Strategic Framework

For MSCP Monitoring Program

March 2001

CONSERVATION
BIOLOGY
INSTITUTE

STRATEGIC FRAMEWORK
FOR MSCP MONITORING PROGRAM

TASKS	RESPONSIBLE	COMPLETION
GIS PRESERVE ASSEMBLY		
1. Define baseline conservation for each jurisdiction	Jurisdictions and wildlife agencies	Completed?
2. Input baseline conservation into Habitrak.	Jurisdictions	Completed?
3. Input refuge acquisitions, mitigation banks, TET parcels, conservation easements, etc. into Habitrak.	USFWS and County	Annually (completed thru 1999?)
4. Input new preserve additions into Habitrak, including state and federal preserve lands.	Jurisdictions	Annually (completed thru 1999?)
5. Input state and federal preserve lands outside of City/County (e.g., in Chula Vista and Imperial Beach).	USFWS	February 2001
6. Review Habitrak inputs (spatial and nonspatial) for accuracy.	USFWS and CDFG	February 2001
7. Compile all Habitrak input and create updated, seamless preserve assembly and ownership databases; distribute to jurisdictions and SANDAG.	USFWS	February 2001
8. Review preserve map for accuracy.	Jurisdictions and agencies	February 2001
9. Review MHPA boundary for accuracy; determine ramifications to jurisdiction-specific conservation targets.	USFWS and CDFG	February 2001
10. Revise preserve assembly, ownership, and MHPA based on comments.	USFWS	March 2001
11. Maintain and update preserve assembly and ownership databases annually and distribute to jurisdictions and SANDAG.	Regional Environmental Information Center (REIC)*	Annually
12. Prepare annual reports.	Jurisdictions	Annually
13. Prepare summary HabiTrak tables.	REIC*	Annually
14. Determine needs for enhancement of Habitrak model.	Jurisdictions and agencies	2001
15. a) Refine Habitrak model to include a species database and other refinements; or b) develop alternative methodology	SANDAG and contractor	2001
16. Consider reworking the HabiTrak model as a web-based application.	SANDAG and contractor or REIC*	2001
17. Determine funding sources for long-term HabiTrak maintenance.	USFWS and CDFG	2001
SUBREGIONAL GIS DATABASE MAINTENANCE		
1. Create USFWS endangered species permit database.	USFWS	2001

STRATEGIC FRAMEWORK
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(continued)

TASKS	RESPONSIBLE	COMPLETION
2. Merge regional (SANDAG) and USFWS species databases, as appropriate.	REIC*	2001
3. Determine procedures, classification system, etc. for regional database maintenance.	REIC*, SANDAG, jurisdictions, and wildlife agencies	2001
4. Map vegetation and species distributions based on baseline surveys of conserved lands	Jurisdictions and wildlife agencies	Annually
5. Incorporate updated species databases into monitoring database, as appropriate.	REIC*	Annually
6. Update subregional vegetation layer with baseline surveys data.	REIC*	Annually
7. Evaluate comprehensiveness of fire coverage and maintain fire history data for preserve areas. Prepare maps or distribute coverages as needed.	REIC*	2001
8. Update subregional fire history data with data from CDF.	REIC*	Annually
9. QA/QC subregional data layers (i.e., conserved lands, ownership, species, vegetation, fire history)	USFWS and CDFG	Annually
DATA MANAGEMENT, ANALYSIS, AND REPORTING		
Monitoring Database Design		
1. Develop draft data fields for recording biological monitoring results.	REIC*	Draft completed
2. Develop attributes and structure based on pilot studies.	REIC*	2001
3. Create attributes/structure for climate database.	REIC*	2001
4. Create attributes/structure for roadkill database.	REIC*	2001
5. Peer review database structures.	REIC, Science Advisors*	2001
6. Develop prototype for data warehouse.	REIC*	2001
7. Develop data warehouse to store and display monitoring data	REIC*	2002
Centralized Data Warehouse Maintenance		
1. Develop process for data input and database management.	USFWS, CDFG, and REIC*	2001
2. Develop QA/AC protocols and assign QA/QC responsibilities.	USFWS, CDFG, and REIC*	2002
3. Input existing monitoring data.	REIC*	2002
4. Collect and input climate data to warehouse.	REIC*	2002
5. Collect and input roadkill data to warehouse.	Jurisdictions, Caltrans, REIC*	2002

STRATEGIC FRAMEWORK
FOR MSCP MONITORING PROGRAM
(continued)

TASKS	RESPONSIBLE	COMPLETION
6. Establish guidelines for submittal of annual data, including data forms/digital files and digital or hard copy maps.	REIC*	2002
7. Maintain archive (hard copy, electronic) of field notes, data forms, maps, etc.	Jurisdictions, USFWS, CDFG	Ongoing
Data Analysis, and Reporting		
1. Determine how data will be analyzed.	USFWS, CDFG, and Science Advisors*.	2002
2. Review and analyze data.	Science Advisors*	Ongoing
3. Establish guidelines for data access.	REIC*	2002
4. Prepare 3-yr monitoring summaries.	USFWS and CDFG	Every 3 yrs
MSCP Website		
1. Develop preliminary (concept) design for web site	CBI	Draft completed
2. Develop prototype for website using HabiTrak (preserve assembly) and species occurrence data.	REIC*	2001
3. Upgrade prototype website to functional interactive database.	REIC*	2002
4. Manage and update website.	REIC*	Annually
5. Annual report summaries, including updated preserve assembly maps, monitoring results, and management actions made available on MSCP website	REIC*	Annually
BIOLOGICAL MONITORING AND MANAGEMENT		
Monitoring Plan Revision		
1. Inventory existing species monitoring and research programs.	CBI	Completed
2. Identify imagery needs and options based on results from pilot studies.	Technologies Assessment Group	Ongoing
3. Compile revisions to CAGN/CSS birds monitoring protocol.	USFWS	December 2000
4. Refine other monitoring protocols and data forms based on pilot studies and wildlife agency direction.	Science Advisors*	2003
5. Peer review on monitoring protocols	Science Advisors*	
6. Refine monitoring protocols based on peer review	USFWS, CDFG	2003
Area-Specific Management Plan Preparation		
1. Develop guidelines for preparing framework and area-specific management plans.	USFWS, CDFG	2001

STRATEGIC FRAMEWORK
FOR MSCP MONITORING PROGRAM
(continued)

TASKS	RESPONSIBLE	COMPLETION
2. Determine responsibilities for management and monitoring of each preserve area.	Jurisdictions, USFWS, CDFG	2001
3. Identify preserve lands needing baseline surveys.	Jurisdictions, USFWS, CDFG	2001
4. Identify preserve lands needing habitat management plans.	Jurisdictions, USFWS, CDFG	2001
5. Identify preserve lands needing habitat managers.	Jurisdictions, USFWS, CDFG	2001
6. Conduct baseline surveys and prepare area-specific management directives for existing conserved lands.	Jurisdictions, USFWS, CDFG	2002
7. Conduct baseline surveys and prepare area-specific management directives for newly conserved lands.	Jurisdictions, USFWS, CDFG	Ongoing
8. Provide baseline survey information for incorporation into subregional database.	Jurisdictions, USFWS, CDFG	Annually
9. Provide electronic copies of management plans to wildlife agencies for archival and distribution on the MSCP website. Update HabiTrak database with preserve manager information.	Jurisdictions	Annually
Monitoring and Management Coordination		
1. Identify priorities for monitoring and management, by year.	Jurisdictions, USFWS, CDFG	Annually
2. Prioritize equipment needs and coordinate among jurisdictions.	Jurisdictions, USFWS, CDFG	Annually
3. Develop annual monitoring and management budgets.	Jurisdictions, USFWS, CDFG	Annually
4. Develop regional priorities among jurisdictions.	Jurisdictions, USFWS, CDFG	Annually
5. Identify/train biological monitors.	Jurisdictions, USFWS, CDFG	Annually
6. Identify grant opportunities and prioritize.	Jurisdictions, USFWS, CDFG, Science Advisors*	Annually
7. Assign staff roles and priorities.	Jurisdictions, USFWS, CDFG	Annually
8. Coordinate monitoring roles and priorities with preserve managers.	Jurisdictions, USFWS, CDFG	Annually
9. Monitor and manage all preserve lands.	Jurisdictions, USFWS, CDFG	Annually
10. Summarize preserve-specific management actions in annual reports.	Jurisdictions, USFWS, CDFG	Annually
11. Distribute aggregated management summaries to MSCP website.	Jurisdictions, USFWS, CDFG	Annually
Science Advisors*		
1. Establish MSCP peer review group.	USFWS, CDFG	2001
2. Review and comment on monitoring protocols.	Science Advisors*	2002
3. Provide technical input on short-term and long-term management and monitoring priorities.	Science Advisors*	Ongoing

STRATEGIC FRAMEWORK
FOR MSCP MONITORING PROGRAM
(continued)

TASKS	RESPONSIBLE	COMPLETION
4. Review and comment on monitoring reports.	Science Advisors*	Ongoing
5. Assist in identifying outside funding sources.	Science Advisors*	Ongoing
6. Based on monitoring results, recommend modifications to management policies.	Science Advisors*	Ongoing
7. Develop a process for compiling and analyzing data at the subregional and NCCP regional scales.	Science Advisors*	2002
8. Develop a conceptual ecological model for scrub ecosystem function.	Science Advisors*	Completed?
9. Contribute data from research projects, and direct students to research projects that contribute to the monitoring and management program.	Science Advisors*	Ongoing
San Diego Land Conservancy Coalition		
1. Identify preserve areas with conservancy participation.	SDLCC	2001
2. Identify specific conservancy roles by preserve area.	SDLCC and preserve managers	Annually
3. Set up training workshops.	Jurisdictions, USFWS, CDFG	As needed
4. Assist with specific roles.	SDLCC	As needed
Funding		
1. Establish a regional funding source.	Jurisdictions	July 2000
2. Establish interim funding.	Jurisdictions	2002
3. Pursue research grants/matching funds.	Academic community	
4. Pursue funding in annual budgets.	State and federal governments	

*See proposed structure for a Regional Environmental Information Center and Science Advisors.

ATTACHMENT A

DRAFT FRAMEWORK FOR HABITAT MONITORING

The following sections are intended as a DRAFT framework that ultimately will be used to refine and replace Sections 3.0 of the MSCP Biological Monitoring Plan (Ogden 1996). This DRAFT is intended for review, discussion, and further refinement based on the results of additional research and pilot studies before establishing a standardized protocol for MSCP monitoring.

1.0 VEGETATION MONITORING OBJECTIVES AND APPROACH

Vegetation communities should be monitored to provide information for a variety of different purposes, including: identifying and prioritizing management actions, tracking the response of communities to management actions, assessing systematic vegetation community patterns that may be an expression of human-induced stresses, and vegetation patterns that may help explain observed distributions and abundance of wildlife species. The need to look at these various issues is generally a function of scale and responsibility. Land managers responsible for specific preserve areas will be concerned with smaller scale issues than the wildlife agencies with responsibility over the entire subregion.

1.1 MONITORING OBJECTIVES AND SCALES

Preserve scale: Vegetation monitoring should be conducted in all preserve units throughout the MSCP subregion and is the responsibility of the preserve manager. The objective of vegetation monitoring at each preserve unit is to identify changes that may require management action and to assess responses to management actions.

Subregion scale: The objective of vegetation monitoring at this scale is to track status and trends of habitats across the subregion, using community-level metrics. The wildlife agencies are responsible for subregion-scale monitoring. Much of the analysis at this scale will be conducted using data aggregated from preserve level monitoring. In addition, collection of additional data describing vegetation community metrics for a sample of preserve units may be useful for assessing subregional trends or for use in analyzing wildlife monitoring data. The specific vegetation community metrics that would be useful for subregional analysis are not clear at this time.

1.2 DATA COLLECTION AND ANALYSIS APPROACH

Monitoring data collected at both the preserve level and subregion level will be used to evaluate subregional scale patterns and trends. Therefore, we recommend establishing minimum requirements for preserve level monitoring that allow information to be aggregated to the subregional scale. These recommendations for vegetation and habitat monitoring are presented below.

Jurisdictions and agencies with land management authority for particular preserve units are responsible for collecting all required monitoring data and reporting on individual preserve units. The wildlife agencies are responsible for aggregating preserve-level data and analyzing and reporting results at a subregional scale.

2.0 VEGETATION COMMUNITY CLASSIFICATION AND MAPPING AT THE PRESERVE SCALE

Vegetation community classification and mapping will be conducted on all preserve units. The purpose of this monitoring is to provide preserve managers with information on the distribution and condition of vegetation communities and habitats to effectively monitor resource status, identify and prioritize potential management actions, and track responses to management.

The following sections describe recommendations related to preserve-scale vegetation community classification and mapping. The monitoring efforts will refine the vegetation community maps developed for the MSCP planning process. For purposes of regional preserve planning, vegetation communities in San Diego County area were originally mapped at a scale of 1" = 2000', using 1990 color-infrared aerials. SANDAG updated the regional vegetation mapping in 1995, using project-specific maps for selected areas. Vegetation communities were classified according to a modified Holland classification (see A-1).

2.1 BASELINE VEGETATION COMMUNITY INVENTORIES OF PRESERVE LANDS

Initial, comprehensive surveys of all preserve lands will serve as the "baseline" against which future monitoring efforts will be compared. For all lands conserved within the MSCP, baseline surveys will be conducted to accurately delineate vegetation communities (i.e., update existing vegetation maps where needed), using both remote sensing information and field verification. In addition to mapping vegetation community polygons, biologists should generally describe relevant attributes for each polygon, such as the dominant species for each area, the health or condition of the patch, and the general level of disturbance (e.g., percent composition of invasive species, percent of bare ground caused by trails or off road vehicles, evidence of grazing or tilling, etc.). The classification system, minimum mapping units, and standard set of attributes must be established for each vegetation community type. The purpose of the community classification and mapping is to develop not just a map of communities but a map of community features that are relevant for habitat management activities.

We recommend that baseline surveys be conducted at the time the lands are dedicated to the preserve and that this information be submitted through the HabiTrak process, as part of the annual reporting requirements. Note that some existing public lands were dedicated to the preserve upon signing of the implementing agreement; these lands will also require baseline surveys.

At the present time, baseline surveys should use the 2000 color infrared aerial photography (digital orthophotos, 2 ft. resolution) for mapping, or other equivalent or better imagery. This photography should be available in spring 2001. Take authorization holders should continue to participate in the SANDAG consortium for imagery acquisition so that the most current and effective imagery is used for all parts of the MSCP preserve.

Information for each preserve area should be maintained by the responsible agency or jurisdiction. Upon receipt of information from the take authorization holders, the U.S. Fish and Wildlife Service (USFWS), or other centralized GIS data maintenance group designated by the agencies, is responsible for annually incorporating the preserve level data into the subregional geographic information system (GIS) database. The subregional database should be distributed to SANDAG or the centralized data maintenance group to incorporate into the regional vegetation database and to the jurisdictions for use in monitoring and management. Questions regarding management of the databases reflecting different spatial scales (e.g., the classification systems and attributes to be used for preserve-level vs. regional information) must still be resolved (see Section 5).

2.2 VEGETATION COMMUNITY MAP UPDATES

At a minimum of 5-year intervals, preserve managers will refine vegetation community maps to show changes in the boundaries or attributes of vegetation community polygons (e.g., changes in the spatial distribution of vegetation communities or attributes such as level of disturbance). It may be desirable to refine maps more frequently if vegetation community changes occur more frequently (e.g., by flood disturbance or frequent recreational activities). It would be useful to ultimately have all vegetation map updates on the same schedule every 5 years (e.g., 2005, 2010, 2015, etc.).

The objectives of regularly refining the vegetation community mapping at preserve areas are to:

- Document changes in habitats that may trigger preserve management actions and habitat responses to these actions.

- Document changes in habitats that may exhibit response patterns relating to factors such as preserve configuration, adjacent land uses, fire, floods, etc.

Managers will utilize the most recent suitable imagery to refine the map (e.g., color infrared photography from the SANDAG consortium in 2005). Vegetation community classification and mapping conventions described for baseline mapping will be used and will focus on areas of change in polygon shape or attributes. Refined vegetation community data will be submitted to USFWS or the designated GIS data maintenance group for incorporation into the subregional GIS database. Upon receipt of information from the take authorization holders, the USFWS or designated GIS data maintenance group is responsible for annually incorporating new vegetation mapping into the subregional database and distributing it to the jurisdictions and other users for use in

monitoring and management. SANDAG or the designated GIS maintenance group would incorporate updates into the regional vegetation database.

Automated change detection analyses using digital imagery may be helpful in updating vegetation maps and monitoring habitat changes; however, a number of issues exist that prevent drawing conclusions regarding the applicability of these approaches (see Section 5 for more discussion).

2.3 FIRE

Temporary habitat changes resulting from fire are important to implementing land management activities at the preserve-scale and to assessing resource trends at the subregional scale. The primary source for burn data is the California Department of Forestry (CDF). The CDF maps all fires 40 acres or greater in size and has mapped fires that have occurred since 1910. Data from 1910 to 1997 have been input into GIS and are available in digital format at SANDAG. Data from 1980 to 1997 are at a scale of 1:24,000 and include detailed attribute data. Data prior to 1980 are less detailed. Data from 1997 to the present are not yet in digital format, but can be obtained in hardcopy form from the CDF.

Each preserve manager or take authorization holder should review the CDF burn data when preparing fire management plans as part of their habitat management planning. CDF burn data should also be used, as necessary, in updating vegetation community maps and attributes every 5 years. Field monitoring conducted as part of the habitat management efforts should include assessments of the post-fire recovery of specific habitats or sensitive species. The following maps, at a minimum, should be prepared for each preserve area to aid in reviewing the fire history for each area: (1) number of fires by region of the preserve area, (2) number of years since the last fire, and (3) fires in the preserve area by year. In addition, preserve managers should tabulate the number of acres burned per year.

3.0 HABITAT ACCOUNTING

In addition to monitoring the distribution of vegetation communities within the MSCP subregion, the wildlife agencies must ensure that all areas of habitat that have been dedicated to the preserve or lost to development in any year occurred in accordance with MSCP permit conditions. Take authorization holders are responsible for annually tracking habitat conservation and loss. This process is being implemented using the HabiTrak tool. The USFWS and California Department of Fish and Game (CDFG) are responsible for reviewing habitat loss and dedication data submitted by take authorization holders for accuracy and compliance with the MSCP. USFWS and CDFG will also prepare their own databases on preserve dedications by the federal and state governments.

Each year the USFWS or central GIS group will compile and consolidate all HabiTrak files received from the jurisdictions and create an updated seamless preserve assembly

database, ownership database, and vegetation database, edited to show areas lost to development. The USFWS or central GIS group will then distribute these data layers to the jurisdictions for review. Once the subregional database is finalized by the USFWS or central GIS group, it should be incorporated into the regional database.

The USFWS will also create an annual report that includes, but is not limited to, the following:

- Baseline acreage (total conserved prior to MSCP)
- Acreage conserved since initiation of the MSCP
- Cumulative conservation and annual conservation for each year
- Total acreage conserved by ownership
- Total acreage conserved by vegetation community
- Total acreage lost in MSCP since 1996
- Aggregated habitat conservation accounting model results

Automated change detection analyses using digital imagery may be helpful in tracking habitat loss (see Section 5).

4.0 SUBREGIONAL VEGETATION MONITORING (formerly referred to as Habitat Value monitoring)

The original intent of the habitat value monitoring element of the MSCP monitoring plan was to assess "edge effects" on vegetation communities by quantitatively monitoring vegetation along habitat edge-to-interior gradients in selected areas of the preserve. Stow et al. at SDSU conducted pilot studies in spring 2000 to compare a variation of the plot methodology described in the original MSCP Biological Monitoring Plan (Ogden 1996) with digital image processing technologies. Results of these studies should be available in spring 2001. However, preliminary findings of these studies indicate that (1) the original plot methods are very labor intensive, (2) there are likely too many confounding factors (e.g., past disturbance history, soils, aspect, etc.) to detect edge effects as originally envisioned, and (3) individual plots were not representative of the preserve as a whole.

Therefore, we recommend that the Habitat Value monitoring protocol described in Ogden (1996) be replaced by a new subregional vegetation monitoring program that is intended to supplement preserve-level vegetation monitoring and habitat accounting described above. However, additional information on the desired objectives of the subregional vegetation monitoring program must be established prior to finalizing recommendations on an appropriate approach. We currently believe that the objectives of the subregional vegetation community monitoring program are to:

- Document changes in habitats across the MSCP subregion over time that may be useful in interpreting population trends observed during subregional wildlife monitoring.

- Quantitatively monitor vegetation community metrics that are not captured during preserve-level monitoring activities (e.g., age or size structure, relative cover of individual species, etc.).

- Provide quantitative metrics to assist with interpretation and validation of remotely sensed imagery.

Depending on the specific information needs relating to these or other objectives, the approach for subregional vegetation monitoring may vary. At a minimum, the wildlife agencies should aggregate the results of preserve scale vegetation community mapping to review patterns of change across the subregion. The primary outstanding issue is what additional information, if any, is desirable to address subregional monitoring objectives.

In the sections below, we discuss options for collecting additional vegetation community data at subregional monitoring locations. It is assumed that these subregional monitoring locations would consist of permanent plots within a subset of all preserve units.

4.1 PHOTODOCUMENTATION FOR MONITORING PLOTS

Permanent photodocumentation points could be established within each monitoring plot and used to provide a photographic record over time of the general vegetative characteristics of the plot. The camera should be mounted at a height above the vegetation to minimize distortion. Color film should be used, and photographs should be taken at the same time of year to minimize discrepancies due to phenology. In addition, cameras should maintain the same orientation and focal length from year to year. Each photograph should include a card that provides relevant information. Photographs should be taken during each monitoring period. This methodology can provide some quantitative species or community metrics (e.g., abundance, relative abundance) and structure (e.g., cover or height).

4.2 AUTOMATED MSCP-WIDE CHANGE DETECTION

Every 5 years, remotely sensed imagery should be obtained for the MSCP area for use in updating vegetation maps and identifying changes in vegetation communities since the previous aerial imagery was flown. Very high resolution digital imaging technologies could be used to monitor changes in habitats at subregional monitoring locations (and additional areas as well). The types of changes that could be targeted include, but are not limited to:

- Openings in vegetation (bare ground or type change)
- Loss of shrub or herbaceous cover
- Trail creation or trail widening
- Road creation or road widening
- Standing water/drainage problems
- Exotic species invasion
- Erosion

- Fire
- Certain vegetation type change (e.g., shrub cover to grass cover)

The specific habitat metrics desired for the subregional monitoring program will dictate the usefulness of image-based monitoring approaches. For example, if species level or fine scale age or community structure information is desired, field collected data may be required.

4.3 FIELD COLLECTED METRICS

Depending on the desired subregional monitoring metrics, quantitative field collected data may be required. For example, to effectively interprete subregional wildlife monitoring data, quantitative metrics describing species dominance or cover, stand structure (e.g., vertical structure), or age structure may be necessary. Collection of these metrics will likely entail use of quadrat or transect sampling methodologies. The specific information required from the subregional vegetation monitoring program must be determined prior to selecting the appropriate monitoring methodology.

5.0 OUTSTANDING ISSUES AND PILOT STUDIES

In order to effectively refine the existing MSCP vegetation monitoring program, a number of unresolved issues must be addressed. We identify a number of these issues in this section; undoubtedly, many more issues will arise in the future. While it is clear that the monitoring program must be allowed to evolve over time as technology changes and our understanding of the ecology of the MSCP preserve system increases, there are some fundamental questions that must be addressed prior to completing even an initial revision of the vegetation monitoring protocols. A primary issue is the objectives of the subregional vegetation monitoring program and whether or not aggregating preserve-level vegetation data will be adequate to address those objectives. What additional data, if any, are desirable at the subregional scale that are not being collected at the preserve scale?

5.1 OUTSTANDING ISSUES

The vegetation community monitoring described in Section 2 relies on field mapping by biologists using remotely sensed imagery. This approach requires that biologists visit all areas of the preserve at 5-year intervals to refine community maps and attributes. In addition to preserve-level monitoring efforts, subregional monitoring may also entail collecting quantitative vegetation community metrics at a subset of preserve units. Remote sensing, image processing, and change detection techniques may be an efficient approach for collecting some of the desired information. However, unresolved issues regarding the applicability of these technologies for monitoring remain. In addition, a number of decisions must be made in order to standardize the approaches for the subregion (and hopefully the region) to allow preserve level data to be synthesized and interpreted in a meaningful way at the subregional scale. We have identified the following issues and necessary decisions below:

- Definition and standardization of minimum mapping units at the preserve scale.
- Community classification system to be used (e.g., modified Holland or Sawyer Keeler-Wolf).
- Mapping rules to be used in assigning vegetation community classifications. As an example, see Dr. John O'Leary's vegetation community mapping rules for studies he conducted at MCAS Miramar (Attachment A-2).
- Attributes to be assigned to vegetation communities during mapping.
- Effort and expense of using high-resolution digital imaging technologies for preserve level mapping.
- Ability of digital imaging to capture habitat metrics of interest to preserve managers (e.g., ability to discriminate community or structural differences and detect changes).
- Logistics of maintaining and updating vegetation maps at the preserve and subregion levels.
- Responsibility for database maintenance at various spatial scales (e.g., preserve-level to regional).

We recommend that a committee be formed to discuss the above and other topics relevant to the monitoring program. The existing Technology Advisory Committee (TAC) would be an appropriate forum to address many of these issues.

5.2 PILOT STUDIES

Before finalizing specific protocols for monitoring habitat value, we recommend conducting the following analyses and pilot studies:

- Review the analyses, results, and recommendations from the year 2000 ADAR mapping and vegetation transects (Doug Stow et al.) to determine what vegetation community metrics can be effectively monitored with current digital image process technologies. Address whether these metrics are adequate to address monitoring information needs of preserve managers and the wildlife agencies for subregional monitoring needs.
- Compare the year 2000 color infrared change detection capabilities with 2000 ADAR change detection capabilities.
- Fly 2001 color infrared imagery to test change detection capabilities with 2000 imagery.

A-1
TERRESTRIAL VEGETATION COMMUNITIES IN SAN DIEGO COUNTY BASED ON HOLLAND'S DESCRIPTIONS
Suggested by Thomas Oberbauer
(revised February 1996)[1,2]

10000 NON-NATIVE VEGETATION, DEVELOPED AREAS, OR UNVEGETATED HABITAT

- 11000 Non-Native Vegetation
  - 11100 Eucalyptus Woodland
  - 11200 Disturbed Wetland
  - 11300 Disturbed Habitat
- 12000 Urban/Developed
- 13000 Unvegetated Habitat
  - 13100 Open Water
    - 13110 Marine
      - 13111 Subtidal
      - 13112 Intertidal
    - 13120 Bay
      - 13121 Deep Bay
      - 13122 Intermediate Bay
      - 13123 Shallow Bay
    - 13130 Estuarine
      - 13131 Subtidal
      - 13132 Intertidal
      - 13133 Brackishwater
    - 13140 Freshwater
  - 13200 Non-Vegetated Channel, Floodway, Lakeshore Fringe
  - 13300 Saltpan/Mudflats
  - 13400 Beach
- 18000 General Agriculture
  - 18100 Orchards and Vineyards
  - 18200 Intensive Agriculture - Dairies, Nurseries, Chicken Ranches
  - 18300 Extensive Agriculture - Field/Pasture, Row Crops
    - 18310 Field/Pasture
    - 18320 Row Crops

20000 DUNE COMMUNITY

- 21000 Coastal Dunes
  - 21100 Active Coastal Dunes (occurred at one time but now nearly extirpated)
  - 21200 Foredunes
    - 21230 Southern Foredunes (tiny fragments remaining in Imperial Beach and Los Peñasquitos Lagoon)

[1]Bold indicates current revisions to Holland.

[2]Asterisk indicates prior revisions to Holland (see May 1995 version).

22000 Desert Dunes
- 22100 Active Desert Dunes (very little in Borrego Valley)
- 22300 Stabilized and Partially-Stabilized Desert Sand Field (mostly in the eastern part of Borrego Valley; may be large enough to map from aerials)

24000 Stabilized Alkaline Dunes*****

29000 ACACIA SCRUB*

30000 SCRUB AND CHAPARRAL

31000 Coastal Bluff Scrub
- 31200 Southern Coastal Bluff Scrub (mappable on Point Loma and Torrey Pines State Park)

32000 Coastal Scrub
- 32400 Maritime Succulent Scrub (Point Loma, etc.)
- 32500 Diegan Coastal Sage Scrub
  - 32510 Coastal form*****
  - 32520 Inland form (>1,000 ft. elevation)*****
- 32700 Riversidian Sage Scrub
  - 32710 Riversidian Upland Sage Scrub (scrub on Banner Grade may fit this category)
  - 32720 Alluvial Fan Scrub

33000 Sonoran Desert Scrub
- 33100 Sonoran Creosote Bush Scrub
- 33200 Sonoran Desert Mixed Scrub
  - 33210 Sonoran Mixed Woody Scrub
  - 33220 Sonoran Mixed Woody and Succulent Scrub
  - 33230 Sonoran Wash Scrub*****
- 33300 Colorado Desert Wash Scrub*****
- 33500 Calcicolous Scrub*****
- 33600 Encelia Scrub*****

34000 Mojavean Desert Scrub
- 34300 Blackbush Scrub (micro locations on eastern edge of mountains)

35000 Great Basin Scrub
- 35200 Sagebrush Scrub
  - 35210 Big Sagebrush Scrub

36000 Chenopod Scrub
- 36110 Desert Saltbush Scrub
- 36120 Desert Sink Scrub (in Borrego sink)

37000 Chaparral
- 37100 Upper Sonoran Mixed Chaparral
  - 37120 Southern Mixed Chaparral
    - 37121 Granitic Southern Mixed Chaparral
    - 37122 Mafic Southern Mixed Chaparral (occurs on Las Posas and Boomer soils)
  - 37130 Northern Mixed Chaparral*****
    - 37131 Granitic Northern Mixed Chaparral*****
    - 37132 Mafic Northern Mixed Chaparral*****

37200 Chamise Chaparral
37210 Granitic Chamise Chaparral*****
37220 Mafic Chamise Chaparral*****
37300 Red Shank Chaparral (near Campo and Chihuahua Valley)
37400 Semi-Desert Chaparral (same as Desert Transition Chaparral; occurs in areas like Jacumba)
37500 Montane Chaparral
37510 Mixed Montane Chaparral
37520 Montane Manzanita Chaparral
37530 Montane Ceanothus Chaparral
37540 Montane Scrub Oak Chaparral
37800 Upper Sonoran Ceanothus Chaparral
37810 Buck Brush Chaparral
37830 Ceanothus crassifolius Chaparral
37900 Scrub Oak Chaparral
37A00 Interior Live Oak Chaparral
37B00 Upper Sonoran Manzanita Chaparral
37C00 Maritime Chaparral
37C30 Southern Maritime Chaparral (occurs in coastal San Diego County and has been described as Coastal Mixed Chaparral)
37G00 Coastal Sage-Chaparral Scrub
37K00 Flat-topped Buckwheat*****

39000 Upper Sonoran Subshrub Scrub

40000 GRASSLANDS, VERNAL POOLS, MEADOWS, AND OTHER HERB COMMUNITIES

42000 Valley and Foothill Grassland
42100 Native Grassland
42110 Valley Needlegrass Grassland
42120 Valley Sacaton Grassland
42200 Non-Native Grassland
42300 Wildflower Field (this is actually a subset of the above, but would be pertinent in the Cuyamaca Lake and Mataguay Valley areas)
42400 Foothill/Mountain Perennial Grassland*****
42470 Transmontane Dropseed Grassland*****

44000 Vernal Pool
44300 Southern Vernal Pool
44320 San Diego Mesa Vernal Pool
44321 San Diego Mesa Hardpan Vernal Pool (northern mesas)
44322 San Diego Mesa Claypan Vernal Pool (southern mesas)

45000 Meadow and Seep
45100 Montane Meadow
45110 Wet Montane Meadow
45120 Dry Montane Meadows
45300 Alkali Meadows and Seeps
45320 Alkali Seep
45400 Freshwater Seep

46000 Alkali Playa Community
46100 Badlands/Mudhill Forbs*****

50000 BOG AND MARSH

- 52000 Marsh and Swamp
  - 52100 Coastal Salt Marsh
    - 52120 Southern Coastal Salt Marsh
  - 52300 Alkali Marsh
    - 52310 Cismontane Alkali Marsh
  - 52400 Freshwater Marsh
    - 52410 Coastal and Valley Freshwater Marsh
    - 52420 Transmontane Freshwater Marsh (San Felipe Creek)
    - 52430 Montane Freshwater Marsh
    - 52440 Emergent Wetland

60000 RIPARIAN AND BOTTOMLAND HABITAT

- 61000 Riparian Forests
  - 61300 Southern Riparian Forest
    - 61310 Southern Coast Live Oak Riparian Forest
    - 61320 Southern Arroyo Willow Riparian Forest
    - 61330 Southern Cottonwood-willow Riparian Forest
  - 61500 Montane Riparian Forest
    - 61510 White Alder Riparian Forest (Cold Spring in the Cuyamaca Mountains)
  - 61800 Colorado Riparian Forest
    - 61810 Sonoran Cottonwood-willow Riparian Forest (Coyote Canyon)
    - 61820 Mesquite Bosque (Borrego Sink)

- 62000 Riparian Woodlands
  - 62200 Desert Dry Wash Woodland
  - 62300 Desert Fan Palm Oasis Woodland
  - 62400 Southern Sycamore-alder Riparian Woodland (Pauma and Pala areas)

- 63000 Riparian Scrubs
  - 63300 Southern Riparian Scrub
    - 63310 Mule Fat Scrub
    - 63320 Southern Willow Scrub
  - 63500 Montane Riparian Scrub
  - 63800 Colorado Riparian Scrub
    - 63810 Tamarisk Scrub
    - 63820 Arrowweed Scrub

70000 WOODLAND

- 71000 Cismontane Woodland
  - 71100 Oak Woodland
    - 71120 Black Oak Woodland (Cuyamaca and Mesa Grande)
    - 71160 Coast Live Oak Woodland
      - 71161 Open Coast Live Oak Woodland
      - 71162 Dense Coast Live Oak Woodland
    - 71180 Engelmann Oak Woodland
      - 71181 Open Engelmann Oak Woodland
      - 71182 Dense Engelmann Oak Woodland
  - 71200 Walnut Woodland
    - 71210 California Walnut Woodland (micro locations occur, such as in De Luz)

72000 Pinon and Juniper Woodlands
- 72300 Peninsular Pinon and Juniper Woodlands
  - 72310 Peninsular Pinon Woodland
  - 72320 Peninsular Juniper Woodland and Scrub

75000 Sonoran Thorn Woodland
- 75100 Elephant Tree Woodland (micro locations such as Indian Wash)

77000 Mixed Oak Woodland*****

78000 Undifferentiated Open Woodland*****

79000 Undifferentiated Dense Woodland*****

80000 FOREST

81000 Broadleaved Upland Forest
- 81100 Mixed Evergreen Forest (Palomar Mountain)
- 81300 Oak Forest
  - 81310 Coast Live Oak Forest
  - 81320 Canyon Live Oak Forest (may be represented in San Diego County in some form but apparently is intended for more northern areas)
  - 81340 Black Oak Forest (as described in Holland represents apparent patches of oak in the midst of coniferous forests)

83000 Closed-cone Coniferous Forest
- 83100 Coastal Closed-cone Coniferous Forest
  - 83140 Torrey Pine Forest (not actually a closed cone pine)
- 83200 Interior Closed-cone Coniferous Forest
  - 83230 Southern Interior Cypress Forest (83330, typo in original Holland document)

84000 Lower Montane Coniferous Forest
- 84100 Coast Range, Klamath and Peninsular Coniferous Forest*****
  - 84140 Coulter Pine Forest
  - 84150 Bigcone Spruce (Bigcone Douglas Fir)-Canyon Oak Forest
- 84200 Sierran Coniferous Forest
  - 84230 Sierran Mixed Coniferous Forest
- 84500 Mixed Oak/Coniferous/Bigcone/Coulter*****

85000 Upper Montane Coniferous Forest
- 85100 Jeffrey Pine Forest

A-2
MAPPING RULES FOR VEGETATION AND LAND COVER TYPES ON MARINE CORPS AIR STATION MIRAMAR
John O'Leary, SDSU

Diegan Coastal Sage Scrub (30)

Greater than 50% ground cover of low, soft-woody subshrubs, i.e. *Artemisia californica, Eriogonum fasciculatum, Salvia mellifera, S. apiana, Mimulus aurantiacus,* and *Hazardia squarrosa* along with *Malosma laurina* and *Rhus integrifolia*. Lacking significant cover of bare ground and/or non-native herbs. Dry wash areas tend to contain most of the above species along with substantial cover of *Baccharis sarothroides*. Holland: 32500. Paysen et. al.: Coastal Sagebrush Series and Baccharis Series. MSCP: Coastal Sage Scrub.

Disturbed Diegan Coastal Sage Scrub (31)

From 20% to 50% ground cover of low, soft-woody subshrubs, i.e. *Artemisia californica, Eriogonum fasciculatum, Salvia mellifera, S. apiana, Mimulus aurantiacus,* and *Hazardia squarrosa* along with *Malosma laurina* and *Rhus integrifolia*. Dry wash areas tend to contain most of the above species along with substantial cover of *Baccharis sarothroides*. Indication of disturbance present in the form of significant percentage cover of bare ground and/or non-native herbs such as, *Avena* spp., *Bromus madritensis, Hemizonia fasciculata,* and *Erodium* spp.. Holland: 32500. Paysen et. al.: Coastal Sagebrush Series and Baccharis Series. MSCP: Disturbed Coastal Sage Scrub.

Chamise Chaparral (50)

Greater than 70% ground cover attributable to evergreen sclerophyllous shrubs and drought- deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with chamise (*Adenostoma fasciculatum)* contributing greater than 50% of the cover. Lacking significant cover of disturbance specialty species or bare ground. Includes recently burned stands with lower coverage values and few non-native species. Holland: 37200. Paysen et. al.: Chamise Series. MSCP: Chaparral.

Disturbed Chamise Chaparral (51)

From 50% to 70% ground cover attributable to evergreen sclerophyllous shrub species and drought-deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with chamise (*Adenostoma fasciculatum*) contributing greater than 50% of the cover. Disturbance indicated by a significant amount of bare ground and/or coverage by disturbance specialist species (e.g. *Eriodictyon*

crassifolium, Avena spp., *Bromus madritensis, Erodium* spp., and *Hemizonia fasciculata,* etc.). Holland: 37200. Paysen et. al.: Chamise Series. MSCP: Disturbed Chamise Chaparral.

Ceanothus Chaparral (52)

Greater than 70% ground cover attributable to evergreen sclerophyllous shrubs and drought-deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with *Ceanothus tomentosus* and/or *C. verrucosus* contributing greater than 50% of the cover. Holland: no analogue. Paysen et. al.: Ceanothus Series. MSCP: Chaparral.

Disturbed Ceanothus Chaparral (53)

From 50% - 70% ground cover attributable to evergreen sclerophyllous shrubs and drought-deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with *Ceanothus tomentosus* and /or *C. verrucosus* contributing greater than 50% of the cover. Disturbance indicated by a significant amount of bare ground and/or coverage by disturbance-specialist species (e.g. *Eriodictyon crassifolium, Avena* spp., *Bromus madritensis, Erodium* spp., *Hemizonia fasciculata,* etc.). Holland: no analogue. Paysen et. al.: Ceanothus Series. MSCP: Disturbed Chaparral.

Scrub Oak Chaparral (54)

Greater than 70% ground cover attributable to evergreen sclerophyllous shrub species and drought-deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with scrub oak (*Quercus dumosa*) contributing greater than 50% of the cover. Holland: 37900. Paysen et. al.: Scrub Oak Series. MSCP: Chaparral.

Disturbed Scrub Oak Chaparral (55)

From 50% - 70% ground cover attributable to evergreen sclerophyllous shrub species and drought-deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with scrub oak (*Quercus dumosa*) contributing greater than 50% of the cover. Disturbance indicated by a significant amount of bare ground and/or coverage by disturbance-specialty species (e.g. *Eriodictyon crassifolium, Avena* spp., *Bromus madritensis, Erodium* spp., *Hemizonia fasciculata,* etc.). Holland: 37900. Paysen et. al.: Scrub Oak Series. MSCP: Disturbed Chaparral.

Southern Mixed Chaparral (56)

Greater than 70% ground cover attributable to evergreen sclerophyllous shrubs and drought-deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with no single species contributing greater than 50% of the cover. Holland: 37120. Paysen et. al.: No analogue. MSCP: Chaparral.

Disturbed Southern Mixed Chaparral (57)

From 50% - 70% ground cover attributable to evergreen sclerophyllous shrub species and drought-deciduous malacophyllous subshrubs (evergreen sclerophyllous shrubs constitute >60% of the relative cover) with no single species contributing greater than 50% of the cover. Disturbance indicated by a significant amount of bare ground and/or coverage by disturbance-specialty species (e.g. *Eriodictyon crassifolium, Avena* spp., *Bromus madritensis, Erodium* spp., *Hemizonia fasciculata,* etc.). Holland: 37120. Paysen et. al.: no analogue. MSCP: Disturbed Chaparral.

Coastal Sage Scrub-Chaparral (72)

Greater than 70% ground cover attributable to evergreen scleropyllous chaparral species and drought-deciduous malacophyllous sage scrub species (40% relative cover ≤ coastal sage scrub species or chaparral species ≤ 60% relative cover; where both types are admixed). Holland: 37600. MSCP: Coastal Sage – Chaparral Scrub.

Disturbed Coastal Sage Scrub-Chaparral (73)

From 30% - 70% ground cover attributable to evergreen scleropyllous chaparral species and drought-deciduous malacophyllous sage scrub species (40% relative cover ≤ coastal sage scrub species or chaparral species ≤ 60% relative cover; where both types are admixed). Disturbance indicated by a significant amount of bare ground and/or coverage by disturbance-specialty species (e.g. *Eriodictyon crassifolium, Avena* spp., *Bromus madritensis, Erodium* spp., *Hemizonia fasciculata,* etc.). Holland: 37600. MSCP: Coastal Sage – Chaparral Scrub.

Non-Native Grassland (80)

Greater than 40% cover of grasses and forbs, with greater than 2/3 cover attributable to non-native annual grasses. Characteristic species are *Avena* spp. and *Bromus madritensis,* although *Nassella* spp. and native/non native annual forbs may be admixed. Holland: 42200. Paysen et. al.: Bromegrass Series and Wild Oats Series. MSCP: Grassland.

Disturbed Non-Native Grassland (81)

From 20% - 40% cover of grasses and forbs of which greater than 2/3 of the cover is attributable to non-native annual grasses. Characteristic species are *Avena* spp. and *Bromus madritensis*, although *Nassella* spp. and native/non-native annual forbs may be admixed. Evidence of recent mechanical disturbance such as tilling or mowing. Significant amounts of bare ground may be present. Holland: 42200. Paysen et. al.: Bromegrass Series and Wild Oats Series. MSCP: Disturbed Grassland.

Native Grassland (82)

Greater than 40% ground cover of grasses and forbs of which greater than 2/3 cover is attributable to *Nassella* spp. although native and introduced annual herbs may be admixed. Holland: 42100. Paysen et. al.: Needlegrass Series. MSCP: Grassland.

Disturbed Native Grassland (83)

From 20% - 40% ground cover of grasses and forbs of which greater than 2/3 cover is attributable to *Nassella* spp. although native and introduced annual herbs may be admixed. Evidence of mechanical disturbance. Significant amounts of bare ground may be present. Holland: 42100. Paysen et. al.: Needlegrass Series. MSCP: Disturbed Grassland.

Non-Native/Native Grassland (84)

Greater than 40% ground cover of grasses and forbs, with greater than 2/3 relative overall ground cover attributable to native and non-native grasses of which 1/3 relative grass cover < *Nassella spp.* or introduced grasses <2/3 relative grass cover. No evidence of recent mechanical disturbance. Holland: no analogue. Paysen et. al.: no analogue. MSCP: Grassland.

Disturbed Non-Native/Native Grassland (85)

From 20% - 40% ground cover of grasses and forbs, with greater than 2/3 relative overall ground cover attributable to native and non-native grasses of which 1/3 relative grass cover < *Nassella* spp. or introduced grasses < 2/3 relative grass cover. Evidence of recent mechanical disturbance may occur. Significant amounts of bare ground may occur. Holland: no analogue. Paysen et. al.: no analogue. MSCP: Grassland.

Vernal Marsh (90)

Strongly dominated by *Juncus bufonius*, with lesser amounts of assorted forbs and graminoids such as *Lythrum hyssopifolium, Ambrosia psilostachya, Eleocharis*

macrostachya, and *Rumex acetosa* admixed. Subject to seasonal inundation. Holland: 52500. Paysen et. al.: Wiregrass Series. MSCP: Disturbed Wetlands.

Disturbed Vernal Marsh (91)

Strongly dominated by *Juncus bufonius,* with lesser amounts of assorted forbs and graminoids such as *Lythrum hyssopifolium, Ambrosia psilostachya, Eleocharis macrostachya,* and *Rumex acetosa* admixed. Subject to seasonal inundation. Holland: 52500. Paysen et. al.: Wiregrass Series. MSCP: Disturbed Wetlands.

Coastal and Valley Fresh Water Marsh (100)

Dominated by perennial, emergent monocots such as cattails (*Typha latifolia, T. domingensis*), bullrushes (*Scirpus americana, S. robusta, S. californicus*) and species of smart weed (*Persicaria* spp.) and dock (*Rumex* spp.). Occurring on sites lacking significant current, permanently flooded by permanent water (rather than brackish, alkaline, or variable). Holland: 52410. Paysen et. al.: Wiregrass Series. MSCP: Freshwater Marsh.

Disturbed Coastal and Valley Fresh Water (101)

Dominated by perennial, emergent monocots such as cattails (*Typha latifolia, T. domingensis*), bullrushes (*Scirpus americana, S. robusta, S. californicus*) and species of smart weed (*Persicaria* spp.) and dock (*Rumex* spp.). Occurring on sites lacking significant current, permanently flooded by permanent water (rather than brackish, alkaline, or variable). Holland: 52410. Paysen et. al.: Wiregrass Series. MSCP: Freshwater Marsh.

Southern Coast Live Oak Riparian Forest (110)

Greater than 40% cover by the Coastal Live Oak (*Quercus agrifolia*). May be associated with an understory of chaparral shrub species such as *Quercus dumosa, Adenostoma fasciculatum, Ceanothus tomentosus, Malosma laurina, Rhus integrifolia* etc., and vines such as *Toxicodendron diversilobum.* Holland: 61310. Paysen et. al.: Coast Live Oak Series. MSCP: Oak Riparian Forest.

Disturbed Southern Coast Live Oak Riparian Forest (111)

From 25% - 45% cover of Coastal Live Oak (*Quercus agrifolia*) with a discontinuous understory of chaparral shrub species such as *Quercus dumosa, Adenostoma fasciculatum, Ceanothus tomentosus, Malosma laurina, Rhus integrifolia* etc. and vines such as *Toxicodendron diversilobum.* Evidence of past mechanical disturbance and/or significant invasion by non-native species such as *Arundo donax, Tamarix* spp.,

Eucalyptus spp., *Cortaderia* spp., etc. Holland: 61310. Paysen et. al.: Coast Live Oak Series. MSCP: Disturbed Oak Riparian Forest.

Southern Arroyo-Willow Riparian Forest (112)

Greater than 60% ground cover of *Salix* spp., that average greater than 20 ft. in height. Holland: 61320. Paysen et. al.: Willow Series. MSCP: Riparian Forest.

Disturbed Southern Arroyo-Willow Riparian Forest (113)

From 40% - 60% overstory cover of *Salix* spp. that average greater than 20 ft. tall. Evidence of past mechanical disturbance, and/or significant invasion by non-native species such as *Arundo donax, Tamarix* spp., *Eucalyptus* spp., *Cortaderia* spp., etc.. Holland: 61320. Paysen et.al.: Willow Series. MSCP: Disturbed Riparian Forest.

Riparian Forest (Sycamore Woodland) (120)

A tall, open, broadleaved, winter-deciduous streamside woodland dominated by *Platanus racemosa*, with an overstory cover greater than 25%. Usually associated with the understory shrubs *Baccharis sarothroides, B. salicifolia,* and *Eriogonum fasciculatum.* Scattered individuals of *Salix* spp. and *Populus fremontii* may be present. Holland: 62400. Paysen et. al.: Sycamore Series. MSCP: Riparian Woodland.

Disturbed Riparian Forest (Disturbed Sycamore Woodland) (121)

A tall, open, broad-leaved, winter-deciduous streamside woodland dominated by *Platanus racemosa* with an overstory cover ranging from 15% - 25%. *Baccharis sarothroides, B. salicifolia,* and to a lesser extent, *Salix* spp. and *Populus fremontii.* Evidence of past mechanical disturbance and/or significant invasion by non-native species such as *Arundo donax, Tamarix* spp., *Eucalyptus* spp., *Cortaderia* spp., etc.. Holland: 62400. Paysen et. al.: Sycamore Series. MSCP: Disturbed Riparian Woodland.

Southern Willow Scrub (130)

Dense (greater than 60%) cover, broadleaved, winter deciduous riparian thickets dominated by several species of *Salix* that average less than 20 ft. high. Holland: 63320. Paysen et. al.: Willow Series. MSCP: Riparian Scrub.

Disturbed Southern Willow Scrub (131)

Less-dense (from 30%-60% coverage), broadleaved, winter deciduous riparian thickets dominated by several species of *Salix* spp. that average less than 20 ft. high. Evidence of past mechanical disturbance and/or significant invasion by non-native species such as

Arundo donax, Tamarix spp., *Eucalyptus* spp., *Cortaderia* spp., etc. Holland: 63320. Paysen et. al.: Willow Series. MSCP: Disturbed Southern Willow Scrub.

Mulefat Scrub (132)

A "depauperate" (greater than 50% cover), tall, "herbaceous," riparian scrub strongly dominated by *Baccharis salicifolia*. An early seral community maintained by frequent flooding; occurs on intermittent stream channels with fairly coarse substrate and moderate depth to water table. Holland: 63310. Paysen et. al.: Baccharis Series. MSCP: Riparian Scrub.

Disturbed Mulefat Scrub (133)

A "depauperate" (20% - 50% cover), tall, "herbaceous," riparian scrub strongly dominated by *Baccharis salicifolia.* An early seral community maintained by frequent flooding; occurs on intermittent stream channels with fairly coarse substrate and moderate depth to water table. Evidence of past mechanical disturbance and/or significant invasion by non-native species such as *Arundo donax, Tamarix* spp., *Eucalyptus* spp., *Cortaderia* spp., etc. Holland: 63310. Paysen et. al.: Baccharis Series. MSCP: Disturbed Riparian Scrub.

Coast Live Oak Woodland (150)

Greater than 25% overstory cover of *Quercus agrifolia* found on north-facing slopes and in moist ravines. May contain a discontinuous understory of shrubs/vines such as *Prunus illicifolia, Heteromeles arbutifolia, Ribes indecorum, Sambucus mexicana,* and *Toxicodendron diversilobum.* Holland: 71160. Paysen et. al.: no analogue. MSCP: Oak Woodland – Dense Phase.

Disturbed Coast Live Oak Woodland (151)

From 15%-25% overstory cover of *Quercus agrifolia* found on north facing slopes and in moist ravines. May contain a discontinuous understory of shrubs/vines such as *Prunus illicifolia, Heteromeles arbutifolia, Ribes indecorum, Sambucus mexicana,* and *Toxicodendron diversilobum.* Evidence of mechanical disturbance and/or invasion by non-native shrubs or trees. Holland: 71160. Paysen et. al.: no analogue. MSCP: Disturbed Oak Woodland – Dense Phase.

Eucalyptus Woodland (190)

Greater than 25% overstory cover by *Eucalyptus* spp., though individuals of *Acacia melanoxylon* may be admixed. Paysen et. al.: Eucalyptus Series. MSCP: Eucalyptus Woodland.

Open Water (200)

Greater than 0.3 acres of perennially standing water. MSCP: Open Water.

Natural Flood Channel/Streambed (220)

Unvegetated or sparsely (< 30% cover of shrubs and trees) vegetated natural flood channel or scoured streambed. MSCP: Natural Flood Channel/Streambed.

Disturbed Habitat (240)

Past or present physical disturbance prevalent (e.g. brushing, tilling, vehicular disturbance, etc.). Typically comprised of a mixture of grasses and forbs with grasses contributing <2/3 of the relative cover and with non-native forbs like *Erodium botrys*, *Hypocheris glabra*, *Foeniculum vulgare*, and *Salsola kali* being common dominants. Native shrub/subshrubs (e.g. *Eriogonum fasciculatum*, *Baccharis sarothroides*, *Eriodictyon crassifolium*, and *Lotus scoparius*) and non-native shrubs (e.g. *Ricinus communis*) may be patchily admixed. Substantial amounts of bare ground may exist. Potential for colonization and succession of native plant communities exists. If area is fragmented, it must have reasonable proximity to native seed sources. MSCP: Disturbed Habitat.

Developed (250)

Little or no short-term potential for the colonization and succession of native plant communities. Includes maintained (irrigated) exotic landscapes, buildings, pavement, exposed bedrock, and recently graded surfaces. MSCP: Developed.

ATTACHMENT B

CONSIDERATIONS FOR COVERED PLANT SPECIES MONITORING PROTOCOLS

Monitoring efforts for covered plant species should be divided into preserve-level monitoring, that will be conducted on all preserves supporting covered plant species, and MSCP-level or subregional monitoring, that will be conducted only at selected preserve areas. The purpose of preserve-level monitoring is to provide preserve managers with information to identify and prioritize species-specific management actions. The subregional monitoring program is intended to evaluate the responses of key resources to loss of habitat outside of the preserve (i.e., the effectiveness of the MSCP conservation strategy) by monitoring these resources within a sample of the overall preserve system. Table B-1 provides a summary framework of CBI's recommendations for revising the MSCP plant monitoring protocols. We suggest that protocols be designed and grouped according to species habit, as follows:

- Tree/shrub/subshrub -- long-lived tree or perennial shrub species whose populations are not expected to fluctuate dramatically over short time periods.

- Herbaceous perennial (rhizomatous) -- perennial species whose populations may or may not fluctuate dramatically over short time periods.

- Herbaceous perennial (non-rhizomatous) -- perennial species whose populations may or may not fluctuate over short time periods.

- Herbaceous perennial (geophyte) -- perennial species whose populations may fluctuate over short time periods.

- Annual (herbs) -- annual herbaceous species whose populations may fluctuate dramatically over short time periods (<5 years).

- Annual (grasses) -- annual grass species whose populations may fluctuate dramatically over short time periods.

We recommend that monitoring intensity be varied according to the growth habitat and sensitivity of the species being monitored. General categories of monitoring intensity are described below, and additional considerations for sampling design are summarized. Table B-2 provides the recommended monitoring locations for species requiring secondary monitoring, as well as the agency responsible for the monitoring.

Monitoring Intensity

Primary or Qualitative Monitoring. Primary or qualitative monitoring should be conducted for all covered plant species at all preserve locations where they occur,

utilizing habitat mapping, aerial photography or other imagery, and species distribution mapping. This methodology assumes that if the habitat is intact and natural ecosystem processes are functioning, then the population will persist. Population abundance can be classified as rare, common, or abundant, and the health or condition of the population should be described.

Secondary or Quantitative Density Monitoring. In addition to determining the distribution of the population, secondary monitoring quantifies the number of individuals (or other population parameters) through time. This methodology can document population trends but will not determine the cause. If declining trends are observed, then more costly and time-intensive demographic monitoring can be initiated. This is most appropriate for annuals and non-rhizomatous perennials or when individual ramets can be discerned. Quantitative monitoring is recommended for species where Table 3-5 requires area-specific management and monitoring directives.

Tertiary or Demographic Monitoring. Demographic monitoring is intended to follow the fate of individual plants over time and to provide information on processes regulating population density and persistence. Demographic monitoring is time-consuming and expensive. It is used only when a species is particularly rare or endangered or when less intensive monitoring indicates that there is a significant decline in abundance. This may be impractical for rhizomatous perennials or annuals with persistent seed banks.

Sampling Design Consideration (for quantitative monitoring)

When secondary or quantitative monitoring is utilized, the design of a sampling program must be considered. Below are various categories relating to sampling design.

Plot Design

Randomized Plot Design. This plot design utilizes random sampling of a geographic area or macroplot, with sampling plot locations (quadrats) changing from year to year within the macroplot. This design is most appropriate for annuals, biennials, short-lived perennials (e.g., species that fluctuate spatially over a relatively short-period of time). A randomized plot design may require more sample plots than a permanent plot design to attain the same level of power to detect change. However, a randomized plot design will provide a better estimate of the average conditions across the macroplot. Annual macroplot sample means and quadrat variances are the basis for determining statistical trends in abundance over time.

Permanent Plot Design. This plot design is most frequently used for population monitoring. This design measures the same individuals or area over time to give the most precise estimate of temporal change in a particular location. Plot locations are randomly located during the first year, and the same plots are re-sampled in following years. This design is most beneficial for long-lived perennials, species with clumped distributions, and bulbs or other species with a prolonged dormancy. Fewer sample plots may be required to attain the same level of power as with temporary plots.

Sample Size

Sample size will vary for all species. Sample size should be based on the minimum number of plots required to detect trends at a given level of power. This requires that a meaningful level of change in density (minimum detectable change) and desired level of power and significance be known or assumed. A power analysis can be used to determine the number of plots necessary to meet those conditions.

Alternatively, conduct a pilot sampling effort to estimate standard deviation for the calculation of a preliminary sample size for data collection. Use a sequential sampling method to compute successive estimates of the average and standard deviation, then determine where these "level off." Sample size will need to be above the point where the average and standard deviation have leveled off in order to capture a robust estimate of these parameters. These parameter estimates can then be used to assess the relationship between sample size and statistical power.

Plot Size/Shape

The plot or quadrat is the most common sampling unit, and the $1m^2$ quadrat is the most frequently used sampling unit size and shape. In general, however, rectangular plots are better than circles or squares for measuring density, because they reduce between-plot variation in patchy environments. Increasing plot size can also reduce between-plot variation.

Considerations for determining an appropriate plot size and shape include (a) the spatial distribution of the population, (b) density of the population, and (c) size of the plant.

If the population is randomly distributed, any plot size and shape will give equally precise estimates with an adequate sample size. If the distribution is clumped, plot size and shape strongly influence sampling variance and precision of population estimates. In this case, plot size should be slightly larger than the estimated mean clump size of the target species. Square quadrats are appropriate in homogenous plant communities. Heterogeneous communities should be sampled with rectangular quadrats. Plotless methods can be used for widely dispersed plants.

For density data, select a quadrat size that doesn't contain too many individual plants, stems, etc. to count accurately.

Plot Placement

The placement and distribution of plots can be varied depending on sampling objectives and the actual distribution of individual plants in the field.

Simple random sampling. Plots are randomly placed throughout the macroplot. Simple random sampling is most appropriate for use in relatively small geographical areas, homogeneous habitats, and randomly distributed populations.

Stratified random sampling. The population is divided into units (strata) prior to sampling to minimize variability within a stratum and to account for variability between strata. Stratification can be based on any factor thought to influence the monitoring metric, such as slope, aspect, moisture gradient, canopy, demography, management units, and disturbance levels. Strata are subsampled with randomly placed quadrats.

Adaptive cluster sampling. This type of plot placement utilizes randomly chosen sampling units and is most appropriate for clonal species. If the species of interest is found in the sampling unit, then all adjacent sampling units are sampled, continuing until the outer sampling units do not contain the species of interest.

Sampling Frequency

Qualitative Monitoring. Monitor at 5-year intervals. Most of the species monitored qualitatively are long-lived perennials, so a longer interval between monitoring would allow change detection.

Quantitative Density Monitoring. Monitoring frequency will vary depending on life form and threats:

- Annuals (herbs and grasses): monitor every year.
- Herbaceous perennials (geophytes): monitor every year; or, monitor 3 or more consecutive years every 5-20 years.
- Herbaceous perennials (non-rhizomatous): monitor yearly for relatively short-lived species or species expected to fluctuate spatially; monitor yearly for 5-10 years for longer-lived perennials subject to edge effects and habitat fragmentation, then monitor at an interval of 3 or more consecutive years every 5-20 years; and monitor at 5-year intervals for longer-lived herbaceous perennials not subject to edge effects and habitat fragmentation.
- Herbaceous perennials (rhizomatous): monitor yearly for 5-10 years, then monitor at an interval of 3 or more consecutive years every 5-20 years.

Table B-1
TYPE AND INTENSITY OF MONITORING FOR COVERED PLANT SPECIES

	Monitoring Intensity[1]			
Habit/Covered Species	**All Preserve Areas[2]**	**Selected Preserve Areas[3]**	**Quantitative Monitoring Method[4]**	**Sampling Frequency**
Tree/Shrub/Subshrub				
Shaw's agave*	1			5 years
Del Mar manzanita (*coastal locations subject to habitat fragmentation and edge effects*)	2[5]		Index	5 years
Otay manzanita	1			5 years
Encinitas baccharis*	2[5]		Index	5 years
Nevin's barberry* (*no naturally occurring populations in the MSCP*)	1			5 years
Lakeside ceanothus*	1[5]			5 years
Wart-stemmed ceanothus	1[5]			5 years
Tecate cypress	1			5 years
Palmer's ericameria*	1			5 years
San Diego barrel cactus	1			5 years
Heart-leaved pitcher sage	1[5]			5 years
Gander's pitcher sage* (*inland locations in relatively large, intact preserve areas*)	1			5 years
Dehesa bear-grass* (*inland locations in relatively large, intact preserve areas*)	1			5 years
Snake cholla* (*coastal locations subject to habitat fragmentation and edge effects*)	2		Index	5 years
Torrey pine	1[5]			5 years
Small-leaved rose (*only on California Terraces*)	2		Direct Measurements	Annually
San Miguel savory	1			5 years
Parry's tetracoccus	1			5 years
Herbaceous Perennial (Rhizomatous)				
San Diego ambrosia	2		Plot	Annually
Dense reed grass (*invalid taxon--synonymous with Calamagrostis koelerioides*).	---			---
Herbaceous Perennial (Non-rhizomatous)				
Del Mar Mesa sand aster (*coastal locations subject to habitat fragmentation and edge effects*)	1	2[5]	Plot	Annually

Table B-1
TYPE AND INTENSITY OF MONITORING FOR COVERED PLANT SPECIES

	Monitoring Intensity[1]			
Habit/Covered Species	**All Preserve Areas[2]**	**Selected Preserve Areas[3]**	**Quantitative Monitoring Method[4]**	**Sampling Frequency**
Sticky dudleya (*populations not expected to fluctuate dramatically over short time periods*)	1			5 years
San Diego button-celery**	2		Plot	Annually
Coast wallflower (*invalid taxon--synonymous with Erysimum capitatum*)	---			---
Felt-leaved monardella (*inland locations in relatively large, intact preserve areas*)	1			Annually
Willowy monardella* (*some populations threatened by hydrological alterations, habitat fragmentation, and edge effects*)	2		Plot	Annually
Gander's butterweed (*inland locations in relatively large, intact preserve areas*)	1[5]			Annually
Narrow-leaved nightshade (*invalid taxon--synonymous with Solanum santii*)	---			---
Herbaceous Perennial (Geophyte)				
Thread-leaved brodiaea*	1			Annually[6]
Orcutt's brodiaea	1	2	Plot	Annually[6]
Dunn's mariposa lily* (*inland locations in relatively large, intact preserve areas*)	1			Annually[6]
Short-leaved dudleya*	2		Plot	Annually[6]
Variegated dudleya*	1	2	Plot	Annually[6]
San Diego goldenstar (*threatened by habitat fragmentation and edge effects*)	1	2	Plot	Annually[6]
Annual (Herbs)				
San Diego thornmint*	1	2	Plot	Annually
Aphanisma (*no known populations in MSCP--if any detected, would require secondary monitoring*)	1			Annually
Coastal dunes milk vetch (*possibly extirpated--if any detected, would require secondary monitoring*)	1			Annually

Table B-1
TYPE AND INTENSITY OF MONITORING FOR COVERED PLANT SPECIES

	Monitoring Intensity[1]			
Habit/Covered Species	**All Preserve Areas[2]**	**Selected Preserve Areas[3]**	**Quantitative Monitoring Method[4]**	**Sampling Frequency**
Slender-pod jewelflower (*invalid taxon--synonomous with Caulanthus heterophyllus*)	---			---
Salt marsh bird's-beak	2		Plot	Annually
Orcutt's bird's-beak	2		Plot	Annually
Otay tarplant* (*threatened by habitat fragmentation and edge effects*)	1	2	Plot	Annually
Nuttall's lotus	2		Plot	Annually
Prostrate navarretia**	2		Plot	Annually
San Diego mesa mint**	2		Plot	Annually
Otay Mesa mint**	2		Plot	Annually
Annual (Grasses)				
California Orcutt grass**	2		Plot	Annually

[1] Level of monitoring data collection intensity required:
- 1 = Primary – Non-quantitative surveys to assess resource presence/absence or distribution, using habitat mapping, aerial photography or other imagery, and mapping of species distribution.
- 2 = Secondary – Mapping species distribution and quantitative or semi-quantitative surveys to assess resource frequency, species abundance, density, or other indices to monitor status and trends through time. Quantitative monitoring is recommended for species where Table 3-5 requires area-specific management and monitoring directives.

[2] Preserve-level monitoring to inform management decisions – required of all preserve managers at all preserve units where species occurs.

[3] MSCP-level (subregion) monitoring – required for monitoring at a subset of all preserve units, using protocols standardized across the MSCP. Data will be collected only at designated locations (not all preserve units where the species occurs).

[4] Quantitative monitoring methods: Index = visual estimate, wherein population abundance is categorized according to cover class or other indices; direct measurement = direct counts or measurements of individual survival, establishment, and growth rate, as indicated in conditions for coverage (applicable only to small-leaved rose on the California Terraces project site); plot = quantitative density monitoring in permanent or temporary, randomly placed quadrats (plots) to track number of individuals (or other simple population parameters) through time.

[5] Area-specific management directives must address the autecology and natural history of these species, which may require quantitative studies not associated with population trend monitoring.

[6] Monitoring for these species is best conducted on an annual basis to identify declining population trends due to environmental conditions, habitat fragmentation, or edge effects. If monitoring is conducted less frequently, it should be structured to capture environmental variability (e.g., sampling for 3 or more consecutive years every 5-20 years. A less frequent sampling regime will require that the interval between sampling periods is initially short to capture the range of climatic variation).

* Narrow endemic species

** Vernal pool species (also narrow endemics)

Table B-2
COVERED PLANT SPECIES MONITORING LOCATIONS

Covered Species	Monitoring Location[1]	Responsible
Tree/Shrub/Subshrub		
Del Mar manzanita	Del Mar Heights (Crest Canyon) (P-3) San Dieguito River Bluffs (P-5) Torrey Pines State Park Extension (P-6) Torrey Pines State Park (P-7) Carmel Mountain (P-8) Del Mar Mesa (P-10) Los Peñasquitos Canyon (P-12)	City of San Diego City of San Diego State Parks State Parks City of San Diego City of San Diego City of San Diego
Encinitas baccharis*	4-S Rnch, Rncho Cielo (P-1) Poway Iron Mountain	County of SD City of Poway City of Poway
Lakeside ceanothus*	Barona Valley-Wildcat Canyon Ramona El Cajon Mountain Crest-Harbison Canyon	County of SD County of SD County of SD County of SD
Wart-stemmed ceanothus	Spooner's Mesa Carmel Mountain Crest Canyon Del Mar Highlands Fairbanks Ranch Santa Fe Valley	City of San Diego City of San Diego City of San Diego City of San Diego City of San Diego County of SD
Heart-leaved pitcher sage	Iron Mountain	City of Poway, County of SD
Snake cholla*	Poggi Canyon (P-24) Spring Canyon (P-26) Lower Salt Creek (P-31) Border Field State Park Sweetwater Marsh Point Loma	City of Chula Vista City of San Diego City of Chula Vista State Parks USFWS refuge USPS, City of SD
Torrey pine	Torrey Pines State Reserve	State Parks
Small-leaved rose	Otay River Valley/West Otay Mesa[2] (P-25)	City of San Diego
Herbaceous Perennial (Rhizomatous)		
San Diego ambrosia*	Santee/Mission Trails (P-16[3])	Cities of Santee/SD
Herbaceous Perennial (Non-Rhizomatous)		
Del Mar Mesa sand aster	San Dieguito River Bluffs (P-4) Torrey Pines State Park (P-7) Del Mar Mesa (P-10) Del Mar Highlands Carmel Mountain Fairbanks Ranch	City of San Diego State Parks City of San Diego City of San Diego City of San Diego City of San Diego

Table B-2
COVERED PLANT SPECIES MONITORING LOCATIONS

Covered Species	Monitoring Location[1]	Responsible
San Diego button-celery**	Otay River Valley	County/City of SD
	Otay Lakes	City of San Diego
	Proctor Valley	County of SD
	Del Mar Mesa	City of San Diego
	Tierrasanta	City of San Diego
Felt-leaved monardella	Sequan Peak	
	Iron Mountain	
Willowy monardella*	Santee (Sycamore Canyon) (P-14)	City of Santee
	Cedar Canyon (P-33)[4]	BLM
	Marron Valley[4]	City of San Diego
Gander's butterweed	McGinty Mountain	USFWS refuge
	Sequan Peak	CDFG
	El Cajon Mountain	County of SD
Herbaceous Perennial (Geophyte)		
Orcutt's brodiaea	Carmel Mountain (P-9)	City of San Diego
	Del Mar Mesa (P-11)	City of San Diego
	East Otay Mesa (P-32)	County of SD
	Cedar Canyon (P-33)	BLM
Short-leaved dudleya*	Del Mar Heights (Crest Canyon) (P-3)	City of San Diego
	Torrey Pines State Park Extension (P-6)	State Parks
	Torrey Pines State Park (P-7)	State Parks
	Carmel Mountain (P-8)	City of San Diego
	Del Mar Mesa	City of San Diego
	Crest Canyon	City of San Diego
Variegated dudleya*	Sycamore Canyon/East Elliott/Fanita (P-15)	Cities of SD/Santee
	San Miguel Mountain (P-18)	County of SD
	Otay River West (P-28)	Cities of Chula Vista/SD/County
	Lower Salt Creek (P-31)	City of Chula Vista
	Marron Valley (P-34)	City of San Diego
	Proctor Valley	County of SD
	Otay Lakes	County of SD
	Otay Mesa	City/County of SD
San Diego goldenstar	Del Mar Mesa (P-11)	City of San Diego
	Sycamore Canyon/East Elliott (P-15)	City of San Diego
	East Otay Mesa (P-32)	County of SD
	Northeast San Ysidro Mountains/ Otay Ranch (P-35)	County of SD
	4S Ranch	County of SD
	Dehesa	County of SD
	Proctor Valley (Jamul Mountains)	County of SD
	Marron Valley	City of San Diego

Table B-2
COVERED PLANT SPECIES MONITORING LOCATIONS

Covered Species	Monitoring Location[1]	Responsible
Annual (Herbs)		
San Diego thorn-mint*	4S Ranch/Santa Fe Valley (P-2) Sycamore Canyon (P-13) McGinty Mountain (P-17) Jamul Mountains (West) (P-30) Sabre Springs/Poway El Capitan Alpine Otay Lakes Sky Mesa Ranch Asphalt Inc.	County of SD County of SD USFWS refuge County of SD Cities of SD/Poway County of SD County of SD City of San Diego
Salt marsh bird's-beak	Sweetwater River Mouth and Vicinity (P-20) South San Diego Bay Wetlands (P-21) Tijuana River Estuary and Vicinity (P-22)	USFWS refuge USFWS refuge USFWS refuge
Orcutt's bird's-beak	Goat Canyon-Spooner's Mesa (P-23) Otay River Valley	City of San Diego City of San Diego
Otay tarplant*	San Miguel Mountain (P-19) Poggi Canyon (P-24) Wolf Canyon (P-27) Otay River West (P-28) Proctor Valley (P-29)	USFWS refuge City of Chula Vista City of Chula Vista City of Chula Vista County of SD
Nuttall's lotus	Tijuana River Estuary and Vicinity (P-22) San Diego River flood control channel D Street Fill Border Field State Park	USFWS refuge City of San Diego USFWS refuge State Parks
Prostrate navarretia**	Otay Mesa	City of San Diego
San Diego mesa mint**		
Otay Mesa mint**	Otay Mesa	
Annual (Grasses)		
California Orcutt grass**	Otay Mesa	County of SD

[1] Includes major populations as specified in Table 5-2 of the MSCP Biological Monitoring Plan, Table 3-5 of the MSCP Plan, MSCP Standards and Guidelines, and USFWS analyses for coverage. Excludes plants on military land.

[2] Refers to the one naturally occurring population on the California Terraces project site.

[3] Note that location P-26 (MSCP Monitoring Plan) has since been identified as supporting a common species of San Diego ambrosia; therefore, it should not be included in the MSCP monitoring effort. In addition, a small population of San Diego ambrosia in the San Diego National Wildlife Refuge will be conserved and managed by the USFWS; this population is not considered a major population.

[4] The Marron Valley and Cedar Canyon populations constitute a new taxon of Monardella.

* Narrow endemic species

** Vernal pool species (also narrow endemics)

ATTACHMENT C

WILDLIFE CORRIDOR MONITORING

Wildlife corridor monitoring will address the following basic questions:

- What large mammals and mesopredators are using the MSCP linkages?
- What potential constraints to animal movement exist in these areas?
- Where are habitat restoration or other management techniques needed to facilitate animal movement?
- Do specific underpasses function effectively for wildlife movement?
- Are the wildlife corridors identified in the MSCP functional?

The target species for corridor monitoring are deer, mountain lion, bobcat, coyote and mesopredators. The objectives for monitoring are to assess distribution, relative abundance, movement patterns, and corridor use through a combination of survey techniques: (1) track counts, (2) remotely-triggered cameras, and (3) incidental scat and sign observations. Observations of other MSCP target species and preserve condition should also be recorded. Both the current corridor studies being conducted in Poway and San Diego and the San Diego Tracking Team surveys use all three survey techniques, varying only in methodology for track surveys, as summarized below.

1. Track Surveys

Methodology A (used in year 2000 corridor studies in Poway and San Diego)
Conduct track surveys to evaluate distribution, relative abundance, and corridor use by target species. In habitat linkages, establish a series of track detection stations at 250-m intervals along dirt roads or trails. Following Linhart and Knowlton (1975), each track station will consist of a 1-m diameter circle of freshly sifted gypsum 1 cm deep and scented with carnivore lures. Each transect will be up to 1 km in length (5 track stations). If the axis of the corridor is long enough to support multiple 1 km transects, each track transect will be established a minimum of 1 km apart.

At roadway undercrossings, construct baited track stations near each opening of the underpass to actively detect animal movement on both sides of the undercrossing. In addition, to passively monitor animals traveling through an underpass, construct non-baited stations directly underneath the roadway (i.e., within the underpass) by sifting a strip of gypsum across the width of the underpass. Identify and measure all tracks and note the direction of travel.

Sample each track transect for a minimum of 5 consecutive days each sampling period: Summer (June-August) and fall (September-November). See attached Track Survey Data Sheet for recording field data. For each transect, relative abundance at each station is expressed as the total number of visits recorded for each species at each station divided by the total sampling effort (Linhart and Knowlton 1975; Diefenbach et al. 1994).

This survey methodology will provide an index of relative abundance and is not a census of the absolute number of individuals in each study area. Rather, it will provide comparative information on the relative numbers of individuals across space and time.

Methodology B (used by San Diego Tracking Team in Los Peñasquitos Canyon and other areas of central San Diego)

The San Diego Tracking Team uses a similar methodology, but with different length transects and without baited gypsum stations. The methodology follows that of the Keeping Track program begun by Susan Morse. A typical transect is about 1 mile in length and 30 feet in width (15 feet on either side of the center of the trail where possible), depending on the specific location. Transects are walked 4 times per year during a specified time period each quarter. Transects are surveyed between dawn and 11 a.m. or between 3 p.m. and sunset. Data are recorded on standardized field forms.

2. Camera Surveys

Remotely-triggered infrared cameras are valuable tools to detect wildlife movement because they can monitor potential corridors for an extended period of time with minimal supervision. In priority locations, establish camera stations at habitat linkages and undercrossings. Restrict camera locations to relatively concealed locations where possibility of camera theft is minimal. Camera systems provide several functions: (a) to positively identify carnivore species present in an area, (b) to provide verification of track identifications at track stations, and (c) to provide an estimate of the frequency of which individuals pass by without visiting track stations. See attached Camera Visitation Data Sheet.

3. Incidental Scat and Sign Observations

Record observations of scat and other sign in association with a track station area, but not found on the actual track station. These observations will provide information on what additional wildlife may be found in the area, but are not visiting track stations.

4. Other Observations

While in the field, record and map observations of other MSCP target species and preserve conditions, including invasive species, trash, inappropriate fencing or brushing, presence of surface water in channels, and potential areas for restoration or enhancement that would enhance wildlife use. See attached Observations Data Sheet.

LITERATURE CITED

Diefenbach, D.R., M.J. Conroy, R.J. Warren, W.E. James, L.A. Baker, and T. Hon. 1994. A test of the scent-station survey technique for bobcats. Journal of Wildlife Management 58:10-17.

Kelly, B.T. 1994. Brief overview of conducting scat surveys on Naval Air Station Miramar to index coyote numbers. Naval Air Station Miramar. Unpublished report.

Linhart, S.B., and F.F. Knowlton. 1975. Determining the relative abundance of coyotes by scent station lines. Wildlife Society Bulletin 3:119-124.

TRACK SURVEY DATA SHEET Page_____

Area_____ **Transect**_____ **Researchers**_____ **Season**_____

Date	Time	#	Visit? Y or N	New Bait Y or N	Omit? Y or N	Species	Width Hind (H) Front (F)	Length Hind (H) Front (F)	Stride (bt 2 or 4)	Straddle	Comments

Observations Data Sheet	
Researchers:	Page____
Date and Field Site	OBSERVATIONS

CAMERA VISITATION DATA SHEET

invstgtr	date	time	cam #	location	arrive exp #	test (Y/N)	flmchng (Y/N)	depart exp #	comments (note setup & pull)

ATTACHMENT D

COASTAL SAGE SCRUB BIRDS

Preserve managers are responsible for conducting annual surveys for all MSCP covered species on each preserve unit. The monitoring objective for covered species at the preserve level is to demonstrate their conservation by documenting their presence in specific preserve areas. An additional objective at the subregional level is to collect community level metrics for the coastal sage scrub avian community in selected areas across the MSCP.

California Gnatcatcher, Coastal Cactus Wren, and California Rufous-Crowned Sparrow Surveys

Preserve managers will annually conduct presence/absence surveys of all covered sage scrub bird species. Surveys should be conducted between January 1 and March 31. Surveys should begin within 1 hour after sunrise and end by noon. Surveys should not be conducted during extreme conditions (very cold or hot or very windy).

Point Counts of Coastal Sage Scrub Birds

The objective of monitoring coastal sage scrub bird species is to track the status and trends of the entire coastal sage scrub bird community, not just MSCP covered species. Coastal sage scrub bird species will be monitored annually at selected locations across all geographic regions of the MSCP (see Figure 4-1 and Table 5-6 in Ogden 1996) using standard point count methodology (e.g., see Ralph et al. 1993). In each patch of coastal sage scrub designated for monitoring, a permanent monitoring plot will be established. In each monitoring plot, point counts will be conducted within 50-m, fixed-radius, circular plots. The circular plots will have adequate separation to avoid double-counting. The number of point counts per monitoring plot will be proportional to the size of the monitoring plot so that the survey effort (proportion of plot surveyed) is roughly equal across monitoring plots. Monitoring plots will be surveyed a minimum of 3 times with a minimum 7-day interval between visits during the period January through March. The numbers of all bird species detected will be recorded for each circular plot. Sex and age will be recorded when possible. Surveys should be conducted between January 1 and March 31. Surveys should begin within 1 hour after sunrise and end by noon. Surveys should not be conducted during extreme conditions (very cold or hot or very windy).

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, D.F. DeSante. 1993. Handbook of Field Methods for Monitoring Landbirds. USDA Forest Service, Pacific Southwest Research Station. General Technical Report PSW-GTR-144.

Ogden. 1996. Biological monitoring plan for the Multiple Species Conservation Program. Prepared for the City of San Diego, California Department of Fish and Game, and U.S. Fish and Wildlife Service. April.

BIRD POINT COUNT DATA FORM

San Diego National Wildlife Refuge

OBSERVER: _____ STATION: _____

DATE: _____ VISIT: _____ TIME ON: _____

DAY / MONTH [SPELL IT OUT] / YEAR 24 HOUR CLOCK

TEMPERATURE: _____ ^{O}C REL HUMIDITY: _____ % WIND (kph): _____

SKY CONDITION: Clear / Partly Cloudy (%) / Overcast / Fog / Drizzle / Showers

NOISE LEVEL: dB HABITAT: TERRAIN LIMIT:

DETECTION CODES: **V** = VISUAL **S** = SONG **C** = CALL

	0 - 3 MINUTES			3 - 5 MINUTES			5 - 8 MINUTES		
SPECIES	_ 50 Meters	_ 50 Meters	FLY OVER	_ 50 Meters	_ 50 Meters	FLY OVER	_ 50 Meters	_ 50 Meters	FLY OVER

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CAGN CENSUS TAPE

INSTRUCTIONS: Play the CAGN tape at the conclusion of each point count for each station. The tape is played regardless if CAGN were detected at the station or not during the surveyed 10 minutes. Play the tape for 30 seconds, listen for 60 seconds and repeat once. Record the number of individuals and, if known, the number of pairs within each radius. After this three minute period depart for the next station. Do not play the tape during the 10 minute point count session.

				0 - 90	SECONDS	Pair / Single	90 - 180	SECONDS	Pair / Single
SP	EC	IE	S	_ 50 Meters	_ 50 Meters		_ 50 Meters	_ 50 Meters	
C	**A**	**G**	**N**						
C	**A**	**G**	**N**						
C	**A**	**G**	**N**						
C	**A**	**G**	**N**						
C	**A**	**G**	**N**						
C	**A**	**G**	**N**						

COMMENTS: _____