APPENDIX D

QUANTITATIVE METHODOLOGIES FOR MONITORING PLANT SURVIVORSHIP AND FITNESS PARAMETERS

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

Plant Survivorship and Fitness Parameters

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

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

Monitoring Methodologies

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

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

Data Analysis

In terms of data analysis, survivorship will be expressed as percent plant mortality over the growing season, while fitness will be expressed as fruit or seed set. The mean and standard deviation percent mortality and fruit or seed set will be calculated for the population. If survivorship and fitness data are collected over a number of monitoring periods, data from tiie initial effort can be compared to site-specific data collected in subsequent years. Percent mortality and fruit or seed set will be graphed as a function of sampling period to illustrate any changes that have occurred. Appropriate statistical hypothesis tests (e.g., ANOVA and multivariate analysis of variance (MANOVA)) should be employed to facilitate drawing conclusions about population trends. Correlation analyses may be used to test for relationships over time among mortality and fruit or seed set. A trend of increasing mortality and low seed set, particularly in conjunction with decreasing population size, may indicate that the viability of the population is threatened, especially with a small population. Simple linear regression, multiple regression, and linear discriminant function analyses may be used to identify significant relationships between environmental factors, such as temperature, rainfall, fire, flooding, or human encroachment, and the population parameters measured.

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

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

APPENDIX E

DATA FORMS FOR COVERED PLANT SPECIES
FIELD MONITORING

FIELD DATA COLLECTION FORM
COVERED PLANT SPECIES MONITORING

COVERED SPECIES ____

MONITORING LOCATION______________________________:__________________

MONITOR(S) ____

DATE • ____

PHOTODOCUMENTATION ____YES________NO IF YES, PHOTO NUMBER(S)________

CNPS FORM ATTACHED ____YES________NO

MAPPING OF DISTURBANCE ____YES________NO

SECTION I. QUALITATIVE ASSESSMENT OF DISTURBANCE FACTORS

LIST INVASIVE SPECIES	APPROXIMATE PERCENT COVER
______________________	______________
______________________	______________
______________________	______________
______________________	______________
______________________	______________

LIST TYPES/EVIDENCE OF VEGETATIVE DISTURBANCE	INDICATE DEGREE OF DISTURBANCE
______________________	______________
______________________	______________
______________________	______________
______________________	______________
______________________	______________

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

ADDITIONAL NOTES:

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

SECTION II. QUANTITATIVE FIELD MONITORING

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

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

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

DATA REDUCTION FORM
COVERED PLANT SPECIES MONITORING

COVERED SPECIES ______________________________

MONITORING LOCATION ______________________________

TOTAL AREA SAMPLED ______________

NUMBER OF TRANSECTS ______________ TOTAL TRANSECT LENGTH______________

NUMBER OF QUADRATS ______________ TOTAL QUADRAT SEE ______________

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

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

NOTES: ______________________________

FINAL SUMMARY FORM
COVERED PLANT SPECIES MONITORING

COVERED SPECIES ____________________
MONITORING LOCATION ____________________
MONITORING DATE ____________________

I. POPULATION DENSITY

MEAN NUMBER OF INDIVIDUALS = ____________

AREA SAMPLED = ____________

DENSITY = $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}}$ = ____________

II. POPULATION SIZE

POPULATION SIZE = AREA SAMPLED X DENSITY

= ____________X____________ = ____________

III. AGE CLASS STRUCTURE

AGE CLASS STRUCTURE = $\frac{\text{NUMBER OF QUADRATS IN WHICH THE AGE CLASS OCCURS}^{(1)}}{\text{TOTAL NUMBER OF QUADRATS SAMPLED}}$

SEEDLINGS____________%

JUVENILES____________%

FLOWERING ADULTS____________%

NONFLOWERING ADULTS____________%

NOTES: ____________________

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

APPENDIX F

DATA FORMS FOR WILDLIFE MONITORING

MSCP California Gnatcatcher/Coastal Cactus Wren Plot Summary Form
(For each plot fill out this form for each year of monitoring)

Plot ID:________________________**Map Number(s):**____________

Survey Period: ____________________ **Cumulative Hours of Field Effort:** __________

Observers: ____________ ____________ ____________

____________ ____________ ____________

Detected Focal Bird Species

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

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

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

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

Monitoring Plot ID:____________ Map Number(s):______________________ Date:_______________

Observer(s):_______________________________ Time Start: _____________ Time Finish: _____________

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

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

* If sighting is within 200' of monitoring plot boundary, record "Y", otherwise enter "N". On maps/data forms, record sightings outside of plot that are < 200' from boundary.
** Due to the timing of the surveys, it is assumed gnatcatchers and cactus wrens are in adult plumage. Any detected juveniles should be clearly labeled as such. Other detected sensitive species should also be entered onto this form. *** "Comments" should include info. on banding status, breeding activity, plumage, and any interesting observations.

MSCP Focal Bird Species Plot Survey Database

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

Upland Reptile Diversity Data Form

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