Biological Monitoring Plan for the Multiple Species Conservation Program

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1.0 INTRODUCTION

The Multiple Species Conservation Program (MSCP) is a comprehensive habitat conservation planning program which addresses multiple species habitat needs and the preservation of natural communities in southwestern San Diego County. Jurisdictions and special districts participating in the MSCP have prepared or are preparing subarea plans which identify preserve areas and compatible land uses within and adjacent to preserves. It is important to maintain biological values of preserve areas over time by reducing human-related causes of species extirpations. Biological monitoring will evaluate whether the preserve system is meeting subarea plan conservation targets for covered plant and animal species and their habitats, identify threats to covered species and habitats, and help prioritize management needs. Habitat management plans prepared as part of subarea plans should coordinate with this biological monitoring plan to achieve maximum efficiency. In addition to this biological monitoring program, local jurisdictions and special districts will provide an annual accounting of the amount, type, and location of habitat conserved and destroyed (taken) by permitted land uses and other activities.

1.1 RESPONSIBILITIES AND COORDINATION OF EFFORTS

The MSCP participating jurisdictions and special districts have prepared or are preparing habitat management plans and are responsible for implementing these plans. The U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG) will oversee the biological monitoring program. A critical factor in the success of the biological monitoring program will be the coordination of monitoring efforts throughout the MSCP study area to ensure spatial and temporal consistency in data collection and analysis, and to allow compilation of data from different sources into comprehensive monitoring reports every three years. It also will be important to establish a centralized data storage repository, with data accessible to biological monitors, researchers, and reviewers, and to coordinate with monitoring programs in other subregions.

1.2 BIOLOGICAL MONITORING OBJECTIVES

Biological monitoring focuses on detecting changes in habitat quality and population trends in those habitats and plant and animal species considered covered by the MSCP. The successful maintenance of these resources will be measured against specific habitat acreages and/or species populations, as documented in the subarea plans and implementing

agreements of participating jurisdictions and special districts. Permit holders and the wildlife agencies will have detailed maps providing locations of habitats and covered species populations included in the preserve and/or targeted for conservation.

Specific biological monitoring objectives include the following:

1. Document the protection of habitats and covered species as specified in subarea plans and implementing agreements. This will be accomplished by tracking permanent habitat losses (Section 3.2) and covered species (Section 5.0).

2. Document changes in preserved habitats or preserved populations of covered species. This will be accomplished through monitoring temporary habitat changes (Section 3.3), habitat value (Section 3.4), and covered species (Section 5.0).

3. Describe new biological data collected. such as new species sightings and information on wildlife movements and corridors. Although not the focus of the monitoring program, collection of new biological data will occur during corridor monitoring (Section 4.0) and covered species monitoring (Section 5.0). This information will be disseminated through the reporting program (Section 6.0).

4. Evaluate impacts of land uses and construction activities in and adjacent to the preserve. Impact evaluation will occur on both a landscape level (tracking permanent habitat losses, Section 3.2) and a local level (monitoring habitat value, Section 3.4; corridor monitoring, Section 4.0; covered species monitoring, Section 5.0). Results of this evaluation will be presented in periodic reports (reporting program, Section 6.0) and correcting actions implemented through the remediation and adaptive management program (Section 7.0).

5. Evaluate management activities and enforcement difficulties. An assessment of the effectiveness of specific management and enforcement activities will occur through the habitat monitoring (Section 3.0), corridor monitoring (Section 4.0), and covered species monitoring (Section 5.0) components of this program. It should be noted that ongoing efforts of the preserve manager(s) will also assess these activities. Management and enforcement issues will be discussed in the reporting program (Section 6.0), along with remediation or adaptive management strategies, as necessary (Section 7.0).

6. Evaluate funding needs and the ability to accomplish resource management goals. An assessment of funding needs and management goals will be provided every three years, as specified in the reporting program (Section 6.0). Accomplishment of management goals will be measured against specific habitat and species conservation targets set forth in subarea plans and implementing agreements.

Because of budgetary limitations, the highest priority monitoring tasks will be those (1) that provide direct evidence of human-induced declines in key biological resources and (2) for which corrective or remedial management actions are possible. Refer to Section 7.0 for remediation and adaptive management in those cases where negative or declining trends are identified.

1.3 EXISTING MONITORING EFFORTS

Several existing monitoring programs are currently being conducted in the MSCP study area. The MSCP biological monitoring program attempts to complement existing monitoring efforts by (1) monitoring biological resources not already covered by these programs and (2) utilizing the same or similar study sites and methodologies, to the degree feasible. When existing monitoring efforts are terminated, the wildlife agencies will evaluate the need to incorporate these monitoring efforts into the MSCP monitoring program and/or re-prioritize monitoring efforts to continue assessing these resources over time. Existing programs include the following:

1. Autecological' Studies of Coastal Sage Scrub Birds and Small Mammals. This study is being conducted by U.C. Riverside, under contract to the CDFG. This study includes 30 sites in Riverside, Orange, and San Diego counties. Sampling sites within the proposed preserve include the San Diego Wild Animal Park (12 sampling points), Sweetwater River (15 sampling points), and possibly, Marron Valley (sampling points not yet determined). This study involves bird censusing and small mammal trapping.

2. Autecological Studies of Coastal Sage Scrub Herpetofauna. This study, which is restricted to San Diego County, is being conducted by U.C. San Diego, under contract to the CDFG. Sampling sites within (or near) the proposed preserve areas include Torrey Pines State Reserve, Torrey Pines Extension, the U.C. Elliott

Reserve, San Diego Wild Animal Park, Little Cedar Ridge (Otay Mountain), Rancho San Diego (same as Sweetwater site, above), and Chula Vista. Although this study is geared towards herpetofauna, it will also collect incidental data on small mammals.

3. Post-fire Recovery of Coastal Sage Scrub. This study is being conducted by the U.S. Forest Service Pacific Southwest Research Station and Pomona College, under contract to the CDFG. Although 4 sites are located within San Diego County, the only sampling location in the MSCP preserve is in the San Diego Wild Animal Park. This objective of this study is to collect data that can be applied towards adaptive management. Burned and unburned stands of coastal sage scrub will be compared over time to determine minimum burn frequencies needed to maintain the desirable composition, cover, and other attributes of the scrub vegetation.

4. Audubon Monthly Bird Surveys. The monthly bird surveys are censuses that provide an indication of long-term trends of bird populations. San Diego County survey locations in or near the MSCP preserve include Mission Bay, Los Peñasquitos Lagoon, and San Dieguito Lagoon.

5. Vernal Pool Studies. Biologists at San Diego State University (SDSU) are currently conducting short- and long-term monitoring of several vernal pools or vernal pool complexes (e.g., Miramar Road, Del Mar Mesa, Landmark pools, Otay Mesa (west of Cactus Road), and Murphy Canyon). The Environmental Trust (TET) has acquired the responsibilities for monitoring and managing (in perpetuity) some of the vernal pools on Otay Mesa *(326* series). Additional pools in the City of San Diego and County of San Diego and selected pools in other jurisdictions will be monitored in conjunction with the proposed National Wildlife Refuge, when established.

Additional short- or long-term monitoring efforts that are proposed or currently in progress include the biota monitoring program for Phase 2 of the Otay Ranch Resource Management Plan, long-term monitoring studies associated with the San Diego County Water Authority, a 5-year monitoring program for the Rancho del Rey development, riparian bird surveys conducted by San Diego State University (San Diego River, Sweetwater River, Tijuana River Estuary), breeding bird surveys conducted by the USFWS (25-mile roadside

census), least tern and clapper rail surveys conducted by the USFWS and CDFG, and Christmas bird counts conducted by the Audubon Society.

1.4 LIMITATIONS OF MONITORING PROGRAM

The intensity and scale of any monitoring program is ultimately limited by the priorities and resources (funding and staff) made available and considered sufficient to accomplish the stated goals of the program. Since the proposed preserve network may encompass over 164,000 acres, a sampling design that monitors representative sites and focal species within the preserve network was deemed a practical approach to follow. Limitations of the proposed monitoring program include:

- Sampling plots may not be completely representative of the spatial variability found throughout the preserve, thus limiting extrapolation of monitoring data to the unmonitored portion of the preserve network.

- Focal species monitored at selected sites are assumed to act as indicators of preserve function and are assumed to act as surrogates for other covered species not monitored.

- The sampling interval of each plot ranges from 1 to 5 years. Ability to detect adverse human-caused change or downward trends in population size may require time-series data of relatively long duration. For longer sampling intervals, some temporal variation will not be measured.

- Qualitative measures of habitat characterization are less precise/accurate than detailed (and time-consuming) quantitative measures.

- Temporal incorporation of sites into the preserve will complicate data collection and analysis.

2.0 MSCP COVERED SPECIES

Table 2-1 presents a list of the 87 MSCP covered species that will be protected by the ultimate MSCP preserve configuration and implementation of habitat management plans. Species location, by jurisdiction, is also included in Table 2-1. In general, this table can be used to predict which jurisdictions will be responsible for individual covered species populations. Because the MSCP focuses on protecting key or core populations of species, however, presence alone does not always indicate jurisdictional responsibility in terms of long-term protection or conservation. Details on specific plant or animal populations that are covered under the MSCP will be included in subarea plans and implementing agreements, and will be delineated on maps. Monitoring of covered species is prioritized in this document, and focuses on key indicator species (e.g., gnatcatcher) and/or species assessed as being conserved under moderate or high risk conditions. This monitoring program will be used to identify and prioritize management activities for specific species and habitats.

Table 2-1

MSCP COVERED SPECIES OCCURRENCES BY JURISDICTION

SCIENTIFIC NAME	COMMONNAME	JURISDICTION[1,2]											
PLANTS		CV	CD	DM	EC	IB	LM	LG	NC	PO	SD	SN	CO
Acanthomintha ilicifolia	San Diego thorn-mint	E								-	-		-
Agave shawii	Shaw's agave					-					-		
Ambrosia pumila	San Diego ambrosia	-							E	E	-	-	-
Aphanisma blitoides	Aphanisma		-	E		-					-		
Arctostaphylos glandulosa var. *crassifolia*	Del Mar manzanita			-							-		-
Arctostaphylos otayensis	Otay manzanita												-
Astragalus tener var. *titi*	Coastal dunes milk vetch		E										
Baccharis vanessae	Encinitas baccharis									-	-		-
Brodiaea filifolia	Thread-leaved brodiaea												-
Brodiaea orcuttii	Orcutt's brodiaea	-								-	-		•
Calamagrostis densa	Dense reed grass									-			-
Calochortus dunnii	Dunn's mariposa lily												-
Caulanthus stenocarpus	Slender-podjewel flower									-	-	E	-
Ceanothus cyaneus	Lakeside ceanothus									E			•
Ceanothus verrucosus	Wart-stemmed ceanothus			-							-		-
Cordylanthus maritimus ssp. *maritimus*	Salt marsh bird's-beak	-	-			-			-		E		
Cordylanthus orcuttianus	Orcutt's bird's-beak					-					-		-
Corethrogyne filaginifolia var. *linifolia*	Del Mar Mesa sand aster			-							-		-
Cupressus forbesii	Tecate cypress												-
Dudleya brevifolia	Short-leaved dudleya			•							-		
Dudleya variegata	Variegated dudleya	E	•							-	-	E	-
Dudleya viscida	Sticky dudleya												-
Ericameria palmeri ssp. *palmeri*	Palmer's ericameria									-	-		-
Eryngium aristulatum var. *parishii*	San Diego button-celery	E									-		-
Erysimum ammophilum	Coast wallflower										-		
Ferocactus viridescens	San Diego barrel cactus	-		-		E	-	-	-	-	-	-	-
Hemizonia conjugens	Otay tarplant	-									-		-
Lepechinia cardiophylla	Heart-leaved pitcher sage									-			E
Lepechinia ganderi	Gander's pitcher sage												-
Lotus nuttallianus	Nuttall's lotus		-	E		-			E		E		

Table 2-1 (Continued)

MSCP COVERED SPECIES OCCURRENCES BY JURISDICTION

SCIENTIFIC NAME	COMMON NAME	JURISDICTION[1,2]											
		CV	CD	DM	EC	IB	LM	LG	NC	PO	SD	SN	CO
Mahonia nevinii	Nevin's barberry												-
Monardella hypoleuca ssp. *lanata*	Felt-leaved rock-mint												-
Monardella linoides ssp. *viminea*	Willowy monardella									-	-	-	-
Muilla clevelandii	San Diego goldenstar	E								E	-	E	-
Myosurus minimus ssp. *apus*	Little mousetail	E									-		-
Navarretia fossalis	Prostrate navarretia	E									-		-
Nolina interrata	Dehesa bear-grass	-											-
Opuntiaparryi var. *serpentina*	Snake cholla	-				-					-		-
Orcuttia californica	California orcutt grass	E									-		-
Pinus torreyana ssp. *torreyana*	Torrey pine			-							-		
Pogogyne abramsii	San Diego mesa mint										*	•	-
Pogogyne nudiuscula	Otay Mesa mint	E									-		-
Rosa minutifolia	Small-leaved rose										-		E
Satureja chandleri	San Miguel savory												-
Senecio ganderi	Gander s butterweed												-
Solanum tenuilobatum	Narrow-leaved nightshade									E	E	E	-
Tetracoccus dioicus	Parry's tetracoccus									E			-
ANIMALS													
Mitoura thornei	Thorne's hairstreak butterfly												-
Panoquina errans	Salt marsh skipper butterfly	-	E	-		-			-		-		*
Streptocephalus woottoni	Riverside fairy shrimp	-									*	E	-
Branchinecta sandiegoensis	San Diego fairy shrimp			-							-		-
Bufo microscaphus californicus	Arroyo southwestern toad	E		E	E		E	E		E	E	E	E
Clemmys marmoratapallida	Southwestern pond turtle	-		E					E	E		E	-
Rana aurora draytoni	California red-legged frog	E		E					E	E		E	E
Cnemidophorus hyperythrus beldingi	Orange-throated whiptail	»		-	-		•	•	•	•	•	•	•
Phrynosoma coronatum blainvillei	San Diego homed lizard	-		-	-		•	•	•	•	•	•	•
Accipiter cooperii	Cooper's hawk	4		-	-		-			*	-	t	-
Agelaius tricolor	Tricolored blackbird	-		E			E	E		-	-	E	-
Aimophila ruficepscanescens	California rufous-crowned sparrow	*		•	•	•	•	•	•	•	•	•	•
Ammodramus savannarum	Grasshopper sparrow	- *		E	E		E	E	E	-	-	-	-
Aquila chrysaetos	Golden eagle	*		E	-		E	E	E	-	-	-	-
Buteo regalis	Ferruginous hawk	-		E	E		E	*E*	E	-	-	-	*

Table 2-1 (Continued)

MSCP COVERED SPECIES OCCURRENCES BY JURISDICTION

SCIENTIFIC NAME	COMMON NAME	JURISDICTION[1,2]											
ANIMALS		CV	CD	DM	EC	IB	LM	LG	NC	PO	SD	SN	CO
Buteo swainsoni	Swainson's hawk	-		E	E		E	E	E	-	-	-	-
Campylorhynchus brunneicapillus couesi	Coastal cactus wren	-		E	-	-	-	E	E	E	-	-	-
Charadrius alexandrinus nivosus	Western snowy plover	-	-	E		-			E		-		-
Charadrius montanus	Mountain plover	E				-					E		-
Circus cyaneus	Northern harrier	-		E	E	-	E	E	E	E	-	-	-
Egretta rufescens	Reddish egret	E		E		-			E		E		E
Empidonax traillii extrimus	Southwestern willow flycatcher	E		E		E				E	•	E	-
Branta canadensis	Canada goose												-
Falco peregrinus anatum	American peregrine falcon	-	-	E	E	-				E	-	E	-
Haliaeetus leucocephalus	Bald eagle	E				-				E	-	E	-
Numenius americanus	Long-billed curlew	-	-	-		-			-		-		-
Passerculus sandwichensis beldingi	Belding's Savannah sparrow	-	E	-		-					-		-
Passerculus sandwichensis rostratus	Large-billed Savannah sparrow	-	E	-		-					-		-
Pelecanus occidentalis californicus	California brown pelican	-	-	-		-					-		-
Plegadis chihi	White-faced ibis	E		E		E					-		E
Polioptila californica californica	Coastal California gnatcatcher	-		-	-	-	-	-	-	-	-	-	-
Rallus longirostris levipes	Light-footed clapper rail	-		E.		-			E		-		-
Sialia mexicana	Western bluebird	-		E	-	E	E	E		-	-	E	-
Speotyto cunicularia hypugaea	Burrowing owl	-	-	E	E	E			E	E	-	E	-
Sterna antillarum browni	California least tern	-	-	E		-			-		-		-
Sterna elegans	Elegant tern	-	E	E		-			-		-		-
Vireo bellii pusillus	Least Bell's vireo	-		E		-				E	-	-	-
Felis concolor	Mountain lion	-		E	-	-	E		E	-	-	-	-
Odocoileus hemionus fuliginata	Southern mule deer	-		-	-	-	-	-	-	-	-	-	-
Taxidea taxus	American badger	E			E	E-				E	E	E	E

1 CV = Chula Vista; CD = Coronado; DM = Del Mar; EC = El Cajon; IB = Imperial Beach; LM = La Mesa; LG = Lemon Grove; NC = National City; PO = Poway; SD = City of San Diego; SN = Santee; CO = County of San Diego (i.e., within MSCP study area).

2 • = Verified occurrence (not all verified occurrences are depicted on MSCP sensitive species maps); E = Expected occurrence and/or reported but unverified occurrence.

3.0 HABITAT MONITORING

Habitat monitoring will focus on three areas: (1) permanent habitat loss as a result of development; (2) temporary habitat changes as a result of natural events (e.g., fires and flooding); and (3) loss of habitat value as a result of edge effects or other human-related impacts.

3.1 BASELINE INVENTORY

The MSCP vegetation map was based primarily on 1990 color infra-red aerial photography. Additional data sources included high altitude photographs and existing environmental documentation (both digital data and hardcopy sources). Through a "heads up" digitizing process, on-screen satellite imagery from the same time period as the color infra-red aerial photos was used to input the vegetation communities into the Geographic Information System (GIS). For the most part, limited field-verification of vegetation maps was conducted; however, detailed verification was conducted in selected portions of the study area that had been identified as comprising gaps in the database. Refinements to the vegetation map were made based on comments received on the draft MSCP maps, and were often based on post-1990 field work. As a result, there are localized updates to the 1990 base map that reflect more recent data.

3.2 TRACKING PERMANENT HABITAT LOSSES

Monitoring of landscape-level habitat changes within targeted preserve areas will focus on changes from vegetation to urban and agricultural development, and will be measured against the baseline MSCP vegetation map. Local jurisdictions will track habitat loss within their jurisdictions through their permitting process. This subregional monitoring program will provide an MSCP-wide assessment of habitat acreage lost. This tracking effort will achieve the plan objectives of documenting the protection of habitats, evaluating the impacts of land uses and construction activities in and adjacent to the preserve, and evaluating enforcement difficulties in the preserve.

3.2.1 Methodology

The San Diego Association of Governments (SANDAG) is updating the 1990 vegetation information to reflect 1995 conditions, using a multi-date satellite image change detection

model (1990 and 1995 imagery) and 1995 land use coverages for urban and agricultural areas.

Currently, change areas are automatically identified from differences between multi-date panchromatic (black-and-white) satellite imagery. This process identifies areas that have changed, but does not identify the type of change. Change areas are then overlaid with the appropriate land use coverages or color infra-red satellite imagery to determine areas of urban and agricultural change, and appropriate modifications are made to the vegetation map. This process is largely a GIS function, but does require review of changed areas by a biologist to ensure that vegetation is not erroneously classified as developed. Problematic polygons are typically vegetation to agriculture changes. The review process by the biologist includes examination of on-screen imagery and/or hardcopy plots, and limited field-verification efforts, as necessary.

3.2.2 Schedule

SANDAG is currently in the process of updating the 1990 vegetation database to 1995 conditions; the updated vegetation map will be finalized in 1996. SANDAG envisions that they will continue to perform a regional-level land use change detection analysis at approximately five-year intervals, given existing levels of funding. Changes in land cover in habitat areas (i.e., urban development or agriculture) will be documented as part of this process.

3.2.3 Products

Products of this analysis will include an updated vegetation map (scale 1" = 2000') that reflects habitat-to-development changes, and revised preserve acreage figures.

3.2.4 Cost

Costs associated with this task (Tracking Permanent Habitat Loss) are not included in this monitoring plan.

3.3 MONITORING TEMPORARY HABITAT CHANGES

Monitoring temporary habitat changes (e.g., from fire and floods) can be useful in interpreting vegetative trends, thereby ensuring that habitats are not undervalued during "point-in-time" assessments. Monitoring temporary changes also can identify areas in need of active management and provide baseline information for regional vegetation ecology studies. This monitoring effort will achieve the plan objective of documenting change in preserved habitats. Monitoring successional changes in vegetation communities is not proposed as part of this program.

3.3.1 Methodology

3.3.1.1 Fire

Temporary habitat changes resulting from fire can be monitored through post-fire mapping of burned areas, incorporating mapped information into a regional GIS burn layer, and correlating this information with the vegetation map. The primary source for burn data is the California Department of Forestry (CDF). The CDF maps all fires that are 40 acres or greater in size, and has been conducting bum mapping since 1910. Data from 1910 to 1979 are currently on acetate overlays, while data from 1980-1993 have been input into the County of San Diego's GIS and are available in digital format at SANDAG. Data from 1994 to the present are not yet in digital format, but can be obtained in hardcopy form from the CDF. The automated change detection methodology (Section 3.2.1) may also be useful in identifying changes due to fire.

Post-fire field monitoring is not included as a component of the biological monitoring plan. Habitat management plans for each subarea will include fire management plans, and these fire management plans will be the vehicle for any field monitoring that is deemed necessary or desirable. Field monitoring conducted as part of the habitat management plans may include assessments of the post-fire recovery of specific habitats or sensitive species.

3.3.1.2 Floods

Flooding along major drainages may result in the temporary loss of riparian habitat, which provides habitat for several sensitive bird species and cover for additional wildlife species that use drainages as movement corridors. Flooding is a natural component of riverine

ecosystems, however, and is important for rejuvenation of the vegetation. As with fires, it is important that temporary conditions associated with flooding, such as bare channels, are not misinterpreted and the habitat undervalued.

Changes associated with flooding (i.e., vegetation to scoured, bare channels) are often dramatic and easily detected from aerial photographs. These types of changes would also be apparent on the panchromatic satellite imagery used in the change detection process. Results of the change detection process will be used to identify changes associated with flooding. Change areas identified along major drainages will be reviewed by a biologist to determine the correct vegetation classification for the changed polygon. This review process will include examination of on-screen imagery and/or hardcopy plots, and limited field-verification.

3.3.2 Schedule

Assessment of temporary habitat changes will be conducted at five-year intervals, in conjunction with the vegetation-to-development change detection process.

3.3.3 Products

Products from monitoring of temporary habitat changes within the preserve system will include (1) a digital burn layer and (2) updates to the baseline vegetation map.

3.3.4 Cost

Costs associated with these tasks are strictly for a biologist to review change areas, direct GIS personnel in on-screen modifications, and conduct limited field-verification efforts, as necessary. It is assumed that SANDAG will be responsible for obtaining satellite imagery and other photography, providing personnel to identify potential change areas, making changes (with the assistance of a biologist), and updating the GIS vegetation database. The cost for a biologist (per monitoring period and in 1996 dollars) is approximately $6,000 for reviewing changes associated with burns and flooding. This includes 80 hours of office time and 40 hours of field time. If SANDAG does not conduct an assessment of temporary habitat changes, it is estimated that an additional $15,000 - $20,000 would be required for someone else to conduct this work.

3.4 MONITORING HABITAT VALUE

Vegetation monitoring for habitat value is designed to identify adverse changes in the vegetation over time as a result of human activities. Detection of such changes may warrant active management. Habitat value monitoring will focus on potential edge-affected areas, although selected habitats within the core of the preserve also will be monitored to provide a comparison to edge areas. Prioritized habitats for monitoring include coastal sage scrub (including maritime succulent scrub), southern maritime chaparral, and grassland. As monitoring budgets allow, additional habitat types such as oak woodland, riparian habitats, and chaparral should be monitored, as well. It is assumed that vernal pools will be adequately assessed in association with other existing or proposed monitoring programs. When existing or proposed vernal pool monitoring efforts are terminated, the wildlife agencies will evaluate the need to re-prioritize monitoring efforts to continue assessing these resources over time. This monitoring effort will achieve the plan objectives of documenting changes in preserved habitats, evaluating the impacts of land uses and construction activities in and adjacent to the preserve, and evaluating management activities and enforcement difficulties in the preserve.

3.4.1 Methodology

The primary objective of long-term habitat monitoring is to identify temporal trends in vegetative conditions that may require active management. Although quantitative monitoring using a large number of transects is the most precise way to identify trends, it is labor-intensive and cost-prohibitive when applied to an area the size of the MSCP preserve. It is therefore recommended that an alternative plot method be used to assess vegetative trends over time. This alternative method will utilize a combination of cover class estimations and direct counts within plots, allow a larger number of locations to be monitored, and allow monitoring to occur on a more regular basis. This plot method will, in effect, function as an early indicator of declining vegetative conditions.

It is assumed that temporal trends in vegetation can be extrapolated beyond the boundaries of the sampling sites. It is important to note, however, that habitat value monitoring is not intended to be representative of habitat quality and condition throughout the entire preserve, nor is it intended to identify all areas of habitat disturbance. Although some disturbance events will certainly be identified during habitat monitoring, the overall assessment of habitat quality and condition within the entire preserve area will generally be accomplished

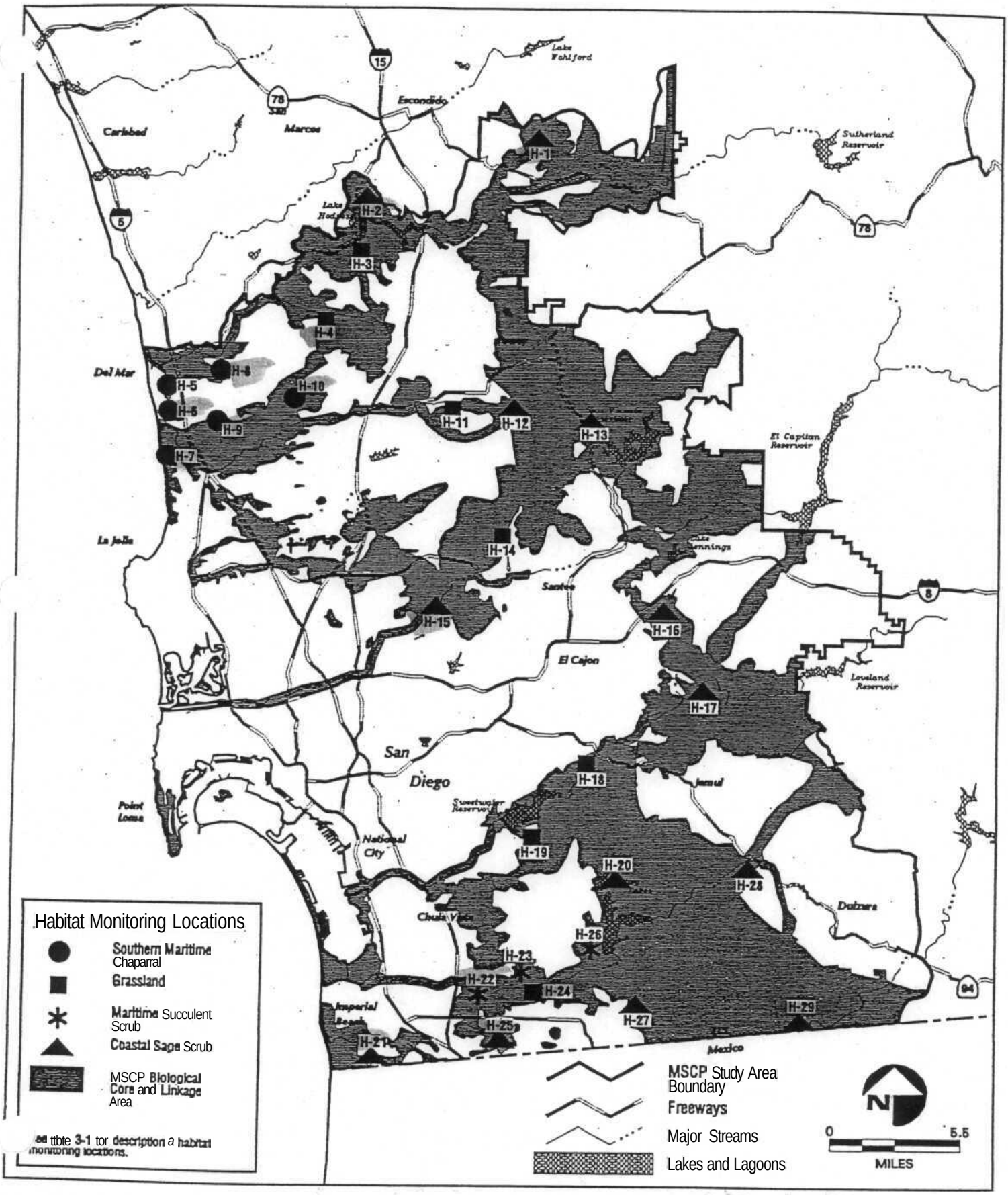
by a combination of habitat monitoring through satellite imagery (Section 3.2) and on-ground visual inspections by the habitat reserve manager as part of the habitat management program.

The objective of habitat monitoring is to detect changes over time, as measured against baseline conditions rather than any pre-set "success criteria." In most cases, a determination of significant adverse declines in habitat condition will be made only after two or more consecutive monitoring periods indicate declining conditions. Furthermore, data will need to be assessed in relation to climate and rainfall factors to ensure that declines are not due to environmental parameters. The type and cause of habitat decline will determine the type and extent of management activities that are applied.

This section outlines tasks necessary to conduct the habitat value monitoring program. These include establishing specific monitoring plots within general monitoring locations, and establishing permanent point locations for sampling; acquiring appropriately-scaled base maps; refining the baseline vegetation map; establishing photodocumentation points; field monitoring; and data collection and analysis. It should be noted that not all monitoring parameters can be identified within the context of this plan, since some parameters will be dependent on a detailed assessment of field conditions.

3.4.1.1 Habitat Monitoring Locations

Locations for long-term vegetation monitoring are depicted in Figure 3-1 and summarized in Table 3-1. For the most part, habitat monitoring locations will be used for other types of monitoring, as well. Of the 29 habitat monitoring locations that have been identified, 13 are for coastal sage scrub, 7 are for grasslands, 6 are for southern maritime chaparral, and 3 are for maritime succulent scrub. Although the objective is to monitor all identified locations, some redundancy has been incorporated into the selection of monitoring locations to accommodate both access issues and potential limitations on monitoring budgets and/or personnel. Within each habitat category, monitoring locations can be prioritized, if needed. Considerations for prioritizing monitoring locations should include the following: (1) adequate geographic representation of the habitat type; (2) need for replicate locations; (3) presence of other types of monitoring at the same location; and (4) sensitivity/priority of other types of monitoring.



See table 3-1 for description of habitat monitoring locations.

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FIGURE

3-1

Habitat Monitoring Locations

04/19/96

Table 3-1

HABITAT MONITORING LOCATIONS[1]

MONITORING LOCATION[2]	GENERAL LOCATION	HABITAT	OTHER MONITORING[3,4]
H-1	San Diego Wild Animal Park	Coastal Sage Scrub	Wildlife (C-4)
H-2	Lake Hodges	Coastal Sage Scrub	Wildlife (C-3)
H-3	Eastern Santa Fe Valley/4-S Ranch	Grassland	Wildlife (C-2)
H-4	Santa Fe Valley	Grassland	Linkage (L-4)
H-5	Del Mar Heights (Crest Canyon)	Southern Maritime Chaparral	Plants (P-3)
H-6	Torrey Pines State Reserve Extension	Southern Maritime Chaparral	Plants (P-6)
H-7	Torrey Pines State Reserve	Southern Maritime Chaparral	Plants (P-7)
H-8	San Dieguito River Bluffs	Southern Maritime Chaparral	Plants (P-5)
H-9	Carmel Mountain	Southern Maritime Chaparral	Plants (P-8)
H-10	Del Mar Mesa	Southern Maritime Chaparral	Plants (P-10)
H-11	Poway	Grassland	
H-12	South Poway	Coastal Sage Scrub	Wildlife (C-10)
H-13	Northwest San Vicente Reservoir	Coastal Sage Scrub	Wildlife (C-11)
H-14	Sycamore Canyon	Grassland	Plants (P-15)
H-15	Mission Trails Regional Park	Coastal Sage Scrub	Wildlife (C-13)
H-16	Lakeside/Crest	Coastal Sage Scrub	Wildlife (C-17)
H-17	McGinty Mountain and Vicinity	Coastal Sage Scrub	Wildlife (C-18)
H-18	Rancho San Diego-Campo Village South	Grassland	
H-19	San Miguel Mountain	Grassland	Plants (P-19), Wildlife (R-5)
H-20	Southwest Jamul Mountains	Coastal Sage Scrub	Wildlife (C-23)
H-21	Goat Canyon-Spooner's Mesa	Coastal Sage Scrub	Plants (P-23), Wildlife (C-29)
H-22	Otay River Valley/West Otay Mesa	Maritime Succulent Scrub	Plants (P-25)
H-23	Wolf Canyon	Maritime Succulent Scrub	Plants (P-27), Wildlife (C-25)
H-24	Otay River West	Grassland	Plants (P-28)
H-25	Spring Canyon	Coastal Sage Scrub	Plants (P-26), Wildlife (C-30)
H-26	Lower Salt Creek	Maritime Succulent Scrub	Plants (P-31), Wildlife (C-26)
H-27	East Otay Mesa	Coastal Sage Scrub	Plants (P-32), Wildlife (C-28)
H-28	Northeast San Ysidro Mountains	Coastal Sage Scrub	Plants (P-35), Wildlife (C-24)
H-29	Marron Valley	Coastal Sage Scrub	Plants (P-34), Wildlife (C-31)

1 Includes only priority habitat types.

2 Refer to Figure 3-1 for a depiction of habitat monitoring locations.

3 Refers to other types of monitoring that may occur at the same location; see Rgures 4-1, 5-2, and 5-6.

4 Under wildlife, C = Coastal sage scrub plots for gnatcatcher and cactus wren. R = Raptor monitoring locations.

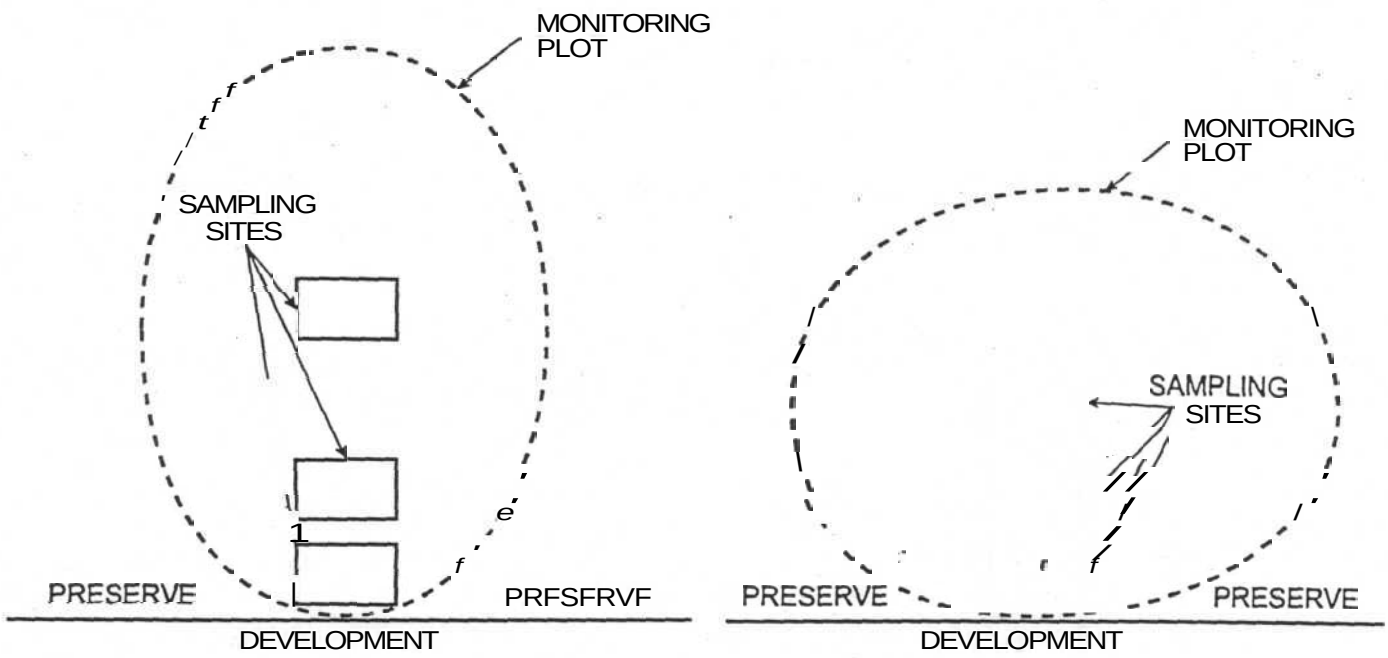
Monitoring locations shown in Figure 3-1 are generalized and represent habitat patches of varying sizes. In actuality, a monitoring "plot" will be established within each of the generalized monitoring locations shown in Figure 3-1 for habitat monitoring. These monitoring plots will range from approximately 50-200 acres in size, depending on the amount of habitat available. In general, monitoring plots in coastal locales will be smaller than monitoring plots in inland areas. This is a direct correlation of the amount of habitat fragmentation (and thus, smaller habitat patches) in the more coastal, urbanized portions of the preserve versus larger, more intact blocks of habitat toward the interior.

Because the primary objective of the monitoring program is to detect temporal changes in vegetative conditions relative to distance from preserve edges, the monitoring plot will be divided (stratified) into three areas or sampling sites, as described in Section 3.4.1.2 and depicted in Figure 3-2. The shape of the monitoring plot (and thus, the sampling sites) may vary, depending on the shape of the habitat patch and its position relative to development or other potential sources of edge effects (Figure 3-2). Exact position and shape of the monitoring plots will be determined during the implementation phase of the monitoring program.

Once monitoring plots have been established, their exact coordinates will be mapped onto orthophotographs and input into a GIS. If orthophotographs are not available, coordinates could be registered in the field using a Global Positioning System (GPS). Detailed field notes should record the methodology for selecting monitoring plots so that subsequent plots in other areas of the preserve will be established in a consistent manner.

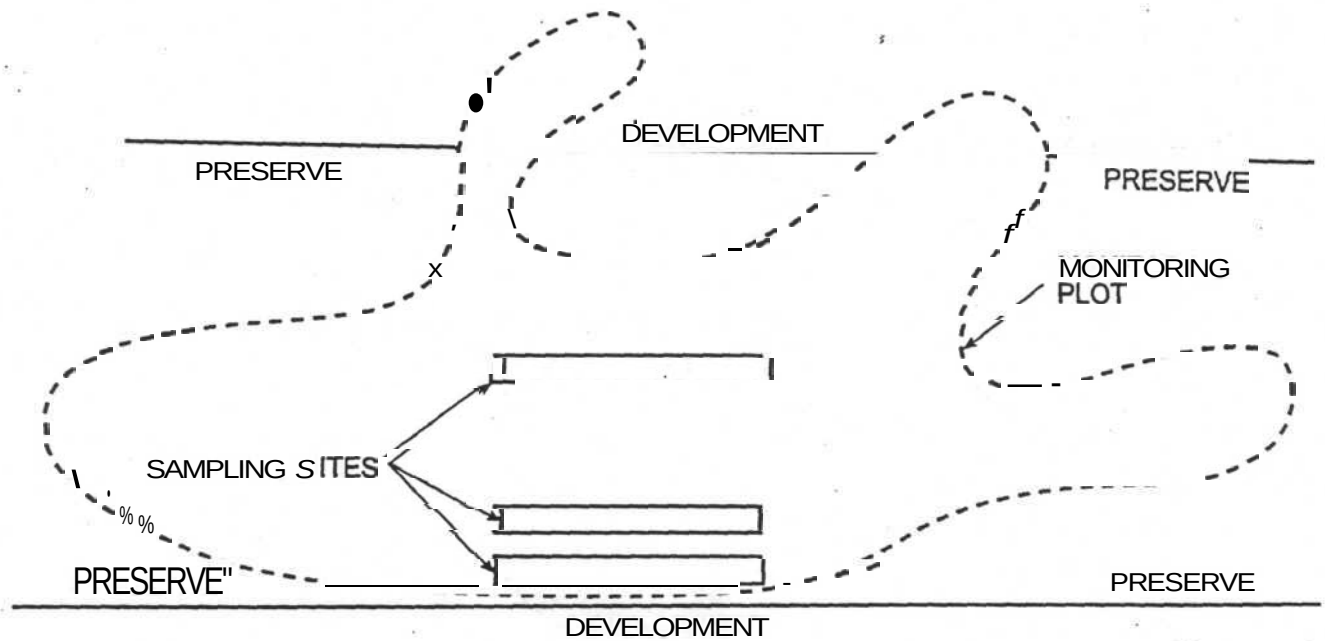
3.4.1.2 Sampling Sites

Stratification of the monitoring plots into sampling sites will allow an assessment of habitat value relative to potential sources of disturbance assumed to originate primarily at preserve edges. Stratification will occur as follows: (1) "edge" sites (<60 m from the preserve boundary), (2) "interior edge" sites (60-180 m from preserve boundary), and (3) "core" sites (>180 m from preserve boundary) (Figure 3-3). Prior to full buildout of the surrounding area, the preserve boundary may not correspond to the edge of development. Therefore, edge sites may not initially be situated in true edge zones. Sampling sites may be contiguous or disjunct, depending on the shape and size of the monitoring plot. Monitoring within each site will provide a measure of the temporal trends in vegetative



A. Large monitoring location with "core" sampling site well-removed from "edge" and "interior to edge" sites.

B. Smaller monitoring location with all sampling sites in proximity.



C. Narrow monitoring location requiring rectangular sampling sites.

Not to Scale

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Potential Sampling Site Shapes and Locations within Monitoring Plots

FIGURE 3-2

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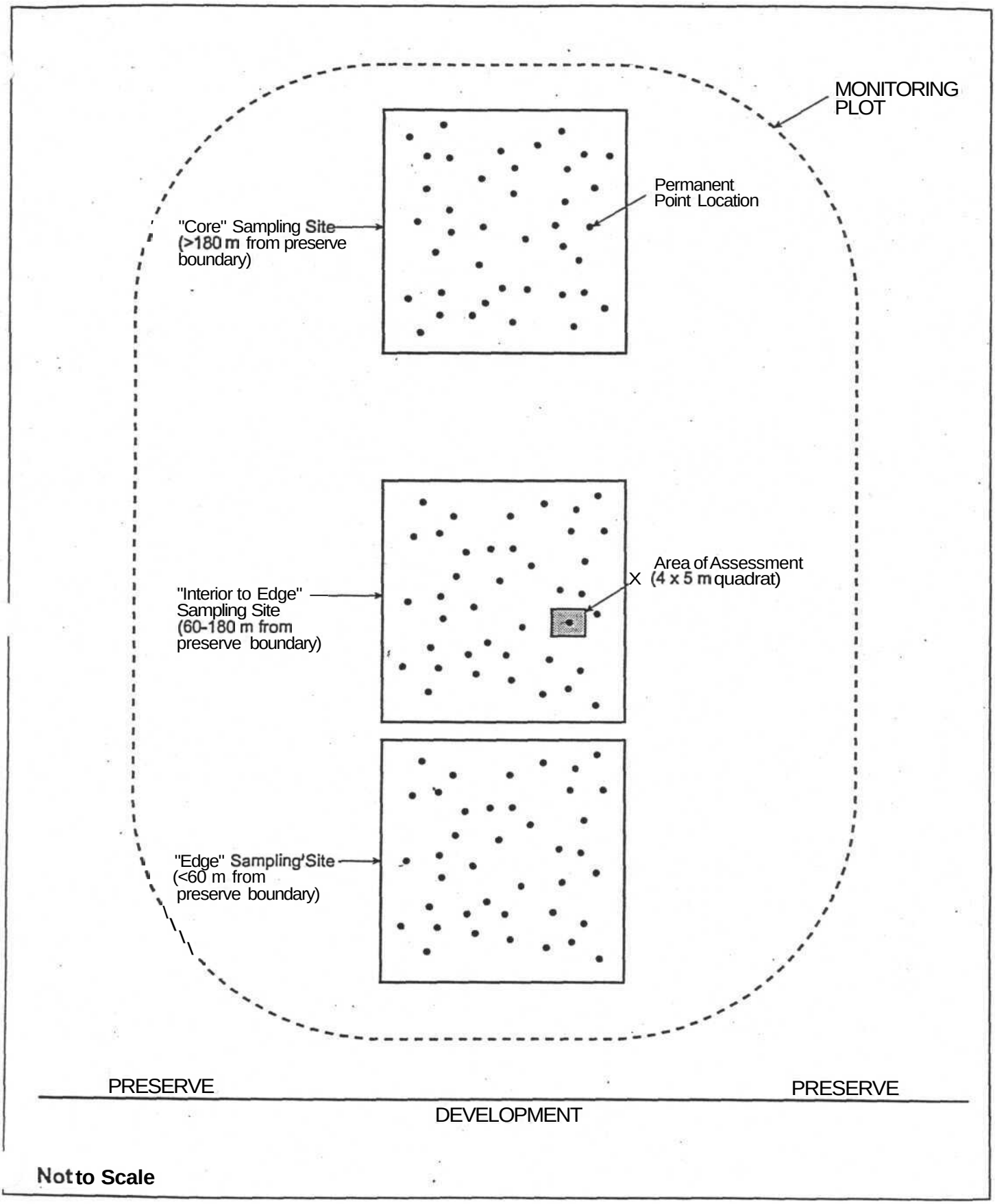

Not to Scale

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Example of a Sampling Design within a 200 acre Habitat value Monitoring Plot

FIGURE 3-3

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conditions within the larger preserve area surrounding the monitoring plot. Within the sampling sites, vegetation will be assessed for long-term trends.

3.4.1.3 Permanent Point Locations

To monitor long-term trends, permanent point locations will be established for sampling; these point locations can then be reliably resampled to document changes in vegetative conditions over time. Permanent points will be located in each of the three sampling sites within each monitoring plot (Figure 3-3). Point locations will be distributed throughout each site, using a stratified approach. Placement of the points within each site will be randomized during the initial set-up period, and fixed thereafter. Habitat will be assessed in a 4 x 5 m quadrat around each point, as described in Section 3.4.1.7. For costing purposes, it is assumed that a maximum of 40 points will be required in any one monitoring plot.

Sampling point locations will be permanently marked on the ground using steel rods or other devices to facilitate relocation in subsequent monitoring years. This placement of permanent point locations is designed to detect change in the overall vegetative condition of the monitoring plot over time. It is based on the following assumptions: (1) data collected in the area around each point location can reasonably be extrapolated to the rest of the monitoring plot and (2) there is an adequate density of point locations to reasonably characterize vegetative conditions within the sampling sites. This design has the advantage of being cost-effective and allowing the detection of trends over time. This design will not necessarily detect all problems within the habitat monitoring plot, however, because only a small percentage of the area is being sampled. Because the sampling points are permanent, there will be areas of the monitoring plot that will not be assessed using this method.

An alternative approach using a yearly random placement of point locations (e.g., the location of sampling points would shift each year) would provide a greater potential for sampling more of the monitoring plot, provide a better assessment of the average conditions within the entire monitoring plot, and potentially detect problems that may occur between permanent point locations. However, in order to achieve sufficient statistical power to detect temporal trends in vegetative conditions using this method, the number of point locations would be large and, therefore, cost-prohibitive.

3.4.1.4 Digital Orthophotography

Monitoring for vegetation trends will require more detailed base maps within monitoring plots than have been available to date. Digital Orthophotography of the monitoring locations will be used as a photographic base map for detailed vegetation mapping of the monitoring plot (Section 3.4.1.5) and will be useful as a permanent record. Development of a digital terrain model (DTM), which is an array of point data with elevation values, is required to create the digital orthophotos. This DTM can then be used to generate slope, aspect, and elevation contour information that can be used in the monitoring program. The digital orthophotographic data will need to be obtained only once at the start of the monitoring program. Ideally, digital orthophotos will be taken in both the visual spectrum and near-infrared with a minimum 1 m pixel resolution. If black-and-white orthophotos are used, then color aerial photographs also may be needed to assist in photointerpretation of vegetation types. The digital orthophotos should be corrected for distortion related to terrain and camera tilt, and should have a minimum accuracy of 1.5 m.

Currently, 1992 black-and-white digital Orthophotography exists for the City of San Diego, and would be available for use in the monitoring program. These data have a resolution of 0.15-0.6 m (0.5-2 feet [ft]), with 0.6-m (2-ft) contours. The City of Chula Vista is in the process of compiling similar data, and is currently having the orthophotos flown. In addition, a consortium of local partners is proposing to fund a similar effort for the County of San Diego. These 1994/1995 back-and-white digital orthophotos, which will have a resolution of 1 m, are expected to be available in early 1997. In addition to the digital orthophotographs, it may be valuable to obtain color aerial photographs for specific monitoring locations', as warranted by natural or man-induced disturbance events (e.g., fire, flooding, clearing, off-road vehicle activity).

Another imagery acquisition project may also benefit the monitoring process. Color infrared orthos at 1 m resolution probably will be flown in summer 1996 as part of a transborder (U.S./Mexico) project for a 100-mile buffer on each side of the border. A local partnership with the U.S. Geological Survey may be formed to create digital orthos. These orthos probably would be available in late 1997 or 1998.

3.4.1.5 Vegetation Map Refinements for Monitoring Plots

Vegetation within the MSCP study area is currently mapped at a regional level of detail. Identifying vegetative trends, however, will require a more detailed vegetation map for the monitoring plots. Currently, for example, areas of chamise or southern mixed chaparral may be included within southern maritime chaparral, and maritime succulent scrub may not always be differentiated from other forms of coastal sage scrub. Therefore, refined vegetation mapping will be conducted for each monitoring plot. The refined mapping will be a one-time event, and mapping units will be to the association or sub-association level, as appropriate. This mapping effort will also correct for categorical and positional errors inherent in the regional database. Mapping will be conducted directly onto a hardcopy version of the digital orthophotograph, and input into the GIS. For some monitoring plots, detailed, project-level information may be available and should be used as the basis for this detailed mapping. Field-verification should still be conducted, however, to ensure that the mapping reflects the most recent vegetative conditions.

3.4.1.6 Photodocumentation for Monitoring Plots

Permanent photodocumentation points will be established within each monitoring plot and will be utilized to provide a photographic record over time of the general vegetative characteristics of the plot. At least one photodocumentation point will be established within each sampling site (three sites per monitoring plot); this photodocumentation point will correlate to a permanent sampling point location. The camera will be mounted at a height above the vegetation to minimize distortion. Color film will be used, and photographs will be taken at the same time of year to minimize discrepancies due to phenology. In addition, cameras will maintain the same orientation and focal length from year to year. Each photograph will include a card that provides relevant information (e.g., transect identification number, date). Photographs will be taken during each monitoring period.

3.4.1.7 Habitat Value Monitoring in the Field

Habitat value monitoring will focus primarily on measurable aspects of the vegetation that can serve as indicators of both short- and long-term vegetative "health." This monitoring is not intended to identify vegetative disturbances throughout the preserve; rather, it will provide an indication of vegetative trends. This quantitative monitoring will be supplemented by visual observations of disturbance events or other physical conditions in

or near the monitoring plot that may be affecting the vegetation (e.g., invasive exotic species, clearing of vegetation). This "qualitative" information is easily collected and intended primarily to supplement overall habitat management monitoring by the preserve manager. This information may also be valuable in interpreting results of the quantitative data collection effort

Quantitative Monitoring

Quantitative monitoring will obtain data on both native (or naturalized) plants and invasive plants in the monitoring plots. For the purpose of this program, invasive species are defined as aggressive or noxious weed species (i.e., nonnative species that are growing or spreading rapidly, outcompeting native species, and difficult to control). A list of the more common invasive species in the MSCP study area is included as Appendix B to this document. In addition, the Jepson Manual (Hickman 1993) lists species considered legally noxious by the State of California, and the California Exotic Pest Plant Council has produced a list of exotic pest plants of greatest ecological concern in California (CalEPPC 1994). These sources will be consulted to determine whether or not a species is considered invasive, as defined above.

Quantitative data will be collected within permanent, established quadrats at each point location within each sampling site (Section 3.4.1.3). The goal for the first monitoring period at any monitoring plot will be to establish baseline conditions. Thereafter, between-year comparisons can be made to identify significant changes in vegetative conditions. With enough years of data, a time-series analysis can be performed to identify significant trends in vegetative conditions. Positive trends will be considered stable conditions (assuming the vegetation is undisturbed at the time baseline data are collected) or shifts toward climax or subclimax communities, whereas negative trends will be an increase in nonnative species. An assessment of negative trends will need to consider site factors such as recent burns before recommending management actions.

Vegetative Parameters. Quantitative vegetation data collection will focus on estimates and/or direct counts of species cover, density, and frequency. Cover is the percentage of the ground surface that is covered by vegetation material, and is a useful measure for long-term monitoring because it is sensitive to biotic and edaphic influences. Cover is an important measurement as it relates to plant biomass within a sampling site if the vegetation layers or stratum are considered (Daubenmire 1968; Mueller-Dombois and Ellenberg

1974). Plant biomass has a major influence on the light and temperature within a vegetative stand, it influences water relations and relates to nutrient cycling within a stand, and it is directly related to the wildlife use in an area (Mueller-Dombois and Ellenberg 1974).

Density refers to the number of individuals in a given unit of area. This measure is used to describe vegetation characteristics of a community. Estimates of density are useful for monitoring plant responses to environmental perturbations. One difficulty in density counts is the recognition of individuals. Tree and single-stemmed growth forms present few problems, but many other plant forms can be problematical. Accurate density measurements rely on a knowledge of the plant life forms being sampled. A second consideration for density counts is the marginal effect of the quadrat and the decision of whether to include an individual as being in or out of the sampling area. Generally, if the individual is rooted within or largely rooted within the sampling quadrat, it is included in the density count.

Frequency is a measure of a species' presence and distribution in a community, and is a useful tool to detect changes in the vegetative composition of a plant community over time. No counting is involved; frequency simply relates to the number of times a species occurs in a set number of stratified sampling plots, expressed as a percentage of the total number of plots evaluated. Although frequency data will indicate a change in species population, it will not identify the vegetative characteristic that has changed (Bonham 1989). Therefore, additional measurements (e.g., cover, density) are needed to provide a more complete analysis of the nature of the change, since frequency measurements can overemphasize the importance of species whose individuals are widely distributed in the sampled vegetation (Bonham 1989; Clarke 1986).

Monitoring Methodologies. Biologists will obtain quantitative data using quadrat sampling methods. Data can be collect either by species or by canopy level (i.e., tree, shrub or subshrub, herb). Recommended methodologies are summarized below.

For all habitats, it is recommended that a 4 x 5 m quadrat be used for sampling at each point location within each strata or sampling site. Assuming 40 point locations per sampling site, a total sampling area of 800 m^2 will be obtained per sampling site, or 2400 m^2 per monitoring plot.

Cover data for all species will be obtained by estimating cover within the 4 x 5 m quadrat at each sampling point. Estimates of plant species cover will be collected using a modified Daubenmire cover scale (Mueller-Dombois and Ellenberg 1974). This modified method utilizes cover ranges, as shown below. For statistical calculations, cover ranges for all observations will be converted to the cover range midpoint values shown below.

Cover Range (%)	Cover Range Midpoint (%)
95-100	97.5
75-95	85
50-75	62.5
25-50	37.5
5-25	15
1-5	3

Data should be collected for the tree, shrub or subshrub, and herbaceous layers, as applicable, as well as the ground layer (including bare ground, rock, or plant litter).

Density counts of all shrub species also will be estimated within the quadrats. However, density of herbaceous species in grassland habitat will not be measured. Density and size of individual annual plants can vary tremendously between years depending on environmental conditions and factors of inter- and intraspecific competition. Percent cover is a better estimate of dominance and plant biomass in grasslands and will be used for this habitat.

Frequency data will be obtained by recording all species (i.e., presence) rooted in each quadrat. The proportion of quadrats that contain a species is the frequency for that species. Thus, if a species occurs in 20 of the 40 quadrats, it has a frequency of 50 percent.

Qualitative Monitoring

In addition to quantitative monitoring at permanent point locations, obvious signs of disturbance will be recorded in each sampling site, regardless of whether or not they are associated with a point location. Factors that will be of interest include habitat disturbance (both natural and human-induced) and surface or subsurface disturbance. The natural

habitat disturbance event of particular concern is fire. Human-induced habitat disturbance refers to direct vegetative disturbance, as might be caused by recreational activities (trampling), unauthorized off-road vehicles (crushing, fragmentation), or disking or clearing of vegetation. The degree of disturbance may result in temporary or permanent vegetation impacts and will require different levels of management activities. Observations of surface or subsurface disturbance will focus on those physical characteristics of the site or surrounding area that affect the vegetation onsite. Examples of surface or subsurface disturbance include erosion and changes in watershed or hydrological patterns caused by landform alterations or water diversion. Areas of obvious disturbance will be recorded in field notes and mapped onto base maps during the monitoring effort. However, no quantitative measurements of habitat, surface, or subsurface disturbances will be made.

3.4.1.8 Data Collection

It is critical to the success of the monitoring program that a central data collection system and a central repository for data be established and accessible to all personnel involved in the monitoring program. Standardizing data collection is essential to meeting monitoring objectives and streamlining the data collection, analysis, and reporting efforts. Protocol and/or refinements can be made as the program evolves and as monitoring priorities shift; however, any changes should be well-documented and accessible to all persons involved in monitoring.

Monitoring documentation should include the following: data collection field forms, data reduction forms, and final summary forms (Clarke 1986) (Appendix A). Establishing these forms in advance of the field effort will ensure that all aspects of the monitoring effort are examined, and will focus the effort on the stated objective(s). In addition, maps should be provided (as needed) that depict individual site disturbances and other indicators/evidence of change.

Data collection field forms will be used to record quantitative data at each point location and assess general conditions within the sampling site. Data reduction forms will be used in the office subsequent to the quantitative data collection effort to summarize sampling site data and perform initial data analyses (i.e., means, variances, standard deviations, etc.). A final summary form will be used to provide an evaluation of each monitoring plot. Final summary forms are designed to condense quantitative data into summary statistics that

reveal the overall patterns being monitored. These forms will provide information used in the monitoring reports.

Any mapping that accompanies the qualitative habitat monitoring evaluation will be conducted on the refined vegetation maps prepared for each monitoring location (Section 3.4.1.5). The focus of this mapping will be to show the extent of the disturbance and/or area of vegetative decline.

3.4.1.9 Data Analysis

The quantitative vegetation data for each site will be analyzed by the wildlife agencies using parametric methods. The intent of the analysis will be to (1) compare vegetative characteristics within a given monitoring plot over time and (2) compare different sites within a monitoring plot over time. The sampling design also will allow a comparison of edge effects among different monitoring locations within the MSCP preserve, if desired. However, this latter analysis is not included in the cost estimates for this program.

Data analysis can occur at either the species or canopy level, and should include an assessment of native (or naturalized) species versus invasive exotic species. Percent cover, estimated by cover classes in quadrats, will be averaged among quadrats for each sampling site. Densities of shrub or tree species will be averaged among quadrats for each sampling site. Plant species frequencies will be obtained for each sampling site from the species presence data within the quadrats. Means and standard deviations for species cover, density, and frequency data will be calculated for an entire sampling site from all quadrats in a given habitat. These data also may be grouped and summarized to show means and standard deviations for tree, shrub or subshrub, and herbaceous species and for native (or naturalized) species and invasive exotic species, respectively. Where quadrats have sampled different micro-environments (e.g., slope aspect, slope position, elevation), these data may be combined and summarized to show possible trends relative to these features. The primary intent, however, is not to compare different sites or micro-environments within a sampling site, but to provide a reference from which to compare vegetative characteristics within a given site over time.

If quantitative data collection at a monitoring location occurs over a period of monitoring years, then "baseline" data from the initial quantitative sampling period can be compared to data collected in subsequent years. In this case, percent cover and mean densities and

frequencies for trees, shrubs or subshrubs, and herbaceous plants (as appropriate) will be graphed as a function of sampling period to illustrate any changes that have occurred. A statistical hypothesis test, such as a paired t-test, Analysis of Variance (ANOVA), or repeated measures ANOVA, should be employed to facilitate drawing conclusions about trends in the vegetation. A paired t-test could be used to test whether the deviation between years, for a particular variable, is significantly different from zero.

In addition to statistical testing, a simple index number will be calculated to show the percentage increase or decrease in the parameters measured. The index number is defined as the ratio of one value to the other, multiplied by 100. When the comparison number equals the base number, the resulting index number will have a value of 100. Apparent trends that are statistically insignificant (i.e., index numbers are not statistically different from a value of 100) will be tested for adequacy of sample size with statistical power analysis methods. Study sites for which a decline in vegetation quality is detected from the qualitative monitoring may require management actions and/or may potentially warrant quantitative sampling to better-define the problem.

Once multiple years of data are collected, a time series analysis will be used to identify significant trends. The major task of a time series analysis is'to describe the nature of the variation of a variable at different points in time so that its future values can be predicted (Kachigan 1986).

3.4.2 Schedule

Habitat value monitoring will occur at approximately five-year intervals. Certain aspects of this monitoring, such as establishing monitoring plots, acquiring digital orthophotography, refining vegetation maps, and establishing sampling sites and permanent point locations, will occur during the first year of the program or the first year that a monitoring location is included in the program. Other aspects of the monitoring program, such as acquiring other photography, photodocumentation, and data collection and analysis, will occur at each monitoring plot during each monitoring period (i.e., at five-year intervals).

3.4.3 Products

The main product of the habitat value monitoring will include a report (with accompanying maps) that indicates the status of the habitat at each monitoring location. The report format

will facilitate its use by preserve managers, and will provide a concise summary of proposed actions, their purpose and priority, schedule for implementation, maintenance frequency, labor and materials, and cost estimate for implementing any proposed actions. If habitat monitoring occurs in a year in which a comprehensive report will be prepared, then results of the monitoring and any recommendations will be included in this comprehensive report. If monitoring occurs in an alternate year, a brief status report will be prepared, as outlined in Section 6.0, with complete results and recommendations included in the next comprehensive report.

3.4.4 Cost

Habitat value monitoring costs may vary between monitoring plots depending on the size of the plot and number of points. In addition, some monitoring costs will occur only during the first monitoring period. First year costs are estimated at $117,740 (in 1996 dollars) for the entire MSCP preserve system. Of this total, approximately $62,321 are strictly one-time costs associated with the set-up of the habitat monitoring program. Note, however, that the preserve system will not be dedicated all at once, but will be developed over a period of time. Thus, actual costs will be dependent on the number of these locations that have been dedicated to the MSCP preserve system in any one monitoring period.

A breakdown of monitoring costs is presented in Table 3-2. These costs assume that (1) 29 plots will be monitored; (2) monitoring plots will be approximately 200 acres in size; and (3) a maximum of 40 monitoring points per monitoring plot will be evaluated. It is further assumed that both digital orthophotography and color aerial photographs will be available; neither of these items is included in the costs presented in Table 3-2. Should it become necessary to purchase either orthophotographs or color aerials, the maximum additional cost per initial survey period is estimated to be $7,800 ($2,000 for orthophotographs; $5,800 for color aerials of 29 monitoring locations). An additional, optional cost of about $20,000-$30,000 is estimated for the purchase of a GPS device with an accuracy level of approximately 1 m.

Table 3-2

COST ESTIMATE FOR HABITAT VALUE MONITORING[1]

	First Monitoring Period	Subsequent Monitoring Periods[2]	Subsequent Monitoring Periods[3]
Baseline Data Collection (Per Monitoring Plot)	$514	---	---
Sampling Design Set-up (Per Monitoring Plot)	$1,635	---	—
Field Effort (Per Monitoring Plot)	$1,500	$1,500	$1,500
Data Analysis/Report Preparation (Per Monitoring Plot)	$300	$734	$921
Coordination/Senior Review (Per Monitoring Plot)	$111	$193	$264
Total Costs (Per Monitoring Plot)	$4,060	$2,427	$2,685
Total Costs (Per Survey Year)[1]	$117,740	$70,383	$77,865

1 Assumes 29 monitoring locations; however, actual costs will depend on the number of locations that have been dedicated to the MSCP preserve system in any one monitoring period.

2 Refers to monitoring periods that have a status report requirement (see Section 6.0).

3 Refers to monitoring periods that have a comprehensive report requirement (see Section 6.0).

4.0 CORRIDOR MONITORING

A wildlife corridor can be defined as a linear landscape feature that allows animal movement between two patches of habitat or between habitat and geographically discrete resources (e.g., water). It is useful to differentiate between regional and local wildlife corridors. Regional corridors link two or more large areas of natural open space and are necessary to maintain demographic and genetic exchange between wildlife populations residing within these geographically disjunct areas. Local corridors allow resident animals access to necessary resources (e.g., water, food, cover, or den sites) within a large habitat patch, and they also may function as secondary connections to the regional corridor system.

The term "corridor" is used in a species-specific context (Soule 1991; Beier and Loe 1992). For example, a landscape feature that functions as a corridor for a songbird, such as a gnatcatcher, may not suffice for a bobcat or a reptile. In order to evaluate the arrangement of open space for its usefulness as a wildlife corridor, it is first necessary to identify a group of focal target species. These are species that naturally occur in relatively low densities and are unable to cross large areas of man-modified or otherwise unsuitable habitat. No single parcel of open space in southwestern San Diego County is likely to support viable populations of these focal species, and habitat linkages between large blocks of occupied habitat are required for regional population viability. The focal species to be monitored at the designated preserve habitat linkages are California gnatcatcher, coastal cactus wren, mammalian predators (mountain lion, coyote, and bobcat), and deer. This monitoring effort will achieve the plan objectives of collecting new biological data, evaluating the impacts of land uses and construction activities in and adjacent to the preserve, and evaluating management and enforcement difficulties in the preserve.

4.1 METHODOLOGY

The monitoring locations for assessing utilization of key habitat linkages are listed in Table 4-1 and depicted in Figure 4-1. Identification of the presence of focal species will be based on the detection of animal sign (tracks and scat) and visual sightings. Constrained linkage areas where these species are consistently detected throughout the linkage will be considered actively utilized as corridors. Constrained linkages include narrow habitats limited by development such as buildings, paved roads, and fencing greater than 7 ft in

Table 4-1

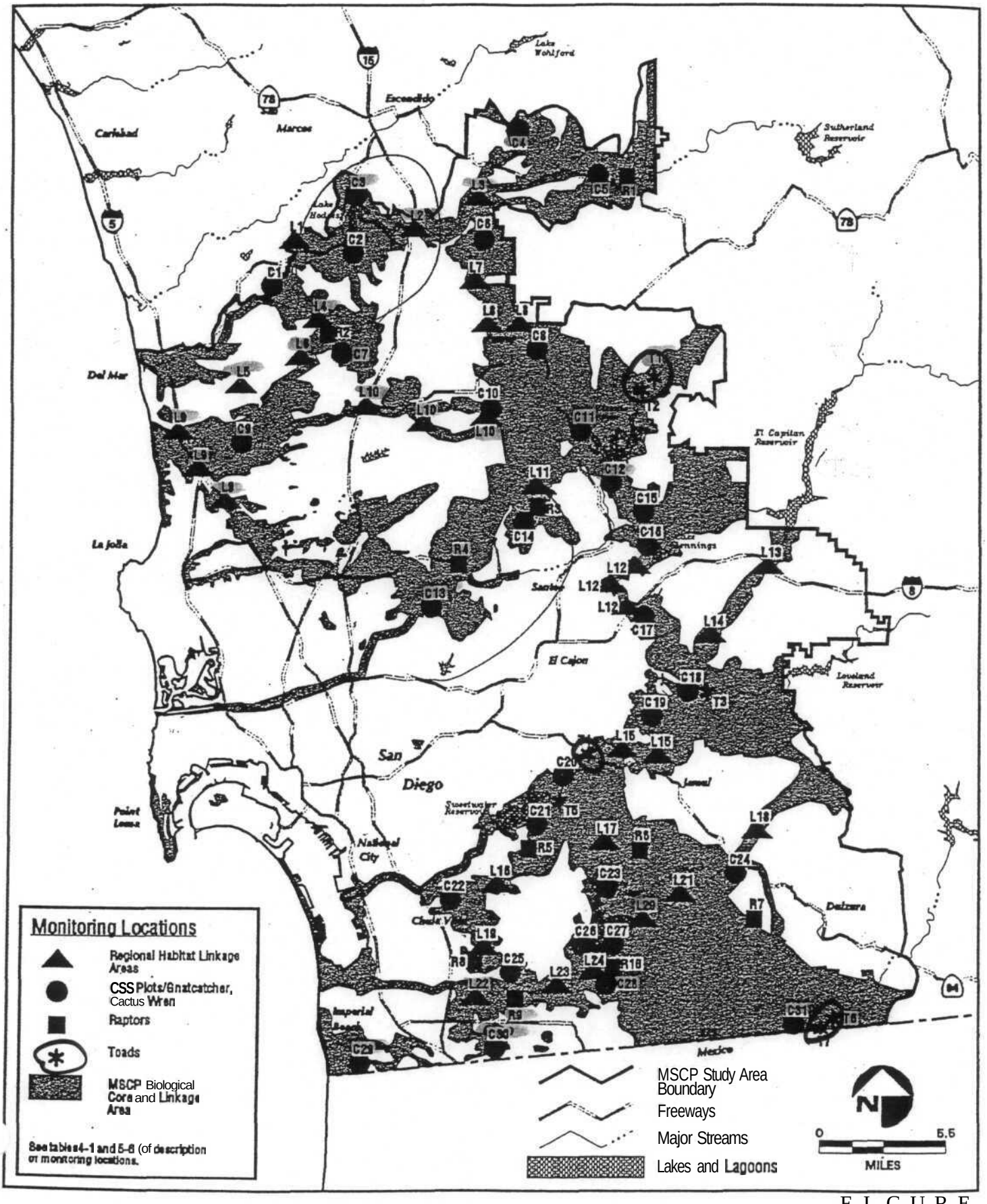
REGIONAL HABITAT LINKAGE MONITORING LOCATIONS[1]

MONITORING SITE[1]	GENERAL LOCATION	OTHER MONITORING[2,3]
L-1	Rancho Cielo/San Dieguito River	—
L-2	Lake Hodges/San Pasqual Valley	—
L-3	San Pasqual Valley/North Poway (Highland Valley)	---
L-4	Santa Fe Valley	Habitat (H-4)
L-5	Gonzales Canyon	—
L-6	McGonigle Canyon	—
L-7	Old Coach Road/Blue Sky Reserve	—
L-8	Central Poway	—
L-9	Torrey Pines Reserve/Los Penasquitos Canyon/NAS Miramar	---
L-10	Los Penasquitos Canyon/South Poway (Beeler Canyon	—
L-11	South Poway/Santee (Sycamore and Clark Canyons)	---
L-12	Lakeside/Crest/El Cajon	—
L-13	Harbison Canyon at Interstate-8	—
L-14	Southern Harbison Canyon	—
L-15	McGinty Mesa/Rancho San Diego (Middle Sweetwater River)	—
L-16	Sweetwater Reservoir/Rancho Del Rey	—
L-17	San Miguel Mountains/Proctor Valley/Jamul Mountains	---
L-18	Hollenbeck Canyon	—
L-19	Poggi Canyon	Plants (P-24)
L-20	Jamul Mountains/SE side of Lower Otay Lake	---
L-21	Jamul Mountains/San Ysidro Mountains (Little Cedar and Cedar Canyons)	—
L-22	Otay River Valley/West Otay Mesa	Habitat (H-22)
L-23	Otay River Valley at Future Highway 125 Crossing	---
L-24	O'Neal Canyon	—
L-25	Spring Canyon	—
L-26	Salt Creek	—
L-27	East Otay Mesa	—
L-28	San Ysidro Mountain East	—
L-29	Marron Valley	—

1 Refer to Figure 4-1 for a depiction of regional habitat linkage monitoring locations.

2 Refers to other types of monitoring that may occur at the same location; see Figures 3-1 and 5-2.

3 Refer to Table 3-1 for a complete list of habitat monitoring locations; refer to Table 5-2 for a complete list of field monitoring locations for covered plant species. •



FIGURE

OGDEN

Regional Habitat Linkage and Covered Animal Species Monitoring Locations

4-1

height. An even spatial distribution of animal detection will indicate animals are successfully traversing the linkage. Animal sign at only one end of the corridor suggests that the linkage may be blocked and a more intensive evaluation program should be initiated.

Prior to initiation of the field effort, the field biologists will review the previous survey data and other information to be familiar with survey sites and previous site conditions. During the initial site reconnaissance, a qualitative assessment of each site's habitat condition will be made to document any change relative to previous survey years. Changes to areas within and directly adjacent to the habitat linkage will be detailed on field forms (Appendix C) and maps/aerial photos (e.g., more development or disturbance since previous survey). Noise levels, lighting, and fencing conditions within and adjacent to the linkage will be assessed.

New animal sign in natural substrate conditions and at tracking stations will be recorded. These stations will be of four types: (1) finely raked sand or dirt, (2) graphite-powdered cards (Taylor and Raphael 1988), (3) bands of lime chalk, and (4) combinations of these methods. Poster-weight cards (22 inch x 28 inch and 44 inch x 56 inch in size), coated on one side with graphite powder or soot from a burning kerosene lamp, will be placed on the ground in physically constrained locations (e.g., drainage channels or culverts) within the corridor and checked every two to four days for tracks. When lime chalk is used, a four-inch layer of chalk will be spread across a 1.2 m wide area of the corridor pathway. Old tracks will be marked to avoid confusion with fresh tracks. Track identification will be verified using several source references (Halfpenny 1986; Taylor and Raphael 1988; Stall 1990). The number of tracking stations will vary between locations, but typically 3-5 stations will be adequate to detect wildlife use of the linkages. Linkage areas will be surveyed for bird species presence using standard survey protocol (refer to Section 5.3.2 for species-specific protocols).

Data will be collected on roadkills in the vicinity of monitored habitat linkages. CALTRANS and most jurisdictions in the MSCP study area maintain logs of the location and species of roadkilled animals. It is recommended that the County of San Diego implement a roadkill recording program for areas in the vicinity of monitored habitat linkages in their jurisdiction. Roadkill data will be collected continually for inclusion in the three-year comprehensive report. Observations of focal and other species will be recorded

on standard field forms (Appendix C) and sightings plotted on base maps of the monitored area.

4.2 SCHEDULE

Assessment of habitat linkage functions will occur on a three-year schedule which is concurrent with the monitoring of the coastal sage scrub plots for birds (Section 5.3.2.3). The field work will be scheduled between late July and late September. This is the tune period when young animals are dispersing away from their natal territories and such movements have the greatest likelihood of being detected. Stations will be checked every 3-4 days over two weeks each month (July, August, September) and the lime chalk re-raked and tracking cards replaced.

4.3 PRODUCTS

A monitoring report documenting results of the current assessment of habitat linkage function will be prepared within six months of completion of field work. This report will include a detailed reporting of focal species detected at each linkage location and recommendations for improving regional habitat connectivity (e.g., fencing at specific road undercrossings) for monitored linkages not apparently utilized by focal species.

4.4 COST

The estimated cost for monitoring all 29 designated habitat linkages is $75,840 (1996 dollars) for a three-year period, which includes $13,200 for coordination/review, data analysis, and report preparation. This effort includes approximately 1392 hours of field work for 29 linkage locations (48 field hours per location). Cost per location is $2,610. Additional costs associated with acquisition of digital orthophotography are discussed in Section 3.4.4.

5.0 COVERED SPECIES MONITORING

Preservation of rare plant and animal populations in protected areas is the initial step in achieving long-term conservation. Monitoring efforts are needed to ensure that human-related activities do not present immediate threats to preserved populations nor threaten the ability of a population to persist over time. The covered species monitoring program will identify (1) short-term threats to species persistence and (2) longer-term trends that may suggest declining populations. In either case, active management may be required. The covered species monitoring effort will achieve the plan objectives of documenting the protection of covered species and changes in preserved populations of covered species, collecting new biological data, evaluating the impacts of land uses and construction activities in and adjacent to the preserve, and evaluating management activities and enforcement difficulties in the preserve.

This section outlines tasks necessary to conduct the species monitoring program. These include establishing monitoring locations, acquiring appropriately-scaled base maps, establishing permanent plots and monitoring methodologies, and data collection and analysis. It should be noted that not all monitoring parameters can be identified within the context of this plan, because some parameters will be dependent on a detailed assessment of field conditions. Further, it is acknowledged that monitoring data beyond that recommended below would be highly desirable and could provide a more accurate depiction of population viability. Refer to Section 8.0 for additional research studies that should be implemented as funds and/or researchers become available.

5.1 CLIMATIC DATA

Both short- and long-term plant and animal population trends can be influenced by climatic parameters such as temperature and rainfall. For example, gnatcatcher populations can experience large yearly fluctuations depending on short-term weather events such as cold temperatures and precipitation. Likewise, many annual plant species germinate in response to moisture and temperature cues, with population sizes fluctuating widely from year-to-year based on weather conditions in the days and months preceding germination. Under unfavorable conditions, these species may not germinate at all, yet are able to persist as a viable soil seedbank. Longer-term climatic patterns can affect reproductive potential of perennial plant species, thereby influencing species composition and, ultimately, vegetation

trends (Bonham 1989). Monitoring of population trends for the covered species cannot rely on population size alone, but must correlate this size to the factors that influence it.

5.1.1 Methodology

Temperature and precipitation data will be collected from a number of weather stations in the MSCP study area (Figure 5-1), and input and maintained in digital format in a central repository. This information will be used to analyze population trend data obtained from qualitative and quantitative sampling efforts.

5.1.2 Schedule

Monthly weather information will be collected on at least a yearly basis. Data collection can occur more frequently, as needed.

5.1.3 Products

The product of this task will be a digital database of temperature and precipitation information that can be easily accessed by field monitors, resource managers, and researchers.

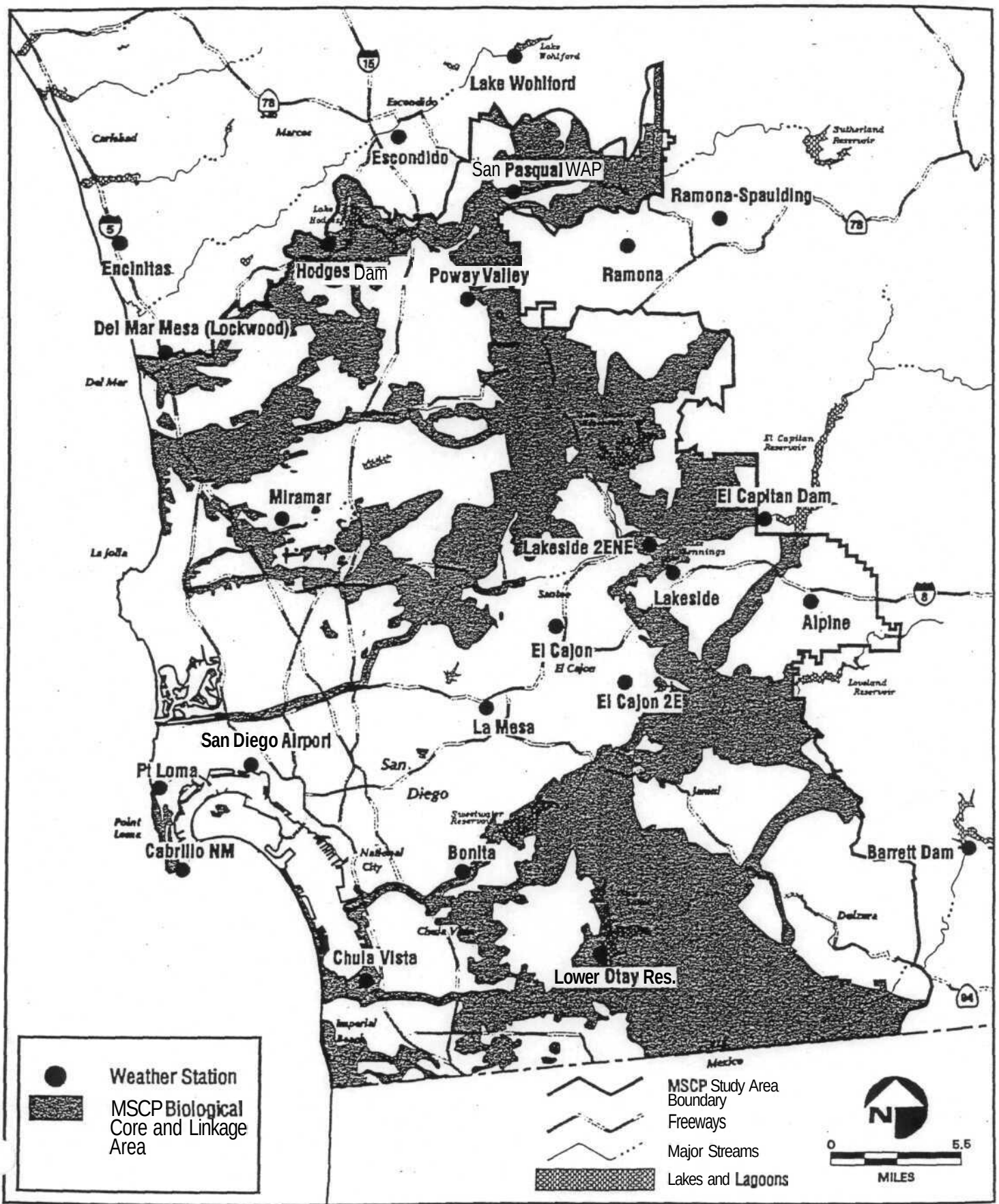
5.1.4 Cost

The annual cost (in 1996 dollars) for obtaining and inputting weather information is estimated at approximately $2000.

5.2 PLANT SPECIES MONITORING

5.2.1 Prioritization of Covered Plant Species Monitoring Efforts

It is anticipated that limited funding will be available for plant species monitoring within preserves; therefore, prioritization is necessary to ensure that field efforts focus on covered species most susceptible to population declines and/or threats to overall viability. For plant species, prioritization will be based on overall risk to species viability and an assessment of research/active management priority levels. Allocation of monitoring efforts will be further refined by filtering out those plant species that (1) do not have biologically significant



FIGURE

Weather Stations

5-1

populations within the preserve system; (2) are covered by existing monitoring programs; (3) are questionably extant within the preserve system; or (4) can be monitored by means other than field verification (e.g., habitat monitoring from aerial photographs or satellite imagery).

Table 5-1 provides a summary of plant species monitoring priorities based on the filtering process described above. Species prioritized for field monitoring face the greatest threats to species' viability, and it is recommended that detailed field monitoring be conducted to assess both immediate threats and long-term population trends. Third priority species for field monitoring may actually be monitored by a combination of field and habitat assessment techniques (Sections 5.2.2.4 and 5.2.2.5). Species prioritized for habitat monitoring are generally less threatened than species prioritized for field monitoring, or general habitat monitoring from satellite imagery and aerial photography can be used effectively to monitor habitat patches in which these species occur. Most of the species prioritized for habitat monitoring are shrubs and subshrubs, or occur in inland areas that may not be as susceptible to impacts as more coastal locales.

Not all covered plant species are included in Table 5-1. For example, *Brodiaea filifolia* has not been recorded in the MSCP study area, so is not prioritized for monitoring. In addition, it is assumed that certain species, particularly those associated with vernal pools or occurring in state parks, will be monitored through existing programs (e.g., *Myosurus minimus* ssp. *apus*, *Navarretia fossalis*, *Pogogyne abramsii*, *Orcuttia californica*, *Pogogyne nudiuscula*, *Eryngium aristulatum* var. *parishii*, *Pinus torreyana*, and *Agave shawii*). If existing or proposed monitoring efforts for these species are terminated, the wildlife agencies will investigate the need to continue assessing these species over time. A final set of species (*Astragalus tener* var. *titi*, *Aphanisma blitoides*, *Caulanthus stenocarpus*, and *Erysimum ammophilum*) is not included in either field or habitat monitoring at this time because these species are questionably extant in the MSCP study area and/or have taxonomic problems. These issues should be resolved prior to committing resources to long-term monitoring programs.

5.2.2 **Methodology**

A baseline inventory of plant population status will be required for all identified monitoring locations. This inventory, and subsequent monitoring, will focus on population parameters that are most likely to exhibit evidence of change within a reasonable time frame, or which

Table 5-1

MONITORING PRIORITIES FOR COVERED PLANT SPECIES[1,2]

	FIELD MONITORING	PHOTO PLOT MONITORING
FIRST PRIORITY	*Cordylanihus maritimus* (not City) *Dudleya brevifolia* *Lotus nuttallianus* *Monardella linoides* ssp. *viminea* *Cordylanihus orcuttianus* *Dudleya variegata* ~~*Hemizonia*~~ Deinandra *conjugens*	*Ceanothus verrucosus*
SECOND PRIORITY	*Ambrosia pumila* *Acanthomintha ilicifolia* ~~*Corethrogyne filaginifolia*~~ Lessingia var. *linifolia* *Brodiaea orcuttii* *Muilla clevelandii*	*Lepechinia cardiophylla* *Arctostaphylos otayensis* *Ceanothus cyaneus* *Tetracoccus dioicus* *Solanum tenuilobatum* *Nolina interrata* *Satureja chandleri* *Senecio ganderi*
THIRD PRIORITY	*Arctostaphylos glandulosa* ssp. *crassifolia* *Baccharis vanessae* ~~*Opuntia parryi* var. *serpentina*~~ Cylindropuntia → *J californica* var. *californica* *Rosa minutifolia*	*Calochortus dunnii* *Cupressus forbesii* *Ericameria palmeri* *Ferocactus viridescens* *Lepechinia ganderi* *Monardella hypoleuca* ssp. *lanata*

1 Refer *to* text (Section 5.2.1) for a discussion of priority categories for monitoring.

2 Refer to Table 5-3 for monitoring frequencies for covered plant species that will be monitored in the field. All other covered plant species will be monitored once every 5 years.

can serve as warning indicators of adverse change. The level of monitoring accuracy and sensitivity will be geared towards detecting vegetation changes at the population level. Quantitative species monitoring is expected to occur at regular intervals for certain covered species (Section 5.2.3). Frequency of monitoring will be determined by species' habit (e.g., annual versus perennial) and prioritization status.

5.2.2.1 Monitoring Locations

Locations for covered plant species to be monitored through the collection of field data are depicted in Figure 5-2 and summarized in Table 5-2. Monitoring locations for species to be monitored through satellite imagery and aerial photography (e.g., habitat monitoring) are not included in Figure 5-2.

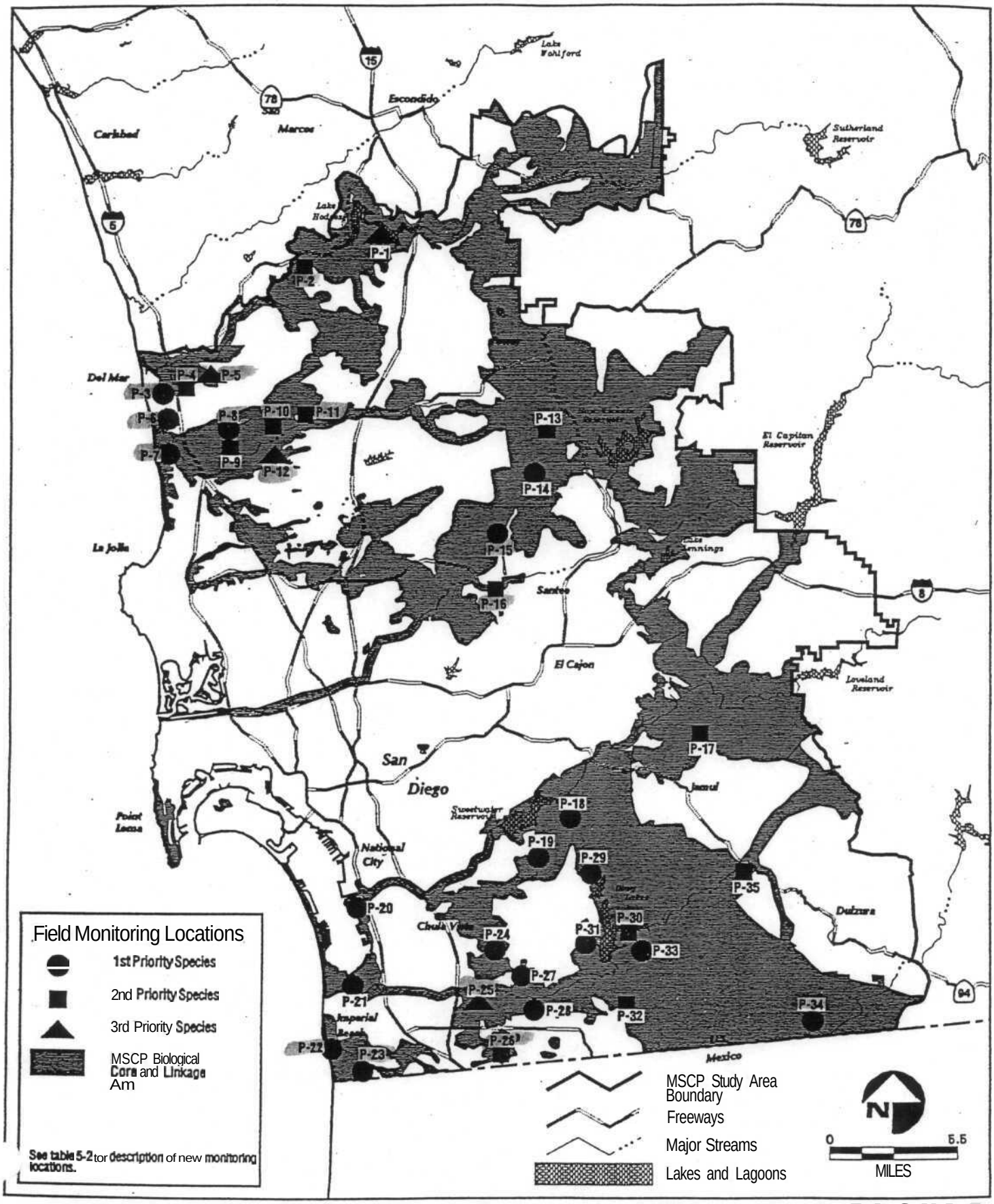
Monitoring locations shown in Figure 5-2 are necessarily generalized. In actuality, the monitoring site will be determined by the location of the plant population. Where populations are small, the entire population may be included in the field monitoring effort. In larger populations or populations comprised of numerous, disjunct stands, an appropriate sample will be monitored. Exact position and shape of the monitoring locations will be determined during the implementation phase of the monitoring program.

Once monitoring locations have been determined, their exact coordinates will be mapped onto the orthophotographs and input to a GIS. If orthophotographs are not available, coordinates could be registered in the field using a GPS.

5.2.2.2 Permanent Transects

Within each monitoring location, permanent transects will be established. Establishment of permanent transects will allow populations to be reliably resampled over time.

Transect placement within the monitoring location will be based on a random stratified sampling approach, with the selection process tailored to capture important microhabitats. Once transect locations have been determined, they will be mapped onto the orthophotographic base maps. If orthophotos are not available, the exact coordinates of the transects could be registered in the field using a GPS. Transects will be permanently marked in the field with steel rods or other devices to facilitate relocation in subsequent monitoring years. Permanent markers will remain in place for the duration of the



FIGURE

5-2

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Covered Plant Species Field Monitoring Locations

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Table 5-2

COVERED PLANT SPECIES FIELD MONITORING LOCATIONS[1]

MONITORING LOCATION[2]	MONITORING PRIORITY[3]	GENERAL LOCATION	SPECIES	OTHER MONITORING[4,5]
P-1	Low	Lake Hodges (4-S Ranch)	*Baccharis vannessae*	—
P-2	Moderate	Lake Hodges	*Acanthomintha ilicifolia*	—
P-3	High	Del Mar Heights (Crest Canyon)	*Arctostaphylos glandulosa* ssp. *crassifolia* *Dudleya brevifolia*	Habitat (H-5)
P-4	Moderate	San Dieguito River Bluffs	*Corethrogyne filaginifolia* var. *linifolia*	—
P-5	Low	San Dieguito River Bluffs	*Arctostaphylos glanaulosa* ssp. *crassifolia*	Habitat (H-8)
P-6	High	Torrey Pines State Park Extension	*Arctostaphylos glandulosa* ssp. *crassifolia* *Dudleya brevifolia*	Habitat (H-6)
P-7	High	Torrey Pines State Park	*Arctostaphylos glandulosa* ssp. *crassifolia* *Corethrogyne filaginifolia* var. *linifolia* *Dudleya brevifolia*	Habitat (H-7)
P-8	High	Carmel Mountain	*Arctostaphylos glandulosa* ssp. *crassifolia* *Dudleya brevifolia*	Habitat (H-9)
P-9	Moderate	Carmel Mountain	*Brodiaea orcuttii*	—
P-10	Moderate	Del Mar Mesa	*Arctostaphylos glandulosa* ssp. *crassifolia* *Corethrogyne filaginifolia* var. *linifolia*	Habitat (H-10)
P-11	Moderate	Del Mar Mesa	*Brodiaea orcuttii* *Muilla clevelandii*	—
P-12	Low	Peñasquitos Canyon	*Arctostaphylos glandulosa* ssp. *crassifolia*	—
P-13	Moderate	South Poway (Sycamore Canyon)	*Acanthomintha ilicifolia*	—
P-14	High	Santee (Sycamore Canyon)	*Monardella linoides* ssp. *viminea*	—
P-15	High	Sycamore Canyon	*Dudleya variegata* *Muilla clevelandii*	Habitat (H-14)
P-16 -NO Yes	Moderate	Santee Kumeyaay Immed	*Ambrosia pumila*	—
P-17	Moderate	McGinty Mountain	*Acanthomintha ilicifolia*	—
P-18	High	San Miguel Mountain	*Dudleya variegata*	—
P-19	High	San Miguel Mountain	*Hemizonia conjugens*	Habitat (H-19), Wildlife (R-5)
P-20	High	Sweetwater River Mouth and Vicinity	*Cordylanthus maritimus* ssp. *maritimus*	—
P-21	High	South San Diego Bay Wetlands	*Coraylanthus maritimus ssp. maritimus*	—
P-22 -NO	High	Tijuana River Estuary and Vicinity	*Coraylanthus maritimus* ssp. *maritimus* *Lotus nuttallianus*	---
P-23	High	Goat Canyon-Spooner's Mesa	*Cordylanthus orcuttianus*	Habitat (H-21), Wildlife (C-29)
P-24	High	Poggi Canyon	*Hemizonia conjugens* *Opuntia parryi* var. *serpentina*	Linkage (L-19)
P-25	Low	Otay River Valley/West Otay Mesa	*Rosa minutifolia*	Habitat (H-22), Linkage (L-22)
P-26	Moderate	Spnng Canyon	*Ambrosia pumila* *Opuntia parryi* var. *serpentina*	Habitat (H-25), Wildlife (C-30)
P-27	High	Wolf Canyon	*Hemizonia conjugens*	Habitat (H-23), Wildlife (C-25)
P-28 ?	High	Otay River West	*Dudleya variegata* *Hemizonia conjugens*	Habitat (H-24)
P-29	High	Proctor Valley	*Hemizonia conjugens*	—
P-30 -NO	Moderate	Jamul Mountains (West)	*Acanthomintha ilicifolia*	—

Otay lakes

Table 5-2 (con't.)

COVERED PLANT SPECIES FIELD MONITORING LOCATIONS[1]

MONITORING LOCATION[2]	MONITORING PRIORITY[3]	GENERAL LOCATION	SPECIES	OTHER MONITORING[4,5]
P-31	High	Lower Salt Creek	*Dudleya vanegata* *Opuntiaparryi* var. *serpentina*	Habitat (H-26), Wildlife (C-26)
P-32	Moderate	East Otay Mesa	*Brodiaea orcuttii* *Muilla clevelandii*	Habitat (H-27), Wildlife (C-28)
P-33	High	Cedar Canyon	*Brodiaea orcuttii* *Monardella linoides* ssp. *viminea*	—
P-34	High	Marron Valley	*Dudleya vanegata*	Habitat (H-29), Wildlife (C-31)
P-35	Moderate	Northeast San Ysidro Mountains	*Muilla clevelandii*	Habitat (H-28), Wildlife (C-24)

1 Includes only those species for which field monitoring is recommended per Table 5-1.

2 Refer to Figure 5-2 for a depiction of field monitoring locations for covered plant species.

3 If a higher priority species occurs at the same monitoring location, then the site is assigned the higher monitoring priority level in Figure 5-2; however, monitoring within the site may reflect species monitoring priorities (Table 5-1).

4 Refers to other types of monitoring that may occur at the same location; see figures 3-1, 4-1, and 5-6.

5 Under wildlife, C = Coastal sage scrub plots for gnatcatchers and cactus wrens. R = Raptor monitoring locations.

monitoring program. Recommended transect length and quadrat size are provided in Section 5.2.2.4; however, transect length and quadrat size may vary between species and/or populations of the same species, and will be dependent on population size and density. Preliminary sampling will be conducted to determine an adequate number and size of transects and quadrats needed to estimate parameters at each site.

5.2.2.3 **Digital Orthophotography**

Species populations included in the field monitoring program should be mapped on accurate base maps. Refer to Section 3.4.1.4 for a discussion of appropriate digital orthophotographic base maps recommended for use in the monitoring program. The same base maps should be used for all types of monitoring.

5.2.2.4 **Field Monitoring**

Field monitoring will focus on detecting both immediate threats to population viability and long-term trends that indicate population decline. Immediate threats may include habitat loss or degradation (e.g., vehicles, trampling, plant collecting, illegal trash disposal), and will be measured through visual assessments. Natural events that temporarily affect plant populations (e.g., fire or flood) will be recorded, but typically will not be considered detrimental to the long-term survival of a population. Population declines may be harder to assess because many species experience natural fluctuations in population size over time. Efforts will be made to correlate apparent changes in population status with environmental or ecological factors.

Population Parameters

Long-term qualitative habitat monitoring will focus on those population parameters that indicate whether or not a population is expanding, stable, or declining, such as population size, population density, and population structure (e.g., age classes). Parameters to be measured may vary according to species life history. Two additional parameters, survivorship and fitness (e.g., significant decreases in fruit or seed set), are acknowledged as important in identifying causes of population decline but will not be included in the field monitoring program. A discussion of survivorship and fitness, and methodologies for measuring these parameters, are included in Appendix D. Parameters included in this program are discussed below.

Population Size. It is well-recognized that small populations are at an increased risk for extirpation through both short-term, catastrophic events and long-term genetic events that threaten population viability (Allendorf 1983; Gilpin and Soulé 1986; Messick 1986; Falk and Holsinger 1991; Ellstrand and Elam 1993). Although it would be desirable to determine minimum viable population sizes for the plant species of concern and manage populations accordingly, this task is beyond the scope of this monitoring program. All covered species included in the field effort will be monitored to determine trends in population size. Population size data will be correlated with environmental and ecological data, to the degree feasible, to determine possible causes for declining trends. Depending on the cause, significant declines in population size over time may warrant remedial measures to reverse the declining trend.

Population Density. Populations that are too widely dispersed face the same risks as small populations, but are particularly susceptible to adverse genetic effects associated with lowered outcrossing rates. All covered species included in the field effort will be monitored to determine trends in population density. Population density data will be correlated with environmental and ecological data, to the degree feasible, to determine possible causes for declining trends. Depending on the cause, significant declines in population density over time may warrant remedial measures to reverse the declining trend.

Population Structure. For some species, the presence of flowering plants does not provide an adequate indication of the state of the population or its potential for persistence (Oostermeijer et al. 1992). For example, a high percentage of flowering may be observed in a relatively old, feven-aged. stand of plants. By its very structure, however, this population may be more susceptible to extirpation than a population with a lower percentage of flowering but a variety of age classes. Population structure, as measured by the presence of various age classes, can provide an additional indication of the overall vigor and long-term "potential" of a population. The presence of individuals representing more than one stage of a life cycle (e.g., seedlings, juveniles, flowering and nonflowering adults) is representative of a "dynamic" population. Conversely, populations that are characterized by minimal or no seedling recruitment are typically considered "stable," even if there is a high degree of adult flowering or nonflowering individuals. Although stable populations may persist for long periods of time, they have a greater probability of becoming extinct over time due to their lack of recruitment. In addition, stable populations may experience declining trends in population size, even if the rate of mortality is relatively

low, simply because those individuals that do die are not replaced (Oostermeijer et al. 1992).

The presence of age classes within a population will be monitored for most of the herbaceous perennials and shrubs that are on the covered species list and included in the field monitoring program. Exceptions include those species that germinate only in response to fire or other disturbance, form a persistent seed bank, and occur in an area where no recent disturbance has been documented or is otherwise evident. The presence of vegetative reproduction (e.g., clones, stem or corm offshoots) will be considered evidence of a dynamic population.

Monitoring Methodologies

During the initial monitoring effort, a reconnaissance survey will be conducted for all populations included in the field monitoring program. The purpose of this survey will be to refine existing information and establish baseline conditions. Specific objectives of this survey will be to define population limits, estimate population sizes, and map populations onto base maps. The reconnaissance survey is expected to be a one-time effort, and can be eliminated if recent and sufficiently detailed baseline information is available.

Field monitoring will include a qualitative assessment of disturbance factors that may threaten the population. These factors will be recorded on the appropriate data sheets and monitored over time to determine their effect on the target population. Where adverse effects are obvious, however, remedial measures may be implemented immediately.

In most cases, quantitative sampling will occur along established transects. Where plant populations are very small or patchy, permanent quadrats may be established in a stratified random manner instead of along a transect line. The number of transects and/or sampling points, transect length, and quadrat size will be based on species habit, population size, and population density. Number of transects/sampling points will be refined during the initial quantitative monitoring effort through an analysis of the variances of measured parameters. An initial guideline, however, is that the sampling area should encompass at least 5 percent of the total area of the population. Transect length will typically range from 10-100 m. Recommended quadrat sizes are 1 m^2 for herbaceous species or diminutive herbaceous perennials, 4 m^2 for larger herbaceous perennials or subshrubs, and 15-20 m^2 for shrubs. Sampling parameters established during the initial monitoring period will be followed in

subsequent monitoring periods, to the degree feasible. Where deviations occur, these will be well-documented and include an explanation of the rationale for change(s).

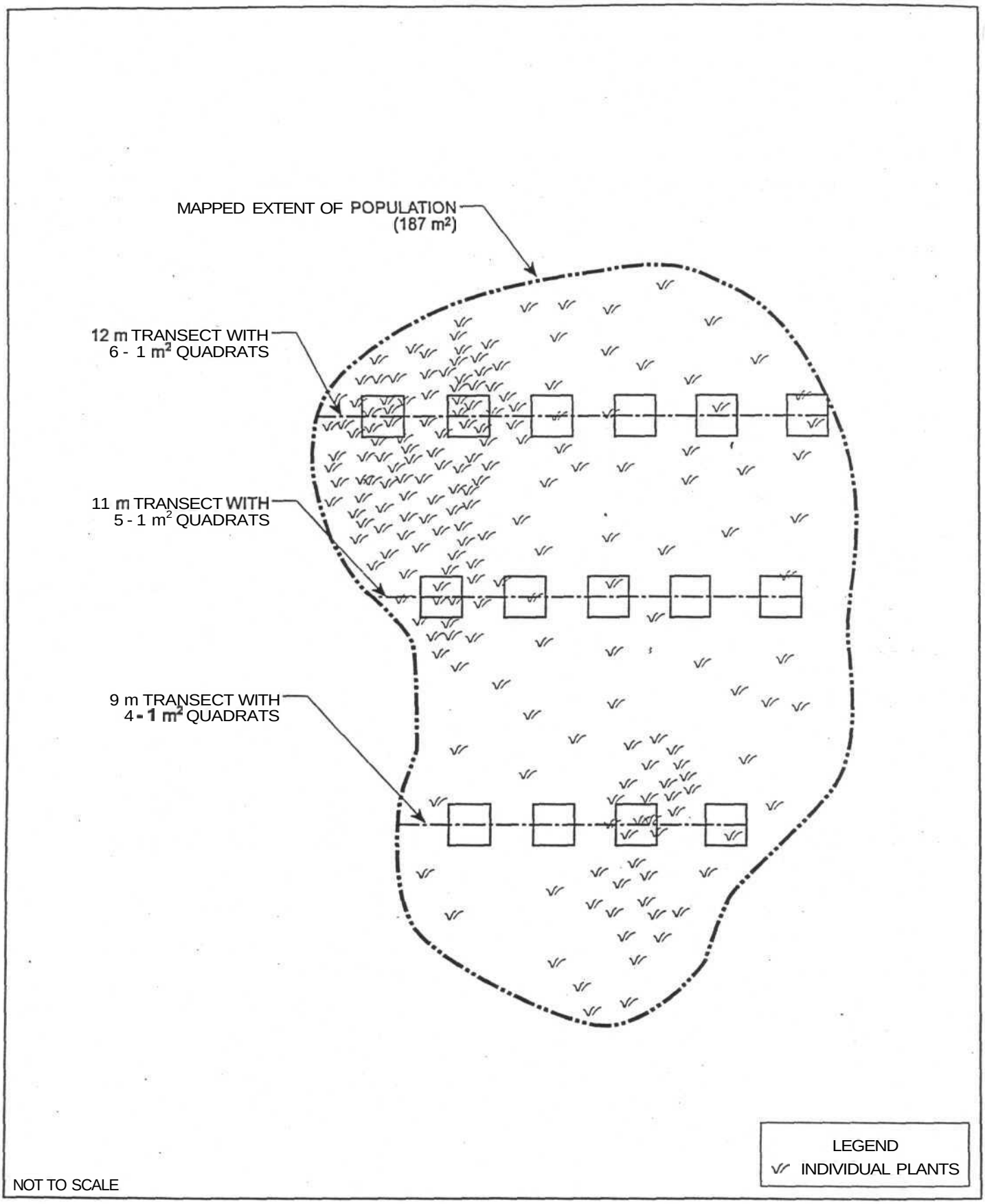
Population Size. Population size will be estimated using both density data (see below) and the cumulative area mapped for the target species population. The areal extent of the sensitive plant population will be mapped as accurately as possible. The mapped area(s) will be planimetered or otherwise evaluated to determine the extent of occupied habitat (e.g., m^2 or acreage). Average plant density within the population will be calculated from the sample quadrats. The estimated population size will then be determined by multiplying the population area by the average plant density. An example of this method of estimating population size is depicted in Figure 5-3. In this example, the average plant density, based on 15-1m^2 quadrats, is 1.9 plants per m^2. If the total area of the mapped population is 187 m^2, then the estimated population size is 355 plants (187 m^2 x 1.9 plants per m^2). The exception to this methodology for estimating plant population size will be where populations are small (e.g., <1000 individuals) and can be accurately censused by direct counts.

Population Density. Density information will be obtained by sampling in appropriately-sized quadrats placed at alternating intervals along the transect line. Individuals of the target species will be tallied only if rooted in the quadrat. Recommended intervals for quadrat sampling are 1 m for herbaceous species or diminutive herbaceous perennials, 5 m for larger herbaceous perennials or subshrubs, and 10 m for shrubs. Sampling intervals may be longer or shorter depending on the area that the population encompasses.

Population Structure. Within the established quadrats, population structure data will be estimated for herbaceous perennials and shrubs by recording all age classes or life states that can be recognized (e.g., seedlings, juveniles, flowering and nonflowering adults).

5.2.2.5 **Photo Plot Monitoring**

In recognition of potential limitations to monitoring budgets and personnel, covered plant species have been prioritized, with field monitoring recommended for those species subject to the most immediate threats from human activities (Section 5.2.1). There is another group of species, however, for which "photo plot" monitoring may be an economical way to assess species persistence. Species recommended for photo plot monitoring are typically



OGDEN

Sampling Design for **Qualitative** Monitoring of Annual or Herbaceous Perennial Covered Plant Species

FIGURE

5-3

less threatened than species included in the field monitoring program or they occur as dominant components of the vegetation, and monitoring of the patches of habitat in which they occur may be an effective way to track population persistence. In either case, the assumption is that if the habitat remains intact, then the species will persist or at least have the ability to persist. Photo plot monitoring will be conducted from satellite imagery and aerial photography as part of the overall vegetation change detection process that is expected to occur at approximately five-year intervals (Sections 3.2.2 and 3.3.2). Photo plot monitoring will focus solely on extrinsic factors (i.e., habitat loss or disturbance) rather than intrinsic factors (e.g., disruption of breeding systems, low seed viability), and will function as an "early warning system" for species. Species- or population-specific field monitoring can be implemented, if warranted by photo plot monitoring results.

5.2.2.6 **Data Collection**

Data collection for field monitoring will follow the standardization and documentation protocols discussed in Section 3.4.1.8. Sample data forms are included in Appendix E.

5.2.2.7 **Data Analysis**

The quantitative plant population data for each site will be analyzed by the wildlife agencies and presented in summary tables and figures. Population parameters measured to indicate whether a population is expanding, stable, or declining include population size, plant density, and population structure (e.g., expressed as age class frequency). The mean and standard deviation plant density will be calculated for each target species within the study site. Population size will be calculated based on the cumulative area of the population and the plant densities within this area, as described above. Population structure will be analyzed by plotting the frequencies of plants in each life stage (i.e., seedlings, juveniles, flowering and nonflowering adults). Baseline data from the initial studies will be compared to site-specific data collected in subsequent years. Population size and mean plant density will be graphed as a function of sampling period to illustrate any changes that have occurred. Appropriate statistical hypothesis tests (e.g., ANOVA and multivariate analysis of variance (MANOVA)) will be employed to facilitate drawing conclusions about population trends. Correlation analyses will be used to test for relationships over time among population size, plant density, and age class frequency. A trend of decreasing population size may indicate that the viability of the population is threatened, particularly with a small population. Simple linear regression, multiple regression, and linear

discriminant function analyses may be used by the wildlife agencies to identify significant relationships between environmental factors, such as temperature, rainfall, fire, flooding, or human encroachment, and the population parameters measured.

In addition to statistical testing, a simple index number will be calculated to show the percentage increase or decrease in the parameters measured over time. The index number is defined as the ratio of one value to the other, multiplied by 100. When the comparison number equals the base number, the resulting index number will have a value of 100.

After multiple years of data are collected, a test for time series analysis may be used by the wildlife agencies to identify significant trends. The major task of a time series analysis is to describe the nature of the variation of a variable at different points in time so that its future values can be predicted (Kachigan 1986). A time series analysis is also used to determine whether a long-term trend is significant or just part of an extended cyclic process of population change.

5.2.3 Schedule

Monitoring frequency for covered plant species will vary according to the type of monitoring (i.e., field versus habitat), species priority level (Table 5-1), and species' habit (e.g., annual versus perennial). Other considerations in monitoring frequency may be population trends noted over time, and budget and personnel available for monitoring. Recommendations for initial field monitoring frequencies are provided in Table 5-3. Because species priorities may shift over time, and additional species may be added to the monitoring program, all habits are included for each priority in this table, regardless of whether or not they are currently represented within that priority level. Table 5-4 provides guidelines for determining monitoring frequencies in the future, should revisions to the recommended monitoring frequencies be warranted based on the above-mentioned considerations. Habitat monitoring for covered plant species will be conducted at approximately five-year intervals, in conjunction with the change detection process for monitoring permanent and temporary habitat losses for vegetation (Sections 3.2.2 and 3.3.2). For this reason, habitat monitoring will be initiated during the first monitoring period, whereas field monitoring for second and third priority species may not be initiated until the second and fifth years of the monitoring program, respectively.

Table 5-3

INITIAL FIELD MONITORING SCHEDULE FOR COVERED PLANT SPECIES

Priority[1]	Habit[2]	Monitoring Frequency
First Priority	Annuals or Herbaceous Perennials (7 species)	Every Year
First Priority	Shrubs (0 species)	5 Years
Second Priority	Annuals or Herbaceous Perennials (5 species)	2 Years
Second Priority[3]	Shrubs (0 species)	5 Years
Third Priority[3]	Annuals or Herbaceous Perennials (0 species)	3 Years
Third Priority	Shrubs (4 species)	5 Years

1 Refer to Section 5.2.1 for a discussion of covered plant species priority levels.
2 Number in parentheses = number of covered species currently in that category.
3 Currcntiy, there are no second priority shrubs or third priority annual or herbaceous perennial plant species that will be included in the field monitoring.

Table 5-4

GUIDELINES FOR DETERMINING FUTURE MONITORING FREQUENCIES FOR COVERED PLANT SPECIES[1,2]

Species or Population Characteristic	Monitoring Frequency	
	More Often	Less Often
Overall Distribution	Few Populations	Widespread
Habitat State	Serai	Climax
Habit	Annual or Herbaceous Perennial	Long-lived Perennial
Population Size	Small	Large
Population Density	Sparse	Dense
Population Structure	Few Age Classes	Several Age Classes
Protected Populations	Few	Several
Risk Factors	High	Low
Taxonomic Distinctiveness	High (e.g., endemic)	Low (e.g., subspecies or variety)

1 Spellerberg 1991.

2 These guidelines are to be used to alter the monitoring frequency recommendations provided in Table 5-3, as warranted by monitoring budgets/personnel and/or the results of several years of monitoring data.

5.2.4 Products

The main product of the covered plant species monitoring will include a report (with accompanying maps) that indicates the status of species at each monitoring location. The first-year monitoring effort will provide the "baseline" for subsequent monitoring years. The report will provide a concise summary of proposed actions, their purpose and priority, schedule for implementation, maintenance frequency, labor and materials, and cost estimate for implementing any proposed actions. If plant species viability monitoring occurs in a year in which a comprehensive report will be prepared, then results of the monitoring and any recommendations will be included in this comprehensive report If monitoring occurs in an alternate year, a brief status report will be prepared, as outlined in Section 6.0, with complete results and recommendations included in the next comprehensive report (Section 6.0).

5.2.5 Cost

Costs for field monitoring of covered plant species will vary from year to year, depending on species to be monitored and type of report to be prepared. Over a 10-year time frame, costs (in 1996 dollars) are expected to range from approximately $52,720 to $117,320 per monitoring year (Table 5-5). Costs for the first year of field monitoring (baseline data collection and sampling design set-up at all monitoring locations plus monitoring of first priority annual and herbaceous perennial species) are estimated to be approximately $107,500. Of this total, $54,800 are considered one-time costs associated with baseline data collection and sampling design set-up. Thereafter, yearly monitoring of first priority annuals and herbaceous perennials is estimated to be $47,280 per monitoring period, excluding report preparation. Monitoring of second priority annuals and herbaceous perennials (every 2 years) is estimated at $37,960 per monitoring period (excluding report preparation), while monitoring of third priority shrubs (every 5 years) is estimated at $26,640 per monitoring period (excluding report preparation). Costs per plant population monitored (excluding baseline data collection, sampling design set-up, and report preparation) is approximately $2250 per monitoring period. Report preparation is estimated at $5440 for status reports and $12,520 for comprehensive reports. Photo plot monitoring for selected covered plant species (not included in Table 5-5) is estimated at $15,480 per monitoring period. Monitoring and report costs assume all monitoring sites have been dedicated to the MSCP preserve; however, this may occur over a period of several years. In addition to potential costs associated with acquisition of digital

Table 5-5

SUMMARY OF COSTS FOR FIELD MONITORING FOR COVERED PLANT SPECIES

Tasks	Monitoring Year 1	2	3	4	5	6	7	8	9	10
Baseline Data Collection	$23,300	---	---	---	---	---	---	---	---	---
Sampling Design Set-up	$31,500			—	. . . . .		---	---	---	---
Field Effort[1]										
• First Priority Species	$42,000	$42,000	$42,000	$42,000	$42,000	$42,000	$42,000	$42,000	$42,000	$42,000
• Second Priority Species	---	$34,000		$34,000		$34,000	—	$34,000		$34,000
• Third Priority Species	---	---	---	---	$24,000	—				$24.000
Data Analysis										
• First Priority Species	$5.280	$5,280	$5,280	$5,280	$5,280	$5,280	$5,280	$5,280	$5,280	$5,280
• Second Priority Species	---	$3,960		$3,960		$3,960		$3,960	— .	$3,960
• Third Priority Species	---	---	---	---	$2,640	— .				$2,640
Report Preparation										
• Comprehensive	---	---	$12,520	—	---	$12,520	—	—	$12,520	---
• Status	$5.440	$5.440		$5,440	$5.440		$5,440	$5.440		$5.440
Subtotal Costs[2,3]										
• First Priority Species	$52,720	$52,720	$59,800	$52.720	$52,720	$59,800	$52,720	$52,720	$59,800	$52,720
• Second Priority Species	---	$37,960		$37.960		$37,960		$37,960		$37,960
• Third Priority Species	---	---	---	---	$26,640	—				$26,640
Total Costs	$107,520	$90,680	$59,800	$90,680	$79,360	$97,760	$52.720	$90,680	$59.800	$117,320

1 Costs assume 21 monitoring locations for first priority species, 17 monitoring locations for second priority species, and 12 monitoring locations for third priority species. However, actual costs will depend on the number of locations that have been dedicated to the MSCP preserve system in any one monitoring period.

2 Subtotal costs for first priority species in Year 1 exclude baseline data collection and sampling design set-up.

3 For all monitoring years, report preparation costs are included in the subtotal costs for first priority species.

orthophotography, color aerial photographs, and purchase of a GPS device cited in Section 3.4.4., a maximum of an additional $3400 could be required for the purchase of color aerial photographs during any one survey year. This assumes that all plant monitoring locations would require a color photograph.

5.3 ANIMAL SPECIES MONITORING

5.3.1 Prioritization of Covered Animal Species Monitoring Efforts

Monitoring of focal wildlife populations is prioritized toward species that are considered indicators of ecosystem function and species whose population status are of concern to the USFWS and CDFG. The focal species selected for monitoring are key coastal sage scrub-dependent species (California gnatcatcher and coastal cactus wren), upland reptile species, arroyo southwestern toad, and grassland-dependent raptors (northern harrier, golden eagle, burrowing owl).

5.3.2 Methodology

The goal of population monitoring is to implement a monitoring program that is sufficient to detect significant long-term declines in population levels of focal species within the preserve system. This requires a consistent time series of population size estimates of monitoring plots to detect population trends at the plot and preserve-wide scales (cumulative trend across plots). This monitoring design is similar to programs already initiated for other endangered animal species (e.g., least Bell's vireo, California least tern, Kirtland's warbler, spotted owl). However, unlike these other programs, most of the focal sage scrub species are much more numerous and evenly distributed throughout the landscape, which precludes complete surveys of all of the potential habitat within the preserve. Thus, a subsampling approach must be used.

5.3.2.1 Monitoring Locations

Locations for monitoring changes in population size of focal species are listed in Table 5-6 and depicted in Figures 3-1 and 4-1. These locations were selected so that there is even geographical coverage of the focal habitats and there are plots in areas where populations of the focal species are known or are suspected to be present.

Table 5-6

WILDLIFE MONITORING LOCATIONS[1]

MONITORING LOCATION[2]	GENERAL LOCATION	TYPE OF MONITORING	OTHER MONITORING[3,4]
C-1	Western Santa Fe Valley	Coastal Sage Scrub-dependent Species	—
C-2	Eastern Santa Fe Valley/4-S Ranch	Coastal Sage Scrub-dependent Species	Habitat (H-3)
C-3	Lake Hodges	Coastal Sage Scrub-dependent Species	Habitat (H-2)
C-4	San Diego Wild Animal Park	Coastal Sage Scrub-dependent Species	Habitat (H-1)
C-5	Eastern San Pasqual Valley	Coastal Sage Scrub-dependent Species	
C-6	North Poway	Coastal Sage Scrub-dependent Species	—
C-7	Black Mountain (west side)	Coastal Sage Scrub-dependent Species	—
C-8	Central Poway	Coastal Sage Scrub-dependent Species	—
C-9	Los Peñasquitos Preserve	Coastal Sage Scrub-dependent Species	—
C-10	South Poway	Coastal Sage Scrub-dependent Species	Habitat (H-12)
C-11	Northwest San Vicente Reservoir	Coastal Sage Scrub-dependent Species	Habitat (H-13)
C-12	South San Vicente Reservoir	Coastal Sage Scrub-dependent Species	—
C-13	Mission Trails Regional Park	Coastal Sage Scrub-dependent Species	Habitat (H-15)
C-14	Fanita Ranch	Coastal Sage Scrub-dependent Species	—
C-15	Wildcat Canyon (south end)	Coastal Sage Scrub-dependent Species	—
C-16	Lake Jennings	Coastal Sage Scrub-dependent Species	—
C-17	Lakeside/Crest	Coastal Sage Scrub-dependent Species	Habitat (H-16)
C-18	McCinty Mountain and Vicinity	Coastal Sage Scrub-dependent Species	Habitat (H-17)
C-19	McGinty Mesa	Coastal Sage Scrub-dependent Species	
C-20	Rancho San Diego (southern half of Campo Village North)	Coastal Sage Scrub-dependent Species	---
C-21	Northwest San Miguel Mountain	Coastal Sage Scrub-dependent Species	—
C-22	Rancho Del Rey	Coastal Sage Scrub-dependent Species	—
C-23	Southwest Jamul Mountains	Coastal Sage Scrub-dependent Species	Habitat (H-20)
C-24	Northeast San Ysidro Mountains	Coastal Sage Scrub-dependent Species	Habitat (H-28), Plants (P-35)
C-25	Wolf Canyon	Coastal Sage Scrub-dependent Species	Habitat (H-23), Plants (P-27)
C-26	Lower Salt Creek	Coastal Sage Scrub-dependent Species	Habitat (H-26), Plants (P-31)
C-27	Southeast Otay Reservoir	Coastal Sage Scrub-dependent Species	—
C-28	East Otay Mesa	Coastal Sage Scrub-dependent Species	Habitat (H-27), Plants (P-32)
C-29	Goat Canyon - Spooner's Mesa	Coastal Sage Scrub-dependent Species	Habitat (H-21), Plants (P-23)
C-30	Spring Canyon	Coastal Sage Scrub-dependent Species	Habitat (H-25), Plants (P-26)
C-31	Marron Valley	Coastal Sage Scrub-dependent Species	Habitat (H-29), Plants (P-34)
H-1	Wild Animal Park	Reptile Diversity	Habitat (H-1), Wildlife (C-4)
H-7	Torrey Pines Main Reserve	Reptile Diversity	Habitat (H-7)
H-13	Northwest San Vicente Reservoir	Reptile Diversity	Habitat (H-13), Wildlife (C-11)
H-15	Mission Trails Regional Park	Reptile Diversity	Habitat (H-15), Wildlife (C-13)
H-16	Lakeside/Crest	Reptile Diversity	Habitat (H-16), Wildlife (C-17)
H-17	McGinty Mountain	Reptile Diversity	Habitat (H-17), Wildlife (C-18)
H-18	Rancho San Diego	Reptile Diversity	Habitat (H-18)
H-21	Spooner's Mesa	Reptile Diversity	Habitat (H-21)

Table 5-6 (Continued)

WILDLIFE MONITORING LOCATIONS[1]

MONITORING LOCATION[2]	GENERAL LOCATION	TYPE OF MONITORING	OTHER MONITORING[3,4]
H-23	Wolf Canyon	Reptile Diversity	Habitat (H-23), Plants (P-27), Wildlife (C-25)
H-26	Lower Salt Creek	Reptile Diversity	Habitat (H-26), Plants (P-31), Wildlife (C-26)
H-27	East Otay Mesa	Reptile Diversity	Habitat (H-27), Plants (P-32), Wildlife (C-27)
H-29	Marron Valley	Reptile Diversity	Habitat (H-29), Plants (P-34), Wildlife (C-31)
R-1	East San Pasqual Valley	Grassland (Raptor) Species	—
R-2	Santa Fe Valley and Future Urbanizing Area	Grassland (Raptor) Species	—
R-3	Fanita Ranch and Vicinity (Santee)	Grassland (Raptor) Species	—
R-4	Mission Trails Regional Park	Grassland (Raptor) Species	—
R-5	San Miguel Mountain	Grassland (Raptor) Species	Habitat (H-19), Plants (P-19)
R-6	North Jamul Mountains	Grassland (Raptor) Species	—
R-7	East San Ysidro Mountains	Grassland (Raptor) Species	—
R-8	Rancho Del Rey/Poggi Canyon	Grassland (Raptor) Species	—
R-9	Otay Mesa	Grassland (Raptor) Species	—
R-10	Southwest San Ysidro Mountains	Grassland (Raptor) Species	—
T-1	Kimball Valley, San Vicente Reservoir to Daney Cyn.	Arroyo Toad	—
T-2	San Vicente Creek, Daney Canyon to Wildcat Canyon Road	Arroyo Toad	---
T-3	Sloan Canyon, Singing Hills Golf Course to Loveland Dam	Arroyo Toad	—
T-4	Rancho San Diego, Highway 94 to Willow Glen Road	Arroyo Toad	---
T-5	Sweetwater River, Sweetwater Reservoir to Highway 94	Arroyo Toad	—
T-6	Cottonwood Creek, Tijuana River to Highway 94	Arroyo Toad	—
T-7	Tijuana River, Mexican Border to Cottonwood Creek	Arroyo Toad	---

' Includes only prioritized covered animal species.

2 Refer to Figures 3-1 and 4-1 for a depiction of wildlife monitoring locations.

3 Refers to other types of monitoring that may occur at the same location; see Figures 3-1 and 5-2.

4 Refer to Table 3-1 for a complete list of habitat monitoring locations; refer to Table 5-2 for a complete list of field monitoring locations for covered plant species.

5.3.2.2 Monitoring Plots

The parameter to be measured by this field sampling program is the presence/absence and abundance of focal species within the designated monitoring plots. Monitoring plots correspond to the locations listed in Table 5-6 and shown in Figures 3-1 and 4-1. Plot size will vary depending on the habitat. For example, coastal sage scrub plots will be limited to a maximum of 200 acres due to the extensive amount of coastal sage scrub available. Some coastal sage scrub plots may be less than 200 acres due to lack of available habitat, but a minimum plot size should be 100 acres. Grassland plots may be larger than 200 acres due to the wide-ranging habits of the focal raptor species. Any known burrowing owl breeding localities would need to be included in the grassland area being monitored.

5.3.2.3 Coastal Sage Scrub Monitoring

Gnatcatcher and Cactus Wren Surveys

A standard protocol for surveying California gnatcatchers and coastal cactus wrens has been developed and used to generate much of the existing regional database for San Diego County. In order to develop comparable trends this protocol will continue to be followed in this monitoring program. This survey protocol is detailed below.

Survey Frequency. Gnatcatchers/wrens are difficult to detect and can easily be missed with just one site visit. At a minimum, a given area within a plot will be surveyed twice with at least a 7-day interval between site visits during January through mid-March. A third site visit to the plot will focus on relatively large areas of the plot (i.e., >20 acres) that lack any gnatcatcher/wren sightings after two site visits. Survey efforts for each plot will be approximately 30 cumulative field hours.

Time of Day. Surveys will begin within 1 hour after sunrise and end by noon. Surveys will begin later in the morning when ambient morning temperatures are less than 40°F.

Areal Coverage of Survey. The calling rate of California gnatcatchers is highly variable. Relatively slow, methodical transects through presumptive gnatcatcher habitat are required to maximize the potential for detecting gnatcatchers/wrens. Rate of coverage will be 100 acres per person per 5 hours of survey effort. Surveys are most effective when pairs of biologists survey an area together in order to distinguish between pairs and minimize

double counting of the same pair/individual. Individuals detected at the plot boundary will be classified as to whether the majority of their territory is within the plot boundaries. Inclusion of marginal territories will cause an overestimate of population density and size.

Survey Weather Conditions. Gnatcatchers/wrens may be more difficult to detect under windy (> 10 mph) and/or cold (< 40 °F) conditions. Very hot conditions (> 95 °F) also seem to depress activity. Surveys will not be conducted under these extreme conditions.

Taped Vocalizations. Taped vocalizations will be used on all surveys since there may be extensive inter-observer variation in pishing. Volume of tape players should be similar to that of a quiet mew call or contact note produced by a California gnatcatcher/cactus wren. Excessive volume can either draw in or scare off birds from their normal territory and thus influence the estimate of population size. Use of the tape should be infrequent in both time and space. Allow sufficient time for the birds to respond (e.g., 5-10 minutes) before playing the tape again. Do not induce detected birds to follow the taped call, thereby minimizing potential double counting.

Survey Routes. Survey routes through the plot will be systematic so that the area is completely covered. Survey routes will be varied relative to time of day between visits. A ziz-zag pattern that starts from the center of the plot and moves toward the periphery of the habitat patch is highly recommended. Distinct topographical features (e.g., ridgelines or major trails) often form the boundaries between gnatcatcher territories. Note the location of territorial behavior if observed.

Detailed Recording of Sighting Information. Gnatcatcher/cactus wren sightings will be recorded on a standard field data form (Appendix F), as well as on a standard field topographic map of the plot (e.g., the orthophotographic base maps discussed in Section 3.4.1.4) . Information to be recorded for each sighting will include the following:

- Date and start/stop time of sighting
- Sex and age of individual(s)
- Are any of the birds detected color banded? — record the color code
- Habitat type, dominant plant species, and vegetative condition (i.e., extent of disturbance)
- Is the sighting a single bird, a pair, or a family group?
- Is there any evidence of breeding activity (e.g., nesting behavior)?

- Are there any other sensitive coastal sage scrub species in the vicinity of the sighting?

5.3.2.4 Herpetofauna Monitoring

Upland Reptile Species Diversity Monitoring

Upland reptile species diversity will be monitored at a selected number of fixed sites. Essential information to be obtained includes species presence and relative abundance and diversity.

Monitoring Sites. A minimum of twelve sites will be censused for upland reptile species, using several of the same general locations selected for habitat monitoring (Figure 3-1). These include: H-1 (Wild Animal Park - coastal sage scrub [CSS]), H-7 (Torrey Pines State Reserve - CSS/southern maritime chaparral [SMC]), H-13 (Northwest San Vicente Reservoir - CSS), H-15 (Mission Trails Regional Park - CSS), H-16 (Lakeside/Crest - CSS), H-17 (McGinty Mountain - CSS), H-18 (Rancho San Diego - CSS), H-21 (Spooner's Mesa - maritime succulent scrub [MSS]), H-23 (Wolf Canyon - MSS), H-26 (Lower Salt Creek - MSS), H-27 (East Otay Mesa - CSS), and H-29 (Marron Valley - CSS).

Monitoring Method. Pit trap arrays will be used for monitoring upland species. A minimum of five arrays will be installed at each monitoring site, covering at least 100 acres (maximum array density of 1 array per 20 acres of suitable habitat). Arrays will be constructed and installed per the protocol developed by UCSD in association with the wildlife agencies.

Monitoring Frequency. Pit trap arrays will be opened for a minimum 5-day interval and checked daily. One 10-day sampling period or two 5-day sampling periods will occur in May/June, and one 5-day sampling period will occur in August/September. Each site will be monitored every other year, with half of the sites monitored in a given monitoring year.

Data Collection and Analysis. One biologist and one wildlife technician will check and record all information from a monitoring site in 4 hours (including 1 hour travel time). All data will be collected on standardized forms (Appendix F) to facilitate data transfer to an electronic format. Field data will be analyzed and a report prepared that includes the

following for each site: (1) list of all reptile species captured or observed within 100 ft of each pit trap array; (2) relative abundance of each species; (3) species diversity index (e.g., Simpson index or Shannon-Weaver Index); and (4) an assessment of any changes to the physical setting or immediate surroundings of each site (fires, development, obvious habitat disturbance, etc.).

Costs. Pit trap array installation will be completed by wildlife technicians. Arrays need to be constructed at seven new sites. Assuming three arrays can be installed each day by two technicians, the total effort for array installation is 210 hours. Materials costs are $150 for each pit trap array and three snake traps, or a per site cost of $750 (five arrays/site). These one-time installation costs total $10,800 for seven sites (35 arrays).

Pit trap field monitoring costs assume one associate biologist and one technician will spend 4 hours per site (including 1 hour travel time). Each site will be monitored for 15 days per year. The per site field cost is $4420/site/year. This includes travel expenses, miscellaneous supplies to maintain the arrays, and food for "pit trapped" animals. Annual field cost for six sites is $26,520. Data reduction, analysis, report preparation, and administration costs would be $14,500 annually. Total annual cost for six monitored sites, not including cost of array installation, would be $41,022 ($6837/site/year). The initial year's cost including array installation would be $51,820.

Arroyo Southwestern Toad Surveys

The focused survey protocol for arroyo southwestern toad was developed by the USFWS. Riparian plots in seven locations (Table 5-6) will be surveyed once every three years. Three site visits will be made between late March and late May by qualified and permitted biologists familiar with the male arroyo toad's breeding call and identification of toad eggs, tadpoles, and adults.

Time of Day. Surveys should occur between 1 hour after dusk and midnight on nights lacking a full moon. Surveyors must be silent during surveys so as not to disturb calling toads. Strong flashlights are used to visually identify adult toads; otherwise lighting should be kept to a minimum. Surveyors must not enter the water near mating pairs, and minimize their time near mating pairs. Do not handle any toads.

Survey Weather Conditions. Avoid surveying on night when air temperatures at dusk are less than 55 °F or during rain, high winds, or flood flows. Surveys are best conducted after warm spring rains.

Survey Routes. Survey along the bank of the watercourse 10 ft back from the water's edge. If possible, survey up one bank and back along the other, concentrating on open habitats adjacent to suitable breeding habitats. Stop, listen ahead for calls, then proceed to the next listening point until all suitable habitat has been covered. Shine a bright light ahead to detect eyeshine as well as keeping a visual survey for toads at close range. If stream crossings are necessary, they should be accomplished at the downstream ends of potential breeding areas or on stable substrate, to avoid trampling eggs or larvae, and to avoid clouding the water with silt, which can smother eggs and young.

Detailed Recording of Sighting Information. Each sighting of a toad, egg mass, or group of tadpoles must be entered as a separate line on the standard field form, as well as on a field topo map of the plot. This map should be at least 1"=200' (1:2400) scale. Other species observed should be noted, and other sensitive species recorded and mapped.

5.3.2.5 **Grassland** (Raptor) **Monitoring**

Monitoring populations of golden eagles, northern harriers, and burrowing owls is difficult due to their large home ranges and varied nesting requirements. Burrowing owls are a semi-colonial species that nest within grassland habitats. All known burrowing owl breeding localities within the preserve should be monitored for level of occupation; thus, grassland plot delineation needs to account for the known distribution of burrowing owls.

Survey Frequency. Grassland plots used to monitor these three raptor species will be surveyed eight times for raptor use from July through September. This is the time period when family groups can be detected and an index of productivity can be estimated.

Time of Day. Each visit to a monitoring plot will be limited to the mid-day (0900 to 1500 hours), which is the time of day when birds are most active over grassland habitats. The duration of a site visit will be at least 3 hours (cumulative effort: 30 field hours per plot).

Areal Coverage of Survey. Survey routes will be varied relative to time of day between visits. Two adjacent grassland plots will be surveyed in one day whenever possible in order to minimize travel time.

Detailed Recording of Sighting Information. All raptor species sightings will be recorded on standard field forms (Appendix F), as well as on a standard field topographic map (e.g., the orthophotographic base maps discussed in Section 3.4.1.4) of the plot. Information to be recorded includes species, number of individuals, age class (adult/juvenile), and behavior during observation. Nesting locations of burrowing owls and northern harriers also will be mapped. In addition, sightings of other raptors and other sensitive species, such as grasshopper sparrow, will be documented.

5.3.2.6 Data Analysis

Data analysis for wildlife species will utilize trend analysis methods. The statistical analysis of time-series data for trends has received extensive attention (e.g., Ralph and Scott 1981; Verner 1985; Sauer and Droege 1990; Gerrodette 1987, 1993). Once a sufficient time-series of data points for each plot is developed, long-term trend analyses can be conducted by the wildlife agencies. The number of years of data necessary to reliably identify a long-term population decline is dependent on the variability of the data. Time-series with high variability will require longer time frames for a definitive detection of population decline. In the short-term, presence/absence and relative abundance of each plot and the cumulative total for all plots will be calculated for each monitoring cycle. For the focal coastal sage scrub species, the number of occupied sites, site turnover rate, and change in plot population size between years will be indicative of at least short-term variation in local population levels which can be related to weather and site conditions (e.g., cold weather induced population decline). Autocorrelated fluctuations in population size between sites can be discerned. The degree of inter-site correlation will likely be a function of distance between sites. If a negative population trend is detected, then a more intensive investigation of the potential causes of the population decline (e.g., cowbird parasitism) should be initiated.

5.3.3 Schedule

The animal monitoring program will be scheduled so that staff time is available to complete the monitoring program for coastal sage scrub birds, grassland raptors, and arroyo

southwestern toads over a three-year cycle. Each survey effort will be conducted once every three years and should be staggered to minimize staffing and budgetary conflicts. Upland reptile species sites will be monitored every other year, with half of the sites monitored in a given monitoring year.

5.3.4 Products

A monitoring report documenting the results of the year's survey efforts will be prepared within six months of the completion of field work. This report will identify any management actions (e.g., more detailed investigations) required to clarify or resolve problems identified by the monitoring program.

5.3.5 Cost

Thirty field hours per plot for each species group is the assumed level of effort for coastal sage scrub and grassland plots for wildlife monitoring. This assumed level of effort was used to estimate costs. According equal effort per plot across years will provide comparable indices of abundance and allow for detection of long-term trends. The cost per plot (in 1996 dollars) varies from $2,700 to $6,837 for the focal animal species surveys (Table 5-7). The annual costs for these survey efforts vary from $27,160 to $83,700. The total cost to complete a three year cycle of animal surveys is approximately $226,104. Costs in Table 5-7 do not include preparation of a comprehensive report, which is required every three years. The total cost for a comprehensive report that encompasses all wildlife monitoring is estimated to be $7,000. Monitoring and report costs assume all monitoring locations have been dedicated to the MSCP preserve; however, this may occur over a period of several years. Additional costs associated with acquisition of digital orthophotography are discussed in Section 3.4.4.

Table 5-7

COST ESTIMATE FOR ANIMAL SPECIES MONITORING

	Coastal Sage Scrub Birds (31)1	Reptile Species (12)[2]	Arroyo Toad (7)1	Grassland (Raptors) (10)1
Field Effort (Per Plot)	$2,000	$4,420 '	$2,880	$2,000
Data Analysis/Report Preparation (All Plots)[3]	$11,300	$8,500	$4,000	$7,200
Coordination/Senior Review (All Plots)	$10,000	$6,000	$6,000	$6,000
Total Costs (Per Plot)	$2,700	$6,837	$3,880	$3,300
Total Costs (Per Survey Year)	$83,700	$41,022[4]	$27,160	$33,200

1 Number in parentheses = number of monitoring locations to be surveyed once every three years. Monitoring and report costs assume all monitoring locadons have been dedicated to the MSCP preserve; however, this may occur over a period of several years.

2 Reptile diversity sites monitored every other year, six sites in each year.

3 Does not include the cost of comprehensive reports, which are estimated at an additional $7,000 every three years (see Table 9-1, Section 9.0).

4 Initial year's cost is $51,820 due to installation of pit trap arrays.

6.0 REPORTING PROGRAM

The reporting program will be the primary vehicle for (1) providing monitoring results and (2) notifying preserve managers of habitats or species within their jurisdictions that require specific management activities. Key components of the reporting program will be comprehensive monitoring reports (prepared every three years) and resource-specific status reports (prepared in each of the intervening two years between comprehensive reports). Where monitoring indicates that biological resources are imminently threatened and in need of immediate attention, interim letter reports may be used to document problems and notify the appropriate personnel in a more timely fashion. All monitoring reports will be reviewed by the USFWS and CDFG. The reporting efforts will achieve the plan objectives of describing new biological data, providing results of impact evaluations, evaluating management activities and enforcement difficulties, and evaluating funding needs and the ability to accomplish resource management goals.

A comprehensive monitoring report will be prepared every three years, and will include both a synthesis of all data collected in the preceding three years and an analysis of overall trends in biological resources. Because of the schedule for various monitoring activities (Table 6-1), not all resources will be covered in every comprehensive monitoring report. This report will:

- Summarize monitoring efforts, according to each of the major monitoring categories (permanent habitat losses, temporary habitat losses, habitat viability, corridors, covered species). Monitoring results can be grouped according to the subarea in which they occur, although an overview of the entire MSCP preserve, or at least an area larger than a subarea, will be important for certain biological resources (e.g., gnatcatcher).

- Identify management needs and provide specific management recommendations for the coming three-year period.

- Prioritize management needs within each subarea.

- Evaluate monitoring priorities for the coming three-year period and detail any proposed shifts in monitoring priorities.

Table 6-1

MONITORING AND REPORTING SCHEDULE

TYPE OF MONITORING/REPORTING	MONITORING YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	20	21
HABITAT MONITORING (29)[1]																					
•Permanent Habitat Losses	X					X					X					X					X
•Temporary Habitat Changes	X					X					X					X					X
•Habitat Value	X					X					X					X					X
CORRIDOR MONITORING (29)2																					
	X			X			X			X			X			X			X		
COVERED SPECIES MONITORING																					
•Climatic Data	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
•Plant Species[3]																					
- Field Monitoring																					
First Priority/Annuals or Herbaceous Perennials	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
First Priority/Shrubs					X					X					X					X	
Second Priority/Annuals or Herbaceous Perennials		X		X		X		X		X		X		X		X		X		X	
Third Priority/Shrubs					X					X					X					X	
- Photo Plot Monitoring (all species)	X					X					X					X					X
•Animal Species																					
- Gnatcatcher (31)[2]	X			X			X			X			X			X			X		
- Cactus Wren (31)[2]	X			X			X			X			X			X			X		
- Reptiles (12)[4]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
- Arroyo Southwestern Toad (7)[2]		X			X			X			X			X			X			X	
- Raptors (10)[2]		X			X			X			X			X			X			X	
REPORTING																					
•Comprehensive Reports			X			X			X			X			X			X			X
•Status Reports[5]	X	X		X	X		X	X		X	X		X	X		X	X		X	X	

1 Number of locations to be monitored once every 5 years.
2 Number of locations to be monitored once every 3 years.
3 See Table 5-3 for number and frequency of plant species monitoring.
4 Total of 12 sites; only 6 sites will be monitored in a given monitoring year.
5 Status reports shall be prepared only for biological resources monitored during that year.

- Evaluate funding needs for the coming three-year monitoring period.

Resource-specific status reports will be prepared on a yearly basis (except when a comprehensive report is scheduled) for all biological resources that have been monitored during that year. These reports will summarize data and provide a brief synopsis of resource status, problem areas, proposed management recommendations, and a schedule for implementation of management activities. Threats to resources that require immediate action or a change in the monitoring schedule will be detailed. These reports also will be used in preparing the comprehensive report.

Interim letter reports will be prepared on an as-needed basis, and only where monitoring indicates that immediate management action is required to preserve biological resources. These reports will describe the problem and provide specific management recommendations to the appropriate jurisdiction(s)/special districts to correct the problem. Issues outlined in the interim letter reports should be described in more detail in the status or comprehensive reports (including supporting data).

- Evaluate funding needs for the coming three-year monitoring period.

Resource-specific status reports will be prepared on a yearly basis (except when a comprehensive report is scheduled) for all biological resources that have been monitored during that year. These reports will summarize data and provide a brief synopsis of resource status, problem areas, proposed management recommendations, and a schedule for implementation of management activities. Threats to resources that require immediate action or a change in the monitoring schedule will be detailed. These reports also will be used in preparing the comprehensive report

Interim letter reports will be prepared on an as-needed basis, and only where monitoring indicates that immediate management action is required to preserve biological resources. These reports will describe the problem and provide specific management recommendations to the appropriate jurisdiction(s)/special districts to correct the problem. Issues outlined in the interim letter reports should be described in more detail in the status or comprehensive reports (including supporting data). This Page Intentionally Left Blank

7.0 REMEDIATION AND ADAPTIVE MANAGEMENT

Report documents will provide specific management recommendations to reverse declining trends in habitat or species' populations. Although it is difficult to anticipate the types of remediation that will be requked prior to monitoring, potential actions may include the following:

- Fencing, signage, or redirecting trails to protect habitat or species populations from trampling or other adverse, direct impacts;

- Removal of invasive exotic plant species to protect native habitats, plant populations, and wildlife values;

- Removal or control of nonnative animal species (e.g., cowbirds, feral cats) to protect native animal populations;

- Erosion control measures to protect key habitats or populations of covered species;

- Habitat enhancement to provide pollinator habitat, breeding areas for covered wildlife species, or structural diversity for covered wildlife species;

- Habitat restoration to reverse the effects of habitat disturbance and/or improve habitat quality for covered species where natural regeneration processes are expected to be unacceptably slow or delayed;

- Prescribed burns (or alternative, mechanized methods) to revitalize senescent stands of habitat or promote germination of fire-adapted covered plant species (note: prescribed burns likely will be limited in urbanized portions of the reserve);

- Plant population enhancements where preserved population numbers become so low due to human- or environmentally-induced factors as to threaten the continued viability of the population, and where suitable habitat and other factors necessary for survival still exist; and

- Plant population reintroductions in areas where species populations have been inadvertently extirpated, or into historical but unoccupied habitat where overall number of populations is less than five.

Adaptive management may include reconfiguring preserve boundaries to include more or different habitat if a species is declining, or reprioritizing monitoring efforts.

Implementation of management activities will be the responsibility of individual subareas. Monitoring results and the resultant degree of management required may result in a shift in monitoring priorities over time, as mentioned above. For example, if a specific population proves to be stable over a period of time (e.g., 10-20 years), then the frequency of monitoring may be reduced, particularly if its habitat and physical site characteristics remain unchanged and another species or population requires more intensive monitoring due to declining trends. The remediation and adaptive management program will achieve the objectives of providing correcting actions where (1) resources are threatened by land uses in and adjacent to the preserve, (2) current management activities are not adequate or effective, or (3) enforcement difficulties are identified.

8.0 RESEARCH RECOMMENDATIONS

Following is a summary of recommendations for future studies that would advance our knowledge and improve our ability to manage for the covered species and their habitats. Population and distribution studies, for example, could aid in the characterization and prioritization of areas for preservation or the refinement of preserve planning area boundaries in subarea planning, while other studies would help in managing preserve areas and individual target species once preserves are established. Some of these studies may be conducted as part of future subarea and project planning efforts, whereas others will be the focus of longer-term university or agency research projects. These research recommendations are not included in the monitoring plan budget.

The research recommendations provided below can be grouped into several generalized categories, including basic inventories, taxonomic studies, core and linkage studies, habitat and life history studies, population biology and genetic studies, habitat restoration and/or population reestablishment studies, and management studies. These recommendations are consistent with the research agenda recommended by the Scientific Review Panel for the State's Natural Communities Conservation Planning (NCCP) program. Additional recommendations may be generated based on results of the monitoring program and/or findings of the studies recommended below.

Inventories

- Conduct reconnaissance level surveys of large representative subplots (ca. 300 acres in size) within the easternmost area of the MSCP study area where biological resource information is considered insufficient to assess biodiversity and habitat value.

- Conduct surveys to better determine the distribution and/or extent of certain covered species (e.g., *Lotus nuttallianus, Cordylanthus orcuttianus, Ambrosia pumila*).

Taxonomic Studies

- Conduct taxonomic studies or otherwise resolve the taxonomic validity and thus, the legal status of certain covered plant species (e.g., *Caulanthus*

stenocarpus, Erysimum ammophilum, Opuntiaparryi var. *serpentina, Solarium tenuilobatum*).

- Investigate the recent merging of *Corethrogyne filaginifolia* var. *linifolia* into the more common and widespread taxon, *Lessingia filaginifolia* var. *filaginifolia.* This will require further studies on the distribution and morphological differences between these taxa (Skinner et al. 1995).

Core and Linkage Studies

- Using vegetation and topography, identify potential alternative wildlife corridors and habitat linkages between proposed preserve areas. Assess the relative use of potential linkages by tracking focal covered animal species. Identify opportunities to enhance degraded linkages (e.g., retrofit existing roads with wildlife undercrossings, restore disturbed vegetation, use fencing, etc.).

- Conduct multi-year nestling banding programs of California gnatcatcher and coastal cactus wren within and adjacent to the following regional habitat linkages (listed in order of priority):

  - Lake Jennings/Lakeside/Crest/El Cajon
  - Los Penasquitos Canyon/Beeler Canyon/South Poway
  - Los Penasquitos Canyon/Black Mountain/Santa Fe Valley
  - Rancho del Rey/Poggi Canyon/Lower Salt Creek/San Miguel Mountains
  - Lower Salt Creek/Spring Canyon
  - Rancho Cielo/Santa Fe Valley/Lake Hodges
  - Lake Hodges/San Pasqual Valley/North Poway
  - South Poway/Central Poway/North Poway
  - South Poway/Santee/Miramar/Mission Trails
  - South Poway/Vicente Reservoir/Lake Jennings

  Potentially suitable habitat for gnatcatchers and cactus wrens within 5 miles of the banding locations on the opposite end of the presumptive dispersal corridor should be surveyed between July and November to detect banded nestlings that have dispersed.

Habitat and Life History Studies

- Determine the ecological requirements and life histories of covered plant species. This information would complement the long-term status monitoring of key covered plant species, and would provide the practical information necessary to enhance or establish populations. Specific studies might focus on:

  - Specific habitat requirements;
  - Reproductive, pollination, and dispersal strategies;
  - Seed and pollen viability studies;
  - Germination requirements;
  - Seedbank ecology; and
  - Seedling mortality studies.

Population Biology and Genetic Studies

- On a species-specific basis, determine (1) the minimum size for viable self-sustaining plant populations, (2) the effective size (generally larger than the minimum size) for viable self-sustaining plant populations, (3) the minimum and optimum densities of stable plant populations, and (4) the optimum level of relatedness between outcrossing individuals (Messick 1986).

- Monitor representative populations of focal target animal species (California gnatcatcher, coastal cactus wren, willow flycatcher, burrowing owl, golden eagle, northern harrier) to estimate variance in demographic parameters and dispersal capability.

- Conduct genetic studies of populations of coastal cactus wren and willow flycatcher to assess relative levels of genetic variation within and between populations.

- Conduct inter- and intrapopulational genetic analyses of representative populations of covered plant species.

Habitat Restoration and/or Population Enhancement/Reintroduction Studies

- Using results of studies above, conduct and monitor small-scale habitat restoration studies within the preserve system. The restoration of native grasslands, wetlands, and vernal pools would be of particular value.

- Create coastal cactus wren breeding habitat (i.e., cactus patches) between existing occupied habitat to increase the viability of this species.

- Using results of the studies above and species' overall distribution and risk status, identify candidates for population enhancement or reintroduction studies. Conduct and monitor small-scale enhancement, translocation, or reintroduction studies.

- Establish and maintain seedbanks in conjunction with recognized institutions for certain covered plant species as a guarantee against extinction and as a possible source of research and enhancement/reintroduction material.

Management Studies *

- Develop and implement watershed management plans for coastal drainages and their estuaries.

- Conduct and monitor small-scale experimental burns to determine the effectiveness (and appropriate methodology) of fire as a management tool for specific covered species and priority habitats.

- Conduct and monitor small-scale experiments that use alternative methods (e.g., mechanical chopping) to simulate the effects of burns on species or habitats in areas where burning is not appropriate due to public safety concerns. These experiments would be most appropriate for species that germinate in response to increased light (or decreased canopy cover), rather than those species that germinate in response to heat or specific chemicals in the charate.

9.0 COST SUMMARY

Table 9-1 presents a summary of costs to implement the monitoring program over a 10-year period. Costs per year range from $182,742 to $460,100. Note, however, that the preserve system will not be dedicated all at once, but will be developed over a period of time. Thus, actual costs will be dependent on the number of monitoring locations that have been dedicated to the MSCP preserve system in any one monitoring period, and the species and habitats within those locations to be monitored. Refer to Sections 3.2.4, 3.3.4, 3.4.4, 4.4, 5.1.4, 5.2.5, and 5.3.5 for a breakdown of costs. Costs presented in Table 9-1 do not include remediation and adaptive management (Section 7.0) or any of the research recommended in Section 8.0.

Table 9-1

SUMMARY OF MONITORING COSTS

Type of Monitoring	Monitoring Year									
	1	2	3	4	5	6	7	8	9	10
Habitat **Monitoring (29)**[1]										
• Temporary Habitat Changes	$6,000					$6,000	---	---	---	---
• Habitat Value	$117,740					$70,383	---	---	---	---
Corridor **Monitoring (29)**[2]	$75,840	---	-	$75,840	—	-	$75,840	---	---	$75,840
Covered Species Monitoring										
• Climatic Data	$2000	$2000	$2000	$2000	$2000	$2000	$2000	$2000	$2000	$2000
• Plant Species[3,4]										
- Field Monitoring										
- Baseline/Set-up	$54,800	---	---	---	---	---	---	---	---	---
- First Priority Species	$52,720	$52,720	$59,800	$52,720	$52.720	$59.800	$52,720	$52,720	$59,800	$52,720
- Second Priority Species	---	$37,960	---	$37,960	---	$37,960	---	$37,960	—	$37,960
- Third Priority Species	---	---	---	---	$26,640	---	---	---	---	$26,640
- Habitat Monitoring	$15,480	---	---	---	---	$15,480	---	---	---	---
• Animal Species										
- Coastal Sage Scrub Birds (31)[2]	$83,700	—	—	$83,700	---	---	$83,700		---	$83,700
- Reptile Diversity (12)[5]	$51,820	$41,022	$41,022	$41,022	$41,022	$41,022	$41,022	$41,022	$41,022	$41,022
- Arroyo Toad (7)[2]	—	$27,160	—	—	$27,160	---	-	$27,160	---	---
- Grassland (Raptors) (10)[2]	---	$33,200	—	—	$33,200	---	---	$33,200	---	---
- Comprehensive Reports	---	---	$7,000	---	---	$7,000	—	—	$7,000	---
Total Costs	$460,100	$194,062	$109,822	$293,242	$182,742	$239,645	$255,282	$194,062	$109,822	$319,882

Note: Costs assume all monitoring locations have been dedicated to the MSCP preserve and all are being sampled. However, actual costs for any given monitoring year will depend on the number of monitoring locations actually preserved at that time. SANDAG costs for satellite change detection analyses for land uses and habitats are not included.

1 Number of locations to be monitored once every 5 years.
2 Number of locations to be monitored once every 3 years.
3 See Table 5-3 for number and frequency of plant species monitoring.
4 Comprehensive report costs are included in the cost for field monitoring first priority covered plant species.
5 Sites monitored once every two years, half the sites in any one monitoring year.

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APPENDIX A

DATA FORMS FOR HABITAT VALUE MONITORING

FIELD DATA COLLECTION FORM
HABITAT VALUE MONITORING

DATE/MONITOR(S) _____
HABITAT TYPE _____
MONITORING LOCATION _____ PLOT NUMBER _____
SAMPLING SITE NUMBER _____
PHOTODOCUMENTATION _____ YES OR NO IF YES, PHOTO NUMBER _____
MAPPING OF DISTUBANCE _____ YES OR NO

QUADRAT NO.	SPECIES	STRATUM[1]	STATUS[2]	COVER RANGE MIDPOINT	DENSITY[4]

[1]Stratum = Tree (T); Shrub or subshrub (S), Herb (H); Ground (G). Ground includes plant litter, bare ground, rock.
[2]Status = Native or naturalized (N) or Invasive (I).
[3]Cover Class:

Cover Range (%)	Cover Range Midpoint (%)
95-100	97.5
75-95	85
50-75	62.5
25-50	37.5
5-25	15
1-5	3

[4]Indicate density (number of individuals).

ADDITIONAL NOTES (Note natural or human-induced vegetation, surface, or subsurface disturbance):

DATA REDUCTION FORM
HABITAT VALUE MONITORING

HABITAT TYPE _____
MONITORING LOCATION _____
SAMPLING SITE NUMBER _____
MONITORING PLOT NUMBER _____
SAMPLING SITE TYPE[1] _____

I. COVER

HABITAT COMPONENT[6]	QUADRAT[3] 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	SUM	MEAN	STD DEV.[4]	VAR.[5]
Native Trees																																												
Invasive Trees																																												
Native Shrubs or Subshrubs																																												
Invasive Shrubs or Subshrubs																																												
Nallve Herbs																																												
Invasive Herbs																																												
Ground																																												

II. DENSITY

HABITAT COMPONENT[2]	QUADRAT[6] 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	SUM	MEAN	STD DEV.[4]	VAR.[5]
Native Trees																																												
Invasive Trees																																												
Native Shrubs or Subshrubs																																												
Invasive Shrubs or Subshrubs																																												
Native Herbs																																												
Invasive Herbs																																												
Ground																																												

III. FREQUENCY

HABITAT COMPONENT[2]	QUADRAT[7] 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	SUM	MEAN	STD DEV.[4]	VAR.[5]
Native Trees																																												
Invasive Trees																																												
Native Shrubs or Subshrubs																																												
Invasive Shrubs of Subshrubs																																												
Native Herbs																																												
Invasive Herbs																																												
Ground																																												

[1]Site Type = "Edge," "Interior to Edge," or "Core"; [2]Can also be sorted and/or analyzed by species; [3]Indicate cover class value for each quadrat; [4]STD. DEV. - Standard Deviation; [5]VAR. = Variance
[6]Indicate density (number of individuals) for each quadrat; [7]Indicate frequency (presence or absence) for each quadrat.

FINAL SUMMARY FORM
HABITAT VALUE MONITORING

HABITAT TYPE _____
MONITORING LOCATION _____
MONITORING PLOT NUMBER _____

I. COVER

HABITAT COMPONENTS[1]	SAMPLING SITES[2]			SUM	MEAN	STD. DEV.[3]	VARIANCE
	1	2	3				
Native Trees							
Invasive Trees							
Native Shrubs or Subshrubs							
Invasive Shrubs or Subshrubs							
Native Herbs							
Invasive Herbs							
Ground[4]							

II. **DENSITY**

HABITAT COMPONENTS[1]	SAMPLING SITES[2]			SUM	MEAN	STD. DEV.[3]	VARIANCE
	1	2	3				
Native Trees							
Invasive Trees							
Native Shrubs or Subshrubs							
Invasive Shrubs or Subshrubs							
Native Herbs							
Invasive Herbs							
Ground[4]							

III. FREQUENCY

HABITAT COMPONENTS[1]	SAMPLING SITES[2]			SUM	MEAN	STD. DEV.[3]	VARIANCE
	1	2	3				
Native Trees							
Invasive Trees							
Native Shrubs or Subshrubs							
Invasive Shrubs or Subshrubs							
Native Herbs							
Invasive Herbs							
Ground[4]							

[1] Habitat components can also be analyzed by species rather than canopy layer, or by native versus invasive species.

[2] Sampling Site 1 = "Edge." Sampling Site 2 = "Interior to Edge," Sampling Site 3 = "Core."

[3] Std. Dev. = Standard Deviation

[4] Ground can include plant litter, bare ground, or rock.

APPENDIX B

COMMON INVASIVE EXOTIC PLANT SPECIES

Appendix B

COMMON INVASIVE EXOTIC PLANT SPECIES
(Partial List[1])

Scientific Name	Common Name
Acacia spp.	Acacia
Ailanthus altissima	Tree-of-heaven
Arundo donax	Giant reed
Avena spp.	Wild oat
Bambusa spp.	Bamboo
Brassica spp.	Mustards
Carpobrotus edulis	Iceplant
Cortaderia spp.	Pampas grass
Cotoneaster pannosa	Cotoneaster
Cynodon dactylon	Bermuda grass
Cytisus monspessulanus	French broom
Cytisus scoparius	Scotch broom
Eucalyptus spp.	Gum
Foeniculum vulgare	Fennel
Hedera helix	English ivy
Mesembryanthemum chilensis	Ice plant
Muehlenbeckia complexa	Mattress vine
Nicotiana glauca	Tree tobacco
Pennisetum setaceum	Fountain grass
Phragmites communis	Common reed
Pyracantha angustifolia	Pyracantha
Ricinus communis	Castor bean
Robinia pseudoacacia	Black locust
Salsola australis	Russian thistle
Schinus molle	California pepper
Schinus terebinthifolius	Brazilian pepper
Senecio mikanoides	German ivy
Sparteum junceum	Spanish broom
Tamarix spp.	Tamarisk
Ulex europaeus	Gorse
Vinca major	Periwinkle

[1] See also the Jepson Manual (Hickman 1993) for a list of species considered legally noxious by the State of California and the California Exotic Pest Plant Council (CalEPPC 1994) for a list of exotic pest plants of greatest ecological concern in California.

APPENDIX C

DATA FORMS FOR CORRIDOR MONITORING

MSCP WILDLIFE CORRIDOR MONITORING PROTOCOL FOR SURVEY AND TRACKING STATION DATA COLLECTION

The following three data sheets should be filled out during each monitoring visit to a wildlife corridor:

MSCP Wildlife Corridor Survey Data Sheet
MSCP Wildlife Corridor Tracking Station Data Form
MSCP Wildlife Species List Form

These forms should be accompanied by map(s) of the entire corridor study area and should be augmented by detailed field notes. At the end of the monitoring period all field maps and data sheets should be turned in. Summary data sheets compiling the raw data into a format ready for computer entry should also be turned in. Samples of the resulting computerized database are attached to ensure information is collected in the proper format.

Instructions for Collecting Data and Filling Out Data Forms

Wildlife Corridor Surveys

MSCP Wildlife Corridor Survey Data Sheet

This data sheet records all animals detected during each walk-through survey of the corridor study area. A map should be used for each survey to show the locations of each focal/sensitive species. The map should be labeled with corridor ID, date, and observer name(s). Observation times for each focal/sensitive species location should be noted (start and finish times if the animal is followed for greater than 5 minutes).

Header information on the data sheet should always be filled out completely. If more than one corridor is visited in a field day, a separate data form should be filled out for each corridor. Record all map numbers for each corridor study area. Time start and time finish for each survey is important in determining field effort and allowing comparison of results between survey areas. If the survey is interrupted for more than 10 minutes, note the length of time the survey was interrupted. Information concerning weather conditions (minimum and maximum encountered during the survey period) is important in interpreting the results of each survey.

Primary focal species include California gnatcatcher, coastal cactus wren, coyote, mountain lion, bobcat, and mule deer. Secondary focal or sensitive species include any species considered sensitive by state or federal governments, other species on the MSCP target species list, and species that are of significant local concern. All sign or visual sightings of primary and secondary focal species should be entered onto the map and onto the data sheet. An unique numbering system should link the information on the map with the data sheet. It is important not to double count animal sign (e.g., scat and tracks) detected on previous surveys. To avoid double counting bring copies of previous field maps showing the location and number of sign detected previously. For each visual sighting the number, age, sex, and pairing status of individuals should be determined, as feasible. The "No. Heard/Not Seen" column applies primarily to birds that were not visually detected. It is important to map the location of birds detected only by vocalizations. All visual sightings of focal individuals should be recorded on the maps and data sheets even if individuals were thought to be detected on a previous survey.

MSCP Wildlife Corridor Survey Summary Form

At the end of the monitoring period information for primary focal species should be summarized into cumulative counts of mammal sign and numbers of resident and dispersing birds. These data are summarized on the Wildlife Corridor Summary Form and on a clean map. Using spot mapping interpretation, information should be compiled so that resident or dispersing pairs and individuals are only counted once on summary maps and data sheets.

MSCP Wildlife Corridor Survey Database

Two databases will be created from the corridor survey data, one for focal bird species and one for mammals. Information on primary focal species will be input, but data on secondary species will be entered only if there are sufficient funds and time available to do so. Examples of the databases with data entered are attached.

Wildlife Corridor Mammal Tracking Station Data

MSCP Wildlife Corridor Mammal Tracking Station Data Form

This form should be filled out during each visit to a corridor. Data from multiple stations within a single corridor may be entered onto one form. Header information should be filled out completely. "Tracking Station ID" refers to a unique numbering system for each tracking station, with no replication of numbering between corridors. These numbers link

tracking station data to large scale corridor maps showing the specific location of each station. "Tracking Method" refers to the substrate at the tracking station (e.g., sand, graphite powdered cards, lime chalk, or a combination of methods). If a species is detected at a station an "X" should be entered into the appropriate species column for that station. If a track's identity cannot be determined, pictures should be taken of the track(s). If graphite cards are used they should be saved when possible. These precautions allow for future identification of the tracks. Other species detected at the tracking station should be listed in the "Other Species" column. Field notes should clearly describe any unusual tracks, the number of individuals detected, any information on the activity of the animal at the tracking station, and any other interesting observations.

MSCP Wildlife Corridor Mammal Tracking Station Database

For the wildlife corridor mammal tracking station database, information should be summarized (by species) for cumulative visits to each station. The number of visits to a station when the focal species was detected should be entered. The proportion of visits the species was detected at the station can be calculated by dividing the number of visits it was observed by the total number of visits to the station. Summarized data should be entered into the appropriate columns of the database form.

Wildlife Species List

MSCP Wildlife Corridor Species List and Species Richness Database

The species list form should be filled out for each field visit and all detected vertebrate species should be checked off or written down in the appropriate sections. At the end of the monitoring period, all species sighting information should be compiled into the MSCP Wildlife Corridor Species Richness Database (see example). The name of each species that was detected should be entered under the "Species Name" column (list by taxonomic groups as shown on the species list form). Header information (e.g., Corridor ID, Map No., Sur. Year, and Total Visits to Station) should be listed for each row of the database.

MSCP **Wildlife Corridor Survey Data Sheet**

(Fill out this form, a tracking station form, and a species list form for each corridor visit)

CorridorED: _____ Map **Number(s):** _____

Date: _____ Observer: _____

Time Start: _____ Time Finish: _____

Weather:	Minimum	Maximum
Temperature (°F):		
Wind (mph):		
Cloud Cover (%):		
Precipitation (e.g., heavy fog, rain, drizzle):		

Map Sight. No.	Focal Species	No. of Sightings*	No. of Tracks	No. of Scats	No. Heard/ Not Seen	Other Sign (Explain)
		t				

* Enter number of inividuals detected by sex and age or pairing status (e.g., 2 Ad. Male, 1 Ad. Pr., 3 Juv, etc..)

MSCP Wildlife Corridor Summary Form

(For each corridor fill out this form for each year of monitoring)

Corridor ID: _____ **Map Number(s):** _____

Survey Period: _____

Cumulative Hours of Field Effort: _____

Observers: _____

_____

_____

Detected Focal Mammal Species

First Priority Focal Species	No. of Tracks	No. of Scats	No. of Sightings
Coyote			
Mountain Lion			
Bobcat			
Mule Deer			
Other Species (List)			

Qualitative Habitat Assessment

(habitat abundance, quality, noise, lighting, human disturbance, etc.)

Detected Focal Bird Species

First Priority Focal Species	No of Pairs				No of Single Birds			
	Ad Pr	Juv Pr	Ad/Juv Pr	Unk. Age Pr	Fem Ad	Male Ad	Juv.	Unk. Age/Sex
California gnatcatcher								
Cactus Wren								
Other Species (List)								

MSCP Wildlife Corridor Focal Mammal Species Survey Database

Corridor ID	Map No.	Sur. Year	Tot. Hours Effort	Focal Species	Total Sign	No. of Tracks	No. of Scats	No. of Sightings

MSCP Wildlife Corridor Focal Bird Species Survey Database

Corrido ID	Map No	Focal Species	Sur. Year	Tot Hours Effort	Total Birds	No. Pairs	No. Singl Indiv.	Number of Pairs by Age/Sex			Number of Unpaired Individuals by Age/Sex			
								Ad. Prs.	Juv. Prs.	Unk. Age Prs.	Fem. Ad.	Male Ad.	Juv.	Unk Age/Sex

MSCP Wildlife Corridor Tracking Station Data Form

(Fill out this form, a wildlife corridor survey data form, and a species list form for each corridor visit)

Corridor ID: _____ Map Number(s): _____

Date: _____ Observer: _____

Tracking Station ID	Tracking Method	Presence of Species Tracks at Station (X = Species Detected)				
		Coyote	Mountain Lion	Bobcat	Mule Deer	Other Species (List)

MSCP Wildlife Corridor Mammal Tracking Station Database

Corridor ID	Tracking Station ID	Map No	Sur. Year	Tot Visits to Station	Focal Species	No. of Visits Species Detected	Proportion of Visits Species Detected

COMPLETE SPECIES LIST

Corridor ID_____
DATE_____
OBSERVER_____

FISH

AMPHIBIANS

REPTILES

MAMMALS

INVERTEBRATES

LOONS
___Red-throated Loon
___Pacific Loon
___Common Loon

GREBES
___Pied-billed Grebe (B)
___Horned Grebe
___Red-necked Grebe *
___Eared Grebe (B)
___Western Grebe (B)
___Clark's Grebe (B)

ALBATROSSES
___Short-tailed Albatross *
___Black-footed Albatross
___Laysan Albatross *

FULMARS & SHEARWATERS
___Northern Fulmar
___Cook's Petrel
___Pink-footed Shearwater
___Flesh-footed Shearwater *
___Buller's Shearwater
___Sooty Shearwater
___Short-tailed Shearwater
___Black-vented Shearwater

STORM-PETRELS
___Wilson's Storm-Petrel *
___Fork-tailed Storm-Petrel *
___Leach's Storm-Petrel
___Ashy Storm-Petrel
___Band-rumped Storm-Petrel *
___Black Storm-Petrel
___Least Storm-Petrel

TROPICBIRDS
___Red-billed Tropicbird
___Red-tailed TropicbM *

BOOBIES
___Masked Booby * *
___Blue-footed Booby *
___Brown Booby *

PELICANS
___American White Pelican
___Brown Pelican

CORMORANTS
___Double crested Cormorant (B)
___Brandt's Cormorant (B)
___Pelagic Cormorant

DARTERS
___Anhinga *

FRIGATEBIRDS
___Magnificent frigatebird

BITTERNS & HERONS
___American Bittern
___Least Bittern (B)
___Great Blue Heron (B)
___GreaEgret (B)
___Snowy Egret (B)
___Little Blue Heron (B)
___Tricolored Heron
___Reddish Egret * *
___Cattle Egret (B)
___Green-backed Heron (B)
___Black-crowned Night-Heron (B)
___Yellow-crowned Night-Heron *

IBISES & SPOONBILLS
___White Ibis *
___White-faced Ibis (B)
___Roseate Spoonbill *

STORKS
___Wood Stork

SWANS, GEESE & DUCKS
___Fulvous Whistling-Duck *
___Tundra Swan
___Greater White-fronted Goose
___Snow Goose
___Ross' Goose
___Brant
___Canada Goose
___Wood Duck
___Green-winged Teal (8)

BIRDS
___Mallard (B)
___Northern Pintail (B)
___Blue-winged Teal
___Cinnamon Teal (B)
___Northern Shoveler (B)
___Gadwall (B)
___Eurasian Wigeon
___American Wigeon
___Canvasback
___Redhead (B)
___Ring-necked Duck
___Greater Scaup
___Lesser Scaup
___King Eider *
___Harlequin Duck *
___Oldsquaw
___Black Scoter
___Surf Scoter
___White-winged Scoter
___Common Goldeneye
___Barrow's Goldeneye *
___Bufflehead
___Hooded Merganser
___Common Merganser
___Red-breasted Merganser
___Ruddy Duck (B)

AMERICAN VULTURES
___Turkey Vulture (B)
___California Condor (E)

KITES, EAGLES & HAWKS
___Osprey
___Black-shouldered Kite (B)
___Mississippi Kite *
___Bald Eagle
___Northern Harrier (8)
___Sharp-shinned Hawk
___Cooper's Hawk (B)
___Northern Goshawk *
___Harris' Hawk *
___Red-shouldered Hawk (B)
___Broad-winged Hawrit
___Swainson's Hawk
___Zone tailed Hawk (a
___Red-tailed Hawk (B)
___Ferruginous Hawk
___Rough legged I lawk
___Golden Eagle (B)

FALCONS
___American Kestrel (B)
___Merlin
___Peregrine Falcon (B)
___Prairie Falcon (8)

PHEASANTS, TURKEYS & QUAIL
___Ring-necked Pheasant (I)
___Wild Turkey (I)
___Gambel's Quail (B)
___California Quail (B)
___Mountain Quail (B)

RAILS, GALLINULES & COOTS
___Black Rail
___Clapper Rail (B)
___Virginia Rail (8)
___Sora
___Purple Gallinule *
___Common Moorhen (8)
___Amancan Coot (B)

CRANES
___Sandhill Crane *

PLOVERS
___Black-bellied Plover
___Lesser Golden-Plover
___Snowy Plovv (B)
___Wilson's Plovv *
___Semipalmated Plover
___Killdeer (B)
___Mountain Plover

OYSTER CATCHERS
___American Oystercatcher *
___Black Oystercatcher

STILTS & AVOCETS
___Black-necked Stilt (B)
___American Avocet (B)

SANDPIPERS & PHALAROPES
___Greater Yellowlegs
___Lesser Yellowlegs
___Spotted Redshank *
___Solitary Sandpiper
___Willet
___Wandering Tattler
___Spotted Sandpiper (B)
___Whimbrel
___Long-billed Curlew
___Bar-tailed Godwit *
___Marbled Godwit
___Ruddy Turnstone
___Black Turnstone
___Surfbird
___Red Knot
___Sanderling
___Semipalmated Sandpiper
___Western Sandpiper
___Rufous-necked Stint *
___Least Sandpiper
___Baird's Sandpiper
___Pectoral Sandpiper
___Sharp-tailed Sandpiper *
___Dunlin
___Curlew Sandpiper *
___Stilt Sandpiper
___Buff-breasted Sandpiper *
___Ruff
___Short-billed Dowitcher
___Long-billed Dowitcher
___Common Snipe
___Wilson's Phalarope
___Red-necked Phalarope
___Red Phalarope

SKUAS, GULLS, TERNS & SKIMMERS
___Pomarine Jaeger
___Parasitic Jaeger
___Long-tailed Jaeger
___South Polar Skua
___Laughing Gull
___Franklin's Gull
___Little Gull *
___Com. Black-headed Gull *
___Bonaparte's Gull
___Heermann's Gull
___Mew Gull
___Ring-billed Gull
___California Gull
___Herring Gull
___Thayer's Gull
___tealandQull*
___Yellow footed GuB *
___Western Gull (B)
___Glaucous winged Gull
___Glaucous Gull
___Black-legged Kittiwake
___Sabine's Gull
___Gull-billed Tern (B)
___Caspian Tern (B)
___Royal Tern IB)
___Elegant Tern IB)
___Sandwich Tern *
___Common Tern
___Arctic Tern
___Forster's Tern (B)
___Least Tern (B)
___Sooty Tern *
___Black Tern
___Black Skimmer (B)

AUKS, MURRES & PUFFINS
___Common Murre
___Pigeon Guillemot *
___Marbled Murrelet *
___Kittlitz's Murrelet *
___Xantus' Murrelet
___Craven's Murrelet
___Ancient Murrelet
___Cassin's Auklet
___Parakeet Auklet *
___Rhinoceros Auklet
___Tufted Puffin *
___Horned Puffin

PIGEONS & DOVES
___Rock Dove (I)
___Band-tailed Pigeon (B)
___Spotted Oova (I)
___White-winged Dove (8)
___Mourning Dove (B)
___Inca Dove *
___Common Ground-Dove (B)
___Ruddy Ground-Dove *

CUCKOOS & ROADRUNNERS
___Yallow billed Cuckoo*
____Greater Roadrunner (B)

BARN OWLS
___Bam Owl (B)

TYPICAL OWLS
____Flammulated Owl
____Western Screech-Owl IB)
___Great Homad Owl (B)
____Nortftam Pygmy-Owl (B)
____Burrowing Owl (B)
____Spotted Owl (8)
____Long-eared Owl (B)
____Short-eared Owl
____Nortftam Saw-whet Owl (B)

GOATSUCKERS
____Laaaaf Nighthawk IB)
___Common Nighthawk •
___Common Poorwill (Bl
___Whip-poor-will •

SWIFTS
___Black Swift
____Oiimnay Swift •
___Vaux's Swift
___White-throated Swift (B)

HUMMINGBIRDS
___Broad-billed Hummingbird
___Xantua Hummingoird •
____Black-chinned Hummingoird (B)
____Anna's Hummingbird IB)
____Coaia a Hummingbird IB)
___CaJlooa Hummingbird
___Broad-Uilad Hummingoird •
__flvrloua Hummingbird
____Allan a Hummingbird

KINGFISHERS
___Belted Kngfiahar (B)

WOODPECKERS
____Lewis' Woodpecker
____Acorn Woodpecker IB)
___Yellow-bellied Sapaucxar •
___Red-naped Sapsucker
___Red-breasted Sapsucker (B)
___Williamaon a Sapsucker
___Ladder-backed Woodpecker
___Nuttall's Woodpecker (8)
___Downy Woodpaekar (B)
___Hairy Woodpecker (B)
___White-headed Woodpecker
___Northern Flicker(B)

TYRANT FLYCATCHERS
___Olive-sided Fiycatcnar (8)
___Greater Pewee
___Waatam Wood-Pewee (B)
___Willow Flycatcher (B)
___Least Flycatcher
___Hammond's Flycatcher
___Dusky Flycatcher (B)
___Gray Flycatcher
___Pacific-slope Flycatcher (B)
___Black Phoaoa (B)
___Eastern Phoaoa
___Say t Phoaoa (B)
___Vermilion Flycatcher (B)
___Dusky-capped Flycatcher •
___Ash-throated Fiycatcnar (B)
___Great Crested Fiycatcnar •
___Sulphur-bellied Flycatcher •
___Tropical Kingbird
___Cassin a Kingoird (B)
___Thick-billed Kingoird •
___Western Kingbird (B)
___Eastern Kingoird
___Scissor-tailed Flycatcher

LARKS
___Horned Lark (B)

SWALLOWS
___Purple Maran IB)
___Tree Swallow 18)
___Violet-green Swallow (B)
___N. Rough-winged Swallow (B
___Bank Swallow
___Cliff Swallow (B)

JAYS A CROWS
___Steller's Jay (8)
___Scrub Jay (8)
___Pinyon Jay
___Clark's Nutcracker
___American Crow (8)
___Common Raven (B)

TITMICE
___Mountain Chickadee (B)
___Plain Titmouse (B)

VERDINS
___Verdin (B)

BUSHTITS
___Bushtit(B)

NUTHATCHES
___Red-breasted Nuthatch IB)
___White-breasted Nuthatch (B)
___Pygmy Nuthatch (B)

CREEPERS
___Brown Creeper (B)

WRENS
___Cactus Wren (8)
___flockWren(B)
___Canyon Wran (B)
___Bewick's Wran (B)
___Houaa Wran (B)
___Winter Wren
___Maran Wran (8)

DIPPERS
___American Dipper

MUSCICAPIDS
___Golden-crowned Kinglet
___Ruby-crowned Kinglet
___Blue-gray Gnatcatcher (B)
___California Gnatcatcher (B)
___Black-tailed Gnatcatcher (B)
___Western Bluebird (B)
___Mountain Bluebird
___Townsend's Solitaire
___Gray-cheeked Thrush •
___Swainson • Thruah (8)
___Hermit Thrush
___Wood Thrush •
___American Robin (B)
___Varied Thruan
___Wrentit (B)

MOCKINGBIRDS & THRASHERS
___Gray Catbird
___Nortftam Mockingbird IB)
___Saga Thraanaf
___Brown Thrasher
___Bendire's Thraanaf
___California Thrasher (B)
___Crissal Thraanaf (B)
___La Coma a Thrasher (B)

PIPITS
___Red-throated Pipit
___American Pipit
___Sprague • Pipit •

WAXWINGS
___Bohemian Waxwing •
___Cedar Waxwing

SILKY-FLYCATCHERS
___Phainopepla (B)

SHRIKES
___Loggerhead Shrike (8)

STARLINGS
___European Starling (I)

VIREOS
___White-eyed Virao •
___Ball a Virao (B)
___Gray Virao (B)
___Solitary Virao (B)
___Yellow-throated Virao •
___Hutton a Vireo (B)
___Warbling Virao IB)
___Philadelphia Virao

EMBERIZIDS
___Blue winged Warbler •
___Golden winged Warbler *
___Tennessee Warbler
___Orange-crowned Warbler (B)
___Nashville Warblaf
___Virginia's Warbler
___Lucy a Warblaf
___Northern Parula
___Yellow Warblaf (B)
___Chestnut-sided Warblaf
___Magnolia Warblaf
___Cape May Warblaf
___Black-throated Blua Warbler
___Yellow-rumped Warblaf (B)
___Black-throated Gray Warblar (B)
___Townsend's Warblaf
___Harms Warolaf
___Black-throated Green Warblaf
___Blackburnian Warblaf
___Yellow-throated Warblaf
___Grace a Warblaf •
___Pine Warblaf •
___Prairie Warbler
___Palm Warbler
___Bay-breasted Warblaf
___Blackpoll Warblaf
___Cerulean Warolaf *
___Black-and-white Warblaf
___American Redstart
___Prothonotary Warblaf
___Worm-eating Warblaf
___Ovenbird
___Northern Waterthrush
___Louisiana Waterthrush •
___Kentucky Warbler *
___Connecticut Warblaf •
___Mourning Warolaf •
___MacGillivray's Warblaf
___Common Yellowthroat (8)
___Hooded Warbler
___Wilson a Warblaf
___Canada Warblaf
___Red-faced Warblaf •
___Painted Redstart (B)
___Yellow-breasted Chat (81
___Hepatic Tanager
___Summer Tanager
___Scarlet Tanager
___Western Tanager (B)
___Pyrrhuloxia •
___Rose-breasted Grosbeak
___Black-headed Grosbeak (B)
___Blua Grosbeak (B)
___Lazuli Bunting (8)
___Indigo Bunting
___Painted Bunting •
___Dickcissel
___Green-tailed Towhee (B)
___Rufous-sided Towhee (S)
___California Towhee (B)
___Cassin's Sparrow •
___Rufous i rowned Sparrow (B)
___American Tree Sparrow
___Chipping Sparrow (B)
___Clay-colored Sparrow
___Brewer • Sparrow
___Black chinned Sparrow (B)
___Vesper Sparrow
___Lark Sparrow (B)
___Black-throated Sparrow (B)
___Sage Sparrow (B)
___Lark Bunting
___Savannah Sparrow (B)
___Baird's Sparrow • •
___Grasshopper Sparrow (8)
___Sharp-tailed Sparrow
___Fox Sparrow (B)
___Song Sparrow fB)
___Lincoln's Sparrow
___Swamp Sparrow
___White-throated Sparrow
___Golden-crowned Sparrow
___White crowned Sparrow
___Harris' Sparrow
___Dark-eyed Junco (8)
___McCown a Longspur•
___Lapland Longspur
___Chestnut-collared Longspur
___Bobolink
___Red winged Blackbird (8)
___Tricolored Blackbird IB)
___Western Meadowlark (B)
___Rusty Blackbird •
___Brewer's Blackbird (B)
___Great-tailed Grackle (B)
___Common Grackle •
___Bronzed Cowbird •
___Brown-headed Cowbird (B)
___Orchard Oriola
___Hoodad Oriola (B)
___Streak-backed Oriola •
___Northern Oriola IB)
___Scott's Oriola (B)

FINCHES
___Purple Finch (B)
___Cassin's Finch
___House Finch IB)
___Red Crossbill
___Pine Siskin
___Lesser Goldfinch (B)
___Lawrence• Golcfincn (B)
___American Golcfincn (81
___Evening Grosbeak

OLD WORLD SPARROWS
___Houaa Sorrow (I)

FIELD CHECKLIST
of the
BIRDS OF SAN DIEGO COUNTY

prepared by Guy McCaskie
for the

SAN DIEGO COUNTY
PARKS AND RECREATION DEPARTMENT

August. 1990

f ~ species known to have brad in the county in recent times
* ~ species sighted fawar than 10 times in ma last 25 years.
native species now extirpated in the county.
~ nonnative species introduced in the county.

S

MSCP Wildlife Corridor Species Richness Database

Corridor ID	Map No	Survey Year	Total Visits to Corridor	Species Name

APPENDIX D

QUANTITATIVE METHODOLOGIES FOR MONITORING PLANT SURVIVORSHIP AND FITNESS PARAMETERS

QUANTITATIVE METHODOLOGIES FOR MONITORING PLANT SURVIVORSHIP AND FITNESS PARAMETERS

Plant survivorship and fitness are two parameters that are widely recognized as indicators of population viability, particularly when assessed in conjunction with other aspects of population biology. These parameters are not included as part of the field monitoring program for covered plant species, however, because they can be time-intensive and, thus, add significantly to monitoring costs. In addition, initial indications of population viability can be obtained using other methods. However, the monitoring plan does recommend that these parameters be investigated if significant declines in population viability are detected through other methods. Therefore, a discussion of each parameter is presented below, along with specific monitoring methods.

Plant Survivorship and Fitness Parameters

Survivorship data, as measured by individual plant mortality, can be used in conjunction with population size, age class, and reproductive data to provide an indication of the stability of a population, its potential for long-term persistence, and the source (e.g., intrinsic versus extrinsic) of any threats. For example, a species may be short-lived, but produce enough seed so that population size remains stable over time. Conversely, individuals of a long-lived species may experience low mortality, but reproduce infrequently. Because of their relatively long reproductive life, however, these populations may also be stable. Species with small populations that experience high mortality and low levels of fitness face the greatest threats to long-term viability.

Fitness refers to the ability of a species to successfully reproduce, as measured by fruit or seed set. Research indicates that small populations may be more susceptible to disruptions of their normal breeding system than larger populations, with the effect that their feproductive capacity and, ultimately, long-term viability are threatened (Falk and Holsinger 1991; Ellstrand 1992; Ellstrand and Elam 1993). Populations that are becoming smaller may experience a change in pollinator behavior, with pollinator flights becoming more restricted or pollinators unable to find the population at all. In either case, the effects may include reduced outcrossing, lower seed set, and if the rate of self-pollination increases, possibly lower seed viability (Oostermeijer et al. 1992).

Monitoring Methodologies

Survivorship data will be recorded in a subset of the monitoring quadrats (Section 5.2.2.4 of the monitoring plan). Survivorship data for annual plants will be obtained by recording number of individuals in the subplots two times during any monitoring year: (1) early in the growing season and (2) late in the growing season. The exact timing of monitoring will be species-specific and may vary due to climatic conditions. Survivorship data for herbaceous perennials and shrubs will be obtained by marking individuals and following their survivorship over time. Individuals will be recorded as either live or dead. Within the survivorship quadrats, recruits will also be tagged and followed for survivability. Survivorship information can be used in conjunction with population structure information to determine survivability in different age classes.

Using this same subset of quadrats, fitness data will be obtained for the target species. Data on seed set will be collected one time during any monitoring year, at the period of maximum seed production for the species of concern. Mature fruits will be collected from a pre-determined number of plants and tallied according to the number of developed seed, aborted seed, and dead seed. The width, height, and length of plants from which seed is collected will also be measured to obtain an estimate of canopy volume that can be correlated to seed production. Seed collection methodology will follow the Center for Plant Conservation (CPC) guidelines for collecting sensitive plant propagules (Falk and Holsinger 1991). It is imperative, however, that seed collection does not intefere with the species' reproductive ecology or demographics. In some cases, this may limit the frequency with which seed is collected. In the case of very small populations, seed collection may not be appropriate at all, in which case a qualitative assessment of seed production may be necessary. An institution such as Rancho Santa Ana Botanic Garden may be interested in collected seed for viability and germination testing, and for long-term storage in their existing seed storage bank.

Data Analysis

In terms of data analysis, survivorship will be expressed as percent plant mortality over the growing season, while fitness will be expressed as fruit or seed set. The mean and standard deviation percent mortality and fruit or seed set will be calculated for the population. If survivorship and fitness data are collected over a number of monitoring periods, data from tiie initial effort can be compared to site-specific data collected in

subsequent years. Percent mortality and fruit or seed set will be graphed as a function of sampling period to illustrate any changes that have occurred. Appropriate statistical hypothesis tests (e.g., ANOVA and multivariate analysis of variance (MANOVA)) should be employed to facilitate drawing conclusions about population trends. Correlation analyses may be used to test for relationships over time among mortality and fruit or seed set. A trend of increasing mortality and low seed set, particularly in conjunction with decreasing population size, may indicate that the viability of the population is threatened, especially with a small population. Simple linear regression, multiple regression, and linear discriminant function analyses may be used to identify significant relationships between environmental factors, such as temperature, rainfall, fire, flooding, or human encroachment, and the population parameters measured.

In addition to statistical testing, a simple index number can be calculated to show the percentage increase or decrease in the parameters measured over time. The index number is defined as the ratio of one value to the other, multiplied by 100. When the comparison number equals the base number, the resulting index number will have a value of 100.

Where multiple years of data are collected, an appropriate test for time series analysis may be used to identify significant trends. The major task of a time series analysis is to describe the nature of the variation of a variable at different points in time so that its future values can be predicted (Kachigan 1986). A time series analysis is also used to determine whether a long-term trend is significant or just part of an extended cyclic process of population change.

APPENDIX E

DATA FORMS FOR COVERED PLANT SPECIES FIELD MONITORING

FIELD DATA COLLECTION FORM
COVERED PLANT SPECIES MONITORING

COVERED SPECIES _____
MONITORING LOCATION _____ : _____
MONITOR(S) _____
DATE • _____
PHOTODOCUMENTATION _____YES_____NO IF YES, PHOTO NUMBER(S)_____
CNPS FORM ATTACHED _____YES_____NO
MAPPING OF DISTURBANCE _____YES_____NO

SECTION I. QUALITATIVE ASSESSMENT OF DISTURBANCE FACTORS

LIST INVASIVE SPECIES	APPROXIMATE PERCENT COVER

LIST TYPES/EVIDENCE OF VEGETATIVE DISTURBANCE	INDICATE DEGREE OF DISTURBANCE

LIST TYPES/EVIDENCE OF SURFACE OR SUBSURFACE DISTURBANCE	INDICATE DEGREE OF DISTURBANCE

ADDITIONAL NOTES:

FIELD DATA COLLECTION FORM
QUANTITATIVE MONITORING FOR COVERED PLANT SPECIES
(con't.)

SECTION II. QUANTITATIVE FIELD MONITORING

TRANSECT NUMBER ___ TRANSECT LENGTH _____
QUADRAT SIZE _____ NUMBER OF QUADRATS _____
TOTAL AREA SAMPLED._____ (Can be calculated in the office, based on population extent)

QUADRAT NUMBER	NUMBER OF PLANTS	AGE CLASSES[1]			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
TOTALS					

[1]ADULT FL = ADULT FLOWERING; ADULT NFL = ADULT NONFLOWERING; SCORE AS PRESENCE OR ABSENCE IN EACH QUADRAT.

DATA REDUCTION FORM
COVERED PLANT SPECIES MONITORING

COVERED SPECIES _____
MONITORING LOCATION _____
TOTAL AREA SAMPLED _____
NUMBER OF TRANSECTS _____ TOTAL TRANSECT LENGTH _____
NUMBER OF QUADRATS _____ TOTAL QUADRAT SEE _____

TRANSECT NUMBER	NUMBER OF PLANTS	AGE CLASSES[1]			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
N					
SUM					
MEAN					
STANDARD DEVIATION					
VARIANCE					

[1] ADULT FL = ADULT FLOWERING; ADULT NFL = ADULT NONFLOWERING.

NOTES: _____

FINAL SUMMARY FORM
COVERED PLANT SPECIES MONITORING

COVERED SPECIES _____
MONITORING LOCATION _____
MONITORING DATE _____

I. POPULATION DENSITY

MEAN NUMBER OF INDIVIDUALS = _____

AREA SAMPLED = _____

DENSITY = NUMBER OF INDIVIDUALS / AREA SAMPLED = _____

II. POPULATION SIZE

POPULATION SIZE = AREA SAMPLED X DENSITY

= _____ X _____ = _____

III. AGE CLASS STRUCTURE

AGE CLASS STRUCTURE = NUMBER OF QUADRATS IN WHICH THE AGE CLASS OCCURS[1] / TOTAL NUMBER OF QUADRATS SAMPLED

SEEDLINGS _____ %

JUVENILES _____ %

FLOWERING ADULTS _____ %

NONFLOWERING ADULTS _____ %

NOTES: • _____ : _____

[1] Refer to field data collection form for number of quadrats in which each age class occurs and the total number of quadrats sampled.

APPENDIX F

DATA FORMS FOR WILDLIFE MONITORING

MSCP California Gnatcatcher/Coastal Cactus Wren Plot Summary Form

(For each plot fill out this form for each year of monitoring)

Plot ID:_____ **Map Number(s):**_____

Survey Period: _____ **Cumulative Hours of Field Effort:** _____

Observers: _____ _____ _____

_____ _____ _____

Detected Focal Bird Species

First Priority Focal Species	Total Birds				Birds in Interior of Plot *				Birds in Periphery of Plot**			
	No. Pairs	No. Single Males	No. Single Females	No. Unk. Sex	No. Pairs	No. Single Males	No. Single Females	No. Unk. Sex	No. Pairs	No. Single Males	No. Single Females	No. Unk. Sex
Californiagnatcatcher												
Cactus Wren												
Second Priority Species (List)												

*** Individuals seen on at least one visit >200' inside plot boundaries.**

**** Individuals not detected on any visit >200' inside or outside of plot boundaries.**

MSCP California Gnatcatcher/Coastal Cactus Wren Survey Data Sheet
(Fill out this form and a species list form for each monitoring plot visit)

Monitoring Plot ID:_____ Map Number(s):_____ Date:_____

Observer(s):_____ Time Start: _____ Time Finish: _____

Weather:	Minimum	Maximum
Temperature (°F):		
Wind (mph):		
Cloud Cover (%):		
Precipitation (e.g., heavy fog, rain, drizzle):		

Map Sight. No.	Periphery Y/N*	Focal Species**	Time Start Sighting	Time Finish Sighting	No. of Prs	No. of Single Males	No. of Single Females	No. of Unk Sex	No. Heard Not Seen	Comments (Continue on Back)

* If sighting is within 200' of monitoring plot boundary, record "Y", otherwise enter "N". On maps/data forms, record sightings outside of plot that are < 200' from boundary.

** Due to the timing of the surveys, it is assumed gnatcatchers and cactus wrens are in adult plumage. Any detected juveniles should be clearly labeled as such. Other detected sensitive species should also be entered onto this form. *** "Comments" should include info. on banding status, breeding activity, plumage, and any interesting observations.

MSCP Focal Bird Species Plot Survey Database

					Total Birds				Birds in Interior of Plot				Birds in Periphery of Plot			
Plot ID	Map No	Focal Species	Sur. Year	Tot. Hrs. Effort	No. Pairs	No. Single Males	No. Single Females	No. Unk. Sex	No. Pairs	No. Single Males	No. Single Females	No. Unk. Sex	No. Pairs	No. Single Males	No. Single Females	No. Unk. Sex

Upland Reptile Diversity Data Form

Date	Site ID	Array ID	Bucket ID	Snake Trap ID	Species	Sex/Age	Mass	Length	Marks	Toeclip No.	Recap?	Disposition	Tissue Sample?