1	2	3	4	5	6	7	8	9	10	M
COUNT	12	128	93	75	35	28	67	110	126	34	71
% FL	95	95	90	90	95	100	95	85	90	100	94
% FR	5	0	5	10	5	0	0	5	5	0	3
% VEG	0	5	5	0	0	0	5	10	5	0	3
SLOPE	0	0	0	0	0	0	0	0	0	0	0
ASPECT	-	-	-	-	-	-	-	-	-	-	-
% NATIVE COVER	85	80	85	90	90	85	90	80	80	90	86
% NON-N COVER	10	15	15	10	10	20	10	15	15	10	13
% BARE GROUND	5	10	5	5	5	0	15	5	10	5	7

The western end of the site has been more disturbed than the rest of the site, and it appears that a number of basins have been reconstructed. Some of these basins have a few vernal pool plants, but all have a higher weed cover than the less disturbed pools to the east. It is only a matter of time before these more weedy pools begin to impact the high quality pools by allowing for the spread of non-native plant species.

4. SCRIPPS RANCH/MIRAMAR

Orcutt's *Brodiaea* is known from many areas in and around the numerous vernal pools found on Marine Corps Air Station (MCAS) Miramar. The three populations found this season on the City's property at the northeast corner of the air station are new to the database. Two of these populations had over 500 individuals, and one was very large with an estimated population of over 10,000 plants.

The two smaller populations occur in native grassland habitat along the terraces above a small drainage at this site. The small population up the canyon and to the east has been partially destroyed by a number of pit-fall trap arrays that were installed in the middle of the population. The large population is at the northern end of the parcel, in the last canyon near the boundary of USIU. Most of this population is in a wet meadow area dominated by sedge (*Carex* sp.) and other wet meadow species. The surrounding

associated habitat of all three populations is chaparral with a small portion of coastal sage scrub. This entire site is mapped as Redding soils (USDA, 1973).

While not quantitatively monitored, these populations have a low cover of non-native plant species and a high cover of associated native species.

5. NOBEL DRIVE

This small population is associated with vernal pool habitat on a small mesa, above Nobel Drive to the north and Rose Canyon to the south. Five vernal pools remain on the mesa, and four of the five have been fenced. Most of the fencing is barely adequate to protect the pools, and unprotected vernal pool habitat still exists in the trail/road that cuts between the pools.

2001 MSCP RARE PLANT MONITORING DATA

Brodiaea orcuttii

General Locality: Nobel Drive

Site #: 2

Surveyor(s): Scott McMillan

USGS Quad: La Jolla

Date: 5-19-01

QUAD (1m ²)	1	2	3	M
COUNT	13	8	22	14
% FL	85	90	95	90
% FR	5	5	5	5
% VEG	10	5	0	5
SLOPE	0	0	0	0
ASPECT	-	-	-	-
% NATIVE COVER	75	75	85	78
% NON-N COVER	15	20	20	18
% BARE GROUND	10	10	5	8

These pools support many vernal pool indicator species, including large populations of toothed Downingia. Two of the five pools have spreading Navarretia in moderate numbers (258 and 102 individuals), which is also a new locality for the MSCP database for this species. Three quadrats were surveyed for this locality and all of the Orcutt's Brodiaea individuals (43 plants) were counted. Although San Diego Mesa mint was not found in these pools, it was known from extirpated vernal pools near this population. The habitat in these pools is well within the range of San Diego Mesa mint habitat

preferences. San Diego fairy shrimp were seen in two of these pools during the 2001 season. The habitat surrounding the pools is primarily native grassland, with chaparral closer to the edges of the mesa. The mesa portion of this site is mapped as Redding soils (USDA, 1973).

Along with the vernal pool habitat, this population of Orcutt's *Brodiaea* is being disturbed by foot traffic, off-road activity, and weed invasion. The three pools with Orcutt's *Brodiaea* have a mean non-native cover of less than 20%, but the other two pools have a much higher cover of weeds. One of these pools is not fenced and continues to suffer the direct effects of foot and vehicle traffic. The pool that is not fenced is also one of the pools that supported San Diego fairy shrimp in 2001.

The density of this population is lower than other sites (mean of 14 plants/m²), partially due to natural conditions, but primarily due to the continued disturbance of the habitat.

6. CARROLL CANYON

This population occurs in and around vernal pool habitat that is perched above Carroll Canyon to the south, on a small remnant of the native mesa. This small piece of mesa supports numerous vernal pools surrounded by dense chaparral. The fence around the

2001 MSCP RARE PLANT MONITORING DATA

Brodiaea orcuttii

General Locality: Carroll Canyon

Site #: 3

Surveyor(s): Scott McMillan

USGS Quad: Del Mar

Date: 5-19-01

QUAD (1m ²)	1	2	3	4	5	6	7	8	9	10	M
COUNT	38	102	63	120	25	24	57	30	82	14	56
% FL	95	95	95	90	85	95	100	85	90	90	92
% FR	0	0	5	0	5	0	0	5	5	5	3
% VEG	5	5	0	10	10	5	0	10	5	5	6
SLOPE	0	0	0	0	0	0	0	0	0	0	0
ASPECT	-	-	-	-	-	-	-	-	-	-	-
% NATIVE COVER	85	90	85	90	90	90	90	85	80	90	88
% NON-N COVER	5	10	10	10	5	5	5	10	10	5	8
% BARE GROUND	10	10	5	5	5	10	15	5	10	5	8

property is in good condition with good signage, so the disturbance level in these pools is low. Some of the pools have vehicle ruts from past disturbance, but this is limited.

These pools support many vernal pool indicator species, including large populations of toothed Downingia (over 10,000 plants), San Diego Mesa mint (over 10,000 plants), and San Diego button-celery (an estimated 1,000 plants). Although the first survey at this site was later in the spring (mid-May), San Diego fairy shrimp were found in two of the pools. The entire parcel is mapped as Redding soils (USDA, 1973).

The vernal pool habitat at this site is some of the very best habitat remaining in the central part of the city. Non-native plant cover is under 10%, which is very uncommon for vernal pool habitat in any part of the world. Another indicator of the good habitat quality is the high density of individuals (mean of 56 plants/m²). The total estimated population of Orcutt's Brodiaea at this location is over 10,000 plants. Although the effects of children playing in the habitat are minimal at this point, the threat of disturbance from adjacent homes is still present. This piece of mesa is still in good condition, but the site is small and could easily be disturbed in a short period of time.

7. BROWN PARCEL

The Brown Parcel vernal pool habitat is located on the southern edge of Los Peñasquitos Canyon, associated with chaparral habitat around the pools and in the canyons. These pools support numerous indicator species, including San Diego Mesa mint (over 5,000 plants), San Diego button-celery (1,000 plants), and toothed-Downingia (over 5,000 plants). San Diego fairy shrimp have been observed in all of these pools during past monitoring efforts (RECON, 1998). Most of this site is mapped as Redding soils (USDA, 1973).

This site was the subject of a 6-year restoration project funded by the City of San Diego and conducted by RECON (RECON, 1998). Most of the restoration effort was in the early implementation phase of the project, while work in the following years was monitoring the hydrology, plant cover, and invertebrate fauna, with little effort spent on control of non-native plant species. Because of this, most of these pools continue to decline in native vernal pool cover, while the weed species continue to increase. While there are over 1,000 individuals of Orcutt's Brodiaea in the few pools at this site, this population is threatened by continued weed invasion.

8. DEL MAR MESA

The Del Mar Mesa vernal pool complex is located on the north side of Los Peñasquitos Canyon, on the flat mesa that extends north toward Carmel Valley and Deer Canyon. This mesa top area is mapped as Redding soils and is covered with chamise chaparral surrounding vernal pools of various sizes.

This vernal pool complex supports extensive populations of San Diego button-celery (over 10,000 plants), San Diego Mesa mint (over 10,000 plants), and other vernal pool

species. Associated with the vernal pools and the Orcutt's *Brodiaea* are large populations of rough Muilla (5,000 plants) and San Diego golden-star (see below). San Diego fairy shrimp were seen in many of the pools that ponded during the 2001 season and would be expected from most of the other vernal pools during a season with high rainfall.

2001 MSCP RARE PLANT MONITORING DATA

Brodiaea orcuttii

General Locality: Del Mar Mesa

Site #: 4

Surveyor(s): Scott McMillan

USGS Quad: Del Mar

Date: 5-20-01

QUAD (1m ²)	1	2	3	4	5	6	7	8	9	10	M
COUNT	7	29	56	33	41	18	46	44	14	13	30
% FL	85	95	95	100	100	90	90	80	90	95	92
% FR	5	0	5	0	0	5	5	10	5	5	4
% VEG	10	5	0	0	0	5	5	10	5	0	4
SLOPE	0	0	0	0	0	0	0	0	0	0	0
ASPECT	-	-	-	-	-	-	-	-	-	-	-
% NATIVE COVER	75	70	65	70	75	85	65	75	75	65	72
% NON-N COVER	25	30	35	35	25	15	25	15	25	35	27
% BARE GROUND	10	10	5	5	5	0	10	10	5	0	6

The vernal pool habitat at Del Mar Mesa is in good condition in most areas and supports large populations of many rare species. This complex is one of the most unique vernal pool areas in the MSCP area. Some of the vernal pools have dense populations of San Diego button-celery that are almost completely covered by the overlapping branches of the scrub oaks and other woody species on the site.

Unfortunately, heavy use by off-road activity and trash dumping continue to destroy the vernal pool and chaparral habitats in some areas. Although Del Mar Mesa currently supports good vernal pool habitat, this activity is having very serious impacts on the quality of these pools and their associated species.

Ten quadrats were surveyed at this site with a mean density of 30 plants/m²; however, estimated non-native cover is almost 30% and will continue to increase as long as the current disturbances are allowed to persist.

***Cordylanthus maritimus* - salt marsh bird's-beak**

CNPS: 1B, 2-2-2

State: Endangered

Fed: Endangered

All of the MSCP monitoring localities for salt marsh bird's-beak are on National Wildlife Refuge lands, and the USFWS is responsible for managing and monitoring these populations. Surveys were conducted for this species in a number of localities, but no new localities were discovered during the 2001 season.

***Cordylanthus orcuttianus* - Orcutt's bird's-beak**

CNPS: 2, 3-3-1

State: None

Fed: None

Orcutt's bird's-beak is an annual species that occurs in coastal sage scrub in southern San Diego County and northwest Baja California, Mexico. This species flowers from April to July and can be found in small patches in the sage scrub near the base and drip-line of woody shrubs. This species is known only from a few localities within the United States and is not very common in Baja California (CNPS, 2001). Both of the Orcutt's bird's-beak populations were previously known from MSCP database records.

1. OTAY VALLEY

The Otay Valley population of Orcutt's bird's-beak is located on the alluvial terraces on the south side of Otay Valley, just west of Interstate 805. The soil at this site is mapped as Riverwash, but most of the population is at or above the flood zone (USDA, 1973). The vegetation is fragmented and disturbed coastal sage scrub with pockets of native and non-native grasslands. The entire area is bisected by roads and trails that support considerable off-road activity, and some of the small patches of Orcutt's bird's-beak are on the very edges of these roads and trails.

This is probably the largest population (over 1,000 plants) of Orcutt's bird's-beak on this side of the U.S.-Mexico border. A quadrat with a count of 30 or more plants is essentially a solid patch of Orcutt's bird's-beak, and more than a few areas of the population were almost 100% covered by this species.

Although this population is currently in good condition, continual disturbance by off-road activities and non-native plant invasion is likely to change this. As mentioned above, some of the large patches are immediately adjacent to active off-road trails, and any expansion of these trails will negatively impact these patches. In addition, the mean cover of non-native species was moderately high at 35% and is expected to increase over time under the current disturbance regime.

2001 MSCP RARE PLANT MONITORING DATA

Cordylanthus orcuttianus

General Locality: Otay Valley

Site #: 1

Surveyor(s): Scott McMillan

USGS Quad: Imperial Beach

Date: 6-20-01

QUAD (1m ²)	1	2	3	4	5	6	7	8	9	10	M
COUNT	12	35	26	58	19	7	67	17	14	38	29
% FL	85	95	95	95	90	95	95	90	95	100	94
% FR	0	0	0	0	0	0	0	0	0	0	0
% VEG	10	5	0	5	10	5	5	10	5	0	6
SLOPE	2	2	1	1	2	2	0	0	0	0	1
ASPECT	34 5	330	340	340	340	355	-	-	-	-	342
% NATIVE COVER	55	60	75	90	55	45	85	50	65	75	66
% NON-N COVER	45	35	25	15	40	60	15	45	35	35	35
% BARE GROUND	5	10	5	5	5	0	10	10	5	0	6

2. DENNERY RANCH

This small population of Orcutt's bird's-beak is located up a small side canyon along the south side of Otay Valley. This population is much smaller than the population to the west. Although the surrounding vegetation is still intact, this area has also suffered damage from extensive off-road activity. Much of this habitat is fragmented by roads and trails created by off-road vehicles. This population is on property currently owned by Pardee Development, but the property will become part of the City of San Diego's MSCP lands in the future. This site is mapped as Linne soils (USDA, 1973).

As with the larger population to the west, this site continues to suffer from heavy off-road activities and the subsequent weed invasion. Population densities at this site are slightly less than the western site (mean of 25 plants/m²), and the non-native cover is almost the same (mean of 32%). The estimated total population size for this locality is between 200 and 300 plants. Invasion by non-native species is expected to increase as the off-road disturbance continues.

2001 MSCP RARE PLANT MONITORING DATA

Cordylanthus orcuttianus

General Locality: Dennery Ranch

Site #: 2

Surveyor(s): Scott McMillan

USGS Quad: Imperial Beach

Date: 6-20-01

QUAD (1m ²)	1	2	3	M
COUNT	18	26	31	25
% FL	95	95	100	97
% FR	0	0	0	0
% VEG	5	5	0	3
SLOPE	5	5	5	5
ASPECT	20	20	15	18
% NATIVE COVER	65	70	85	73
% NON-N COVER	35	40	20	32
% BARE GROUND	5	0	0	2

Dudleya brevifolia - short-leaved Dudleya

CNPS: 1B, 3-3-3

State: Endangered

Fed: None

Short-leaved Dudleya was monitored by City of San Diego staff and volunteers during the 2001 season. There were no new localities discovered during the 2001 season for this species.

Dudleya variegata - variegated Dudleya

CNPS: 1B, 2-2-2

State: None

Fed: None

Variegated Dudleya is a cormose perennial that is found in heavy clay soils and rock outcrops from northern San Diego County to northwest Baja California, Mexico. This species flowers from April to June and occurs in native grassland and clay lens habitats associated with vernal pools, chamise chaparral, and coastal sage scrub (CNPS, 2001). This species ranges from the coast to the inland valleys and foothills.

Seven of the ten populations monitored in 2001 are new to the MSCP database.

1. GOAT MESA/SPRING CANYON

Although there are already two historical localities for variegated *Dudleya* in the Spring Canyon and Goat Mesa areas, this population is believed to be a new addition to the MSCP database. This population is along the western edge of Goat Mesa overlooking one of the fingers of Spring Canyon. This site is covered in a mixture of fragmented coastal sage scrub, native grassland, and non-native grassland habitats. Most of the variegated *Dudleya* population is in the rocky native grassland habitat on soils that are mapped as Stockpen (USDA, 1973).

Goat Mesa has been very heavily disturbed by off-road activity (including the Border Patrol), grazing, and weed invasion. These disturbance factors have all but destroyed the vernal pools on Goat Mesa. Just 10 years ago, these vernal pools supported dense populations of many vernal pool indicator species, including spreading *Navarretia* and San Diego button-celery (Bauder, 1986; Beauchamp and Cass, 1979). Currently, the button-celery occurs in low numbers (about 25-50 plants per pool), and spreading *Navarretia* appears to have been extirpated from the site.

It appears that this population once extended further into the middle of the mesa, but currently this population occurs only along the mesa edge where traffic is reduced.

2001 MSCP RARE PLANT MONITORING DATA

Dudleya variegata

General Locality: Goat Mesa

Site #: 1

Surveyor(s): Scott McMillan

USGS Quad: Imperial Beach

Date: 4-20-01

QUAD (1m ²)	1	2	3	4	5	M
COUNT	46	55	78	23	71	55
% FL	10	20	15	10	20	15
% FR	0	5	0	0	5	2
% VEG	90	75	85	90	75	83
SLOPE	2	2	2	2	1	2
ASPECT	345	340	355	350	350	348
% NATIVE COVER	65	60	70	65	75	67
% NON-N COVER	35	45	30	35	35	36
% BARE GROUND	5	0	0	5	0	2

There was a mean density of 55 plants/m² at this site. Non-native cover was moderately high at a mean of 36%, but this is expected to increase over time as the mesa continues to be subjected to the current level of disturbances. The estimated total count for this site is over 1,000 plants.

Off-road activity in and around Spring Canyon and Goat Mesa has increased dramatically in the last few years. This is due in part to the increased presence of the Border Patrol in the area, but is also due to increased activity by the public using the open space for an off-road area. As other areas of Otay Mesa are developed and closed to off-road activity, this area has become one of the last areas on Otay Mesa that is not patrolled. Without patrols by City of San Diego staff or San Diego Police Department, portions of Spring Canyon and Goat Mesa are becoming completely destroyed.

In addition to the off-road activity at this site, the habitat has also been subjected to many years of grazing by goats. Unfortunately, this illegal grazing continues every season on this piece of public land. Almost every year, the goats graze the vernal pool plants to the ground. The goats are almost as responsible for the loss of vernal pool diversity (including spreading *Navarretia*) as the off-road activity. As with other native habitat sites, these disturbance factors allow for accelerated invasion by non-native plant species.

2. CALIFORNIA TERRACES

The California Terraces population of variegated *Dudleya* is part of the vernal pool and canyon restoration project being conducted by RECON for Pardee Construction. The site supports existing variegated *Dudleya* populations, along the edges of the mesa near the slopes of Dennerly Canyon, as well as populations that were introduced to the site during restoration efforts. The total estimated size for all populations at this locality is over 1,000 plants. The restoration project is currently active, so off-road activity has been eliminated and weed control is undertaken every season. Because of this, these populations appear to be in excellent condition.

This site is mapped as Stockpen soils and is dominated by vernal pool habitat, native grasslands, and coastal sage scrub.

3. PARADISE VALLEY

The Paradise Valley population of variegated *Dudleya* is on the southern slopes of the valley west of Paradise Hills Park. This population is new to the MSCP database, with over 500 plants seen during the 2001 season.

The vegetation on this site is coastal sage scrub mixed with native grassland and clay lens habitats. This site is mapped as a combination of Diablo and Linne soils (USDA, 1973). In addition to variegated *Dudleya*, this site also has a small population (over 500 plants) of Otay tarplant (*Hemizonia conjugens*) just down-slope from the *Dudleya* population in the same patch of grassland habitat.

Although there is moderate evidence of trampling by children playing on the slope (sliding down the grasslands on cardboard), this site is relatively isolated and undisturbed. Even so, the trampling has adversely impacted both the variegated Dudleya and the Otay tarplant populations, both of which were trampled in some areas. Some grassland areas near Paradise Valley Road have been converted to non-native grasslands, but, for the most part, the native grassland habitat is intact with a low cover of non-native plant species.

4. OTAY LAKES

The Otay Lakes population of variegated Dudleya occurs on a mesa along the southern side of the lake. This mesa supports a native grassland with pockets of chaparral along the edges. In addition to the variegated Dudleya, this mesa supports a large population of San Diego goldenstar and a small population of San Diego thornmint. The

2001 MSCP RARE PLANT MONITORING DATA

Dudleya variegata

General Locality: Otay Lakes

Site #: 3

Surveyor(s): Scott McMillan

USGS Quad: Jamul Mountains

Date: 5-14-01

QUAD (1m ²)	1	2	3	4	5	6	7	8	9	10	M
COUNT	58	128	79	12	111	80	44	69	85	104	77
% FL	85	90	90	85	80	85	80	90	75	90	85
% FR	5	5	0	0	10	5	5	5	5	5	5
% VEG	10	5	10	15	10	10	15	5	20	5	11
SLOPE	0	0	0	0	0	0	0	0	0	0	0
ASPECT	-	-	-	-	-	-	-	-	-	-	-
% NATIVE COVER	70	65	75	80	75	80	65	65	60	80	72
% NON-N COVER	35	30	25	40	40	30	35	30	35	25	33
% BARE GROUND	5	10	5	0	5	0	5	5	10	0	5

large clay lens is mapped as Olivenhain and supports many vernal pools of various sizes. The vernal pools on this mesa and the two finger mesas to the east support numerous rare vernal pool indicator species, including large populations of toothed Downingia, San Diego button celery, and a few pools with spreading Navarretia. San Diego fairy shrimp were observed in some of these pools during the early spring of 2001.

The population of variegated Dudleya at Otay Lakes is very large, with an estimated total population size of 10,000 individuals or more. Unlike the San Diego thornmint at this locality, the variegated Dudleya occurs throughout the large clay lens mesa. Although the mean non-native cover was 33%, the weedy non-native species have not excluded the variegated Dudleya like they have the thornmint. However, very few seedlings of variegated Dudleya were found, most likely due to the moderate cover of weed species. Without seedling recruitment, this population eventually will decline, as the older senescent plants will not be replaced by new individuals.

5. LAKE MURRAY

The Lake Murray population of variegated Dudleya is downstream from the dam along the east-facing canyon edges. This site is mapped as Friant soils, with large boulders and rock outcrops (USDA, 1973). The rocky soils support fragmented coastal sage scrub mixed with numerous non-native plants (weeds and garden escapes).

This population is small in size (115 plants) and occurs only on the large pieces of exposed bedrock. Although there are heavy clay soils near these exposed chunks of rock, the Dudleya population was not in the clay areas. The Dudleya individuals were growing in the very shallow cracks of the large rocks, where small amounts of soil have collected. The plants were reduced in plant and inflorescence size. Much like the leaves of short-leaved Dudleya, the leaves appeared to be maintaining the juvenile phase of leaf morphology, even at the flowering stage (with pale-yellow flowers). Any research on the genetics of variegated Dudleya should include this population.

6. MARGERUM AVENUE

This population of variegated Dudleya is located just off of Margerum Avenue in the large open space canyon halfway between Mission Gorge Road and Navajo Road. The population is along the north-facing slope towards the head of the canyon. This site is mapped as Redding soils, but has large patches of other soil types (Linne, Diablo, etc.). Much of the canyon has white and gray soils, which are not consistent with our local definition of Redding soils. Soils in San Diego County that are mapped as Redding are usually deep red and brown.

The variegated Dudleya is growing in heavy clay soil native grassland surrounded by coastal sage scrub vegetation. As with the Paradise Valley population of variegated Dudleya, this site has suffered from impacts by children sliding down the grass slopes on cardboard. The Dudleya plants and other native grassland species have been trampled. Otherwise, this population is isolated from most of the traffic in the canyon.

Without the trampling by children, this site would be in very good condition. Many native grassland species occur in this area with the variegated Dudleya. The mean density at this site was 23 plants/m², and the total estimated population size is 500 plants. The non-native cover is high enough (mean of 36) to have adverse impacts on the Dudleya population, and it is only going to increase if the trampling continues each year.

2001 MSCP RARE PLANT MONITORING DATA

Dudleya variegata

General Locality: Margerum Ave.

Site #: 2

Surveyor(s): Scott McMillan

USGS Quad: La Mesa

Date: 5-11-01

QUAD (1m ²)	1	2	3	4	5	M
COUNT	35	12	41	10	19	23
% FL	15	25	30	25	20	23
% FR	0	0	5	0	0	1
% VEG	85	75	70	75	80	77
SLOPE	5	5	5	5	5	5
ASPECT	330	330	330	330	330	330
% NATIVE COVER	75	60	70	70	75	71
% NON-N COVER	35	40	35	40	30	36
% BARE GROUND	0	5	5	0	5	3

7. MISSION TRAILS (WEST)

A number of variegated *Dudleya* populations are scattered through west Mission Trails Regional Park. Only one of these localities, located by Mike Kelly, is new to the MSCP database. Most of these populations are in areas of grassland and clay lens habitats, but the new population is on more rocky soils.

All of the populations in west Mission Trails are in habitat that has been impacted by any number of different disturbances, including foot, bike, and off-road vehicle traffic, as well as mechanical disturbances (grading, brushing, etc.) and weed invasion. This area has been subjected to clearing and searching for unexploded military ammunition, as well as past and present construction and maintenance of the major water lines that connect our water supply to the northern sources.

Because of the many disturbance factors in west Mission Trails, some of the populations are either extirpated or in poor condition. At least one of the known populations that is very close to the large pipelines has not been seen since 1999. The last time it was seen, there were less than 10 individuals, and the site is now almost 100% non-native cover.

The population near the vernal pools is also in poor condition due to weed invasion. The population has less than 100 plants. The hiking and biking trail that cuts along the mesa near the variegated *Dudleya* allows for an increase in weed invasion and trampling. This specific trail also cuts through portions of at least two of the vernal pools, both of which had San Diego fairy shrimp and western spadefoot toads (*Scaphiopus hammondi*) during the 2001 season.

8. MISSION TRAILS (EAST)

As with the west side of Mission Trails, the east side has quite a few variegated *Dudleya* localities scattered in the heavy clay soils and exposed rocky areas in the northeast corner of the park. These populations are growing in native grassland and clay lens habitats surrounded by coastal sage scrub and chamise chaparral.

Until recently, most of these populations were in better condition than those on the west side of the park, but the construction of State Route 52 disturbed a large area of contiguous habitat in and around the park. Many of the variegated *Dudleya* populations are now in close proximity to developed land and are now subject to higher rates of weed invasion.

The amount of foot and bike traffic on the east side is just as great as the west side, so these types of disturbances are also affecting the *Dudleya* populations on the east side.

9. MERCY ROAD

This moderate-sized population (over 1,000 plants) is on the south-facing slopes above Los Peñasquitos Canyon, west of Interstate 15. The site is mapped as San Miguel soils and is covered in a mixture of native grassland, non-native grassland, and coastal sage scrub. This population is close to a new population of San Diego goldenstar (see below) and is also surrounded by large patches of California Adolphia (*Adolphia californica*). Most of these plants are in the exposed rocky areas that are surrounded by heavy clay soils.

This site is a few hundred feet above the hiking and riding trail that follows Los Peñasquitos Canyon and is a few hundred yards west of the major water pipelines that connect our water supply to the north. Although these disturbances are not directly impacting this population, the indirect impacts of weed invasion are a problem. Most of this population of variegated *Dudleya* is in areas with an estimated 30% cover of non-native plant species. As with other populations of this species, seedling establishment is being impacted by the invasion of these weed species.

10. BLACK MOUNTAIN RANCH

Two new variegated *Dudleya* sites were found on Black Mountain Ranch in 2001. Both of these are near the southern edges of the open space portions of the Ranch.

These sites are mapped as San Miguel and Altamont soils. The variegated *Dudleya* occurs in the grassland and clay lens habitats that have exposed rocky areas. These clay lens grasslands are surrounded by coastal sage scrub and chaparral habitats. Both of these populations have been on the edge of agricultural fields for many years, so weed invasion has been a problem for quite some time.

Beginning last year (2000), most of the fallow agricultural fields on Black Mountain Ranch were graded for a large housing development. For the most part, this development is on the old fields and not the high quality habitat that remains on the Ranch. Although both populations of variegated *Dudleya* on the Ranch are in dedicated open space, portions of the western population have been destroyed by grading that extended beyond the boundaries of the approved development.

Five quadrats were surveyed at this site. Although some of these quadrat surveys were conducted in areas adjacent to the grading disturbance, none of these quadrats was in the area that was graded.

2001 MSCP RARE PLANT MONITORING DATA

Dudleya variegata

General Locality: Black Mountain Ranch

Site #: 4

Surveyor(s): Scott McMillan

USGS Quad: Del Mar

Date: 5-16-01

QUAD (1m ²)	1	2	3	4	5	M
COUNT	33	12	35	21	27	26
% FL	75	90	90	85	80	84
% FR	5	5	0	0	5	3
% VEG	20	5	10	15	15	13
SLOPE	5	5	5	5	5	5
ASPECT	160	165	160	345	340	234
% NATIVE COVER	55	45	40	65	60	53
% NON-N COVER	45	50	55	40	35	45
% BARE GROUND	5	10	5	5	5	6

The estimated total population size at this locality is about 500 plants. Although mean density was 26 plants/m², the native habitat is obviously under heavy pressure with a mean non-native cover of 45%. Because of the adjacent agricultural field, this site was already heavily impacted by weed invasion. The housing development is not likely to

improve this problem, especially as a large portion (25%) of the population has been graded. Not only is this a problem because of the loss of plants (estimated to be between 100 to 200 plants), but it will also allow for an even greater rate of weed invasion than currently exists.

***Lessingia filaginifolia* var. *linifolia* - Del Mar sand aster**

CNPS: 1B, 3-2-3

State: None

Fed: None

Del Mar sand aster is a perennial herb that occurs in coastal sage scrub and chaparral habitats. This species occurs on the coastal mesas and in the canyons of northern San Diego County and northwest Baja California, Mexico. Del Mar sand aster flowers from June to September and is usually found in open areas of the surrounding habitat (CNPS, 2001). As mentioned in Section 2.3.2, the quadrat surveys for Del Mar sand aster were 10 m² in size.

1. CARMEL MOUNTAIN

The Carmel Mountain population of Del Mar sand aster is in the small side canyons that drain into Carmel Valley, on the north side of Carmel Mountain. This population was previously known from the MSCP database. This population occurs in the more open areas between the coastal sage scrub and chaparral habitats. This site is mapped as a

2001 MSCP RARE PLANT MONITORING DATA

Lessingia filaginifolia* ssp. *linifolia

General Locality: Carmel Mountain

Site #: 1

Surveyor(s): Scott McMillan

USGS Quad: Del Mar

Date: 7-7-01

QUAD (10m ²)	1	2	3	4	5	M
COUNT	12	34	70	12	35	33
% FL	85	95	60	70	60	74
% FR	0	0	0	0	0	0
% VEG	15	5	40	30	40	26
SLOPE	5	5	5	7	5	5
ASPECT	290	310	310	15	5	330
% NATIVE COVER	65	75	70	80	80	74
% NON-N COVER	30	15	30	30	25	26
% BARE GROUND	10	10	5	0	5	6

combination of Corralitos soils and terrace escarpments (a generic term used for soil on steep slopes where soil surveys were not conducted)(USDA, 1973).

Until recently, this population (over 200 plants total) was relatively isolated from disturbances, but recent development in the Carmel Valley and Carmel Mountain areas has brought disturbance factors much closer to this population.

Mean density was 33 plants/10 m², and the non-native cover at this site was moderate (mean of 26%), but this is expected to increase as weed invasion continues from the new developments in and around these canyons. Because this species is a perennial subshrub, an increase in weed cover may not impact the population immediately. These impacts will become more obvious over time, as the older senescent plants die off and seedling establishment is restricted by non-native plants.

2. CARMEL VALLEY

The Carmel Valley population of Del Mar sand aster is located at the western end of Carmel Valley, just east of Interstate 5. This population occurs on the northwest-facing slopes overlooking Soledad Valley and Carmel Valley. The plants occur in the open

2001 MSCP RARE PLANT MONITORING DATA

Lessingia filaginifolia ssp. *linifolia*

General Locality: Carmel Valley

Site #: 2

Surveyor(s): Scott McMillan

USGS Quad: Del Mar

Date: 7-7-01

QUAD (10m ²)	1	2	3	4	5	M
COUNT	32	40	15	5	11	21
% FL	75	85	90	75	65	78
% FR	0	0	0	5	5	2
% VEG	25	15	10	20	30	20
SLOPE	7	10	5	10	5	7
ASPECT	270	255	275	270	265	267
% NATIVE COVER	75	90	70	60	80	75
% NON-N COVER	30	25	30	30	15	26
% BARE GROUND	5	0	10	10	5	6

areas between the coastal sage scrub and chaparral habitats in an area that is mapped as a combination of Corralitos soils and terrace escarpments (a generic term used for soil on steep slopes where soil surveys were not conducted) (USDA, 1973).

As with the Carmel Mountain site, this population (over 150 plants total) is relatively isolated from disturbances, but recent development in the Carmel Valley and Carmel Mountain areas has brought the disturbance factors much closer to this population.

The mean density was 21 plants/10 m², and the mean non-native cover was 26%, but this is expected to increase as weed invasion continues from the new developments in and around the canyons. Because this species is a perennial subshrub, an increase in weed cover may not impact the population immediately. As with the other populations of Del Mar sand aster, these impacts will become more obvious over time, as the older senescent plants die off and seedling establishment is restricted by non-native plants.

3. OVERLOOK PARK

Overlook Park is located on the southern slopes at the west end of the San Dieguito River Valley, just east of Interstate 5. These northwest-facing slopes overlook the San Dieguito Valley and are covered in chaparral with small patches of coastal sage scrub.

The plants occur in the open areas between the chaparral and coastal sage scrub habitats in an area that is mapped as a combination of Carlsbad soils, Corralitos soils, and terrace escarpments (a generic term used for soil on steep slopes where soil surveys were not conducted). The Del Mar sand-aster plants (almost 200 plants total) are located along the top of the mesa, as well as down on the steeper slopes.

Although the upper edges of this open space park are adjacent to a housing development and a recreational park, this site is currently in good condition, i.e., shows few signs of disturbances such as trampling and non-native species. However, recent development in the Del Mar Heights and El Camino Real areas have brought the disturbance factors much closer to this population.

Three quadrats were surveyed at this site. The mean density was 18 plants/10 m² and mean non-native cover was 23%, but non-native cover is expected to increase as weed invasion continues from the new developments near this site. This problem is especially great in and around the small recreational park space, as many cultivated species are planted immediately adjacent to the open space. Because this species is a perennial subshrub, an increase in weed cover may not impact this population immediately. As with the other populations of Del Mar sand aster, these impacts will become more obvious over time, as the older senescent plants die off and seedling establishment is restricted by non-native plants.

2001 MSCP RARE PLANT MONITORING DATA

Lessingia filaginifolia* ssp. *linifolia

General Locality: Overlook Park

Site #: 3

Surveyor(s): Scott McMillan

USGS Quad: Del Mar

Date: 7-18-01

QUAD (10m ²)	1	2	3	M
COUNT	18	22	13	18
% FL	80	75	75	77
% FR	0	5	10	5
% VEG	20	20	15	18
SLOPE	5	10	10	8
ASPECT	275	275	260	270
% NATIVE COVER	75	70	80	75
% NON-N COVER	25	25	20	23
% BARE GROUND	5	5	5	5

4. TORREY HIGHLANDS

The Torrey Highlands population of Del Mar sand aster is located on the generally north-facing slopes of a large canyon off of Del Mar Heights Road. This population is in one of the main tributary canyons for Gonzales Canyon to the north.

The plants are in the open areas between the chaparral and coastal sage scrub habitats that are associated with a few patches of Torrey pine (*Pinus torreyana*) woodland. This area is mapped as a combination of Corralitos soils and terrace escarpments (a generic term used for soil on steep slopes where soil surveys were not conducted) (USDA, 1973).

Similar to the Overlook Park population of Del Mar sand aster, this population is adjacent to a recreational park and housing developments. The population (almost 200 plants total) was relatively isolated from disturbances, but recent development in the Del Mar Heights and El Camino Real areas has brought the disturbance factors much closer to this population. In addition, the population is bisected by powerlines and the associated access roads. These roads are used for powerline maintenance access, as well as riding, hiking, and some off-road activities. All of these road and trail impacts are adversely affecting the population of Del Mar sand aster at this locality.

This site is new to the MSCP database. The mean density was 18 plants/10 m², and mean non-native cover was 25%, but this is expected to increase as weed invasion continues from the new developments near this site. This problem is especially great in and around the powerline maintenance access roads, where contiguous high quality habitats have been bisected by this disturbance. Because this species is a perennial subshrub, an increase in weed cover may not impact the population immediately. As with the other populations of Del Mar sand aster, these impacts will become more obvious over time, as the older senescent plants die off and seedling establishment is restricted by non-native plants.

2001 MSCP RARE PLANT MONITORING DATA

Lessingia filaginifolia* ssp. *linifolia

General Locality: Torrey Highlands

Site #: 4

Surveyor(s): Scott McMillan

USGS Quad: Del Mar

Date: 7-18-01

QUAD (10m)	1	2	3	4	5	M
COUNT	25	12	5	22	28	18
% FL	75	85	50	75	40	65
% FR	0	0	0	0	0	0
% VEG	25	15	50	25	60	35
SLOPE	5	5	7	10	7	7
ASPECT	10	350	300	295	290	321
% NATIVE COVER	65	75	75	70	55	68
% NON-N COVER	30	10	15	30	40	25
% BARE GROUND	10	20	20	5	10	13

***Lotus nuttallianus* - Nuttall's Lotus**

CNPS: 1B, 3-3-2

State: None

Fed: None

Nuttall's lotus was monitored by City of San Diego staff and volunteers during the 2001 season. There were no new localities discovered during the 2001 season for this species.

***Monardella linoides* ssp. *viminea* - willowy Monardella**

CNPS: 1B, 2-3-2

State: Endangered

Fed: Endangered

Willowy Monardella is a perennial herb that occurs in some of the coastal and foothill canyons, from central San Diego County south into northwest Baja California, Mexico (CNPS, 2001). Willowy Monardella flowers between June and September and is usually found in cobbly streambeds and on shallow alluvial terraces above the drainages.

This species is known from City of San Diego MSCP lands in a number of localities, most of which are in the central part of the City. Most of the known localities were monitored by City staff or by volunteer efforts, and these localities include Sycamore Canyon, and Lopez Canyon (City of SD, 2001). A population at Marron Valley was surveyed as part of the development of a habitat management plan for the property (CBI 2000). Survey and monitoring results for the Otay Lakes population are included here.

1. OTAY LAKES

The Otay Lakes willowy Monardella is just upstream from Otay Lakes on the border of City lands. Almost all of this population is upstream from City of San Diego MSCP lands, with the exception of one individual that is immediately under the fence that

2001 MSCP RARE PLANT MONITORING DATA

Monardella linoides* ssp. *viminea

General Locality: Otay Lakes

Site #: 1

Surveyor(s): Scott McMillan

USGS Quad: Otay Mesa

Date: 5-14-01

QUAD (1m²)	1
COUNT	1
% FL	5
% FR	0
% VEG	95
SLOPE	0
ASPECT	-
% NATIVE COVER	60
% NON-N COVER	5
% BARE GROUND	35

borders the parcel. This one individual is growing along the edge of the rocky streambed that empties into Buschalaugh Cove. This site is mapped as San Miguel soil (USDA, 1973).

The stream-side habitat was burned in the late 1990s and is recovering from fire. Many saplings of Tecate cypress (*Cupressus forbesii*) are sprouting along the streambed, including a few on the City of San Diego MSCP lands.

At the time of monitoring, this plant was just beginning to flower (5%) along with other willowy *Monardella* upstream. There appear to be no immediate threats to the plants. Non-native cover is low (5%), and open habitat is available for this species.

***Muilla clevelandii* - San Diego goldenstar**

CNPS: 1B, 2-2-2

State: None

Fed: None

San Diego goldenstar is a perennial bulb that occurs in grassland and clay lens habitats associated with coastal sage scrub, chaparral, and vernal pool areas in San Diego County and northwest Baja California, Mexico (CNPS, 2001). This species flowers between the months of April and June and is usually associated with clay soils on the coastal mesas and foothill slopes. Three of the five populations surveyed were new to the MSCP database.

1. OTAY LAKES

The Otay Lakes population of San Diego goldenstar occurs on a mesa along the southern side of the lake. This mesa is covered with native grassland with pockets of chaparral along the edges. In addition to the goldenstar, this mesa supports a large population of variegated *Dudleya* and a small population of San Diego thornmint. The large clay lens is mapped as Olivenhain and also supports many vernal pools of various sizes. The vernal pools on this mesa and the two finger mesas to the east support numerous rare vernal pool indicator species, including large populations of toothed *Downingia*, San Diego button-celery, and a few pools with spreading *Navarretia*. San Diego fairy shrimp were observed in some of these pools during the early spring of 2001.

Similar to the variegated *Dudleya* at this site, the San Diego goldenstar population is large and dense (over 10,000 plants). The mean density was high (42 plants/m²), and this density is spread over a large area. As mentioned above, this clay mesa has a relatively high cover of non-native species (mean of 33%). This non-native cover appears to be adversely affecting the ability of this species to establish new seedling recruits. Without this annual seedling recruitment, this population will eventually decline, as the older senescent plants will not be replaced by new individuals.

2001 MSCP RARE PLANT MONITORING DATA

Muilla clevelandii

General Locality: Otay Lakes

Site #: 1

Surveyor(s): Scott McMillan

USGS Quad: Jamul Mountains

Date: 5-15-01

QUAD (1m ²)	1	2	3	4	5	6	7	8	9	10	M
COUNT	13	34	61	76	78	23	43	9	22	65	42
% FL	15	10	10	5	10	20	25	5	10	10	12
% FR	85	90	90	95	90	80	75	95	90	90	88
% VEG	0	0	0	0	0	0	0	0	0	0	0
SLOPE	0	0	0	0	0	0	0	0	0	0	0
ASPECT	-	-	-	-	-	-	-	-	-	-	-
% NATIVE COVER	65	50	55	65	80	50	30	50	30	65	54
% NON-N COVER	30	50	25	40	15	25	30	35	60	20	33
% BARE GROUND	10	15	25	5	20	40	50	30	10	25	23

2. MISSION TRAILS (WEST)

San Diego goldenstar is known from Mission Trails Regional Park, but the previously known localities are on the east side of the park (see below). This is the first population of goldenstar found on the west side of Mission Trails, and it occurs on a north-facing slope towards the northern end of the park. This site supports a native grassland with heavy clay soils, surrounded by coastal sage scrub habitat. This small population was found in and around a much larger population of common goldenstar (*Bloomeria crocea*), making species determination in quadrat surveys difficult. This site is mapped as Redding soils with Diablo soils in close proximity (USDA, 1973).

All of the habitats in west Mission Trails Regional Park are in areas that have been impacted by any of a number of different disturbances, including foot, bike, and off-road vehicle traffic, as well as mechanical disturbances (grading, brushing, etc.) and weed invasion. This area has been subjected to clearing and searching for unexploded military ammunition, as well as past and present construction and maintenance of major water lines that connect our water supply to the northern sources.

2001 MSCP RARE PLANT MONITORING DATA

Muilla clevelandii

General Locality: Mission Trails (West)

Site #: 2

Surveyor(s): Scott McMillan

USGS Quad: La Mesa

DATE: 5-12-01

QUAD (1m ²)	1	2	M
COUNT	3	9	6
% FL	50	50	50
% FR	40	45	43
% VEG	10	5	8
SLOPE	5	5	5
ASPECT	310	310	310
% NATIVE COVER	45	50	48
% NON-N COVER	55	50	53
% BARE GROUND	0	0	0

The population of San Diego goldenstar at west Mission Trails is on the brink of extirpation. A total of 12 plants were found at this location, and this is partially due to the large population of common goldenstar that occupies much of the available habitat. The other, more important factor is the very high non-native plant cover (53%), which is more than enough to impact this species and all the associated native plant species at this site. This site is only a few hundred yards up-slope from the large water pipelines, and the construction and maintenance of these pipelines have allowed for an increased influx of weeds in these grassland habitats. Like other populations of this species, seedling establishment is being impacted by the invasion of weed species.

3. MISSION TRAILS (EAST)

San Diego goldenstar is known from the east side of Mission Trails Regional Park from a few scattered localities. These populations are growing in native grassland and clay lens habitats surrounded by coastal sage scrub and chamise chaparral in the northeast corner of the park.

Until recently, most of these populations had a relatively low cover of non-native species, but the construction of State Route 52 disturbed a large area of contiguous habitat in and around the park. Many of the San Diego goldenstar populations are now in close proximity to developed land and are now subjected to much higher rates of weed

invasion. Similar to other populations of this species, seedling establishment is being impacted by the invasion of these weed species.

4. MERCY ROAD

This small population (22 plants) is on the south-facing slopes above Los Peñasquitos Canyon, west of Interstate 15. The site is mapped as San Miguel soils and is covered in a mixture of native grassland, non-native grassland, and coastal sage scrub. This population is close to a new population of variegated *Dudleya* (see above) and is also surrounded by large patches of California *Adolphia*.

This site is a few hundred feet above the hiking and riding trail that follows Los Peñasquitos Canyon and is a few hundred yards west of the major water pipelines that connect our water supply to the north. Although these disturbances are not directly impacting this population, the indirect impacts of weed invasion are a problem. Most of this population of San Diego goldenstar is in areas with an estimated 50% cover of non-native plant species. As with other populations of this species, seedling establishment is being impacted by the invasion of weed species.

5. DEL MAR MESA

The Del Mar Mesa vernal pool complex is located on the north side of Los Peñasquitos Canyon, on the flat mesa that extends to the north toward Carmel Valley and Deer Canyon. This mesa top area is mapped with Redding soils and supports chamise chaparral surrounding vernal pools of various sizes (USDA, 1973).

This vernal pool complex supports extensive populations of San Diego button-celery, San Diego Mesa mint, and other vernal pool species. Associated with the vernal pools and the San Diego goldenstar are large populations of rough *Muilla* and Orcutt's *Brodiaea*. San Diego fairy shrimp were seen in many of the pools that ponded during the 2001 season, and this species would also be expected from most of the other vernal pools during a season with high rainfall.

The vernal pool habitat at Del Mar Mesa is in good condition in most areas and supports large populations of many rare species. This complex is one of the most unique vernal pool areas in the MSCP lands. Some of the vernal pools have dense populations of San Diego button-celery that are almost completely covered by the overlapping branches of the scrub oaks and other woody species on the site.

Unfortunately, heavy use by off-road activity and trash dumping continue to destroy the vernal pool and chaparral habitats in some areas. Although Del Mar Mesa currently supports good vernal pool habitat, this activity is having serious impacts on the quality of these pools and their associated species.

The monitoring data show a mean density of 19 plants/m². Estimated non-native cover was over 30% and will continue to increase as long as the current disturbances are allowed to persist.

2001 MSCP RARE PLANT MONITORING DATA

Muilla clevelandii

General Locality: Del Mar Mesa

Site #: 3

Surveyor(s): Scott McMillan

USGS Quad: Del Mar Mesa

Date: 5-20-01

QUAD (1m²)	1	2	3	4	5	M
COUNT	28	7	9	32	18	19
% FL	5	10	10	0	15	8
% FR	95	90	90	100	85	92
% VEG	0	0	0	0	0	0
SLOPE	0	0	0	0	0	0
ASPECT	-	-	-	-	-	-
% NATIVE COVER	70	50	60	60	70	62
% NON-N COVER	30	40	25	35	25	31
% BARE GROUND	10	20	15	10	10	13

4.0 RECOMMENDATIONS

4.1 Future Surveys

During the 2001 season, most of the City of San Diego's properties were visited at least once (see Appendix 1). Some of the City's lands have had past surveys, while other areas had never been surveyed until the 2001 season. However, many areas of City land still have not been adequately surveyed for rare plants. We recommend that adequate baseline inventorying and mapping of rare plant populations in the field be prioritized over quantitative monitoring.

For rare plant surveys to be considered adequate, all portions of the properties should be covered on foot, and any habitats with the potential for rare species should be visited at different, suitable times throughout the growing season. Many rare plant species are annual or herbaceous perennials. It is much easier and more accurate to locate these herbaceous species during the narrow spring window for flowering that is specific to each species. Multiple visits during different times of the season are necessary because of this seasonal variation among the different species. This is especially true with vernal pool, grassland, and clay lens habitats, which are usually dominated by herbaceous species.

While most of the City's lands were included in the 2001 surveys reported herein, some areas were surveyed more completely than others. Table 5 lists all of the sites that were visited during the 2001 season and ranks (low vs. high) the need for additional survey efforts in each locality. The recommendation for additional surveys is based on either the need for more complete area coverage (on foot), the need for multiple, appropriately timed visits, or both. A low rank is given if the probability of finding additional species and/or locations in future survey efforts is estimated to be less than 50%, and a high rank is given if the probability is greater than 50%. In addition, the types and amounts of sensitive habitats (vernal pools, grasslands, clay lenses) at each location were considered. Localities with extensive sensitive habitats and inadequate coverage were ranked high, and those without extensive sensitive habitats and adequate coverage were ranked low.

General locations that rank low for both factors in Table 5 (e.g., Los Peñasquitos Canyon, Overlook Park) are considered a LOW PRIORITY for baseline surveys relative to the other general locations in the City's MSCP lands. Locations that rank high for one factor and low for the other (e.g., Aero Drive, Chollas Creek) are considered a MODERATE PRIORITY for baseline surveys relative to the other locations. Areas that rank high for both factors (e.g., Rose Canyon, Del Mar Mesa, etc.) are considered a HIGH PRIORITY for future surveys and are shaded in Table 5.

TABLE 5
RECOMMENDATIONS FOR FUTURE RECONNAISSANCE SURVEYS
OF CITY OF SAN DIEGO MSCP LANDS¹

General Location	More Complete Area Coverage Needed²	Repeat Visits Needed³
60 th Street	L	L
Aero Drive	L	H
Black Mountain	L	L
Black Mountain Ranch	H	H
Boy Scout/Hwy 163	L	L
California Terraces	L	L
Camino Del Rio (north)	L	L
Camino Del Rio (south)	H	H
Carmel Mountain	L	L
Carmel Valley	H	H
Carroll Canyon (east)	H	H
Carroll Canyon (west)	H	H
Carroll Canyon/Sorrento Mesa	H	H
Cedar Canyon	L	L
Chicarita Creek	H	H
Cholla Creek	H	L
Copley Drive/Hwy 52	H	L
Crest Canyon	L	L
Del Mar	L	L
Del Mar Mesa	H	H
Dennery Ranch/Oceanview	L	L
Fairbanks Ranch	H	H
Fairmont/I-805	H	H
Fairmont/Montezuma	H	L
Famosa Slough	L	H
Fiesta Island	L	L
Florida Canyon/Morley Field	L	L
Florida Canyon (east)	H	H
General Dynamics	L	L
Goat Mesa	L	H
Gonzales Canyon	H	H
Governor/Hwy 52	H	L
Heritage Park	L	L
Highway 94/I-15	H	L
Kate Sessions Park	L	H
Kelton Road/Hwy 94	L	H
Kendall Frost Preserve	L	H
La Jolla Drive Canyon	H	H
Lake Hodges	H	H

TABLE 5
RECOMMENDATIONS FOR FUTURE RECONNAISSANCE SURVEYS
OF CITY OF SAN DIEGO MSCP LANDS¹
(continued)

General Location	More Complete Area Coverage Needed²	Repeat Visits Needed³
Lake Murray	H	H
Lopez Canyon	H	H
Lopez Ridge	L	L
Lusardi Creek	H	H
Lusk Blvd.	H	H
Margerum Ave.	H	H
Mariner's Point	L	L
Market Street	L	H
Mercy Road/Black Mt. Rd.	L	H
Merrian Bear Park	L	L
Scripps Ranch/Miramar (east)	H	H
Scripps Ranch/Miramar (west)	H	H
Miramar Lake	H	H
Miramar/Miramar Place	L	H
Miramar/Nancy Ridge Dr.	L	H
Miramar/Rasha Street	L	H
Mira Mesa/Camino Santa Fe	H	H
Mira Mesa/Carrol Canyon	H	H
Mira Mesa/Flanders Street	H	H
Mission Hills Park	L	L
Mission Trails (east)	H	H
Mission Trails (west)	H	H
Mission Valley/I-15	L	H
Mission Valley/Hwy 163	L	H
Mission Village	H	H
Murphy Canyon	H	H
Nobel Drive/I-805	L	H
Otay Lakes	H	H
Otay Mesa (western slopes)	H	H
Otay River Valley	H	H
Overlook Park	L	L
Paradise Valley	L	H
Penasquitos Canyon	L	L
Plaza Blvd.	L	H
Robinhood Ridge	L	L
Rose Canyon (main canyon)	H	H
Rose Canyon/Regents	H	H
Rose Creek Inlet	L	L

TABLE 5
RECOMMENDATIONS FOR FUTURE RECONNAISSANCE SURVEYS
OF CITY OF SAN DIEGO MSCP LANDS¹
(continued)

General Location	More Complete Area Coverage Needed²	Repeat Visits Needed³
Rutgers Road Canyon	H	L
San Dieguito River	H	H
San Pasqual Valley	H	H
San Vicente Reservoir	H	H
Scripps Coastal Preserve	L	H
Scripps Ranch/Miramar (south)	L	L
Scripps Ranch/Miramar (north)	L	L
SDSU	L	L
Sea World Drive (east)	L	H
Sea World Drive (west)	L	H
Shepard Canyon	L	L
Sorrento Hills	H	H
Sorrento Valley/I-5	H	H
Sorrento Valley/I-805	H	H
Sorrento Valley/Genesse	H	H
Sorrento Valley/Science Center	L	L
Sorrento Valley/Torrey Pines	L	L
Sunset Cliffs Park	L	L
Spring Canyon	H	H
Sword Street	L	L
Tecalote (main canyon)	H	H
Tecalote/Genesse (north)	H	H
Tecalote/Genesse (south)	H	H
Torrey Highlands Park	H	H
Torrey Pines State Park	L	L
Vallencia Dr.	H	H
Van Dam Peak	H	H
Waring Rd.	L	H

¹ Based on 2000-2001 reconnaissance surveys and past survey records. Locations that rank High for both columns are shaded. The three highest priorities for future surveys are shaded and in bold font.

² Entire area of site has not been surveyed.

³ Need several surveys in same season to ensure observation of blooming periods for multiple species.

L = Lower priority for future surveys - Less than 50% probability of finding new species and/or new locations.

H = Higher priority for future surveys - Greater than 50% probability of finding new species and/or new locations.

See Appendix 1 for potential species expected at these locations and the basis for this assumption.

Three localities, Lake Hodges, San Pasqual Valley, and San Vicente Reservoir, have had very little survey effort compared to the amount of acreage at each location. In addition, both the Lake Hodges and San Pasqual Valley areas have extensive area with the potential to support sensitive species and habitats. These three localities are considered to have the HIGHEST PRIORITY for baseline surveys on City MSCP lands. These locations are shaded and bolded in Table 5.

4.2 Monitoring Protocols

A meaningful monitoring objective for rare plants, particularly annual herbaceous species, is to assess changes in density of the individuals in the population. Density provides a useful metric for management purposes, in that it can be directly related to changes in non-native plant cover. Total population size can be projected from density estimates, if the area occupied by the population is known. In addition, sampling effort can be allocated to obtain reasonable confidence intervals about density estimates that will allow temporal changes or spatial differences to be compared statistically with known power.

The recommended protocol for monitoring annual herbaceous species uses the relevé quadrat survey method (Braun-Blanquet 1932) and is a variation of the methods described in the MSCP Biological Monitoring Plan (Ogden 1996). To determine the number of 1 m² quadrats needed, evaluate the population size and distribution of the population. Distribute quadrat plots across the observed range of rare plant densities at each locality (i.e., stratified sampling based on visual estimates of density). Place quadrats in areas with low, medium, and high densities of the target rare plant species and at varied distances from the center of the population.

Quadrats should not be permanently marked but rather should be redistributed throughout the population each monitoring period. Reallocating sampling units each monitoring period will provide an assessment of the change in the average condition of the area from one sampling period to the next, instead of the change in condition of the fixed quadrat locations. In addition, permanent quadrats can result in more foot traffic disturbance from repeated visits in the monitored areas, thus contributing to an increase in non-native plant cover. It is likely that the results of monitoring permanent quadrat locations would be influenced by the repeated presence of the field investigator, rather than changes associated with natural variability or other stresses.

In each quadrat, count the number of rare plant species, and estimate the percent cover of native and non-native species. In very small populations, all individuals should be counted and the quadrats can be used to estimate native and non-native cover. This approach allows the density of the target plant species and the average cover of native and non-native species to be estimated for the monitored population.

During the 2001 surveys, the number of quadrats surveyed at each location varied from one to ten. For some of the smaller (in area) populations, the monitoring effort resulted in 50% or more of the population being counted. For the larger populations, the

proportion of the population sampled within the quadrats was much less than 50% and as little as 1%. If obtaining a precise estimate of total population size is the objective of monitoring, then ensuring that a reasonable proportion of individuals in large populations are counted will require that a large number of quadrats be sampled.

In addition to counting numbers of individuals of a rare plant species, estimate percent of individuals in vegetation, flower, and fruit for each quadrat. Also record the slope and slope aspect (slope direction) for each quadrat, and the percent native cover, non-native cover, and bare ground. Describe the habitat surrounding the population, noting specific management problems and disturbances. The recommended data form, used during the 2001 rare plant monitoring, is included in Appendix 2.

Flag the monitored populations in the field, and map the perimeter of each population using a GPS (Global Positioning System) unit for better geographic accuracy and improved relocation of each population. Knowing the exact boundary of each population will make it easier to detect changes in the size and shape of the population. This will also allow calculation of the total area for each population which, in combination with knowing the plant densities, will allow for a more accurate estimate of the total population size.

4.3 Future Monitoring Locations

Future rare plant monitoring on the City's lands should concentrate primarily on the populations that were monitored during the 2001 season (see Table 4). It is important to continue monitoring these populations, as a data baseline has been established which will allow for future assessment of habitat and population trends. The effects of weed invasion, off-road activity, and other disturbance factors on the rare plant populations can not be quantitatively evaluated until data can be collected from multiple years.

In addition, to address the monitoring priorities described in Section 2.3.1, we recommend that the following populations be included in future quantitative monitoring:

- Marron Valley populations of Orcutt's Brodiaea and willowy Monardella.
- West Mission Trails populations of variegated Dudleya.
- Mercy Road population of variegated Dudleya.

To direct monitoring across the full geographic range of each species in the City, the following populations that were monitored in 2001 are recommended to be removed from future monitoring efforts to allow for the new populations listed above:

- Otay Lakes population (only 1 plant) of willowy Monardella.

- Carmel Valley and Torrey Highlands populations of Del Mar sand-aster. (These populations are essentially in the same general geographic location of the Carmel Mountain and Overlook Park populations, respectively.)

Table 6 lists all of the summary data for the populations monitored during the 2001 season as well as the priority for future monitoring, based on geographic location, degree of disturbance, and status in MSCP database (new or previously known). As described in Section 2.3.1, we recommend that the populations to be monitored represent the (1) full range of the geographic distribution of each species in the City and (2) the full range of disturbance levels for each species. We also recommend prioritizing populations for monitoring that are new to the MSCP database over previously known populations.

We recommend that monitoring of the priority 1 (Table 6) populations be continued at least 5 years in order to establish trends in the density of rare plants from each monitored population and estimates of sampling variability. CBI has previously recommended changes to the sampling frequencies (CBI 2001) of the various covered plant species that are specified in the MSCP Monitoring Plan. We recommend that the monitoring results and trends be evaluated following this 5-year period and refinements to monitoring protocols be considered at that time.

Regardless of which populations are quantitatively monitored in the future, all populations should be evaluated annually, as part of preserve management efforts, to ensure that the populations and habitats are stable.

4.4 Management

The City's MSCP lands support numerous native habitats, many of which are unique to the southern California and Baja California region. These habitats support populations of sensitive plant species that are dependent on the stability and health of the general habitat. Although portions of the City's lands appear stable and healthy in habitat quality, much of the City's lands have one or more problems. In some of these areas, these problems are having adverse impacts on the rare plant populations and the habitat quality in general. Without active management of these rare plant populations and habitats, many will continue to decline. The baseline data collected in this report is a starting point for building a program that will not only monitor but also manage these rare plant populations and habitats. This program of monitoring and management will ensure that these rare plant populations and habitats continue to thrive into the future as intended in the City's MSCP subarea plan.

Most of the City's properties are faced with the same management issues, which are common throughout all of the open space areas in San Diego County. These problems include invasion by non-native weed species, encroachment by adjacent property owners, illegal off-road activity, unauthorized trail development, and a lack of patrols by staff and/or law enforcement. These problems are discussed further below.

TABLE 6
SUMMARY DATA FOR RARE PLANT SPECIES POPULATIONS
MONITORED DURING THE 2001 SEASON

Species	Locality ¹	Priority ²	New to MSCP Database	General Geographic Location ³	Disturbance Types ⁴	% Non-Native Cover (1m ²)	Estimated Population Size (# of plants) ⁵	Mean Density (# plants/quad)	Standard Deviation of Mean Density	# of Quads Sampled (1m ²)
<i>Acanthomintha ilicifolia</i> San Diego thornmint	Otay Lakes		No	S	F,G,W	49	127	17.8	6.7	5
<i>Brodiaea orcuttii</i> Orcutt's Brodiaea	Marron Valley	1	Yes	S	-	-	24	-	-	-
	Otay Lakes*	2	No	S	-	-	-	-	-	-
	Mission Trails (E)*	2	No	C	-	-	-	-	-	-
	General Dynamics	1	Yes	C	D,M,W	13	10,000+	70.8	42.6	10
	Scripps R./Miramar	2	Yes	C	M,O,W	-	10,000+	-	-	-
	Nobel Drive	1	Yes	C	O,M,T,W	18	53	14.3	7.1	3
	Carroll Canyon	1	Yes	C	M,T,W	8	10,000+	55.5	36.0	10
	Brown Parcel	2	No	N	F,T,W	-	1,000+	-	-	-
<i>Cordylanthus orcuttii</i> Orcutt's bird's-beak	Del Mar Mesa	1	No	N	D,O,M,W	27	5,000+	30.1	16.6	10
	Otay Valley	1	No	S	D,O,M,T,W	35	1000+	29.3	20.1	10
<i>Dudleya variegata</i> Variegated Dudleya	Dennery Ranch	1	Yes	S	O,W	32	200-300	25.0	6.6	3
	Marron Valley	2	No	S	F,G,W	-	11,000+	-	-	-
	Goat Mesa	1	Yes	S	D,G,O,M,T,W	36	1,000+	54.6	21.7	5
	Cal Terraces	2	Yes	S	NONE	-	1,000+	-	-	-
	Paradise Valley	2	Yes	S	T,W	-	500+	-	-	-
	Otay Lakes	1	Yes	S	F,G,W	33	10,000+	77.0	33.8	10
	Lake Murray	2	No	C	M,T,W	-	115	-	-	-
	Margerum Ave.	1	Yes	C	T,W	36	500	23.4	13.9	5
	Mission Trails (W)	1	No	C	O,M,T,W	-	1,000+	-	-	-
	Mission Trails (E)	2	No	C	O,M,T,W	-	1,000+	-	-	-
	Mercy Road	1	Yes	N	W	-	1,000+	-	-	-
	Black Mtn. Ranch	1	Yes	N	M,W	45	500	25.6	9.4	5
<i>Lessingia filaginifolia</i> var. <i>linifolia</i> Del Mar sand-aster	Carmel Mountain	1	No	N	O,M,W	26	200+	32.6	23.7	5@
	Carmel Valley	2	No	N	D,O,M,W	26	150+	20.6	14.8	5@
	Overlook Park	1	Yes	N	T,W	23	200	17.7	4.5	3@
	Torrey Highlands	2	Yes	N	D,O,M,T,W	25	200	18.4	9.6	5@
<i>Monardella linoides</i> ssp. <i>viminea</i> Willow Monardella	Otay Lakes	2	No	S	F,G,W	5	1	1	-	1
	Marron Valley	1	Yes	S	-	-	42	-	-	-

TABLE 6
SUMMARY DATA FOR RARE PLANT SPECIES POPULATIONS
MONITORED DURING THE 2001 SEASON
(continued)

Species	Locality ¹	Priority ²	New to MSCP Database	General Geographic Location ³	Disturbance Types ⁴	% Non-Native Cover (1m ²)	Estimated Population Size (# of plants) ⁵	Mean Density (# of plants/quad)	Standard Deviation of Mean Density	# of Quads Sampled (1m ²)
<i>Muilla clevelandii</i> San Diego goldenstar	Marron Valley	2	No	S	F,G,W	-	1,500+	-	-	-
	Otay Lakes	1	Yes	S	F,G,W	33	10,000+	42.4	26.0	10
	Mission Trails (W)	1	Yes	C	O,M,T,W	53	12	6.0	4.2	2
	Mission Trails (E)	2	No	C	O,M,T,W	-	1,000+	-	-	-
	Mercy Road	2	Yes	N	W	-	22	-	-	-
	Del Mar Mesa	1	No	N	D,O,M,W	31	1,000+	18.8	11.1	5

¹Localities in bold were quantitatively monitored during spring 2001. These same localities are a priority for future quantitative monitoring, with the exception of the willow monardella at Otay Lakes which is not a priority for future monitoring.

²**Priority for future monitoring** (based on geographic distribution, degree of disturbance, and status in MSCP database -- see text)

1 = First priority

2 = Second priority

³**General Geographic Location**

N = Northern portion of the City of San Diego

C = Central portion of the City of San Diego

S = Southern portion of the City of San Diego

* = Population not relocated during the 2001 season

⁴**Disturbance Types** (evaluated during reconnaissance surveys)

D = Trash dumping

F = Increased fire frequency

G = Grazing

M = Mechanical disturbance (other than off-road activity)

O = Off-road activity

T = Illegal trails and foot traffic

W = Weed invasion

⁵**Estimated Population Size**

Population size estimates in bold were quantitatively monitored. Population size estimates not in bold were estimated during the reconnaissance surveys.

@ = Monitored with 10m² quads

1. Invasion by non-native weed species. This is a common problem throughout all of the City's lands and is often the most serious current threat to the rare plant populations. Although perennial weed species are problems in some areas (especially riparian habitats), it is the annual weed species that present the greatest threat to the long-term stability and health of the rare plant populations. Table 7 lists some of the common annual and perennial weed species associated with the habitats on the City's lands.

TABLE 7
COMMON ANNUAL AND PERENNIAL WEED SPECIES ON
CITY OF SAN DIEGO MSCP LANDS

Species	Common Name
<i>Atriplex semibaccata</i>	Australian saltbush
<i>Avena</i> spp.	Wild oats
<i>Brassica</i> spp.	Mustard
<i>Bromus</i> spp.	Brome grass
<i>Centaurea melitensis</i>	Tocalote, star-thistle
<i>Erodium</i> spp.	Filaree, storksbill
<i>Foeniculum vulgare</i>	Fennel
<i>Hedypnois cretica</i>	Crete Hedypnois
<i>Hypochaeris glabra</i>	Smooth cat's-ear
<i>Lolium</i> spp.	Rye-grass
<i>Rumex</i> spp.	Dock
<i>Salsola tragus</i>	Russian thistle, tumbleweed
<i>Spergularia</i> spp.	Sand-spurry

Some of the rare plant populations within the City's lands, including San Diego thornmint (Otay Lakes), variegated Dudleya (Mission Trails), and San Diego goldenstar (Mission Trails and Mercy Road), are close to disappearing because of the weed species. Other populations and species will soon be added to this list if the weed invasion is allowed to continue.

While funding for weed control throughout all of the habitats in the City's MSCP lands is not available, funding should be prioritized for weed control in and around the rare plant populations. Control of weeds on a local basis is effective for maintaining rare plant populations, as long as buffers are established and weed control is maintained for 5 or more years. Weed control can be achieved through a variety of management methods, including herbicides, mechanical controls, and hand weeding.

2. Encroachment by adjacent homeowners and businesses. This problem is minor compared to weed control, but the problem is growing in scope and size. Residential housing and commercial development uses have encroached into City lands. Many homeowners and business parks have extended their

properties into the open space areas and/or have cleared or modified the native habitats in and around their properties.

Systematic surveys of the properties adjacent to the City's MSCP lands will identify the parties responsible for habitat encroachment. Illegal encroachment by home and business owners should be documented, and those responsible should be notified. Remedial action plans for habitat restoration and protection should be developed for the areas that have been impacted.

3. Illegal off-road activity. This is not a problem in all of the City's lands, but in some areas this continues to be a very serious threat. These areas include, but are not limited to, Mission Trails Regional Park, Del Mar Mesa, Otay Mesa, Otay River Valley, and the Scripps Ranch/Miramar portion of City MSCP lands. Off-road activity not only causes physical impacts to the landscape and vegetation, but also increases the rate of weed invasion in and around the impacts.

Options for controlling this problem include improved fencing and signs, increased patrols by City staff, and public education. Some areas are currently fenced, but fence destruction or removal allows access to the open space. In many cases, this destruction or removal of fencing has not been addressed for many years, allowing for long-term access for illegal off-road activities. Many areas would benefit from improved signs and other methods of public education.

4. Unauthorized trail access and development. Public access and use of the City's open space lands is an important part of the management of MSCP areas. The public should be allowed to enjoy the MSCP open space areas, but not at the expense of the rare plants and other natural resources. Most of the trails established by the City within MSCP lands are not impacting rare plant populations and provide for public access without habitat destruction. Unfortunately, many unauthorized access trails have been established within the City's lands, and many of these are having serious impacts on the rare habitats and plant populations. As with the off-road activity, the solutions to this problem include better fencing, improved signs and public education, and increased patrol.
5. Limited patrol by City of San Diego staff. Although some areas of the City's MSCP lands are patrolled (Mission Trails, Los Peñasquitos Canyon, Tecolote Canyon), most of the open space areas do not have regular patrols. Even the areas that have patrols continue to have problems with illegal encroachment, off-road use, trash dumping, and other destructive activities. The areas without patrols have all of the same problems, but no efforts are being made to keep track of the impacts or develop strategies to control them. Without these patrols, fencing and signs continue to be destroyed, and habitat is used

for off-road activity, trash dumping, and other illegal impacts. Without patrols and other forms of oversight, management plans will not be effective.

Increased patrols are warranted throughout all areas of the City's MSCP lands and should not be limited to the official City parks (e.g., Mission Trails). City staff and or City police patrols should be authorized to issue citations for illegal uses.

5.0 REFERENCES CITED

- Bauder, E.T. 1986. San Diego Vernal Pools, Recent and Projected Losses, Their Condition, and Threats to Their Existence 1979-1980. Prepared for the California Department of Fish and Game, Endangered Plant Project, Sacramento, CA.
- Bauder, E.T. and S. McMillan. 1996. Current Distribution and Historical Extent of Vernal Pools in Southern California and Baja California, Mexico. Proceedings of the Conference on the Ecology, Conservation, and Management of Vernal Pool Ecosystems. June 19-21, Sacramento, CA.
- Beauchamp, R.M., and T. Cass. 1979. San Diego Vernal Pool Study. California Department of Fish and Game, Endangered Plant Program 145.
- Beauchamp, R.M. 1986. *A Flora of San Diego County, California*. Sweetwater River Press. National City, CA.
- Braun-Blanquet, J. 1932. *Plant Sociology: The Study of Plant Communities*. McGraw-Hill, New York.
- City of San Diego. 1978. City of San Diego Guidelines for Conducting Biological Surveys. September.
- City of San Diego. 1994. Addendum to City of San Diego Guidelines for Conducting Biological Surveys. April.
- City of San Diego. 1997. Multiple Species Conservation Program: City of San Diego MSCP Subarea Plan. March.
- City of San Diego. 2001. MSCP Rare Plant Monitoring Program.
- California Native Plant Society (CNPS). 2001. Inventory of Rare and Endangered Plants of California (6th Edition). CNPS, Sacramento, CA. August.
- Conservation Biology Institute (CBI). 2000. Spring 2000 Field Survey Results for the Marron Valley Property. Prepared for the City of San Diego MSCP. August.
- Conservation Biology Institute (CBI). 2001. Status Summary of Biological Monitoring Protocols for the Multiple Species Conservation Program (MSCP). Prepared for the City of San Diego MSCP and California Department of Fish and Game. February.
- Hickman, J.C. (ed.). 1993 *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley and Los Angeles, CA.

- Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. Non-game-Heritage Program, California Department of Fish and Game. October.
- Munz, P.A. 1974. *A Flora of Southern California*. University of California Press. Berkeley and Los Angeles, CA.
- Oberbauer, T. 1992. Terrestrial Vegetation Communities in San Diego County Based on Holland's Description. May 28.
- Ogden. 1996. Biological Monitoring Plan for the Multiple Species Conservation Program. January 25.
- Raven, P.H. and D.I. Axelrod. 1978. *Origin and Relationships of the California Flora*. University of California Publications in Botany Volume 72. Berkeley, CA.
- RECON. 1998. Year 5 Monitoring Report for the Lopez Ridge Vernal Pool Preserve Restoration Program, San Diego, California. January 14.
- U. S. Department of Agriculture (USDA). 1973. *Soil Survey, San Diego Area, California*. Soil Conservation Service and Forest Service. San Diego, CA. December.
- Wiggins, I.L. 1980. *A Flora of Baja California*. Stanford University Press, Stanford, CA.

APPENDICES

- Appendix 1: MSCP Reconnaissance Surveys for 2001 Rare Plant Monitoring, City of San Diego
- Appendix 2: Rare Plant Density Monitoring Data Form
- Appendix 3: California Native Plant Society Status Designations
- Appendix 4: MSCP Rare Plant Seed Collection, Storage, and Propagation Protocols

APPENDIX 1a
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

Surveyor	Site#	Date	General Location	Vegetation Types
SM	12/21/A	12/21/00	Otay River (West of I-805)	R, CSS
SM	12/21/B	12/21/00	Otay River (West of I-805)	R, CSS
SM/BM	12/26/A	12/26/00	Mission Village	CSS,C,G/C
SM/BM	12/26/B	12/26/00	Mission Village	R,CSS,C,G/C
SM		6/17/01	2nd Visit	
SM/BM	12/26/C	12/26/00	Mission Village	CSS,G/C
SM/BM	12/26/D	12/26/00	Waring	R,CSS,C,G/C
SM		2/8/01	2nd Visit	
SM/BM	12/26/E	12/26/00	Margerum Ave.	R,CSS,G/C
SM		3/1/01	2nd Visit	
SM		5/11/01	3rd Visit	
SM/BM	12/26/F	12/26/00	Lake Murray	R,CSS,G/C,NG,P
SM		2/26/01	2nd Visit	
SM		6/1/01	3rd Visit	
SM	12/27/A	12/27/00	SDSU	R,CSS,G/C
SM	12/27/B	12/27/00	Fairmont/Montezuma	R,CSS,C,G/C
SM		6/1/01	2nd Visit	
SM	12/27/C	12/27/00	I-15/Mission Valley	R,CSS,G/C
SM	12/27/D	12/27/00	Camino Del Rio (south)	R,CSS,C,G/C
SM	12/27/E	12/27/00	Camino Del Rio (north)	R,CSS
SM	12/27/F	12/27/00	Hwy 163/Mission Valley	R,CSS,G/C
SM		6/29/01	2nd Visit	
SM	1/4/A	1/4/01	Aero Drive	R,CSS,C,G/C,VP
SM		5/28/01	2nd Visit	
SM	1/4/B	1/4/01	General Dynamics	CSS,C,G/C,VP
SM/BM		5/12/01	2nd Visit	
SM	1/4/C	1/4/01	Murphy Canyon	R,CSS
SM	1/4/D	1/4/01	Shepard Canyon (west)	R,CSS,G/C
SM	1/4/E	1/4/01	Santo Park	R,CSS,C,G/C
SM		5/28/01	2nd Visit	
SM	1/4/F	1/4/01	Tierrasanta Blvd.	R,CSS,G/C,P

APPENDIX 1a
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

Surveyor	Site#	Date	General Location	Vegetation Types
SM	1/4/G	1/4/01	Shepard Canyon (east)	R,CSS,C,G/C
SM/BM	1/12/A	1/12/01	Famosa Slough	SM/CSS
SM		5/24/01	2nd Visit	
SM/BM	1/15/A	1/15/01	Paradise Valley	R,CSS,G/C
SM		3/2/01	2nd Visit	R,CSS,G/C
SM		6/16/01	3rd Visit	
SM/BM	1/15/B	1/15/01	Plaza Blvd.	R,CSS,G/C
SM		6/16/01	2nd Visit	
SM/BM	1/15/C	1/15/01	Vallencia	CSS,G/C
SM		6/16/01	2nd Visit	
SM	1/16/A	1/16/01	Sunset Cliffs Park	CSS,P
SM	1/16/B	1/16/01	Heritage Park	R,CSS,G/C,P
SM	1/16/C	1/16/01	Mission Hills Park	CSS,G/C,P
SM	1/16/D	1/16/01	Hwy 163/Boy Scout	CSS,G/C,P
SM		7/10/01	2nd Visit	
SM	1/16/E	1/16/01	Florida Canyon/Morley Field	R,CSS,C,G/C
SM	1/16/F	1/16/01	Florida Canyon (east)	R,CSS,C,G/C
SM		7/10/01	2nd Visit	
SM	1/16/G	1/16/01	I-15/Hwy 94	R,CSS,C,G/C
SM		4/28/01	2nd Visit	
SM	1/23/A	1/23/01	San Dieguito Rd.	CSS,C,G/C
SM	1/23/B	1/23/01	Overlook Park	C
SM		6/28/01	2nd Visit	
SM		7/18/01	3rd Visit	
SM	1/23/C	1/23/01	San Dieguito River	R,G/C,SM,AG,NG
FR		6/8/01	2nd Visit	
FR		7/26/01	3rd Visit	
SM	1/23/D	1/23/01	Torrey Highlands Park	R,CSS,C,G/C
FR		6/8/01	2nd Visit	
SM		7/18/01	3rd Visit	
SM	1/23/E	1/23/01	Sword Street	CSS,C,G/C

APPENDIX 1a
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

Surveyor	Site#	Date	General Location	Vegetation Types
SM/BM	1/26/A	1/26/01	Copley Drive/Hwy 52	R,C
SM/BM	1/26/B	1/26/01	Governor/Hwy 52	R,CSS,C,P
SM/BM	1/26/C	1/26/01	Rose Canyon/Regents	R,CSS,G/C,P,NG
SM/BM	1/26/D	1/26/01	Nobel Drive/I-5	CSS,C,G/C,VP
SM		3/22/01	2nd Visit	
SM		5/19/01	3rd Visit	
SM/BM	1/27/A	1/27/01	Scripps Ranch/Miramar (north)	CSS,R,P
SM/BM	1/27/B	1/27/01	Scripps Ranch/Miramar (west)	R,CSS,C,G/C
SM		5/28/01	2nd Visit	
SM/BM	1/27/C	1/27/01	Carroll Canyon (east)	R,CSS,C,P
SM/BM	1/27/D	1/27/01	Scripps Ranch/Miramar (east)	CSS,C,G/C
SM/BM	1/27/E	1/27/01	Scripps Ranch/Miramar (south)	CSS,G/C
SM/BM	1/27/F	1/27/01	Carroll Canyon (west)	R,CSS,C,P
SM	2/1/A	2/1/01	Otay Lakes	R,C,G/C,VP
SM		3/8/01	2nd Visit	
SM		4/24/01	3rd Visit	
SM/BM		5/15/01	4th Visit	
SM/BM		6/15/01	5th Visit	
SM	2/1/B	2/1/01	Cedar Canyon	R,C,CCS,G/C,NG
SM		6/14/01	2nd Visit	
SM	2/6/A	2/6/01	Mariner's Point	D
SM	2/6/B	2/6/01	Sea World Drive (west)	SM,D
SM	2/6/C	2/6/01	Sea World Drive (east)	D,CSS
SM	2/6/D	2/6/01	Fiesta Island	D,SM,CSS
SM		5/24/01	2nd Visit	
SM	2/6/E	2/6/01	Rose Creek Inlet	SM
SM	2/6/F	2/6/01	Kendall Frost Preserve	D,SM,CSS
SM	2/6/G	2/6/01	Kate Sessions Park	CSS,C,G/C,P
SM		5/29/01	2nd Visit	
SM	2/6/H	2/6/01	La Jolla Drive Canyon	R,CSS,G/C,P
SM		5/29/01	2nd Visit	

APPENDIX 1a
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

Surveyor	Site#	Date	General Location	Vegetation Types
SM	2/6/I	2/6/01	Rutgers Road Canyon	R,CSS,G/C,NG,P
SM		5/29/01	2nd Visit	
SM	2/7/A	2/7/01	Mission Trails	R,CSS,C,G/C,VP,NG
SM		2/21/01	2nd Visit	
SM		5/26/01	3rd Visit	
SM	2/9/A	2/9/01	Van Dam Peak	CSS,C,G/C
SM		4/26/01	2nd Visit	
SM	2/9/B	2/9/01	Chicarita Creak	R,CSS,C,G/C
SM	2/9/C	2/9/01	Black Mountain (east)	R,C,
SM	2/10/A	2/10/01	Del Mar Mesa	C,G/C,VP
SM		3/27/01	2nd Visit	
SM		5/20/01	3rd Visit	
SM	2/15/A	2/15/01	Otay Valley/I-805	R,CSS,G/C,P
SM		6/20/01	2nd Visit	
SM		6/22/01	3rd Visit	
SM	2/23/A	2/23/01	Chollas Creek (east)	R,CSS,G/C
SM		4/27/01	2nd Visit	
SM	2/23/B	2/23/01	Chollas Creek (west)	R,CSS,G/C,NG
SM		4/27/01	2nd Visit	
SM	2/23/C	2/23/01	Kelton Rd/Hwy 94	R,CSS,G/C,VP
SM		3/19/01	2nd Visit	
SM		4/27/01	3rd Visit	
SM/BM	2/24/A	2/24/01	Mercy Rd/Black Mountain Rd.	R,CSS,G/C,NG
SM		5/8/01	2nd Visit	
SM	3/5/A	3/5/01	Tecalote/Genesse (north)	R,CSS,G/C,NG
SM	3/5/B	3/5/01	Tecalote/Genesse (south)	R,CSS,C,G/C,NG,P
SM	3/19/A	3/19/01	Market St.	CSS,G/C
SM		4/27/01	2nd Visit	
SM	3/20/A	3/20/01	60th St.	CSS,G/C,NG,P
SM	3/28/A	3/28/01	California Terraces	R,CSS,G/C,VP
SM		4/20/01	2nd Visit	

APPENDIX 1a
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

Surveyor	Site#	Date	General Location	Vegetation Types
SM	3/28/B	3/28/01	Dennergy/Oceanview	R,CSS,G/C,NG
SM		4/24/01	2nd Visit	
SM		5/6/01	3rd Visit	
SM	3/28/C	3/28/01	Robinhood Ridge	R,CSS,G/C,VP,NG
SM		4/20/01	2nd Visit	
SM	3/29/A	3/29/01	Goat Mesa/Spring Canyon	R,CSS,G/C,VP,NG
SM		4/20/01	2nd Visit	
SM		5/15/01	3rd Visit	
SM	4/21/A	4/21/01	Miramar Lake	R,CSS,C,G/C,NG
SM	4/22/A	4/22/01	Tecalote (main canyon)	R,CSS,C,G/C,NG
SM	4/28/A	4/28/01	I-805/Fairmont	C,CSS,G/C,NG
SM	5/22/A	5/22/01	Merrian Bear Park	R,C,CSS,G/C,NG
SM	5/25/A	5/25/01	Otay Mesa (west slopes)	R,CSS,G/C,NG
SM	7/11/A	7/11/01	Rose Canyon (main canyon)	R,C,CSS,G/C,NG
SM	7/18/A	7/18/01	Gonzales Canyon	R,C,CSS,G/C,NG
FR	2/6/A	2/6/01	Sorrento Valley/Science Center	R,CSS,C,G/C,NG,P
SM		6/25/01	2nd Visit	
FR	2/6/B	2/6/01	Sorrento Valley/Genesse	R,CSS,C,NG,P
SM		6/25/01	2nd Visit	
FR	2/6/C-F	2/6/01	Sorrento Valley/Torrey Pines	CSS,C,P
SM		6/25/01	2nd Visit	
FR	2/6/G	2/6/01	Miramar/Rasha St.	R,CSS,G/C,P
FR	2/6/H	2/6/01	Miramar/Miramar Pl.	R,C
FR	2/7/A	2/7/01	Sorrento Valley/I-805	CSS,C
FR	2/7/B-C	2/7/01	Miramar/Nancy Ridge Dr.	R,CSS,C,G/C
FR	2/7/D-E	2/7/01	Miramar/Carroll Rd.	CSS,C,NG
FR	2/7/F-K	2/7/01	Carroll Canyon/Sorrento Mesa	R,CSS,C,G/C,NG
FR	2/7/L-M	2/7/01	Sorrento Valley (north)/I-805	R,CSS,C,G/C,NG
SM		5/9/01	2nd Visit	
FR	2/7/N	2/7/01	San Dieguito/Crest Canyon	SM,R,CSS,C,G/C,NG
FR	2/8/A	2/8/01	Mira Mesa/Camino Santa Fe	CSS,C

APPENDIX 1a
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

Surveyor	Site#	Date	General Location	Vegetation Types
FR	2/8/B	2/8/01	Mira Mesa/Carroll Canyon	C,VP
SM		5/19/01	2nd Visit	
FR	2/8/C-D	2/8/01	Mira Mesa/Flanders St.	R,C,CSS
SM		6/4/01	2nd Visit	
FR	2/8/E-H	2/8/01	Lopez Canyon (east)	R,C,CSS,G/C,NG,P
SM		6/4/01	2nd Visit	
FR	2/8/I	2/8/01	Lopez Ridge	C,G/C,VP
SM		6/4/01	2nd Visit	
FR	2/8/J-M	2/8/01	Del Mar Mesa (west)	CSS,G/C,C
SM		6/6/01	2nd Visit	
FR	2/8/N&P	2/8/01	Lusk Blvd.	CSS,C,G/C,NG,P
FR	2/8/O,Q-R	2/8/01	Sorrento Valley (I-805 & I-5)	CSS,C,G/C,NG,P
FR	2/17/f-H	2/17/01	2nd Visit	
SM		5/9/01	3rd Visit	
FR	2/8/S	2/8/01	Torrey Pines State Reserve	CSS,C,G/C,NG,SM,T
FR	2/17/B-E	2/17/01	2nd Visit	
SM		6/8/01	3rd Visit	
FR	2/17/A	2/17/01	Torrey Pines State Reserve (north)	C,T
FR	2/17/F	2/17/01	Scripps Coastal Preserve	C,CSS
FR	2/17/I	2/17/01	Del Mar	CSS
FR	2/17/J	2/17/01	Carmel Valley	R,C,CSS,G/C,FM
SM		7/3/01	2nd Visit	
FR	2/17/J	2/17/01	Carmel Mountain	R,C,CSS,G/C,FM
SM		7/3/01	2nd Visit	
FR	2/17/K-Q	2/17/01	Sorrento Hills	C,CSS,G/C,NG
FR	2/20/A-B	2/20/01	2nd Visit	
SM		7/3/01	3rd Visit	
FR	2/20/C-E,J-K	2/20/01	Black Mountain Ranch	R,C,CSS,G/C,NG
FR	2/24/E	2/24/01	2nd Visit	
SM		5/16/01	3rd Visit	
FR		6/1/01	4th Visit	

APPENDIX 1a
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

Surveyor	Site#	Date	General Location	Vegetation Types
FR	2/20/F-I	2/20/01	Penasquitos Canyon	C,G/C
SM		6/27/01	2nd Visit	
FR	2/24/A-F	2/24/01	Fairbanks/Black Mountain/Penasquitos	R,C,CSS,G/C,NG
FR	6/6/A	6/6/01	Lusardi Creek	R,C,CSS,G/C,NG
FR		6/7/01	2nd Visit	
FR	6/9/A	6/9/01	Crest Canyon	C,CSS,G/C,NG
VM	2/9/A-G	2/9/01	Lake Hodges/San Pasqual	R,CCS,G/C,NG,OW
VM	2/16/A	2/16/01	Lake Hodges/San Pasqual	R,CCS,G/C,NG,OW
VM	3/2/A	3/2/01	Lake Hodges/San Pasqual	R,CCS,G/C,NG,OW
VM	3/2/B-D	3/2/01	Lake Hodges/San Pasqual	R,CCS,G/C,NG,OW
VM	3/11/A-D	3/11/01	Lake Hodges/San Pasqual	R,CCS,G/C,NG,OW
Vegetation Types				
R=Riparian			Bold font =localities and species that were part of the 2001 MSCP quantitative monitoring	
CSS=Coastal Sage Scrub				
C=Chaparral				
G/C=Grassland/Clay Lens				
NG=Non-native Grassland				
P=Park Landscape				
VP=Vernal Pools				
SM=Salt Marsh				
AG=Agriculture				
D=Coastal Dunes				
T=Torrey Pine Woodland				
FM=Freshwater Marsh				
OW=Oak Woodland				

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:													
	ACil	AMpu	ARgl	BAva	BRor	CEcy	CEve	COfi	COma	COor	DUbr	DUva	ERar	HEco
Otay River (West of I-805)										P1				
Otay River (West of I-805)										P1				
Mission Village	P1,3				P1							P1		
Mission Village														
2nd Visit	P1,3				P1,2							P1,2		
Mission Village	P1				P1							P1,2		
Waring														
2nd Visit	P1,2,3	P1			P1							P1,2		
Margerum Ave.														
2nd Visit														
3rd Visit	P1,2											N		
Lake Murray														
2nd Visit														
3rd Visit	P1,2											K		
SDSU												P1,2		
Fairmont/Montezuma														
2nd Visit	P1,2,3	P1										P1,3		
I-15/Mission Valley	P1,2													
Camino Del Rio (south)	P1,2											P1,2		
Camino Del Rio (north)														
Hwy 163/Mission Valley														
2nd Visit	P1,2,3	P1												
Aero Drive														
2nd Visit		P1			P1,2,3							P1,2		
General Dynamics														
2nd Visit					N							P1	K	
Murphy Canyon					P1,2							P1		
Shepard Canyon (west)	P1,2	P1			P1							P1,2		
Santo Park														
2nd Visit					P1,2							P1		
Tierrasanta Blvd.	P1,2											P1		

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:														
	ACil	AMpu	ARgl	BAva	BRor	CEcy	CEve	COfi	COma	COor	DUbr	DUva	ERar	HEco	
Shepard Canyon (east)	P1,2											P1,2			
Famosa Slough															
2nd Visit									P13			P1			
Paradise Valley															
2nd Visit															
3rd Visit	P1,2,3	P1								P1		N		N	
Plaza Blvd															
2nd Visit	P1,2,3	P1								P1		P1		P1,2	
Vallencia															
2nd Visit	P1,2,3									P1		P1		N	
Sunset Cliffs Park								P1		P1	P1,2				
Heritage Park										P1					
Mission Hills Park								P1		P1					
Hwy 163/Boy Scout															
2nd Visit		P1								P1					
Florida Canyon/Morley Fld		P1	P1				P1			P1		P1,2			
Florida Canyon (east)															
2nd Visit		P1	P1				P1			P1		P1			
I-15/Hwy 94															
2nd Visit			P1				P1			P1		P1			
San Dieguito Rd.	P1,2		P1	P1			P1	K							
Overlook Park															
2nd Visit															
3rd Visit			P1	P1			N	K			P1,2				
San Dieguito River															
2nd Visit															
3rd Visit									P1,3						
Torrey Highlands Park															
2nd Visit															
3rd Visit	P1,2		P1	P1			P1	N							
Sword Street			P1	P1			P1	P1							

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:														
	ACil	AMpu	ARgl	BAva	BRor	CEcy	CEve	COfi	COma	COor	DUbr	DUva	ERar	HEco	
Copley Drive/Hwy 52					P1,2										
Governor/Hwy 52												P1			
Rose Canyon/Regents	P1,2											P1			
Nobel Drive/I-5															
2nd Visit															
3rd Visit					N							P1	P1,3		
Scripps Ranch/Miramar (north)															
Scripps Ranch/Miramar (west)															
2nd Visit	P1		P1									P1,2			
Carroll Canyon (east)															
Scripps Ranch/Miramar (east)			P1									P1			
Scripps Ranch/Miramar (south)												P1			
Carroll Canyon (west)															
Otay Lakes															
2nd Visit															
3rd Visit															
4th Visit															
5th Visit	K	P1			K?					P1		K	K	P1,2,3	
Cedar Canyon															
2nd Visit	P1				P1,2					P1		P1,2		P1,2	
Mariner's Point															
Sea World Drive (west)															
Sea World Drive (east)															
Fiesta Island															
2nd Visit									P1						
Rose Creek Inlet									P1						
Kendall Frost Preserve									P1,2,3						
Kate Sessions Park															
2nd Visit			P1		P1,2			P1			P12				
La Jolla Drive Canyon															
2nd Visit			P1					P1				P1			

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:													
	ACil	AMpu	ARgl	BAva	BRor	CEcy	CEve	COfi	COma	COor	DUbr	DUva	ERar	HEco
Rutgers Road Canyon														
2nd Visit		P1	P1					P1				P1		
Mission Trails														
2nd Visit														
3rd Visit	K	K	P1		K							K	P1,2,3	
Van Dam Peak														
2nd Visit	P1			P1								P1		
Chicarita Creak	P1											P1		
Black Mountain (east)			P1	P1								P1		
Del Mar Mesa														
2nd Visit														
3rd Visit	P1,2		P1		K		P1	P1				P1	K	
Otay Valley/I-805														
2nd Visit														
3rd Visit		P1								K		P1		P1,2
Chollas Creek (east)														
2nd Visit										P1		P1		
Chollas Creek (west)														
2nd Visit										P1		P1		
Kelton Rd/Hwy 94														
2nd Visit														
3rd Visit					P1,2					P1		P1		
Mercy Rd/Black Mountain Rd.														
2nd Visit	P1,2	P1						P1				N		
Tecalote/Genesse (north)	P1	P1										P1		
Tecalote/Genesse (south)			P1		P1						P1,2	P1		
Market St.														
2nd Visit										P1		P1		
60th St.	P1									P1		P1		
California Terraces														
2nd Visit	N*	N*								N		K	K/N*	K

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:														
	ACil	AMpu	ARgl	BAva	BRor	CEcy	CEve	COfi	COma	COor	DUbr	DUva	ERar	HEco	
Dennery/Oceanview															
2nd Visit															
3rd Visit	N*									N		K		K	
Robinhood Ridge															
2nd Visit	P1									P1		K	K	K	
Goat Mesa/Spring Canyon															
2nd Visit															
3rd Visit	P1									P1		K	K	K	
Miramar Lake	P1		P1			P1						P1			
Tecalote (main canyon)	P1	P1	P1									P1			
I-805/Fairmont			P1									P1			
Merrian Bear Park	P1	P1			P1							P1			
Otay Mesa (west slopes)	P1									P1		P1		P1,2	
Rose Canyon (main canyon)	P1	P1										P1			
Gonzales Canyon	P1		P1			P1	P1	P1							
Sorrento Valley/Science Center															
2nd Visit			P1					P1							
Sorrento Valley/Genesse															
2nd Visit			P1					P1							
Sorrento Valley/Torrey Pines															
2nd Visit			P1				P1	P1							
Miramar/Rasha St.												P1			
Miramar/Miramar Pl.			P1				P1								
Sorrento Valley/I-805								P1							
Miramar/Nancy Ridge Dr.												P1			
Miramar/Carroll Rd.															
Carroll Canyon/Sorrento Mesa												P1			
Sorrento Vly (north)/805															
2nd Visit								P1				P1			
San Dieguito/Crest Canyon			P1	P1			P1	P1			K				
Mira Mesa/Camino Santa Fe															

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:													
	ACil	AMpu	ARgl	BAva	BRor	CEcy	CEve	COfi	COma	COor	DUbr	DUva	ERar	HEco
Mira Mesa/Carroll Canyon														
2nd Visit					N							P1	N	
Mira Mesa/Flanders St.												P1		
2nd Visit														
Lopez Canyon (east)														
2nd Visit	P1				P1,2			K				P1		
Lopez Ridge														
2nd Visit			P1		K							P1	K	
Del Mar Mesa (west)														
2nd Visit	P1		K		P1			K			K	P1		
Lusk Blvd.														
Sorrento Valley (I-805 & I-5)														
2nd Visit														
3rd Visit								P1				P1		
Torrey Pines State Reserve														
2nd Visit														
3rd Visit			K				K	K	P1		K			
Torrey Pines St. Reserve (north)			K				K	P1			K			
Scripps Coastal Preserve								P1						
Del Mar								P1						
Carmel Valley														
2nd Visit				P1				K			P1,2			
Carmel Mountain														
2nd Visit				P1				K			P1			
Sorrento Hills														
2nd Visit														
3rd Visit			P1		P1,2		P1	P1			P1,2			
Black Mountain Ranch														
2nd Visit														
3rd Visit														
4th Visit	K		P1	P1	P1			P1				N		

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:													
	ACil	AMpu	ARgl	BAva	BRor	CEcy	CEve	COfi	COma	COor	DUbr	DUva	ERar	HEco
Penasquitos Canyon														
2nd Visit			P1		K			P1						
Fairbanks/Black Mountain/Penasquitos	P1				P1			K				P1		
Lusardi Creek														
2nd Visit	P1		P1	P1		P1	P1					K		
Crest Canyon	K		P1				P1	N			P1			
Lake Hodges/San Pasqual	P1	P1		P1	P1							P1		
Lake Hodges/San Pasqual	P1	P1		P1	P1							P1		
Lake Hodges/San Pasqual	P1	P1		P1	P1							P1		
Lake Hodges/San Pasqual	P1	P1		P1	P1							P1		
Lake Hodges/San Pasqual	P1	P1		P1	P1							P1		
P=Potential														
P1=determined by associated plant community														
P2=determined by soil types and distributions														
P3=determined by associated plant species														
K=Previously known														
N=New locality, 2001														
N*-Reintroduced new locality, 2001														
Bold font =localities and species that were														
part of the 2001 MSCP quantitative monitoring														

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:												
	LEca	LOnu	MOhy	MOli	MUcl	NAfo	OPpa	ORca	Plto	POab	POnu	ROmi	SEga
Otay River (West of I-805)													
Otay River (West of I-805)													
Mission Village					P1								
Mission Village													
2nd Visit					P1								
Mission Village					P1								
Waring													
2nd Visit				P1	P1,2,3		P1						
Margerum Ave.													
2nd Visit													
3rd Visit					P1,2,3		P1						
Lake Murray													
2nd Visit													
3rd Visit					P1,2,3		P1						
SDSU					P1,2								
Fairmont/Montezuma													
2nd Visit					P1,3								
I-15/Mission Valley													
Camino Del Rio (south)					P1,2								
Camino Del Rio (north)				P1									
Hwy 163/Mission Valley													
2nd Visit													
Aero Drive													
2nd Visit					P1,2					P1,2,3			
General Dynamics													
2nd Visit					P1	P1,2,3				K			
Murphy Canyon													
Shepard Canyon (west)				P1	P1								
Santo Park													
2nd Visit				P1	P1,2								
Tierrasanta Blvd.					P1								

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:												
	LEca	LOnu	MOhy	MOli	MUcl	NAfo	OPpa	ORca	Plto	POab	POnu	ROmi	SEga
Shepard Canyon (east)					P1								
Famosa Slough													
2nd Visit		N					P1						
Paradise Valley													
2nd Visit													
3rd Visit					P1,3		P1						
Plaza Blvd													
2nd Visit					P1								
Vallencia													
2nd Visit					P1		P1						
Sunset Cliffs Park		N					P1						
Heritage Park					P1								
Mission Hills Park					P1								
Hwy 163/Boy Scout													
2nd Visit					P1								
Florida Canyon/Morley Fld					P1		P1						
Florida Canyon (east)													
2nd Visit				P1	P1		P1						
I-15/Hwy 94													
2nd Visit					P1		P1						
San Dieguito Rd.					P1								
Overlook Park													
2nd Visit													
3rd Visit													
San Dieguito River													
2nd Visit													
3rd Visit		P1,3											
Torrey Highlands Park													
2nd Visit													
3rd Visit					P1				N				
Sword Street					P1								

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:												
	LEca	LOnu	MOhy	MOli	MUcl	NAfo	OPpa	ORca	Plto	POab	POnu	ROmi	SEga
Copley Drive/Hwy 52				P1									
Governor/Hwy 52					P1								
Rose Canyon/Regents				P1	P1								
Nobel Drive/I-5													
2nd Visit													
3rd Visit					P1	N				P1,2,3			
Scripps Ranch/Miramar (north)													
Scripps Ranch/Miramar (west)													
2nd Visit				P1	P1								
Carroll Canyon (east)				P1									
Scripps Ranch/Miramar (east)					P1								
Scripps Ranch/Miramar (south)					P1								
Carroll Canyon (west)				P1									
Otay Lakes													
2nd Visit													
3rd Visit													
4th Visit													
5th Visit	P1			P1	N	K	P1	P1,2,3			P1,2,3		P1
Cedar Canyon													
2nd Visit	P1			K	P1								
Mariner's Point		K											
Sea World Drive (west)		P1,2											
Sea World Drive (east)		P1,2											
Fiesta Island													
2nd Visit		P1,2											
Rose Creek Inlet													
Kendall Frost Preserve		P1,2											
Kate Sessions Park													
2nd Visit					P1								
La Jolla Drive Canyon													
2nd Visit					P1								

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:												
	LEca	LOnu	MOhy	MOli	MUcl	NAfo	OPpa	ORca	Plto	POab	POnu	ROmi	SEga
Rutgers Road Canyon													
2nd Visit					P1								
Mission Trails													
2nd Visit													
3rd Visit				P1	N	P1,2,3				P1,2,3			
Van Dam Peak													
2nd Visit					P1								
Chicarita Creak					P1								
Black Mountain (east)					P1								
Del Mar Mesa													
2nd Visit													
3rd Visit				K	K	P1,2,3		P1,2,3		K			
Otay Valley/I-805													
2nd Visit													
3rd Visit					P1		P1						
Chollas Creek (east)													
2nd Visit					P1		P1						
Chollas Creek (west)													
2nd Visit					P1		P1						
Kelton Rd/Hwy 94													
2nd Visit													
3rd Visit					P1		P1						
Mercy Rd/Black Mountain Rd.													
2nd Visit				P1	N								
Tecalote/Genesse (north)				P1	P1								
Tecalote/Genesse (south)					P1								
Market St.													
2nd Visit					P1		P1						
60th St.					P1		P1						
California Terraces													
2nd Visit						K/N*	N*	N*			K/N*	N*	

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:												
	LEca	LOnu	MOhy	MOli	MUcl	NAfo	OPpa	ORca	Plto	POab	POnu	ROmi	SEga
Dennergy/Oceanview													
2nd Visit													
3rd Visit							N					N*	
Robinhood Ridge													
2nd Visit						K	P1						
Goat Mesa/Spring Canyon													
2nd Visit													
3rd Visit						K	K	K			P1,2,3		
Miramar Lake				P1	P1								
Tecalote (main canyon)				P1	P1		P1						
I-805/Fairmont					P1		P1						
Merrian Bear Park				K	P1								
Otay Mesa (west slopes)					P1		P1						
Rose Canyon (main canyon)				P1	P1								
Gonzales Canyon					P1								
Sorrento Valley/Science Center													
2nd Visit					P1								
Sorrento Valley/Genesse													
2nd Visit					P1								
Sorrento Valley/Torrey Pines													
2nd Visit					P1								
Miramar/Rasha St.					P1								
Miramar/Miramar Pl.													
Sorrento Valley/I-805													
Miramar/Nancy Ridge Dr.					P1								
Miramar/Carroll Rd.													
Carroll Canyon/Sorrento Mesa				P1	P1								
Sorrento Vly (north)/805													
2nd Visit					P1								
San Dieguito/Crest Canyon					P1				K				
Mira Mesa/Camino Santa Fe													

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:												
	LEca	LOnu	MOhy	MOli	MUcl	NAfo	OPpa	ORca	Plto	POab	POnu	ROmi	SEga
Mira Mesa/Carroll Canyon													
2nd Visit					P1	P1,2,3				N			
Mira Mesa/Flanders St.													
2nd Visit					P1								
Lopez Canyon (east)													
2nd Visit					P1								
Lopez Ridge													
2nd Visit					P1					K			
Del Mar Mesa (west)													
2nd Visit					P1								
Lusk Blvd.					P1								
Sorrento Valley (I-805 & I-5)													
2nd Visit													
3rd Visit					P1								
Torrey Pines State Reserve													
2nd Visit													
3rd Visit		P1,2			P1				K				
Torrey Pines St. Reserve (north)									K				
Scripps Coastal Preserve													
Del Mar													
Carmel Valley													
2nd Visit					P1								
Carmel Mountain													
2nd Visit					P1								
Sorrento Hills													
2nd Visit													
3rd Visit				P1	P1								
Black Mountain Ranch													
2nd Visit													
3rd Visit													
4th Visit													

APPENDIX 1b
MSCP RECONNAISSANCE SURVEYS FOR
2001 RARE PLANT MONITORING
CITY OF SAN DIEGO

General Location	SPECIES:												
	LEca	LOnu	MOhy	MOLi	MUcl	NAfo	OPpa	ORca	Plto	POab	POnu	ROmi	SEga
Penasquitos Canyon													
2nd Visit				K	K								
Fairbanks/Black Mountain/Penasquitos					P1								
Lusardi Creek													
2nd Visit					P1								
Crest Canyon					P1				K				
Lake Hodges/San Pasqual													
Lake Hodges/San Pasqual													
Lake Hodges/San Pasqual													
Lake Hodges/San Pasqual													
Lake Hodges/San Pasqual													
P=Potential													
P1=determined by associated plant community													
P2=determined by soil types and distributions													
P3=determined by associated plant species													
K=Previously known													
N=New locality, 2001													
N*-Reintroduced new locality, 2001													
Bold font =localities and species that were													
part of the 2001 MSCP quantitative monitoring													

APPENDIX 2

RARE PLANT DENSITY MONITORING DATA FORM

General Locality:
 Surveyors:
 Species:

USGS Quad:
 Date

QUAD (1 sq.m)	1	2	3	4	5	6	7	mean
Count								
% Flowering								
% Fruiting								
% Vegetative								
Slope								
Aspect								
% Native Cover								
% Nonnative								
% Bare Ground								
Soil Types								
Dominants								
Associates								
Notes on habitat quality:								
Notes on disturbances:								
Other management issues:								

APPENDIX 3

CALIFORNIA NATIVE PLANT SOCIETY STATUS DESIGNATIONS

1B = Rare or endangered in California and elsewhere (meets CDFG criteria for rare or endangered listing)

2 = Rare or endangered in California, more common elsewhere

3 = Plants about which more information is needed

4 = Plants of limited distribution

R-E-D Code

R - Rarity

1 = Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction or extirpation is low

2 = Occurrences confined to several populations or one extended population

3 = Occurrence limited to one or a few highly restricted populations, or present in such small numbers that it is seldom reported

E - Endangerment

1 = Not endangered

2 = Endangered in a portion of its range

3 = Endangered throughout its range

D - Distribution

1 = More or less widespread outside California

2 = Rare outside California

3 = Endemic to California

APPENDIX 4

MSCP SEED COLLECTION, STORAGE, AND PROPAGATION PROTOCOLS

In 1997, the City of San Diego signed an Implementing Agreement with the resource agencies (United States Fish and Wildlife Service [USFWS] and the California Department of Fish and Game [CDFG]) to implement the City's Subarea Plan, prepared to comply with the requirements of the California Natural Community Conservation Planning (NCCP) Act of 1992. The Subarea Plan (City of San Diego, 1997) and the Biological Monitoring Plan for the Multiple Species Conservation Program (MSCP) (Ogden, 1996) direct the implementation, monitoring, and management of the City's portion of the MSCP Preserve. These plans identify the known populations of covered plant and animal species to monitor and manage within the City's lands. Covered species are those species addressed or "covered" by the MSCP Plan and the City's Subarea Plan, and for which endangered species take authorizations have been issued by USFWS and CDFG.

The City of San Diego is responsible for monitoring and managing 23 covered plant species (Table App.4-1). Some populations of these species may require stabilization or enhancement of the population, as part of the conservation and management program. This document includes protocols for seed collection, seed storage, seed propagation, and seed reintroduction of rare plant species. Persons involved in seed collection and seed reintroduction of listed species will require the appropriate federal and state permits. Reintroduction into native habitat within the species' historic range will require review and approval by the USFWS and CDFG.

A. SEED COLLECTION

Published recommendations for native seed collection vary considerably, especially when concerning rare and endangered species (Emery, 1988; Hartman and Kester 1997; Mortlock 1998). Four important questions have been outlined by the Center for Plant Conservation, and each of these questions should be addressed before collecting any rare plant species for conservation and management purposes (Falk and Holsinger, 1991):

1. Which species should be collected?
2. How many populations should be sampled per species?
3. How much seed should be sampled per population?
4. Under what circumstances is a multiyear collection plan indicated?

Seeds of rare or endangered plants should be collected by a qualified biologist or under the supervision of a biologist with experience in seed maturation and seed collection.

The timing of seed collection is very important, especially when seed is limited. Seeds should be collected after the fruit has ripened completely to ensure seed viability. In many species, ripening is quickly followed by seed loss and dispersal. There are a number of private seed collection and seed propagation companies in southern California, but these companies do not usually employ biologists to collect the seed.

**TABLE APP.4-1
CITY OF SAN DIEGO MSCP COVERED PLANT SPECIES**

Species	Common Name	Annual/ Perennial	Potential # of Seeds/Flower*
<i>Acanthomintha ilicifolia</i>	San Diego thornmint	A	4
<i>Agave shawii</i>	Shaw's Agave	P	Numerous
<i>Ambrosia pumilla</i>	San Diego Ambrosia	P	1-5
<i>Arctostaphylos glandulosa</i> ssp. <i>crassifolia</i>	Del Mar manzanita	P	2-10
<i>Brodiaea orcuttii</i>	Orcutt's Brodiaea	P	Numerous
<i>Ceanothus verrucosus</i>	Wart-stemmed Ceanothus	P	3
<i>Cordylanthus maritimus</i> ssp. <i>maritimus</i>	Salt marsh bird's-beak	A	15-20
<i>Cordylanthus orcuttianus</i>	Orcutt's bird's-beak	A	Numerous
<i>Dudleya brevifolia</i>	Short-leaved Dudleya	P	Numerous
<i>Dudleya variegata</i>	Variegated Dudleya	P	Numerous
<i>Eryngium aristulatum</i> var. <i>parishii</i>	San Diego button-celery	P	1
<i>Hemizonia conjugens</i>	Otay tarplant	A	1
<i>Lessingia filaginifolia</i> var. <i>linifolia</i>	Del Mar sand-aster	P	1
<i>Lotus nuttallianus</i>	Nuttall's Lotus	A	2
<i>Monardella linoides</i> ssp. <i>viminea</i>	Willowy Monardella	P	4
<i>Muilla clevelandii</i>	San Diego goldenstar	P	Numerous
<i>Navarretia fossalis</i>	Spreading Navarretia	A	5-25
<i>Opuntia parryi</i> var. <i>serpentina</i>	Snake cholla	P	Numerous
<i>Orcuttia californica</i>	California Orcutt's grass	A	1
<i>Pinus torreyana</i>	Torrey pine	P	Numerous
<i>Pogogyne abramsii</i>	San Diego Mesa mint	A	4
<i>Pogogyne nudiusscula</i>	Otay Mesa mint	A	4
<i>Rosa minutifolia</i>	Small-leaved rose	P	Numerous

* Flower = Floret = Cone (for the purposes of this table).
Numerous = More than 25 seeds per flower/floret/cone.

1. Which Species Should Be Collected?

To determine which species should be collected, it is necessary to determine the degree of endangerment, the taxonomic and evolutionary uniqueness, the degree of population decline, and the potential for biological management and recovery.

The MSCP covered species are considered the most threatened plant taxa in southern California and northwest Baja California. Most of these species are considered well-defined taxa, except for Del Mar sand-aster, Del Mar manzanita, and snake cholla (Hickman, 1993). These taxa should be considered legitimate species until published data suggest otherwise and, therefore, should be considered for seed collection. Baseline monitoring data have been collected on most of these species, but only for 1 or 2 years. Collection of data over multiple years will allow a better determination of the health of each population and document population trends.

The potential for seed storage, propagation, and reintroduction for all of the covered plant species is excellent. Most of these species have been cultivated from seed under greenhouse conditions and successfully established in revegetation projects in southern California. Those that have not been cultivated from seed appear to have good potential based on the cultivation of related species (Hanson, pers. comm.).

2. How Many Populations Should Be Sampled Per Species?

The literature varies considerably in the recommendations made to address this question (e.g., Emery, 1988; Mirov, 1945; Stebbins and Day, 1967). Much of the literature addresses the issue of the degree of genetic difference among populations. Many studies discuss the problems of over-collecting rare plant populations to the point that the populations suffer reduced genetic viability. No studies have been published on the genetic patterns found among any of the species listed in Table App.4-1, but similar species have been studied.

Without information on the genetic variation among the covered rare plant populations, it is important to be conservative when collecting seed. Some of these rare plant populations could be adversely impacted by just a small amount of seed collection. Seeds of the MSCP covered rare plants should be collected only if they are going to be used for restoration and enhancement of native habitats and native rare plant populations. If a population is in decline, a restoration or enhancement program should be developed for the individual population and the associated habitat. Once a program has been developed and reviewed by the wildlife agencies, seed should be collected from the site to be placed back into the same site following habitat improvements. As long as a population is extant, it should not be revegetated with seed from another population.

If a rare plant population is extirpated and a restoration plan is developed to restore the species, the seed should be collected from the most genetically related population. If genetic information is available at that time, then these data should be used to determine which population is most closely related. If genetic information is unavailable, it should

be assumed that the closest geographic population is the most closely related. In some cases, there may be more than one population that is close geographically, and in this case, seed should be collected from all of the proximal populations.

3. How Many Seeds Should Be Sampled Per Population?

The literature also varies considerably in the recommendations made to address this question, with the primary issue being the appropriate degree of collecting. Without information on the genetic variability among the rare plant populations as well as within the populations, this question is difficult to address. In an effort to be conservative and protect the genetics of each population, collection amounts should also be conservative.

- Seeds should not be collected from more than 5% of the individuals at each population in any given year. If the population has less than 20 plants, then only a portion of the seeds on each plant should be collected. In this case, seeds should be partially collected from multiple individuals as opposed to collecting 100% of the seeds from one plant.
- When partially collecting seeds from plants, no more than 25% of the seeds on any individual should be collected.

If seed is partially collected from multiple plants, then the genetics will be maximized, while the impacts to the genetics of the entire population will be minimized.

4. Under What Circumstances Is A Multiyear Collection Plan Indicated?

Multiyear collection of rare plant seeds increases the chance that seed collection will have negative impacts on the genetics of the plant populations. Therefore, seeds should not be collected over multiple years unless previous propagation and revegetation efforts have failed. In the case of failed propagation and revegetation efforts, seed should not be collected again until there is adequate proof that the propagation and revegetation programs have the potential for success. Propagation and revegetation programs should be revised to address the failure of seed production and seedling survival before any more seed collection is allowed.

Seed that is rare should be propagated under greenhouse conditions to maximize the collected seed. With greenhouse propagation and proper restoration and enhancement methods, multiyear collection can usually be avoided.

B. SEED STORAGE

SHORT-TERM STORAGE

Short-term storage should be the preferred protocol for rare plant seed collections. Seeds can be stored for one to a few years while restoration and enhancement is conducted on the reintroduction site. The seed can be used for propagation either on-site or in a greenhouse, to be reintroduced in later generations.

Short-term storage methods (1 to 3 years) are less expensive and less complicated than longer-term storage methods. Short-term storage can be implemented with simple equipment and facilities and can be accomplished without the hazardous chemicals and processes involved in long-term storage. The following guidelines should be used when establishing a short-term seed storage facility.

- Thoroughly dry the seed to prevent mold and to insure reasonable longevity. Place fresh seeds in a warm (85°-100°F) dry place that is protected from dew for several weeks.
- Separate seed with pulps as soon as possible by soaking in water overnight. Once the seeds have soaked, a sieve can be used to rub the fruit against to separate the pulp from the seeds.
- Clean the seeds of chaff (leaves, twigs, empty pods, etc.) before storage.
- Store seeds in envelopes or paper bags for optimum air circulation. Never store seeds in plastic bags or containers unless the seeds are completely dried.
- Label bags (species name, collector's name, date of collection, location of collection) and place in a sealed container with several crystals of moth larvicide for a couple of days to kill any seed-eating insects or their eggs.
- Keep the storage facility cool and dry, maintaining stable temperatures and humidity. Temperature should be kept at 50°-60°F with 50% humidity or less, and the facility should have adequate air circulation. Normal refrigeration will lengthen seed storage time and should be used if seeds are to be stored for more than 3 years.

LONG-TERM STORAGE

If it is necessary to store rare plant seeds more than 3 years, a long-term seed storage facility will be needed. Long-term seed storage involves a more complicated drying process and cold storage below 0°F. This type of cold storage is done with expensive processing and refrigeration equipment and should be conducted by a facility specifically designed for this task.

Long-term seed storage requires an expert seed bank facility. There are two long-term seed bank facilities in southern California: (1) the Rancho Santa Ana Botanical Gardens Seed Bank and (2) the Seed Banking for Endangered Plant Conservation Project at the Wild Animal Park, which is a cooperative project between the San Diego Zoological Society and The Center for Reproduction of Endangered Species (ZSSD and CRES, 2002). However, the availability of seed storage for MSCP purposes is uncertain at both facilities.

C. SEED PROPAGATION

SEED TREATMENT

The seeds of some plant species require special treatments to improve the ability to germinate. Based on the literature reviewed, none of the treatments discussed below has been used on any of the MSCP covered species. However, some of these treatments may prove beneficial in future germination attempts.

1. Scarification. Mechanical scarification may be required for some species to rupture the seed coat and allow for the initiation of seed germination (Stidhand et al., 1980). Scarification can be accomplished using sandpaper, a file, a pin, or a knife. Large seeds are easily scarified mechanically, while small seed may require the hot water treatment (see below).
2. Hot water. For small to medium-sized seeds, the hot water treatment can be more effective than scarification (Emery, 1988). Water should be 180°-200°F, and the seeds should be left to cool and soak in the water for 12 to 24 hours. Seeds should be sowed after treatment and should not be stored again.
3. Charate. The char from burned plant stems and leaves has been shown to be good at neutralizing the germination inhibitors in seeds of several herbaceous species (Keeley and Keeley, 1982; Horton and Kraebel, 1955). Charate can be prepared by burning the stems of native woody plant species and then grinding the stems into a powder. This powder is then mixed with the seeds on the germination bed.
4. Fire. Some species have thick seed coats that are ruptured only for germination when subjected to the affects of fire (Went et al., 1952). Seeds should be sowed in a slightly moist bed with a layer of dry kindling on top. The kindling is burned, and once the seedbed cools, the bed should be watered thoroughly. Species of *Arctostaphylos* and *Ceanothus* have been shown to benefit from fire treatment (Carlson and Sharp, 1994; Keeley, 1995). Torrey pine is also known to benefit from fire, which helps to open the cone and release the seeds (Keeley and Zedler, 1998).

5. Acid. Acid treatments can also be used to break down especially thick seed coats. Seeds can be placed in sulfuric acid (H₂SO₄) and soaked at room temperature for a period of a few minutes to several hours, depending on the species (Mirov, 1945). The length of time required will vary from species to species (or between seed batches) and should be determined empirically. Following treatment, the seeds should be washed thoroughly before sowing. Acid treatment has been used to improve germination rates in species of *Arctostaphylos* (Quick and Quick, 1961).
6. Mulch. Mulch treatment can often hasten the microbial breakdown or softening of the seed coat. This method is what often occurs in the wild and can be a much slower process (Emery, 1988). Sown seeds should be covered with a thin layer (1"-2") of old composted shavings from native plant material and kept moist. After germination, the plants should be transplanted into the native habitat.
7. Water. For some species, the germination-inhibiting chemicals in the seed coat can be leached out by simply soaking the seeds in tap water for various lengths of time just prior to sowing. The length of time depends on the species, but changing the water every 12 to 24 hours will hasten the leaching process.
8. Cold Stratification. Cold stratification may be required with seeds that have internal dormancy because it helps to simulate cold winter conditions (Went et al., 1952). Cold stratification can be accomplished with a normal refrigerator at a temperature of 35°-41°F; with a few species, freezing the seeds at 28°-32°F is required. Seed must be kept moist during the treatment and should be checked often to determine if the seeds are starting to germinate. Depending on plant species, cold stratification can last from a few days to several months.
9. Photochemical Treatment. Some species have seeds that are light-sensitive and must receive light during germination. The intensity and duration of the light, as received by the seed's photoreceptors, interact with the available moisture and temperature to control germination (Cruden, 1974). Photochemical dormancy is most pronounced in freshly harvested seeds and usually disappears over time. When germinating seeds indoors to break photochemical dormancy, use a cool, white fluorescent light source for 8 hours per day. Seeds that require light should not be covered when sown, but merely watered-in.

SEED PRODUCTION IN THE GREENHOUSE

Because the covered MSCP plant species are rare and endangered, the threat of over-collecting seed from each population is high. To minimize the impacts of seed collection on each of the rare plant populations, seed quantities should be increased using greenhouse propagation. Table App.4-1 lists the number of seeds that a flower can

produce for each of the covered plant species. Although the number of seeds per flower varies greatly among the covered species, the potential number of seeds per individual is more than 100 per plant for every species listed in Table App.4-1. However, many of these seeds would fail to germinate in the wild under natural conditions. Germination and survival rates in the wild are much lower than under controlled conditions in the lab or greenhouse.

When grown under controlled conditions (lab or greenhouse), germination can be maximized and mortality can be minimized using the treatments discussed above. In addition, germinated plants can be grown in optimal conditions, which will produce plants that are much larger and healthier than those growing in the wild. Pollination can usually be achieved in the greenhouse using native and non-native pollinators or hand pollination, resulting in high seed production under greenhouse conditions (Hanson, pers. comm.). For most of the species listed in Table App.4-1, seed amounts can be exponentially increased in just a few generations without any additional impacts to the natural donor populations. A small amount of seed collected in 1 year can be turned into a large amount of seed in just a couple of years.

SEED REINTRODUCTION

Before seeds are reintroduced, the habitat at the restoration or enhancement site should be prepared for sowing. Rare and endangered seed should not be sowed into habitat that is disturbed by weed invasion, off-road activity, grazing, or other disturbance factors. The seeds of species listed in Table App.4-1 are too important to waste on a site that does not provide optimal conditions for germination and survival.

Rare plant seed should be reintroduced only into sites that are part of habitat restoration and enhancement projects. The areas for seed reintroduction should provide open viable soil with less than 5% weed cover. This will allow for high rates of germination and low rates of non-native plant competition. In some cases, native plant control will be required to provide adequate open habitat for the target rare plant species.

The field germination of sowed rare plant seeds can also be improved by hand-watering the sowed areas. Given the climate of southern California, rainfall can often be too unpredictable to insure high rates of germination and survival, and supplementary watering can improve this.

Finally, some species (especially perennial species) will benefit from germination and development under greenhouse conditions. Once the rare plants are healthy and established, they can be transplanted into the restored or enhanced native habitat. This method requires more care and time than sowing the seeds directly into the site, but for some species this may be needed to maximize the survivorship of the plants. The use of this method should be determined for each species and for each habitat restoration or enhancement project.

D. REFERENCES CITED

- Carlson, J.R. and W.C. Sharp. 1994. Germination of high elevation manzanitas. *Tree Planters' Notes* 26(3):10-11;25.
- City of San Diego. 1997. Multiple Species Conservation Program: City of San Diego MSCP Subarea Plan. March.
- Cruden, R.W. 1974. The adaptive nature of seed germination in *Nemophila menziesii*. *Aggr. Ecology* 55:1295-1305.
- Emery, D.E. 1988. *Seed Propagation of Native California Plants*. Santa Barbara Botanical Garden, Santa Barbara, CA.
- Falk, D.A. and K.E. Holsinger. 1991. *Genetics and Conservation of Rare Plants*. Center for Plant Conservation. Oxford University Press, New York, NY.
- Hanson, B. 2002. Personal communication with Bruce Hanson, Recon, on February 2.
- Hartman, H.T. and D.E. Kester. 1997. *Plant Propagation: Principles and Practices* (6th edition). Prentice Hall, Upper Saddle River, NJ.
- Hickman, J.C. (ed.). 1993. *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley and Los Angeles, CA.
- Horton, J.S. and C.J. Kraebel. 1955. Development of vegetation after fire in the chamise chaparral of Southern California. *Ecology* 36:244-262.
- Keeley, S.C. and J.E. Keeley. 1982. The role of allelopathy, heat, and charred wood on the germination of chaparral herbs. *Proceedings of Symposium on Dynamics and Management of Mediterranean-type Ecosystems*. USDA Forest Service General Technical Report PSW-58.
- Keeley, J.E. 1995. Seed germination and life history syndromes in the California chaparral. *Botanical Review* 57:81B116.
- Keeley, J.E. and P.H. Zedler. 1998. Evolution of life histories in *Pinus*. In Richardson, D.M. (ed.), *Ecology and Biogeography of Pine*. Cambridge University Press, Cambridge, UK.
- McMillan, S. and Conservation Biology Institute (CBI). 2002. 2001 MSCP Rare Plant Survey and Monitoring Report. February.
- Mirov, N.T. 1945. Additional data on collecting and propagating the seeds of California wild plants. USDA Forest Service, California Forest and Range Experiment Station, Forest Research Notes No. 21.

- Mortlock, W. 1998. Native seed storage for revegetation. Flora Bank Program, Australia. www.florabank.org.
- Ogden. 1996. Biological Monitoring Plan for the Multiple Species Conservation Program. Prepared for the City of San Diego, California Department of Fish and Game, and U.S. Fish and Wildlife Service. January 25.
- Quick, C.R. and A.S. Quick. 1961. Germination of *Ceanothus* seed. Madroño 16:23B30.
- Rancho Santa Ana Botanical Gardens (RSA). 2002. RSA Seed Bank. Clairemont, CA. www.rsabg.org/seedbank.
- Stebbins, G.L. and A. Day. 1967. Cytogenetic evidence for long continued stability in the genus *Plantago*. Evolution 21:409-428.
- Stidhand, N.D., R.M. Ahring, J. Powell, and P.L. Claypool. 1980. Chemical scarification, moist prechill, and thiourea effects on germination of 18 shrubs. Journal of Range Management 33:115-118.
- Went, F.W., G. Juhren, and M.C. Juhren. 1952. Fire and biotic factors affecting germination. Ecology 33:351-364.
- Zoological Society of San Diego (ZSSD) and Center for Reproduction of Endangered Species (CRES). 2002. International Conservation Project: Seed Banking for Endangered Plant Conservation. San Diego, California. www.sandiegozoo.org/conservation/fieldproject_seed_bank.