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.

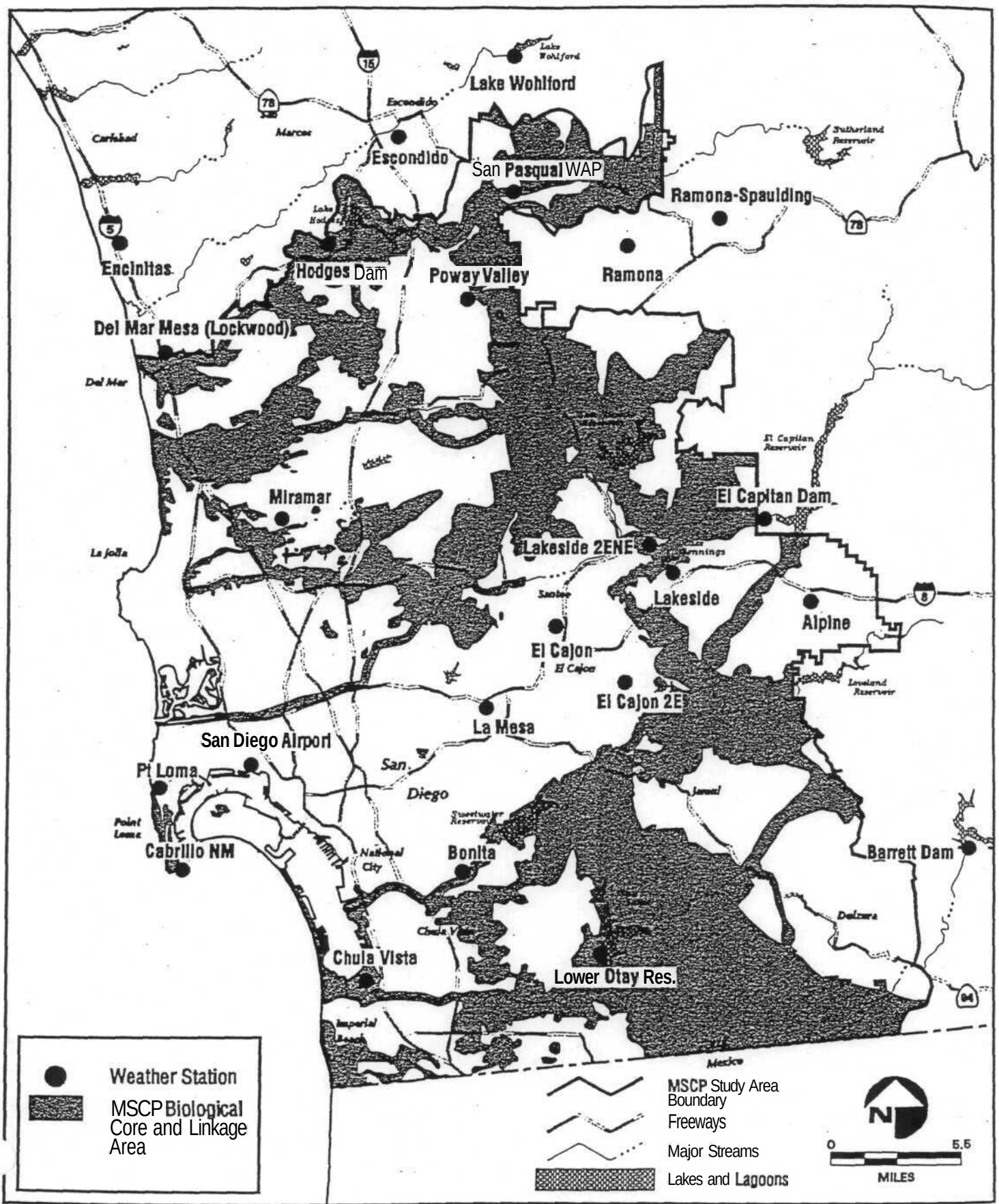
5.1.4 Cost

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.

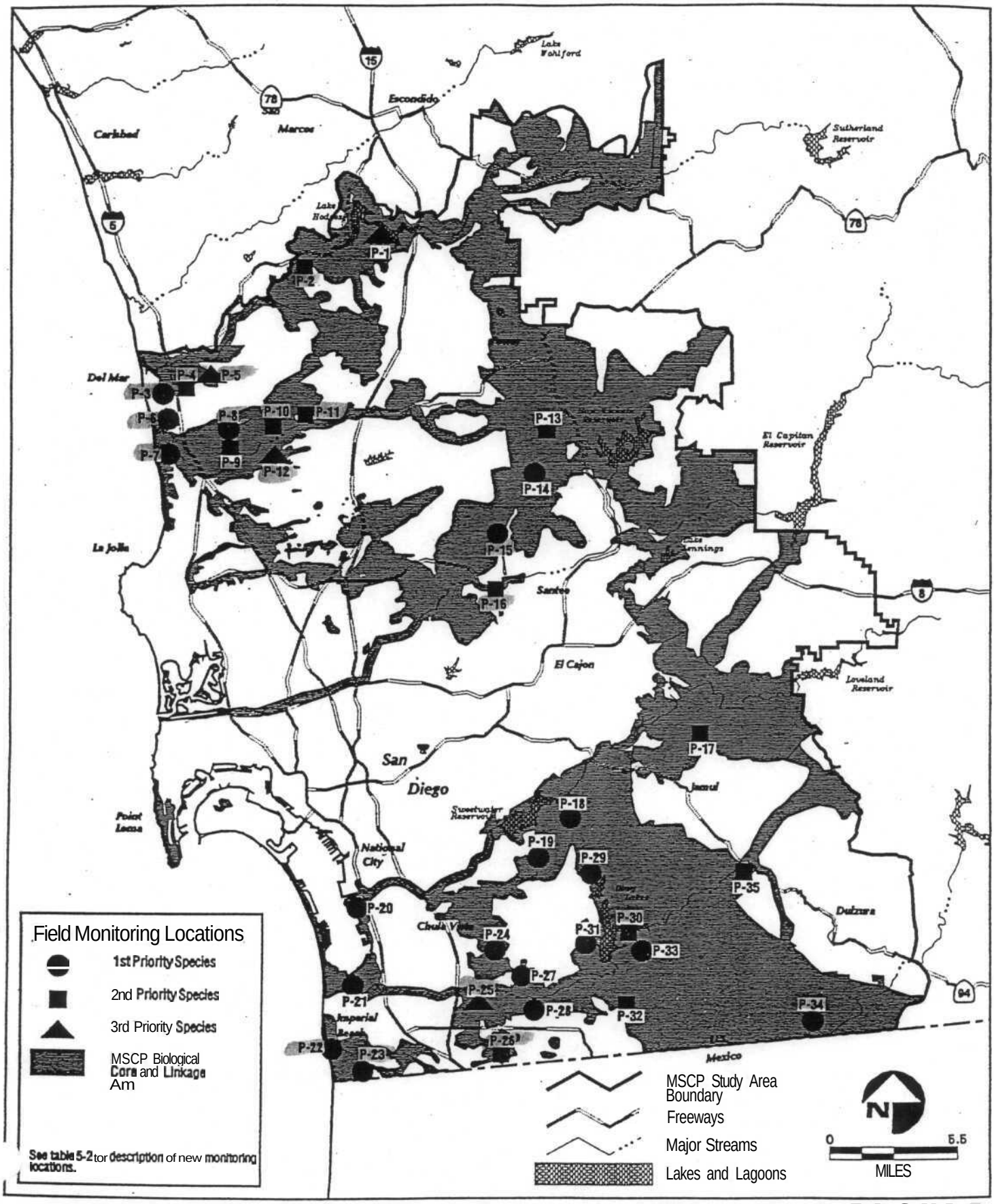
Monitoring locations shown in Figure 5-2 are necessarily generalized. In actuality, the monitoring site will be determined by the location of the plant population. Where populations are small, the entire population may be included in the field monitoring effort. In larger populations or populations comprised 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).

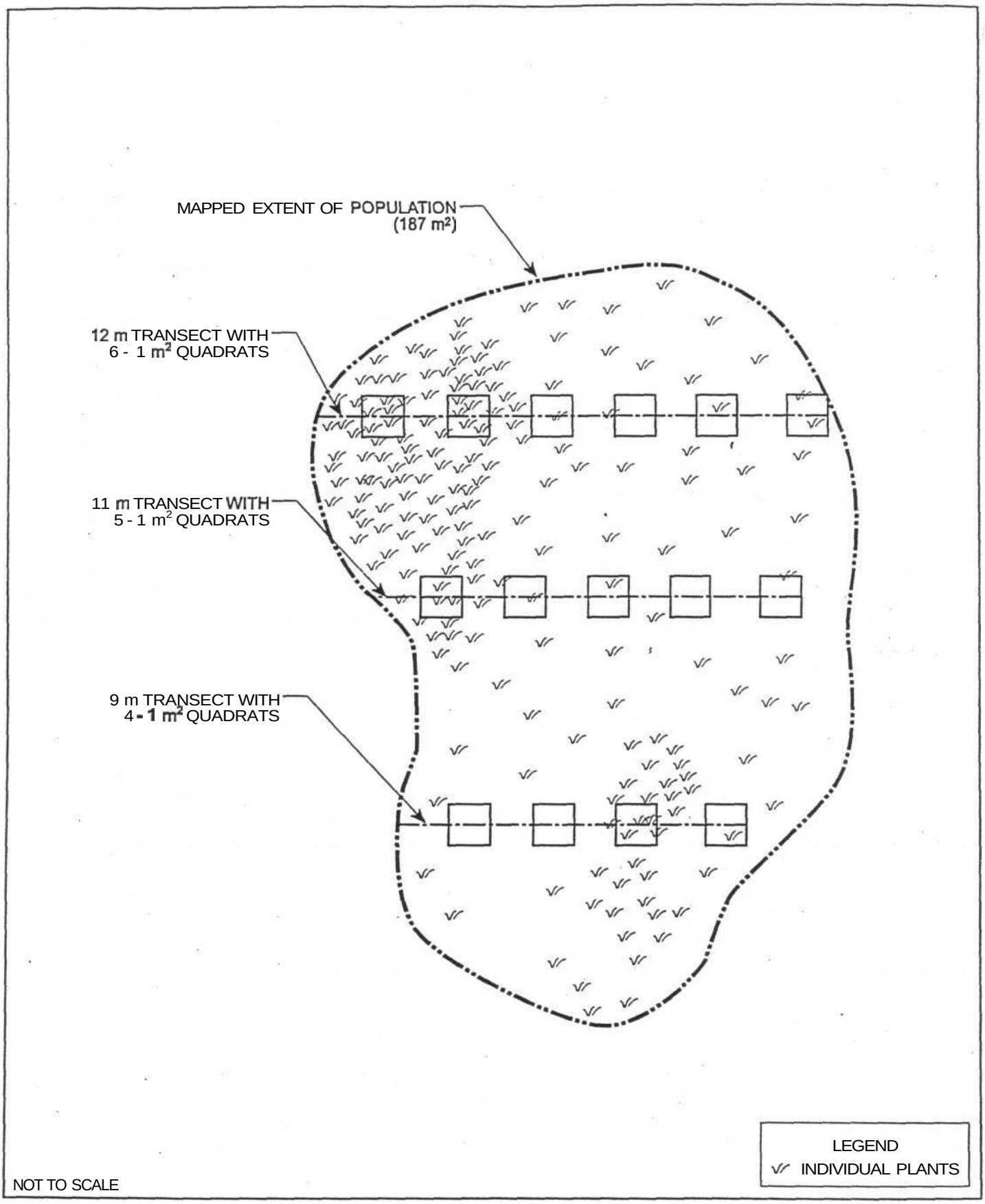
Population Size. Population size will be estimated using both density data (see below) and the cumulative area mapped for the target species population. The areal extent of the sensitive plant population will be mapped as accurately as possible. The mapped area(s) will be planimetered or otherwise evaluated 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



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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.